CM701

PSK Digital Satellite Modem

Installation and Operation Guide

COMSTREAM®

A Spar Company

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For the proper installation and operation of this equipment and/or all parts thereof, the instructions in this guide must be strictly and explicitly followed by experienced personnel. All of the contents of this guide must be fully read and understood prior to installing or operating any of the equipment or parts thereof.

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and radiates radio frequency energy and, if not installed and used in accordance with the instruction guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

Warning! Shock Hazard!

Do Not Open The Equipment! Service Only By ComStream!

Gefährliche Spannung!

Öffnen des Gerätes und Service nur durch ComStream!

The CM701 contains no user-serviceable parts. Do not attempt to service this product yourself. *Any attempt to do so will negate any and all warranties.*

This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

$C \in$

EC Declaration of Conformity

We, ComStream Corporation, declare under sole responsibility that the CM701 PSK Digital Satellite Modem, manufactured at either or both of the following locations:

- ComStream Corporation
  6350 Sequence Drive
  San Diego, CA 92121-2724

- GSS Array Technology
  6835 Via Del Oro
  San Jose, CA 95119-1315

to which this declaration relates, is in conformity with the requirements of the following EC Directives:

- Council Directive 73/23/EEC (and 93/68/EEC) on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits is based on compliance with the following harmonized standards:

  - EN60950:1992 + Amendments +1+2:1993 + Amendment 3:1995

  - Listed under TÜV Product Service Certification System, 13184

- Council Directive 89/336/EEC (92/31/EEC and 93/68/EEC) on the approximation of the laws of the Member States relating to electromagnetic compatibility is based on compliance with the following harmonized standards:

  - Electromagnetic Emissions – EN55022:1994

    - Harmonic Current – EN61000-3-2:1995

    - Voltage Fluctuations – EN61000-3-3:1995

  - Electromagnetic Immunity – EN50082-1:1992

    - ESD – IEC801-2:1991

    - Radiated Immunity – IEC801-3:1992

    - EFT – IEC801-4:1984

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Preface

Using This Guide

Welcome to the ComStream world of satellite-based communications products and systems. This guide is your sourcebook for using the ComStream CM701 PSK Digital Satellite Modem. It describes the installation, operation, and performance specifications of this product.

The chapters in this guide provide step-by-step instructions for a variety of tasks and activities, including unpacking, setting up, mounting, and operating the CM701. The chapters also provide an overview of system operations as well as technical specifications and troubleshooting procedures.

This guide is designed to help you find information quickly and easily. To take full advantage of this design, please take a moment to review the specific formats.

Locating Information

To help you quickly locate information, this guide includes:

- Table of contents
- Glossary
- Index
- Quick reference cards

Important Information

Throughout this guide you will find the following icons designed to help you identify important information:

The note icon identifies information for the proper operation of your equipment, including helpful hints, shortcuts, or important reminders.

The caution icon identifies information that requires careful attention in order to prevent equipment damage and/or injury to the operator.

The troubleshooting icon identifies information that will assist you in solving malfunctions in your equipment.

Illustrations

Some illustrations contained in this guide may differ slightly from those shown on your front panel display or computer console due to variations in your system setup, configuration, or customization.

Figures depicting equipment may differ from those at your site; therefore, refer to the labeling on your ComStream equipment to identify the components. An effort has been made to use illustrations that reflect basic equipment and configurations of the majority of customers.

Keyboard Entries

Each activity or task is presented in a series of numbered, step-by-step instructions. Commands or information that you type into the system appear in a different, bold type:

Type **ST ?**.

If the command contains variable information that is to be typed into the system, the variable information is in different type but not bold:

CPA <packet address>

In this example, you would type **CPA** then the correct value for <packet address>.

Keys that are pressed in combination appear with a plus sign (+). For example:

CTRL+SHIFT+3

You hold down the Control and Shift keys and press the number 3.

Key names appear in a different type. For example:

PAGE DOWN

Navigation

This guide uses right angle brackets (>) to indicate a sequence of menus, submenus, and menu items. For example, "Select Text>Print" means the same as "From the Text menu, select Print."

DOS Displays

The system may return values and messages on a front panel LCD, remote terminal, or both. In this guide, these values and messages appear in a different type:

```
PTP 27   PRP 62
STP 0    SRP 0
TTP 0    TRP 0
```

Warranty Statement   ComStream warrants that its products are free from defects in material and workmanship at the time of shipment and that they conform to applicable specifications. In no event will ComStream be liable for consequential misuse or damages.

The ComStream CM701 is warranted against any above-mentioned defects that may occur within one year of the shipping date.

Should it be necessary to make a claim against this warranty, the buyer shall first notify ComStream Customer Service to define the nature of the problem. When returning products, please be aware of the following:

1. Products returned to ComStream, whether for upgrade, warranted or out-of-warranty repair work, or maintenance, must comply with the ComStream Return Procedure.

2. Products shall be forwarded to ComStream, transportation prepaid.

3. Products returned to ComStream freight collect or without a return material authorization number *will not be accepted*.

4. ComStream shall not accept any responsibility for returned products that are improperly packaged and/or damaged in shipment. If possible, please use original shipping and packaging materials.

5. Original product identification markings and labels must not have been removed, defaced, or altered. Further, to preserve the warranty the product should not be subjected to abuse, improper installation or application, alteration, accident, or negligence in use, storage, transportation, or handling.

6. Any returned product shall be completely evaluated in an attempt to duplicate the problem so that appropriate corrective action and repair may be completed. Following repair, the product shall be thoroughly tested for compliance with appropriate specifications. This process will be handled promptly but may be subject to available labor and material resources.

The ComStream warranty, as stated herein, is in lieu of all other warranties, expressed, implied, or statutory.

For further information, please contact ComStream Customer Service at 619-657-5454 or toll free at 888-559-0831.

Return Procedure   If it is necessary to return a product for out-of-warranty repair, upgrade, or any modification, the following procedures must be followed:

1. Contact ComStream Customer Service, located in the United States, by phone or fax, at:

   □ Phone   619-657-5454, or toll free at 888-559-0831

   □ Fax   619-657-5455

2. Speak to a ComStream Customer Service representative about any questions, issues, or problems. Quite often equipment problems can be corrected over the phone, which keeps your equipment in service and avoids unnecessary and costly downtime.

3. Should it be necessary to return a product to ComStream for any reason, the ComStream Customer Service representative will issue you a return material authorization (RMA) number. To issue an RMA number, the ComStream representative will need the product serial number and model number.

4. You may be returning a product for either repair, upgrade, or modification. If you are returning the product for:

   □ Repair – Include a complete description of the problem, the operating conditions that caused the problem, and any circumstances that may have led to the problem. This information is essential for ComStream repair technicians to reproduce, diagnose, and correct the problem.

   □ Upgrade or modification – Include a complete description of the current configuration and the desired change(s). This information will allow a ComStream Customer Service representative to provide a formal quote for the upgrade.

5. Include a purchase order (PO) for any upgrade or out-of-warranty repair work being performed. ComStream will begin repair work *after* a PO is received.

6. Reference the RMA number on all paperwork that accompanies the equipment, and write the RMA number clearly on the outside of the shipping container.

7. Ship your module in the original shipping carton and packaging (or its equivalent), prepaid, to:

   ComStream
   6350 Sequence Drive
   San Diego, CA 92121-2724 USA

   RMA Number

Do not include product accessories such as manuals, other printed material, or rack-mount brackets.

When handling or shipping static-sensitive equipment, observe antistatic procedures, and always use antistatic bags for shipment.

All equipment upgrade and repair requests will be completely evaluated and the required work performed promptly. The equipment will then be thoroughly tested for compliance with appropriate specifications.

Revision History This guide is periodically updated and revised. For documentation updates, call ComStream Customer Service, located in the United States, at 619-657-5454, toll free 888-559-0831, or fax your request to 619-657-5455.

Revision[1]	Date	Type of Revision
A	02/97	Initial release
B	06/95	Manual update and reorganization. This reorganization affected chapter names and numbering. References from option module card manuals to the CM701 manual will be updated as those manuals are revised. During the interim, please check the table of contents or index to locate required information.
C	04/98	Added the HWV, LGE, LGN, LGT, LIT, LPW, MQE, MQL, and MQN commands; incorporated CM701 Supplement into the appendix on CX801/CX101 Protection Switches
D	07/98	Added Customer Service toll free number, removed CPN and revision information from body pages

[1]Revision A is always the first official release to ComStream customers.

Customer Support We hope this guide provides all the information and instructions you need to operate the CM701.

However, in the event that you need further assistance, or if problems are encountered, ComStream has set up a Customer Support Line for your use. Please feel free to contact ComStream Customer Support, located in the United States, by phone or fax at:

- Phone   619-657-5454, toll free 888-559-0831
          Monday through Friday, 8:00 a.m. to 5:00 p.m. Pacific time

- Fax   619-657-5455

Safety Precautions

Carefully read and follow all safety, use, and operating instructions before operating the CM701. Heed all warnings and cautions contained in this guide. Retain these instructions for future reference.

Follow the Startup Procedure

Do not plug in the CM701 until you have connected the system and read the chapter on external connections and installation.

Provide a Safe Location

Place the CM701 in a rack or on a stable surface of sufficient size and strength, where it will not be jarred, hit, or pushed off its surface. Ensure that all cables and cords are out of the way and will not be tripped over, as this could cause personal injury or serious damage to the CM701.

Avoid Water and Moisture

Do not expose the CM701 to any liquids, which are often found in flower vases, coffee cups, rain from open windows, and so on. If the CM701 is exposed to any liquid, contact ComStream, as serious damage could occur to the CM701 or its components.

Avoid Heat, Humidity, and Dust

To avoid internal damage, the CM701 should be placed away from all heat sources, including radiators, heater ducts, and so on, out of direct sunlight and away from high humidity, excessive dust, or mechanical vibrations that can cause damage to internal parts.

Provide Adequate Ventilation

Slots and openings on the CM701 are provided for ventilation that is needed to ensure reliable operation. To avoid overheating and ensure that the ventilation slots are not blocked, place the CM701 on a smooth, hard surface that has at least two inches of clearance around the unit and adequate air circulation. If the CM701 is placed in a closed area, such as a bookcase or rack, ensure that proper ventilation is provided and that the internal rack operating temperature does not exceed the maximum rated temperature at the position of the CM701.

Never place the CM701 on a soft surface that would obstruct the required airflow into the CM701 ventilation slots.

Use the Correct Power Source

For CM701 units equipped with a North American power cord, the cord has an IEC 320 female plug on one end, and an NEMA 5-15P male plug on the other end. This cord is UL and CSA approved up to 125 VAC at 10 A and is ready to use with no user wiring required.

For CM701 units equipped with an International power cord, the cord has an IEC 320 female plug on one end, and three stripped and tinned bare wires on the other end. This cord is HAR approved up to 250 VAC at 6 A and complies with the international color codes of green/yellow (ground), blue (neutral), and brown (line).

If these color codes do not correspond to the colored markings on the terminals in the plug, use the following standards:

- The green/yellow wire must be connected to the plug terminal marked by the letter E or by the earth symbol (⏚) or color-coded green and yellow.

- The blue wire must be connected to the plug terminal marked with the letter N or color-coded black.

- The brown wire must be connected to the plug terminal marked with the letter L or color-coded red.

An AC plug must be attached to the International power cord in accordance with government standards and codes in effect at the CM701 installation site. If an unterminated power cord is supplied with the unit, the appropriate certified termination plug must be installed. The following is a list of the required certifying agencies for various countries:

Country	Agency
Australia	SAA
Austria	OVE
Belgium	CEBEC
Canada	CSA
Denmark	DEMKO
Finland	FEI
France	UTE
Germany	VDE
India	ISI
Ireland	IIRS
Italy	IMQ
Japan	MITI
Netherlands	KEMA
New Zealand	SECV
	SECQ
	SECWA
	EANSW
	ETSA
	HECT
Norway	NEMKO
Rep. S. Africa	SABS
Spain	AEE
Sweden	SEMKO
Switzerland	SEV
United Kingdom (UK)	ASTA
	BSI

Route Power Cords Safely

Route power cords so that they are not walked on or pinched. Pay particular attention to cords and connections at the plugs, receptacles (such as power strips), and the point where they exit from the CM701 and attach to other equipment. Do not place any items on or against power cords.

No Stacking

Do not place or stack any objects on top of the CM701. Other equipment may be placed in a rack or on a shelf above or below the CM701, but never stacked directly on top of the CM701 itself.

Protect Against Lightning and Power Surges

When the CM701 equipment is installed, have the professional installer ground the system to protect against voltage surges and built-up static charges. For information on grounding standards for electrical and radio equipment, refer to the electrical code in the country of installation. For example, in North America refer to the National Electrical Code (NEC) Article 250 for grounding, and Article 810 for radio equipment.

Protect the CM701 from lightning and power-line surges during a storm by unplugging it from the wall outlet and disconnecting the coaxial cable.

Turn the CM701 Off When Changing Circuit Boards

Turn the CM701 off before installing or removing circuit boards from chassis slots that do *not* have the Hot Plug/Pull symbol on their filler plate. Possible damage may occur to modem, boards, or related equipment if power is left on during this procedure.

Provide Antistatic Protection

Wear a properly grounded antistatic wrist strap to prevent electrostatic damage to components when handling circuit boards or other electronic modules.

Keep Objects Outside

Touching internal CM701 parts is dangerous to both you and the unit. Never put any object, including your fingers, through CM701 slots or openings, as this could result in touching dangerous voltage points, short-circuiting parts, electric shock, or fire.

There are no user-serviceable parts inside the CM701. If an object falls into the CM701, unplug the unit and contact ComStream Customer Service, as serious damage could occur to the CM701 or its components.

Use Approved Attachments Only

Use only ComStream-approved option cards and other satellite communication equipment with the CM701.

Clean the CM701

Before cleaning the CM701, unplug it from the wall outlet. Do not use any type of abrasive pads, scouring powders, aerosol cleaners, or solvents such as alcohol or benzene.

Use only a clean, soft cloth lightly moistened with a mild detergent solution. Wipe all equipment with a clean, soft cloth lightly moistened with water to remove the detergent solution.

Service the CM701

Do not attempt to service the CM701 yourself, as there are no user-serviceable parts. Opening or removing covers may expose you to dangerous voltages or other hazards as well as void your warranty. Contact ComStream Customer Service to obtain qualified service personnel.

The following conditions indicate that the CM701 needs servicing:

- The power cord or plug has been damaged.

- An object has fallen into the CM701.

- Liquid has been spilled into the CM701, or it has been exposed to rain or water.

- The unit has been dropped, or the cover has been damaged.

- The CM701 does not operate normally, or it shows a marked change in performance.

Perform Safety Checks

Upon completion of any service or repairs to the CM701, ask the service technician to perform safety checks to verify that the system is in safe operating condition.

Overview

The ComStream CM701, shown in Figure 1-1, is a high performance PSK digital modem used in satellite communication applications requiring continuous transmission and reception.
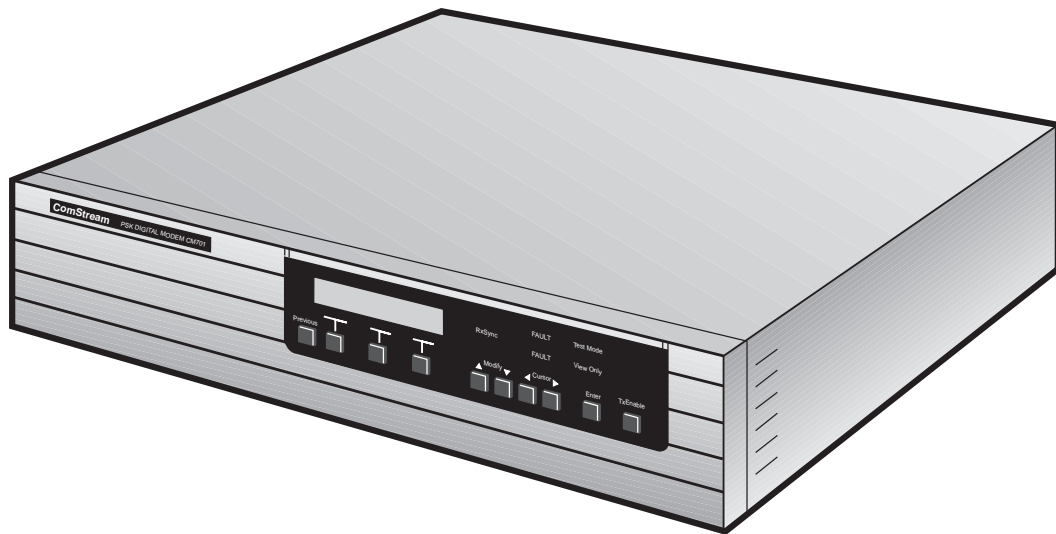
F174-01

Figure 1-1   CM701 PSK Digital Satellite Modem

The CM701 is extremely versatile and continues the ComStream tradition of providing the very best modem performance in the industry. Better performance contributes directly to lower operating costs for satellite circuits.

What makes the CM701 unique is its modular design. This design makes on-site reconfiguration and servicing possible and easier to accomplish. The CM701 is outfitted with four standard option cards and expansion slots for up to three user-specified option cards. To add or change a modem function, simply slide an option card into the chassis at the rear panel. No internal or external cabling is needed; cards fit into edge connectors on the modem's backplane.

The standard CM701 modem chassis includes an autoranging power supply that senses and automatically responds to incoming voltage. The modem is designed for total software control from an interactive front panel or via a remote control port, thereby eliminating all jumpers and switches.

Setup is easy because each card contains its own microprocessor and nonvolatile memory, allowing it to store individual configurations and run comprehensive self-test operations. The CM701 has a built-in bit error rate tester (BERT) and extensive system diagnostics to aid in network checkout and problem solving.

Applications   The CM701 is well suited for point-to-point satellite communications applications with data capacity requirements that change periodically. It can be reconfigured at any time for a different data rate, code rate, or modulation type.

It is also valuable for users with many different communication requirements. One CM701 can be software-configured for virtually any common operating mode.

For applications requiring only one or a few configuration settings, a lower-cost, low-speed option card for the modem is available.

Applications include:

- Private voice/data networks

- Broadcast network uplinks

- INTELSAT and EUTELSAT services

- High-speed video transmission.

An SCPC application using ComStream modems is shown in Figure 1-2.
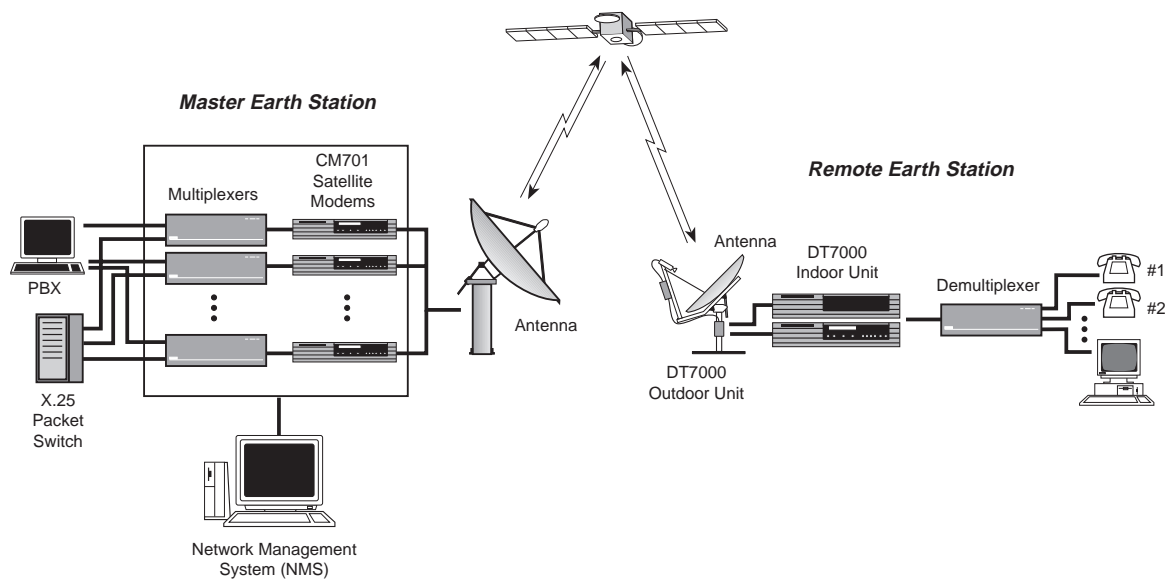
Figure 1-2   SCPC Application Using CM701 Modems

Features   The CM701 provides quality, flexibility, reliability, and value through the following features:

- Ability to communication with any other ComStream closed network modem including the CV and CM satellite modem product line on an SCPC basis

  The CM2000 and CM720 do not communicate with the CM701.

- Compatibility with the ComStream DT series of interactive earth stations and the DBR series of clear-channel, digital broadcast receivers

- Ability to be configured for open network applications

  With the addition of the optional ComStream Framing Unit card, the CM701 can communicate with any other modem that complies with Intelsat Intermediate Data Rate (IDR) and Intelsat Business Services (IBS) open network specifications (IESS-308 and IESS-309), as well as the Eutelsat Satellite Multiservice System (SMS) open network specification (BS 7-40).

- Use of ComStream state-of-the-art, digital, application-specific integrated circuits (ASICs), which result in robust, reliable performance.

- Front panel LED indicators provide *at-a-glance* status checking.

- Local configuration selections made from either the front panel or a remote terminal

  Every CM701 has an interactive front panel with push buttons, LED indicators, and an LCD display allowing the CM701 to be completely configured, monitored, and controlled from the front panel.

  A remote terminal is easily connected to a rear panel port allowing the CM701 to be configured, monitored, and controlled with character-oriented ASCII protocol and RS-232 electrical levels. In addition, through the use of a remote command, the front panel can be disabled to prevent tampering by unauthorized personnel if required.

  Applications requiring the control of many CM701 units on a single remote bus can be configured for RS-485 electrical levels and packet-based protocol to accommodate this operating mode.

- There are no internal jumpers, straps, or switches required for operation. And, since there is no need to disassemble the unit, configuration is simpler with less chance of damaging circuit cards or misplacing cables.

- Custom configurations can be order and shipped from the factory or configurations can be easily changed on-site through the installation of CM701 option cards.

- Flexible operating parameters, including:

  - User data rates from 4.8 kbps to 2.34 Mbps. Operation below 9.6 kbps may have reduced performance.

  - Bi-phase shift keying (BPSK) and quadrature-phase shift keying (QPSK) modulation

  - Intermediate frequency (IF) synthesizer resolution of 1 Hz

  - Code rates including $\frac{1}{2}$, $\frac{3}{4}$, $\frac{7}{8}$, as well as uncoded operation

  - Viterbi and Sequential decoding algorithms

  - IBS, IDR, and SMS framing

  - Variety of digital filter shapes

  - Autoranging 90 to 264 VAC switching power supply

- Enhanced circuit availability

  A CM701 with a ComStream protection switch can automatically replace a failed primary modem with a spare. The CX101 switch offers 1:1 protection by providing a spare modem for each primary model. The CX801 switch offers 8:1 protection by providing a spare modem for up to eight primary modems.

- Extensive built-in diagnostics, including system loopback and self-test capabilities, aimed at detecting faults in both the internal circuitry and the external satellite communications link

  Each CM701 option card has an integrated microcontroller that performs built-in test algorithms to verify proper operation.

- A standard, built-in integrated bit error rate tester (BERT) that allows satellite link integrity testing through remote terminal or the front panel, which helps reduces satellite circuit operating costs.

Modular Architecture   The CM701 was designed using a modular architecture which provides the following advantages:

- Independent functioning of each option card

  The CM701 can be customize for specific needs today and easily upgraded or expanded to meet the planned or unforeseen needs of tomorrow.

- Simple, less costly sparing

- Easy, on-site configuration changes

- Fast, manageable repairs

  Most repairs can be completed onsite, eliminating shipment of the CM701 to the factory and avoiding long transit or customs delays. This ensures that, in the unlikely event of a failure, your network is up and running in minimal time.

Option Cards   The CM701 can be customized with up to three user-specified option cards in order to provide different data interfaces, IDR/IBS/SMS open network compatibility, high performance Reed-Solomon coding, an in-band satellite control channel, and doppler buffering.

The most common option cards are:

- Framing Unit for IDR/IBS/SMS Operation

- Reed-Solomon

- Satellite Control Channel

- Doppler Buffer

- Burst Modulator

- Low-Speed Modem

- L-Band Demodulator

- Additional 70/140 MHz modulators and demodulators

Framing Unit for IDR/IBS/SMS Operation

The Framing Unit option card meets all specifications for Intelsat IDR (IESS-308) and IBS (IESS-309), as well as Eutelsat SMS (BS7-40). The signal shape, scrambling formats, and code rates are all programmable, so the touch of a button can change the modem from one type of service to another.

IDR (intermediate data rate) is an Intelsat service for digital telephony over satellite, IBS (Intelsat business services) is an Intelsat service, and SMS (satellite multiservice system) is a Eutelsat service. Both IBS and SMS are for general satellite data communications.

The Framing Unit in the CM701 modem provides all international overhead functions as standard features. In IBS and IDR operation, drop-and-insert multiplexing is a standard feature, allowing easy selection of specific channels in a data stream.

High Performance Reed-Solomon Coding

The Reed-Solomon coder-decoder (codec) encodes on top of standard Viterbi decoders, so it can be added to CM701s in the field, improving the performance of these industry-leading products. It corrects the bulk of the data errors that are not detected by the other coding systems, significantly reducing the BERs at nominal signal-to-noise levels (4 to 8 dB E_b/N_0).

Typically, Reed-Solomon coding is used in areas where sensitivity to transmission errors is particularly high. The Reed-Solomon option card is well suited to data communication applications with little or no packet acknowledgment or no packet retransmission. Also, broadcast applications, digital video, and generally power-limited satellite links gain performance from the Reed-Solomon codec. The Reed-Solomon option comes in several models such as the ComStream proprietary, Intelsat-compatible, and DVB-compatible (Digital-Video-Broadcast) versions.

Satellite Control Channel

The Satellite Control Channel option card multiplexes a low-rate, duplex control channel onto the main satellite data channel. Separate connectors allow the user to supply either an RS-232 or RS-485 data connection for the control channel.

The main application for this option card is monitoring and controlling remote earth station equipment from a central hub facility. By connecting the in-band channel at the remote site to the M&C port of the remote modem, an operator at the hub can issue commands as if directly connected to the remote equipment. When combined with ComStream's Star Network Management System (SNMS), all of the equipment in an SCPC/MCPC (Multiple Channel per Carrier) star network can be monitored and controlled from a single workstation.

Doppler Buffer

ComStream's Doppler Buffer option card buffers data received from the satellite on a First-In-First-Out (FIFO) basis. Data is input to the buffer using the receive clock from the satellite signal. It can be output from the buffer using either an externally supplied clock, the transmit clock, or the internal clock.

Although satellites are geostationary, most drift slightly in their orbits every 24 hours. This motion causes a doppler shift in the satellite signals, resulting in data rate clocks at the receive site that are slightly different than clocks at the transmit site. Most data communication applications operate correctly; however, some require that the receive clock and data from the satellite be exactly synchronized to another clock. These applications require the use of a doppler buffer.

Low-Speed Modem

When you have applications that require only simple, low-speed data transmission, the CM701 using a Low Speed Modem card is the solution. This option card is particularly well suited to single channel per carrier (SCPC) star networks requiring multiple modems at the hub, SCPC demand assigned (DAMA) networks requiring fast acquisition and low cost, and complex networking needing additional modulators or demodulators.

The Low Speed Modem card is a complete 4.8 to 512 kbps modem contained on a single option card. The card contains a modulator, a demodulator, doppler buffer, and an RS-449 interface port. This option provides a low-cost modem on a modular CM701 platform, supporting variable rates in 1 bps steps. The card offers QPSK and BPSK operation with Viterbi decoding at rates $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{7}{8}$ or sequential decoding at rates $\frac{1}{2}$ and $\frac{3}{4}$. All programable low speed modem features can be modified via the CM701 control front panel or serial remote control port.

The modem card can be mixed and matched with standard CM701 modulator or demodulator cards to provide a mix of high- and low- speed services in the same chassis.

Theory of Operation

CM701 Architecture Overview

The CM701 is a 2U (3.5 inch), 19 inch, rack-mount unit consisting of the following major components:

- Chassis
- Power Supply
- Backplane
- Option cards; four standard cards and up to three user-specified cards

Chassis

The CM701 chassis is constructed of a steel sheet-metal frame with a removable top cover and an injection-molded plastic front panel.

The front panel, shown in Figure 2-1, allows local control of the CM701.
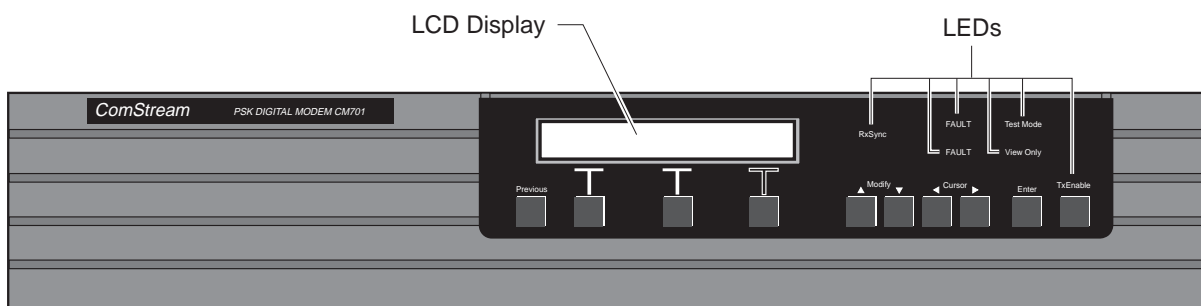
Figure 2-1   CM701 Front Panel

The front panel consists of:

- 24-character LCD which displays commands used to configure, monitor, and control the network, as well as status, fault, and error information
- The following LED indicators which provide *at-a glance* status and fault alert information:
  - RxSync
  - Two Fault LEDs
  - Test Mode
  - View Only

- Command tree push buttons, located directly below the LCD, used to navigate through and select configuration, monitor, and fault commands

- Selection push buttons, including previous, modify, cursor, and enter, which are used to navigate through commands, select command parameters, and issue commands to the system

- A dedicated TxEnable push button with illuminated message

The rear panel, shown in Figure 2-2, houses all external connections and is configured with four vertical card slots and three horizontal card slots. The rear panel consists of the following components:

- User specified option cards located in slots 1, 3, and 5

- Standard RS-449 data interface card in slot 2, with a single 37-pin, female D connector

- Standard M&C option card located in slot 4, with two female D connectors

- AC power connector which interfaces to the power supply inside

- Cooling fan

- Demodulator card in slot 6, with three female BNC connectors

- Modulator card in slot 7, with two female BNC connectors
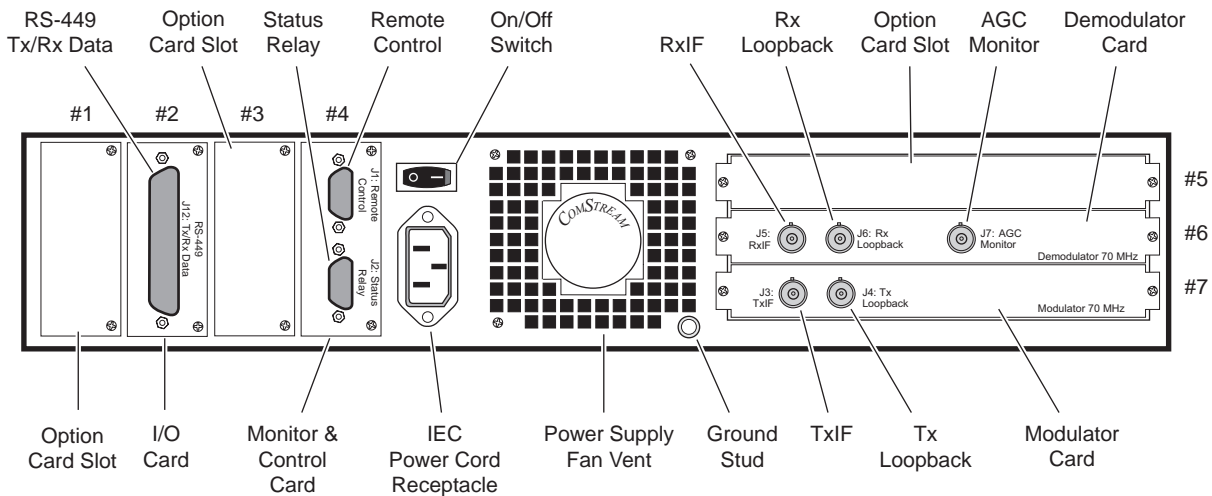
Figure 2-2   CM701 Rear Panel

Power Supply

The CM701 has an autoranging AC power supply that accommodates typical input voltages from 110 to 220 VAC at frequencies from 50 to 60 Hz. Two AC power cords are provided with each CM701, one for North American applications and another for all international applications. In addition, there is an on/off power switch, cooling fan, power connection receptacle, and ground stud.

Backplane

The CM701 backplane, shown in the block diagram in Figure 2-3, provides all interconnections for control, data, clock, frequency reference, and various other handshake signals between option cards. The backplane hardware connections support three elementary clock and data transmit paths and three elementary clock and data receive paths, referred to as *backplane resources*. Each of the transmit and receive paths can be accessed by a circuit card in any of the available slots.

The front panel circuit card is connected to the backplane by an insulation displacement connector on the DC harness.
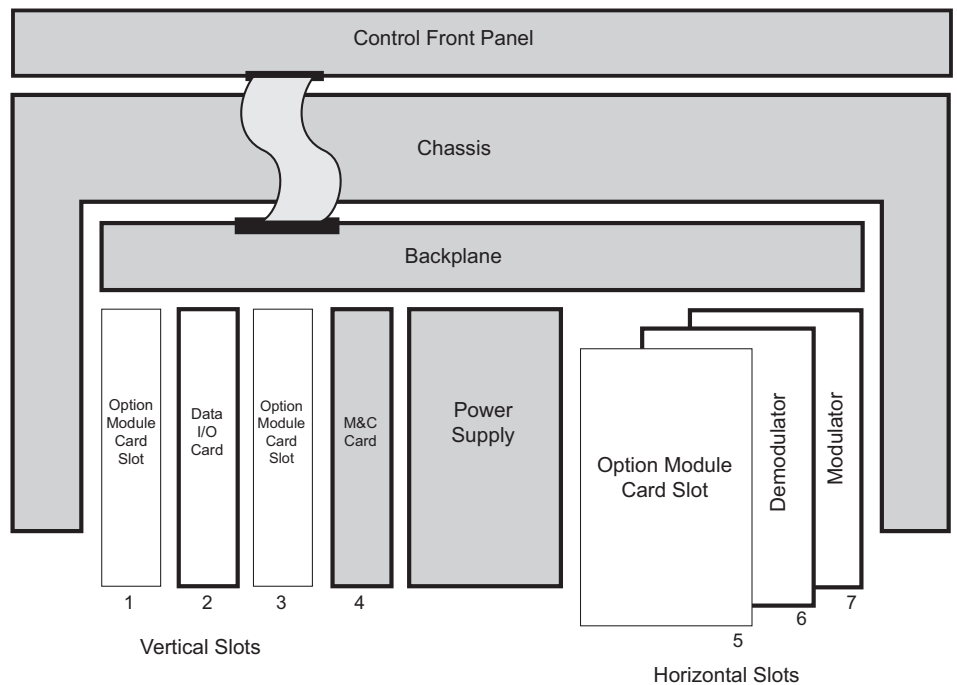
Shaded Portions = CM701 Basic Structure
Heavily Outlined Portions = Standard CM701 Configuration

F176-01

Figure 2-3   CM701 Mechanical Block Diagram

Option cards are interconnected to each other and to a master CM701 M&C card by a backplane which was designed with one 40-pin edge-card connection for each of the seven card slots.

Standard Cards

All CM701 option cards contain an integrated microcontroller, NV memory, and unique control commands for configuration and status reporting. The CM701 consists of four standard cards and can be customized with up to three user-specified option cards.

The four standard cards are:

- I/O card, located in slot 2
- M&C card, located in slot 4
- Demodulator card, located in slot 6
- Modulator card, located in slot 7

The data I/O card may be RS-449, V.35, RS-232, DS-1, G.703, or any other electrical interface required by the user.

The M&C card is the focal point for all user interface command and control activities. This card serves as a command gateway between the user and any other cards in the CM701. It supports status relay output, as well as status relay sense signal inputs. The remote control port and front panel user interfaces are supported by the M&C master microcontroller.

Modulators and demodulators are factory-configured for either 70 ±18 MHz IF or 140 ±36 MHz IF. These selections are made at the time of customer order and are configured in the factory. The rear panel filler plate of each card is labeled with the IF frequency it supports. Each CM701 option card is independent, thus a mix between 70 and 140 MHz option cards in the same CM701 chassis is acceptable.

Optional Cards

The CM701 can accommodate up to three option cards in addition to the four standard cards. Option cards can be easily added, changed, or removed on-site in order to provide the CM701 with different data interfaces, IDR/IBS/SMS open network compatibility, high performance Reed-Solomon coding, an in-band satellite control channel, and doppler buffering.

The most common option cards are:

- Framing Unit for IDR/IBS/SMS operation
- Reed-Solomon
- Satellite Control Channel
- Doppler Buffer
- Burst Modulator
- Low-Speed Modem
- L-Band Demodulator
- Additional 70/140 MHz modulators and demodulators

System Configuration, Monitor, and Control

The CM701 can be configured, monitored, and controlled from either the front panel or remote terminal. All commands can be addressed to a specific option card using either the front panel or the remote terminal.

Local CM701 control is provided through the front panel push buttons, LCD display, and LED indicators.

Remote control is provided through a remote computer terminal which is connected to the remote control port on the CM701 rear panel. The remote terminal is used to issue commands and monitor status typically using ASCII protocol and RS-232 electrical levels. This remote interface can also be configured for RS-485 electrical levels and packet-based protocol when required.

BERT

The ComStream CM701 built-in BERT is an easy-to-use yet highly sophisticated testing feature. The BERT reports Bit Error Rate (BER), errors, number of bits, blocks, and block error rates with programmable data patterns. It can be used to:

- Verify satellite link performance and modem/RF equipment operation
- Troubleshoot basic satellite link and equipment problems without external test equipment

Self-Diagnostics

The modem and each option card contain extensive self-test capabilities to verify proper operation and calibration. A real-time clock time-stamps fault indicators to help track system problems.

CM701 Data Interface The CM701 can have multiple I/O cards installed at one time. By using multiple I/O cards, transmit and receive data can be in different formats, or one modem can be moved from one application to another. The active interface is selected through commands issued through either the front panel or remote terminal.

The CM701 supports different electrical and mechanical data interface standards with a number of vertical plug-in option cards. Every option card is functionally identical, differing only in the electrical and mechanical data terminal equipment (DTE) data interface. Once the unique signal levels are converted to digital logic levels, every option card operates the same.

A functional block diagram of a data interface card is shown in Figure 2-4. The data interface card serves primarily as a data and clock routing switch. Near data loopback, far data loopback, and normal data paths are all selected and controlled by this card. Although not specifically shown in this diagram, the data interface card also supports data control handshaking signals included in some data interface standards. Signals such as request-to-send and clear-to-send are valid if the CM701 is configured to respond to these data control signals.
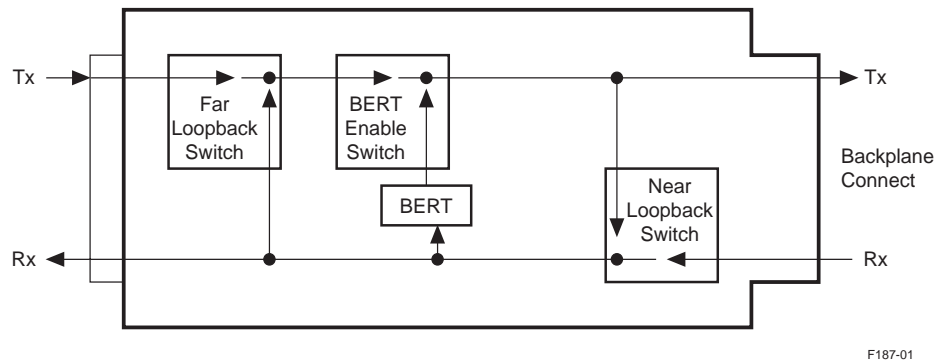
Figure 2-4   Data Interface Card Block Diagram

Every data interface card also provides a built-in BERT which can be operated from the CM701 front panel or the remote terminal. The BERT operates by preempting the user transmit data with BERT-generated data, and then monitoring the receive data to measure bit errors, block errors, etc.

The following data interfaces are supported:

- RS-449/422
- V.35
- G.703
- DS-1
- RS-232

Data Processing Path Examples

The following examples illustrate the types of data processing paths that can be realized with the CM701 backplane signal connectivity. Backplane connections support two or three basic configurations (depending upon the communications system configuration capabilities) in each of the transmit and receive data paths:

- A direct connection between the modulator and a selected data interface card in the transmit direction, and the demodulator and a selected data interface card in the receive direction. This configuration is illustrated in both the transmit and receive paths of Figure 2-5 and Figure 2-9. It is also in the transmit path of Figure 2-6.

- A data processing option in the data path between the data interface card and the modulator or demodulator. This configuration is illustrated in the transmit and receive paths of Figure 2-7 and Figure 2-8, and in the receive path of Figure 2-6.

For information on nonstandard configurations, refer to the chapter on advanced configuration.
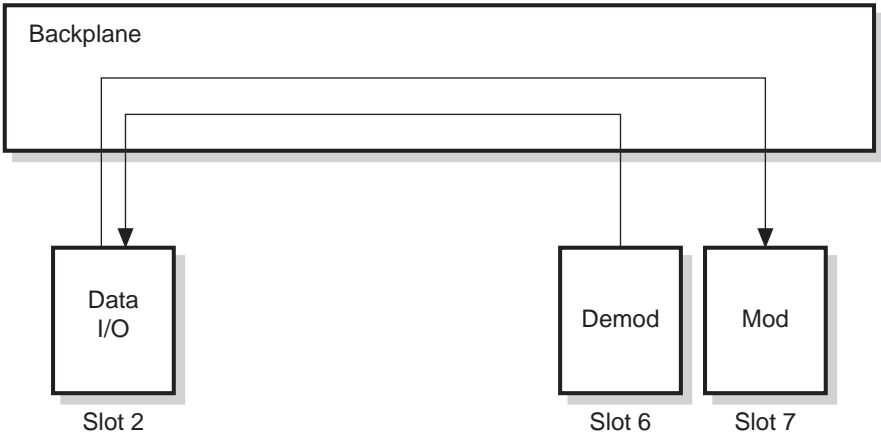
F179-01

Figure 2-5   Standard CM701
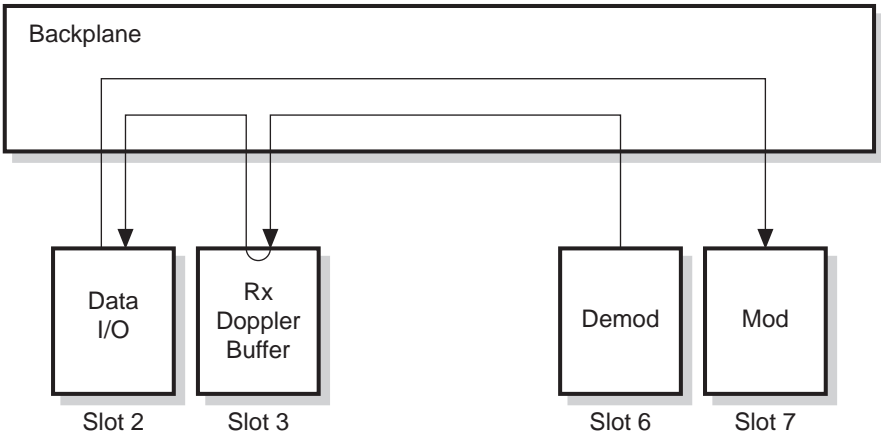
F180-01

Figure 2-6   Standard CM701 with Receive Doppler Buffer
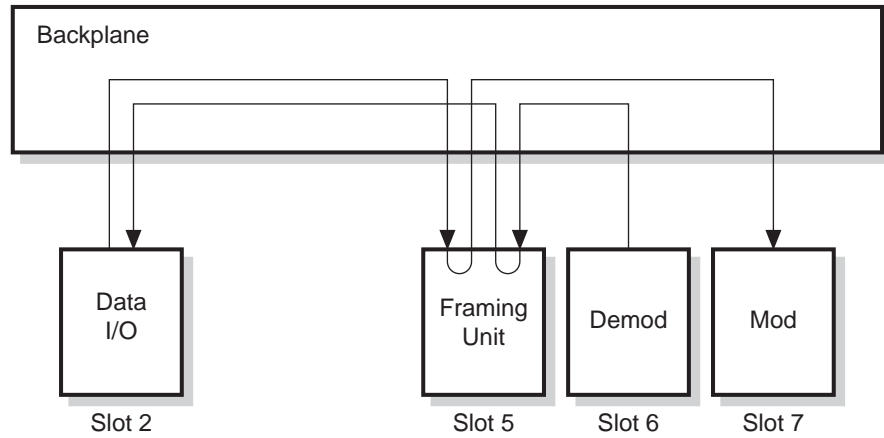
Figure 2-7   Open Network with a Framing Unit
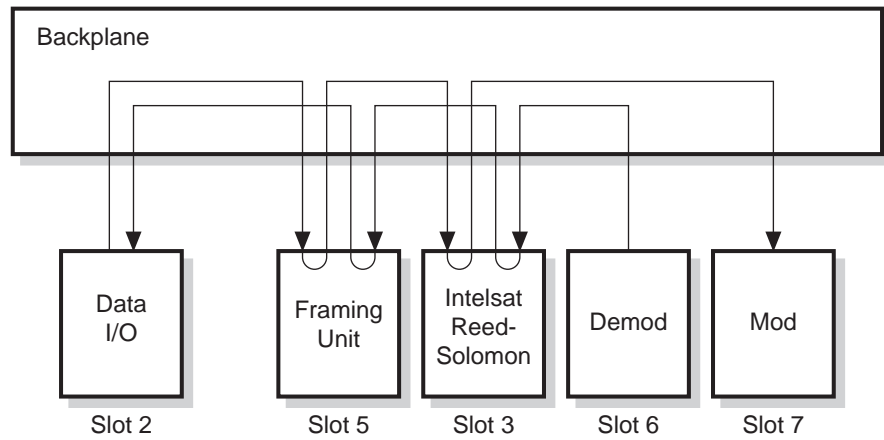
Figure 2-8   Open Network with a Framing Unit & Intelsat Reed-Solomon Card
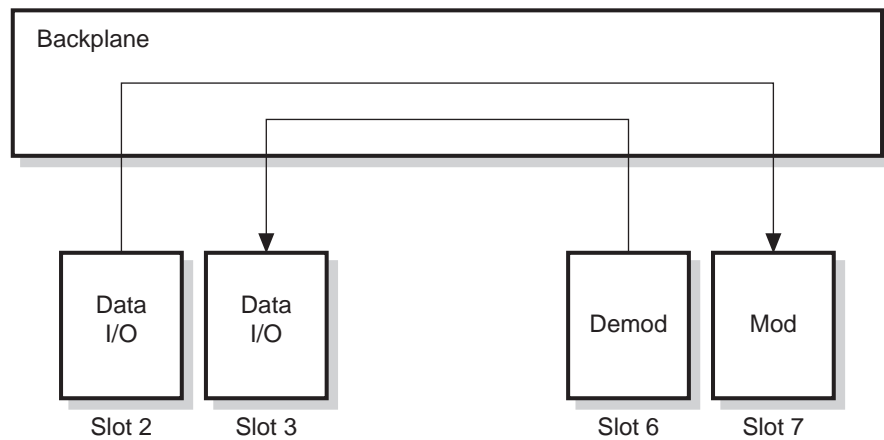
Figure 2-9   Standard CM701 with Multiple Data Interface Cards

M&C Card   The M&C card, illustrated in Figure 2-10, performs traffic management and relays messages between the front panel or remote control interface and the target CM701 option card. In this bus-oriented control configuration, the M&C card is called the master and each option card is called a slave.
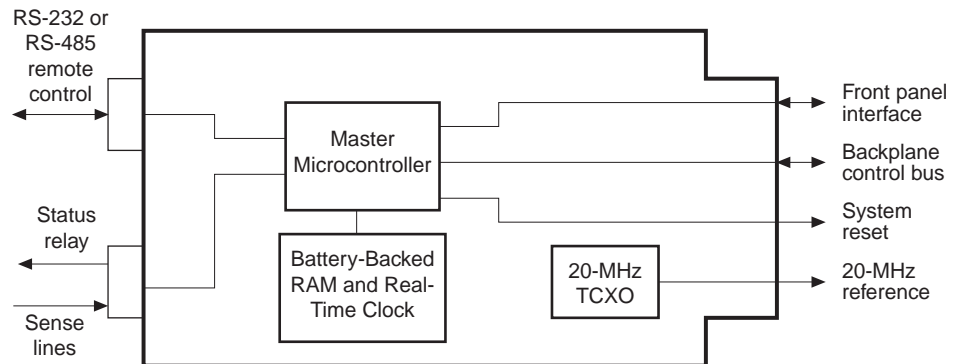
Figure 2-10   Monitor & Control Card

The user issues CM701 commands through the front panel or remote terminal. These commands are executed by the master by passing addressed message packets along the multidrop bus to a particular slave. The slave responds and the master displays a response on either the front panel LCD or the remote terminal as appropriate.

In addition to command processing and user-interface management, the M&C card maintains the CM701 configuration in a battery-backed RAM. A real-time clock allows fault events to be time-tagged and stored in nonvolatile memory for viewing at a later date.

A 20 MHz temperature-compensated crystal oscillator (TCXO) provides a single frequency reference to the entire CM701 chassis and all cards within it. This single frequency reference provides the following benefits:

- Reduced cost

- Reduced frequency source interactions within the chassis

- Completely synchronous digital data path processing within a single option card, as well as within data paths across the backplane

The system reset signal is controlled by the master microcontroller and the internal backplane control bus, which connects to each card in the chassis.

Modulator Operation

The CM701 is typically configured for full-duplex operation — transmitting and receiving data from the satellite. For most applications, these two paths are independent.

Transmit Process

In the transmit process, illustrated in Figure 2-11, the CM701:

1. Accepts user data at the data interface card (data I/O card)

2. Directs the transmit data (SD) across the backplane, clocking the data by either station timing (ST) or transmit timing (TT), depending upon the clocking configuration of the unit

3. Directs the data through any optional, transmit data-processing card (for example, the Framing Unit)
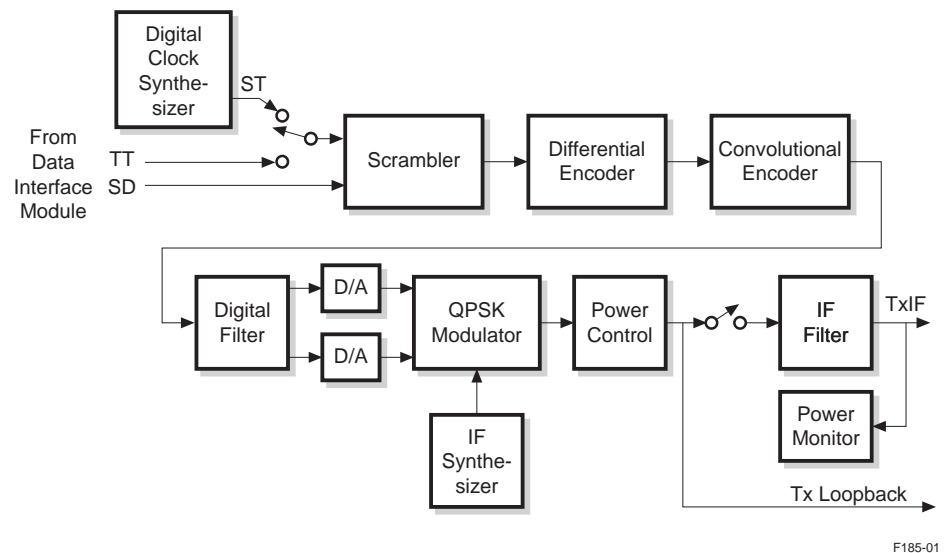
F185-01

Figure 2-11   CM701 Transmit Process

4. Provides data to the modulator for processing. Data processing consists of:

   a. Scrambling (ComStream version or IDR)

   b. Differential encoding

   c. Convolutional encoding for error-correction decoding

   The modulator can encode the data with convolutional codes that are Viterbi rate $\frac{1}{2}$, $\frac{3}{4}$, or $\frac{7}{8}$ compatible, as well as ComStream Sequential rate $\frac{1}{2}$ and $\frac{3}{4}$, compatible.

5. Passes the processed data through a digital matched filter

6. Converts the data from digital to analog (D/A) signal

7. Uses the signal to PSK modulate an IF carrier.

   Once the signal reaches the IF frequency, the modulated carrier is available for transmission. In this illustration, the QPSK modulator is used.

8. Passes the carrier signal through a power control attenuator and is then fed to a BNC output at the rear of the CM701.

   A small amount of energy is diverted to the Tx Loopback output port labeled TxIF.

The proprietary, digital-matched filter design allows tremendous flexibility under software control to create virtually any PSK waveform necessary to comply with open network specifications or to optimize channel performance. The 20 MHz reference from the backplane is used to synthesize the internal clock and the IF carrier frequency on the modulator, and is used as the system clock for the microcontroller. There are no other frequency references on the modulator card.

Receive Process

In the receive process, illustrated in Figure 2-12, the following occurs:

1. The receive IF input signal is input at a BNC connector on the rear of the CM701, labeled RxIF.

2. The input passes through an AGC amplifier.

   The AGC amplifier section has a wide dynamic range and is controlled to keep its output signal at an optimal level, regardless of the input signal level.

3. The IF carrier is removed by a QPSK demodulator.
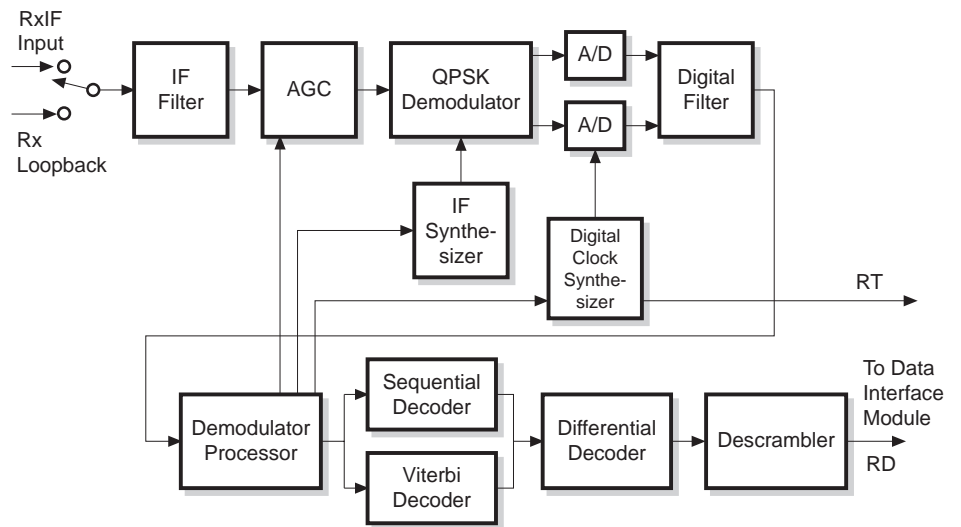
Figure 2-12   CM701 Receive Process

4. The resulting analog baseband signals are digitized.

   During IF loopback testing, the RxIF signal is switched off and the Rx Loopback signal is selected. The loopback signal passes through the same signal processing path as the normal RxIF signal.

5. After the signal is digitized, all remaining signal processing is digital. The first digital block encountered after the analog-to-digital (A/D) converters is a digital baseband filter. This patented filter ASIC is software-programmable to realize a variety of equalized filter shapes at data rates from below 9.6 kbps to above 2.2 Mbps.

6. The filtered samples are passed to the digital demodulator processor ASIC.

    This processor closes the tracking loops for the IF carrier, symbol time clock, and AGC amplifier, all under digital control. The carrier and clock frequency tracking loops are digitally controlled using Direct Digital Synthesizer (DDS) ASICs in the IF synthesizer and digital clock synthesizer blocks.

7. The demodulator mixes the IF carrier down to baseband where the demodulated channel symbols are then:

    a. Decoded by a Viterbi or Sequential decoder. Both types of decoder ASICs are included in the CM701.

    b. Differentially decoded

    c. Descrambled

8. The data is directed across the backplane through any optional, receive data-processing card (for example, the Framing Unit card).

9. The data is directed to a data I/O card where it is converted and clocked to the appropriate electrical levels. The signals are then passed to the user.

Decoder ASICs   The decoder ASICs perform soft-decision Viterbi or Sequential decoding, differential decoding, and IDR and ComStream-compatible compliant, self-synchronizing descrambler functions. They are equipped with Forward Error Correction (FEC).

Decoders accept channel symbols and a symbol clock from the demodulator processor and provide user receive data (RD) as an output. To accompany the receive data, a receive clock (RT) is provided by the digital clock synthesizer block. This synthesizer generates a symbol clock for the demodulator processor and a receive data clock to accompany the receive data. These clocks are related as a function of modulation type and code rate.

The receive clock and data are provided by the demodulator card to the data interface card across the CM701 backplane. All external clocks are smoothed, that is, there are no punctured clocks.

The demodulator ASICs include:

■ CDP331 Digital Filter ASIC

    The ComStream CDP331 Digital Filter ASIC performs baseband signal filtering to optimally match the baseband filter on the modulator. The CDP331 accepts two channels of high-speed sampled input signals, in-phase and quadrature-phase (I and Q) channels, and applies a programmed digital filter to them. The two channels are then output at a sample rate equal to some binary multiple of the input sample rate.

The digital filter shape and the clock division ratio are programmed by a microcontroller using the CDP331 microcontroller interface. The CDP331 also provides various status and fault indications through this microcontroller interface to indicate conditions such as signal path saturation.

- CD3000 Demodulator Processor ASIC

For wide-range carrier acquisition, the ComStream CD3000 Demodulator Processor ASIC performs:

- Second order Costas Loop

- Carrier tracking with a corresponding lock indicator

- AGC

- Automatic Frequency Control (AFC)

The CD3000 also contains a timing processor which provides the various input and output clocks, as well as microcontroller interfaces that allow flexible monitoring and control of demodulator operations. Soft-decision data and associated clock outputs of the CD3000 are provided to the decoder ASICs.

- CDS300 Direct Digital Synthesizer ASIC

The ComStream CDS300 Direct Digital Synthesizer ASIC generates a digitized ramp or sinusoidal waveform output based upon a frequency reference input and a programmed phase increment value.

The CDS300 has an extensive microcontroller interface to allow mode configuration, phase increment programming, and status condition monitoring. The phase increment value is derived from a microcontroller programmed value plus a direct term provided by the demodulator processor. This direct term allows the CDS300 to be used in frequency and phase tracking loops, such as the demodulator carrier tracking and clock recovery loops.

- CS1101 Sequential Decoder ASIC

The ComStream CS1101 Sequential Decoder ASIC performs soft-decision FEC decoding at code rates of $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{1}{1}$ (uncoded). The CS1101 includes a differential decoder and ComStream-compatible, self-synchronizing descrambler which follow the FEC decoder in the data path. Also, the CS1101 provides the demodulator with various status and fault indications such as estimated channel error rate. The decoder is self-synchronizing for all code rates and BPSK as well as QPSK modulation.

- CDV5000 K-7 Viterbi Decoder ASIC

The ComStream CVD5000 K-7 Viterbi Decoder performs soft-decision FEC decoding at code rates of $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{7}{8}$. The CVD5000 includes a differential decoder and IDR-compatible descrambler that follow the FEC decoder in the data path. The CVD5000 also provides the demodulator with various status and fault indications such as estimated channel error rate. The decoder is self-synchronizing for all code rates and BPSK as well as QPSK modulation.

CM701 Solutions to Network Requirements

The versatile CM701 provides basic to very complex, customized solutions that meet your specific network requirements today, and are easily upgraded or expanded to meet planned or unforeseen future requirements. Various network requirements and their corresponding CM701 solutions are found in Table 2-1.

Table 2-1   CM701 Solutions

Network Requirement	CM701 Solution	Scenario/Example
Transmit-only	Only modulator card and I/O card required	—
Receive-only	Only modulator card and I/O card required	—
Designation of transmit and receive I/O when transmit interface differs from receive interface	The transmit I/O and receive I/O is set by issuing CM701 commands through either the front panel or remote terminal	The transmit data is 2.048 Mbps with a G.703 balanced electrical interface, but the receive data is only 9.6 kbps on an RS-232 electrical interface. This requirement is easily supported with a CM701 containing both a balanced G.703 data I/O card and an RS-232 data I/O card. The transmit I/O and receive I/O is set using CM701 commands.
Single modem must handle transmission or reception of multiple carriers	Use two modulators or two demodulators	If communication needs dictate that a single modem handle the transmission or reception of multiple carriers, the CM701 can support two modulators or two demodulators. The only requirement for multiple carrier operation is the installation of an extra I/O card for the additional modulator or demodulator.
	Add a second modulator or demodulator	A second demodulator or modulator can be added to a standard modem configuration. This requires a second I/O card. A second demodulator can be used to receive a shared broadcast control channel allowing a central site to reach every modem in the satellite network.
Switch from closed to open network	Add a Framing Unit card	Requirements dictate a switch from a closed network to a network consisting of modems from other manufacturers. The addition of a Framing Unit card immediately adds IDR/IBS/SMS open network compatibility.
More satellite power	Add a Reed-Solomon Decoder card	The satellite link is at its maximum power limit at the transponder or RF unit and more power is required. The coding gain can be boosted in the field with the addition of the high performance Reed-Solomon Decoder card.
Doppler buffer	Add a Doppler Buffer card	The modems on the network are all slaved to a single clock and another node needs to be added. However, the modem in stock does not have a Doppler buffer. There is no need to return the modem to the factory for the addition; simply have a Doppler buffer option card shipped to the site, slide it into the CM701, and the CM701 is immediately usable in the network.
DTE and data interface change requires new I/O	Add to or replace the existing I/O card	The uplink's data processing equipment and data interface changes. Slide in and install a new I/O card. Retain the old interface card in the CM701for switches back and forth until the new DTE is completely integrated.
Inexpensive support of receive-only and transmit-only applications	Remove option cards that are not needed	The system has more than one CM701 installed, some of which have option cards that are not being used. One of the CM701s needs a replacement or additional option card. Remove the unused option card and install it in the other modem.
Sparing	Change the option cards	Option cards can be ordered and then installed in the field. Usually the modem does not need to be returned to the factory.
Control over unmanned remote locations	Add a Satellite Control Channel card	—

More advanced configurations are possible to address unique customer requirements using the spare backplane signals and special configuration commands. For more information, refer to the chapter on advanced usage. Consult your ComStream sales representative or call ComStream Customer Service for information on option card availability.

Common Configuration Issues

3

Overview   There are a number of commonly experienced system issues that arise during the design, installation, and operation of a satellite communications system. This chapter covers the following system issues to help you better plan your system design, installation, and operation and avoid potential system issues:

- QPSK versus BPSK modulation
- Modem acquisition time reduction
- Channel spacing and band occupation
- Doppler shift effects on data transmission
- System clocking
- Multiple data interface application support

QPSK versus BPSK Modulation   Modulation is required to impress information onto an RF carrier for transmission from one location to another. One of the more efficient methods of modulation is phase shift keying (PSK). BPSK and QPSK are two forms of PSK modulation.

In PSK modulation, data is represented by the phase relationship of the RF carrier to itself or to a reference. For example, the phase of the carrier may be offset from a zero-degree reference to represent one type of data. Or, the phase offset of the carrier in one direction may represent one type of data, while the phase offset in the opposite direction may represent another.

BPSK Modulation

In BPSK modulation, zeros and ones are represented by two phases of the RF carrier signal that differ by 180 degrees. Such a signal may be produced by mixing an RF carrier with a clocked data stream in a double-balanced mixer.

QPSK Modulation

In QPSK modulation, four phases of the RF carrier, each differing by 90 degrees from the next, are used to represent two consecutive bits of the data stream. Such a signal may be produced by using two double-balanced mixers and summing their outputs in quadrature.

Also in QPSK modulation, two information bits are encoded at one time. When transmitting at the same data rate in QPSK, the RF carrier phase must change at half the rate required for BPSK modulation. Since the rate at which the phase of the RF carrier changes is proportional to the bandwidth of the modulated carrier, QPSK occupies half the bandwidth of BPSK.

BER Performance

Both BPSK and QPSK are extremely efficient modulation techniques. With careful filtering, BER performance within less than 1 dB of the theoretical limit may be achieved. One approach to achieving this low error rate is to filter the baseband data before modulation with a Nyquist filter. Such a filter not only allows optimum performance to be achieved, but it also constrains the PSK signal to the minimum possible bandwidth.

BPSK and QPSK Comparison

When designing a satellite communications system, one of the main objectives is to make optimum use of satellite characteristics. There are two limitations:

- The total power of all the desired carriers must not exceed the power level that can be handled by the satellite.

- The total bandwidth of all desired carriers must not exceed the bandwidth of the transponder.

By considering satellite limitations, hardware costs, and system goals, an intelligent decision regarding BPSK or QPSK modulation can be made.

An analysis of PSK modulation shows that the theoretical performance of BPSK and QPSK modulation is identical in a channel dominated by Gaussian noise, such as a satellite channel. Thus, choosing between BPSK and QPSK modulation must be based on other considerations, such as:

- Bandwidth efficiency requirement

  With QPSK, the transmitted spectrum occupies only half the bandwidth of BPSK and is, therefore, a good choice for an environment where bandwidth efficiency is required.

- Phase noise tolerance

  The prime advantage of BPSK is its tolerance of phase noise.

  □ If the communications system has been designed with BPSK in mind, lower-cost microwave components can be used in the up- and downconversion processes without compromising performance, thus making BPSK more cost-effective than QPSK at a comparable performance level.

  □ In a burst mode system, BPSK has a second advantage over QPSK in that a shorter acquisition time is required in the burst demodulator. This allows the frame overhead to be kept to a minimum, leading to increased efficiency while utilizing a lower-cost transponder.

  BPSK has a higher tolerance to phase noise than does QPSK due to the demodulator circuit design. Modem performance is most sensitive to phase noise at and above the cut-off frequency of the carrier reference filter. Since phase noise typically falls steeply as frequency increases, the higher BPSK carrier reference filter bandwidth falls at a point where phase noise is much lower, making a BPSK demodulator less sensitive to phase noise.

- Power-limited system

  BPSK is a potential way of handling a system in which the satellite capabilities cannot accommodate the BER requirement.

- BER performance

  In BPSK, a phase error in the reference carrier slightly reduces the signal-to-noise ratio of the data detection process, but in QPSK, a phase error quickly introduces crosstalk between the in-phase and quadrature channels, causing a more noticeable degradation. For equivalent BER performance using QPSK, a better signal-to-noise ratio for the reference carrier is required.

- Burst mode system

  BPSK has another advantage over QPSK with respect to the efficient use of the burst channel. In a burst mode system, the reference carrier has to be recovered on a burst-by-burst basis. The narrower carrier reference filter bandwidth in QPSK results in a time constant that is larger than that of BPSK by a factor of five to 10. In terms of equivalent circuitry, this means that the BPSK reference carrier can be recovered five times faster than in QPSK. This faster recovery leads to the requirement for shorter preambles, thus the more efficient use of the burst channel.

Modem Acquisition Time Reduction

Acquisition is the process by which the demodulator adjusts its frequency, phase, gain, and code-word synchronization to match that of the incoming carrier. The modem will acquire the incoming carrier when all of the following circumstances occur:

- Carrier is within the search window (+30 kHz is the default, programmable up to ±500 kHz) of the most recently commanded receive synthesizer frequency

- Power is within the dynamic range specification of the demodulator

- Signal-to-noise ratio is adequate

In most applications, the time taken to acquire the received IF must be as short as possible. Such sensitivity to time delay becomes critical in circuits where rain fades or power interruptions are frequent. In symbol rates lower than 19.2 ksps, normal acquisition is very slow and sometimes results in false lock conditions. By using the Acquisition Offset (AO), Receive Offset (RO), and Acquisition Range (AR) commands, these system issues can be resolved or at least improved to the point of acceptable circuit operation.

Acquisition Process

The modem starts acquisition at a specified frequency that is set with the Receive Synthesizer (RS) parameter plus a specified offset that is set with the AO command, in other words, RS + AO. From there, the modem searches the center bin for a valid carrier. (Bin size is determined by the symbol rate and modulation type.) It proceeds to search neighboring bins until the full preset range is searched, or until a valid carrier is found.

To ensure the modem does not lock onto a true carrier image (especially in systems operating at low symbol rates), slightly smaller frequency bins (smaller than false lock distances) are searched in an iterative manner. The search starts at RS + AO, moving just below and then above, and then searching below a greater distance and above a greater distance until one of the following occurs:

- Full acquisition range is searched
- Carrier is found

The acquisition may start in the correct bin or the true frequency of the incoming carrier. When it does, acquisition is accomplished quickly— in one to four seconds—regardless of symbol rate. Otherwise, the acquisition may take up to several minutes depending on symbol rate and frequency distance from the true receive carrier frequency.

For systems operating with high symbol rates (greater than 200 ksps), the modem will typically acquire a valid carrier within one to two seconds. Images of the true carrier, however, exist at frequency offsets of the SR/2 from the carrier for BPSK operation and at SR/4 for QPSK operation.

Additionally, if the modem is operating with little or no noise in an uncoded mode, it may lock onto one of the images of the true carrier. This does not occur when operating under normal satellite conditions in coded mode.

Once the modem acquires the carrier, it will continuously track the carrier as it moves over the specified range as long as the frequency rate of change is small, and regardless of data rate, modulation type, or FEC coding.

Reducing the Modem Acquisition Range (AR)

One way to reduce modem acquisition time is to reduce the size of the frequency range searched during acquisition. The factory default value for acquisition range is ±30 kHz. However, if the carrier is stable and well-centered on a specific frequency, it may be possible to decrease the acquisition range. Decreasing the worst-case acquisition time is accomplished by adjusting the command parameter, AR, to a smaller number. The worst-case acquisition time will be reduced proportionally by a factor equal to the new range parameter. For example, an AR value of 15000 will reduce acquisition time by half; a value of 5000 will reduce the time by a factor of six.

Reducing Time in a Bin

Acquisition time can be decreased by reducing the amount of time the demodulator waits in a bin. This can be done using the Acquisition Bits/Bin (ABB) command. This command effectively serves as a divider for the time spent waiting within one bin. For example, ABB 3 causes the demodulator to wait for $\frac{1}{3}$ the time normally spent waiting in the bin.

Reducing the amount of time spent in a bin is not recommended for low E_b/N_0 applications. If the signal-to-noise ratio is not very high and the time spent in a bin is reduced too much, it is possible that the signal will fail to acquire.

Fine-Tuning the Acquisition Starting Frequency (RS + AO and RO)

Another effective way of reducing modem acquisition time is to start the acquisition process at a frequency closer to the actual receive frequency. The AO command is used for this, but only after at least one acquisition has been made. Adjusting the AO command causes the acquisition process to start at a frequency equal to the RS frequency plus the AO frequency. To determine what the offset is, the RO frequency is queried after an initial acquisition is complete.

For example, once a circuit is installed and running, the receive offset value would be queried by using the RO status command. From this query, a response of RO -2400 might appear, which would indicate that the value of the receive offset is negative 2400 Hz. This value would then be entered using the command AO -2400, which would cause the modem to begin acquisition at the receive synthesizer frequency less 2400 Hz.

Adjusting the acquisition offset frequency is usually an effective means of reducing acquisition time, however, problems could occur without proper supervision. If the RO parameter is not monitored periodically, it could change over time due to satellite or radio reference drift. This means that the effectiveness of the AO parameter is only as good as the last RO measurement used to update the AO parameter.

The AO value is stored in the nonvolatile memory of the demodulator card. The nonvolatile memory is EEPROM technology. EEPROM technology has a large but limited number of write cycles (10,000) that can be performed before the integrity of the nonvolatile data becomes questionable. If updating the AO command is computer controlled, it is recommended that the update be done only once or twice a day. For information on using the NVO command to inhibit writing to nonvolatile memory, refer to the chapter on command descriptions.

Fast Acquisition

Fast acquisition (AQ 2) is recommended only for situations where there is low noise and high E_b/N_0 (above 8.0 dB). If fast acquisition is chosen when there is a relatively low E_b/N_0, there is a chance that the acquisition process will not find and acquire the incoming carrier.

Fast acquisition is similar to normal acquisition with the following exceptions:

- In fast acquisition, waiting time in a bin is 10% of the time spent waiting during regular (normal) acquisition. For example, assume that normal acquisition waiting time in a bin is 20 seconds. During fast acquisition, waiting time is reduced to two seconds.

- The iterative bin search pattern is slightly different for fast acquisition. During fast acquisition, the center bin is periodically checked for the presence of the incoming carrier. The acquisition process begins in the center bin, then a check is made one bin below and one bin above, and then the center bin is rechecked. Next, a check is made two bins below, two bins above, and then a recheck is made of the center bin. This process continues until the carrier has been found or the acquisition range has been exceeded.

Channel Spacing and Band Occupation

The recommended bandwidth allocation for ComStream modems is about 1.3 to 1.4 times the symbol rate for two adjacent carriers of equal power and symbol rate without noticeable impact on performance from either. Test data is provided regarding the degradation that occurs for neighboring carriers of greater power or for channel spacing less than 1.3 times the symbol rate.

Basic Modem Performance

The performance curves in Figures 3-1, 3-2, 3-3, and 3-4 represent typical CM701 performance taken from a production unit operating with QPSK modulation in a white Gaussian noise (WGN) channel. The coded BER curves include modem implementation losses, effects of asynchronous scrambling, and differential coding, but do not include the effects of adjacent carrier interference. Refer to Figures 3-5, 3-6, 3-7, and 3-8 for adjacent carrier performance degradation curves.

Modem operation without asynchronous scrambling and differential coding can improve BER performance by a factor of five to six. However, only very specialized applications can operate without scrambling and differential. To account for this performance difference, subtract the following from the expected E_b/N_0 for a given BER:

- Sequential $\frac{1}{2}$ — 0.35 dB

- Sequential $\frac{3}{4}$ — 0.35 dB

- Viterbi $\frac{1}{2}$ — 0.40 dB

- Viterbi $\frac{3}{4}$ — 0.50 dB

- Viterbi $\frac{7}{8}$ — 0.55 dB

In applications where a synchronous scrambler is used, as is the case with IBS applications, the effect of scrambling is removed and performance is only affected by an approximate factor of 2 (differential effect only).

If the sequential decoder is operating at 64 kbps or less and the short decoder length is selected (128 bit delay versus 4096 bits), a performance reduction of approximately 0.3 dB at a BER of 1×10^{-8} and about 0.65 dB of performance reduction at BER of 1×10^{-5} can be expected. Figures 3-1, 3-2, 3-3, and 3-4 illustrate the BER versus E_b/N_0 performance curves for QPSK uncoded, sequential data rates of $\frac{1}{2}$ and $\frac{3}{4}$, and Viterbi coding types $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{7}{8}$.

The performance curves in Figures 3-1 through 3-4 include the effects of scrambling and differential encoding, but not the effects of adjacent carriers.
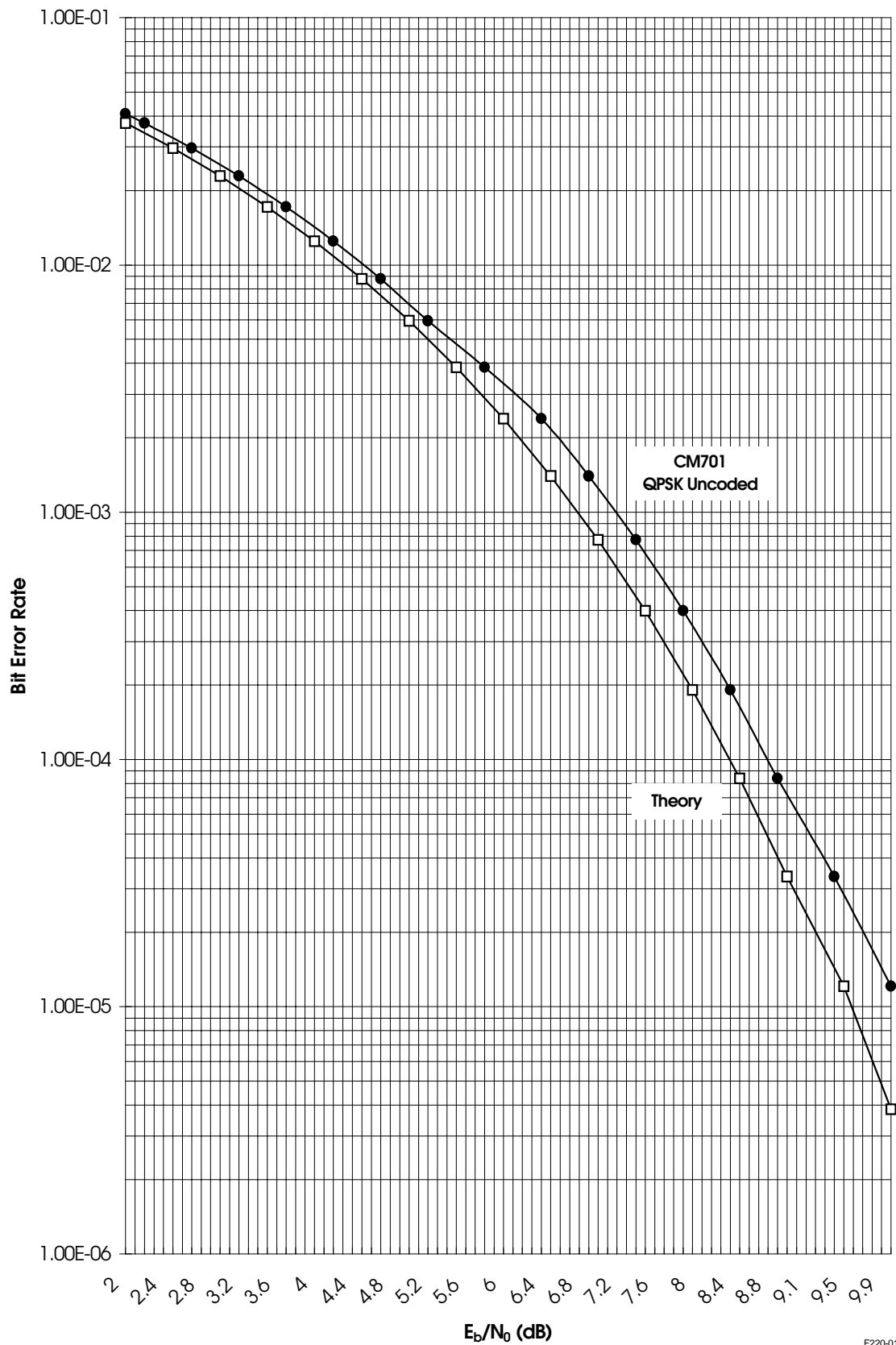
Figure 3-1   Performance QPSK Uncoded
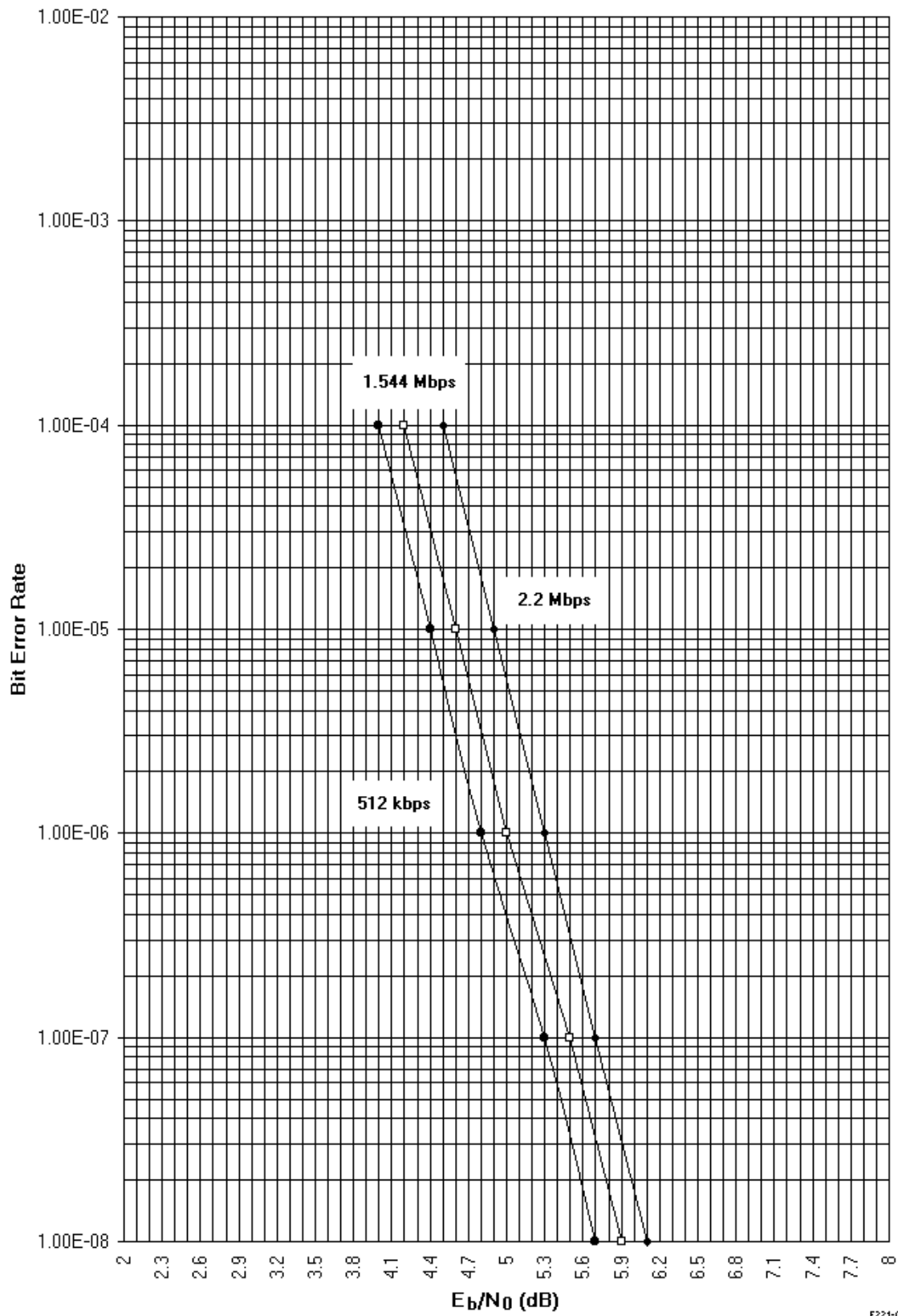
Figure 3-2   Performance QPSK Sequential Rate $\frac{1}{2}$
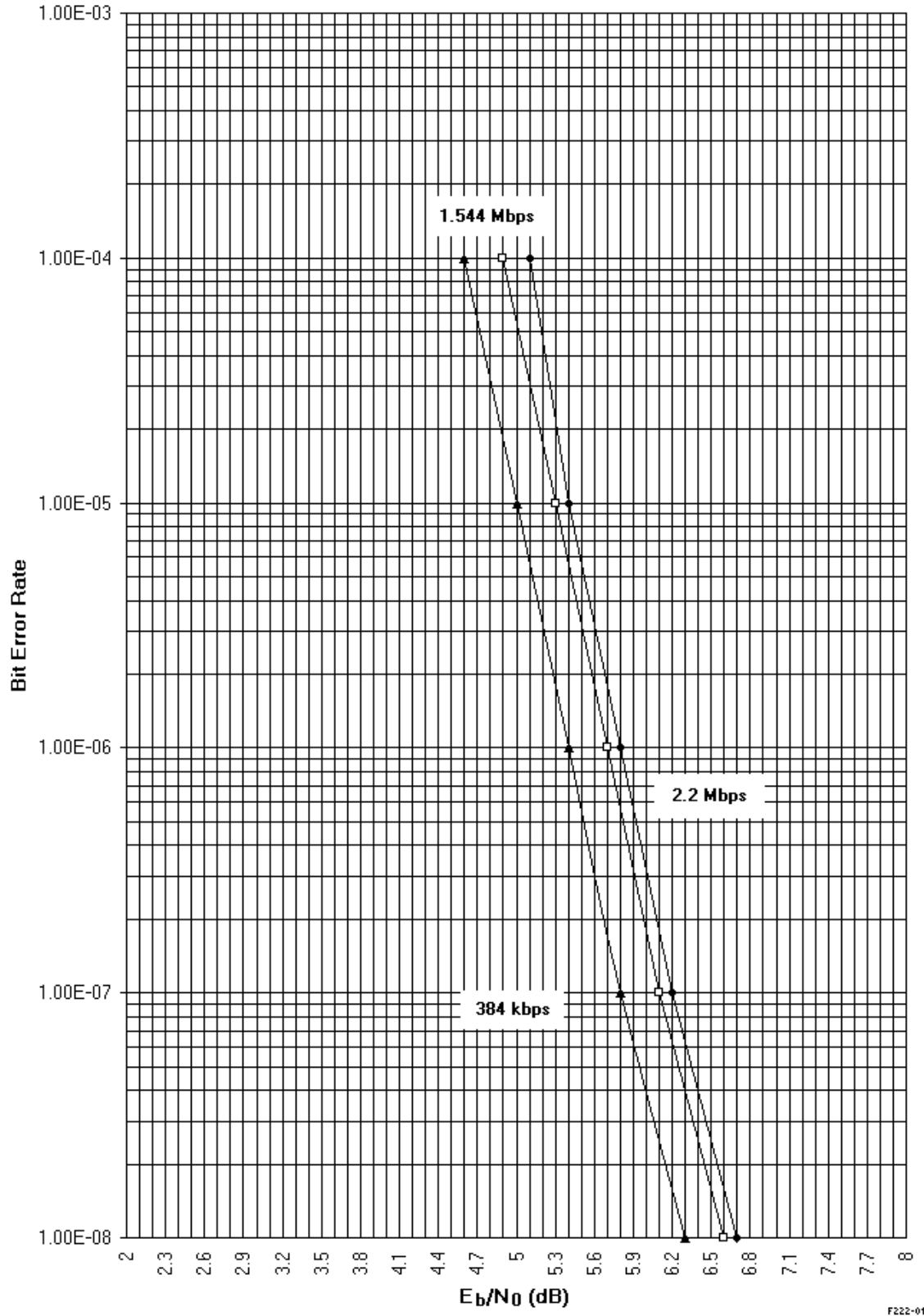
Figure 3-3   Performance QPSK Sequential Rate ¾
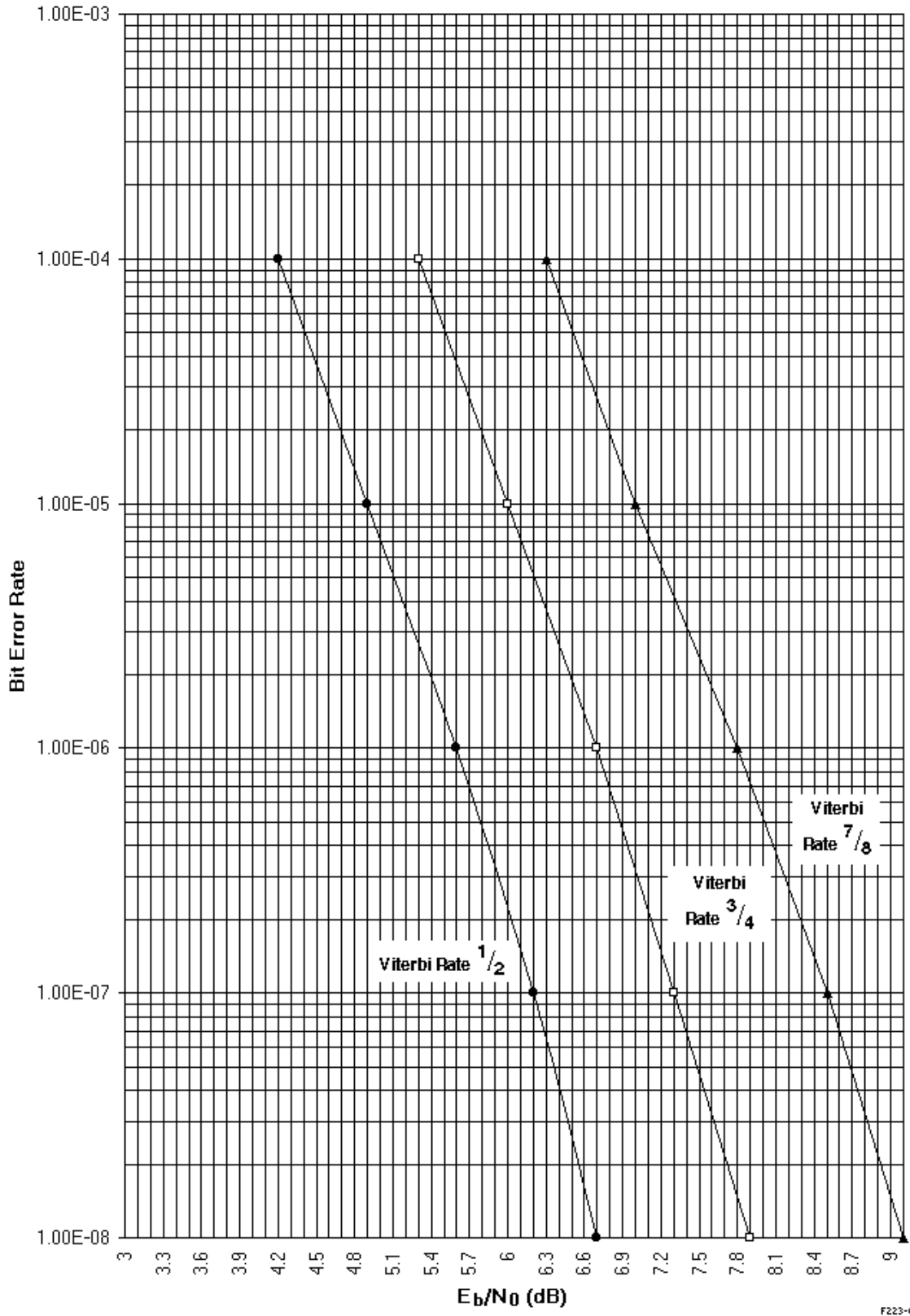
Figure 3-4   Performance QPSK Viterbi

Modem Performance Degradation: QPSK Modulation

The following graphs illustrate modem performance degradation as a function of adjacent carrier spacings and power levels. This data, presented in four QPSK modulation graphs, was collected from a single sample production modem and should be viewed as representative, or typical, rather than worst case. Measurements were taken in the presence of two like modulated carriers at 0, +7, and +14 dB relative to the main carrier.

In Figure 3-5 the test conditions were as follows:

- Spectral Mask — ComStream

- Modulation — QPSK

- Coding — Uncoded

- E_b/N_0 — 2.0 dB (equivalent to 5 dB E_b/N_0 with ½ rate coding)
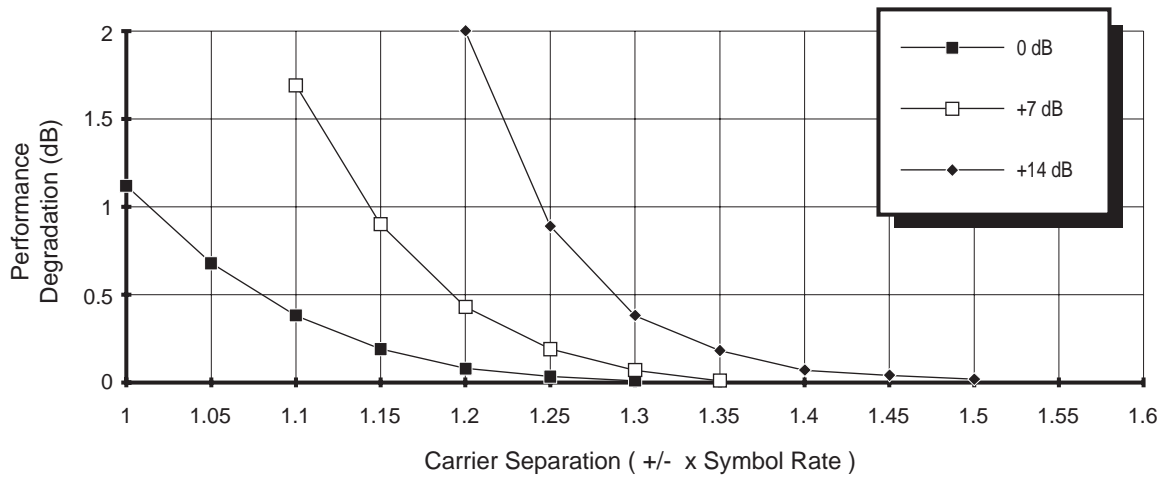
F192-01

Figure 3-5   QPSK Performance Degradation versus Carrier Spacing Using ComStream Spectral Mask and E_b/N_0 2.0 dB

In Figure 3-6 the test conditions were as follows:

- Spectral Mask — ComStream

- Modulation — QPSK

- Coding — Uncoded

- E_b/N_0 — 4.0 dB; equivalent to 7 dB E_b/N_0 with $\frac{1}{2}$ rate coding or 4.58 with $\frac{7}{8}$ coding)
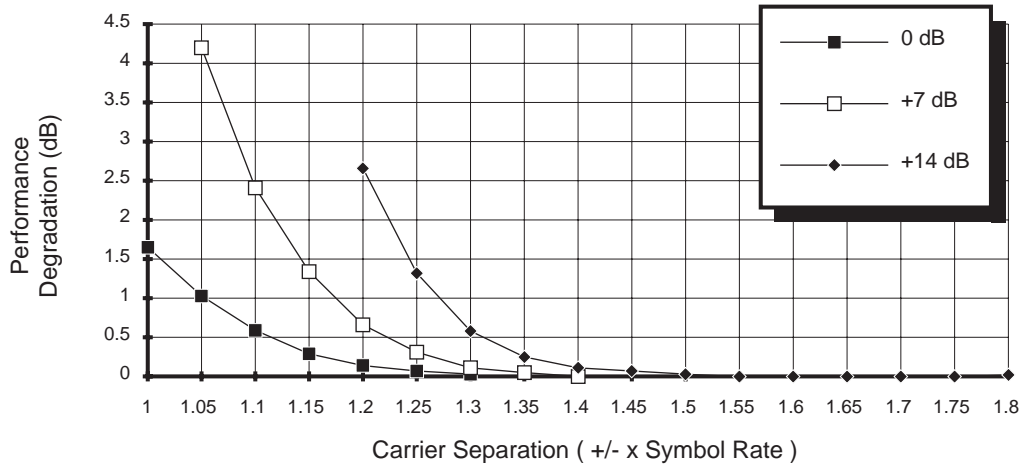
F193-01

Figure 3-6   QPSK Performance Degradation versus Carrier Spacing Using
ComStream Spectral Mask and E_b/N_0 4.0 db

In Figure 3-7 the test conditions were as follows:

- Spectral Mask — IBS/IDR

- Modulation — QPSK

- Coding — Uncoded

- E_b/N_0 — 2.0 dB (equivalent to 5 dB E_b/N_0 with $\frac{1}{2}$ rate coding)
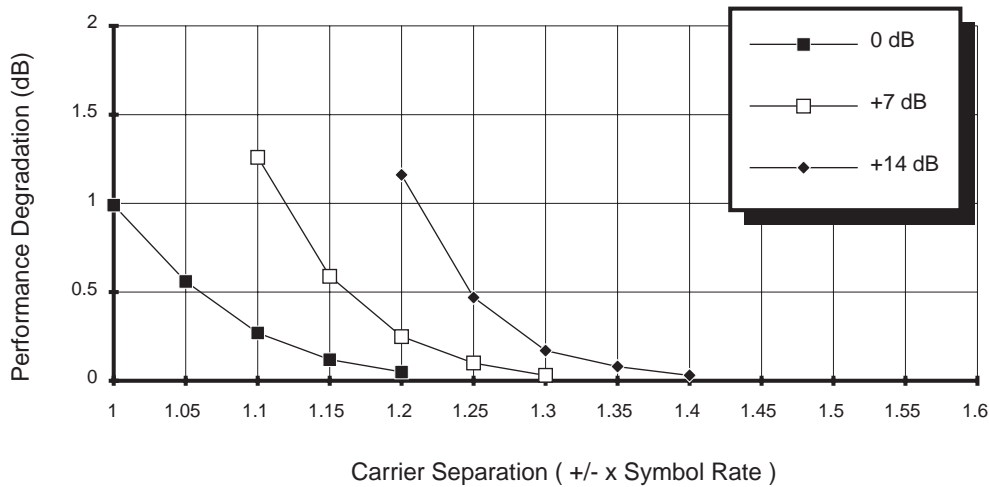
F194-01

Figure 3-7   QPSK Performance Degradation versus Carrier Spacing Using
IBS/IDR Spectral Mask and E_b/N_0 2.0 db

In Figure 3-8 the test conditions were as follows:

- Spectral Mask — IBS/IDR

- Modulation — QPSK

- Coding — Uncoded

- E_b/N_0 — 4.0 dB (equivalent to 7 dB E_b/N_0 with $\frac{1}{2}$ rate coding or 4.58 with $\frac{7}{8}$ coding)
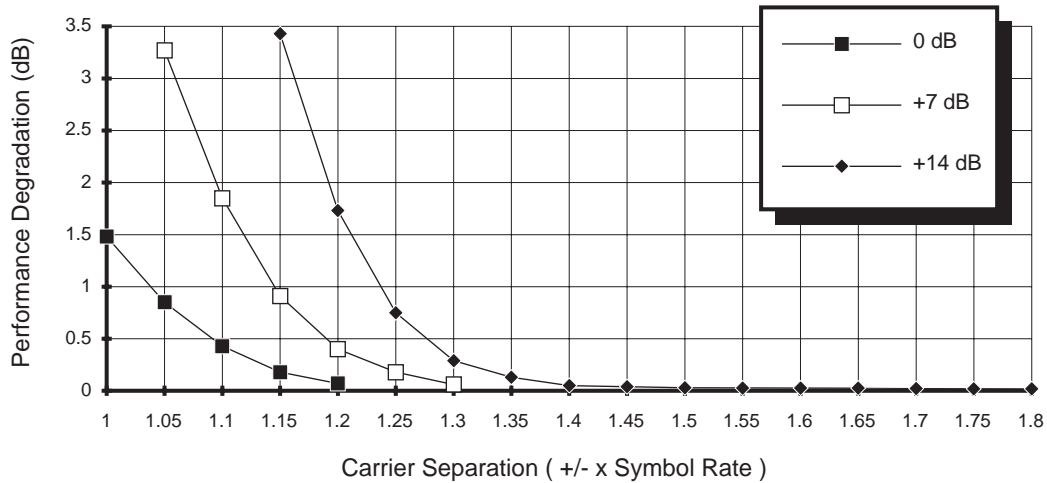
Figure 3-8   QPSK Performance Degradation versus Carrier Spacing Using
IBS/IDR Spectral Mask and E_b/N_0 4.0 db

Modem Performance Degradation: BPSK Modulation

In the presence of adjacent carriers, BPSK performed better than QPSK with as much as a 1 dB improvement.

Doppler Shift   Although satellites are geostationary, most drift slightly in their orbits every 24 hours. This motion causes a doppler shift in the satellite signals, resulting in data rate clocks at the receive site that are slightly different from clocks at the transmit site. Although identical in a 24-hour average, the data rate clock at a receive station will be slightly slower or slightly faster at different times of the day.

Effects of Doppler Shift on Data Transmission

Doppler shift has two effects on data transmission:

- The change of data rate and frequency translation results in a received frequency that can be slightly different from the one originally expected by the modem.

- The bit time frequency within a modulated data stream is also affected. This data stream is where error tolerances become most critical.

Most data communication applications have no problem with this. These applications generally have independent transmit and receive clocks at each site and can tolerate the slight differences in data rate. Examples include most DTEs, such as voice and data multiplexers, that send an aggregate data rate over the satellite. Some applications, however, require that the receive clock and data from the satellite be synchronized exactly with another clock. These applications require the use of a doppler buffer.

Determining Doppler Buffer Size

It is possible to calculate the size of the buffer needed to prevent normally occurring data overflows or underflows and to guard against most synchronization losses due to doppler frequency shift. The minimum buffer capacity, in bits, is found by multiplying 1.1 ms by a factor equal to twice the data rate:

$$\text{minimum buffer capacity } = \text{ 1.1 milliseconds} \times 2(\text{data rate})$$

A *typical* time change due to doppler shift in a transmission between a satellite and its earth station is about 550 µsec. Therefore, an entire one-way satellite link between a master and remote station would have a time variation of approximately 1.1 ms. Depending upon the satellite and location of the ground stations, more or less time may be required.

Twice the data rate is used as a worst-case situation. If the incoming data arrived immediately after a synchronization between the RT and TT occurred, an entire cycle would have to be endured. For example, if the data rate is 19.2 kbps (19,200 bps), the minimum buffer capacity of a Doppler-compensating receive buffer should be approximately 42 bits:

$$42 = .0011 \text{ seconds} \times 2(19,2000)$$

System Clocking   System clocking issues are the most common sources of periodic bit slip (error), loss of modem synchronization, and problematic installations of satellite communications circuits. ComStream satellite modems support a synchronous data interface and, therefore, need stable and synchronous clocks and data to provide robust link performance.

Some clocking synchronization issues are related to doppler shift.

Common System Clocking Schemes

There are two basic types of synchronous timing schemes used for the clocking of satellite communications links:

- Loop timed system—uses a single clock source for the entire point-to-point round trip circuit. This circuit extends from the master station through a satellite relay to a slave station, and then back through a satellite to the master station.

- Independently timed system—uses two different clock sources that independently drive either end of a point-to-point satellite link.

Loop Timed Systems

Figure 3-9 depicts various configurations of loop timed systems, including DCE and DTE timing sources and timing loopback locations.
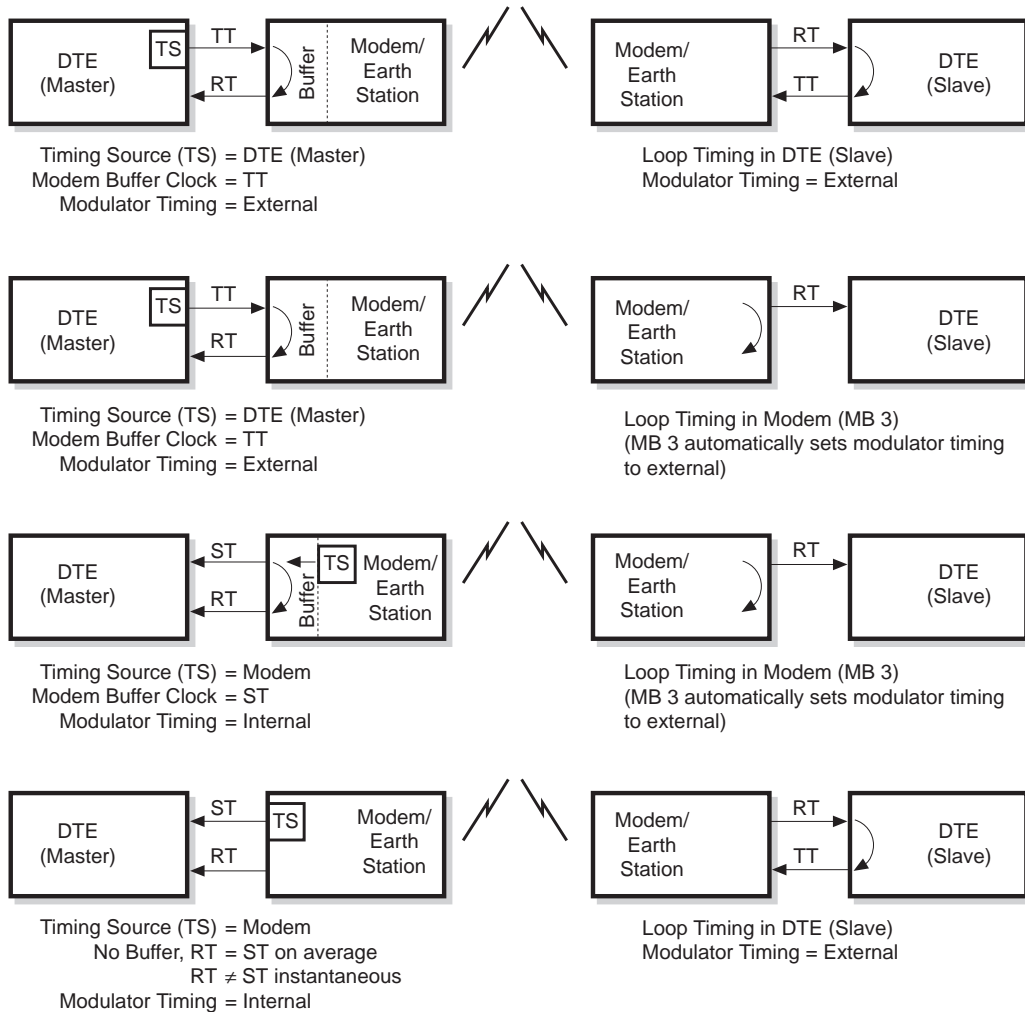
Figure 3-9   Loop Timed Systems

There are two important aspects of loop timed systems:

- On the far end of a satellite link, the remote station (also known as a slave or node) clocks its Tx data with the receive timing (RT) taken from the signal transmitted from the local, in this case the master, station at the near end. The remote station must be able to tolerate slight variations in the transmitted clock to maintain synchronization with the received data. Such variations are due to doppler shift or other dynamic propagation delays that routinely occur over satellite links between stations.

■ It is recommended that the master station have a plesiochronous, or elastic, buffer in its receive path, as in the first three clocking configurations shown in Figure 3-9. This buffer allows newly received data to be clocked in with the clock recovered from the receive data. Once in the buffer, the data is temporarily held until it can be clocked out coincident with the more stable timing source of the receiving modem or DTE.

If there is no buffer present, there is no allowance for any short-term variations between the receive and transmit clocks. In other words, even though the variations of clock and data compared to the original source may average out over an extended period of 24 hours, short-term variations due to doppler shift could cause errors in the receive data at the master station. However, if a buffer of sufficient capacity (delay) is used on the receive side of the master station, a single source clocking scheme will never be the cause of data errors due to mismatches in timing.

Independently Timed Systems

If a satellite link is operated with independent transmit and receive timing, the DTE at each end must be able to tolerate propagation delays, as well as transmit and receive clocks that may be substantially out of sync with each other due to their independent origins. When an independent clock source configuration is used, the satellite link is operated as two independent one-way links. Data errors will not occur due to timing mismatches that may have otherwise occurred if a timing source was shared. Figure 3-10 illustrates examples of independently timed systems.
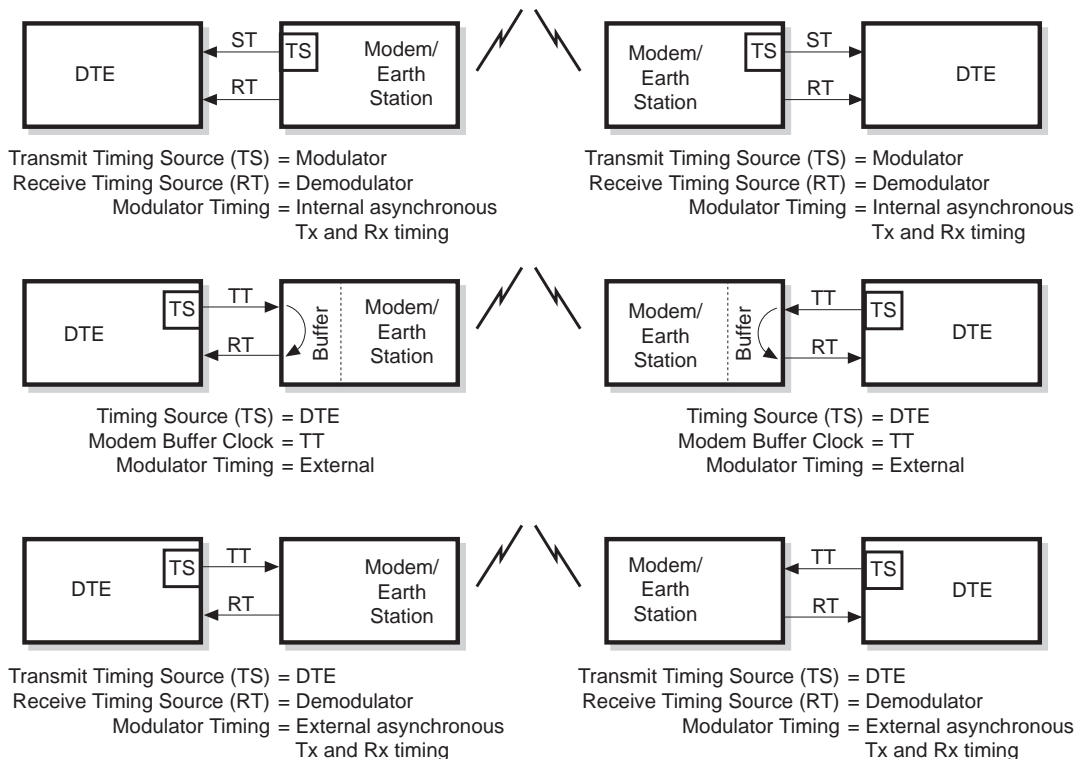
Figure 3-10   Independently Timed Systems

If the circuit is operated with each station supplying its own transmit and receive timing, the following considerations must be observed:

- The two clocks must be close enough in frequency such that the number of bit slips that occurs is tolerable in the system for a given time.

- There must be a plesiochronous, or elastic, buffer in the receive path of each station to absorb a propagation-induced delay and phase difference between the RT and the local clock. Then the received data output must be properly adjusted to the DTE.

In independent clock source configurations, the two-way satellite link is routed between two independent clocks and will lose synchronization over time due to the mismatch in clock frequencies that periodically become intolerable.

The frequency with which synchronization loss occurs depends on the capacity of the plesiochronous buffer and the accuracy of each clock. The smaller the buffer and the lower the clock accuracy, the more often synchronization will be lost.

Effects of High Data Rate or Long Cable Length on Internal Timing

When internal timing is selected, the modem generates the station timing clock (ST). This clock is sent to the DTE, which sends the transmit data back to the modulator synchronized to that clock.

There is a finite delay time between the rising edge of ST at the modulator to the time that valid data is presented to the modulator. If this time is greater than approximately one-half of a clock cycle, the modulator may be trying to latch invalid data. This time delay can be caused by either one of the following factors:

- High data rate

  The data rate is so high that half a clock cycle provides insufficient time to accommodate all the delays between the DTE and the modulator (backplane, I/O, and DTE reaction time delays).

- Long cable length

  The cable length is so long that the propagation delay along the cable delays the data by half a clock cycle, even if medium data rates are used.

If you are operating with high data rates or you cannot avoid using a long cable between the DTE and the modem, configure the CM701 modem to accommodate both of the following:

- Have the DTE return the ST clock to the modem on the TT clock line as if it were TT.

- Direct the modem to latch data on the falling edge of TT.

This is accomplished with the modulator latching clock (ML) command. The ML command is a switch on the modulator that latches transmit data (SD) on the falling edge of either ST (ML 1) or TT (ML 0). To avoid clocking problems, set the modulator clock data to TT whenever possible.

If ML 0 is selected, regardless of timing source, and no TT clock is present, or TT is significantly different from the modulator data rate, the modulator will interpret it as a modulator bit time fault and shut off its output. To override this fault signal, refer to the OM command in the chapter on command descriptions.

When the modem is in external timing, the ML command is ignored and the modulator always latches data on the falling edge of TT.

Multiple Data Interface Application Support

The CM701 modem is built to support the need for multiple data interfaces. When the DTE requires an interface that operates at one or limited data rates, such as G.703, DS-1, or RS-232, options include:

- Installation of another data interface that covers a wider bandwidth such as V.35 or RS-449.

- Have modems on hand that contain two or more of the DTE interfaces commonly used in the network. This is a plausible option in situations where the installation location of the modem is uncertain.

- Have a spare modem with as many as three different interfaces installed so that the modem can be sent to several different sites and still be compatible.

- Maintain a supply of the various interface cards, and, when the final destination of the modem is determined, install the appropriate card(s).

The CM701 will support three data interfaces simultaneously. These interfaces can be of the same type or any combination of available types. Additional interface cards can be purchased with the modem or at a later date and installed in the field. For additional information regarding nonstandard configurations, refer to the chapter on advanced usage.

Installation

4

Overview   This chapter provides directions for installing the CM701 in a communications circuit. The installation procedure begins at the preparation stage, which includes reviewing system issues and determining operating parameters, and ends with a verified data communications link and an operational CM701.

Troubleshooting tips are included throughout this chapter to assist you in solving errors commonly encountered during a CM701 installation. In addition, information regarding front panel lockout is provided if the front panel must be disabled.

A shorter, less-detailed version of the CM701 installation procedure is available as a separate quick reference card that accompanies this guide. This quick reference is for those:

- Familiar with satellite communications
- Experienced with both ComStream products and the CM701

Installation Process Overview   The following steps provide a high-level outline of the installation process. Detailed directions for each step are presented in this chapter.

1. Prepare for CM701 installation.
2. Inspect the CM701 system.
3. Familiarize yourself with the CM701.
4. Perform a bench-top test.
5. Install and connect the CM701 in a permanent location.
6. Configure the CM701.
7. Validate the system.
8. Optional – lockout the front panel.

For detailed installation procedures and information on other option cards, refer to the specific user guide that accompanies that option card.

Step 1:
Prepare for CM701
Installation

Before installing the CM701, perform the following:

1. Identify any system issues that might impact this installation

2. Determine the required operating parameters

System issues and operating parameters are often identified and defined in a satellite communications system link budget and overall system design. You may want to determine if one was conducted and, if so:

■ What issues were identified and resolved

■ Which parameters were defined

If a link budget and overall system design were not conducted, they should be completed prior to beginning this installation.

Identify System Issues

It is important to identify and resolve system issues before installing the CM701 in order to ensure an efficient and cost-effective installation and system operation. The variety of system issues that may impact this system configuration and should be considered include:

■ Locking configurations

■ Error correction coding

■ Modulation types

■ Modem performance

■ Data throughput requirements

■ Link availability requirements

■ Outdoor dish antenna size

■ Radio and frequency converter gains

■ System monitor and control mechanism

For a detailed review of these and other issues that will affect CM701 installation and configuration, as well as system performance, refer to the chapter on configuration examples.

Establish Operating Parameters

Operating parameters must be defined prior to the CM701 installation in order to correctly configure the CM701 and verify that the unit performs in accordance with system design specifications. The following parameters need to be identified:

■ Transmit parameters

▫ Transmit IF frequency (TS)

▫ Modulation type (TM)

▫ Transmit data (TD) and symbol rates (TR)

▫ FEC encoding type and code rate (TC)

▫ Transmit output power level (TP)

- Receive parameters

  - Receive IF frequency (RS)

  - Demodulation type (RM)

  - Receive data (RD) and symbol rates (RR)

  - FEC decoder type and code rate (RC)

  - Required IF frequency acquisition range (AR)

- Clocking and timing interface parameters between the CM701 and the user DTE include:

  - Internal (MB 2), external (MB 1), or loop timing (MB 3)

  - TT or ST modulator latching clock (ML)

For more information on these parameters, refer to the chapter on command descriptions. Once all of the above parameters have been defined, continue with the next step.

**Step 2:
Inspect the CM701
System**

Before performing a bench-top test or installing the CM701, examine the shipping carton, and unpack and examine the modem.

ComStream satellite communications products contain static-sensitive electronics. Use standard antistatic precautions and procedures when unpacking and handling this equipment.

Examine the Shipping Carton

CM701 shipping cartons are labeled with customer information and a list of the contents. This information can be used to verify shipments against orders without having to open the box. The customer name and P.O. number are included, as well as the ComStream model number, part number, and Customer Order Entry (C.O.E.) number. Note these numbers and include them in any correspondence to ComStream concerning an order.

The standard CM701 is shipped in cartons, with packing lists, and contains the following:

- CM701 modem (with configuration sheet)
- Shipping kit

  - Installation and operation guide

  - IF loopback cable (with DC block)

  - 26-to-37-pin adapter cable

  - 9-to-25-pin adapter cable

  - AC power cord – North American, includes AC plug

  - AC power cord – International, does not include AC plug

- Option manuals (if applicable)

Open the Carton

The CM701 is shipped in reinforced cardboard cartons that have internal air-suspension supports. To ensure that the air-suspension system is protected during opening, use a cutting tool that extends less than one-half inch into the carton.

Keep the carton and original packaging to return a unit for repair in the unlikely event of a failure.

Examine the Carton Contents

After the cartons are opened, perform the following steps:

1. Carefully remove the CM701 system.

2. Visually inspect the system to ensure that no physical damage has occurred during shipping.

3. Verify that CM701 configuration matches the features and options that were ordered.

4. If any discrepancies are found, contact ComStream Customer Service.

Step 3: Familiarize Yourself with the CM701 Chassis

The following labels and identification tags are found on the CM701 chassis:

- Model label - appears on the front panel in the upper left corner and contains the CM701 model number. The CM701 model number applies to all standalone modem products in this chassis, including the standard full-duplex modem configuration, various optional cards, and optional configurations.

- Product serial number - found on the rear panel in the center of the fan cutout. This label contains safety and emissions agency certifications and the unit serial number.

- Unit ratings label - located on the bottom of the chassis. This label contains the voltage, current, and power consumption ratings for this unit.

- Filler plate card labels - included on the rear panel filler plates of each installed card. Each of the filler plates contains information that has been silk-screened onto the metal. These labels include a card description and reference designator for each connector.

Issuing Commands

In order to enter the necessary commands to complete both the bench-top test and initial configuration of the CM701, determine if commands will be entered through the front panel, a remote terminal, or both. If commands will be issued through:

- Front panel - review the chapter on front panel operations to become familiar with the front panel, the command tree structure, and front panel commands

- Remote terminal - review the chapter on remote operations to familiarize yourself with the available remote commands and their syntax

- Both the front panel and a remote terminal - review both chapters on CM701 command operations

Step 4:
Perform a Bench-Top
Test

It is important to perform a bench-top test prior to CM701 system installation in order to verify proper configuration and confirm that the hardware capabilities match the application. This important step can help you avoid schedule and budget impacts, as it helps you identify and resolve cabling problems or system requirement incompatibilities prior to installation.

The test sequence in this section is written for a CM701 configured as a basic SCPC modem with a Data Interface card installed.

Equipment Requirements

The bench-top test requires an asynchronous RS-232 computer terminal, or a personal computer with a terminal emulator program and an RS-232 serial port, and access to AC power.

Test Procedure

When following the bench-top procedure, the exact location of the J numbers may vary from one modem to another. Check the silk screened labels for the locations of the jumpers. To perform a bench-top test, follow this procedure:

1. Place the CM701 on a bench or tabletop.

2. Ensure that the AC switch is in the Off position.

3. Connect the remote terminal, if it will be used to issue commands:

    a. Attach the 5" coaxial IF loopback cable between the TxLoopback and the RxLoopback on the rear panel.

    b. Attach the 9-to-25-pin adapter cable between the computer terminal and the remote control connection located on the rear panel. Table 4-1 lists the pinout specifications for a DB-9 straight-through cable.

Table 4-1   Straight-Through Cable

Male	Female
1	1
1	1
3	3
4	4
5	5
6	6
7	7
8	8
9	9

4. Select an AC power cord, connect it to the CM701 IEC receptacle on the rear panel, and plug the other end into an AC outlet. For additional information on using the correct power source and rules and regulations for attaching an international power cord refer to the Safety Precautions section.

5. Power on the CM701. Press the rear panel rocker switch toward the On position.

6. Monitor the message sequences on the front panel and remote terminal display. The power-up message sequences are presented in Table 4-2.

Table 4-2   Power-up Sequence (Bench-top Test)

Front Panel Power-Up Sequence	Remote Terminal Power-Up Sequence
LEDs illuminate for a short time while all LED lamps are tested	CM701 information including: ■ Model number ■ Unit serial number ■ Pass or fail indication for the power-up, self-test sequence
Power-Up Test Messages: ■ `Power-Up Test in Progress` ■ `Power-Up Test Complete` message indicating the test passed or failed	Information for each card installed in the chassis: ■ Card description ■ Chassis slot location ■ Software version ■ Other hardware configuration information
ComStream CM701 identification message appears indicating power-up is complete	System prompt (>) appears indicating power-up is complete
Troubleshooting Tip	
If the terminal fails to display the power-up message sequence, check the following: ■ Cables ■ Remote terminal baud rate set at 1200 ■ Terminal data/parity set at 7/odd Once the parameters are correct, turn the power switch off and then back on. Monitor the power-up message sequence on the remote and front panel terminal displays.	

7. Verify front panel button operation. To do this, select the following options in the order in which they are listed, using the buttons on the front panel:

Table 4-3   Front Panel Button Operation Verification

Button or Option	LCD Message Display	Remarks
Config	4:Systm 4:M&C More	—
More	6:Demod 7:Mod More	—
7:Mod	TxDataRate	TxDataRate is the first of the list of modulator commands that appears
Previous button	6:Demod 7:Mod More	—
Previous button	Config Monitor Faults	—

8. Verify remote operation from the remote keyboard. To do this, type `EM ?` at the system prompt and press Enter.

   A response of `EM 1` or `EM 0` should appear on the display followed by the system prompt >.

9. To perform additional testing, refer to the chapter on troubleshooting and maintenance.

10. Perform a BERT IF loopback test to verify basic modem operation.

    For additional information on the BERT IF Loopback test, refer to the chapter on BERT.

The CM701 system is now tested and verified. If no further testing is required, power off the unit and proceed to the next step.

Step 5:
Install and Connect the CM701 in a Permanent Location

It is important that all rack-mount installations allow adequate ventilation to the modem at all times. To keep the system cool and running smoothly, the power supply cooling fan pulls external air through an opening on the rear panel and exhausts air out of the slots in the sides of the unit. The minimum airflow clearance is three inches at the sides of the CM701 and six inches in the rear.

To install and connect the CM701, perform the following steps:

1. Install the CM701 in a standard 19-inch rack, if appropriate.

   a. Determine if rubber feet need to be removed.

      • Remove the rubber feet from the bottom of the CM701 if the rack installation will not fit or if airflow clearance minimums are violated.

      • If there is room, leave the rubber feet on the unit as they protect bench-tops and tables when the unit is being handled.

   b. Determine the method of installation from the following three options:

      • Rack-mount ears with handles - shipped standard with every CM701 and are the most commonly used mount. They are easy to install, provide adequate support for fixed-site applications, and have handles that are used to install or move the unit.

        The handles protrude a few inches from the front panel and may not allow rack front doors to close without interfering.

      • Rack-mount ears without handles - functionally equivalent to those with handles, however, the handles have been removed to allow CM701 installation in racks with front doors.

      • Rack-mount slides - suggested for mobile applications or in installations that are subject to vibration and shock stresses above and beyond normal fixed-site installations.

      Rack-mount ears attach the CM701 unit to the front of the rack and support it in a cantilevered manner. Rack-mount slides provide full support of the CM701 from front to back.

   c. Attach the ears or slides to the CM701 following the instructions provided in the shipping or slide kit.

   d. Install the CM701 in the rack.

2. Attach all external system connections after the unit has been positioned. Since the J numbers and locations may vary, use the silk-screen labeling to identify their locations. (Refer to Figure 4-1.)

   a. Place the AC switch on the CM701 in the Off position.

   b. Connect a heavy gauge wire to the ground stud located on the rear panel and to the rack ground (or other solid connection to earth ground).

   c. Connect the 5" coaxial IF loopback cable to the TxLoopback and the RxLoopback rear panel connectors.

   d. Connect the coaxial cable to the downconverter RxIF and the CM701 rear panel RxIF BNC connector.

   e. If remote operation is desired, connect the RS-232 plug of an asynchronous data terminal to the remote control DB-9 connector.

      The CM701 shipping kit includes a male DB-9-to-female DB-25 adapter cable that can be used to convert the 9-pin remote control connector to a standard 25-pin RS-232 DCE pinout.
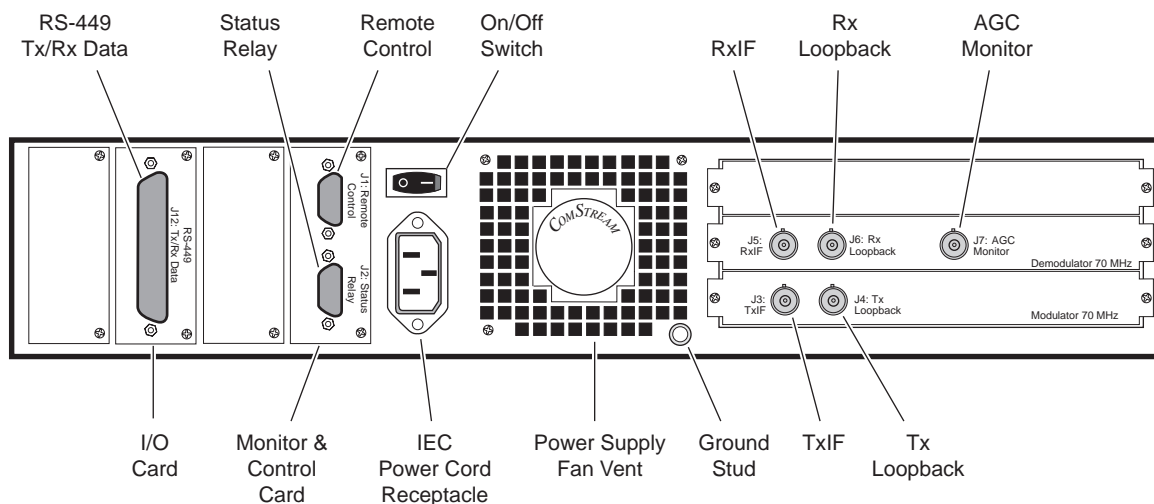
Figure 4-1   CM701 Standard Rear Panel

For systems requiring packet protocol remote control, connect a data terminal with supporting packet driver software (for example, a personal computer) directly to the remote control connector. For details on packet-based remote communications, refer to the appendix on ComStream Packet Protocol.

   f. Connect a cable, appropriate for the selected data interface, to the Tx/Rx Data connector and the DTE. DTE interface/cable specifications are:

      • RS-449 interface - requires a DB-37 type connector

      • V.35 interface - refer to the manual that accompanies this I/O card

      • RS-232 interface - refer to the manual that accompanies this I/O card

      For detailed specifications for these and other interface connectors, refer to the chapter on external connections.

g. Select and connect an AC power cable to the CM701 IEC receptacle on the rear panel and plug the other end into an AC outlet. If an international AC power cable is selected, a locally compatible plug must be attached to the stripped and tinned bare wires of the cable in accordance with any local laws or regulations.

For information on installation, and rules and regulations for international AC power cords, refer to the chapter on external connections and the technical specifications appendix. For a list of certifying agencies for various countries, refer to the Preface.

h. Connect the coaxial cable to the upconverter TxIF and the CM701.

Do not plug the cable into the TxIF connector on the rear panel until the proper IF transmit frequency, power level, and symbol rate have been configured. The upconverter may be damaged, or other carriers on the satellite transponder may be disrupted if the cable is connected before the system is configured.

The CM701 is factory shipped with the remote command settings AE 1 and EM 1. These settings indicate that the modulator will automatically transmit an IF signal upon a reset or power-up sequence.

3. Power up the CM701.

a. Press the rear panel rocker switch toward the On position.

b. Monitor the message sequences on both the front panel and remote terminal as described in Table 4-4.

Table 4-4   Power-Up Sequence (Permanent Location)

Front Panel Power-Up Sequence	Remote Terminal Power-Up Sequence
LEDs illuminate for a short time while all LED lamps are tested	CM701 information including: ■ Model number ■ Unit serial number ■ Pass or fail indication for the power-up, self-test sequence
Power-Up Test Messages: ■ `Power-Up Test in Progress` ■ `Power-Up Test Complete` message indicating the test passed or failed	Information for each card installed in the CM701 chassis: ■ Card description ■ Chassis slot location ■ Software version ■ Other hardware configuration information
ComStream CM701 identification message appears indicating power-up is complete	System prompt (>) appears indicating power-up is complete
Troubleshooting Tip	
If the terminal fails to display the power-up message sequence, check the following: ■ Cables ■ Remote terminal baud rate set at 1200 ■ Terminal data/parity set at 7/odd Once the parameters are correct, turn the power switch off and on. Monitor the power-up message sequence on the remote and front panel displays.	

For applications using packet protocol for remote control, no power-up messages are issued by the CM701. For detailed information regarding packet protocol specifications and commands, refer to the appendix on ComStream Packet Protocol.

Step 6:
Configure the CM701

The CM701 can accommodate a variety of configurations to allow for customization of your network communications system.

Table 4-5 lists commonly used configuration commands divided under the headings Modulator and Demodulator, and then listed alphabetically by command functions. For each command, the following information is provided:

- Command function
- Remote commands
- Corresponding front panel commands

Included in the table headings is the level where the front panel commands are accessed. A complete listing of all commands can be found in the remote operations and front panel operations chapters.

To configure the CM701, follow these steps:

1. Use the remote terminal or the front panel to configure the CM701 according to your system design and operating parameters. Table 4-5 lists commonly used configuration commands in front panel order.

Table 4-5   Commonly Used Configuration Commands

Command Function	Remote Commands	Front Panel Commands
Modulator Commands (front panel Config>Mod)		
Transmit data rate	TD	TxDataRate
Transmit synthesizer frequency	TS	Tx Freq
Transmit symbol rate	TR	TxSymRate
FEC encoding type and code rate	TC	Tx Code Rate
Transmit modulation type	TM	Tx Mod Type
Scrambling for the transmit path	SM	Tx Scrambling
Differential encoding on the modulator	DM	Tx Diff Encoding
Modulator transmit baseband matched filter select	MFS	Tx Filter Type
Transmit output power level	TP	Tx Pwr Level
Modulator bit time selection	MB	Tx Clock Source
TT or ST modulator latching clock	ML	None*
Pure carrier	PC	Tx Pure Carrier

Table 4-5   Commonly Used Configuration Commands

Command Function	Remote Commands	Front Panel Commands
Demodulator Commands (front panel Config>Demod)		
Receive data rate	RD	RxDataRate
Receive synthesizer frequency	RS	Rx Freq
Receive symbol rate	RR	RxSymRate
FEC decoder type and code rate	RC	Rx Code Rate
Demodulation type	RM	Rx Mode Type
Descrambling for the receive path	SD	Rx Scrambling
Differential decoding on the demodulator	DD	Rx Diff Decoding
Demodulator receive baseband filter select	DFS	Rx Filter Type
Acquisition range	AR	None*
Other Commonly Used Commands		
E_b/N_0 Query	EB	E_b/N_0 (monitor command)

*This entry currently does not appear on the front panel. Use the terminal emulator (:AA) to enter this command from the front panel.

2. After the system has been configured, verify the parameter settings by accessing the appropriate front panel commands or issuing remote commands DP and DP 7 to display the summary configuration parameter settings.

If it is necessary to start the configuration process over or to reconfigure an existing unit, the CM701 may be restored to its original factory configuration using the Initialize Nonvolatile Memory command:

- From a remote unit: **IN 9346**

- From the front panel Config>Systm list: **Init Factory Default**

 If the CM701 is configured for nonstandard data paths, those paths may be overwritten during initialization.

Acquire the Carrier

In a standard factory configuration, the CM701 modem will automatically acquire the carrier within:

- Few seconds when:

  - E_b/N_0 level is greater than 4 dB

  - Data rate is 1 Mbps

- Several minutes when the data rate is 9.6 kbps

Two items occur when carrier acquisition is complete:

- Rx Sync message on the front panel changes from white to green
- Unsolicited ST 0 message appears on the ASCII remote terminal screen

If the modem does not acquire the carrier within its time period, an acquisition failure error code will be displayed. If this occurs, ensure that the:

- External connections to the modem are correctly attached
- Configuration parameters of the modulator and demodulator are compatible; reset the parameters as needed
- Modulator output is enabled
- Signal-to-noise ratio is sufficient for operation
- Modem has searched the entire acquisition range
  - Check the fault registers; bit 9 should be set
  - Use the VS and VF queries
- Signal is present on the RxIF connector; check the AG parameter; a value of 60 to 170 indicates good signal level; a value of 255 indicates no signal

For additional help in solving common acquisition problems, refer to the chapter on troubleshooting and maintenance.

Acquisition Commands

Use the remote terminal or the front panel to issue acquisition commands. Table 4-6 lists commonly used acquisition commands listed alphabetically by their command functions. A complete listing of all commands can be found in the chapters on remote operations and front panel operations.

Table 4-6   Commonly Used Acquisition Commands

Command Function	Remote Command	Front Panel Command
Acquisition offset frequency	AO	None*
Acquisition	AQ	Acquisition (Config>Demod)
Acquisition range	AR	None*
*This entry does not appear on the front panel. Use the front panel terminal emulator (:AA) to enter this command from the front panel.		

<table>
<tr><td align="right">**Step 7:**
Validate the System</td><td>To validate the system and isolate system faults, the tests described in Table 4-7 can be performed using the remote LB, or front panel LoopBack, command.</td></tr>
</table>

Table 4-7   CM701 System Tests

Test	Description
Near data loopback	Validates the connection between the DTE and the CM701.
IF loopback	Validates the CM701 transmit and receive paths including IF modulation and demodulation. This loopback also uncovers timing problems between the DTE and the CM701.
Satellite loopback	Validates the coaxial cabling between the CM701 and the outdoor radio, confirms the radio transmit and receive paths, and confirms the satellite receive and transmit paths.
Far data loopback	Ensures that each modem is receiving the carrier from the satellite with an acceptable E_b/N_0 level within the anticipated link availability.
Long-term BER measurement	Indicates if the: ■ Satellite link is operational 24 hours a day, 7 days a week, with no periodic interruptions along the way ■ Doppler effects of satellite motion on the circuit operation are nonexistent, or are at least within tolerable limits This test should be performed for one week, but at a minimum should be conducted for at least 24 hours. The week duration is optimum as neighboring carriers on the satellite may interfere only at certain times during the week. This test can be run with the internal built-in CM701 BERT or with an external DTE data integrity tester.

For detailed testing information, illustrations, and procedures, refer to the chapter on troubleshooting and maintenance.

<table>
<tr><td align="right">**Step 8:**
Optional Front Panel
Lockout</td><td>For some installations, the front panel may need to be disabled. For these applications the CM701 provides view-only and complete front panel lockout modes. These modes prohibit accidental or unauthorized modifications to the CM701 operating configuration. Since the lockout configuration parameter is stored in NV memory, it remains unchanged after a CM701 reset or power-up.</td></tr>
</table>

Issuing the Front Panel Lockout Command from the Front Panel

To lock out the front panel, change from one lockout mode to another, or return the front panel to normal operation, perform the following steps:

1. Access the front panel LockOut command by pressing the Previous, Up Modify, and left Cursor buttons `Previous^<` simultaneously (these three buttons are pressed together).

   The LCD will display the message `Front Panel Normal`.

2. Press the right LCD button or a Cursor button so that Normal is blinking.

3. Press the right LCD button to scroll through the parameter list until the desired configuration is found. Each button press scrolls to the next item on the parameter list. Available parameters are:

  - Normal – all features are enabled; front panel is fully functional

  - ViewOnly – front panel responds to all push buttons, except Enter and Tx Enable, to allow you to read all operating parameters and configuration parameters, but not change parameters; this mode is indicated by a yellow ViewOnly message on the front panel to the right of the LCD display and above the Enter button

  - LockOut – this mode is indicated by the message `Front Panel LockOut` on the LCD; while this mode is active, all button presses are ignored except the `Previous^<` button sequence

4. Press the Enter button to issue the command. The front panel is set at the desired operating mode.

Issuing the Front Panel Lockout Command from a Remote Unit

To lock out the front panel, change from one Lockout mode to another, or return the front panel to normal operation, issue the following remote commands:

- To lock out the front panel, issue an **`FPL 2`** command. While this mode is active, all front panel button presses are ignored.

  During lockout mode, the front panel will only acknowledged the following three-button sequence `Previous^<` (these three buttons are pressed together). When this front panel command sequence is entered, users are able to modify the front panel lockout parameters from the front panel

- To place the front panel in ViewOnly mode, issue an **`FPL 1`** command. The front panel will respond to all button presses *except* the Enter and Tx Enable buttons. This mode allows users to view, but not change, CM701 parameters, status information and other information displayed on the front panel LCD.

- To restore the front panel to Normal mode, issue an **`FPL 0`** command. The front panel will be fully functional with all features enabled.

Remote Operation

This chapter presents the following information for remote command operations:

- An overview of remote communications

- Instructions for issuing commands from a remote terminal

- Summary of all remote commands

- Security commands

- Front panel lockout

- Error codes

For information on fault monitoring, logging, and conditions, refer to the chapter on fault handling. For a detailed description of each command, refer to the chapter on command descriptions.

Remote Communications Overview

CM701 commands can be issued from a compatible remote unit which can be an ASCII computer terminal, a personal computer, or any other control unit capable of asynchronous communications, which is connected to the CM701 remote control port. The CM701 remote control port can be configured to support RS-232 or RS-485 electrical levels. For details on the remote control port connector pinout, electrical levels, and 9-to-25-pin converter cable, refer to the chapter on external connections.

ASCII and ComStream Packet Protocol

The two types of remote communications protocol supported by the CM701 are ASCII and ComStream packet protocol. ASCII protocol is provided for use with character-based computer terminals. These terminals issue an asynchronous ASCII character to the CM701 each time a keyboard key is pressed. If the echo enable parameter (EE) is set to 1, the CM701 echoes the character back to the terminal for display on the screen.

ComStream packet protocol was developed for computer control of one or more ComStream products on an RS-485 multidrop or party-line control bus. This protocol is also used by network management systems to control a remote CM701 through an in-band channel provided by a Satellite Control Channel option card.

Configuration

The BR, MDP, MEI, MPT, and MPA commands are used to configure the remote control port from a remote terminal. For detailed information on these commands, RS-232 or RS-485 electrical interface, communications baud rate, data and parity bits, ASCII or ComStream packet protocol, and packet protocol device address, refer to the chapters on command descriptions and ComStream packet protocol.

Issuing Remote Commands

Command Syntax

To issue an ASCII protocol command from a remote terminal, type the command at the prompt (>) with the appropriate parameter, and then press ENTER. Use the following syntax:

```
<command mnemonic> <parameter>
```

where:

- `<command mnemonic>` refers to a two- or three-letter command abbreviation
- There must be one space between the command mnemonic and the parameter; a space is inserted by pressing the SPACE BAR.
- `<parameter>` is any value pertaining to the command, if applicable. The parameter for a query command is a question mark (?); some commands do not require a parameter.

For example:

- To set the real-time date (DAY) as March 4, 1999 (030499), use the syntax `DAY 030499`.
- To query (?) the receive synthesizer frequency (RS), use the syntax `RS ?`.
- To display a list of command parameters, use the syntax `DP`.

When the same command mnemonic exists for two or more CM701 option cards, a slot number must precede the command:

```
<slot number>:<command mnemonic> <parameter>
```

Direct slot addressing of commands is not required for most CM701 configurations. It is required only when a command mnemonic is common to two or more CM701 option cards. For example:

- To query (?) the receive timing clock frequency (RTF) for slot 2, use the syntax `2:RTF ?`.

Command Entry

To issue a command from the remote unit, use the following procedure.

1. At the prompt (>), type the command using the correct syntax. When there are duplicate cards, precede the command with the appropriate slot number. A command without a slot number will cause an error (ER) message.

2. Press ENTER. If the command was completed, a prompt (>) appears. This may take a few moments. If the command was not completed, an error message appears.

For example, to query the transmit synthesizer frequency of the modem card in slot 6, you would type **6:TS ?** at the prompt (>) and press ENTER.

Prior models and versions of ComStream modems required that you press ESC before typing the command. The CM701 does *not* have this requirement; however, it will accept and process any command that includes an initial ESC keypress.

Command Summary   CM701 commands can be categorized into two memory types and four functional types. Memory types of configuration commands are listed in Table 5-1and command functions are listed in Table 5-2.

Table 5-1   Configuration Command Memory Types

Memory Type	Description
Nonvolatile (NV)	Command parameters that are stored in NV memory do not have to be reentered each time the CM701 is powered on or reset.
Volatile (V)	Command parameters that are stored in volatile memory are not retained after power-on or reset of the CM701.

Table 5-2   Command Function Types

Function	Description
Configuration	In general, these commands have parameters that can be modified and entered to change the operating characteristics of the CM701 and direct it to perform real-time functions.
Monitor	These commands provide query (view-only) information about the performance, operating environment, and nonfault-related conditions of the CM701. Monitor commands used when the built-in BERT is enabled are referred to as BERT Monitor (BMonitor) commands.
Fault	These commands provide information about the functional status of the CM701 and may indicate when an external piece of equipment is not configured properly or is faulty. Fault commands are query-only with the exception of the Clear Faults (CF) command.
Security	These commands control access to the remote control port to prevent unauthorized operation of the CM701 over telephone lines or other types of remote access.

All commands for a standard CM701 are summarized in alphabetical order in Table 5-3. This table is also provided as a quick reference card. Detailed descriptions of these commands are located in the chapter on command descriptions. Commands for option cards can be found in the guide provided with each card. Table 5-3 provides the following information:

- Remote command mnemonic

- Function (Mem Type)

- Front panel command equivalent or terminal emulator (if available)

- Parameter or range

- Default value

- Description, notes, and remote/front panel response

A dash (—) is used to indicate no entry.

Table 5-3   Remote Command Summary

Cmd	Func/Mem Type	Front Panel	Param Range	Default Value	Brief Description [Notes]
ABB	Config (NV)	Use terminal emulator	1 to 255	1	Time demod waits in bin during acquisition
ACP	Config (NV)	Use terminal emulator	0, 1	1	Disable/enable autoconfig path
AE	Config (NV)	Use terminal emulator	0, 1	1	Manual/auto modulator enable
AG	Monitor	AGC Level	?	—	AGC gain register
AL	Config (NV)	Use terminal emulator	0, 1, 3	1	Disable/enable fault reporting [5]
AO	Config (NV)	Use terminal emulator	+30000 to -30000	0	Start frequency for acquisition
AQ	Config (NV)	Acquisition	0, 1, 2	1	Disable/enable acquisition
AR	Config (NV)	Use terminal emulator	0 to ±500000	30000	Acquisition range
BBC	BMonitor	BERT BitCnt	?	—	BERT bit count
BBE	BMonitor	BERT BlkBER	?	—	BERT BER over previous block
BBL	Config (NV)	BERT Blk Length	1, 5 to 8	6	BERT block length of 1 sec or 10n bits
BDI	BMonitor	BERT Data	?	—	BERT receive data inverted
BDP	BMonitor	Use terminal emulator	—	—	BERT display parameters
BEC	BMonitor	BERT BitErr	?	—	BERT bit error count
BEI	Config (V)	BERT Error	—	—	BERT transmit single error insert
BEN	Config (V)	BERT Test Mode	0, 1	0	BERT disable/enable
BER	BMonitor	BERT AvgBER	?	—	BERT average BER since last reset
BIT	Config (V)	Self Test	0	—	Built-in self-test
BLC	BMonitor	BERT BlkCnt	?	—	BERT block count
BLE	BMonitor	BERT AvgBLER	?	—	BERT block error rate
BPT	Config (NV)	BERT Pattern	0 to 4	0	BERT user pattern type
BR	Config (NV)	Baud Rate	[1]	1200	Remote control baud rate [1]
BRE	Config (V)	BERT Control	0, 1, 2, -	0	BERT stop(0)/start(1)/reset(2 or -)
BSF	BMonitor	BERT Sync History	?	—	BERT sync fault: 0=in sync, 1=sync loss
BSS	BMonitor	BERT Sync	?	—	BERT sync status: 0=in sync, 1=sync loss
BST	Config (NV)	BERT SyncLvl	0,1	0	BERT sync threshold 1 K/10 K or 2.5 K/10 K
BUP	Config (NV)	BERT Usr Ptrn	0 to 255	85	BERT user program 8-bit pattern
BWE	BMonitor	BERT BlkErr	?	—	BERT blocks with errors
CAP	Config (V)	Use terminal emulator	0, 1, 2, 3	0	Sets the data path to which subsequent commands will be issued
CAS	Config (V)	Use terminal emulator	0, 1, 2, 3	0	Sets the data path to which a status query command will be issued
CD	Config (NV)	Use terminal emulator	1, 2	1	Disable/enable data control
CDC	—	—	—	—	Use the ACP command instead of the CDC command
CE	Monitor	Chan Err Rate	?	—	Provides channel error rate
CF	Fault (V)	Clear	—, 0	—	Clears fault log register

Table 5-3   Remote Command Summary

Cmd	Func/Mem Type	Front Panel	Param Range	Default Value	Brief Description [Notes]
CFG	Config (V)	Use terminal emulator	?	—	Card configuration
CLP	Config (V)	Use terminal emulator	0	—	Clears all data paths; issuing CLP 0 has the same affect as issuing a 0 parameter with each of the transmit and receive data path commands
CPC	Config (V)	Use terminal emulator	1	—	Enables the configuration path control function; attempts to reestablish autoconfiguration default settings when issued
DAY	Config (NV)	Date Mo/Da/Yr	010100 to 123199	[8]	Real-time date in month/day/year (mm/dd/yy); query (?), clock off (0)
DC	Config (V)	Use terminal emulator	—, 0, 1, 7	—	Displays config of modem (-, 0), symbol rates (1), mod format (7) [6]
DD	Config (NV)	Rx Diff Decoding	0, 1, 2	1	Disable, standard, or auto/QPSK differential decoding
DFS	Config (NV)	Rx Filter Type	0, 1, 2	0	ComStream, IBS/IDR, or SMS demod baseband receive filter select
DI	Config (NV)	Use terminal emulator	0, 1	0	Disable/enable demod spectral inversion
DL	Config (NV)	Use terminal emulator	0, 1, 2	2	Short/long/auto decoder memory
DM	Config (NV)	Tx Diff Encoding	0, 1, 2	1	Disable, standard, or auto/QPSK differential encoding
DP	Config (V)	Use terminal emulator	-, 0, 1, 2, 7	—	Display parameter values [6]
DRM	Config (NV)	Use terminal emulator	0, 1	[9]	Symbol/data rate mode
EB	Monitor	E_b/N_0	?	—	Display E_b/N_0 (query only)
EBT	Config (NV)	Use terminal emulator	0 to 210	0	E_b/N_0 threshold
EE	Config (NV)	Use terminal emulator	0, 1	1	Disable/enable character echo
EM	Config (V)	Tx Enable button	0, 1	1	Disable/enable mod TxIF output
FL	Fault	Modem Faults	?	—	Fault log query
FLO	Config (NV)	Use terminal emulator	[7]	[7]	Yellow fault message overlay mask
FO	Config (NV)	Use terminal emulator	[7]	[7]	Status relay fault overlay mask
FPL	Config (NV)	Previous + Up Modify + Left Cursor buttons	0, 1, 2	0	Front panel normal, view only, or lockout access
FRX	Config (NV)	Use terminal emulator	0 to 7	0	Fault relay sense external signal polarity; bit mapped to status relay rear panel connector pins
GAV	Monitor	Gate Array	?	—	Gate array software version by slot number ID
HWV	Monitor	Use terminal emulator	?	—	Hardware version; by slot, syntax is *n*:HWV ? where *n* = 1, 2, 3, 4, 5, 6, or 7
ID	Config (NV)	Use terminal emulator	1 to 16 characters	ComStream CM701	Modem identification; 1 to 16 characters in length
IN	Config (V)	Init Factory Default	9346	—	Initialize NVRAM config parameters to default
INF	Config (V)	Initialize New Firmware	9346	—	Initialize new firmware (ver. 4.4)
LB	Config (V)	LoopBack	0, 1, 2, 4	0	Mode: normal/IF/near/far data
LGE	Security (NV)	Use terminal emulator	0 = disable 1 = enable	0	Login security enable; remote control port security function

Table 5-3   Remote Command Summary

Cmd	Func/Mem Type	Front Panel	Param Range	Default Value	Brief Description [Notes]
LGN	Security (V)	Use terminal emulator	1 to 8 characters	password	Login; establishes remote control port communication with CM701; use alphanumeric characters with no spaces; enabled when LGE = 1
LGT	Security (V)	Use terminal emulator	—	—	Logout; remote control port security; use if LGN established communication
LIT	Security (NV)	Use terminal emulator	0 = disable 5 to 255 sec	60	Login inactivity time-out (in seconds); automatic logout occurs unless disabled
LMP	Config (V)	Lamptest	1	Off	Lamptest; tests all six backlit message LEDs; automatically returns to OFF state after a few seconds; remote LMP command available with M&C version 5.4 or greater
LPW	Security (NV)	Use terminal emulator	1 to 8 char	—	Login password; remote control port, changes password; <string> is current followed by space and new password of 1 to 8 alphanumeric characters with no spaces
LT	—	—	—	—	Use the MB command instead of the LT command
MB	Config (NV)	Tx Clock Source	1, 2, 3	2	External/internal/loop mod bit timing
MD1... MD9	Config (V)	Use terminal emulator	<string>,?	—	Modem data buffers 1 to 9; <string> is one or more CM701 commands separated by semicolons in a string up to 120 char
MDC	Config (V)	Use terminal emulator	—, 1 to 9	—	Clears MD1 to MD9; no parameter clears all MD buffers
MDP	Config (NV)	Remote Dat/Par	0, 1	0	Remote format 7/Odd or 8/None
MDR	Config (V)	Use terminal emulator	—, ?	—	Queries number of seconds remaining until MD buffers will be executed
MDS	Config (V)	Use terminal emulator	—	—	Stops countdown started by MDR and clears MDT value
MDT	Config (V)	Use terminal emulator	00:00:002 to 3:59:59; 0 to 172,800 seconds; **or** ?	—	Set or query (?) time when MD commands will be executed; absolute time is in hour:minutes:seconds; seconds range from 0 to 172,800
MEI	Config (V)	Remote Control	0, 1	0	Remote port RS-232 or RS-485
MFS	Config (NV)	Tx Filter Type	0, 1, 2	0	ComStream, IBS/IDR, or SMS modulator Tx filter select
MI	Config (NV)	Use terminal emulator	0, 1	0	Disable/enable mod spectral inversion
ML	Config (NV)	Use terminal emulator	0, 1	1	TT/ST mod latching clock for SD
MPA	Config (NV)	Packet Address	1 to 31	1	Sets device address for packet protocol
MPT	Config (NV)	Protocol	0, 1	0	Protocol: ASCII or Packet
MQE	Monitor	Use terminal emulator	—	—	Executes current modem query list and returns first result buffer
MQL	Config (V)	Use terminal emulator	<string>	—	Combines multiple queries into single command; <string> is one or more CM701 commands, up to 120 characters separated by commas
MQN	Monitor	Use terminal emulator	—	—	Displays next modem query list result buffer if response to MQE ends with plus (+)
MS	Config (NV)	Use terminal emulator	0, 1	0	Monitor/not monitor modulator status

Table 5-3   Remote Command Summary

Cmd	Func/Mem Type	Front Panel	Param Range	Default Value	Brief Description [Notes]
NVO	Config (NV)	Use terminal emulator	0, 1	0	Enable/disable nonvolatile memory override
OM	Config (NV)	Use terminal emulator	0, 1	0	Disable/enable mod bit time fault override
PC	Config (V)	Tx Pure Carrier	0, 1	0	Disable/enable pure carrier TxIF output
PRD	Config (NV)	UserRxData	?, [9]	—	Queries systems receive data rate or invokes all Rx data rate commands (bps)
PRP	Config (NV)	Use terminal emulator	—	—	Sets the primary receive data path; issued as PRP <entry slot><data slots><exit slot>
PTD	Config (NV)	UserTxData	?, [9]	—	Queries systems transmit data rate or invokes all Tx data rate commands (bps)
PTP	Config (NV)	user terminal emulator	—	—	Sets the primary transmit data path; issued as PTP <entry slot><data slots><exit slot>
RC	Config (NV)	Rx Code Rate	0 to 5	1	Set receive code rate [2]
RD	Config (NV)	RxDataRate	4800 to 2340000	9600	Receive demodulator data rate in bps
RDI	Config (NV)	Use terminal emulator	0, 1	0	Pass/invert receive data
RE	Config (V)	Modem	—	—	System reset
RIO	Config (NV)	Rx Active IO	1, 2, 3	2	Select active receive I/O card by slot #
RM	Config (NV)	Rx Mod Type	0, 1	0	BPSK/QPSK receive mod type
RO	Monitor	Rx Offset	?	—	Displays receive frequency offset (Hz)
RR	Config (NV)	RxSymRate	4800 to 2340000	19200	Receive symbol rate in bps
RS	Config (NV)	Rx Freq	51997 to 8020; 103995 to 176018	70000 140000	Set receive carrier synthesizer frequency for demod with IF centered at 70 MHz or 140 MHz (parameters shown in kHz)
RTF	Monitor	Rx Clk	?	—	RT clock frequency (Hz)
SD	Config (NV)	Rx Scrambling	[9]	1	Disable, ComStream, or IDR receive descrambling
SHP	Monitor	Use terminal emulator	—	—	Displays all current data paths set either by an autoconfiguration cycle or as the result of issuing manual path commands
SM	Config (NV)	Tx Scrambling	[9]	1	Disable, ComStream, or IDR transmit scrambling
SRD	Config (NV)	Secd Rx Data	4800 to 2340000	—	Automatically issues all appropriate receive data rate commands to all cards in the secondary receive data path and accounts for any overhead removed by a card from the data stream
SRP	Config (NV)	Use terminal emulator	—	—	Sets the secondary receive data path; issued as SRP <entry slot><data slots><exit slot>
ST	Fault	Modem Status	?	—	Provides current fault status [3]
STD	Config (NV)	Secd Tx Data	4800 to 2340000	—	Automatically issues all appropriate transmit data rate commands to all cards in the secondary transmit data path and accounts for any overhead removed by a card from the data stream
STO	Config (NV)	Use terminal emulator	[7]	[7]	Red fault message fault overlay mask
STP	Config (NV)	Use terminal emulator	—	—	Sets the secondary transmit data path; issued as STP <entry slot><data slots><exit slot>

Table 5-3   Remote Command Summary

Cmd	Func/Mem Type	Front Panel	Param Range	Default Value	Brief Description [Notes]
SWV	Monitor	Software Vx.xx	?	—	Provides software version by slot (n); syntax is n:SWV ?
TC	Config (NV)	Tx Code Rate	0 to 5	1	Set transmit code rate [2]
TD	Config (NV)	TxDataRate	4800 to 2340000	9600	Transmit modulator data rate in bps
TDI	Config (NV)	Use terminal emulator	0, 1	0	Pass/invert transmit data
TIM	Config (NV)	Clock	000000 to 235959	[8]	Real-time clock in hours, minutes, seconds (hh/mm/ss)
TIO	Config (NV)	Tx Active IO	1, 2, 3	2	Select transmit I/O card by slot #
TM	Config (NV)	Tx Mod Type	0, 1	0	BPSK/QPSK transmit mod type
TP	Config (NV)	Tx Pwr Level	250 to 50	100	Set mod TxIF output power level [4]
TR	Config (NV)	TxSymRate	4800 to 2340000	19200	Transmit symbol rate in sps
TRD	Config (NV)	Tern Rx Data	4800 to 2340000		Automatically issues all appropriate receive data rate commands to all cards in the ternary receive data path and accounts for any overhead removed by a card from the data stream
TRP	Config (NV)	Use terminal emulator	—	—	Sets the ternary receive data path; issued as TRP <entry slot><data slots><exit slot>
TS	Config (NV)	Tx Freq	51997 to 88020; 103995 to 176018	70000 140000	Set transmit frequency for mod with IF centered at 70 MHz or 140 MHz (parameters shown in kHz)
TT	Monitor	Tx Clk	?	—	TT clock frequency (Hz)
TTD	Config (NV)	Tern Tx Data	4800 to 2340000	—	Automatically issues all appropriate transmit data rate commands to all cards in the ternary transmit data path and accounts for any overhead removed by a card from the data stream
TTP	Config (NV)	Use terminal emulator	—	—	Sets the ternary transmit data path; issued as TTP <entry slot><data slots><exit slot>
VBM	Config (NV)	Use terminal emulator	—	—	Verbose mode
VF	Fault	Use terminal emulator	—	—	View faults
VFT	Fault	Use terminal emulator	—	—	View faults with time stamp
VS	Fault	Use terminal emulator	—	—	View status
VST	Config (NV)	Use terminal emulator	0, 1	0	VSAT mode

[1] Available baud rates: 75, 300, 1200, 2400, 4800, and 9600
[2] FEC encoder/decoder type and rate: 0=uncoded rate 1, 1=sequential rate 1/2, 2=sequential rate 3/4, 3=Viterbi rate 1/2, 4=Viterbi rate 3/4, 5=Viterbi rate 7/8
[3] Response to query is a decimally encoded bit map of register status (5 = 1st and 3rd bits set)
[4] Power is displayed in negative tenths dBm (for example, 100 is -10.0 dBm)
[5] Autodial Fault Reporting (AL2) is not currently supported
[6] Command supported by ASCII protocol only; refer to the chapter on ComStream packet protocol for packet versions of these commands
[7] Parameter range is 1 to 4294967295; default parameter is 4294967295 which includes all fault bits
[8] Default is U.S.A. west coast (standard time)
[9] Depends on modem configuration

Security Commands   To prevent unauthorized access to the CM701 over telephone lines or other remote-access methods, the CM701 has built-in security for the remote control port.

Security is *disabled* by default. When enabled, remote users must enter a login command with a valid password before they can access other remote commands. When finished, users issue a logout command.

A timed logout command, based on inactivity, can also be issued. If no activity occurs on the remote port for a specified interval, users are automatically logged out.

Any attempts to access the port without a valid login will return an `ER 7` error code.

The following commands are used to implement CM701 remote security:

- LGE – login security enable
- LGN – login
- LGT – logout
- LIT – login inactivity time-out
- LPW – login password

There is no process to identify a password if it is lost or forgotten. Instead the initialize factory default command `(Init factory default)` must be issued from the front panel. This command resets the password to the default ***and*** it also ***resets all modem parameters***.

Error Codes   After a command has been issued, the CM701 may return an error message indicating the command request was not completed. The ER message appears in the following format: `ER <error code>`

where:

- ER indicates an error has occurred
- `<error code>` is a numerical parameter indicating the type of error

A description of each error code, including its probable cause and the action to be taken, is provided in Table 5-4.

Table 5-4   Remote Control Error Codes

ER #	Description	Problem	Action
ER 1	Command format error	Typographical errors, incorrect command mnemonic, extra spaces between the command and the parameter	Reenter the command using the correct syntax.
ER 2	Invalid command parameter	Parameter may be incorrect, out of range, missing, or exceed16 characters	Reenter the command using the correct parameter.
ER 3	Command not supported by current hardware	Command does not match hardware configuration or settings; for example, attempting a loopback test when no modulator has been installed	Check hardware configuration and settings and make modifications if required. Reenter the command using the correct syntax.
ER 4	Command temporarily not supported	Command cannot be executed immediately. Example: ER 4 will be returned if: ■ Receive offset query or E_b/N_0 query is issued and the demodulator carrier is not locked to a receive carrier ■ Firmware configuration or mode does not temporarily support the command	Wait for a short period of time and then reenter the command.
ER 5	CM701 internal communications error	Breakdown in microcontroller communications between cards	Reenter the command. Repeated occurrences of this error message suggest a bad connection between cards or a faulty card in the system.
ER 6	Slot address required	More than one card can respond to the command	Reenter the command making sure that the desired slot number is specified.
ER 7	Security error	Security is enabled and there is no current login, or an incorrect password has been entered	Enter the correct password using the LGN command.

Front Panel Operation

6

Every CM701 has an interactive front panel with push buttons, LED indicators, and an LCD display allowing the CM701 to be completely configured, monitored, and controlled from the front panel.

The valuable front panel status and fault LEDs provide *at-a-glance* status checking enabling you to quickly scan the front panel to check for any abnormal operating conditions. This is especially useful for large earth station or rack-mounted system applications.

This chapter describes the front panel:

- Components

- Commands, including command functions and valid parameters, navigating through the command tree, as well as command syntax and entry

For information on fault monitoring, logging, and conditions, refer to the chapter on fault handling. For a detailed description of any command, refer to the chapter on command descriptions.

CM701 Front Panel Components

The front panel, shown in Figure 6-1, provides access to various commands for local control of the CM701. This panel consists of:

- 24-character LCD

- Illuminated status and fault alert messages

- Tx Enable dedicated push button with illuminated message

- Push buttons below the LCD to select configuration, monitor, and fault commands, and Previous, Modify, Cursor, and Enter selection buttons
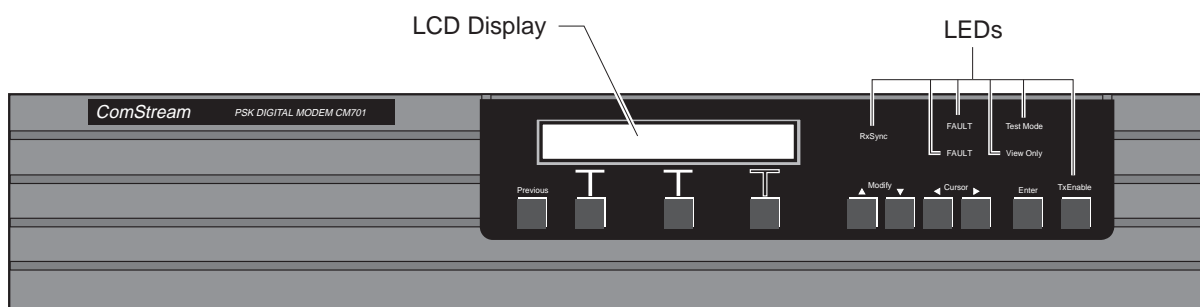
F175-01

Figure 6-1   CM701 Front Panel

LCD Display

The 24-character LCD displays the types of information described in Table 6-1. Descriptions of the functional types of commands are listed in Table 6-2.

Table 6-1   LCD Display Information

Type	Description
Messages	Provides information such as modem ID, error messages, fault log history, and so on.
	If the command response is specific to a card in a duplicate-card configuration, the slot number will precede the message.
	The >> characters following a message indicate a continuation of the message, which can be viewed by pressing the right Cursor button.
Functional commands	Categorizes commands into functional groups: configuration, monitor, and fault.
Installed card	Displayed in the format: `<slot>:<card>`
	For example, `6:Demod` indicates that slot #6 contains a demodulator card.
Command	May be displayed in a group of commands, such as FaultLog-Current-Clear, or in a list that can be scrolled, such as demodulator commands.
	▪ If the command has an associated parameter, both the command and current value of the parameter are displayed in the format: `<command> <parameter>`
	▪ If the command is specific to a card in a duplicate-card configuration, the slot number will precede the command.
Navigation	*More* indicates that there are additional options available on the current level of the command tree.

Table 6-2   Command Functional Types

Function	Description
Configuration	In general, these commands have parameters that can be modified and entered to change the operating characteristics of the CM701.
	Included in this category are the commands that direct the CM701 to perform real-time functions.
Monitor	Provide query (view-only) information on the performance, operating environment, and nonfault-related conditions of the CM701.
	Monitor commands used when the built-in BERT is enabled are referred to as BERT Monitor (BMonitor) commands.
Fault	Provide information on the functional status of the CM701; may indicate when an external piece of equipment is not configured properly or is faulty.
	Fault commands are query-only with the exception of the Clear Fault Log (CF) command.

LEDs

The CM701 front panel LED messages are described in Table 6-3. The LEDs are located to the right of the LCD display above the buttons. These LEDs indicate the status of certain CM701 operating and hardware conditions. Some are visible with or without illumination; others are visible only when illuminated.

Table 6-3   CM701 LEDs

LED Message	Active	Inactive	Description
Rx Sync	Green	White	Illuminates when the entire receive signal and data path of the CM701 is synchronized to the receive signal and valid data is being provided at the user data port. Receive synchronization includes demodulator carrier sync, demodulator bit time sync, decoder sync (if operating with Sequential or Viterbi decoding enabled), and receive path synchronization of any receive data processing card installed in the CM701. For example, if an optional open network Framing Unit is installed, it must have receive frame sync before the Rx Sync message can be illuminated.
			The Rx Sync message appears white if the CM701 is *not* synchronized to the receive signal. This status message is not directly affected by any push buttons on the front panel.
Fault	Red	Not visible	Illuminates as long as a selected CM701 fault condition exists. You can select which CM701 fault conditions affect this indicator. Some users are concerned only with hardware fault conditions that may indicate a bad card that must be replaced. Others are concerned with operational fault conditions and hardware faults; for example, you may want to know when the demodulator loses sync.
			The red Fault message is associated with the CM701 current fault status register. This fault register is 32 bits long, each bit representing one fault condition. Refer to the chapter on command descriptions for Current Fault Status (ST), Current Fault Status Overlay Mask (STO), and View Current Status (VS) commands.
Fault	Yellow	Not visible	Indicates that a selected CM701 fault has been logged. Once a fault is detected, it is *remembered* in the CM701 fault log, even if the fault disappears, until the fault register is cleared. You can select which CM701 faults affect this indicator.
			The yellow Fault message is associated with the CM701 fault log register. The fault log register is 32 bits long, each bit representing one fault event. Refer to the chapter on command descriptions for Fault Log History Query (FL), Fault Log Overlay Mask (FLO), View Faults (VF) and View Faults with Time Stamp (VFT) commands.
			The fault register is cleared by the Clear fault register command accessed through the front panel Faults, or the remote Clear Fault Log (CF) command. For information on the CF command, refer to the chapter on command descriptions.
Test Mode	Yellow	Not visible	Illuminates as long as one or more of the CM701 test modes is active. For example, if any LoopBack function, Pure Carrier, or Internal BERT is enabled and running, this message is illuminated.
			The purpose of this message is to provide a visible warning that the CM701 is not configured for normal operation when a special test mode or test function is active. The message must *not* be visible for the CM701 to operate normally.
View Only	Yellow	Not visible	Indicates that configuration parameters may *not* be changed using the front panel buttons. The buttons can be used to scroll through and view the command lists.
Tx Enable	Green	White	Illuminates when the modulator output is enabled.

Buttons

CM701 commands are organized in a tree structure. Table 6-4 lists the buttons used to navigate through the tree structure and to select and enter commands.

Table 6-4   CM701 Front Panel Buttons

Button	Description
Previous	Used to navigate from a lower level to a higher level in the command tree.
Previous^<	Used to access the front panel lockout command. This command prohibits accidental or unauthorized modifications of the CM701 operating configuration.
LCD (left, center, and right)	Below the 24-character LCD are three buttons that have T-shaped icons above them. They are used for selecting commands from the command tree.
Modify (up and down)	Used to scroll up and down through parameter lists for the command currently displayed in the LCD.
Cursor (left and right)	Used to: ■ Navigate among commands on the same level ■ Activate the cursor, represented by one or more flashing characters, in the LCD display ■ Move the cursor through the parameter field within the LCD display
Enter	Used to issue the command with the parameter that is currently displayed.
Tx Enable	Used to enable and disable modulator output. This button does not affect the LCD display and is independent of all other buttons on the front panel.

CM701 Command Tree   The front panel provides access to various commands for local control of the CM701. These commands reflect the configuration of the CM701 and are organized in a tree structure that is accessed using the front panel buttons. The command tree for a standard CM701, is shown in Figure 6-2.

ComStream CM701

Config   Monitor   Faults

FaultLog   Current   Clear

▲ Eb/No
Rx Offset
AGC Level
Chan Err Rate
Tx Clk
▼ Rx Clk

4:Systm   4:M&C   More

6:Demod   7:Mod   More

2:RS449   2:BERT   More

▲ UserTxData
UserRxData
Modem
LoopBack
Init Factory Default
Initialize New Firmware
Tx Active IO
▼ Rx Active IO

▲ RxDataRate
Rx Freq
RxSymRate
Rx Code Rate
Rx Mod Type
Rx Diff Decoding
Rx Filter Type
Acquisition
▼ Rx Scrambling

▲ TxDataRate
Tx Freq
TxSymRate
Tx Code Rate
Tx Mod Type
Tx Diff Encoding
Tx Filter Type
Tx Pwr Level
Tx Pure Carrier
Tx Clock Source
▼ Tx Scrambling

No Commands Present

BConfig   BMonitor

Remote   S/W Ver   Misc

▲ BERT Test Mode
BERT Control
BERT Error
BERT Pattern
BERT Usr Ptrn
BERT Blk Length
▼ BERT SyncLvl

▲ BERT Sync
BERT Sync History
BERT BitErr
BERT BitCnt
BERT AvgBER
BERT BlkBER
BERT BlkErr
BERT BlkCnt
BERT AvgBLER
▼ BERT Data

▲ Baud Rate
Remote Control
Remote Dat/Par
Protocol
▼ Packet Address

1:⟨card⟩⟨software ver.⟩
2:   "   "
3:   "   "
4:   "   "
5:   "   "
6:   "   "
7:   "   "

▲ :AA
Lamptest
Clock
Date Mo/Da/Yr
▼ Self Test

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Figure 6-2   CM701 Front Panel Command Tree

In Figure 6-2, note that:

- The third T-shaped icon above the right LCD button is not filled, indicating its dual purpose of navigation and selection.

- There is a dashed line between Config>Monitor>Faults and Modem and BERT. To navigate to Modem and BERT from Config>Monitor>Faults, you must first access System>M&C>More and then select More. If you are on Modem>BERT>More, pressing the Previous button takes you directly to the Config>Monitor>Faults level, while selecting More takes you back to System>M&C>More.

A brief description of the function of each command tree level is provided in Table 6-5.

Table 6-5   CM701 Front Panel Command Tree Levels

Level/Components	Description
Config	Access to commands that determine CM701 operating characteristics or direct the CM701 to perform specific real-time functions
Systm	Macro, multi-card, and chassis configuration commands
M&C	Access to monitor and control functions ■ Remote – commands associated with the remote control interface port ■ S/W Ver – access to software version number of each installed card in the CM701 ■ Misc – miscellaneous M&C functions such as terminal emulation and system self-test
Modem	Modulator, demodulator, ODU, and Doppler buffer commands
BERT	Access to BERT configuration and monitor commands: ■ BConfig – configuration commands used to access, modify, and issue BERT commands ■ BMonitor – commands used to review the status results of the BERT
Monitor	Commands that report performance and nonfault information provided by various monitoring points located within the CM701
Faults	Commands that provide information on the status of the CM701 or indicate when an external piece of equipment is improperly configured or is faulty
FaultLog	Provides historical account of all faults that occurred since the last time the faults were cleared; associated with yellow fault LED. A displayed fault is preceded by the slot number of the card that is generating the fault message.
Current	Provides account of all faults present at any one point in time; associated with red fault LED. A displayed fault is preceded by the slot number of the card that is generating the fault message.
Clear	Erases the contents of the fault log

Navigating Through the Command Tree

Shortly after the CM701 is powered on, identification (ID) information appears on the LCD. The default ID is `ComStream CM701`. At this time, pressing any of the LCD buttons causes Config>Monitor>Faults to appear on the LCD. The LCD, Cursor, and Modify buttons are used to navigate through the front panel command tree.

Tree Level Navigation

To navigate between levels of the command tree, perform the following:

- To move down to the level associated with a displayed item, press the LCD button directly below that item.

- To move to the next higher level, press the Previous button.

- If More is displayed, access more selections at the same level by pressing the LCD button below More, *or* press the Cursor buttons.

Command List Navigation

To navigate to commands associated with an installed card or command group, display the name of that card and press the LCD button below it. A command will appear on the LCD with one of its parameters. To scroll through the command list, use one of the following methods:

- Press the left or center LCD button. Each button press will scroll down one command in the command list. When the bottom of the list is reached, pressing the left or center LCD button will display the command at the top of the list.

- Use the Modify buttons to scroll up or down the command list.

- Press the Previous button to return to the next higher level.

Navigating Between Command Lists

If you access a command from a command list and then navigate to other commands on that same level, when you return to the list, the last command viewed will be displayed. However, if you navigate to different levels and then return to a previously viewed command list, the command at the top of that list will be displayed. Following are some examples:

Example: Comparing Command Parameters on the Same Level

This example requires the CM701 to be configured for IF loopback operation with the BERT enabled. To insert a bit error and verify that it is received:

1. Navigate to BConfig>BMonitor.

2. Select BMonitor.

3. Scroll down the BMonitor command list to the BERT BitErr command and note the number of errors.

4. Press the Previous button to return to BConfig>BMonitor.

5. Select BConfig.

6. Scroll to the BERT Error command.

7. Select Insert and press the Enter button.

8. Press the Previous button to return to BConfig>BMonitor.

9. Select BMonitor and verify that a bit error was received. It is not necessary to scroll down the BMonitor command list.

Example: Comparing Command Parameters on Different Levels

This example is similar to the previous one except that steps are added to check the AGC level. Perform the following steps to insert a bit error, check the AGC level, and verify that the bit error is received:

1. Navigate to BConfig>BMonitor.

2. Select BMonitor.

3. Scroll down the BMonitor command list to the BERT BitErr command and note the number of errors.

4. Press the Previous button to return to BConfig>BMonitor.

5. Select BConfig.

6. Scroll to the BERT Error command.

7. Select Insert and press the Enter button.

8. Press the Previous button three times to return to Config>Monitor>Faults.

9. Select Monitor.

10. Scroll down the Monitor command list to the AGC Level command and note the value.

11. Press the Previous button to return to Config>Monitor>Faults.

12. Navigate to BConfig>BMonitor.

13. Select BMonitor. In this example the first command in the BMonitor command list is displayed.

14. Scroll down the BMonitor command list to the BERT BitErr command and verify that a bit error was received.

Command Display

Configuration commands can be viewed, and some modified, using the LCD, Cursor, Modify, and Enter buttons. Other remote commands that are not directly accessible from a command tree list can be modified using the terminal emulator (:AA) feature. Monitor and fault messages are view-only.

Entering Commands with the Terminal Emulator

Commands not directly accessible from the command tree can be issued and modified from the front panel using the terminal emulator function.

Terminal Emulator Command Syntax

The following remote command syntax is used when issuing commands using the front panel terminal emulator :AA command:

```
:<command mnemonic> <parameter>
```

where:

- `<command mnemonic>` refers to a two- or three-letter remote command abbreviation that replaces the AA on the display. For a duplicate-card configuration, the slot number replaces the initial blank space as follows:
  `<slot number>:<command mnemonic> <parameter>`

- There must be one space between the command mnemonic and the parameter; this space is entered by pressing the → (right arrow) key.

- `<parameter>` refers to any value pertaining to the command. The parameter for a query command is a question mark (?); some commands do not require a parameter.

For example, to reduce the acquisition range from 30000 Hz to 10000 Hz, the LCD will appear as follows:

- Initial display of :AA command `:AA`

- Use the terminal emulator function to type the remote syntax `AR 10000`

- Display after command is typed `:AR 10000`

Command Entry

To issue a command using the terminal emulator:

1. Navigate to the terminal emulator :AA command using the LCD, Cursor, and Modify buttons.

2. Press the right LCD button or the Cursor buttons to select the command.

3. Enter the command using terminal emulator syntax.

   a. If the character that you want to change is not flashing, use the Cursor buttons to make it flash.

   b. Scroll through the list of characters using the Modify buttons. The characters display in the following order:

      - Space

      - ? (question mark)

      - - (hyphen)

      - , (comma)

      - 0 through 9

      - A through Z

   c. Repeat steps a and b until the entire command appears as desired.

4. Issue the command by pressing the Enter button.

     □ If the command was a query, the LCD will display the response for a few seconds and then redisplay `:AA`.

     □ If the command was successfully executed, the LCD will redisplay `:AA`.

     □ If an error occurs, the LCD will display an error message for a few seconds and then redisplay `:AA`.

Front Panel Command   Entry

To issue a command from the front panel:

1. Navigate to the desired command using the LCD, Cursor, and Modify buttons.

2. Press the right LCD button or one of the Cursor buttons to select the command. All or part of the command and its parameter will flash.

3. Change the parameter as needed.

    If the parameter is one of a set of options, scroll through the parameter list by doing one of the following:

    □ Press the right LCD button to scroll down the parameter list.

    □ Use the Modify buttons to scroll up or down the parameter list.

    If the parameter requires entry of a number:

    a. If the numeric character that you want to change is not flashing, use the Cursor buttons to make it flash.

    b. Scroll through the list of numeric characters using the Modify buttons.

    c. Repeat steps a and b as necessary until the entire parameter appears as desired.

       For numeric parameters such as frequency values or transmit power level, cursor location determines the amount the value is changed based on its numeric position (tens, hundreds, and so on). For example, assume that the number 4957 is displayed. If the 9 in the hundreds' digit position is flashing and the up Modify button is pressed, the value of the parameter will increase by one hundred and appear as 5057.

4. Issue the command by pressing the Enter button. An asterisk (*) will appear briefly to the left of the command parameter and then disappear. The command and its updated parameter will then be displayed and will not flash.

    □ If the Enter button is *not* pressed, the parameter will not be changed.

    □ If *no* part of the command is flashing, pressing the Enter button will have no effect.

To leave a command *without* modifying it, when all or part is flashing, navigate to another command or level using the left or center LCD buttons or the Previous button.

Summary

Table 6-6 lists the front panel commands for a standard CM701 with no installed option cards. These commands are summarized in the order in which they appear in the command tree, from top to bottom, and then left to right. Included are:

- Level to which the front panel command is attached

- Front panel command

- Remote command equivalent and memory type — either nonvolatile (NV) or volatile (V)

- Command function

- One of the following:

  - Parameters available for the front panel command

  - Response format for the monitor and status commands

This table is also provided as a quick reference card.

Table 6-6   Front Panel Command Summary

Command	Remote Equiv. & Memory Type	Function	Parameters or Response Format
Config>Systm			
UserTxData	PTD (NV)	Primary transmit data rate macro	4800 to 2340000
UserRxData	PRD (NV)	Primary receive data rate macro	4800 to 2340000
Modem	RE (V)	Reset CM701	RESET
LoopBack	LB (V)	Loopback test modes	DISABLE, IF, NEAR, FAR
Init Factory Default	IN (V)	Initialize factory default	—
Initialize New Firmware	INF (V)	Initialize new firmware	(all config parameters are returned to defaults)
Tx Active IO	TIO (NV)	Transmit active IO	1, 2, 3
Rx Active IO	RIO (NV)	Receive active IO	1, 2, 3
Config>M&C>Remote			
Baud Rate	BR (NV)	Remote baud rate	75, 300, 1200, 2400, 4800, 9600
Remote Control	MEI (NV)	Remote control electrical interface	RS-232, RS-485
Remote Dat/Par	MDP (NV)	Remote parity	8/NONE, 7/ODD
Protocol	MPT (NV)	Remote protocol	PACKET, ASCII
Packet Address	MPA (NV)	Packet address	1 to 31
Config>M&C>S/W Ver			
n:SWV	SWV (NV)	Display of software version by slot	*n* = 1, 2, 3, 4, 5, 6, 7

Table 6-6   Front Panel Command Summary

Command	Remote Equiv. & Memory Type	Function	Parameters or Response Format
Config>M&C>Misc			
:AA	—	Terminal emulator	allows commands to be issued and modified from the front panel using use remote command syntax
Lamptest	LMP (V)	Lights front panel LEDs	ON; returns LEDs to valid state after a few seconds
Clock	TIM (NV)	Real-time clock	hh:mm:ss
Date Mo/Da/Yr	DAY (NV)	Real-time date	mm/dd/yy (month/day/year)
Self-Test	BIT (V)	Built-in self-test	EXECUTE
Config>Demod			
RxDataRate	RD (NV)	Receive data rate	n where n=4800 to 2340000 bps
Rx Freq	RS (NV)	Receive IF frequency	$nnnnn.nnn$ kHz
RxSymRate	RR (NV)	Receive symbol rate	n where n=4800 to 2340000 sps
Rx Code Rate	RC (NV)	Receive coding rate	Uncoded, Seq $\frac{1}{2}$, Seq $\frac{3}{4}$, Vit $\frac{1}{2}$, Vit $\frac{3}{4}$, Vit $\frac{7}{8}$
Rx Mod Type	RM (NV)	Receive modulation type	QPSK, BPSK
Rx Diff Decoding	DD (NV)	Differential decoding	OFF, ON (remote equivalent: 0, 2)
Rx Filter Type	DFS (NV)	Receive filter mask	ComStrm, IBS/IDR, SMS
Acquisition	AQ (NV)	Acquisition restart	FAST, NORMAL, STOP
Rx Scrambling	SD (NV)	Demod descrambling	OFF, COMSTRM, IDR Man.
Config>Mod			
TxDataRate	TD (NV)	Transmit data rate	n where n=4800 to 2340000 bps
Tx Freq	TS (NV)	Transmit IF synth frequency	$nnnnn.nnn$ kHz
TxSymRate	TR (NV)	Transmit symbol rate	n where n=4800 to 2340000 sps
Tx Code Rate	TC (NV)	Transmit FEC coding	Uncoded, Seq $\frac{1}{2}$, Seq $\frac{3}{4}$, Vit $\frac{1}{2}$, Vit $\frac{3}{4}$, Vit $\frac{7}{8}$
Tx Mod Type	TM (NV)	Transmit modulation type	QPSK, BPSK
Tx Diff Encoding	DM (NV)	Transmit differential encoding	OFF, ON (remote equivalent: 0, 2)
Tx Filter Type	MFS (NV)	Transmit filter mask	ComStrm, IBS/IDR, SMS
Tx Pwr Level	TP (NV)	Transmit IF power level	-25.0 to -5.0 dBm
Tx Pure Carrier	PC (V)	Pure carrier test	OFF, ON
Tx Clock Source	MB (NV)	Transmit timing	EXT, INT, LOOP
Tx Scrambling	SM (NV)	Transmit scrambling	OFF, COMSTRM, IDR Man.
Config>RS449 (no standard commands available; commands may appear depending upon installed I/O card)			

Table 6-6   Front Panel Command Summary

Command	Remote Equiv. & Memory Type	Function	Parameters or Response Format
Config>BERT>BConfig			
BERT Test Mode	BEN (V)	BERT enable	ENABLE, DISABLE
BERT Control	BRE (V)	BERT reset and control	START, STOP, RESET
BERT Error	BEI (V)	BERT error insert	INSERT
BERT Pattern	BPT (NV)	BERT pattern type	2^9-1, USER, 1:1, MARK, SPACE
BERT Usr Ptrn	BUP (NV)	BERT user pattern	0 to 255
BERT Blk Length	BBL (NV)	BERT block length	10^8, 10^7, 10^6, 10^5, 1 sec
BERT SyncLvl	BST (NV)	BERT synch threshold	1000/10^4, 2500/10^4
Config>BERT>BMonitor			Return Format
BERT Sync	BSS	BERT synchronization status	In Sync, Out of Sync
BERT Sync History	BSF	BERT sync history	LOSS, OK
BERT BitErr	BEC	BERT Bit Error Count	*nnnnn*
BERT BitCnt	BBC	BERT bit count	*nnnnn*
BERT AvgBER	BER	BERT average BER	*n n*10^-y
BERT BlkBER	BBE	BERT block BER	*n n*10^-y
BERT BlkErr	BWE	BERT block error count	*nnn*
BERT BlkCnt	BLC	BERT block count	*nnn*
BERT AvgBLER	BLE	BERT average block error rate	*n n*10^-y
BERT Data	BDI	BERT Data Inverted	Inverted, Not Inverted
Monitor			
E_b/N_0	EB	Estimated E_b/N_0 query	*nn.n* dB
Rx Offset	RO	Receive IF offset query	*nnnn*
AGC Level	AG	AGC level query	*ny* where *n* x 10^-4
Chan Err Rate	CE	Channel error rate query	*nnn* Hz
Tx Clk	TT	Transmit clock frequency query	*n.nnn* kHz
Rx Clk	RTF	Receive clock frequency query	*n.nnn* kHz
Faults			
Faults>FaultLog	FL	Fault log query	displays list of modem faults
Fault>Current	ST	Current fault status	displays current modem status
Fault>Clear	CF (V)	Clear fault	—
Buttons			
Tx Enable	EM (V)	Modulator TxIF output	enabled (green, illuminated); disabled (white)
Previous^>	FPL (NV)	Front panel lockout	normal/view-only/lockout front panel access

Note: n and y indicate numeric characters

Parameters are listed here as they appear on the LCD. The carat symbol represents superscript, as it is not an available option on the LCD.

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Internal BERT

The ComStream CM701 internal Bit Error Rate Tester (BERT) is an easy-to-use yet highly sophisticated testing feature that is standard on every CM701 I/O card. The BERT is used to verify satellite link performance and modem/RF equipment operation, and to troubleshoot basic satellite link and equipment problems without external test equipment.

This chapter provides:

- BERT functional description

- Step-by-step instructions for issuing and monitoring BERT commands

- Table of all BERT commands

- Instructions for initiating a standard BER test and an explanation of the BERT results

- Advanced BERT operation and error analysis tips

For a list of BERT specifications, refer to the appendix on technical specifications. For information on issuing commands from a remote terminal or front panel, refer to the appropriate chapter. For detailed description of BERT commands, refer to the chapter on command descriptions. A shorter, less detailed version of BERT usage is available as a separate quick reference card that accompanies this guide.

Functional Description   The BERT, an integral part of every ComStream CM701 I/O card, enables error measurements to be performed with 100 percent accuracy when used with the BERT Reset and Control command feature. The BERT, shown in Figure 7-1, consists of an independent:

- Transmit side pattern generator

- Receive side error analyzer
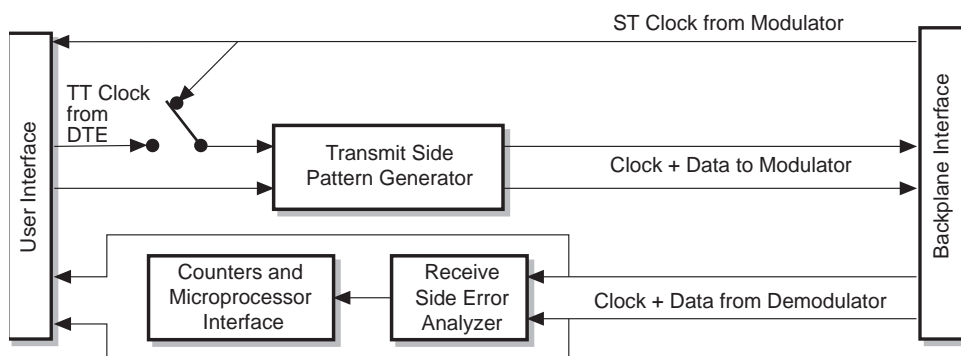
F196-01

Figure 7-1   CM701 BERT Block Diagram

Transmit Side Pattern Generator

The transmit side pattern generator generates a pseudorandom 511-bit (2^9-1) pattern, or any 8-bit repeating pattern that you select. The pseudorandom pattern, used for most normal error analysis functions, is compatible with the 2^9-1 patterns found on most error analysis test devices. The 8-bit repeating patterns are useful for in-depth, digital troubleshooting.

The transmit BERT will output data synchronously with the selected transmit clock. If the modem is set for external timing, the BERT must have an external clock applied in order to operate.

Receive Side Error Analyzer

The BERT receive side error analyzer functions on only a 511-bit (2^9-1) pattern. The analyzer consists of an error detection circuit and counters, which provide the BER, block error rate, and so forth. The received data is passed uninterrupted to the external interface.

Issuing BERT Commands

BERT commands can be issued and the results monitored from either a remote terminal or the front panel. All BERT monitor commands display an N/A parameter or error code if issued when the BERT is *not* enabled.

Remote Terminal

All BERT commands can be issued and their results monitored from a remote terminal. For remote users, there is an extra monitor command available — the BERT Display Parameters (BDP) command. The BDP command is used to summarize and list all current BERT monitor parameters on one display.

BERT commands are issued like all remote commands:

1. At the prompt, type the BERT command followed by a space and the appropriate parameter. If there is more than one data I/O card, the slot address must be included.

2. Press ENTER.

To enable the BERT, type `BEN 1` and press ENTER.

When you are finished using the BERT, remember to disable it.

Front Panel

BERT functions are issued and monitored from the CM701 front panel. All BERT commands are accessed through the front panel command tree, shown in Figure 7-2.
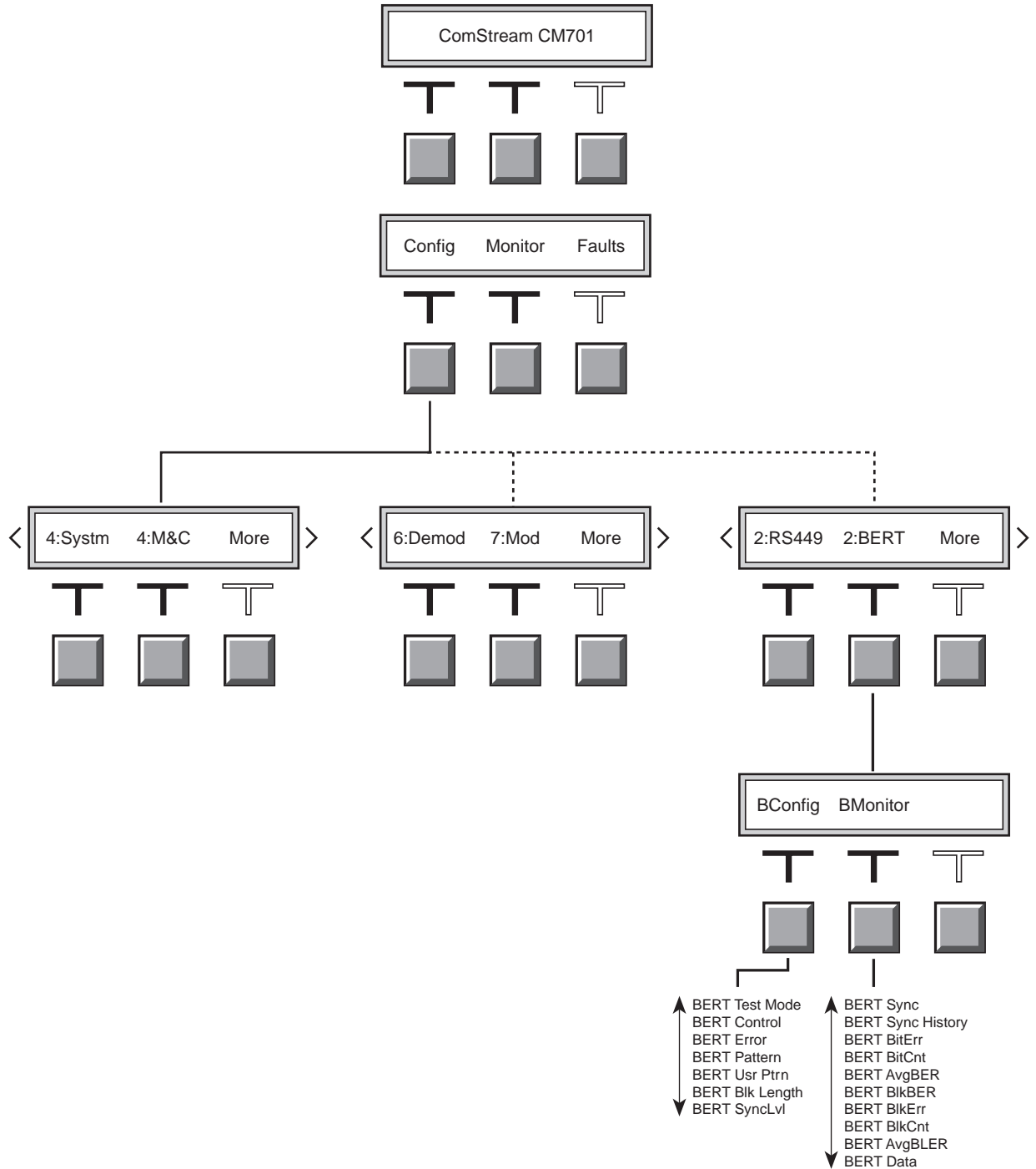
F191-01

Figure 7-2   Accessing BERT Commands

Using the BERT

Enable the BERT

To access the BERT commands perform the following steps (depending upon your configuration):

1. From the Config-Monitor-Faults menu, select Config. `Systm-M&C-More` displays.

2. Select More. `Modem-BERT-More` displays.

3. Select BERT. `BConfig-BMonitor` displays.

4. Select BConfig. The `BConfig` command menu displays.

5. Access the BERT Test Mode command. `BERT Test Mode Disable` displays.

6. Press the button directly below the word Disable twice. `Enable` appears and is flashing.

7. Press the Enter button.

   The Test Mode LED on the front panel illuminates. Any data being transmitted through the selected data I/O card will be interrupted. The BERT transmit pattern generator will be switched into the transmit data path and will become the source of transmit clock and data for the modulator. The BERT receive error analyzer will begin monitoring clock and data from the demodulator and accumulating results.

8. Disable the BERT when you are finished using it.

Check Pattern Types

To verify pattern types when one CM701 is transmitting to another CM701:

1. Ensure that the pattern type is `2^9-1`.

2. Scroll through the BConfig command list until the display reads `BERT Pattern xxxx`, where `xxxx` represents the current pattern.

3. If needed, modify the pattern type. To do this scroll through the parameter options until the desired pattern option appears on the display. Press the Enter button.

View Measurement and Error Detection Results

To view the results of the BERT measurement and error detection functions perform these steps:

1. Navigate to `BConfig-BMonitor`.

2. Press the button under BMonitor and scroll through the BERT measurement parameters.

BERT Commands   There are two types of BERT commands:

- Configuration (BConfig) – used to access, modify, and issue BERT commands

- Monitor (BMonitor) – used to review the status results of the BERT

Table 7-1 lists the BERT commands. These commands are listed first by type, BConfig and BMonitor, and then in the order in which they appear on the command lists. For each command the following information is provided:

- Front panel command name, function, and parameters

- Corresponding remote command and remote parameters

- Front panel command default

- Memory type (configuration commands only), either volatile (V) or nonvolatile (NV).

Table 7-1   BERT Commands

Front Panel Command[1]	Function	Front Panel Parameters[2,3]	Remote Command	Remote Parameters[3]	Front Panel Default	Memory Type
BERT>BConfig						
BERT Test Mode	BERT enable/disable	DISABLE, ENABLE	BEN	0, 1	DISABLE	V
BERT Control	BERT reset and control	STOP, START, RESET	BRE	0, 1, 2	RESET	V
BERT Error	BERT transmit error insert	INSERT	BEI	—	—	V
BERT Pattern	BERT pattern type	2^9-1, USER, 1:1, MARK, SPACE, 2^15-1	BPT	0, 1, 2, 3, 4, 5	2^9-1	NV
BERT Usr Ptrn	BERT user-programmable pattern	0 to 255	BUP	0 to 255	85	NV
BERT Blk Length	BERT block length	1SEC, 10^5, 10^6, 10^7, 10^8	BBL	1, 5, 6, 7, 8	10^6	NV
BERT SyncLvl	BERT synchronization threshold	1000/10^4, 2500/10^4	BST	0, 1	1000/10^4	NV
BERT>BMonitor						
BERT Sync	BERT synchronization status	In Sync, Out of Sync	BSS	?	—	—
BERT Sync History	BERT synchronization history	OK, LOSS	BSF	?	—	—
BERT BitErr	BERT bit error count	Refer to footnote[3]	BEC	?	—	—
BERT BitCnt	BERT bit count	Refer to footnote[3]	BBC	?	—	—
BERT AvgBER	BERT average BER	Refer to footnote[3]	BER	?	—	—
BERT BlkBER	BERT block BER	Refer to footnote[3]	BBE	?	—	—
BERT BlkErr	BERT block error count	Refer to footnote[3]	BWE	?	—	—
BERT BlkCnt	BERT block count	Refer to footnote[3]	BLC	?	—	—
BERT AvgBLER	BERT average block error rate	Refer to footnote[3]	BLE	?	—	—
BERT Data	BERT receive data inverted	Not Inverted/Inverted	BDI	?	—	—
—	BERT display parameters	—	BDP	—	—	—

[1] Commands are listed in the order in which they appear in their respective lists. All monitor commands display an N/A parameter or error code if issued when BERT is not enabled.
[2] Parameters are listed here as they appear on the LCD. The carat symbol represents superscript, as it is not an available option on the LCD.
[3] Error rates and counts are displayed in scientific notation when required.

Modem Verification Using the BERT

The BERT may be used in a variety of applications to verify satellite link performance and modem/RF equipment operation, as well as to troubleshoot basic satellite link and equipment problems without requiring external test equipment.

Each time the BERT is enabled, your transmit data is replaced with data from the BERT transmit pattern generator.

Performing a BERT IF Loopback Test

This commonly used test, shown in Figure 7-3, performs a standard modem verification by enabling the BERT and then configuring the modem for an IF loopback. This easy-to-perform BERT/IF loopback test checks the checks the complete data paths of the modem with the exception of the user interface. (The user interface can be verified using a near data loopback test.)
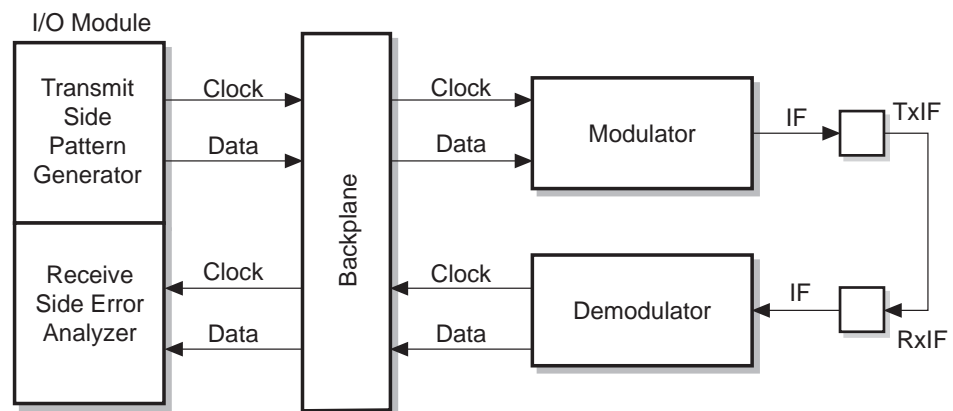
F197-01

Figure 7-3   BERT/IF Loopback Test

To perform a BERT/IF loopback test, follow these steps from either the remote unit or the front panel:

1. Issue the following BERT configuration commands with their parameters:

Remote Unit Commands	Front Panel Commands
1. **BPT 0**	1. **BERT Pattern 2^9-1**
2. **BST 0**	2. **BERT SyncLvl 1000/10^4**
3. **BBL 1**	3. **BERT Blk Length 1SEC**

2. Enable the BERT using the following configuration command.

   □ From a remote unit: **BEN 1**

   □ From the front panel: **BERT Test Mode ENABLE**

   The Test Mode LED illuminates. If the modem is receiving data from another modem and from a BERT with the same pattern, the BERT will synchronize and the monitor information will be valid.

3. Set an internal IF loopback using the following configuration command:

- From the remote unit: **LB 1**

- From the front pane in Config>Systm: **LoopBack IF**

  The test mode indicator will be illuminated and all RxIF inputs are ignored while in an IF loopback.

The Bert is now enabled and the modem in IF loopback.

4. Check the modem status information by reviewing the BERT BMonitor commands on either:

  □ Remote terminal by issuing the **BDP** command

  □ Front panel by accessing and reviewing the BMonitor command list

  If all systems are working properly, the BMonitor commands will report the data shown in Table 7-2.

Table 7-2   BERT BMonitor Command Status Data

Remote Display	Front Panel Display	Command Function
BSS 0	BERT Sync In Sync	BERT sync status
BSF 0	BERT Sync History OK	BERT sync history
BEC 0	BERT BitErr 0	BERT bit error count
BBC 30219	BERT BitCnt 30219	BERT bit count
BER 0 X 10^-x	BERT AvgBER 0 X 10^-x	BERT average BER
BBE 0 X 10^-x	BERT BlkBER 0 X 10^-x	BERT block BER
BWE 0	BERT BlkErr 0	BERT block error count
BLC 3	BERT BlkCnt 3	BERT block count
BLE 0 X 10^-x	BERT AvgBLER 0 X 10^-x	BERT average block error rate
BDI 0	BERT Data Not Inverted	BERT receive data inverted

Although all status parameters are important, the following status parameters should be reviewed closely, as they indicate a major fault or error:

□ Front panel BERT Sync (remote BSS) indicates the present synchronization of the BERT, either:

  • In Sync (remote 0)

  • Out of Sync (remote 1)

□ Front panel BERT Sync History (remote BSF) indicates if the BERT has either:

  • Remained in sync since the last BERT reset – OK (remote 0)

  • Lost sync since the last BERT reset – LOSS (remote 1)

  The BERT is always autosynchronizing and continuously attempts to regain sync if it is lost.

□ Front panel `BERT BitErr` (remote `BEC`) indicates the total number of errors since the BERT last regained sync or was reset.

Perfect test results are indicated by front panel `BERT Sync History OK` (remote `BSF 0`).

□ Front panel `BERT AvgBER` (remote `BER`) indicates the total BER since the last BERT sync or reset.

> The BERT Reset and Control command can be used to temporarily freeze the display of all status parameters.

5. Identify and troubleshoot BERT monitor parameters that are indicating faults or errors as listed in Table 7-3.

Table 7-3   BER Test Troubleshooting

Remote Display	Front Panel Display	Action
BSS 1	BERT Sync Out of Sync	Recheck the modem configuration and ensure that any loopback cables are properly installed.
BSF 1	BERT Sync History LOSS	Issue a BERT reset command. This command resets all monitor measurements. Review the modem configuration and ensure that any loopback cables are properly installed.
BEC n	BERT BitErr n	n is a stable reading other than zero. Issue a BERT reset command. This command resets all monitor measurements. Review the modem configuration and ensure that any loopback cables are properly installed.

6. Disable the BERT.

□ From a remote unit: **BEN 0**

□ From the front panel: **BERT Test Mode DISABLE**

The BER test is now complete and the BERT is disabled. However, the test mode indicator remains illuminated until the IF loopback is disabled.

7. Disable the IF loopback:

□ From a remote unit: **LB 0**

□ From the front panel: **LoopBack DISABLE**

The BERT and IF Loopback tests are now complete and disabled.

Advanced BERT Verification and Error Analysis

For advanced BERT verification and troubleshooting, the CM701 BERT provides the most reliable error analysis data when a ComStream modem is at both the transmit and the receive ends. With ComStream modems at both ends of the communications link, both modems are put into BERT mode. This allows the BERT to perform a two-way error analysis; modem A sources data to modem B, while modem B sources data to modem A.

Troubleshooting Random Errors

For troubleshooting hard-to-find, seemingly random errors:

1. Set up a single modem to generate the 511-bit (2^9-1) pattern while two or more modems receive and analyze the identical IF or RF signal.

2. Determine the probable source of the errors.

   □ If both receive modems have identical BERs, the problem probably exists in the transmit equipment.

   □ Different results on the receive modems indicate a potential problem with the receive equipment.

3. Localize the problems to the appropriate equipment.

Troubleshooting External DCE Equipment

The BERT can be used to generate a known 8-bit pattern for troubleshooting DCE equipment external to the modem. To do this, operate the modem in and IF loopback mode with the BERT generating a repeating 8-bit pattern. The resulting receive pattern can be used by a technician performing oscilloscope or logic analyzer measurements.

Time-Based Error Analysis Measurements

To provide time-based error analysis measurements, the BERT is operated in one-second block mode. During this test procedure, the block error rate is equivalent to the percentage of errored seconds measurement required by many specifications.

Pattern Slip Analysis

The CM701 BERT recognizes a pattern slip as a complete loss of BERT synchronization. If a modem looses BERT synchronization but has no other associated faults, the most likely cause of synchronization loss is a clocking problem.

Since the 511 pattern in the CM701 BERT is compatible with most commercially available error analysis equipment, a ComStream modem can generate a pattern that can be transmitted to any compatible open network modem. The output of this modem can then be analyzed using external error analysis devices. The reverse setup is also a valid testing procedure.

ComStream makes no claims for equipment compatibility with any individual test equipment manufacturer. Individual compatibility tests should be performed with your particular test devices.

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Command Descriptions

8

This chapter presents the procedures for issuing commands from both the remote terminal and the front panel, as well as a detailed description of all CM701 commands.

Issuing Remote Commands

To issue an ASCII protocol command from a remote terminal, type the command at the prompt (>) with the appropriate parameter, and then press ENTER. Use the following syntax:

```
<command mnemonic> <parameter>
```

where:

- `<command mnemonic>` refers to a two- or three-letter command abbreviation

  There must be one space between the command mnemonic and the parameter; a space is inserted by pressing the SPACE BAR.

- `<parameter>` is any value pertaining to the command, if applicable

  The parameter for a query command is a question mark (?); some commands do not require a parameter.

Issuing Front Panel Commands

To issue a command from the front panel, perform these steps:

1. Navigate to the desired command using the LCD, Cursor, and Modify buttons.

2. Press the right LCD button or one of the Cursor buttons to select the command. All or part of the command and its parameter will flash.

3. Change the parameter as needed. If the parameter is one of a set of options, scroll through the parameter list. If the parameter requires entry of a number:

   a. Use the Cursor buttons to make the parameter flash.

   b. Scroll through the list of numeric characters using the Modify buttons.

   c. Repeat steps a and b as necessary until the entire parameter appears as desired.

4. Issue the command by pressing the Enter button. An asterisk (*) will appear briefly to the left of the command parameter and then disappear. The command and its updated parameter will then be displayed and will not flash.

To leave a command *without* modifying it, navigate to another command or level using the left or center LCD buttons or the Previous button.

Issuing Commands Using the Terminal Emulator

Commands not directly accessible from the front panel can be entered from the front panel using the terminal emulator command. Use the remote command syntax when issuing commands using the front panel terminal emulator :AA command. The remote command syntax is:

```
:<command mnemonic> <parameter>
```

where:

- `<command mnemonic>` refers to a two- or three-letter command abbreviation used for remote command entry that replaces the AA on the display. For a duplicate-card configuration, the slot number replaces the initial blank space as shown:
    ```
    <slot number>:<command mnemonic>
    ```

    There must be one space between the command mnemonic and the parameter; this space is entered by pressing the $\rightarrow$ (right arrow) key.

- `<parameter>` refers to any value pertaining to the command. The parameter for a query command is a question mark (?); some commands do not require a parameter.

Command Types

CM701 commands are categorized into two memory types and four functional types. These command types are listed in Table 8-1 and Table 8-2.

Table 8-1   Command Memory Types

Memory Type	Description
Nonvolatile (NV)	Command parameters that are stored in NV memory do not have to be reentered each time the CM701 is powered on or reset.
Volatile (V)	Command parameters that are stored in volatile memory are not retained after power-on or reset of the CM701.

Table 8-2   Command Function Types

Function	Description
Configuration	These commands have parameters that can be modified and entered to change the operating characteristics of the CM701 and direct it to perform real-time functions.
Monitor	These commands provide query (view-only) information about the performance, operating environment, and nonfault-related conditions of the CM701.
Fault	These commands provide information about the functional status of the CM701 and may indicate when an external piece of equipment is not configured properly or is faulty. Fault commands are query-only with the exception of the Clear Faults (CF) command.
Security	These commands control access to the remote port to prevent unauthorized operation of the CM701 over telephone lines or other types of remote access.

Alphabetical Command Listing

CM701 commands are listed in alphabetical order by command mnemonic. For each command, the following information is presented:

- Command mnemonic and command name

- Function and memory type

- Detailed description of the command's function

- Syntax, for both remote and front panel commands. This information is listed as Remote/front panel, with the remote syntax shown first, followed by a slash, followed by the front panel syntax.

- Parameter values or range of values, including the default value

- Examples, as appropriate

- Additional information, as appropriate, which may include return values, response formats, or how various commands work in conjunction with, or impact, one another.

For information on option card commands, refer to the appropriate option card guide.

:AA   Front Panel Terminal Emulator

Use this command to enter remote commands from the front panel that have no front panel equivalent.

Syntax

- Remote: no command equivalent

- Front panel: `<slot#>:<rem cmd>`

Parameters

`<slot#>` and `<rem cmd>` parameter values are:

- `<slot#>` – slot number of the card to which the command is directed; slot number is required only when the command exists on two or more of the installed cards

- `<rem cmd>` – remote command to be issued; use remote syntax and enter the parameter if applicable

Example

To query the receive timing clock frequency of the card in slot 2, from the front panel issue the `2:RTF ?` command.

ABB   Acquisition Bits per Bin (Config) (NV)

Use this command to reduce the amount of time the demodulator waits in a bin when performing acquisition.

Reducing the amount of time spent in a bin is *not* recommended for low E_b/N_0 applications. If the signal-to-noise ratio is not very high and the time spent in a bin is reduced too much, it is possible that the signal will fail to acquire.

Syntax

- Remote: ABB <time divider>
- Front panel: use terminal emulator

Parameters

The <time divider> parameter value range is 1 to 255. The default is 1.

Example

To have the demodulator wait one-fifth of the acquisition time in a bin, issue the remote command ABB 5.

For more information on reducing acquisition time, refer to the chapter on system configuration issues.

ACP   Autoconfiguration Path (Config) (NV)

Use this command to enable or disable the autoconfiguration path function. During a power-up or soft reset (RE) of the CM701, autoconfiguration default settings are reestablished.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: ACP <setting>
- Front panel: use terminal emulator

Parameters

<setting> parameter values are 0 and 1:

- 0 – during power-up or soft reset, the CM701 will not reconfigure automatically to autoconfiguration defaults; this parameter disables the autoconfiguration path function

- 1 (default) – during power-up or soft reset, the CM701 will automatically reconfigure to autoconfiguration defaults; this parameter enables the autoconfiguration path function

Example

To disable autoconfiguration, issue the remote command `ACP 0`.

Additional Information

One benefit of the modular design of the CM701 is that multiple transmit or receive configurations are possible within one chassis. To assist you in configuring the unit correctly, the CM701 automatically assigns cards to various logical transmit and receive paths as required. This is accomplished at power-up or during a soft reset if ACP is set to 1.

If ACP is set to 0, the last configuration remains valid, allowing custom configurations to be saved. If an IN 9346 or INF 9346 command is issued, the ACP parameter will be set to 1 and the CM701 will automatically reconfigure.

To modify the assignment of I/O cards to the primary transmit or receive path, refer to the TIO and RIO commands.

AE   Automatic Modulator Enable (Config) (NV)

Use this command to automatically enable or disable the modulator TxIF at modem power-up or reset (refer to the RE command), or upon resolution of a modulator fault condition.

Syntax

- Remote: `AE <setting>`
- Front panel: use terminal emulator

Parameters

`<setting>` parameter values are:

- 0 – automatic disable

  On the next power-up or reset, the modulator TxIF will be disabled, regardless of the last specified enable modulator (EM) command parameter. Afterward, the modulator can be enabled only by issuing an EM command with a parameter of 1, or by pressing the Tx Enable button. If a modulator fault occurs, an EM 1 command must be reissued to turn the modulator back on after the fault condition is resolved.

- 1 (default) – automatic enable

  On the next power-up or reset, the modulator TxIF state will assume the condition last specified by the EM command parameter. If the modulator turns itself off due to a fault condition, it will automatically turn itself back on when the fault is resolved, and without an EM 1 command being reissued.

Examples

- If the latest entries for AE and EM were both 0, upon reset the modulator TxIF will remain disabled until an EM 1 command is entered.

- If prior to reset the latest entries were AE 0 and EM 1 (modulator enabled), the modulator TxIF will be disabled until an EM 1 command is entered.

- If the latest entries for AE and EM were both 1, upon reset the modulator TxIF will be enabled automatically.

- If prior to reset the latest entries were AE 1 (automatic enable) and EM 0 (modulator disable), the modulator TxIF will remain disabled until an EM 1 command is entered.

The default EM parameter is 1; thus, a factory-configured modulator TxIF will be enabled automatically upon power-up or reset.

AG   AGC Level (Monitor)

Use this command to view the gain factor applied to the received signal.

Syntax

- Remote: `AG ?`
- Front panel: `AGC Level`

Response

A low number indicates a strong receive signal as high as -10 dBm; a high number indicates a weak receive signal as low as -55 dBm. A return value of 60 to 80 indicates a good signal level.

Additional Information

The demodulator automatically adjusts the gain factor to keep the baseband signal at a constant level, regardless of RxIF input signal power. The range for this input signal power is 0 to 255.

AL   Alarm Reporting (Config) (NV)

Use this command to enable or disable fault reporting and to allow or prevent unsolicited fault messages from being issued by the CM701 to a remote terminal. It affects operation only with ASCII protocol. Packet protocol does not allow any unsolicited messages, regardless of the AL command parameter.

Syntax

- Remote: `AL <setting>`
- Front panel: use terminal emulator

Parameters

`<setting>` parameter values are:

- 0 – disables fault reporting, prevents unsolicited fault messages from being issued; unsolicited `ST 0` message appears when demodulator gains sync

- 1 (default) – enables unsolicited fault messages to be issued upon detection of a fault; unsolicited `ST 0` message appears when demodulator gains sync

- 3 – disables fault reporting, prevents unsolicited fault messages from being issued; no unsolicited `ST 0` will appear

Example

If AL 1 is issued, the message `Rx AGC Range Fault` will appear on the
remote terminal if the receive signal becomes too weak to detect. A subsequent
fault message will not be displayed until the current message is cleared with a
clear fault (CF) command.

AO   Acquisition Offset Frequency (Config) (NV)

Use this command to set the offset frequency from which the acquisition search
will begin. The acquisition offset frequency is expressed in hertz.

Syntax

- Remote: `AO <freq>`
- Front panel: use terminal emulator

Parameters

`<freq>` parameter values are integers in the range of -30000 to +30000. The
default is 0.

AQ   Acquisition (Config) (NV)

Use this command to determine the acquisition status of the demodulator or to
restart acquisition.

Syntax

- Remote: `AQ <status>`
- Front panel: `Acquisition <status>`

Parameters

Remote/front panel `<status>` parameter values are:

- 0/STOP – causes the demodulator to stop searching for a receive signal
  carrier. This is typically used if the demodulator is synchronized to the receive
  signal and is actively demodulating valid data.

- 1/NORMAL (default) – causes the demodulator to begin searching for the
  receive signal carrier. The demodulator will acquire the carrier closest to the
  frequency at which the search begins. For a CM701 operating at a symbol rate
  above 200 ksps, acquisition time is typically less than one second. Reentering
  this command restarts acquisition.

- 2/FAST – causes the demodulator to go into fast acquisition. This is
  recommended for low noise applications only, where E_b/N_0 is greater than
  8 dB.

For more information, refer to the chapter on system configuration issues.

Example

To cause the demodulator to begin searching for a carrier, issue the remote
command `AQ 1`.

AR   Acquisition Range (Config) (NV)

Use this command to define the size of the frequency range over which the demodulator will search for the carrier. The acquisition range is expressed in hertz.

Syntax

- Remote: `AR <range>`
- Front panel: use terminal emulator

Parameters

`<range>` parameter values are integers from 0 to 500000. The default is 30000.

Example

To set the acquisition range to ±30000 Hz, issue the `AR 30000` command.

Additional Information

The widest acquisition range is ±500 kHz. In some applications that use lower data rates, the acquisition range may need to be reduced to prevent false-lock conditions, reduce lengthy acquisition times, or both.

BBC   BERT Bit Count (Monitor)

Use this command to display the bit count since the last BERT sync or reset.

Syntax

- Remote: `BBC ?`
- Front panel: `BERT BitCnt`

BBE   BERT Block BER (Monitor)

Use this command to display the BER over the previous block. BERT block length is defined in the BBL command.

Syntax

- Remote: `BBE ?`
- Front panel: `BERT BlkBER`

BBL   BERT Block Length (Config) (NV)

Use this command to establish the block length used by the BERT for error analysis. The number of bits in a one-second block equals the current data rate in units of bits per second.

Syntax

- Remote: `BBL <bits>`
- Front panel: `BERT Blk Length <bits>`

Parameters

- Remote/front panel `<bits>` parameter values are:

    - 1/1 sec – one second

    - 5/10^5 – 10^5 bits

    - 6/10^6 (default) – 10^6 bits

    - 7/10^7 – 10^7 bits

    - 8/10^8 – 10^8 bits

BDI   BERT Data Inverted (Monitor)

Use this command to determine if the BERT receive data is inverted.

Syntax

- Remote: `BDI ?`

- Front panel: `BERT Data`

Return Value

Once synchronized, the remote/front panel return values to the BDI command are either:

- 0/Not Inverted – data is not inverted if the receive data is true

- 1/Inverted

BDP   BERT Display Parameters (Monitor)

Use this command to display a summary of all current BERT status parameters. This command is issued without any parameters.

Syntax

- Remote: `BDP`

- Front panel: use terminal emulation

Response Format

The following is an example of the BDP response format:

```
BSS 0       BERT Sync Status
BSF 0       BERT Sync Fault
BEC 0       BERT Error Count
BBC 30219   BERT Bit Count
BER 0       BERT Average BER
BBE 0       BERT Block BER
BWE 0       BERT Blocks w/Errs
BLC 3       BERT Block Count
BLE 0       BERT Block Err Rate
BDI 0       BERT Data Inverted
```

BEC BERT Bit Error Count (Monitor)

Use this command to display the bit error count since the last BERT sync or reset.

Syntax

- Remote: `BEC ?`
- Front panel: `BERT BitErr`

BEI BERT Error Insert (Config) (V)

Use this command to insert a single error in the BERT transmit data stream. This is typically used to validate that a link has been established between two units with both BERTs enabled. When an error is inserted at one end of the link, it is verified at the other end to ensure that the link has been correctly established.

Syntax

- Remote: `BEI`
- Front panel: `BERT Error INSERT`

Additional Information

The BEI command is issued without parameters. An error message displays if this command is issued when the BERT is disabled.

BEN BERT Enable (Config) (V)

Use this command to enable or disable the BERT. During normal operation, the BERT must be *disabled* for the CM701 to pass user data. User transmit data is interrupted and replaced by BERT-generated data, and there is a possible corruption of user receive data by the BERT error analyzer circuitry if BERT is *not* disabled.

Syntax

- Remote: `BEN <setting>`
- Front panel: `BERT Test Mode <setting>`

Parameters

Remote/front panel `<setting>` parameter values are:

- 0/DISABLE (default) – disables the BERT
- 1/ENABLE – enables the BERT; front panel Test Mode LED illuminates

The Doppler buffer must be disabled (DBM 1) *before* enabling the BERT.

BER   BERT Average BER (Monitor)

Use this command to display the average BER since the last BERT sync or reset.

Syntax

- Remote: `BER ?`
- Front panel: `BERT AvgBER`

BIT   Built-In Self-Test (Config) (V)

Use this command to perform a built-in, card-level self-test for all the cards installed in a CM701.

Syntax

- Remote: `BIT 0`
- Front panel: `Self Test EXECUTE`

Return Value

A report of the results will be displayed on the remote terminal or the front panel as a list that can be scrolled. A response other than `X:XXXXX PASS (0)`, where X:XXXXX is the slot # and card type, indicates a hardware failure; contact ComStream Customer Service. After the completion of a self-test, the unit is returned to its original configuration. To view the results again, reissue the remote `BIT 0` or front panel `Self Test` command.

BLC   BERT Block Count (Monitor)

Use this command to display the block count since the last BERT sync or reset. BERT block length is defined in the BBL command.

Syntax

- Remote: `BLC ?`
- Front panel: `BERT BlkCnt`

BLE   BERT Average Block Error Rate (Monitor)

Use this command to display the block error rate since the last BERT sync or reset. Block error rate is defined as the number of blocks with errors divided by the number of blocks of received data. BERT block length is defined in the BBL command.

Syntax

- Remote: `BLE ?`
- Front panel: `BERT AvgBLER`

BPT   BERT Pattern Type (Config) (NV)

This command establishes the BERT data pattern for transmission and reception.

Syntax

- Remote: `BPT <pattern>`
- Front panel: `BERT Pattern <pattern>`

Parameters

Remote/front panel `<pattern>` parameter values are:

- 0/2^9-1 (default) – pseudorandom sequence of pattern length 2^9-1 (511)
- 1/USER – pattern is defined by and used in conjunction with the BUP command
- 2/1:1 – 1:1 pattern
- 3/MARK – mark
- 4/SPACE – space

BR   Baud Rate (Config) (NV)

Use this command to select the asynchronous communication baud rate for the remote control port. The CM701 baud rate must match the baud rate of the remote control device.

Syntax

- Remote: `BR <rate>`
- Front panel: `Baud Rate <rate>`

Parameters

`<rate>` parameter values are:

- 75
- 300
- 1200 (default)
- 2400
- 4800
- 9600

Example

To select a communication baud rate of 9600, issue the `BR 9600` command. If a custom baud rate has been set, the front panel command `Baud Rate <rate>` will respond with an asterisk in front of the custom value.

BRE   BERT Reset and Control (Config) (V)

The built-in BERT continually updates and displays all receiver parameters. Use this command to stop, start, or reset the BERT.

Syntax

- Remote: `BRE <setting>`
- Front panel: `BERT Control <setting>`

Parameters

Remote/front panel `<setting>` parameters may have no value or values of:

- 0/STOP – temporarily freezes the monitor parameters so that an accurate relationship between performance and data can be easily reviewed; the BERT continues to store parameters in the background
- 1/START – updates the monitor parameters while continuing the BERT test
- 2/RESET (default) – clears all bit, block, and error counters, clears the sync fault parameter, restarts the BERT, and all counters and accumulators are set to zero; reset does not affect BERT pattern transmit circuitry, only BERT receive circuitry

If the remote BRE command is entered without a parameter, an entry of 2 is assumed and a BERT reset occurs.

BSF   BERT Sync Fault History (Monitor)

Use this command to determine if the BERT has stayed in synchronization since the last BERT reset.

Syntax

- Remote: `BSF ?`
- Front panel: `BERT Sync History`

Return Value

The BERT is always autosynchronizing and continuously attempts to regain synchronization if it is lost. The BERT determines that synchronization has been established when it detects fewer than *n* error bits out of *m* received bits, where *n* and *m* are defined by the BST parameter. The BERT will declare loss of synchronization upon detection of *n* error bits out of any group of *m* received bits.

Remote/front panel BSF responses are:

- 0/OK – BERT has remained in sync since last BERT reset
- 1/LOSS – BERT has lost sync at least once since last BERT reset

  The status message remains at `LOSS` until BERT is reset

BSS   BERT Sync Status (Monitor)

Use this command to determine if the BERT is currently in or out of synchronization. The BERT indicates synchronization based upon detection of fewer than *n* error bits out of *m* received bits, where *n* and *m* are defined in the BST command. Once synchronized, the BERT declares sync loss upon detection of greater than *n* error bits out of *m* received bits.

Syntax

- Remote: `BSS ?`
- Front panel: `BERT Sync`

Return Value

Since the BERT sync status is maintained in real time, the status display may report both in- and out-of-synchronization messages if the current synchronization status fluctuates. Remote/front panel BSS responses are:

- 0/In Sync – BERT synchronized
- 1/Out of Sync – BERT not synchronized

BST   BERT Sync Threshold (Config) (NV)

Use this command to set the threshold for the BER and to determine if synchronization exists between the BERT and the received data.

Syntax

- Remote: `BST <threshold>`
- Front panel: `BERT SyncLvl <threshold>`

Parameters

Remote/front panel `<threshold>` parameter values are:

- 0/1000/10^4 (default) – establishes low synchronization threshold of 1,000 errors out of 10000 bits
- 1/2500/10^4 – establishes high synchronization threshold of 2,500 errors out of 10000 bits

BUP   BERT User Pattern (Config) (NV)

Use this command to establish an 8-bit, user-programmable pattern for BERT transmit and receive. The BERT cycles the selected pattern through a shift register that continuously repeats the pattern. The BPT command must be set to 1/USER in order for the BUP command to have any effect.

Syntax

- Remote: `BUP <pattern>`
- Front panel: `BERT Usr Ptrn <pattern>`

Parameters

The `<pattern>` parameter value is any decimal value from 0 to 255. The default is 85, which converts to binary 01010101.

BWE   BERT Block Error Count (Monitor)

Use this command to get a count of all blocks containing one or more errors since the last BERT sync or reset. BERT block length is defined in the BBL command.

Syntax

- Remote: `BWE ?`
- Front panel: `BERT BlkErr`

CAP   Current Active Path (Config) (V)

Use this command to set the data path to which subsequent commands will be issued.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `CAP <transmit path>,<receive path>`
- Front panel: use terminal emulator

Parameters

`<transmit path>` and `<receive path>` parameter values are:

- 0 (default) – uses cards in all paths
- 1 – specifies cards only in the primary path
- 2 – specifies cards only in the secondary path
- 3 – specifies cards only in the ternary path

Example

To specify cards in the primary transmit and receive paths as the data path to which subsequent commands will be issued, enter the remote command `CAP 1,1`.

Additional Information

Data rate macro commands can be issued regardless of the CAP setting.

Issuing a DP command will return the modulator and demodulator cards that were specified in the CAP command. However, if no paths were set, the display returned by DP will default to the primary transmit and receive paths.

CAS   Current Active Status (Config) (V)

Use this command to set the data path to which a status query command will be issued.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: CAS <transmit path>,<receive path>
- Front panel: use terminal emulator

Parameters

<transmit path> and <receive path> parameter values are:

- 0 (default) – uses cards in all paths
- 1 – specifies cards only in the primary path
- 2 – specifies cards only in the secondary path
- 3 – specifies cards only in the ternary path

Example

To specify cards in the primary transmit and receive paths as the data path to which a status query command will be issued, enter the remote command CAS 1,1.

Additional Information

Cards in the specified path will be queried to construct the information required by ST, FL, VS, VF, and VFT commands and for fault status LEDs (RxSync, Tx Enable, and the red and yellow FAULT) on the front panel.

CD   Data Control Mode (Config) (NV)

Use this command set the CM701 to monitor and respond to, or ignore, DCE-DTE data control signals.

This mode is *not* available for configurations with multiple modulators. It is however, available with multiple low-speed modem cards *if* the on-board RS-449 interface is used.

Syntax

- Remote: CD <response>
- Front panel: use terminal emulator

Parameters

`<response>` parameter values are:

- 1 (default) – ignore additional data control signals

- 2 – respond to data control signals and cause receive data (RD) to be clamped high when the demodulator is not in sync

Example

To cause the modem to ignore additional data control signals, issue the remote command `CD 1`.

Additional Information

Some data interface specifications include provisions for DTE-to-DCE handshake signals in addition to normal data and clock signals. For example, the RS-449 specification includes the signals terminal ready (TR) and request to send (RS).

CDC   Backplane Clock/Data Connectivity (Config) (NV)

Refer to and use the ACP command instead of the CDC command.

CE   Channel Error Rate (Monitor)

Use this command to monitor the channel error rate only if the demodulator is operating with decoding enabled. If CE is issued when the CM701 is not locked to a receive carrier, or if the CM701 is operating uncoded, a remote `ER 4` error response or `N/A` front panel message will appear.

Syntax

- Remote: `CE ?`

- Front panel: `Chan Err Rate`

Return Value

The returned, two-digit value represents an exponential number. The first digit is the mantissa, and the second is the exponent (for example, 26 represents $2x10^{-6}$, or .000002).

CF   Clear Fault Log (Fault V)

Use this command to clear the fault log and current fault lists and to permit monitoring the recurrence of faults.

Syntax

- Remote: `CF` or `CF 0`

- Front panel: `Clear`

Additional Information

Upon CM701 power-up or reset, the fault log register must be cleared by entering the remote CF or front panel Clear command before fault monitoring can begin.

CFG   Card Configuration (Monitor)

Use this command to query the CM701 for installed cards. The response includes the slot number and a code indicating the type of card installed in that slot.

Syntax

- Remote: `CFG ?`

- Front panel: no command equivalent

Return Value

The response format is a single string that contains the slot number followed by a colon and an integer code for every CM701 card. Slots are delimited by commas. If a card is not present, the return code is 0.

The response format is:

```
CFG 1:<code>,2:<code>,3:<code>,4:<code>,5:<code>,6:<code>,7:<code>
```

`<code>` is a number from 0 and 65535 that represents a particular card, as defined in Table 8-3.

Table 8-3   CFG Card Types and Codes

Type of Card		Code
M&C	M&C	1
Demodulator	70 MHz, Variable Rate	100
	70 MHz, Quad Rate	101
	70 MHz, Single Rate	102
	140 MHz, Variable Rate	110
	140 MHz, Quad Rate	111
	140 MHz, Single Rate	112
	L-band, Variable Rate	120
	L-band, Quad Rate	121
	L-band, Single Rate	122
Modulator	70 MHz, Variable Rate	200
	70 MHz, Quad Rate	201
	70 MHz, Single Rate	202
	140 MHz, Variable Rate	210
	140 MHz, Quad Rate	211
	140 MHz, Single Rate	212
Low-Speed Modem Card	70 MHz, Variable Rate	300
I/O Card	RS-449 (Tx/Rx)	400
	V.35 (Tx/Rx)	401
	RS-232 (Tx/Rx)	402
	G.703 Single Rate (Tx/Rx)	403
	DS-1 (Tx/Rx)	404
	G.703 Multirate (Tx/Rx)	405

Table 8-3   CFG Card Types and Codes

Type of Card		Code
RFIM	C-band	500
	Ku-band	501
SCC Card	SCC	600
	SCC-S	601
Reed-Solomon Card	Intelsat	700
	ComStream	701
	DVB	702
Buffering Card	Doppler Buffer	800
	Framing Unit	810

An example of a response to a CFG ? command is:

```
CFG 1:0,2:400,3:0,4:1,5:0,6:100,7:200
```

In the example, the installed cards are:

- Slot 1 – empty

- Slot 2 – RS-449 (Tx/Rx) I/O card

- Slot 3 – empty

- Slot 4 – M&C card

- Slot 5 – empty

- Slot 6 – 70 MHz, variable rate demodulator

- Slot 7 – 70 MHz, variable rate modulator

CLP   Clear Path (Config) (V)

Use this command to clear all data paths. This has the same affect as issuing a 0 parameter with each of the transmit and receive data path commands.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `CLP 0`

- Front panel: use terminal emulator

CPC   Configuration Path Control (Config) (V)

Use this command to enable the configuration path control function. When the CPC command is issued, autoconfiguration default settings are reestablished. Unlike the ACP command that attempts to reconfigure the backplane paths at modem reset or power-up, the CPC command attempts reconfiguration when issued.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `CPC 1`
- Front panel: use terminal emulator

DAY   Real-Time Date (Config) (NV)

Use this command to query, view, and enter the CM701 real-time date.

Syntax

- Remote

  - To enter the date: `DAY <Mo><Da><Yr>`
  - To turn off the real-time clock until a valid date is entered: `DAY 0`

- Front panel: `Date <Mo>/<Da>/<Yr>`

Parameters

`<Mo>`, `<Da>`, and `<Yr>` parameters are:

- Mo – month expressed in two-digit format from 01 (January) to 12 (December)
- Da – day expressed in two-digit format from 01 to 31
- Yr – year expressed by the last two digits of the year from 00 to 99

There is no default; an IN 9346 or INF 9346 command does not reset the value stored in NV memory for this command. The date, when set by the factory, is the current date for U.S.A. Pacific standard time.

Example

To set the real-time date as 28 August 1999, issue the remote command `DAY 082899`.

DC   Display Configuration (Config) (V)

Use this command to view a summary of the current CM701 configuration as defined by the hardware cards and many NV memory-stored parameters.

The DC command is *not* supported by ComStream packet protocol. For the packet protocol version of the DC command, refer to the chapter on ComStream Packet Protocol and the BD command.

Syntax

- Remote: `DC <format>`
- Front panel: no command equivalent

Parameters

`<format>` parameters may have no value or values of 0, 1, and 7. Formats 0 and 1 are compatible with previous modem product lines.

- No value and 0 – modem configuration format
- 1 – symbol rates format
- 7 – CM701 modular format

Example

To display a configuration in CM701 modular format, issue the `DC 7` command.

Response Format

The following are examples of displayed summaries:

- In response to DC or DC 0

```
MODEM CONFIGURATION:
CM701 V4.50 03-95
DEMOD: 192000 SPS, NO DATA CTRL, USER BAUD, RS-232 INT
MOD: 19200 SPS, INT BIT TIMING
```

This command response is backward compatible with the CM101E, CM401, and CV101. It indicates that the modem is a CM701 with M&C software version 4.50, which was released 03/95. The demodulator symbol rate is 19.2 ksps, data control is disabled, the remote baud rate will power on at a user baud rate, and the remote interface is RS-232 electrical. The modulator symbol rate is 19.2 ksps, with internal bit timing selected.

- In response to DC 1

```
MODEM SYMBOL RATE(S) (SYM/SEC):
DEMOD: VARIABLE
MOD: VARIABLE
```

This command response indicates that the demodulator and modulator are both variable symbol rates.

- In response to DC 7

```
Monitor and Control:4 V4.50

Data RS-449:2 V3.20

Demodulator:6V4.20 70mhz
Data Rate(s):VARIABLE

Modulator:7V4.10 70mhz
Data Rate(s): VARIABLE
```

This modular command response format has been defined specifically for the CM701. For each card, one or more lines of configuration information is displayed. The card description, slot location, software version, and any hardware-specific configuration attributes are included.

DD   Differential Decoding on Demodulator (Config) (NV)

Use this command to control differential decoding on the demodulator.

Syntax

- Remote: `DD <decoding type>`
- Front panel: `Rx Diff Decoding <setting>`

Parameters

Remote/front panel `<decoding type>` parameter values and their front panel `<setting>` equivalents are:

- 0/OFF – disables differential decoding
- 1 (default) – enables *standard* differential decoding for any operating configuration other than QPSK uncoded

There no front panel equivalent command available for this parameter.

- 2/ON – enables support for standard as well as QPSK uncoded operation

Decoding type 2 is recommended as it will cause the demodulator to automatically switch between *standard* and QPSK uncoded processing, depending on the configuration.

DFS   Demodulator Baseband Filter Select (Config) (NV)

Use this command to select the demodulator baseband digital filter spectral shape. The demodulator's digital filter creates an optimal match to the modulator baseband filter, which results in exceptional modem performance.

Syntax

- Remote: `DFS <shape>`
- Front panel: `Rx Filter Type <shape>`

Parameters

Remote/front panel `<shape>` parameter values are:

- 0/ComStrm (default) – ComStream 6-pole Butterworth

  This is used if the CM701 is to operate with existing ComStream CMxxx, CVxxx, DTxxxx, or DBRxxx products in closed-network applications.

- 1/IBS/IDR – filter used for Intelsat-compatible, open-network applications

- 2/SMS – filter used for Eutelsat-compatible, open-network applications

DI   Demodulator Spectral Inversion (Config) (NV)

Use this command to enable or disable the demodulator spectral inversion.

Syntax

- Remote: `DI <setting>`
- Front panel: use terminal emulator

Parameters

`<setting>` parameter values are:

- 0 (default) – disable spectral inversion
- 1 – enable spectral inversion

DL   Decoder Memory Length (Config) (NV)

Use this command to control the decoder path memory length for the sequential decoder on the demodulator. The sequential decoder can operate with 128 bits or 4096 bits of path memory. A shorter memory length provides less throughput delay (128 bit delay versus 4096 bit delay), however, a longer memory provides better performance at data rates above 64 kbps.

Syntax

- Remote: `DL <memory length>`
- Front panel: use terminal emulator

Parameters

`<memory length>` parameter values are:

- 0 – selects short memory length (128 bits)
- 1 – selects long memory length (4096 bits)
- 2 (default) – automatically selects short memory length for all data rates at or below 64 kbps and long memory length for rates above 64 kbps

DM   Differential Encoding on Modulator (Config) (NV)

Use this command to control differential encoding on the modulator.

Syntax

- Remote: `DM <encoding type>`
- Front panel: `Tx Diff Encoding <setting>`

Parameters

Remote/front panel parameter values are:

- 0/OFF – disables differential encoding
- 1 (default) – enables *standard* differential encoding for any operating configuration other than QPSK uncoded. There is no corresponding front panel command equivalent for this parameter.
- 2/ON – enables support for standard as well as QPSK uncoded operation

Parameter 2 is recommended, as it causes the modulator to automatically switch between standard and QPSK uncoded processing, depending on the configuration.

Example

To enable support for standard as well as QPSK uncoded operation, issue the remote `DM 2` command, or, from the front panel, select the `ON` parameter for `Tx Diff Encoding`.

DP   Display Parameters (Config) (V)

Use this command to view a summary of current modem configuration and operating parameters.

The DP command is *not* supported by ComStream packet protocol. For the packet protocol version of the DP command, refer to the chapter on ComStream packet protocol and the BD command.

Syntax

- Remote: `DP <format>`
- Front panel: no command equivalent

Parameters

`<format>` parameters may have no value or values of 0, 1, 2, or 7:

- no value or 0 – standard summary display, compatible with past modem products CM101E, CM401, and CV101
- 1 – operating mode settings, short summary, compatible with past modem products CM101E, CM401, and CV101
- 2 – operating performance indicators, status summary, compatible with past modem products CM101E, CM401, and CV101
- 7 – CM701 format containing card description, location, and parameters

Example

To display a summary of current modem configuration and operating parameters in CM701 modular format, issue the remote command DP 7.

Return Value

The command response depends on the particular hardware cards installed in the CM701. Parameter values returned as xx indicate that no parameter was available at the time of the display. For example, EB xx is displayed in the summary if the demodulator was not synchronized to the receive signal.

DRM   Data Rate Mode (Config) (NV)

Use this command only for variable rate CM701s to specify the type of mode used.

Syntax

- Remote: DRM <mode>
- Front panel: use terminal emulation

Parameters

<mode> parameter values are 0 and 1.

- 0 – symbol rate mode. Transmitted or received symbol rates are held fixed and are not affected by changes to the types or code rates for modulation or demodulation. Instead, the user data rate changes appropriately.

- 1– data rate mode. The user data rate is held fixed and is not affected by changes in the type or code rate for modulation or demodulation. Instead, the symbol rate changes appropriately.

Default:

- The default for single or quad rate CM701s is 0 (an IN 9346 or INF 9346 command will set DRM to 0 in a single or quad rate CM701).

- The default for a variable rate CM701 is 1 (an IN 9346 or INF 9346 command will set DRM to 1).

Use DRM 0 to maintain compatibility with past modem products with the exception of the CM2000 and CM720 modems.

Example

To specify data rate mode, issue the **DRM 1** command.

EB E_b/N_0 Level (Monitor)

Use this command to determine the current E_b/N_0 level.

Syntax

- Remote: `EB ?` or `EB`

- Front panel: Eb/N0

Return Value

The displayed value represents an estimate of the E_b/N_0 and is in the range of 0 to 21 dB in 0.1 dB steps. The accuracy of the measurement depends on two factors:

- Value of the E_b/N_0 when queried – from 5 to 10 dB provides very accurate estimates

- Symbol rate of the modem – high symbol rates provide more accurate measurements than low symbol rates

The result is within 0.5 dB 90 percent of the time.

Additional Information

If the EB query is issued when the modem is not locked to a receive carrier, a remote `ER 4` error or front panel `N/A` response will display.

EBT E_b/N_0 Threshold (Config) (NV)

Use this command to set an E_b/N_0 level threshold that will be used during fault reporting.

Syntax

- Remote: `EBT <dB>`

- Front panel: use terminal emulator

Parameters

The `<dB>` parameter value range is 0 to 210, which corresponds to E_b/N_0 levels 0 to 21.0 dB entered in 0.1 dB steps. The default is 0.

Example

To set the E_b/N_0 level threshold at 10.0 dB, issue the remote command `EBT 100`.

Additional Information

- If the measured E_b/N_0 level drops below the EBT threshold, the CM701 will report a `Low Eb/No` fault, and the Signal Quality (SQ) line on the I/O connector will be low.

- If the measured E_b/N_0 level exceeds the EBT threshold, the SQ line will report `OK` (high level).

EE   Echo Enable (Config) (NV)

Use this command to enable or disable the echoing of characters back to the remote unit when they are received by the modem. The command is for remote control ports operated with ASCII protocol only and has no effect on packet protocol operation.

Syntax

- Remote: EE <setting>
- Front panel: use terminal emulator

Parameters

<setting> parameter values are 0 and 1:

- 0 – disables character echo
- 1 (default) – enables character echo

Example

To enable character echo, issue the remote command EE 1.

EM   Enable Modulator (Config) (NV)

Use the EM command or the front panel Tx Enable button to enable or disable the modulator TxIF output power. If the modulator is stable and without faults, the TxIF power can be enabled. If hardware faults exist or the synthesizers are not stable and locked, the modulator power cannot be enabled, and an error message will be displayed if this is attempted.

Syntax

- Remote: EM <setting>
- Front panel: Tx Enable button

Parameters

Remote/front panel <setting> parameter values and their front panel equivalents are:

- 0/Tx Enable LED white – disable TxIF output

  When the modulator is disabled, the TxIF output power level is at least 60 dB below the enabled TxIF output power level.

- 1/Tx Enable LED green (default) – enable TxIF output power

Example

To enable the modulator TxIF, issue the remote command EM 1.

For information on automatic modulator enable on power-up or reset, refer to the AE command.

FL   Fault History Log (Fault)

Use this command to view the CM701 fault history log.

Syntax

- Remote: `FL ?`
- Front panel: `FaultLog`

Return Value

The CM701 has a 32-bit fault log register that has each bit assigned to represent a fault. The response to this command is a decimal number that represents the contents of that 32-bit fault log register.

All bits in the fault log register are set following power-up or reset. Before faults can be monitored, they must be cleared using the Clear Fault Log (CF) command. Once a fault occurs, it sets the corresponding bit in the fault log register. That fault bit remains set until it is cleared by the CF command.

Common fault conditions, as they appear when displayed, are listed in Table 8-4.

Table 8-4   Common Fault Conditions (Fault History Query)

Bit	Weight*	Fault	Notes
1	1	Tx Power Fault	—
2	2	TxIF Synth Fault	—
3	4	RxIF Synth Fault	—
4	8	Tx Bit Timing Fault	—
5	16	Rx AGC Range Fault	—
6	32	Bit Time Sync Loss	—
7	64	Carr Track Sync Loss	—
8	128	Decoder Sync Loss	—
9	256	Acquisition Failure	—
10	512	Rx Carr Range Fault	—
11	—	(not used)	Not used
12	2048	RxBT Range Fault	—
13	4096	NVRAM Failure	—
14	8192	Receive Buffer Overflow	Doppler buffer only
15	16384	Receive Buffer Underflow	Doppler buffer only
16	32768	(card-specific)	Card-specific
17	65536	ODU Tx Fault	—
18	131072	ODU Rx Fault	Not used
19	262144	Relay Monitor - Pin 3	—

Table 8-4   Common Fault Conditions (Fault History Query) (continued)

Bit	Weight*	Fault	Notes
20	524288	Relay Monitor - Pin 4	—
21	1048576	ODU M&C Fault	Not used
22	2097152	Loss of Rx Clock	Not used
23	4194304	Loss of Tx Clock	—
24	8388608	Relay Monitor - Pin 5	—
25	16777216	Vertical Option Tx Summary Fault	Card-specific
26	33554432	Vertical Option Rx Summary Fault BERT Sync Loss	Card-specific
27	67108864	Vertical Option Tx Hardware Fault	Card-specific
28	134217728	Vertical Option Rx Hardware Fault	Card-specific
29	268435456	Horizontal Option Tx Summary Fault Tx FIFO Full Fault	Card-specific
30	536870912	Horizontal Option Rx Summary Fault Low E_b/N_0 Output Buffer Fault	Card-specific
31	1073741824	Horizontal Option Tx Hardware Fault	Card-specific
32	2147483648	Horizontal Option Rx Hardware Fault	Card-specific

FLO   Fault Log Overlay Mask (Yellow Fault LED) (Config) (NV)

Use this command to designate the fault log conditions that will affect the yellow fault message on the front panel.

Syntax

- Remote: FLO <weighted sum>
- Front panel: use terminal emulator

Parameters

<weighted sum> parameter values are integers in the range of 1 to 4294967295 (the total of all bit weights). The default is 4294967295.

Example

To designate a fault log overlay mask of 6293759, issue the remote command FLO 6293759.

Additional Information

The CM701 has a 32-bit fault log register with each bit assigned to represent a fault.

The FLO command uses a 32-bit mask register to designate which fault conditions will affect the yellow fault LED. In order for a particular fault condition to activate the yellow fault LED, the corresponding FLO mask bit must be set to 1.

FO   Current Fault Overlay Mask (Status Relay) (Config) (NV)

Use this command to designate the current fault conditions that will affect the status relay on the rear panel of the CM701.

Syntax

- Remote: `FO <weighted sum>`
- Front panel: use terminal emulator

Parameters

`<weighted sum>` parameter values are integers in the range of 1 to 4294967295 (the total of all bit weights). The default is 4294967295.

Example

To set the fault conditions at 6293759, issue the `FO 6293759` command.

Additional Information

The CM701 has a 32-bit current fault status register that has each bit assigned to represent a fault condition.

The FO command uses a 32-bit mask register to designate which fault conditions will affect the status relay. In order for a particular fault condition to activate the status relay, the corresponding FO mask bit must be set to 1.

FPL   Front Panel Lockout (Config) (NV)

Use this command to disable the front panel. This prohibits accidental or unauthorized modifications of the CM701 operating configuration.

Syntax

- Remote: `FPL <mode>`
- Front panel: Use Previous^< buttons to access `Front Panel <mode>`

  For the Previous^< command, press the Previous, up Modify, and left Cursor buttons simultaneously.

Parameters

Remote/front panel `<mode>` parameter values are:

- 0/Normal (default) – normal front panel access; front panel is fully functional
- 1/View Only – indicated by yellow `View Only` message on the front panel to the right of the LCD display and above the Enter button; front panel responds to all push buttons except Enter and Tx Enable.
- 2/LockOut – indicated by LCD message `Front Panel Lockout`; front panel ignores all button presses except the three-button sequence Previous^<.

Example

To lock out the front panel, issue the remote `FPL 2` command, or, from the front panel, select the `LockOut` parameter after pressing Previous^<.

FR   Fault Relay Sense (Config) (NV)

Use this command to change the polarity of the Form-C status relay accessed through the status relay connector on the rear panel.

Syntax

- Remote: `FR <polarity>`
- Front panel: use terminal emulator

Parameters

`<polarity>` parameter values are:

- 0 (default) – normal polarity; a fault condition is indicated by contact between the normally closed contact pair of the Form-C status relay

  Fault conditions include not only user-specified fault conditions set with the FO command, but also power failure, power switch turned off, and unplugged unit.

- 1 – inverted polarity; a fault condition is indicated by contact between the normally open contact pair of the Form-C status relay

  Fault conditions include only the user-specified fault conditions. Any faults related to loss of power to the Cm701 cannot be indicated by the Form-C status relay.

Example

To set the Form-C status relay to normal polarity mode, issue the remote command `FR 0`.

FRX   Fault Relay Sense External Signal Polarity (Config) (NV)

Use this command to define whether a fault condition is a closed or open relay contact for each of the three external fault relay sense pins on the Status Relay rear panel connector.

For information on electrical connections and pinouts, refer to the chapter on external connections.

Syntax

- Remote: `FRX <condition>`
- Front panel: use terminal emulator

Parameters

`<condition>` parameter values are integers from 0 to 7, which reflect the bit mapping of the status relay connector pins:

- Status relay connector pin 3 is bit mapped to bit 2
- Status relay connector pin 4 is bit mapped to bit 1
- Status Relay connector pin 5 is bit mapped to bit 0

Each bit can be set to 0 or 1:

- 0 (default) – normal polarity; indicates that a fault condition exists when the external relay contacts are closed

- 1 – inverted polarity; indicates that a fault condition exists when the external relay contacts are opened

Example

For the following example:

- Pin 3 is connected to a radio transmit fault relay that is normally open.

- Pin 4 is connected to a radio receive fault relay that is normally open.

- Pin 5 is connected to a summary fault relay on an uninterruptible power supply (UPS) for the station that is normally closed.

For this scenario, set the bits as follows:

- Bitmap bit 2 to status relay connector pin 3 with the normal fault condition set to open (0)

- Bitmap bit 1 to status relay connector pin 4 with the normal fault condition set to open (0)

- Bitmap bit 0 to status relay connector pin 5 with the normal fault condition set to closed (1)

The bit mapping is binary 001, which is equivalent to decimal number 1. Therefore, the command to be issued is `FRX 1`. The CM701 will now report fault conditions only when the relays connected to pins 3 or 4 are closed or the relay connected to pin 5 is open.

GAV   Gate Array Version (Monitor)

Use this command to display the version of the installed EPROM. Some cards have field-programmable gate array configuration EPROMs installed on them.

Syntax

- Remote: `<slot#>:GAV ?`

- Front panel: use terminal emulator

Parameters

`<slot#>` parameter values are slot numbers 1 through 7.

Example

To display the version of the installed EPROM for the card in slot 6, issue the remote command `6:GAV ?`.

HWV   Hardware Version (Monitor)

Use this command to display the hardware version of any card in the modem.

Syntax

- Remote: `<slot#>:HWV ?`
- Front panel: use terminal emulator

Parameters

`<slot#>` parameter values are slot numbers 1 through 7.

Example

To display the version of the installed card in slot 6, issue the remote command `6:HWV ?`.

ID   Modem Identification (Config) (NV)

Use this command to assign an arbitrary, 16-character ASCII string which is used to identify the modem.

Syntax

- Remote: `ID <ASCII string>`
- Front panel: use terminal emulator

Parameters

`<ASCII string>` must be 16 characters or less. The default is ComStream CM701.

Example

To assign San Diego as the ID, issue the remote command `ID SAN DIEGO`.

Additional Information

The modem ID appears on the front panel after the CM701 power-up test is complete. If the modem ID is modified while the ID is displayed on the front panel, view the updated ID by navigating to any other command, and then return to the modem ID. This command does not affect modem operation.

IN   Initialize Modem (Config) (V)

This command initializes all modem configuration parameters to their default states, stores them in NV memory, and performs a complete modem reset.

Syntax

- Remote: `IN 9346`

- Front panel: `Init Factory Default`

Additional Information

This command is useful when CM701 configuration parameters have changed, their states are unknown, or the unit will not sync or pass data. To return the CM701 to proper functioning, issue the IN command and then issue any commands required for custom configuration of the CM701.

INF   Initialize New Firmware (and Modem) (Config) (V)

Use this command when new software is added to any CM701 option card, including M&C software, to ensure proper operation after installation. The INF command performs a complete initialization and reset of *all* CM701 cards, returning all configuration parameters to their default settings and reconfiguring the NV memory map.

For M&C software prior to v4.4, contact ComStream Customer Service for an alternate method of firmware initialization.

Syntax

- Remote: `INF 9346`

- Front panel: `Initialize New Firmware`

LB   Loopback Mode (Config) (V)

Use this command to test and troubleshoot the CM701 system connections.

Syntax

- Remote: `LB <mode>`

- Front panel: `LoopBack <mode>`

Parameters

Remote/front panel `<mode>` parameter values are:

- 0/DISABLE (default) – normal modem operation, all loopbacks are disabled

- 1/IF – IF loopback enables the demodulator to accept an IF input from the modulator through the external coaxial loopback cable between the two boards on the CM701 rear panel.

Configurations with multiple modulators or demodulators do *not* support IF loopback.

When IF loopback is selected, the microcontroller on the demodulator automatically sets the receive configuration parameters equal to the modulator transmit parameters as follows:

- ❏ RS = TS   IF frequency
- ❏ RM = TM modulation type
- ❏ RC = TC   code rate and type
- ❏ DD = DM differential coding
- ❏ SD = SM   scrambling
- ❏ RR = TR   symbol rate
- ❏ DI = MI   spectral inversion
- ❏ DFS=MFS   filter shape

When IF loopback is disabled, all of the modified parameters return to their original values, even if they were modified by the user during LB 1 operation.

The modulator still transmits through the normal TxIF port during loopback if EM 1 is set.

- ■ 2/NEAR – near data loopback. Enables the transmit clock and data signals (TT and SD) from the DTE to be routed back to the DTE on the receive clock and data lines (RT and RD). In internal timing mode, the ST clock from the modulator is routed to the RT output (instead of TT).

The TT and SD lines are also routed to the modulator during a near data loopback.

- ■ 4/FAR – far data loopback. Enables the receive clock and data signals (RT and RD) to drive the modulator in place of the transmit clock and send data signals (TT and SD) from the DTE. The modulator is temporarily operated in external timing during far data loopback operation but is returned to user-selected timing upon exiting far data loopback mode.

The RT and RD signals are also sent to the data I/O connector during far data loopback.

Additional loopback modes may be available for other installed option cards. Option-specific command parameters are provided in those option card manuals.

Example

To select near data loopback mode, issue the remote `LB 2` command, or, from the front panel, select the `NEAR` parameter for `LoopBack`.

Additional Information

Loopback connections are used primarily to isolate the location of a problem in a communications circuit. There are three basic loopback connections available. There may be other loopback connections available depending upon the installed option cards. The CM701 always power-ups or resets with all loopbacks disabled.

LGE   Login Security Enable (Security) (NV)

Use this command to enable/disable the remote control port login security.

Syntax

- Remote: `LGE <setting>`
- Front panel: use terminal emulator

Parameters

`<setting>` parameter values are:

- 0 (default) – disable
- 1 – enable

LGN   Login (Security) (V)

Use this command to log in to the remote control port security function and establish normal communications with the CM701. When LGE is set to 0, this command is not available and will return an error message.

Syntax

- Remote: `LGN <password>`
- Front panel: use terminal emulator

Parameters

`<password>` can be 1 to 8 alphanumeric characters with no embedded spaces.

LGT   Logout (Security) (V)

Use this command to log out from the remote control port security function. When LGE is set to 0, this command is not available and will return an error message.

Syntax

- Remote: `LGT`
- Front panel: use terminal emulator

LIT   Login Inactivity Time-Out (Security) (NV)

Use this command to set the number of seconds of inactivity allowed before automatic logout occurs.

Syntax

- Remote: `LIT <seconds>`
- Front panel: use terminal emulator

Parameters

`<seconds>` parameter values are 0 and 5 to 255. The default is 60. To disable the inactivity time-out, enter a parameter of 0 (zero).

LMP   Lamp test (Config) (V) (available with M&C version 5.4 and higher)

This command tests all six backlit messages on the front panel by illuminating them for a few seconds and then automatically returning them to their valid states.

Syntax

- Remote: `LMP <setting>`
- Front panel: `Lamptest <setting>`

Parameter

`<setting>` parameter value is 1/ON – causes the messages to light for a few seconds and then return automatically to their valid states

LPW   Login Password (Security) (NV)

Use this command to change the remote control port login password.

Syntax

- Remote: `LPW <oldpassword> <newpassword>`
- Front panel: use terminal emulator

Parameters

`<oldpassword>` and `<newpassword>` parameters are from 1 to 8 alphanumeric characters with no embedded spaces.

Example

To change the password from the default, which is password, to the new password, which is 2USER8, issue the `LPW PASSWORD 2USER8` command.

Additional Information

There is no method for the system to recall a lost or forgotten password. If this occurs, you must use the front panel terminal emulator and issue the `Init Factory Default` command. This command resets the password to the default; it also ***resets all modem parameters***.

LT   Loop Timing

Refer to and use the MB command instead of the LT command.

MB   Modulator Bit Timing (Config) (NV)

Use this command to establish the source of the modulator bit time, transmit data clock. The DTE must provide the CM701 with send data (SD) that transitions on the rising edge of the selected transmit clock.

Syntax

- Remote: `MB <timing>`
- Front panel: `Tx Clock Source <timing>`

Parameters

Remote/front panel `<timing>` parameter values are:

- 1/EXT – external timing. The modulator uses the TT clock provided by the DTE as the transmit clock.
- 2/INT (default) – internal timing. The modulator generates its own transmit clock (station timing, or ST) based upon the internal CM701 TCXO clock.
- 3/LOOP – loop timing. This routes the RT signal from the demodulator into the TT clock input of the modulator and sets the modulator for external timing operation.

It is recommended that loop timing be done in the DTE equipment rather than the modem to prevent data pattern slips due to an incorrect clock-data relationship at the modulator transmit data latch. If the DTE does not support loop timing mode, the CM701 loop timing configuration may be used for data rates below 500 kbps with a data cable length under 5 m (15 ft) from the CM701 to the DTE.

Example

To select external timing as the source of the modulator transmit data clock, issue the remote `MB 1` command, or, from the front panel, select the `EXT` parameter for `Tx Clock Source`.

MD1 through MD9   Modem Data (Config) (V)

Use these commands when controlling a remote modem through an SCC option card. Each of the modem data commands is associated with an individual buffer that can store a CM701 remote command string for later transmission to the modem chassis.

Syntax

- Remote: `MD# <string>`
- Front panel: no command equivalent

Parameters

`MD#` and `<string>` parameter values are:

- MD# – refers to the specific command (MD1 through MD9)
- string – refers to a string of commands
    - □ Total number of characters in string must not exceed 120
    - □ Separate commands with a semicolon (;)

Examples

Examples of remote command syntax are:

- `MD2 PTD 64000; TS 80000`
- `MD1 ?`

Additional Information

When a command buffer is entered, the M&C preprocesses the command string, checking for syntax and command mnemonic errors (parameter types but not ranges are checked). If there are any errors, the first error type found will be reported, and the buffer will retain its last successful command string. Commands in the buffers are executed in modem data buffer order and in the order in which they were listed from left to right. If any errors are detected at execution of the buffers, the original configuration of the system is restored.

MDC   Modem Data Clear (Config) (V)

Use this command to clear the specified MD buffer (MD1 through MD9).

Syntax

- Remote: `MDC <buffer>`
- Front panel: use terminal emulator

Parameters

`<buffer>` parameter values are 1 to 9; if no parameter is entered, *all* MD buffers are cleared.

Examples

Examples of remote command syntax are:

- To clear all MD buffers, issue the command `MDC`.
- To clear the MD1 buffer, issue the command `MDC 1`.

MDP   Modem Data Parity (Config) (NV)

Use this command to set the remote control format. This asynchronous character format for the CM701 remote control interface is independent of packet or ASCII remote control protocol selection.

Syntax

- Remote: `MDP <data parity>`
- Front panel: `Remote Dat/Par <data parity>`

Parameters

Remote/front panel `<data parity>` parameter values are:

- 0/7/ODD (default) – 7 data bits with odd parity
- 1/8/NONE – 8 data bits with no parity

Example

To set the remote control format to 8 data bits with no parity, issue the remote command `MDP 1`, or, from the front panel, select the `8/NONE` parameter for `Remote Dat/Par`.

MDR   Modem Data Time Remaining (Monitor)

Use this command to determine the number of seconds remaining until the MD buffers are executed.

Syntax

- Remote: `MDR ?`
- Front panel: use terminal emulator

Return Value

If the MDT command is issued in absolute time, the MDR command still reports the time remaining in seconds. If the MDT command is not active, this command will return a remote `ER 4` message.

MDS   Modem Data Stop (Config) (V)

Use this command to stop the MDT process and to clear the MDT value. If the MDS command is issued after the MD buffers have begun to execute, it is ignored.

Syntax

- Remote: `MDS`
- Front panel: use terminal emulator

MDT   Modem Data Time (Config) (V)

Use this command to set the time, or time delay, for executing the commands in the MD buffer. The time value can be entered in absolute time or in seconds. The absolute time is relative to the CM701 real-time clock.

Syntax

- Remote: MDT <time>
- Front panel: use terminal emulator

Parameters

<time> parameter values are integers reflecting absolute time or seconds as follows; there is no default.

- Absolute time syntax: <hh:mm:ss>
  - □ hh – hours expressed in two-digit format from 00 to 23
  - □ mm – minutes expressed in two-digit format from 00 to 59
  - □ ss – seconds expressed in two-digit format from 00 to 59
- Time delay in seconds syntax: <sec>
  - □ sec – seconds in one to six digits from 0 to 172800

Example

To set the modem data time to 15 minutes and the time indicated on the CM701 real-time clock is 7:00 a.m., issue one of the following remote command formats:

- MDT 07:15:00 – absolute time
- MDT 900 – time delay in seconds

MEI   Modem Electrical Interface (Config) (NV)

Use this command to set the remote control port at the RS-232 or RS-485 electrical level.

Syntax

- Remote: MEI <level>
- Front panel: Remote Control <level>

Parameters

Remote/front panel <level> parameter values are:

- 0/RS232 (default)
- 1/RS485

Example

To set the remote control port to the RS-485 electrical level, issue the remote command MEI 1, or, from the front panel, select the RS485 parameter for the Remote Control command.

MFS   Modulator Baseband Filter Select (Config) (NV)

Use this command to select the spectral shape of the modulated TxIF signal. The modulator digital filter coefficients are programmed to create an optimal match to the demodulator baseband digital filter, which results in exceptional modem performance.

Syntax

- Remote: `MFS <shape>`
- Front panel: `Tx Filter Type <shape>`

Parameters

Remote/front panel `<shape>` parameter values are as follows; select the shape that matches the CM701 application:

- 0/ComStrm (default) – ComStream 6-pole Butterworth; select if the CM701 is to operate with existing ComStream CMxxx, CVxxx, DTxxxx, or DBRxxx products in a closed-network application.
- 1/IBS/IDR – filter used for Intelsat-compatible, open-network applications
- 2/SMS – filter used for Eutelsat-compatible, open-network applications

Example

To select the IBS/IDR filter as the spectral shape of the modulated TxIF signal, issue the remote command `MFS 1`, or, from the front panel, select the `IBS/IDR` parameter for `Tx Filter Type`.

MI   Modulator Spectral Inversion (Config) (NV)

Use this command to control the transmit spectral inversion feature on the modulator.

Syntax

- Remote: `MI <setting>`
- Front panel: use terminal emulator

Parameters

`<setting>` parameter values are:

- 0 (default) – disable modulator spectral inversion
- 1 – enable modulator spectral inversion

Example

To disable modulator spectral inversion, issue the remote command `MI 0`.

ML   Modulator Latching Clock (Config) (NV)

Use this command to select the clock to be used by the modulator to latch the transmit data (SD) into the CM701. When the modulator is using external timing, this command has no effect and the TT clock is always selected.

Syntax

- Remote: `ML <clock>`
- Front panel: use terminal emulator

Parameters

`<clock>` parameter values are:

- 0 – selects the TT clock
- 1 (default) – selects the ST clock

Example

To select the TT clock for latching transmit data into the modulator, issue the remote command `ML 0`.

Additional Information

If the DTE is capable of providing a TT signal to the CM701, ML 0 is the preferred latching clock for SD. For more information on modulator latching clock, refer to the chapter on system configuration issues.

MPA   Modem Packet Address (Config) (NV)

Use this command to set the device address when packet protocol is selected for the remote control protocol. The Packet Address command is *not* used for ASCII protocol remote control operation.

Syntax

- Remote: `MPA <address>`
- Front panel: `Packet Address <address>`

Parameters

`<address>` parameter values are 1 through 31. The default is 1.

Do *not* assign more than one device to an address on a common control bus.

Example

To set the device address to 2, issue the remote command `MPA 2`, or, from the front panel, enter `2` as the parameter for `Packet Address`.

MPT   Modem Protocol Type (Config) (NV)

Use this command to select the protocol used for the CM701 remote control port.

Syntax

- Remote: `MPT <protocol>`
- Front panel: `Protocol <protocol>`

Parameters

Remote/front panel `<protocol>` parameter values are:

- 0/ASCII (default) – used with character-based computer terminals
- 1/PACKET – ComStream packet protocol

Example

To select ComStream packet protocol, issue the remote command `MPT 1`, or, from the front panel, select the `PACKET` parameter for `Protocol`.

MQE   Modem Query Execute (Monitor)

Use this command to execute the current modem query list and return the first result buffer. The MQE command is issued in order to execute the modem query list (MQL).

Syntax

- Remote: `MQE`
- Front panel: no command equivalent

Example

If the current modem query list (MQL) is entered as `MQL RS,TS,ST,EM,` the displayed response (although setting and values may differ) is:

```
MQE 1 RS 950000000,TS 950000000,ST 0,EM 1;
```

where:

- `MQE 1` indicates that response is from the first result buffer
- Semicolon (`;`) at the end of the response indicates that this is the last result buffer

If the response has a plus sign (+) as the last character, there is additional data in the next result buffer. To display the next set of data, issue the MQN command.

The next response will start with `MQE 2` followed by the data in the second result buffer. If the last character in the second result buffer is a plus sign (+), issue the MQN command again. After viewing each set of date, continue to issue the MQN command until the last character of the response is a semicolon.

The beginning of each additional response to the MQN command will increment (for example, `MQE 3,` `MQE 4,` and so forth).

After entering the modem query list and issuing the MQE command, an error code `ER 4` may display. This error code signifies that the M&C has not completed processing the command or that the response was not received. In this case, continue sending the MQE command after each `ER 4` until the result of the first response buffer is displayed.

MQL   **Modem Query List (Config) (V)**

Use this command to combine multiple queries into a single command. This list is executed by the MQE command. The multiple modem query list remains in effect until replaced by a new list.

Syntax

- Remote: MQL <string>
- Front panel: no command equivalent

Parameters

<string> parameters are one or more CM701 mnemonics separated by commas. The total number of characters used cannot exceed 120.

Example

```
MQL RS,TS,ST,EM
```

MQN   **Modem Query Next (Monitor)**

Use this command to get the next modem query list result buffer.

Syntax

- Remote: MQN
- Front panel: no command equivalent

Example

If the MQL response has a plus sign (+) as the last character, there is additional data in the next result buffer. To display the next set of data, the MQN command is issued.

The next response would start with `MQE 2` followed by the data in the second result buffer. If the last character in the second result buffer is a plus sign (+), issue the MQN command again. After viewing each set of date, continue to issue the MQN command until the last character of the response is a semicolon.

The beginning of each additional response to the MQN command will increment (for example, `MQE 3,` `MQE 4,` and so forth).

MS   Modulator Status (Config) (NV)

Use this command to monitor the state of TxIF.

Syntax

- Remote: MS <mode>
- Front panel: no command equivalent

Parameters

<mode> parameter values are:

- 0 (default) – disable monitoring of the state of the TxIF.
- 1 – monitor the state of the TxIF. If the modulator is not transmitting (that is, TxIF is not enabled), the fault message Mod Not Transmitting is returned, and bit 16 (ST 32768) is set in the fault status register.

Example

To disable monitoring of the TxIF, issue the **MS 0** remote command.

NVO   Nonvolatile Memory Override (Config) (NV)

Use this command to inhibit writing to NV memory when a configuration or other NV command is entered.

During normal operation, configuration parameters can be changed approximately 10,000 times before NV memory operation may be impaired. Once this command is set, almost all subsequent command parameter entries will *not* be updated into their respective NV memory locations. In the case of a power loss, power cycle, or soft reset, the CM701 configuration will return to the last settings stored in NV memory.

Syntax

- Remote: NVO <setting>
- Front panel: use terminal emulator

Parameters

<setting> parameter values are:

- 0 (default) – normal operation
- 1 – NV override on

Example

To turn on NV override and inhibit writing to NV memory, issue the remote command NVO 1.

Limitations

The following limitations apply to NVO usage:

- NVO is supported only in M&C software versions 4.0 and later. It is strongly recommended that all cards in the unit have software version 4.0 or later. However, if a slave module (all other non-M&C cards) has software earlier than 4.0, its related commands will not support NVO.

- Volatile commands (usually test mode commands) always return to their default values after a power loss, power cycle, or soft reset.

- A small subset of commands is not supported. Those related to the standard modem configuration are TIO, RIO, DAY, TIM, and NVO itself. Commands for other cards that do not support NVO in software 4.0+ are specified in their respective option card manual or guide. Currently, all version 4.0+ modulator and demodulator commands *are* supported by NVO.

OM   Override Modulator Bit Time Fault (Config) (NV)

Use this command to control the automatic actions performed by the modulator upon detection of a transmit bit time fault.

A modulator bit time fault is normally considered a hardware fault and causes the TxIF output of the modulator to be disabled. If the modulator is configured for external bit timing (refer to the MB command) and the DTE fails to provide a TT clock, the modulator will report a bit time fault.

However, this is not a hardware fault condition. In this case, many users keep the modulator IF transmission enabled, rather than disabling it. If an option card is installed in the transmit path and OM is set to 1, the modulator bit time fault will *not* be supported, but a TT out-of-range fault will be reported by that option card.

Syntax

- Remote: `OM <setting>`
- Front panel: use terminal emulator

Parameters

`<setting>` parameter values are:

- 0 (default) – modulator disables the TxIF output when a bit timing fault occurs. This occurs regardless of whether bit timing is configured as internal or external.

- 1 – modulator does *not* disable the TxIF output when a bit timing fault is detected

PC   Pure Carrier (Config) (V)

Use this command to force the modulator to transmit an unmodulated carrier—also referred to as continuous wave (CW).

Syntax

- Remote: `PC <setting>`
- Front panel: `Tx Pure Carrier <setting>`

Parameters

Remote/front panel `<setting>` parameter values are:

- 0/OFF (default) – enables the transmission of a normal, modulated carrier
- 1/ON – enables pure carrier transmission

Example

To enable pure carrier transmission, issue the remote command `PC 1`, or, from the front panel, select the `ON` parameter for `Tx Pure Carrier`.

Additional Information

The pure carrier signal is used for diagnostic and system installation. When enabled, the ST clock on the data I/O connector is reduced to 0 Hz.

PRD   Primary Receive Data Rate (Config) (NV)

Use this command to automatically issue *all* appropriate receive data rate commands to all cards in the primary receive data path and to automatically account for any overhead removed by a card from the data stream. The PRD command represents the data rate that is output from the active I/O card on the receive side of the CM701.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `PRD <rate bps>`
- Front panel: `UserRxData <rate bps>`

Parameters

The `<rate bps>` parameter range is 4800 to 2340000 bps (receive data rates of 4.8 kbps through 2.340 Mbps) for the standard CM701.

The range of valid parameters may vary according to the specific configuration of the CM701 in terms of the option cards that are installed and their modes.

Example

To enter a data rate of 4.8 kbps, issue the remote command `PRD 4800`, or, from the front panel, enter `4800` as the parameter for `UserRxData`.

Return Value

PRD is a one-way macro command; issuing PRD ? is effective only if *no* data-rate- or symbol-rate-related commands have been issued to individual cards since the PRD value was entered. Issuing PRD ? at such time would return a value of 0, indicating that it no longer reflected the system receive data rate.

PRP — Primary Receive Path (Config) (NV)

Use this command to set the primary receive data path.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `PRP <entry slot><data slots><exit slot>`
- Front panel: use terminal emulator

PTD — Primary Transmit Data Rate (Config) (NV)

Use this command to automatically issue *all* appropriate transmit data rate commands to all cards in the primary transmit data path and to automatically account for any overhead added by a card to the data stream. The PTD command represents the data rate that is input to the active I/O card on the transmit side of the CM701.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `PTD <rate bps>`
- Front panel: `UserTxData <rate bps>`

Parameters

The `<rate bps>` parameter range is 4800 to 2340000 bps (transmit data rates of 4.8 kbps through 2.340 Mbps) for the standard CM701. The range of valid parameters may vary according to the specific configuration of the CM701 in terms of the installed option cards and the modes in which they are configured.

Example

To enter a data rate of 4.8 kbps, issue the remote command `PTD 4800`, or, from the front panel, enter `4800` as the parameter for `UserTxData`.

Return Value

PTD is a one-way macro command; issuing PTD ? is effective only if no data-rate- or symbol-rate-related commands have been issued to individual cards since the PTD value was entered. Issuing PTD ? at such time would return a value of 0 indicating that it no longer reflected the system transmit data rate.

PTP   Primary Transmit Path (Config) (NV)

Use this command to set the primary transmit data path.

Syntax

- Remote: `PTP <entry slot><data slots><exit slot>`
- Front panel: use terminal emulator

RC   Receive Coding Rate (Config) (NV)

Use this command to set the type and rate of FEC decoding performed by the demodulator. The demodulator supports both Viterbi and Sequential decoding algorithms as well as uncoded operation.

Syntax

- Remote: `RC <FEC>`
- Front panel: `Rx Code Rate <FEC>`

Parameters

Remote/front panel `<FEC>` parameter values are:

- 0/Uncoded – referred to as rate 1
- 1/Seq $\frac{1}{2}$ – Sequential, rate $\frac{1}{2}$
- 2/Seq $\frac{3}{4}$ – Sequential, rate $\frac{3}{4}$
- 3/Vit $\frac{1}{2}$ (default) – Viterbi, rate $\frac{1}{2}$
- 4/Vit $\frac{3}{4}$ – Viterbi, rate $\frac{3}{4}$
- 5/Vit $\frac{7}{8}$ – Viterbi, rate $\frac{7}{8}$

Example

To set the FEC decoding as Sequential, rate $\frac{1}{2}$, issue the remote command `RC 1`, or, from the front panel, select the `Seq` $\frac{1}{2}$ parameter for `Rx Code Rate`.

RD   Receive Data Rate (refer to PRD) (Config) (NV)

It is recommended that the PRD command be used rather than RD.

Use this command to set the data rate that is output by the demodulator after demodulating and decoding the receive signal. This rate is the receive data rate, RT and RD signals, provided at the user data interface, unless the CM701 is configured with a framing unit, demultiplexer, or some other intermediate data processing card. In these cases, the RD rate response parameter is the receive data rate provided to the intermediate data processing card by the demodulator.

Syntax

- Remote: `RD <rate bps>`
- Front panel: `RxDataRate <rate bps>`

Parameters

`<rate bps>` parameter values are receive data rates from 4800 to 2340000 bps, which correspond to 4.8 kbps to 2.340 Mbps. The default is 9600.

Example

To set the receive data rate at 1544000 bps, issue the remote command `RD 1544000,` or, from the front panel, enter `1544000` as the parameter for `RxDataRate.`

Additional Information

The RD and receive symbol rate (RR) are related by the following equation, which depends on modulation index (RM) and code rate (RC):

Data Rate = (Symbol Rate) × (Code Rate) × (Modulation Index)

where:

- Code Rate is 1, $\frac{1}{2}$, $\frac{3}{4}$, or $\frac{7}{8}$
- Modulation Index is 1 for BPSK or 2 for QPSK

Changing the RD parameter causes the receive symbol rate to change automatically according to this equation, using the currently selected modulation index and code rate.

RDI   Receive Data Invert (Config) (NV)

Use this command to specify whether the data received from the demodulator should be inverted or passed as true data to the user DTE equipment.

Syntax

- Remote: `RDI <mode>`
- Front panel: use terminal emulator

Parameters

`<mode>` parameter values are:

- 0 (default) – passes the true data received from the demodulator to the user DTE equipment
- 1 – inverts the data received from the demodulator before going to the user DTE equipment

Example

To pass the data as true data, issue the remote command `RDI 0.`

RE   Modem Reset (Config) (V)

Use this command to reset the CM701. This has the same affect as turning the power switch on the rear panel from Off to On. Upon reset, all conditions and parameters, with the exception of those stored in NV memory (configuration parameters), are returned to default settings.

Syntax

- Remote: `RE`
- Front panel: `Modem RESET`

RIO   Receive Data I/O Card (Config) (NV)

Use this command to select the active receive data I/O card for CM701 configurations that have multiple data I/O cards installed. The parameter determines which data I/O card will provide the receive data and clock (RD and RT signals on the data I/O connector).

Syntax

- Remote: `RIO <slot>`
- Front panel: `Rx Active IO <slot>`

Parameters

`<slot>` parameter values are:

- 1, 2, and 3 (default 2) – corresponds to slot numbers 1, 2, and 3

Example

To select the card in slot 1, issue the remote command `RIO 1,` or, from the front panel, select the `1` parameter for `Rx Active IO.`

For information on multiple data I/O cards and slot locations, refer to chapter on functional descriptions.

RM   Receive Modulation Type (Config) (NV)

Use this command to set the modulation type for the demodulator.

Syntax

- Remote: `RM <type>`
- Front panel: `Rx Mod Type <type>`

Parameters

Remote/front panel `<type>` parameter values are:

- 0/BPSK (default)
- 1/QPSK

Example

To set the modulator type as QPSK, issue the remote command `RM 1`, or, from the front panel, select the `QPSK` parameter for `Rx Mod Type`.

RO   Receive Offset Frequency (Monitor)

Use this command to view the frequency offset between the demodulator synthesizer frequency setting (remote RS command or front panel Rx Freq command) and the actual demodulator RxIF carrier frequency.

Syntax

- Remote: `RO ?`
- Front panel: `Rx Offset`

Return Value

The response is displayed in units of hertz, typically within the range of ±30000 Hz; however, measurement capabilities may extend past 30000 Hz. If the demodulator is not locked to a receive signal, a remote `ER 4` or front panel `N/A` response will display.

RR   Receive Symbol Rate (refer to PRD) (Config) (NV)

Use this command to set the demodulator symbol rate.

It is recommended that the PRD command be used rather than RR.

Syntax

- Remote: `RR <rate sps>`
- Front panel: `RxSymRate <rate sps>`

Parameters

`<rate sps>` parameter values are symbol rates from 4800 to 2340000 sps, which correspond to rates of 4.8 ksps to 2.340 Msps. The default is 19200 sps.

Additional Information

RR and RD are related by the following equation, which depends on modulation index (RM) and code rate (RC):

Symbol Rate = Data Rate ÷ (Code Rate × Modulation Index)

where:

- Code Rate is 1, $\frac{1}{2}$, $\frac{3}{4}$, or $\frac{7}{8}$
- Modulation Index is 1 for BPSK or 2 for QPSK

For example, QPSK modulation and $\frac{1}{2}$ code rate result in equal symbol and data rates. Changing the RR parameter causes the receive data rate to change automatically according to this equation, using the currently selected modulation index and code rate.

> For a CM701 system with a CM701 high-speed modulator option card installed, refer to the MSM command in the option card manual for potential limitations to the RR command.

RS   Receive Synthesizer Frequency (Config) (NV)

Use this command to set the RxIF carrier synthesizer frequency for the demodulator.

Syntax

- Remote: `RS <freq kHz>`
- Front panel: `RxIF <freq kHz>`

Parameters

`<freq kHz>` parameter ranges are related to the frequency at which the IF is centered.

- For demodulators with an IF centered at 70 MHz, the following numerical parameter ranges are acceptable:

    □ For the parameter range of 51997500 to 88020000, the inferred unit of measure is 1 Hz.

    □ For the parameter range of 519975 to 880200, the inferred unit of measure is 100 Hz.

    □ For the parameter range of 51997 to 88020, the inferred unit of measure is 1 kHz.

    The default is 70000 Hz.

    The units are inferred from the value entered. The synthesizer has a resolution below 100 Hz if units of Hertz are entered.

- For demodulators with an IF centered at 140 MHz, the following numerical parameter ranges are acceptable:

    □ For the parameter range of 103995000 to 176017500, the inferred unit of measure is 1 Hz.

    □ For the parameter range of 1039950 to 1760175, the inferred unit of measure is 100 Hz.

    □ For the parameter range of 103995 to 176018, the inferred unit of measure is 1 kHz.

    The default is 140000 Hz.

    The units are inferred from the value entered. The synthesizer has a resolution below 100 Hz if units of Hertz are entered.

Example

To set the IF carrier synthesizer frequency for a demodulator with an IF centered at 70 MHz, issue the remote **RS 70000000** command, or from the front panel enter **70000000** as the parameter for `Rx Freq`.

RTF   Receive Timing Frequency (Monitor)

Use this command to query the frequency of the RT clock supplied by the data I/O connector of the CM701 to the DTE. The parameter has an accuracy that is better than ±1 percent of the frequency being measured. The frequency of the RT clock is expressed in hertz.

This command is only available when a standalone I/O option card is in use. It is not available during BERT operation. When the BEN parameter is 1 (enabled), an RTF query will result in a remote `ER 4` response or a front panel `N/A` message.

Syntax

- Remote: `RTF ?`
- Front panel: `Rx Clk`

SD   Scrambling for Demodulator (Config) (NV)

Use this command to establish the descrambling algorithm applied to the receive data stream.

Syntax

- Remote: `SD <algorithm>`
- Front panel: `Rx Scrambling <setting>`

Parameters

Remote/front panel `<algorithm>` and `<setting>` parameter values are:

- 0/OFF – descrambling disabled
- 1/COMSTRM (default) – ComStream-compatible descrambling
- 2/IDR Man – IDR, IESS-308-compatible descrambling

Additional scrambling types are available depending on the option card(s) installed.

Example

To disable descrambling, issue the remote command `SD 0,` or, from the front panel, select the `OFF` parameter for `Rx Scrambling.`

SHP   Show Path (Monitor)

Use this command to display all current data paths set either by an
autoconfiguration cycle or as the result of issuing manual path commands.

This command is used for advanced configurations only. For additional
information, refer to the chapter on advanced usage.

Syntax

- Remote: `SHP`
- Front panel: no command equivalent

Response Format

The response to an SHP command is a listing of the primary, secondary, and
ternary transmit and receive data paths.

SM   Scrambling for Modulator (Config) (NV)

Use this command to establish the scrambling algorithm applied to the transmit
data stream.

Syntax

- Remote: `SM <algorithm>`
- Front panel: `Tx Scrambling <setting>`

Parameters

Remote/front panel `<algorithm>` and `<setting>` parameter values are:

- 0/OFF – scrambling disabled
- 1/COMSTRM (default) – ComStream-compatible scrambling
- 2/IDR Man. – IDR, IESS-308-compatible scrambling

Additional scrambling types are available depending on the option card(s)
installed.

Example

To select IDR-compatible scrambling, issue the remote command `SM 2`, or,
from the front panel, select the `IDR Man` parameter for `Tx Scrambling`.

SRD   Secondary Receive Data Rate (Config) (NV)

Use this command to automatically issue *all* the appropriate receive data rate commands to all cards in the secondary receive data path and to automatically account for any overhead removed by a card from the data stream.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `SRD <rate bps>`
- Front panel: `SecdRxData <rate bps>`

Parameters

`<rate bps>` parameter values are 4800 to 2340000 bps (receive data rates of 4.8 kbps to 2.340 Mbps) for the standard CM701.

The range of valid parameters may vary according to the specific configuration of the CM701 in terms of the option cards that are installed and the modes in which they are configured.

Example

To set a data rate of 4.8 kbps, issue the remote command `SRD 4800`, or, from the front panel, enter `4800` as the parameter for `SecdRxData`.

Return Value

Since SRD is a one-way macro command, issuing SRD ? is effective only if *no* data-rate- or symbol-rate-related commands have been issued to individual cards since the SRD rate was entered. Issuing SRD ? at such time would return a value of `0`, indicating that it no longer reflected the secondary path receive data rate.

SRP   Secondary Receive Path (Config) (NV)

Use this command to set the secondary receive data path.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `SRP <entry slot><data slots><exit slot>`
- Front panel: use terminal emulator

ST   Current Fault Status (Fault)

Use this command to query the CM701 for its real-time fault conditions.

Syntax

- Remote: `ST ?`
- Front panel: `Current`

Additional Information

The CM701 has a 32-bit current fault register that has each bit assigned to represent a particular fault condition. The response to the ST command is a decimal number, indicating the conditions that are present at the time the query is made. To determine the fault conditions indicated by an ST command response, use the following procedure.

1. Convert the decimal number to a binary number.

2. Note the position of binary 1 values:

   - 0 – fault condition is not present

   - 1 – fault condition is present

An unsolicited `ST 0` will *not* appear when the demodulator gains sync if AL is set to 3.

Common fault conditions and descriptions, as they display on the front panel, are listed in Table 8-5.

Table 8-5   Common Fault Conditions (Current Fault Query)

Bit	Weight*	Fault
1	1	Tx Power Fault
2	2	TxIF Synth Fault
3	4	RxIF Synth Fault
4	8	Tx Bit Timing Fault
5	16	Rx AGC Range Fault
6	32	Bit Time Sync Loss
7	64	Carr Track Sync Loss
8	128	Decoder Sync Loss
9	256	Acquisition Failure
10	512	Rx Carr Range Fault
11	—	Not used
12	2048	RxBT Range Fault

Table 8-5   Common Fault Conditions (Current Fault Query) (continued)

Bit	Weight*	Fault
13	4096	NVRAM Failure
14	8192	Receive Buffer Overflow
15	16384	Receive Buffer Underflow
16	32768	card specific
17	65536	ODU Tx Fault
18	131072	ODU RX Fault
19	262144	Relay Monitor - Pin 3
20	524288	Relay Monitor - Pin 4
21	1048576	ODU M&C Fault
22	2097152	Loss of Rx Clock
23	4194304	Loss of Tx Clock
24	8388608	Relay Monitor - Pin 5
25	16777216	Vertical Option Tx Summary Fault
26	33554432	Vertical Option Rx Summary Fault BERT Sync Loss
27	67108864	Vertical Option Tx Hardware Fault
28	134217728	Vertical Option Rx Hardware Fault
29	268435456	Horizontal Option Tx Summary Fault Tx FIFO Full Fault
30	536870912	Horizontal Option Rx Summary Fault Low E_b/N_0 Output Buffer Fault
31	1073741824	Horizontal Option Tx Hardware Fault
32	2147483648	Horizontal Option Rx Hardware Fault

STD   Secondary Transmit Data Rate (Config) (NV)

Use this command to automatically issue *all* the appropriate transmit data rate commands to all cards in the secondary transmit data path and to automatically account for any overhead added by a card to the data stream.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: STD <rate bps >
- Front panel: SecdTxData <rate bps >

Parameters

`<rate bps>` parameter values are 4800 to 2340000 bps (transmit data rates of 4.8 kbps to 2.340 Mbps) for the standard CM701.

The range of valid parameters may vary according to the specific configuration of the CM701 in terms of the option cards that are installed and their modes.

Example

To set a data rate of 4.8 kbps, issue the remote command `STD 4800,` or, from the front panel, enter `4800` as the parameter for `SecdTxData.`

Return Value

Since STD is a one-way macro command, issuing STD ? is effective only if *no* data-rate- or symbol-rate-related commands have been issued to individual cards since the STD rate was entered. Issuing STD ? at such time would return a value of `0,` indicating that it no longer reflected the secondary path transmit data rate.

STO   Status Overlay Mask (Red Fault LED) (Config) (NV)

Use this command to designate the current fault conditions that will affect the red fault message on the front panel.

Syntax

- Remote: `STO <weighted sum>`
- Front panel: use terminal emulator

Parameters

`<weighted sum>` parameter values are represented by integers in the range of 1 to 4294967295 (the total of all bit weights). The default is 4294967295.

Example

To set the weighted sum to 6293759, issue the remote command `STO 6293759.`

Additional Information

The CM701 has a 32-bit current fault status register with each bit assigned to represent a fault.

The STO command uses a 32-bit mask register to designate which fault conditions will affect the red fault LED. In order for a particular fault condition to activate the red fault LED, the corresponding STO mask bit must be set to 1.

STP   Secondary Transmit Path (Config) (NV)

Use this command to set the secondary transmit data path.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `STP <entry slot><data slots><exit slot>`
- Front panel: use terminal emulator

SWV   Software Version (Monitor)

Use this query command to identify the software version of the card in the specified slot.

Syntax

- Remote: `<slot#>:SWV ?`
- Front panel: `Software`

Parameters

`<slot#>` parameter values are slot numbers 1 to 7.

Example

To identify the software version of the card in slot 2, issue the remote command `2:SWV ?`, or, from the front panel, scroll to `2:` in the `Software` list.

Response Format

The format of the information displayed on the front panel is:

`<slot#>:<card desc.>Software V<ver. #>`

where:

- `<slot#>` indicates the slot number
- `<card desc.>` provides a brief description of the card
- `<ver. #>` indicates the software version number

TC   Transmit Code Rate (Config) (NV)

Use this command to set the type and rate of FEC convolutional encoding performed by the modulator. The modulator supports both Viterbi- and Sequential-compatible convolutional-encoding algorithms as well as uncoded operation.

Syntax

- Remote: `TC <FEC>`
- Front panel: `Tx Code Rate <FEC>`

Parameters

Remote/front panel `<FEC>` parameter values are:

- 0/Uncoded – uncoded (referred to as rate 1)
- 1/Seq $\frac{1}{2}$ – Sequential, rate $\frac{1}{2}$
- 2/Seq $\frac{3}{4}$ – Sequential, rate $\frac{3}{4}$
- 3/Vit $\frac{1}{2}$ (default) – Viterbi, rate $\frac{1}{2}$
- 4/Vit $\frac{3}{4}$ – Viterbi, rate $\frac{3}{4}$
- 5/Vit $\frac{7}{8}$ – Viterbi, rate $\frac{7}{8}$

Example

To set the FEC to Viterbi, rate $\frac{7}{8}$, issue the remote command `TC 5`, or, from the front panel, select the `Vit` $\frac{7}{8}$ parameter for `Tx Code Rate`.

Additional Information

For a CM701 system with a CM701 high-speed modulator option card installed, refer to the MSM command in the option card manual for potential limitations to the TC command.

TD   Transmit Data Rate (refer to PTD) (Config) (NV)

It is recommended that the PTD command be used rather than TD.

Use this command to establish the data rate that is input to the modulator for transmission. This rate is the transmit data rate expected at the user data I/O connector (St, TT, and SD signals), unless the CM701 is configured with a framing unit, multiplexer, or another intermediate data processing card. In these cases, the TD parameter is the transmit data rate provided to the modulator by the intermediate data processing card.

Syntax

- Remote: `TD <rate bps>`
- Front panel: `TxDataRate <rate bps>`

Parameters

`<rate bps>` parameter values are 4800 to 2340000 bps, which correspond to 4.8 kbps to 2.340 Mbps. The default is 9600 bps.

Example

To set the rate to 4.8 kbps, issue the remote command `TD 4800,` or, from the front panel, enter `4800` as the parameter for `TxDataRate`.

Additional Information

TD and TR are related by the following equation, which depends on modulation index (TM) and code rate (TC):

Data Rate = (Symbol Rate) × (Code Rate) × (Modulation Index)

where:

- Code Rate is 1, $\frac{1}{2}$, $\frac{3}{4}$, or $\frac{7}{8}$

- Modulation Index is 1 for BPSK or 2 for QPSK

Changing the TD parameter causes the transmit symbol rate to change automatically according to this equation, using the currently selected modulation index and code rate.

TDI   Transmit Data Invert (Config) (NV)

Use this command to indicate if data received from the user DTE equipment is to be inverted or passed as true data to the modulator.

Syntax

- Remote: `TDI <mode>`

- Front panel: use terminal emulator

Parameters

`<mode>` parameter values are:

- 0 (default) – passes the true data that is received from the user DTE equipment to the modulator

- 1 – inverts the data that is received from the user DTE equipment before sending it to the modulator

Example

To invert the data before sending it to the modulator, issue the remote command `TDI 1`.

TIM   Real-Time Clock (Config) (NV)

Use this command to query or set the CM701 real-time clock. The real-time clock is used for various CM701 functions including time-stamped faults.

For information on time-stamped fault reporting, refer to the VFT command.

Syntax

- Remote: `TIM <hh><mm><ss>`
- Front panel: `Clock <hh>:<mm>:<ss>`

Parameters

`<hh><mm><ss>` parameter values are time expressed in hours, minutes, and seconds as follows:

- hh – hours expressed in two-digit, 24-hour format from 00 to 23
- mm – minutes expressed in two-digit format from 00 to 59
- ss – seconds expressed in two-digit format from 00 to 59

There is no default; an IN 9346 or INF 9346 command does not reset the value stored in NV memory for this command. The time, when set by the factory, is the current time for U.S.A. Pacific standard time.

Example

To set the real-time clock to 4:43:01 p.m. (16:43:01), issue the following:

- Remote: `TIM 164301`
- Front panel: `Clock 16:43:01`

TIO   Transmit Data I/O Card (Config) (NV)

Use this command to select the active transmit data I/O card for CM701 configurations with multiple data I/O cards installed. This parameter determines which data I/O card will accept the transmit data and clock (SD and TT signals on the data I/O connector) and provide the station timing clock (ST signal).

Syntax

- Remote: `TIO <slot>`
- Front panel: `Tx Active IO <slot>`

Parameters

`<slot>` parameter values are:

- 1, 2, and 3 (default 2) – corresponds to slot numbers 1, 2, and 3

Example

To select the card in slot 1, issue the remote command `TIO 1`, or, from the front panel, select the `1` parameter for `Tx Active IO`. For information on multiple data I/O cards and slot locations, refer to the chapter on functional descriptions.

TM   Transmit Modulation Type (Config) (NV)

Use this command to set the modulation type for the modulator.

Syntax

- Remote: `TM <type>`
- Front panel: `Tx Mod Type <type>`

Parameters

Remote/front panel `<type>` parameter values are:

- 0/BPSK (default)
- 1/QPSK

Example

To select QPSK modulation, issue the remote command `TM 1,` or, from the front panel, select the `QPSK` parameter for `Tx Mod Type`.

Additional Information

For a CM701 system with a high-speed modulator card installed, refer to the MSM command in the option card manual for limitations to the TM command.

TP   Transmit Power (Config) (NV)

Use this command to set the output power level of the modulator transmit IF.

Syntax

- Remote: TP <dBm>
- Front panel: Tx Pwr Level <dBm>

Parameters

<dBm> parameter values are integers from 250 to 50, which represent -25.0 to -5.0 dBm in 0.1 dBm steps. The default is 100.

Example

To set the output power level at -15.0 dBm, issue the remote **TP 150** command, or from the front panel enter **150** as the parameter for `Tx Pwr Level`.

TR   Transmit Symbol Rate (Config) (NV)

It is recommended that the PTD command be used rather than TR.

Use this command to set the modulator symbol rate.

Syntax

- Remote: `TR <rate sps>`
- Front panel: `TxSymRate <rate sps>`

Parameters

`<rate sps>` parameters are transmit symbol rates from 4800 to 2340000 sps, which correspond to 4.8 ksps through 2.340 Msps. The default is 19200 sps.

Additional Information

TR and TD are related by the following equation, which depends on modulation index (TM) and code rate (TC):

Symbol Rate = Data Rate $\div$ (Code Rate $\times$ Modulation Index)

where:

- Code Rate is 1, $\frac{1}{2}$, $\frac{3}{4}$, or $\frac{7}{8}$
- Modulation Index is 1 for BPSK or 2 for QPSK

Changing the TR parameter causes the transmit data rate to change automatically according to this equation, using the currently selected modulation index and code rate.

For a CM701 system with a CM701 high-speed modulator option card installed, refer to the MSM command in the option card manual for potential limitations to the TR command.

TRD   Ternary Receive Data Rate (Config) (NV)

Use this command to automatically issue *all* the appropriate receive data rate commands to all cards in the ternary receive data path and to automatically account for any overhead removed by a card from the data stream.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `TRD <rate bps>`
- Front panel: `TernRxData <rate bps>`

Parameters

`<rate bps>` parameter values are 4800 to 2340000 bps (receive data rates of 4.8 kbps to 2.340 Mbps) for the standard CM701.

The range of valid parameters may vary according to the specific configuration of the CM701 in terms of the option cards that are installed and the modes in which they are configured.

Example

To set the data rate to 9.6 kbps, issue the remote command `TRD 9600`, or, from the front panel, enter `9600` as the parameter for `TernRxData`.

Return Value

Since TRD is a one-way macro command, issuing TRD ? is effective only if *no* data-rate- or symbol-rate-related commands have been issued to individual cards since the TRD rate was entered. Issuing TRD ? at such time would return a value of `0`, indicating that it no longer reflected the ternary path receive data rate.

TRP   Ternary Receive Path (Config) (NV)

Use this command to set the ternary receive data path.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `TRP <entry slot><data slots><exit slot>`
- Front panel: use terminal emulator

TS   Transmit Synthesizer Frequency (Config) (NV)

Use this command to set the IF carrier synthesizer frequency for the modulator.

Syntax

- Remote: `TS <freq kHz>`
- Front panel: `TxIF <freq kHz>`

Parameters

`<freq kHz>` parameter ranges are related to the frequency at which the IF is centered.

- For demodulators with an IF centered at 70 MHz, the following numerical parameter ranges are acceptable:

  □ For the parameter range of 51997500 to 88020000, the inferred unit of measure is 1 Hz.

  □ For the parameter range of 519975 to 880200, the inferred unit of measure is 100 Hz.

  □ For the parameter range of 51997 to 88020, the inferred unit of measure is 1 kHz.

  The default is 70000 Hz.

  The units are inferred from the value entered. The synthesizer has a resolution below 100 Hz if units of Hertz are entered.

- For demodulators with an IF centered at 140 MHz, the following numerical parameter ranges are acceptable:

  □ For the parameter range of 103995000 to 176017500, the inferred unit of measure is 1 Hz.

  □ For the parameter range of 1039950 to 1760175, the inferred unit of measure is 100 Hz.

  □ For the parameter range of 103995 to 176018, the inferred unit of measure is 1 kHz.

  The default is 140000 Hz.

  The units are inferred from the value entered. The synthesizer has a resolution below 100 Hz if units of Hertz are entered.

Example

To set the IF carrier synthesizer frequency for a demodulator with an IF centered at 70 MHz, issue the remote **RS 70000000** command, or from the front panel enter **70000000** as the parameter for `Tx Freq`.

TT   Transmit Timing Frequency (Monitor)

Use this command to query the frequency of the TT clock supplied by the DTE to the data I/O connector of the CM701. The parameter has an accuracy that is better than ±1 percent of the frequency being measured. The frequency of the TT clock is expressed in hertz.

This command is only available when a standalone I/O option card is in use. It is not available during BERT operation. When the BEN parameter is 1 (enabled), a TT query will result in a remote `ER 4` response or a front panel `N/A` message.

Syntax

- Remote: `TT ?`

- Front panel: `Tx Clk`

TTD   Ternary Transmit Data Rate (Config) (NV)

Use this command to automatically issue *all* the appropriate transmit data rate commands to all cards in the ternary transmit data path and to automatically account for any overhead added by a card to the data stream.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `TTD <rate bps>`

- Front panel: `TernTxData <rate bps>`

Parameters

`<rate bps>` parameter values are 4800 to 2340000 bps (transmit data rates of 4.8 kbps to 2.340 Mbps) for the standard CM701.

The range of valid parameters may vary according to the specific configuration of the CM701 in terms of the option cards that are installed and the modes in which they are configured.

Example

To enter a data rate of 4.8 kbps, issue a remote command `TTD 4800`, or, from the front panel, enter `4800` as the parameter for `TernTxData`.

Return Value

Since TTD is a one-way macro command, issuing TTD ? is effective only if *no* data-rate- or symbol-rate-related commands have been issued to individual cards since the TTD rate was entered. Issuing TTD ? at such time would return a value of `0`, indicating that it no longer reflected the ternary path transmit data rate.

TTP   **Ternary Transmit Path (Config) (NV)**

Use this command to set the ternary transmit data path.

This command is used for advanced configurations only. For additional information, refer to the chapter on advanced usage.

Syntax

- Remote: `TTP <entry slot><data slots><exit slot>`
- Front panel: use terminal emulator

VBM   **Verbose Mode (Config) (NV)**

Use this command to view returned ER messages with the error code and a brief description. When enabled for advanced configurations, VBM also displays the current active path as a part of the prompt displayed on the remote unit.

The format of the VBM command is subject to change. It is not intended for computer-driven operation.

Syntax

- Remote: `VBM <setting>`
- Front panel: use terminal emulator

Parameters

`<setting>` parameter values are:

- 0 (default) – disables verbose mode
- 1 – enables verbose mode

Example

To enable verbose mode, issue the remote command `VBM 1`.

Response Format

When VBM is enabled, the following ER messages display:

```
ER 1: Invalid command
ER 2: Invalid parameter
ER 3: Not supported
ER 4: Temporarily not supported
ER 5: Internal communications error
ER 6: Slot address required
```

If VBM is enabled in an advanced configuration, the current active path, `<transmit path>/<receive path>`, is included in the prompt. For example, if the current active transmit path is PTP and the current active receive path is SRP, the prompt on the remote unit appears as `PTP/SRP`.

VF   View Faults (Fault)

Use this command to view the CM701 stored fault history as a card-by-card list with detailed fault descriptions per card. The same fault descriptions are used by the VFT and FL commands.

This command is supported in ASCII mode only.

Syntax

- Remote: `VF`
- Front panel: no command equivalent

Response Format

The response consists of a card description and the slot location of that card, followed by descriptions of all active faults for that particular card. No parameter is required for the VF command. Following is an example of the fault history displayed in response to a VF command:

```
Monitor & Control:4
   No Faults Occurred
Data RS-449:2
   Loss of Tx Clock
Demodulator:6
   Rx AGC Range Fault
   Bit Time Sync Loss
   Carr Track Sync Loss
   Decoder Sync Loss
Modulator:7
   TX IF Synth Fault
   Tx Bit Timing Fault
   TX Power Fault
```

VFT   View Faults with Time Stamp (Fault)

Use this command to view the first 10 faults that have occurred since the faults were last cleared. Each detailed fault description in the response is date and time stamped and is saved in volatile memory for subsequent viewing. The same fault descriptions are used by the VF and FL commands.

This command is supported in ASCII mode only.

Syntax

- Remote: VFT

- Front panel: no command equivalent

Response Format

An example of a response to a VFT command is:

```
Rx AGC Range Fault   17:03:43,  06/17/98
Bit Time Sync Loss   17:03:43,  06/17/98
Carr Track Sync Loss 17:03:43,  06/17/98
Tx FIFO Full Fault   17:03:44,  06/17/98
Acquisition Failure 17:04:08,  06/17/98
```

VS   View Current Fault Status (Fault)

Use this command to view the CM701 real-time fault conditions in a card-by-card list containing detailed descriptions of each card's fault conditions. The response consists of a card description and the slot location of that card, followed by descriptions of all existing fault conditions for that particular card.

This command is supported in ASCII mode only.

Syntax

- Remote: VS

- Front panel: no command equivalent

Response Format

An example of a response to a VS command is:

```
Monitor & Control:4
   No Faults Exist
Data RS-449:2
   No Faults Exist
Demodulator:6
   Rx AGC Range Fault
   Carr Track Sync Loss
   Decoder Sync Loss
Modulator:7
   No Faults Exist
```

VST   VSAT Mode (Config) (NV)

Use this command to place the CM701 in VSAT mode.

Syntax

- Remote: VSAT <mode>

- Front panel: no command equivalent

Parameters

<mode> parameter values are:

- 0 (default) — standard non-VSAT mode

- 1 — enables VSAT mode. The modulator's TxIF output will be disabled whenever the demodulator loses the incoming carrier

Configuration Examples

9

Overview   This chapter presents examples of the most common CM701 configurations. These examples are the foundation of CM701 configurations and can be changed and expanded to meet your individual system needs. The following configurations are used in the examples:

- ComStream closed-network-compatible operation with a standard CM701 card set

- ComStream closed-network-compatible operation with a CM701 configuration consisting of two data interface cards

- INTELSAT Business Services (IBS)-compatible operation

  In this exasmple, the CM701 is configured with the standard CM701 card set and an external Framing Unit, operating IBS serial at 512000 bps.

- Intermediate Data Rate (IDR)-compatible operation

  In this example the CM701 is configured with the standard CM701 card set and an external Framing Unit, operating in IDR mode at 1544000 bps.

- Satellite Multiservice System (SMS)-compatible operation

  In this example, the CM701 is configured with the standard CM701 card set and an external Framing Unit, operating SMS mode at a terrestrial data rate of 1536000 bps.

Each example consists of a set of steps to configure the system and an IF loopback test. For these examples, the configuration and IF loopback test commands are issued through a remote terminal.

Additional configuration examples consisting of various option cards may be found in the CM701 option card manuals.

**ComStream Closed-
Network-Compatible
Operation**

Two closed-network-compatible operation examples are provided. One is based on a standard CM701 configuration while the other example is based on a CM701 that has two installed interface cards.

CM701 Configuration with Standard Cards

This configuration consists of:

- Basic CM701 modem with the following cards:
    - One data interface card
    - One M&C card
    - One modulator (70 MHz)
    - One demodulator (70 MHz)
    - No option cards
- Modem data rate is 2.048 Mbps
- QPSK
- Sequential rate ¾ decoding
- Transmit timing:
    - Provided by modem on ST line
    - DTE is returning a buffered version of ST on the TT line
- Filtering is ComStream closed-network

In addition, an IF loopback will be performed.

To configure the system, perform the following steps:

1. Ensure that the Test Mode LED on the front panel is not illuminated. If it is illuminated, issue the following commands:
    a. Turn all loopbacks off, enter **LB 0**
    b. Turn pure carrier mode off, enter **PC 0**
    c. Turn internal BERT off, enter **BEN 0**

2. Configure the modem for the timing mode. For this example:
    a. Set the modem to provide transmit timing, enter **MB 2**
    b. Set the modulator to latch transmit data on the falling edge of TT clock, enter **ML 0**

3. Select ComStream closed-network filtering on the modulator and demodulator, enter **MFS 0** and **DFS 0**.

4. Disable modulator and demodulator spectral inversion, enter **MI 0** and **DI 0**.

5. Select ComStream scrambling and descrambling, enter **SM 1** and **SD 1**.

6. Enable differential encoding and decoding, enter **DM 2** and **DD 2**.

7. Select QPSK modulation and demodulation, enter **TM 1** and **RM 1**.

Once the configuration parameters in steps 3 through 7 are set, they usually are not changed.

8. Set the transmit IF frequency to 70,000 kHz, enter **TS 70000**.

9. Set the receive IF frequency to 70,000 kHz, enter **RS 70000**.

10. Select rate ¾ sequential encoding, enter **TC 2**.

11. Select rate ¾ sequential decoding, enter **RC 2**.

12. Select a transmit data rate of 2048000 bps, enter **PTD 2048000**.

13. Check the transmit data rate, issue a transmit symbol rate query command **TR ?**. The return value should be `1365333 sps`.

14. Select a receive data rate of 2048000 bps, enter **PRD 2048000**.

15. Check the receive data rate, issue the receive symbol rate query command **RR ?**. The return value should be `1365333 sps`.

The configuration parameters set in steps 8 through 13 may be changed after they are set. However, symbol rate cannot change if the modem is single rate.

Perform an IF Loopback

To perform an IF loopback, follow these steps:

1. Connect an IF cable between the Tx and Rx Loopback connectors.

2. Issue an **LB 1** command.

The modem should acquire almost immediately. If it does not acquire, perform the following steps:

1. Issue an **EM 1** command to enable the modulator. When a modem is factory-shipped, AE is set to one; therefore EM should be set to one. If AE is zero, ensure that the zero parameter is correct and determine the correct setting for EM. For additional AE command information, refer to the chapter on command descriptions.

2. Ensure that acquisition (AQ) is enabled. If it is not, reset the demodulator's acquisition process, enter **AQ 1**.

3. Test the equipment using the built-in BERT feature. Issue a **BEN 1** command.

CM701 Configuration with Two Data Interface Cards

This configuration consists of:

- Standard CM701 modem with the following cards:
  - Two data interface cards located in slots 2 and 3
  - One M&C card
  - One modulator (140 MHz)
  - One demodulator (140 MHz)
  - No other option cards
- Modem data rate is 9.6 kbps
- BPSK
- Sequential rate $\frac{1}{2}$ decoding
- Transmit timing:
  - Provided by the DTE
  - Transmit clock and data sent to the I/O card in slot 2 will be used for the transmit portion
- Both I/O cards will output receive data
- Filtering is ComStream closed-network

In addition, a simple IF loopback will be performed.

To configure the system, perform the following steps:

1. Ensure that the Test Mode LED on the front panel is not illuminated. If it is illuminated, issue the following commands:

   a. Turn all loopbacks off, enter **LB 0**

   b. Turn pure carrier mode off, enter **PC 0**

   c. Turn internal BERT off for each I/O card. This is done by preceding the command with the slot number followed by a colon:

      - Enter **2:BEN 0**
      - Enter **3:BEN 0**

2. Configure the modem for the described I/O selection and timing mode. For this example:

   a. Select the I/O card in slot 2 for transmit, enter **TIO 2**

   b. Select DTE to provide transmit timing, enter **MB 1**

3. Select ComStream closed-network filtering on the modulator and demodulator, enter **MFS 0** and **DFS 0**.

4. Disable modulator and demodulator spectral inversion, enter **MI 0** and **DI 0**.

5. Select ComStream scrambling and descrambling, enter **SM 1** and **SD 1**.

6. Enable differential encoding and decoding, enter **DM 2** and **DD 2**.

7. Select BPSK modulation and demodulation, enter **TM 0** and **RM 0**.

Once the configuration parameters in steps 3 through 7 are set, they usually are not changed.

8. Set the transmit IF frequency to 140,000 kHz, enter **TS 140000**.

9. Set the receive IF frequency to 140,000 kHz, enter **RS 140000**.

10. Select rate $\frac{1}{2}$ sequential encoding, enter **TC 1**.

11. Select rate $\frac{1}{2}$ sequential decoding, enter **RC 1**.

12. Select a transmit data rate of 9600 bps, enter **PTD 9600**.

13. Check the transmit data rate, issue a transmit symbol rate query command **TR ?**. The return value should be `19200 sps`.

14. Select a receive data rate of 9600 bps, enter **PRD 9600**.

15. Check the receive data rate, issue the receive symbol rate query command **RR ?.** The return value should be `19200 sps`.

The configuration parameters set in steps 8 through 13 can be changed after they are set. However, symbol rate cannot change if the modem is single rate.

Perform an IF Loopback

To perform an IF loopback, follow these steps:

1. Connect an IF cable between the Tx and Rx Loopback connectors.

2. Issue an **LB 1** command.

The modem should acquire almost immediately. If it does not acquire, perform the following steps:

1. Issue an **EM 1** command to enable the modulator. When a modem is factory-shipped, AE is set to one; therefore EM should be set to one. If AE is zero, ensure that the zero parameter is correct and determine the correct setting for EM. For additional AE command information, refer to the chapter on command descriptions.

2. Ensure that acquisition (AQ) is enabled. If it is not, reset the demodulator's acquisition process, enter **AQ 1**.

3. Test the equipment using the built-in BERT feature:

   a. Place the modem in internal time, enter **MB 2**.

   b. Issue a **2:BEN 1** command.

INTELSAT Business Services (IBS)-Compatible Operation

In this example, the CM701 is configured with the standard CM701 card set and an external Framing Unit, operating IBS serial at 512000 bps. For information about the internal Framing Unit, refer to the Framing Unit option card manual. This IBS-compatible system consists of:

- Basic CM701 modem with the following cards:
    - One data interface card
    - One M&C card
    - One modulator (70 MHz)
    - One demodulator (70 MHz)
    - No option cards
- Modem data rate is 546133 bps
- QPSK
- Viterbi rate ¾ encoding and decoding
- DTE is providing transmit timing
- Filtering is IBS/IDR open network

In addition, a simple IF loopback will be performed.

To configure the system, perform the following steps:

1. Ensure that the Test Mode LED on the front panel is not illuminated. If it is illuminated, issue the following commands:
    a. Turn all loopbacks off, enter **LB 0**
    b. Turn pure carrier mode off, enter **PC 0**
    c. Turn internal BERT off, enter **BEN 0**

2. Configure the modem for the timing mode. For this example, select the DTE to provide transmit timing, enter **MB 1**.

3. Select IBS/IDR open network filtering on the modulator and demodulator, enter **MFS 1** and **DFS 1**.

4. Disable modulator and demodulator spectral inversion, enter **MI 0** and **DI 0**.

5. Disable ComStream scrambling and descrambling. IBS scrambling and descrambling should be selected in the external Framing Unit. Enter **SM 0** and **SD 0**.

6. Enable differential encoding and decoding, enter **DM 2** and **DD 2**.

7. Select QPSK modulation and demodulation, enter **TM 1** and **RM 1**.

Once the configuration parameters in steps 3 through 7 are set, they usually are not changed.

8. Set the transmit IF frequency to 70,000 kHz, enter **TS 70000**.

---

9. Set the receive IF frequency to 70,000 kHz, enter **RS 70000**.

10. Select rate ¾ Viterbi encoding, enter **TC 4**.

11. Select rate ¾ Viterbi decoding, enter **RC 4.**

12. Select a transmit data rate of 546133 bps, enter **PTD 546133**.

    This assumes an IBS serial Framing Unit operating with a terrestrial data rate of 512000 bps. The transmit data rate was calculated as (512000 * 16)/15.

13. Check the transmit data rate by issuing a transmit symbol rate query command **TR ?** which should return a value of 364089 sps.

14. Select a receive data rate of 546133 bps, enter **PRD 546133**.

    This assumes an IBS serial Framing Unit operating with a terrestrial data rate of 512000 bps. The receive data rate was calculated as (512000 * 16)/15.

15. Check the receive data rate by issuing the receive symbol rate query command **RR ?** which should return a value of 364089 sps.

The configuration commands set in steps 8 through 13 can be changed once they are set. However, symbol rate cannot change if the modem is a single rate.

Perform an IF Loopback

To perform an IF loopback, follow these steps:

1. Connect an IF cable between the Tx and Rx Loopback connectors.

2. Issue an **LB 1** command from the terminal.

The modem should acquire almost immediately. If it does not acquire, perform the following steps:

1. Issue an **EM 1** command to enable the modulator. When a modem is factory-shipped, AE is set to one; therefore, EM should be set to one. If AE is zero, ensure that the zero parameter is correct and determine the correct setting for EM. For additional AE command information, refer to the chapter on command descriptions.

2. Ensure that acquisition (AQ) is enabled. If it is not, reset the demodulator's acquisition process, enter **AQ 1**.

3. Test the equipment using the built-in BERT feature. Issue a **BEN 1** command.

    Enabling the BERT will take the external Framing Unit out of the loop.

The BERT needs the TT clock to operate while the modem is in external timing (MB 1).

Intermediate Data Rate (IDR)-Compatible Operation

In this example the CM701 is configured with the standard CM701 card set and an external Framing Unit, operating in IDR mode at 1544000 bps. This IDR-compatible system consists of:

- Basic CM701 modem with the following cards:
    - One data interface card
    - One M&C card
    - One modulator (70 MHz)
    - One demodulator (70 MHz)
    - No option cards
- Modem data rate is 1640000 bps
- QPSK
- Viterbi rate $\frac{1}{2}$ encoding and decoding
- DTE, or external Framing Unit, is providing transmit timing
- Filtering is IBS/IDR open network

In addition, a simple IF loopback will be performed.

To configure the system, perform the following steps:

1. Ensure that the Test Mode LED on the front panel is not illuminated. If it is illuminated, issue the following commands:

    a. Turn all loopbacks off, enter **LB 0**

    b. Turn pure carrier mode off, enter **PC 0**

    c. Turn internal BERT off, enter **BEN 0**

2. Configure the modem for the timing mode. For this example, select the DTE, or external Framing Unit, to provide transmit timing, enter **MB 1**.

3. Select IBS/IDR open network filtering on the modulator and demodulator, enter **MFS 1** and **DFS 1**.

4. Disable modulator and demodulator spectral inversion, enter **MI 0** and **DI 0**.

5. Select IDR-compatible scrambling and descrambling. It is assumed that the external Framing Unit does not have this capability. Enter **SM 2** and **SD 2**.

6. Enable differential encoding and decoding, enter **DM 2** and **DD 2**.

7. Select QPSK modulation and demodulation, enter **TM 1** and **RM** 1.

Once the configuration parameters in steps 3 through 7 are set, they usually are not changed.

8. Set the transmit IF frequency to 70,000 kHz, enter **TS 70000**.

9. Set the receive IF frequency to 70,000 kHz, enter **RS 70000**.

10. Select rate $\frac{1}{2}$ Viterbi encoding, enter **TC 3**.

11. Select rate $\frac{1}{2}$ Viterbi decoding, enter **RC 3**.

12. Select a modem transmit data rate of 1,640,000 bps, enter **PTD 1640000**.

    This assumes an IDR Framing Unit operating with a terrestrial data rate of 1,544,000 bps. The transmit data rate was calculated as (1544000 + 96000).

13. Check the transmit data rate by issuing a transmit symbol rate query command **TR ?** which should return a value of 1640000 sps.

14. Select a receive data rate of 1,640,000 bps, enter **PRD 1640000**.

    This assumes an IDR Framing Unit operating with a terrestrial data rate of 1,544,000 bps. The receive data rate was calculated as (1544000 + 96000).

15. Check the receive data rate by issuing the receive symbol rate query command **RR ?** which should return a value of 1640000 sps.

The configuration commands set in steps 8 through 13 can be changed once they are set. However, symbol rate cannot change if the modem is a single rate.

Perform an IF Loopback

To perform an IF loopback, follow these steps:

1. Connect an IF cable between the Tx and Rx Loopback connectors.

2. Issue an **LB 1** command from the terminal.

The modem should acquire almost immediately. If it does not acquire, perform the following steps:

1. Issue an **EM 1** command to enable the modulator. When a modem is factory-shipped, AE is set to one; therefore, EM should be set to one. If AE is zero, ensure that the zero parameter is correct and determine the correct setting for EM. For additional AE command information, refer to the chapter on command descriptions.

2. Ensure that acquisition (AQ) is enabled. If it is not, reset the demodulator's acquisition process, enter **AQ 1**.

3. Test the equipment using the built-in BERT feature:

    a. Place the modem in internal time, enter **MB 2**.

    b. Issue a **BEN 1** command.

    Enabling the BERT will take the external Framing Unit out of the loop.

Satellite Multiservice System (SMS)-Compatible Operation

In this example the CM701 is configured with the standard CM701 card set and an external Framing Unit, operating SMS mode at a terrestrial data rate of 1536000 bps. This SMS-compatible system consists of:

- Basic CM701 modem with the following cards:

    - One data interface card

    - One M&C card

    - One modulator (70 MHz)

    - One demodulator (70 MHz)

    - No option cards

- Modem data rate is 1638400 bps

- QPSK

- Viterbi rate $^3/_4$ encoding/decoding

- DTE, or external Framing Unit, is providing transmit timing

- Filtering is SMS open network

In addition, a simple IF loopback will be performed.

To configure the system, perform the following steps:

1. Ensure that the Test Mode LED on the front panel is not illuminated. If it is illuminated, issue the following commands:

    a. Turn all loopbacks off, enter **LB 0**

    b. Turn pure carrier mode off, enter **PC 0**

    c. Turn internal BERT off, enter **BEN 0**

2. Configure the modem for the timing mode noted in the assumptions. Select the DTE, or external Framing Unit, to provide transmit timing, enter **MB 1**.

3. Select SMS open network filtering on the modulator and demodulator, enter **MFS 2** and **DFS 2**.

4. Disable modulator and demodulator spectral inversion, enter **MI 0** and **DI 0**.

5. Turn ComStream scrambling and descrambling off. SMS (IBS) scrambling and descrambling should be selected in the external Framing Unit. Enter **SM 0** and **SD 0**.

6. Enable differential encoding and decoding, enter **DM 2** and **DD 2**.

7. Select QPSK modulation and demodulation, enter **TM 1** and **RM 1**.

Once the configuration parameters in steps 3 through 7 are set, they usually are not changed.

8. Set the transmit IF frequency to 70,000 kHz, enter **TS 70000**.

9. Set the receive IF frequency to 70,000 kHz, enter **RS 70000**.

10. Select rate $\frac{3}{4}$ Viterbi encoding, enter **TC 4**.

11. Select rate $\frac{3}{4}$ Viterbi decoding, enter **RC 4**.

12. Select a modem transmit data rate of 1638400 bps, enter **TD 163840**0.

    This assumes an SMS Framing Unit operating with a terrestrial data rate of 1536000 bps. The modem transmit data rate was calculated as (1536000 * 16)/15

13. Check the transmit data rate by issuing a transmit symbol rate query command **TR ?** which should return a value of 1092267 sps.

14. Select modem receive data rate of 1638400 bps, enter **RD 1638400**.

    This assumes an SMS Framing Unit operating with a terrestrial data rate of 1536000 bps. The modem receive data rate was calculated as (1536000 * 16)/15

15. Check the receive data rate by issuing the receive symbol rate query command **RR ?** which should return a value of 1092267 sps.

The configuration commands set in steps 8 through 13 can be changed once they are set. However, symbol rate cannot change if the modem is a single rate.

Perform an IF Loopback

To perform an IF loopback, follow these steps:

1. Connect an IF cable between the Tx and Rx Loopback connectors.

2. Issue an **LB 1** command from the terminal.

The modem should acquire almost immediately. If it does not acquire, perform the following steps:

1. Issue an **EM 1** command to enable the modulator. When a modem is factory-shipped, AE is set to one; therefore, EM should be set to one. If AE is zero, ensure that the zero parameter is correct and determine the correct setting for EM. For additional AE command information, refer to the chapter on command descriptions.

2. Ensure that acquisition (AQ) is enabled. If it is not, reset the demodulator's acquisition process, enter **AQ 1**.

3. Test the equipment using the built-in BERT feature. Issue a **BEN 1** command. The BERT needs the TT clock to operate while the modem is in external timing.

    Enabling the BERT will take the external Framing Unit out of the loop.

ComStream®
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Advanced Usage

10

The standard CM701 configuration is equipped with one modulator, demodulator, I/O card, and an M&C card. Although the standard modulator and demodulator connect to only one I/O at a time, up to three data I/O cards may be installed.

This chapter presents the following topics used to configure the CM701 for advanced applications:

- Data paths

- Autoconfiguration

- Configurations supported by autoconfiguration

- Summary of commands used for advanced configurations

For further information regarding option cards or custom configurations, consult your ComStream sales representative or call ComStream Customer Service.

Data Paths
The CM701 backplane hardware connections support three transmit channels and three receive channels. Each transmit channel consists of three elementary clock and data transmit lines, while each receive channel consists of three elementary clock and data receive lines.

Each of the transmit and receive channels can be accessed by a circuit card in any of the available slots, creating the ability to insert an option card in the data path between an I/O card and a modulator or demodulator. This ability makes the CM701 extremely flexible and allows it to be tailored to support specific applications by installing different option cards in the data path.

The M&C controls the configuration of the data channels by selecting the appropriate backplane drivers and receivers of each of the cards installed in the CM701. During the normal power-up sequence, the CM701 completes an automatic configuration process during which the data paths are configured.

Data paths are defined as the card-to-card connectivity across the CM701 backplane and are created by controlling the access to the backplane data channels. Data paths establish the data flow through the CM701. There are two types of data paths: transmit and receive. A transmit or receive data path may use some, all, or none of the three CM701 data channels.

The actual path followed by the transmit or receive data is expressed as a number that reflects the slot numbers, in order, from data entry to data exit. This expression can be displayed on the remote terminal in response to a data path query.

Standard Data Path Configuration

The standard CM701 configuration is illustrated in Figure 10-1 and has the following data paths:

- Transmit data path (PRP) 27
- Receive data path (PRP) 62
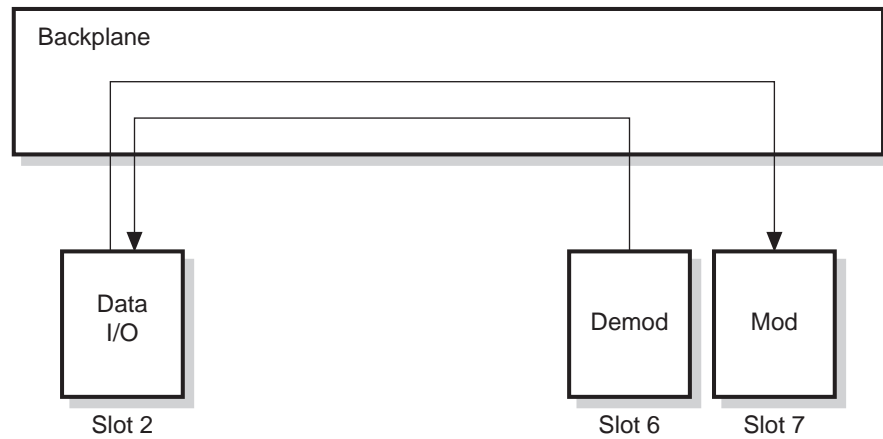
F179-01

Figure 10-1   Backplane Connections for Standard CM701

If an option card is added to the standard configuration, slot numbers reflecting the additions to the data path are included in the data path number. For example, assume that the following two option cards, shown in Figure 10-2, are installed in a standard modem:

- Framing Unit card in slot 5
- Intelsat Reed-Solomon card in slot 3.
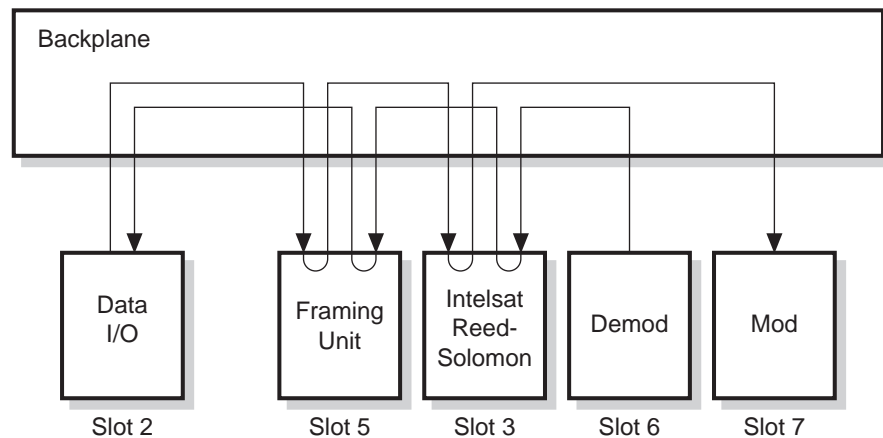
F182-01

Figure 10-2   Open Network with Framing Unit and Intelsat Reed-Solomon

This configuration has the following data paths:

- Transmit data path 2537

  Transmit data enters the CM701 at slot 2, goes through slot 5 (Framing Unit) and slot 3 (Reed-Solomon), then exits through slot 7.

- Receive data path 6352

  Receive data enters the CM701 at slot 6, goes through slot 3 (Reed-Solomon) and slot 5 (Framing Unit), then exits through slot 2.

Data Path Commands   Since the data channels across the backplane are independent, it is possible to have any of the following:

- Single transmit or receive path that uses all three data channels

- Three transmit or three receive paths in which each path uses one data channel if the cards have the hardware to support three data channels

- Transmit or receive path that uses two data channels and a transmit or receive path that uses one data channel

The CM701 has a remote command associated with each of the possible transmit paths and receive paths. The commands are used not only to enter or modify the data paths but also to query them. These remote commands are:

- Primary transmit path (PTP)

- Secondary transmit path (STP)

- Ternary transmit path (TTP)

- Primary receive path (PRP)

- Secondary receive path (SRP)

- Ternary receive path (TRP)

There are no front panel command equivalents. If the commands must be entered through the front panel, use terminal emulation.

Autoconfiguration of Data Paths

Most CM701 configurations do not require the manual entry of transmit path or receive path commands. At power-up or modem reset, the CM701 attempts to automatically establish appropriate data paths based upon the installed cards. The setting of the autoconfiguration path (ACP) command determines whether the CM701 will attempt to:

- Autoconfigure at power-up or soft reset when ACP is set to 1

- Re-establish the last settings, if they are still valid, when ACP is set to 0

The CM701 will display the message, `Manual Path Commands Req` shortly after power-up when the transmit path or receive path commands are required, even if ACP is set to 1.

If data path commands must be entered, it is recommended that autoconfiguration be set to ACP 0 command to ensure that the data paths are not lost in the event of a power loss, power cycle, or soft modem reset.

If ACP is set to 0, that is, autoconfiguration is off, and CM701 cards are removed, added, or swapped, one or more `ER 2` messages may be returned when power is reapplied to the unit. At power-up, the CM701's M&C will attempt to issue the previously entered path commands, that are no longer valid. For example, a slot that is now empty may be included in the stored path command, or a receive-only card may have been replaced by a transmit-only card.

Issuing Data Path Commands

The syntax for data path commands matches the path or flow of data from CM701 entry to exit. Data path commands can also be issued in query format.

- To enter or edit a data path, use the syntax:

  `<data path> <entry slot><data slots><exit slot>`

- To query a data path, use the syntax: `<data path> ?`

where

- `<data path>` refers to the transmit path or receive path command mnemonic (PTP, STP, TTP, PRP, SRP, TRP)

- `<entry slot>`, `<data slots>`, and `<exit slot>` refer to the slots along the CM701 data path from entry to exit.

For example:

- PTP 237 sets the primary transmit path such that data enters through slot 2, goes through slot 3, and exits at slot 7.

- PRP ? queries the primary receive path.

Rules for Issuing Data Path Commands

When entering or modifying data paths, follow the command rules listed below. If the rules are *not* followed, the current data path will *not* be changed, and an `ER 2` message will be returned.

General Data Path Parameter Rules

The following parameter rules apply to *all* data path commands:

- Valid slot numbers are 1, 2, 3, 5, 6, 7

    □ A null parameter is an invalid parameter. For example, issuing PTP by itself returns an `ER 2` message.

    □ A parameter of 0 clears the data path, that is, it removes any existing connectivity. For example, STP 0 means that there is no secondary transmit backplane connection.

    □ The number 4 is not accepted as a slot number in a path command parameter, as the M&C card is always in slot 4.

- Slot numbers *cannot* be repeated within a data path. This rule applies even if a modem card's on-board I/O is being used.

- If there is more than one transmit data path, a slot number can be used in only one of those transmit data paths. Likewise, if there is more than one receive data path, a slot number can be used in only one of those receive data paths.

- Modem card slot numbers should be included in the data path for full M&C support. For example, if there is a standalone modem card in slot 7, the data paths should be set as `PTP 7` and `PRP 7`.

- If a Doppler Buffer card is installed, it will always receive its TT clock, the clock most often used to clock data out of the buffer, from the PTP TT clock.

Additional *Transmit* Data Paths Limits

In addition to the general rules, the following rules apply specifically to transmit data path commands:

- Cards – transmit data paths are limited to cards that can handle transmit data. Slot numbers of receive-only cards (for example, demodulator cards and the Doppler Buffer card) are *not* accepted in transmit path commands.

- Entry slot number – a data interface card (for example, RS-449, V.35, or a transmit initiating type of card) slot number must be the entry slot number in a transmit path command.

- Exit slot number – a modulator, or a transmit terminating type of card, must be the exit slot number in a transmit path command.

A card may be installed in the CM701 that is *not* related to the data path under following conditions:

- The card may need to be associated with a given data path for M&C purposes. An example of this is an IF translating card with an external connection to the modulator.

- If the card must be included in the data path, its slot number should appear as the *exit slot* of the transmit path command.

- Only one transmit terminating card can be included in the transmit data path.

Additional *Receive* Data Paths Limits

In addition to the general rules, the following rules apply specifically to receive data path commands:

- Cards – receive data paths are limited to cards that can handle receive data. Slot numbers of transmit-only cards (for example, modulator cards) are *not* accepted in receive path commands.

- Entry slot number – the demodulator (or a receive initiator type of card) slot number must be the entry slot number in a receive path command.

- Exit slot number – a data interface card (for example, RS-449, V.35, or a receive terminating type of card) slot number must be the exit slot number in a receive path command.

A card may be installed in the CM701 that is *not* related to the data path. The following conditions apply:

- The card may need to be associated with a given data path for M&C purposes. An example of this is an IF translating card.

- If the card must be included in the data path, its slot number should appear as the *entry slot* of the transmit path command.

- Only one receive initiating card can be included in the receive data path.

Using the I/O Connector on the Modem Card

If the I/O connector on the modem card is to be used in the data path, the I/O card slot is not entered. For example, assume a CM701 has a Modem card in slot 7, a ComStream Reed-Solomon card in slot 5, and an SCC option card in slot 3. The following data paths, illustrated in Figure 10-3, should be set to:

- PTP 357

- PRP 753
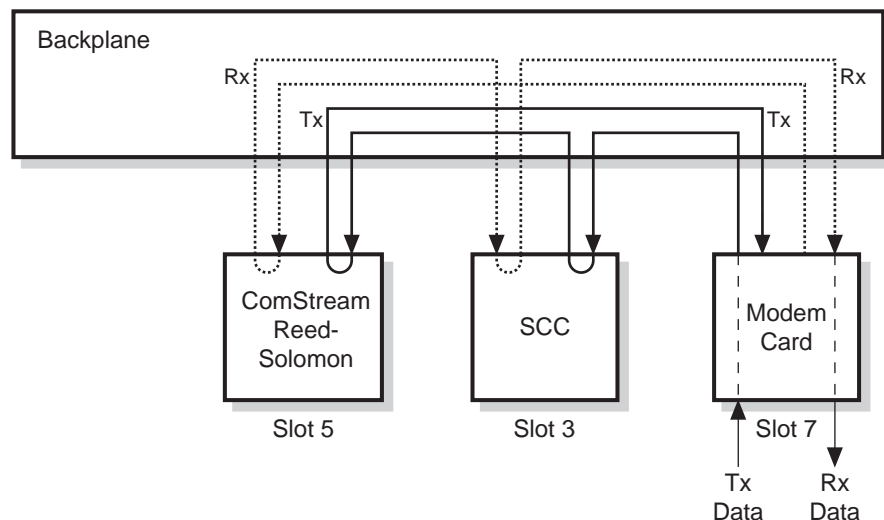
Figure 10-3   Configuration Data Paths in which Modem I/O Connector is Used

Returned Error and Warning Messages

If the data path command parameter rules are *not* followed, an `ER 2` message will be returned on the remote terminal. If this occurs, reissue the command using the appropriate command syntax and data path rules.

A warning 2 (`WNG 2`) message returned on the remote terminal after issuing a data path command indicates that the slot order of the entered path does not follow the standard order within the data path. This is *not* a critical error and the modem will usually function if configured in such a manner. However, consideration should be given as to whether or not the order of the slots is appropriate.

For example, the typical transmit data path for an open-network CM701 that has a Framing Unit in slot 5 and an Intelsat Reed-Solomon in slot 3, is 2537. If PTP 2357 was issued, the configuration would function; however a `WNG 2` message would be returned, and the modem would not be configured to the open-network standard.

Data Path Command Relationships

Data path commands are:

- Interrelated – that is, they are related to one another

- Related to data rate macro commands

- Related to the TIO and RIO commands

Data Path Command Interrelationships

Path commands are hierarchical in relation to the use of the backplane data channels as well as to slot and card usage.

Data channel requirements of higher level paths take precedence over the data channel requirements of lower level paths. For example, if an STP is using two of the transmit data channels and a PTP is issued that requires two or more data channels, the STP will be cleared (STP 0) and the PTP will use the data channels that it requires. The reverse of this situation will not occur.

Data slot requirements of higher level paths take precedence over the data slot requirements of lower level paths. For example, assume that an STP has been set. A PTP is issued with a parameter containing a slot number used by the STP. The STP will be cleared and the slot number will be used by the PTP. The reverse of this situation will not occur.

Data Rate Macro Command Relationships

Data rate macro commands use the paths set by the data path commands to determine where to route data rate information.

- Data rate macro command functions — the transmit data rate and receive data rate macro commands are used to issue all appropriate data rate commands to

  - All cards that affect data rate in the appropriate data path

  - Automatically account for any overhead added by a card to that data stream

The macro commands represent the data rate that is input to or output from the active I/O card on the transmit and receive sides of the CM701. The standard range is 4800 to 2340000 bps; however, the range may vary according to the configuration in terms of the installed option cards and the modes in which they are configured. Although it is possible to use individual card data rate commands to modify system data rates, it is recommended that the data rate macro commands be used even for the most simple configurations.

- Relationship of data rate macro and data path commands — there are primary, secondary, and ternary macro commands associated with the primary, secondary, and ternary data path commands.

  Use the Show Path (SHP) command to identify which paths were made active during manual or autoconfiguration, particularly for a multiple modulator or multiple demodulator configuration, so that the appropriate data rate macro commands can be determined and issued.

- Front panel and remote data rate macro commands — in a standard CM701 configuration, the front panel equivalents of remote data rate macro commands are listed under Config>Systm in the front panel command tree. Front panel commands, their remote equivalents, and their associated path commands are illustrated in Table 10-1.

Table 10-1   Standard Configuration Data Rate Macro Commands

Front Panel	Remote Terminal	Associated Path Command
UserTxData	PTD (Primary Transmit Data)	PTP (Primary Transmit Path)
UserRxData	PRD (Primary Receive Data)	PRP (Primary Receive Path)

When other transmit or receive data paths are added to a standard configuration, the primary data path commands appear as PrimTxData and PrimRxData, and the additional secondary and ternary data macro commands appear in the front panel command tree. Front panel command equivalents to the remote data rate commands for multiple data paths, along with the associated path commands, are illustrated in Table 10-2.

Table 10-2   Multiple Data Path Data Rate Macro Commands

Front Panel	Remote Terminal	Associated Path Command
PrimTxData	PTD (Primary Transmit Data)	PTP (Primary Transmit Path)
PrimRxData	PRD (Primary Receive Data)	PRP (Primary Receive Path)
SecdTxData	STD (Secondary Transmit Data)	STP (Secondary Transmit Path)
SecdRxData	SRD (Secondary Receive Data)	SRP (Secondary Receive Path)
TernTxData	TTD (Ternary Transmit Data)	TTP (Ternary Transmit Path)
TernRxData	TRD (Ternary Receive Data)	TRP (Ternary Receive Path)

TIO and RIO Command Relationships to Data Path Commands

The TIO and RIO parameters used in a standard CM701 configuration are related to PTP and PRP parameters as follows:

- Relationship of TIO and PTP

    The TIO parameter used for the standard CM701 configuration is the same number as the *first* digit of the PTP parameter. Changing either parameter changes the other parameter. The STP and TTP transmit path commands have no command counterparts.

- Relationship of RIO and PRP

    The RIO parameter used for the standard CM701 configuration is the same number as the *last* digit of the PRP parameter. Changing either parameter changes the other parameter. The SRP and TRP receive path commands have no command counterparts.

Working with Data Paths

Commands are available to make working with multiple data paths and issuing multiple commands to the same option card easier.

Show Path Command

Use the show path (SHP) query command to display *all* of the current backplane connections set by either an autoconfiguration cycle or as the result of issuing a path command. No parameters are required for the SHP command.

An example of the response to an SHP command is:

```
PTP 27   PRP 62

STP 0    SRP 51

TTP 0    TRP 0
```

where

- PTP 27 is the primary transmit path. Transmit data enters the CM701 at slot 2 and is transferred across the backplane to slot 7 where it is transmitted out.

- PRP 62 is the primary receive path. Receive data enters the CM701 at slot 6 and is transferred across the backplane to slot 2 where it is sent out.

- STP 0, the secondary transmit path backplane connection, does not exist.

- SRP 0, the secondary receive path backplane connection, does not exist.

- TTP 0, the ternary transmit path backplane connection, does not exist.

- TRP 0, the ternary receive path backplane connection, does not exist.

Clear Path Command

Use the clear path (CLP) command to clear *all* data paths. Issuing CLP 0 has the same effect as issuing a zero parameter with each of the transmit and receive data path commands.

Current Active Status and Current Active Path Commands

The current active path (CAP) and current active status (CAS) commands are volatile commands that make it easier to issue commands to specific or multiple paths, rather than having to specify the slot number for every command issued to a particular card.

Issuing the CAP and CAS Commands

Use the following syntax to issue either the CAP or CAS command:
`<command> <transmit path>,<receive path>`

where

- `<command>` represents either the CAP or CAS command
- `<transmit path>` and `<receive path>` parameter values are:
  - 0 (default) uses cards in all paths
  - 1 specifies cards only in the primary path
  - 2 specifies cards only in the secondary path
  - 3 specifies cards only in the ternary path

Using the CAP and CAS Commands

Use the CAP command to set the data path to which subsequent commands will be issued.

- Data rate commands can be issued regardless of the CAP setting.
- Issuing a DP command will return the configuration of the modulator and demodulator cards that were specified in the CAP command; however, if no paths were set, the display returned by DP will default to the primary transmit and receive paths.

Use the CAS command to set the path to which a status query command will be issued. The M&C card will limit the reported parameters to those associated with the cards in the currently active data path set by the CAS command.

- Only cards in the specified paths will be used to construct the information reported by the fault relay, ST, FL, VS, VF, and VFT commands.
- Only cards in the specified paths will be used for Fault and Status LEDs (Rx Sync, Tx Enable, and red and yellow FAULT) on the CM701 front panel.

Example 1

Assume that a CM701 has the following:

- Two I/O cards in slots 1 and 2

- One modulator in slot 7

- Two demodulators in slots 5 and 6

Autoconfiguration

Autoconfiguration would set the transmit and receive paths. Issuing an SHP command would result in the following display:

```
PTP 27 PRP 62

STP 0  SRP 51

TTP 0  TRP 0
```

Current Active Path Specification

If the active path is set at its default (CAP 0,0), issuing any demodulator or I/O card command will return an `ER 6 slot address required` message. Therefore, either the slot must be included in the syntax for each of those individual commands, or the CAP can be set. Once the CAP is set, commands will be directed as appropriate to the cards in the specified path until CAP is reset, the modem is reset, or the CM701 is powered off and then on.

- Configure the Secondary Receive Path

- To configure the secondary receive path (SRP) only, issue a CAP 0,2 command. All subsequent demodulator and I/O commands will be sent to the demodulator in slot 5 and the I/O card in slot 1. Note that issuing a CAP 1,2 command would have the same results because there is only one specified transmit path.

- Configure the Primary Receive Path

  To configure the primary receive path (PRP) only, issue a CAP 0,1 command. All demodulator and I/O commands will be sent to the demodulator in slot 6 and the I/O in slot 2.

Current Active Status Specification

To view a display of *all* installed cards in the CM701 chassis when a query command is issued, use the CAS 0,0 command, the default.

Assume that a CAS has been set to 1,2 or 0,2 and a status query is issued. The query results will reflect the demodulator in the secondary receive path but not include the demodulator in slot 6, the primary receive path. Therefore, if the demodulator in slot 5 is in sync but the demodulator in slot 6 is not, the Rx Sync LED on the front panel will be illuminated, and the response to a status query will *not* show any demodulator faults.

Example 2

Assume that a CM701 has three modem cards installed in slots 5, 6, and 7.

Autoconfiguration

Autoconfiguration would set the transmit and receive paths. Issuing an SHP command would result in the following display:

```
PTP 7        PRP 7

STP 6        SRP 6

TTP 5        TRP 5
```

Current Active Path Specification

If the active path is set to its default (CAP 0,0), issuing any command returns an `ER 6, slot address required` message. Therefore, either the slot must be included in the syntax for each of the individual commands, or CAP can be set. Once CAP is set, commands are appropriately directed to the cards in the specified path until CAP is reset, the modem is reset, or the CM701 is powered up.

- Configure the primary path (a modem card in slot 7) — issue a **CAP 1,1** command. All subsequent commands will be directed to slot 7.

- Configure the secondary path (a modem card in slot 6) — issue a **CAP 2,2** command. All subsequent commands will be directed to slot 6.

- Configure the ternary path (a modem card in slot 5) — issue a **CAP 3,3** command. All subsequent commands will be directed to slot 5.

Using CAP with Verbose Mode

To keep track of the current active path, enable verbose mode, VBM 1. If VBM is enabled, the current path will display as a part of the prompt on the remote terminal display.

The following example illustrates how VBM and CAP are used together to track the current active path. Assume that standard defaults are set. To issue a series of commands to cards in a specific path, you could enable verbose mode and issue a CAP command in the following manner:

Action	Display
1. Issue the command to enable verbose mode.	>vbm 1
2. Issue the command to set the current active path.	>cap 1,2
3. Prompt reflecting the active path displays. All issued commands will now be directed to the cards in the paths defined by PTP and SRP.	PTP/SRP>
4. Issue the command to change the current active path.	PTP/SRP>cap 0,1
5. Prompt reflecting the updated active path is displayed. All issued commands will now be directed to all transmit data cards and the specified cards in the path defined by PRP.	PRP>

Autoconfiguration Feature   If the autoconfiguration feature is enabled, most CM701 applications do *not* require manual entry of path commands because the commands are issued appropriately and automatically during the CM701 autoconfiguration process.

Autoconfiguration Path Command

The autoconfiguration (ACP) command is a nonvolatile configuration command used to enable or disable the autoconfiguration path function during modem reset or power-up. A setting of ACP 1 causes the CM701 to be reconfigured according to the autoconfiguration defaults. If the setting is ACP 0, the CM701 attempts to reconfigure the backplane to its previous state, if that state is still valid.

Configuration Path Control Command

The configuration path control (CPC) command is a volatile command used to automatically reconfigure the backplane paths without having to perform a modem reset or power-up of the CM701. Issuing a CPC 1 command causes the CM701 to attempt to reconfigure the backplane paths automatically according to autoconfiguration defaults. The SHP command should then be used to check the reconfigured paths.

Autoconfiguration Process

The autoconfiguration process is performed by the M&C card in the following manner:

1. The number of installed modulators, demodulators, and modem cards in the CM701 is determined.

2. The M&C determines if there is a sufficient number of I/O cards to support the installed cards.

3. Option cards are identified as well as their path order precedence.

4. The appropriate path or paths are constructed and issued using the data path commands.

The M&C will abort the process if any one of the following occurs:

- The hardware required to complete a data path is missing.

- A logical configuration for connecting the hardware cannot be determined.

- There is more than one possible configuration for the identified hardware.

If autoconfiguration is aborted, a `Manual Path Commands Req` message will be returned, and no backplane connectivity will be completed. Data path commands will need to be issued manually by the user.

If data paths are set manually, ACP should be set to 0 so that the new settings are recalled in the event of power-up or modem reset.

Precedence Set by Autoconfiguration

During the autoconfiguration process, any installed option cards are included, as required, in the data path. If autoconfiguration successfully configures the CM701, it is recommended that the configuration be used and not altered.

Transmit Precedence

The transmit precedence is listed below in transmit data path order:

1. I/O card (all currently available types)

2. SCC option card

3. Framing Unit

4. Reed-Solomon option card

5. Modulator or other modem card (all currently available types)

Receive Precedence

The receive precedence is listed below in receive data path order:

1. Demodulator or other modem card (all currently available types)

2. Reed-Solomon option card

3. Framing Unit

4. SCC option card

5. Doppler Buffer

6. I/O card (all currently available types)

I/O Card Connections   During autoconfiguration, TIO and RIO are checked. If they are valid, I/O card connections are set according to those TIO and RIO parameters. However, TIO or RIO may *not* be valid due to removal of a card, clearing of data paths, and so on. If TIO or RIO are *not* valid, the I/O cards are connected to other cards in the following manner:

- If there is one modulator, demodulator, or modem card, I/O connections will be made to the first slot in which an I/O card is found. The search for an I/O card proceeds in the following slot order: slot 2, slot 1, slot 3.

- If there are two or more modulator, demodulator, or modem cards, the card in the highest numbered modulator/demodulator slot will be connected to the I/O card in the highest numbered I/O card slot.

Configurations Supported by Autoconfiguration

The configurations, described in Table 10-3, are possible given the modular architecture of the CM701. Many other protocol configurations are possible; however, they currently require the user to manually enter path commands. Contact your ComStream Sales Representative for information regarding other configurations.

It is important to note the following conditions regarding autoconfiguration:

- If the CM701 is configured with multiple modulators, data control mode (CD) is not available. However, multiple standalone modem cards, those that do not use alternate I/O interface cards, do not have this restriction.

- Multiple modulator or demodulator configurations do not support the automatic IF loopback (LB) feature.

- The viability of any of the configurations is based on slot and data channel availability.

For more information regarding the CD and LB commands, refer to the chapter on command descriptions.

Table 10-3   Configurations Supported by Autoconfiguration

Mod	Demod	I/O	Option	Modem	Notes
1	—	1-3	—	—	—
2	—	2-3	—	—	—
3	—	3	—	—	Only if the modulator in slot 5 and the I/O in slot 1 are 3-channel cards
—	1	1-3	—	—	—
—	2	2-3	—	—	—
—	3	3	—	—	Only if the demodulator in slot 5 and the I/O in slot 1 are 3-channel cards
1	1	1-3	—	—	—
2	1	2-3	—	—	—
1	2	2-3	—	—	—
1	—	1-3	1-2	—	—
2	—	2-3	1	—	—
—	1	1-3	1-2	—	—
—	2	2-3	1	—	—
1	1	1-3	1-2	—	—
2	1	2-3	1	—	—
1	2	2-3	1	—	—
1	1	1	-	1	Primary path: I/O mod/demod; secondary path: modem card
—	—	0-3	—	1-3	A configuration with 3 modems and 3 I/O cards can be used only if the I/O card in slot 1 is a 3-channel card
—	—	0-1	1-2	1-3	Primary path: I/O (if installed), 2 option cards, modem card in highest numbered slot

Typically, option cards are inserted in the primary data path, and the simple I/O to modulator paths are used as the secondary or ternary paths. However, there are configurations in which alternate data paths are set to accommodate atypical setups. For more information, contact your ComStream sales representative or Customer Service.

Advanced Configuration Command Summary

Table 10-4 contains an alphabetical summary of CM701 remote commands used in an advanced configuration.

Table 10-4   Advanced Configuration Command Summary

Cmd	Front Panel Equivalent*	Function
ACP	—	Disables/enables autoconfiguration path
CAP	—	Directs commands to cards in a particular path
CAS	—	Defines data paths considered for all fault and status queries
CLP	—	Clears all data paths
CPC	—	Automatically reconfigures the backplane paths
PRD	PrimRxData (UserRxData)	Primary receive data macro; uses PRP to identify data path; equivalent to UserRxData in single data path configurations
PRP	—	Sets or queries primary receive path
PTD	PrimTxData (UserTxData)	Primary transmit data macro; uses PTP to identify data path; equivalent to UserTxData in single data path configurations
PTP	—	Sets or queries primary transmit path
SHP	—	Shows primary, secondary, and ternary transmit and receive paths
SRD	SecdRxData	Secondary receive data macro; uses SRP to identify data path
SRP	—	Sets or queries secondary receive path
STD	SecdTxData	Secondary transmit data macro; uses STP to identify data path
STP	—	Sets or queries secondary transmit path
TRD	TernRxData	Ternary receive data macro; uses TRP to identify data path
TRP	—	Sets or queries ternary receive path
TTD	TernTxData	Ternary transmit data macro; uses TTP to identify data path
TTP	—	Sets or queries ternary transmit path
VBM	—	Displays the current active path set by CAP

* If no front panel command equivalent is listed and the front panel must be used to issue commands, use terminal emulation.

External Connections

This chapter presents a description of the external connections required for a standard CM701 configuration. The following information is provided for each of the CM701 components:

- Functional description

- Electrical specification

- Physical pinout specification

The CM701's modular architecture allows for many different connector configurations depending upon the option cards installed in the CM701. For information on external connections for option cards, including other data interface cards, refer to the appropriate option card manual.

Basic CM701 Configuration

The standard CM701 modem configuration consists of the following components, as illustrated in Figure 11-1:

- RS-449 data interface card in slot 2

- M&C card in slot 4

- AC power supply in the center of the panel

- Demodulator in slot 6

- Modulator in slot 7

- Blank filler plates installed in slots 1, 3, and 5 that provide a solid conductive rear panel required to keep EMI and RFI radiation below regulatory agency limits and provide for proper air flow
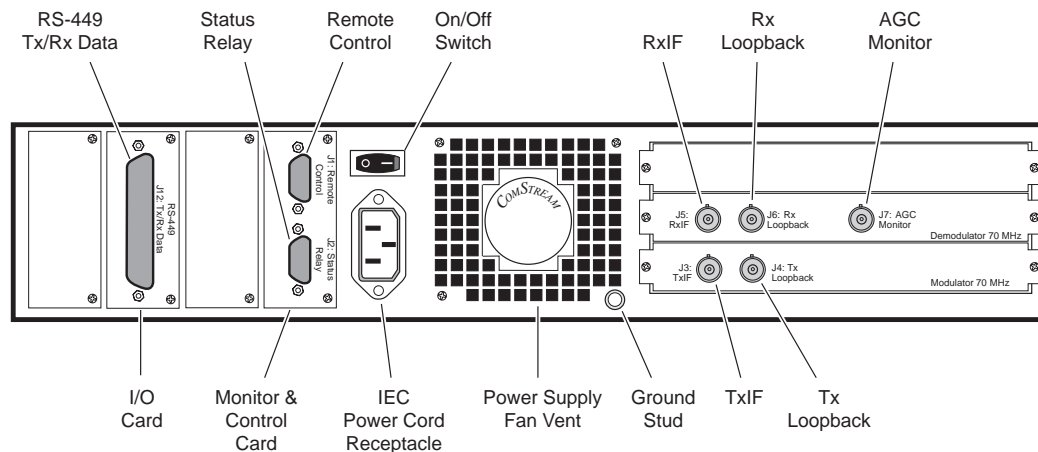
Figure 11-1   Example of Standard CM701 Rear Panel

All external connections are located on the rear panel and include:

- D-type female connector
- BNC female connector
- IEC AC receptacle

The exact location and appearance of the connectors may vary according to your CM701 configuration. Refer to the equipment labels for correct identification of connectors.

External Connections for Basic CM701 Configuration

The electrical specifications, physical pinouts, and functional descriptions for the following CM701 standard components are described in this section:

- AC Power Supply
- RS-449 Data Interface card
- M&C card
- Demodulator card
- Modulator card

AC Power Supply Card External Connections

The rear panel AC power supply is located in the center of the panel. The AC power supply includes:

- On/Off power switch
- Cooling fan
- Ground stud that accepts a banana plug, or a stripped and tinned wire

  The ground stud should have a solid, low impedance connection to AC or earth ground.

- IEC 320 Power Cord Receptacle, male

  The AC power supply is autoranging for input levels from 90 to 264 VAC at frequencies of 47 to 63 Hz.

AC wiring must be done in accordance with government standards and codes in effect at the CM701 installation site.

AC Power Cord Connector

The CM701 shipping kit includes the following two AC power cords:

- North American compatible power cord — which has an IEC-compatible female plug on one end and a North American-compatible male plug on the other. This cord is UL and CSA approved up to 125 VAC at 10A. This cord is ready to use with no user wiring required.

- International compatible power cord — which has an IEC-compatible female plug on one end, and three stripped and tinned bare wires on the other end. This cord is approved by many international safety agencies, including VDE, up to 250 VAC at 6A.

For information on international color codes, or if an unterminated power cord is supplied with the unit, refer to the Preface.

The RS-449 data interface card has a single, 37-pin, D-type, female connector labeled Tx/Rx Data.

The V.35, RS-232, DS-1, G.703, and other data interface cards have labeling similar to that of the RS-449; however, they each have unique reference designators. For detailed information and specifications for other option cards, refer to the specific manual which accompanies that card.

Tx/Rx Data Connector

The Tx/Rx data connector provides the data, clock, and data control signals between the CM701 and the user's data equipment. This interface standard is designed for data rates up to 10 Mbps with cable distances up to 61 meters (approximately 200 feet).

EIA RS-449 Electrical Specifications

The EIA RS-449 electrical specifications are shown in Table 11-1 for differential (RS-422) and single-ended (RS-423) drivers and receivers.

Table 11-1   Electrical Specifications for Differential and Single-Ended Drivers and Receivers

Driver	Specifications
Differential Driver (Output)	B – true signal, 0 or 5 volts A – inverted signal, 5 or 0 volts Less than 100 ohms between A and B
Single-Ended Driver (Output)	Greater than +3 volts or less than -3 volts, with respect to signal ground. Less than 50 ohms with respect to signal ground
Differential Receiver (Input)	B – true signal, 0 or 5 volts A – inverted signal, 5 or 0 volts 100 ohms between A and B
Single-Ended Receiver (Input)	Greater than +3 volts or less than -3 volts, with respect to signal ground. Minimum 4 k ohms, signal to ground
B and A are referenced in Table 11-3 to denote if signal of differential pair is true or inverted.	

The differential pair has a true signal (indicated by B) and an inverted signal (indicated by A). These two differential signals must always be opposite in polarity. With no line attenuation, each signal should be within ±1.5 volts of the nominal level, which is approximately 2.5 volts above signal ground. Driver and receiver impedance are included for reference only.

The Tx/Rx mechanical pinout is presented in Table 11-2.

Table 11-2   RS-449 Data Interface Connector Pinout

Description	Signal	Pin	Signal	Pin	Direction[1]
Send Data	SD-A	4	SD-B	22	Input
Station Timing	ST-A	5	ST-B	23	Output
Receive Data	RD-A	6	RD-B	24	Output
Request to Send	RS-A	7	RS-B	25	Input
Receive Timing	RT-A	8	RT-B	26	Output
Clear to Send	CS-A	9	CS-B	27	Output
Data Mode	DM-A	11	DM-B	29	Output
Terminal Ready	TR-A	12	TR-B	30	Input
Receiver Ready	RR-A	13	RR-B	31	Output
Transmit Timing	TT-A	17	TT-B	35	Input
Signal Quality[2]	SQ	33	-	-	Output
Signal Ground	SG	19	-	-	Ground
Send Common	SC	37	-	-	Ground
Common	-	20	-	-	Ground
Shield	-	1	-	-	Ground
Non-connected Pins: 2, 3, 10, 14, 15, 16, 18, 21, 28, 32, 34, 36					Open

1 Direction with respect to CM701
2 Signal Quality is a single-ended (RS-423) output signal.
A Inverted signal of a differential pair
B True signal of a differential pair.

The CM701 data connector is pinned out as Data Communications Equipment (DCE); therefore, the user's data equipment must be configured as data terminal equipment (DTE) in order to make a straight cable between them.

RS-449 Signal Descriptions

There are two types of RS-449 path signals: transmit and receive.

The signals associated with the transmit path are described in Table 11-3 while the signals associated with the receive path are described in Table 11-4.

Table 11-3   Transmit Path Signals

Transmit Path Signal	Description
Station Timing (ST)	A transmit clock generated by the CM701 when configured for *internal* timing. This clock is accurate to better than ±4 ppm.
Transmit Timing (TT)	The transmit clock provided to the CM701 by the DTE. Typically the CM701 is configured for EXTERNAL timing when TT is supplied.
Send Data (SD)	The transmit data is provided to the CM701 by the DTE. This data should be clocked on the rising edge of TT or ST, depending on which clock is being used, and be stable on the falling edge. The clock rate of TT and ST, together with the transition rate of SD, equals the transmit data rate of the CM701.

Table 11-4   Receive Path Signals

Receive Path Signal	Description
Receive Timing (RT)	The receive clock that is extracted from the receive signal by the demodulator
Receive Data (RD)	The demodulated data that is synchronous with and transitions on the rising edge of the RT

Clock/Data Relationships for the RS-449 Card

The external connection to the RS-449 I/O card is made through a single DB-37 connector. For differential signal pairs that carry clock signals, corresponding data signals must change on the falling edge of the B clock signal and remain stable on the rising edge of the B clock signal. Figure 11-2 illustrates RS-449 timing.
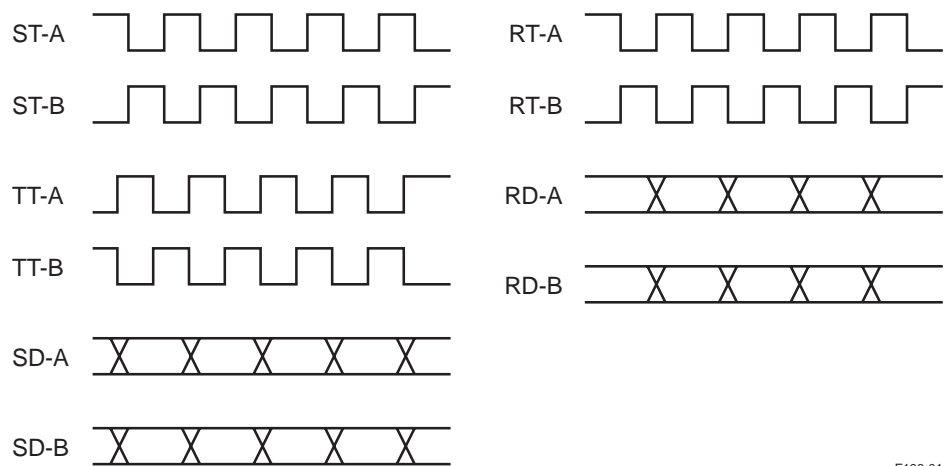
Figure 11-2   RS-449 Timing Diagram

The following should be noted regarding RS-449 timing:

- The ST clock from the modem bears no definite phase relationship to the TT clock or SD. In circuits with high data rates-greater than 512 kbps-or long cable runs-greater than 3 meters or 10 feet-it is critical that the modem latch data on the TT clock. This can be accomplished by setting the modem using the ML 0 command.

- SD must always transition coincident with the low to high transition of the TT-A clock. SD is latched into the modem on the high to low transition of the TT-A clock.

- RD from the modem always transitions on the low to high transition of the RT-A clock. RD should be latched by DCE equipment on the high to low transition of RT-A.

- When the modem is set for data control mode, using the CD 2 command, the data control signals RS, TR, DM, CS, and RR are defined, as shown in Table 11-5.

Table 11-5   Data Control Signals

Data Control Signal	Description
RS and TR	Setting both signals to On will allow the modem to transmit. (t is recommended that RS be used as the primary transmit control line. Setting either line to Off will disable the modem transmission.
DM	DM is set to On by the modem when data control mode is selected.
CS	CS is set to On by the modem when the modulator is ready to accept data.
RR	RR is set to On by the modem when the demodulator has acquired and is receiving valid data.

RS-449 Data Control Signals

For differential signal pairs that carry data control signals, an On condition is indicated by a positive state on the A signal, and an Off condition is indicated by a positive state on the B signal.

Applications Not Requiring Data Control Signaling

For most CM701 applications, data control signaling is not required. For these applications, data control is disabled by issuing the remote command CD 1. With CD set to 1:

- Output data control signals (CS and DM) are set permanently to the On state

- Input data control signals (RS and TR) are ignored

Applications Requiring Data Control Signaling

For applications requiring the use of data control signaling, a remote CD 2 command is issued that enables the CM701 to exchange data control signals with the DTE. With a CD 2 command issued:

- TR signal should be set On when the DTE is powered up

- DM signal will be On indicating that the CM701 is powered up and TR is On

With data control enabled (CD 2), the DTE must:

- Initiate data transmission by setting the Request-to-Send (RS) signal to On

- Wait for the CM701 to set the Clear-to-Send (CS) signal to On

    The CS signal indicates that the CM701 is ready to accept the data that the DTE needs to transmit.

When data control is enabled, RD is clamped when RR is not On to prevent garbage data from being passed by the CM701 to the DTE.

The CM701 will always set the RR signal to On when the entire receive path is locked to the receive signal and RD represents valid data. This will occur whether the CM701 Data Control mode is set to On or Off (CD 1 or 2).

Signal Quality

Signal Quality (pin 33) is supported only by the RS-449 interface. The signal is active when the CM701 E_b/N_0 falls below the user-specified threshold, which is set with the EBT remote command. Signal quality can be used to sound an alarm or log a fault condition when data integrity falls below the specified threshold.

Monitor & Control Card External Connections

The M&C card has the two 9-pin, D-type, female connectors described in Table 11-6.

Table 11-6   M&C Card Connectors

Connector	Purpose
Remote Control	Provides the RS-232 or RS-485 signals that connect the CM701 to the remote unit. Communication between the CM701 and the remote unit is asynchronous serial.
Status Relay	Provides Form-C status relay contacts for the CM701. It accepts three status relay signals from other equipment that can be monitored from the CM701 remote control unit.

Remote Control Connector

The remote control interface can be configured for RS-232 or RS-485 electrical levels remotely or through the front panel.

Signals from the electrical interface driver and receiver connections inside the CM701 are routed through relay contacts. These relay contacts enable one 9-pin connector to support both an RS-232 and RS-485 interface even though the two interfaces must share the same pins for different signals.

For details on selecting various remote configuration parameters, refer to the chapter on remote operations and command descriptions for the BR, MDP, MEI, MPT, MPA commands.

RS-485 Applications

For RS-485 applications, the 9-pin connector is used directly. To connect the CM701 and the remote unit with this straight cable, the CM701 is pinned out as a data DCE device, and the remote unit is configured as DTE.

The RS-485 specification defines a differential pair of signals that basically transition from 0 to 5 volts each. The RS-485, 9-pin remote control connector pinout is illustrated in Table 11-7.

Table 11-7   RS-485 J1: Remote Control Connector Pinout

Pin	Signal Name	Direction*
1	Signal Ground	Ground
3	Transmit +	Input
5	Receive +	Output
7	Transmit -	Input
9	Receive -	Output
2, 4, 6, 8	Not connected	Open

* For master-slave RS-485 bus connections, this pinout represents a slave when a straight cable is used to connect the devices on the bus. Note the signal directions, with transmit being an input and receive an output

RS-232 Applications

A 9-to-25-pin cable is included in every CM701 shipping kit for use in RS-232 applications. This cable is used to convert the 9-pin remote control interface connector to a 25-pin, RS-232 connector, which is commonly found on standard asynchronous computer terminals.

The RS-232 electrical interface defines a single-ended signal with valid levels from +3 to +12 volts and from -3 to -12 volts, with respect to signal ground.

Table 11-8 contains the 9-pin, RS-232 remote control connector pinout specifications. Table 11-9 contains the 9-to-25-pin adapter cable pinout specifications.

Table 11-8   RS-232 Remote Control 9-Pin Connector Pinout

Pin	Signal Name	Direction
1	Carrier Detect	Output
2	Receive Data	Output
3	Transmit Data	Input
4	Not connected	Open
5	Signal Ground	Ground
6	Data Set Ready	Output
7	Request-to-Send	Input
8	Clear-to-Send	Output
9	Not connected	Open

Table 11-9   RS-232 Remote Control 9-to-25-Pin Adapter Cable

Male D-type 9-pin	Female D-type 25-pin	Signal Name 5-pin
1	8	Carrier Detect
2	3	Receive Data
3	2	Transmit Data
4	20	Not connected
5	7	Signal Ground
6	6	Data Set Ready
7	4	Request-to-Send
8	5	Clear-to-Send
9	22	Not connected
-	1, 9-25	Not connected

A cable, described in Table 11-10, may be used in place of the RS-232 remote control 9-to-25-pin adapter cable if an RS-232, 9-pin conductor is in use.

Table 11-10   Customer Cable Replacement for RS-232 Remote Control
9-to-25-Pin Adapter Cable

Male D-type 9-pin	Female D-type 9-pin	Signal Name
1	1	Carrier Detect
2	2	Receive Data
3	3	Transmit Data
4	4	Not connected
5	5	Signal Ground
6	6	Data Set Ready
7	7	Request-to-Send
8	8	Not connected
9	9	Not connected

Status Relay Connector

The Status Relay connector on the M&C card provides:

- Three connections to a Form-C CM701 current fault status relay

- Three pairs of sense signal pins that can be connected to status relays of any other equipment, for example, an outdoor radio.

  Sense signals can be monitored from the CM701 remote terminal or the front panel.

The Status Relay connector pinout is provided in Table 11-11.

Table 11-11   Status Relay 9-Pin Connector Pinout

Pin	Signal Name	Description
1	Status Relay B	Form-C normally open contact
2	Status Relay C	Form-C Common contact
3	Relay Sense Pin 3	Relay sense signal
4	Relay Sense Pin 4	Relay sense signal
5	Relay Sense Pin 5	Relay sense signal
6	Status Relay A	Form-C normally closed contact
7	Ground	Relay sense signal return
8	Ground	Relay sense signal return
9	Ground	Relay sense signal return

Form-C Current Fault Status Relay Usage

The Form-C Current Fault Status Relay is a real-time indicator for certain user-specified current fault conditions. The Form-C relay has three passive relay contacts:

- One common contact - C

- Two other contacts - A and B

Normally, C is connected to A and not connected to B. However, when the relay is indicating a selected fault condition, C is connected to B and not connected to A.

The Form-C relay allows the user to have both normally open (C-B) and normally closed (C-A) contact pairs available to monitor. For example, the Form-C relay indicates an abnormal, or fault, condition when power is off. This condition is indicated by contact between C and B with no contact between C and A.

Status Relay Fault Conditions

The Status Relay can be used to indicate the user-specified fault conditions listed in Table 11-12.

Table 11-12   User-Specified Fault Conditions

NVRAM Failure	Low E_b/N_0
Rx IF Synth Fault	Tx IF Synth Fault
Rx AGC Range Fault	Tx Bit Timing Fault
Bit Time Sync Loss	Tx Power Fault
Carr Track Sync Loss	Tx FIFO Full Fault
Decoder Sync Loss	BERT Sync Loss
Acquisition Failure	Relay Monitor Pin 3
Output Buffer Fault	Relay Monitor Pin 4
Rx Carr Range Fault	Relay Monitor Pin 5
Rx BT Range Fault	—

The fault conditions on this list are bit mapped into the CM701 current fault status register. Each condition is designated by a single bit, as described in Table 11-13.

Table 11-13   Bit Conditions

Bit	Condition
0	The condition does not exist.
1	The condition exists.

Commands Used with the Status Relay

The commands in Table 11-14 are used with the Status Relay.

Table 11-14   Commands Used with the Status Relay

Command	Description
Current Fault Status (ST)	Used to review the current fault status register and bit mapping.
Current Fault Overlay Mask (FO)	Used to designate the fault conditions that will be monitored and reported by the status relay. This command represents a register the same size as the current fault status register. To designate which fault conditions will affect the status relay, the corresponding fault condition bit is set to 1.
Fault Relay Sense (FR)	Used to change the polarity of the Form-C status relay accessed through the status relay connector on the rear panel.
View Current Fault Status (VS)	Used to review a card-by-card, detailed list of fault conditions that exist for each card.

For additional information on each of the fault conditions or the ST, VS, and FO commands, refer to the chapter on troubleshooting and maintenance.

Specifying Status Relay Fault Conditions

To specify status relay fault conditions, follow these steps:

1. Select the fault conditions that will affect the status relay.

2. Use the ST command to identify the bits in the current fault status register which correspond to the selected faults.

3. Use the FO command to set the selected fault bits to 1 and all nonselected fault bits to 0.

Both the current fault reporting register and the status relay are real-time indicators. If a condition exists, it will be indicated. If the condition does not exist or vanishes, the status relay will report a normal condition.

Relay Sense Pins Usage

The Status Relay has three sense signal pins, as shown in Figure 11-3, that can be used to monitor and report a relay sense pin condition or fault. Each relay sense pin is paired with a ground pin that is connected directly to chassis ground.
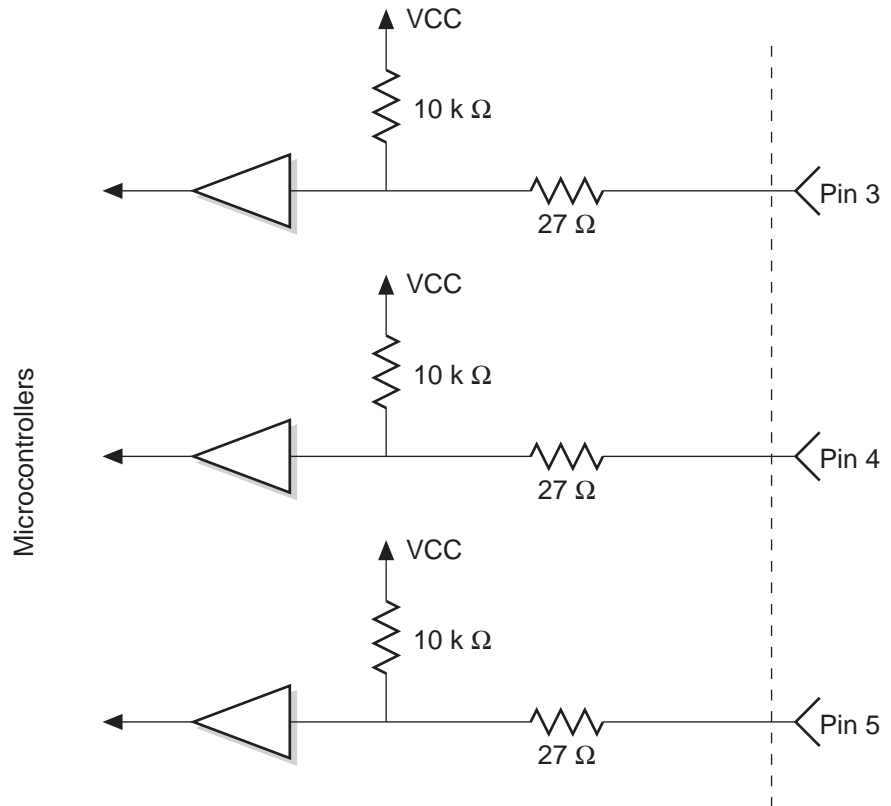
Figure 11-3   Relay Sense Pins

Each relay sense pin is also connected to the input of a bipolar buffer through a 27 ohm series resistor that is connected to a 10 k VCC (+5 volts) pull-up resistor. The bipolar buffer is monitored by the CM701 microcontroller and the buffer's condition is mapped to the current fault status and fault log registers. The current fault status register is maintained in real time; the fault log register maintains a historical record of every fault that has occurred since the faults were last cleared.

Under normal operating conditions, some equipment status relays are open while others are closed. The Fault Relay Sense External signal polarity (FRX) command is used to define the fault polarity of the relay sense pins as open or closed relay contact to ensure accurate monitoring of those conditions.

For more information on fault status and fault log registers, refer to the ST, FL, and FR commands in the command descriptions chapter. For information on remote fault monitoring and fault reporting, refer to the troubleshooting chapter.

Commands Used with Relay Sense Pins

The commands in Table 11-15 are used with relay sense pins.

Table 11-15   Commands Used with Relay Sense Pins

Command	Description
Fault Relay Sense External Signal Polarity (FRX)	Used to define whether a fault condition is a closed relay contact or an open relay contact for each of the three fault relay signals bits
Current Fault Status (ST)	Used to review the current fault status register and bit mapping, with resulting data shown as a decimal number that corresponds to a current fault condition
View Current Fault Status (VS)	Used to review the current fault status register, with resulting data provided in a card-by-card listing accompanied by a detailed description for each current fault condition
Faultlog Query (FL)	Used to review the stored, historical fault log register, with resulting data shown as a decimal number that corresponds to a current fault condition
View Faults (VF)	Used to review the stored, historical fault log register, with resulting data provided in a card-by-card listing accompanied by a detailed description for each current fault condition
View Faults with Time Stamp (VFT)	Used to view the first 10 faults that occurred since the faults were last cleared

Specifying a Relay Sense Pin Fault Condition

To specify a relay sense pin fault condition:

1. Select the relays to be monitored by the CM701.

2. For each selected relay, wire one side of the relay to a CM701 Relay Sense Pin and the other side of the relay to a CM701 ground pin.

3. Use the FRX command to define the correct polarity of the relay for a fault condition.

4. Use the ST or VS commands to monitor the real-time faults of the relays.

5. Use the FL or VF commands to monitor the fault history of the relays.

6. Supply the network or systems control center operator with relay sense pin specifications and equipment connections (for example, to radio transmit, radio receive, or another part of the system). The operator can then take the appropriate corrective action when a relay sense pin condition or fault appears.

Demodulator Card External Connections

There are three female BNC connectors on the demodulator card, which are described in Table 11-16.

Table 11-16   Demodulator Card BNC Connectors

Connector	Function
RxIF connector	Receives the IF signal from a downconverter
Rx Loopback connector	Receives the IF loopback signal from the modulator Tx Loopback connector
AGC Monitor	Is an AGC level monitor output signal

The two holes in the filler plate located below the AGC Monitor silk-screened label identifier provide access to the baseband digitized I and Q signals. They are test points for factory technician use only. Do not insert any probes or foreign objects into these holes.

RxIF Connector (BNC)

The RxIF connector is used to receive the IF signal from a downconverter.

The power of the input signal must be in the range of -10 dBm to -55 dBm. The IF frequency must be in the range of 52 to 88 MHz, or, if a 140 MHz version demodulator is installed, range from 104 to 176 MHz.

The aggregate input power in the receive band (52 to 88 MHz or 104 to 176 MHz) must be less than 0 dBm, with a delta not to exceed 25 dB between the receive signal and the highest signal in the receive band. The input impedance is 75 ohms.

Rx Loopback Connector (BNC)

The Rx Loopback connector is used to receive the IF loopback signal from the modulator Tx Loopback connector.

The input signal level is approximately -20 to -40 dBm. The IF loopback test feature requires:

- Short coaxial cable between the demodulator Rx Loopback connector and the modulator Tx Loopback connector

  A 3.5 inch loopback coaxial cable is included in every CM701 shipping kit.

- Modulator and demodulator IF frequencies to be the same in order for the IF loopback test to work properly

  If the modulator and demodulator IF frequencies are not the same, either 70 or 140 MHz IF, the IF loopback test will not operate.

AGC Monitor Connector (BNC)

The AGC Monitor connector provides an output DC level between 5 and 10 volts, which is proportional to the power level of the receive signal. For example, 5 volts implies no signal is present at the RxIF input; 10 volts implies that a large signal is present.

The AGC Monitor signal levels vary considerably from one CM701 to another. In addition, signal levels can be affected by temperature. For this reason, this signal is a good measure of relative receive signal power; however, it is not a good measure of absolute receive signal power.

The AGC Monitor output level may be used as an aid for pointing and aligning the earth station antenna.

Modulator Card External Connections

There are two female BNC connectors on the Modulator card:

- TxIF

- Tx Loopback

Each of these connectors provides an IF signal output.

TxIF Connector (BNC)

The TxIF connector provides the transmit IF output to an upconverter. The CM701 modulator has electronically adjustable output power. The output power adjustments can be made through either:

- Front panel using the Tx Pwr Level command

- Remote unit using the TP command

The output power can be adjusted between -5 dBm and -25 dBm, in 0.1 dB steps. The output frequency is programmable in the range of 52 to 88 MHz, or 104 to 176 MHz if a 140 MHz modulator is installed. The output impedance is 75 ohms.

Tx Loopback Connector (BNC)

The Tx Loopback connector is used to transmit the IF loopback signal to the demodulator Rx Loopback connector. The output signal level is approximately -20 dBm down to -40 dBm.

To perform an IF loopback test, a short coaxial cable is required between the demodulator Rx Loopback connector and the modulator Tx Loopback connector. A 3.5 inch loopback coaxial cable is included in every CM701 shipping kit.

In addition to the loopback coaxial cable, the demodulator and modulator IF frequencies must be compatible for the IF loopback test to work properly. Both the modulator and demodulator must be either 70 MHz IF or 140 MHz IF. If the frequencies are not compatible, the IF loopback test will not work.

Fault Handling, Troubleshooting, and Maintenance

12

This chapter includes the following information:

- Handling, reporting, and logging of faults
- Querying faults
- Listing of standard faults
- Interpreting fault logs
- Using fault overlay masks
- Troubleshooting CM701 problems
- Performing specification, system validation, fault isolation, and board-level hardware tests
- Specifying a data interface when two or more interface cards are installed in a CM701
- Upgrading software
- CM701 test capabilities
- Installing and removing option cards
- Performing general CM701 maintenance

Fault Handling The CM701 continually checks for any internal hardware faults that may require card replacement, and for operational or fault conditions that may require a change in parameters or system configuration. CM701 commands can be used to:

- Establish the fault conditions that will be monitored and reported by the rear panel status relay connector
- Determine the manner in which external fault conditions are interpreted
- Define the conditions under which fault messages are displayed on the remote terminal or the front panel
- Clear the fault log, thereby resetting fault log register bits to nonfault conditions
- Query the CM701 for its current fault status
- View the faults that have been logged since the last CF command was issued

Fault Reporting

You, the operator, set the faults that are to be monitored and reported, as well as the conditions under which fault messages appear. The commands used to set the faults can be issued from a remote terminal or through the terminal emulator.

Once set, these fault conditions are monitored and reported by the rear panel status relay connector and their corresponding fault messages are displayed on the remote terminal or front panel.

Specifying Faults to be Monitored and Reported

The following commands are used to set which faults are monitored and reported:

- Current Fault Overlay Mask (FO) — specifies the fault conditions that are monitored and reported by the rear panel status relay. The FO parameter is set to the sum of the bit weights of the selected faults.

- Fault Relay Polarity (FR) — this remote command defines whether a current fault condition is reported on the status relay as a contact between the normally closed or normally open contact pairs of the Form C status relay.

- Fault Relay Sense External Signal Polarity (FRX) — specifies how the CM701 will interpret the external faults that are monitored by the relay sense pins. The FRX parameter defines whether a fault condition is a closed relay contact or an open relay contact for each of the three relay sense pins.

Conditions for Remote Fault Messages

If a fault condition is detected by the CM701, an unsolicited fault message is displayed on the remote terminal *only* for systems using ASCII remote protocol. Depending upon the AL setting, a message may also appear when the fault no longer exists. The AL command is used to enable or disable fault reporting and to prevent unsolicited fault messages from being issued to the remote terminal.

For example, assume that the receive signal has become too weak to detect.

- If AL = 0 or 3, a query would have to be issued to discover the fault.

- If AL = 1, the CM701 would automatically display several fault message on the remote terminal.

Now assume that the demodulator gains sync:

If AL = 0 or 1, an unsolicited ST 0 would appear on the remote terminal.

If AL = 3, a query would have to be issued to learn that the fault no longer exists.

Conditions for Front Panel Fault LEDs

The CM701 displays two fault LEDs on the front panel. One illuminates yellow and the other red. To specify which faults will cause these LEDs to illuminate, use the following commands:

- Fault Log Overlay Mask (FLO) — specifies which fault log conditions will cause the yellow front panel fault message to illuminate.

- Current Fault Status Overlay Mask (STO) — specifies which fault conditions will cause the red front panel fault message to illuminate.

The FLO and STO command parameters should be set to the sum of the bit weights of the selected faults.

Fault Logging   Once a fault is detected by the CM701, it is reported and stored in both a 32-bit status register and a 32-bit fault log register. The bits found in either registers are identical and identify which bit is assigned to which fault. The status and fault registers differ in that the:

- Status register only retains faults that are currently occurring

- Fault log register retains faults until they are cleared with the CF command

Each fault message is issued only once; subsequent occurrences of that fault will *not* cause fault messages to appear until the fault log register is cleared.

At power-up or reset, all fault log register bits are set to fault conditions and must be cleared with a remote CF or front panel Clear command before faults can be successfully monitored. The first 10 faults in the fault history log are recorded with a date and time stamp and are saved in volatile memory for subsequent viewing.

Fault Queries   The status of the CM701 can be quickly determined by checking the front panel LEDs. If any fault LEDs are illuminated, the current fault status and fault log registers can be queried from either the front panel or the remote unit for further information.

Current fault status queries return real-time reporting of CM701 fault conditions present only at the time of the query. Prior conditions are *not* included. To determine the current fault status of the CM701 use the following commands:

- Remote Commands

  - Current Fault Status query (ST ?) — displays a decimal number that represents the contents of the bit-mapped current fault status register for the CM701. The decimal number must be converted to binary, the binary 1s must be located, and, finally, the bit locations of the binary 1s must be matched with the corresponding fault condition.

  - View Status query (VS ?) — displays a detailed fault list for each installed card followed by the active fault conditions. The list includes the name of the card, slot location, and descriptions of the faults.

- Front Panel — current faults command displays the current (real-time) status of the CM701. If there are no fault conditions, `Modem Status OK` is displayed. If there are faults, they are displayed in a scrollable list. After 10 seconds of inactivity on the front panel push buttons, the LCD will update the list with any new faults and automatically return to the top of the list.

The fault log, which is a historical record of the CM701 fault conditions, can be queried using the following commands:

- Remote Commands
  - Fault Log query (FL ?) — returns a decimal number representing the bit-mapped fault log register. The decimal number must be converted to binary, the binary 1s must be located, and, finally, the bit locations of the binary 1s must be matched with the corresponding faults.
  - View Faults query (VF ?) — displays a complete card listing that includes the name of the card, slot location, and descriptions of all faults that have occurred since the faults were last cleared.
  - View Faults with Time Stamp query (VFT ?) — displays a list of *only* the first 10 faults that occurred since the fault log register was cleared. The list includes fault descriptions with date and time stamps. The information is saved in volatile memory for subsequent viewing. This feature is very helpful when tracking infrequent system problems, especially those that occur at unmanned sites.
- Front Panel — the Fault Log command displays the fault log. If there are no fault conditions, `Modem FaultLog is Clear` is displayed. If there are faults, they are displayed in a scrollable list.

Standard CM701 Faults

Standard CM701 faults are listed in Table 12-1 by fault log register bit. Included for each fault is the:

- Fault log register bit
- Weight
- Displayed fault message
- Type of fault,
  - Hardware (H) – caused by a circuitry failure in the CM701; usually requires diagnosis and replacement of a faulty card
  - Operational (O) – indicates real or potential problem in the communications path; requires search for an abnormal operating condition and action as appropriate
- Description of the fault
- Possible causes of the fault

For descriptions of faults specific to those cards, the appropriate option card manuals.

Table 12-1   CM701 Fault Summary

Bit	Weight	Fault	Type	Description	Possible Cause
—	0	(No faults)	—	—	—
1	1	Tx Power Fault	H or O	Modulator transmit power control circuit has exceeded its dynamic range either at the power detector or the power control blocks	Type H - May occur during configuration changes. If this fault occurs repeatedly during steady state operation, the modulator power control circuit may be faulty, or it may be operating outside the specified power range. Type O - May occur if running without scrambling (SM 0) and no data is provided.
2	2	TxIF Synth Fault	H	Modulator IF synthesizer is out of lock	May occur when the synthesizer frequency is commanded to change. If this fault occurs during steady state operation, the modulator synthesizer may be faulty, or it may be operating outside the specified frequency range. When this fault occurs, the modulator IF transmission is disabled.
3	4	RxIF Synth Fault	H	Demodulator IF synthesizer is out of lock	May occur when the synthesizer frequency is commanded to change. If this fault occurs during steady state operation, the demodulator synthesizer may be faulty, or it may be operating outside the specified frequency range.
4	8	Tx Bit Timing Fault	H or O	Modulator bit time synthesizer is not locked	Valid only when the CM701 is operated in external or loop timing mode. Type H - When this fault occurs, the modulator IF transmission is disabled unless the OM command parameter is set to 1, in which case this fault has no effect on the modulator transmit IF. Type O - The TT clock that has been provided does not match the specified Transmit Data Rate.
5	16	Rx AGC Range Fault	O	IF input signal to the demodulator is less than -55 dBm or greater than -10 dBm	Typically caused by a signal that is too small due to a rain fade or other environmental condition in the satellite link.
6	32	Bit Time Sync Loss	O	Demodulator bit time loop has lost lock	Typically caused by excessive phase noise on the RF upconverter or downconverter in the satellite link, resulting in excessive clock jitter on the receive signal into the demodulator. When this fault occurs, the CM701 receive data output signal (RD) is disabled if data control is enabled.
7	64	Carr Track Sync Loss	O	Demodulator carrier tracking loop has lost lock	Typically caused by excessive phase noise on the RF upconverter or downconverter in the satellite link or an IF receive signal that is below the minimum specified receive signal level for the CM701 demodulator. When this fault occurs, the CM701 receive data output signal (RD) is disabled if data control is enabled.

Table 12-1   CM701 Fault Summary

Bit	Weight	Fault	Type	Description	Possible Cause
8	128	Decoder Sync Loss	O	Decoder output BER is roughly below 10-2	Typically caused by excessive phase noise on the RF upconverter or downconverter in the satellite link or an IF receive signal that is below the minimum specified receive signal level for the CM701 demodulator. When this fault occurs, the CM701 receive data output signal (RD) is disabled if data control is enabled.
9	256	Acquisition Failure	O	Demodulator searched the entire acquisition range (typically *30 kHz) and failed to acquire a receive signal	Usually occurs during a rain fade or any other loss of receive signal.
10	512	Rx Carr Range Fault	O	Demodulator carrier tracking digital control word is at its limit	Typically occurs when there is a significant difference between the frequency of the receive carrier and the receive synthesizer frequency programmed into the demodulator.
11	—	—	—	Not used.	—
12	2048	Rx BT Range Fault	O	Demodulator clock recovery tracking digital control word is at its limit	Typically occurs when there is a significant difference between the frequency of the transmit clock on the uplink of the link and the expected clock frequency. The demodulator can recover a bit time clock that is within about 300 ppm of the clock rate for which it is configured.
13	4096	NVRAM Failure	H	A parameter stored in a nonvolatile memory location is corrupt	Repeated occurrence of this fault indicates a faulty, nonvolatile memory that may occur on any card and should be replaced. Configuration parameters can be changed about 10,000 times before nonvolatile memory operation may be impaired. Use the NVO command to inhibit writing to nonvolatile memory when a configuration or other nonvolatile command is entered.
14	8192	Receive Buffer Overflow	—	Doppler Buffer fault	Refer to the Doppler Buffer manual.
15	16384	Receive Buffer Underflow	—	Doppler Buffer fault	Refer to the Doppler Buffer manual.
16	32768	(card-specific)	H	Selectable or mode-dependent fault	This fault is typically caused by a faulty card.
17	65536	ODU Tx Fault	—	Earth station fault	Refer to the appropriate DT7000 or DT8000 manual.
18	131072	ODU Rx Fault	—	Earth station fault	Refer to the appropriate DT7000 or DT8000 manual.
19	262144	Relay Monitor Pin 3	H	Fault reported by fault sense signals on the rear panel fault connector	The CM701 can monitor status relay pins and report a fault as defined by the FRX command.

Table 12-1   CM701 Fault Summary

Bit	Weight	Fault	Type	Description	Possible Cause
20	524288	Relay Monitor Pin 4	H	Fault reported by fault sense signals on the rear panel fault connector	The CM701 can monitor status relay pins and report a fault as defined by the FRX command.
21	1048576	ODU M&C fault	—	Earth station fault	Refer to the appropriate DT7000 or DT8000 manual.
22	2097152	Loss of Rx Clock	—	Doppler Buffer fault	Refer to the Doppler Buffer manual.
23	4194304	Loss of Tx Clock	—	Doppler Buffer fault	Refer to the Doppler Buffer manual.
24	8388608	Relay Monitor Pin 5	H	Fault reported by fault sense signals on the rear panel fault connector	The CM701 can monitor status relay pins and report a fault as defined by the FRX command
25	16777216	(vertical option Tx summary fault)	—	—	Card-specific messages.
26	33554432	BERT Sync Loss (vertical option Rx summary fault)	O	Internal BERT lost data synchronization	The demodulator is not in sync and is not passing valid data to the BERT. Card-specific messages may also be associated with this fault bit.
27	67108864	(vertical option Tx hardware fault)	—	—	Card-specific messages.
28	134217728	(vertical option Rx hardware fault)	—	—	Card-specific messages.
29	268435456	Tx FIFO Full Fault (horizontal option Tx summary fault)	O	Data buffer on the modulator has overflowed or underflowed	This fault may occur briefly when changing modulator data rates or changing modulator timing (MB). In addition, if the modulator is running external timing and the user-provided clock (TT) does not match the clock expected by the modulator (TD - data rate), the fault may occur. Card-specific messages may also be associated with this fault bit.

Table 12-1   CM701 Fault Summary

Bit	Weight	Fault	Type	Description	Possible Cause
30	536870912	Low E_b/N_0 Output Buffer Fault (horizontal option Rx summary fault)	O H or O	Demodulator E_b/N_0 level has dropped below the user-specified threshold (EBT) Data buffer on the demodulator has overflowed or underflowed	There has been a decrease in input power level; probably due to a rain fade. This fault may occur briefly during operation, for example, when changing demodulator data rate. If this fault is reported constantly, there is a hardware problem in the demodulator. Card-specific messages may also be associated with this fault bit.
31	1073741824	(horizontal option Tx hardware fault)	—	—	Card-specific messages.
32	2147483648	(horizontal option Rx hardware fault)	—	—	Card-specific messages.

Interpreting Fault Logs   To determine the faults indicated by a fault log command response:

- Convert the decimal number to a binary number

- Note the position of the binary values

Binary 1 indicates that one of the fault conditions occurred, while binary 0 indicates that the fault condition did not occur.

For example, consider a fault log response of 4696. The binary equivalent of this decimal number is 1001001011000. The 1 values in this binary number indicate that five separate faults occurred. The least significant position (reading right-to-left) is the fourth, which means that a transmit bit time fault (bit 4 on the fault listing) has occurred.

The remaining bit positions are 5, 7, 10, and 13, which correspond to the following faults:

- Bit 5 – Rx AGC range fault

- Bit 7 – Carr track sync loss

- Bit 10 – Rx carr range fault

- Bit 13 – NVRAM failure

Fault Overlay Masks   CM701 overlay mask commands can be used to designate the fault conditions that trigger the front panel red and yellow fault messages or the rear panel status relay. The CM701 has a 32-bit fault log register and a 32-bit current fault register that has each bit assigned to represent a single fault or a group of faults.

The mask commands are as follows:

- Faultlog overlay (FLO) – affects yellow fault message on the front panel
- Status overlay (STO) – affects red fault message on the front panel
- Fault overlay (FO) – affects status relay on the rear panel

The FLO, STO, and FO command parameters should be set to the sum of the weights of the selected faults.

For example, the faults in Table 12-2 were set to illuminate the fault LEDs.

Table 12-2   Fault Overlay Masks Example Data

Bit	Weight	Fault
1	1	Tx Power Fault
2	2	TxIF Synth Fault
3	4	RxIF Synth Fault
4	8	Tx Bit Timing Fault
5	16	Rx AGC Range Fault
6	32	Bit Time Sync Loss
7	64	Carr Track Sync Loss
8	128	Decoder Sync Loss
12	2048	RxBT Range Fault
22	2097152	Loss of Rx Clock (doppler buffer card)
23	4194304	Loss of Tx Clock (doppler buffer card)
Total	**6293759**	

To set these faults to illuminate the LEDs, the following commands would be issued through the remote terminal or front panel terminal emulator:

- Yellow fault message - issue the `FLO 6293759` command
- Red fault message - issue the `STO 6293759` command

To set these faults to affect the rear panel status relay, issue `FO 6293759`

Troubleshooting Tips   The troubleshooting tips in Table 12-3 were designed to help you diagnose and correct minor operational problems in the unlikely event that you experience difficulties with your CM701.

For the problems listed, solutions are provided to help you troubleshoot CM701 difficulties. If you try all the suggested solutions and the unit still fails, call ComStream Customer Service.

Table 12-3   CM701 Troubleshooting Common Problems

Problem	Possible Causes	Solutions
M&C Problems		
Commands typed in are not displayed on the RS-232 terminal.	■ Command echo is not enabled.	■ Make sure the command echo is enabled by issuing the EE 1 command.
	■ Terminal is not properly configured as a DTE and/or does not have duplex communications enabled.	■ Verify that the terminal is properly configured as a DTE and has full duplex communications enabled.
Sign-on message is not displayed on ASCII terminal after power-up.	■ CM701 is not receiving power.	■ Verify that power is being supplied to the unit (some front panel LEDs should be lit).
	■ The RS-232 cable is not properly connected.	■ Verify that the RS-232 cable is connected via the 9-to-25-pin converter cable.
	■ Protocol mode and remote control electrical are not properly configured.	■ Verify that the modem is in ASCII protocol mode and that the remote control electrical is selected as RS-232.
	■ Selected parity and baud rates are not properly configured.	■ Verify that the selected parity (either 8/none or 7/odd) and baud rate match that of the terminal.
Transmit Problems		
Carrier is not being transmitted.	■ Modem is set for external timing but is not receiving TT clock from the DTE.	■ Ensure that the DTE is supplying a TT clock and that the data cable is providing continuity between the modem and the DTE.
	■ Modem is set for data control enable but RTS is not set.	■ If the modem is set for DATA CONTROL enabled, verify that the RTS control signal on the data interface is set.
Modulator Transmit Bit Time Fault (FL_8) displays when modem is configured for External Bit timing.	■ The modem probably is not receiving a TT clock from the DTE.	■ Ensure that the DTE is supplying a TT clock and that the data cable is providing continuity between the modem and the DTE.
	■ Modem is set for internal timing and set to latch data on the TT clock (ML 0 command).	■ Ensure that the TR, TC, and TM command parameters are set resulting in a user data rate that equals the TT clock frequency. Use the TT query to verify.
Output power for modulated carrier is not present, but output power is present for Pure Carrier Operation.	■ Data control is used on the DTE interface, but handshake signals from the DTE are not activated.	■ When data control is used on the DTE interface, ensure that the handshake signals from the DTE are activated.
	■ Modulator scrambling is off when operating internal timing without transmit data.	■ When operating internal timing without transmit data, ensure that modulator scrambling is on.

Table 12-3   CM701 Troubleshooting Common Problems

Problem	Possible Causes	Solutions
Receive Problems		
Carrier lock is not stable. The data is corrupted although the modem appears to have locked.	■ Modem is operating with very little or no noise and has false locked.	■ The False lock has a receive offset and transmit offset) differing by $\frac{1}{4}$ or $\frac{1}{2}$ of a symbol rate. This only occurs with low symbol rate modems (<100 ksps) when the modem operates with an extremely high E_b/N_0. When there is no noise floor, the demodulator AGC may pick up very low-level, residual signals and try to lock to them. This is typically not a problem for normal operation over a satellite.
	■ The E_b/N_0 level is too low.	■ Check the E_b/N_0 level to verify that it is too low.
Modem will not acquire the incoming carrier.	■ Cables are not connected properly.	■ Verify that all cables are connected correctly.
	■ Modulator output is not enabled at the far end.	■ Verify that the modulator output is enabled at the far end.
	■ Modulator and demodulator parameters are not compatible.	■ Verify that the modulator and demodulator configuration parameters are compatible.
	■ Signal-to-noise ratio is not correct.	■ Verify that the signal-to-noise ratio is sufficient for operation.
	■ Modem has not searched the entire acquisition range.	■ Verify the fault registers to determine if the modem has searched the entire acquisition range.
	■ If operating in QPSK mode, there may be a spectral inversion problem introduced in the upconversion or downconversion process.	■ Use the MI or DI command to compensate for this. Spectral inversion problems should be corrected on the uplink modulator.
	■ Signal is not present on the RxIF connector.	■ Verify the AG parameter to ensure that a signal is present on the RxIF connector. A value of 255 indicates no signal; values of 20 to 170 indicate a good signal level.
Modem has occasional decoder sync loss, but no carrier tracking loss or bit time lock.	■ Rain fades or other loss of signal power will cause decoder faults before carrier tracking or bit timing faults.	■ Ensure that the E_b/N_0 level is sufficient.
	■ Excess phase noise or interference in the up- or downconverter chain may be the cause if E_b/N_0 level is sufficient.	■ Upconverter or downconverter may be insufficient for the application, or the modem may be in need of repair.
Output data is corrupted after the modem has acquired.	■ Modulator/demodulator configuration parameters are not compatible.	■ Verify that the modulator/demodulator configuration parameters are compatible modulation type, scrambling, differential coding, symbol rate, and code type.
System Problems		
DTE periodically loses synchronization, but the modem operates normally.	■ DTE requires the same clock to be used to clock transmit data and receive data.	■ An elastic data buffer is needed between the DTE and the modem Rx Data output to correct for clock frequency differences caused by the doppler shift. ■ Ensure that the modem and DTE agree on which one is supplying the transmit timing.

CM701 Specification Testing

To perform specification testing, the following equipment is required:

- Oscilloscope
- Spectrum analyzer
- Precision frequency counter
- Power meter
- IF noise test set
- Bit error rate tester (BERT)
- Coaxial cables (75 ohm is recommended, but a 50 ohm cable is acceptable)
- Data cable

Hardware Self-Test

To perform a CM701 hardware self-test, issue the self-test command from either:

- A remote unit, issue **BIT 0**.
- The front panel, select **Self Test** from Config>M&C>Misc.

Each installed card will be processed through a hardware self-test, and the results will be reported on the front panel LCD or remote terminal.

Modulator Output Signal Test

To verify the output signal characteristics of the modulator, follow these steps:

1. Cable a power meter, spectrum analyzer, or frequency counter to the TxIF connector on the rear panel.

2. Enable the modulator from either:

   - A remote unit, issue **EM 1**
   - The front panel, press the **Tx Enable** button

Modem Performance Test

To verify modem performance with an external BERT, follow these steps:

1. Cable a DTE-configured BERT to the Tx/Rx Data connector on the CM701 rear panel.

2. Ensure that the internal CM701 BERT is disabled from either:

   - A remote unit, issue **BEN 0**
   - The front panel, select the **BERT DISABLED** option from Config>BERT>BConfig

3. Combine the modulator output TxIF with a controlled IF noise source and connect it to the demodulator RxIF input port.

4. Set various E_b/N_0 levels by attenuating the noise power or the modulator output power so that various performance points can be measured. The equation is:

$$E_b/N_0 = C - 10Log(\text{Data Rate}) - N_0$$

where C is carrier power and N_0 is noise power density.

Performance testing can be repeated at various data rates, coding rates and types, and modulation types (BPSK and QPSK).

Other Specification Tests

Specification compliance tests can also be performed with the previously described test for the following:

- IF power dynamic range

- Acquisition range

- Acquisition time

- Symbol rate range

- Aggregate power

For test instructions for other cards, refer to the specific manual that accompanies that card, as each card has particular configuration parameter requirements and validation test steps.

System Validation and Fault Isolation Tests

The following CM701 system validation and fault isolation tests can be performed:

- Near data loopback

- IF loopback

- Satellite loopback

- Far data loopback

- Long-term BER measurement

Near Data Loopback

A near data loopback test, shown in Figure 12-1, validates the connection between the DTE and the CM701.
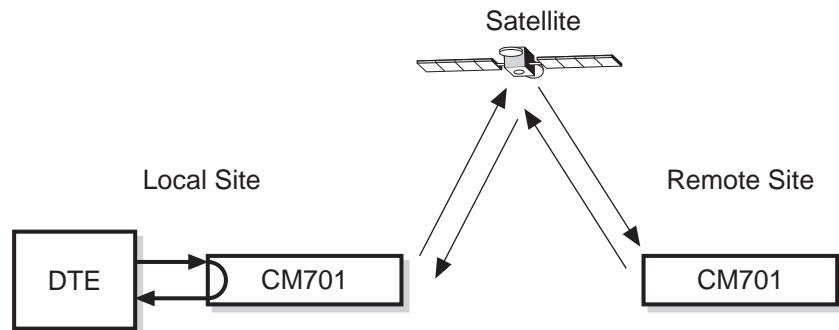
Figure 12-1   Near Data Loopback

Place the CM701 in a near data loopback by performing one of the following:

- Issue a remote near data loopback command: **LB 2**
- From the front panel:
  a. Access the **Config>4:Systm** command list
  b. Select the **Loopback** option (the parameter will blink)
  c. Select the **Near** parameter
  d. Press the Enter button to execute the command

If the DTE receives the transmit data back as receive data with no errors, a successful near data loopback has been accomplished.

If error-free data is not received by the DTE, verify:

- Cabling
- Data control handshaking of the DTE

IF Loopback

An IF loopback, shown in Figure 12-2, tests the CM701 transmit and receive paths, including IF modulation and demodulation, . This loopback also uncovers timing problems between the DTE and the CM701.

Satellite

Local Site   Remote Site

```
┌───────┐      ┌─────────────┐              ┌─────────────┐
│  DTE  │ ───► │    CM701    │╮             │    CM701    │
│       │ ◄─── │             │╯             │             │
└───────┘      └─────────────┘              └─────────────┘
```

F201-01
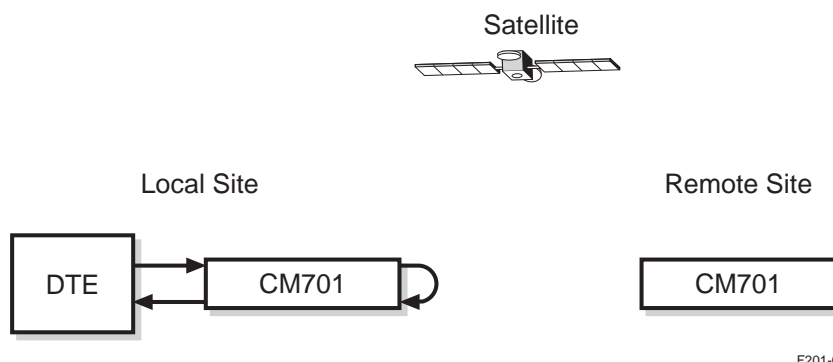
Figure 12-2   IF Loopback

To place the CM701 into an IF loopback either:

- Issue a remote **LB 1** command

- From the front panel:

    a.   Access the **Config>4:Systm** command list by using the buttons

    b.   Select the **Loopback** option (the parameter will blink)

    c.   Select the **IF** parameter

    d.   Press the Enter button to execute the command

A successful IF loopback test has been performed when the DTE transmits and receives its own data with no errors. This is indicated by:

- A green `Rx Sync` message on the front panel

- No fault messages once the faults are cleared. To clear faults either issue a remote **CF** command or use the front panel **Clear** option

If error-free data is not received by the DTE, verify:

- Installation of the IF loopback cable

- Clocking configurations of the DTE and CM701

To verify that LB 1 has been issued, review the modulator and demodulator configuration parameter settings for compatibility, as these are automatically set when LB 1 is issued.

The CM701 built-in BERT can be used instead of the DTE to indicate a successful IF loopback test.

Satellite Loopback

A satellite loopback test validates the coaxial cabling between the CM701 and the outdoor radio and confirms the radio transmit and receive paths and the satellite receive and transmit paths, as illustrated in Figure 12-3.
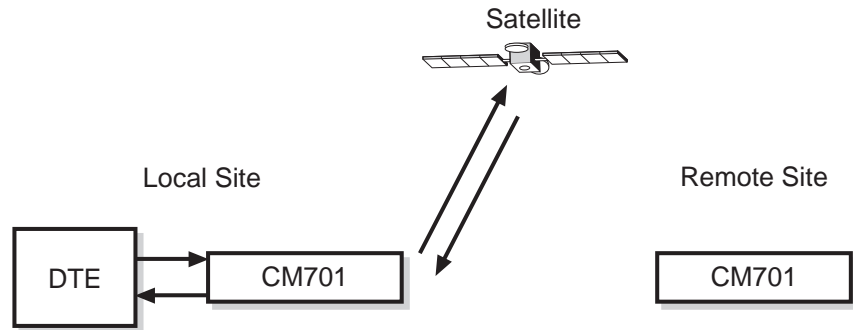
Figure 12-3   Satellite Loopback

To perform a satellite loopback:

1. Connect the CM701 TxIF to the upconverter. Ensure the modulator transmit power is disabled — the Tx Enable message on the front panel will be white — before connecting the upconverter to the CM701 TxIF connector. The transmit path to the upconverter is required for this system validation.

2. Set the receive IF frequency of the local CM701 to match the receive frequency intended for the remote CM701.

3. If necessary, make a similar adjustment to the local downconverter.

4. Verify that all other CM701 Rx parameters match the Tx parameters, and that all loopbacks are disabled.

5. Enable the modulator.

A successful satellite loopback test is performed when the DTE transmits and receives its own data error free. This is indicated by:

- A green `Rx Sync` message on the front panel

- No Fault messages once the faults are cleared. to clear faults either issue a remote **CF** command or use the front panel **Clear** option

If the demodulator is not receiving a carrier, the CM701 receives corrupted data or a response of `255` when a remote AG ? parameter is issued. In this instance, review and verify:

- Cabling

- All frequency settings

- Modulator power to ensure that it is enabled, indicated by a green `Tx Enable` message on the front panel

The CM701 built-in BERT can be used instead of the DTE to perform a satellite loopback test.

Far Data Loopback

The far data loopback, illustrated in Figure 12-4, is used to ensure that each modem is receiving the carrier from the satellite with an acceptable E_b/N_0 level within the anticipated link availability.

F203-01
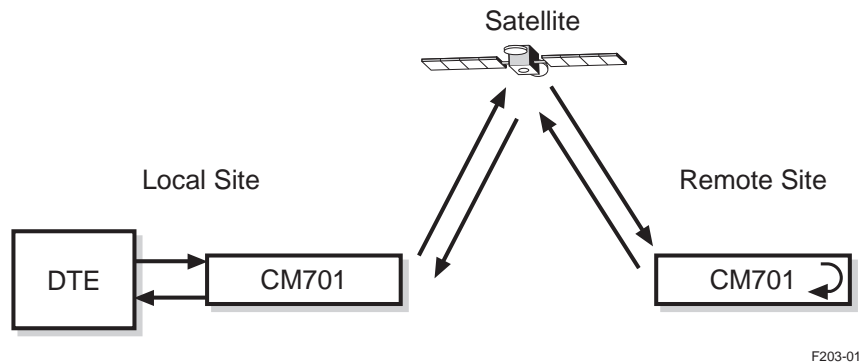
Figure 12-4   Far Data Loopback

To perform a far data loopback test:

1. Set up the CM701 in the intended operating configuration with all loopbacks disabled.

2. Perform a far data loopback at the modem on one end of the circuit by either:

   ▫ Issuing a remote **LB 4** command

   ▫ Using the front panel **FAR Loopback** command

   A successful far data loopback is indicated by the DTE receiving its own transmit data back error free.

   The built-in BERT can be used to validate a far data loopback instead of a DTE data analyzer, if necessary.

3. Complete the loopback process by performing steps 1 and 2 from the other end of the satellite link.

Ensure that each modem is receiving the carrier from the satellite at an E_b/N_0 level acceptable for anticipated link availability, as predicted by the link analysis performed prior to installation. Typical levels range from 6 to 10 dB.

Long-Term Bit Error Rate (BER) Measurement

A long-term BER measurement should be performed for one week, but, at a minimum, should be conducted for at least 24 hours. The one-week duration is optimum as neighboring carriers on the satellite may interfere only at certain times during the week. This test will indicate if the:

- Satellite link is operational 24 hours a day, 7 days a week, with no periodic interruptions along the way

- Doppler effects of satellite motion on the circuit operation are nonexistent, or at least within tolerable limits

This test can be run with the internal, built-in CM701 BERT or with an external DTE data integrity tester. To investigate once-a-day or once-a-week fault events:

- Set the CM701 real-time clock using the remote commands DAY and TIM.

- Use the time-stamped fault feature of the CM701 by issuing a remote command VFT or the front panel FaultLog command.

- Review the time-stamped fault messages.

Board-Level Hardware Testing

Board-level hardware tests can be performed using the built-in self-test (BIT) command and the self-test report (STR) query command. Option cards may be tested:

- As a group, using either the:

  □ Remote `BIT 0` command

  □ Front panel `Self Test` command

- Individually, using either the:

  □ Remote `BIT 4` and `STR ?` commands

  □ Front panel using the terminal emulator. For information on the terminal emulator, refer to the chapter on front panel operation.

Data flow is interrupted during a board-level test. The cards are returned to their original configuration when the test is completed.

Group Board-Level Hardware Test

For information on testing all CM701 option cards as a group, refer to the BIT command in the chapter on command descriptions.

Individual Board-Level Hardware Test

Board-level hardware test commands can be issued from either the remote unit or the front panel.

To perform a board-level hardware test on an individual card from the remote unit, perform the following steps:

1. Issue a BIT 4 command as `<slot#>`**:BIT 4**.

2. Wait at least 30 seconds for the test to finish; some cards may take much longer.

3. Issue an STR query command as `<slot#>`**STR ?**.

4. If a response other than `STR 0` is returned, there is a hardware failure. Contact ComStream Customer Service.

To perform a board-level hardware test on an individual card from the front panel, perform the following steps:

1. Access the terminal emulator (:AA) located at the Config>M&C>Misc level.

2. Issue a BIT 4 command as `<slot#>`**:BIT 4**.

3. Wait at least 30 seconds for the test to finish; some cards may take much longer.

4. Issue an STR query command as `<slot#>`**:STR ?**.

5. A response other than `STR 0` indicates a hardware failure. Contact ComStream Customer Service.

Data Interface Card Activation

When two or more data interface cards are installed in a CM701, the active interface card is selected using the following two configuration commands:

- Receive Active I/O command

    - From a remote unit: `RIO <slot number>`

    - From the front panel: `Rx Active IO <slot number>`

- Transmit Active I/O command

    - From a remote unit: `TIO <slot number>`

    - From the front panel: `Tx Active IO <slot number>`

Where the slot number is either 1, 2, or 3.

Software Upgrade Instructions

When a software upgrade is required, EPROMs or PLCCs located on the option card will need to be replaced. To install a new EPROM or PLCC:

1. Review and list your system's current configuration before continuing with this procedure. This is especially important if your system has been reconfigured and set differently from the factory defaults.

2. Remove the option card from the CM701 chassis.

3. Determine which EPROM or PLCC should be removed from the option card.

   Verify the part number on both the old and new EPROMs or PLCCs to ensure that the correct part is being changed. The part number is located on the EPROM or PLCC label.

   EPROMs and PLCCs are static-sensitive devices. Use standard antistatic procedures when handling and storing these devices.

4. Carefully remove the EPROM or PLCC from the board using an IC pulling device.

5. Store the removed EPROM or PLCC until the new one is installed and verified.

6. Carefully align and install the new EPROM or PLCC, using the silk screen diagram on the option card as a guide to align the indentation found on the EPROM.

   EPROMs installed backwards will be destroyed when the unit is powered on.

7. Inspect the new EPROM or PLCC for any bent or shorted pins after it has been installed.

8. Replace the option card in the CM701 chassis.

9. Initialize new CM701 software to version 4.4 or greater, by performing one of the following:

   ▪ Issue the remote `INF 9346` command.

   ▪ Issue the front panel `Initialize New Firmware` command.

   If the CM701 is being upgraded to software versions 4.0 through 4.3, contact ComStream Customer Service.

   The INF 9346 command will reset the equipment parameters and settings to the factory default settings and reconfigure the NV memory map. If your system has been reconfigured so that it is different from the factory defaults, be sure to review and list the system's current configuration *before* issuing the INF 9346 command.

Option Cards ComStream modems are generally shipped with the option cards already installed. However, due to new requirements, equipment upgrades, or system enhancements, some option cards may require customer installation and removal.

For more information regarding CM701 option cards, consult your ComStream sales representative or call ComStream Customer Service.

Option Card Chassis Location

The standard CM701 modem, shown in Figure 12-5, consists of the following option card slots:

- Slots 1, 3, and 5 generally hold option cards. Which slot each option card occupies is dependent upon the type of option card being installed and the modem configuration.

- Slot 2 (vertical) holds the selected data interface (I/O) card.

- Slot 4 (vertical) holds the M&C card and is dedicated to that card only.

- Slot 6 (horizontal) normally holds the demodulator card.

- Slot 7 (horizontal) normally holds the modulator card for all transmit/receive configured modems.
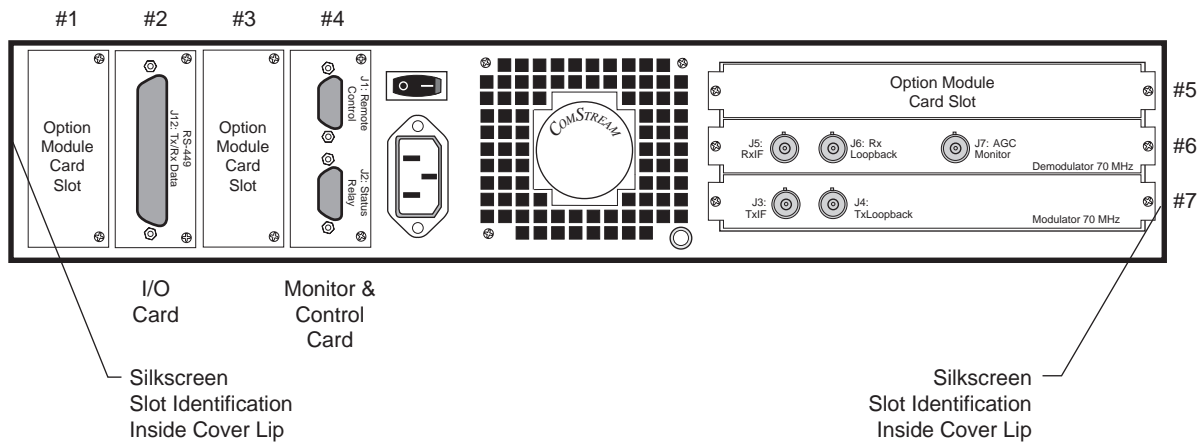
Figure 12-5   Standard CM701 Rear Chassis Configuration Example

Option Card Components

CM701 option cards, shown in Figure 12-6, consist of the following components:

- An extractor which is used to remove the card from the chassis

- A filler plate which must be screwed into the chassis once the card is installed. This ensures adequate grounding for emissions suppression.

- A backplane edge connector which is plugged into the CM701 backplane
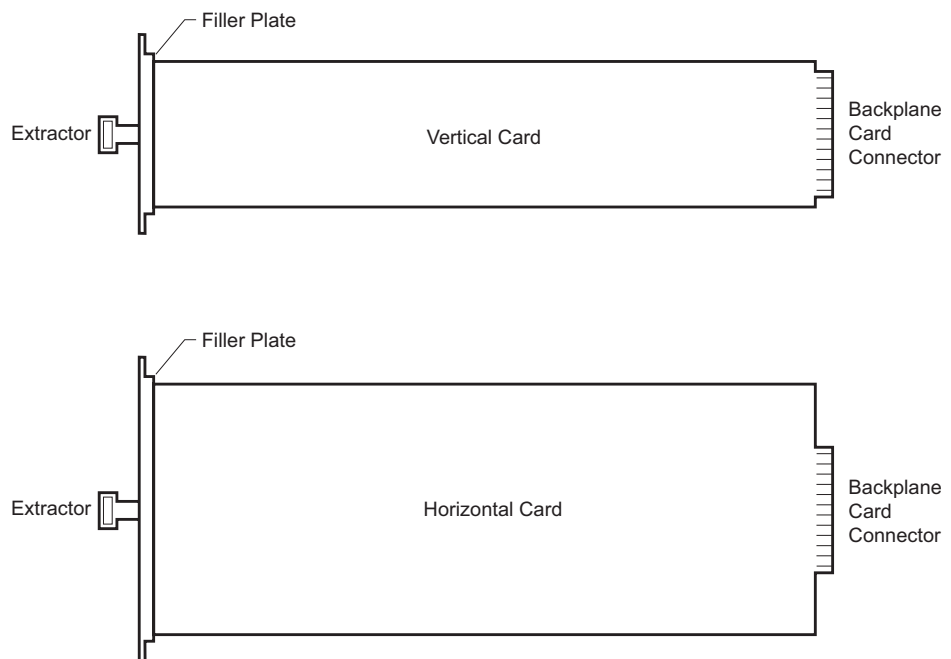
Figure 12-6   Examples of Horizontal and Vertical Option Cards

Card Installation Procedure

To install an option card into the CM701 chassis, follow these steps:

1. Remove power from the CM701.

2. Remove the filler plate from the appropriate slot by unscrewing the two end screws.

3. Align the option card edges so the card slides down the center of the card guides. Ensure that the card edges are inserted down the center of the card guides.

4. Slowly push the card into the chassis. Seat the card into the backplane by applying slightly more pressure to the card. The card is fully seated when both ends of the filler plate are flush with the chassis.

5. Replace the two filler plate end screws.

6. Refer to the option card manual for any additional installation and power-on instructions.

7. Power on the CM701.

   If the autoconfiguration software is installed and set to `ACP 1`, the system will automatically check and configure itself for your specific requirements. For information on the autoconfiguration command, refer to the chapter on command descriptions.

All ComStream cards contain static-sensitive electronics. Use standard antistatic procedures when handling the cards.

Card Removal Procedure

To remove an option card from the CM701 chassis, follow these steps:

1. Remove power from the CM701.

2. Remove any cables, connections, and/or attachments from the option card as required.

3. Remove the filler plate by unscrewing the two end screws.

4. Grasp the extractor tab between your thumb and forefinger.

5. Pull slowly and with even pressure until the card is unseated from the backplane.

6. Slowly withdraw the card from the chassis.

7. Place the card in a static protection bag.

8. Install the blank filler plate and replace the two filler plate end screws.

9. Reattach any cables, connections, and/or attachments as required.

10. Power on the CM701.

    If the autoconfiguration software is installed and set to `ACP 1`, the system will automatically check and configure itself for your specific requirements. For information on the Autoconfiguration command, refer to the chapter on command descriptions.

General Maintenance   ComStream CM701 PSK digital satellite modems require no periodic or preventive maintenance and are designed to deliver years of maintenance-free service. The only task you need to perform is keeping the air intake grill free of debris, blockage, or excessive dust to ensure that the modem receives a free flow of air.

To clean the CM701 modem, first remove power from the unit. Then clean the cabinet, panel, and controls with a soft cloth lightly moistened with water. Do not use any type of abrasive pads, scouring powders, liquid cleaners, aerosol cleaners, or solvents such as alcohol or benzene.

Technical Specifications

A

The following specifications are subject to change without notice.

Electrical and Performance

System

Configuration	Full duplex; receive-only; transmit-only
Data rates	4.8 kbps to 2.336 Mbps[1]
Data rate flexibility	Variable rate (1-bps resolution) Single and quad rates also available
Symbol rates	4.8 ksps to 2.336 Msps[1]
Modulation types	BPSK; QPSK
Code rates	Sequential $\frac{1}{2}$, $\frac{3}{4}$, and 1 (uncoded) Viterbi $\frac{1}{2}$, $\frac{3}{4}$, $\frac{7}{8}$, and 1 (uncoded)
Data interfaces	RS-449; V.35; RS-232; DS-1; G.703 balanced; G.703 unbalanced
Scrambling	ComStream-compatible; IESS 308 (IDR)
IF frequency	Frequency range: 52 - 88 MHz; 104 - 176 MHz Step size: Software programmable in <100 Hz increments Impedance: 75 ohms Return loss: >20 dB typical; $\geq$15 dB minimum
Channel spacing	< 0.5 dB degradation for +10 dB carriers spaced 1.3 x symbol rate away at 6 dB E_b/N_0 < 0.1 dB degradation for like carriers spaced 1.3 x symbol rate away at 6 dB E_b/N_0
Reference stability	$\pm$2 ppm; $\pm$1 ppm over temperature; $\pm$1 ppm per year aging

Modem performance	BPSK: <0.4 dB from theory (0.3 dB typical) at 6 dB E_b/N_0
	QPSK: <0.5 dB from theory (0.4 dB typical) at 6 dB E_b/N_0
Decoder performance (exclusive of modem)	- Sequential rate $\frac{1}{2}$ at 56 kbps: 4.6 dB E_b/N_0 for 10^{-7} BER - Sequential rate $\frac{1}{2}$ at 2.0 Mbps: 5.4 dB E_b/N_0 for 10^{-7} BER - Sequential rate $\frac{3}{4}$ at 56 kbps: 5.4 dB E_b/N_0 for 10^{-7} BER - Sequential rate $\frac{3}{4}$ at 2.0 Mbps: 6.1 dB E_b/N_0 for 10^{-7} BER - Viterbi rate=$\frac{1}{2}$: 5.7 dB E_b/N_0 for 10^{-7} BER - Viterbi rate=$\frac{3}{4}$: 7.0 dB E_b/N_0 for 10^{-7} BER - Viterbi rate=$\frac{7}{8}$: 8.0 dB E_b/N_0 for 10^{-7} BER
System performance	Decoder performance + modem performance + 0.4 dB (scrambling and differential)

Modulator

Transmit power	
Power range	-5 dBm to -25 dBm
Resolution	0.1 dB step
On/off isolation:	>60 dB
Temperature stability	(0 to 50°C) ±.5 dB
Spurious	<-55 dBc in-band -45 dBc out-of-band
Spectral shape	ComStream closed-network IESS 308/309 (IDR/IBS) BS 7-40 (SMS) selectable
Modulator timing	±2 ppm
stability	±1 ppm over temperature
internal)	±1 ppm per year

Dejitter
    Standard   ±10%
    Peak   ±2 unit intervals
    DS-1   per Bell Tech Pubs 41451
    CEPT   per G.832

Demodulator

Receive level   -10 dBm to -55 dBm
Aggregate   0 dBm

Rx acquisition range
    Carrier   ±30 kHz standard
                                       programmable up to ±500 kHz

    Clock   ±100 ppm maximum

BERT

Patterns
    Fixed   All marks, all spaces, 1:1, 8-bit user selected
    Pseudorandom $511(2^9\text{-}1)$

Error analysis
- Number of bit errors
- Number of blocks with errors
- Average BER
- BER over previous block
- Average block error rate

Time-based analysis   Capable of using 1 sec block length

Block lengths   1 sec; 10^5, 10^6, 10^7, 10^8 bits

Sync acquisition modes
    High   <2,500 errors out of 10000 bits
    Low   <1,000 errors out of 10000 bits

Faults indicated   BERT sync loss; loss of received clock

Maximum counts
- Number of errors: 4.3×10^9
- Number of blocks: 4.3×10^9
- Number of bits[2]: 4.3×10^9

Measurement accuracy   100% when used with BERT start-stop feature

Mechanical and Environmental Size

    Width   48.2 cm (19 in.) rack-mountable
    Height   8.9 cm (3.5 in.) (2 rack units)
    Depth   45.7 cm (18 in.)
    Weight   11.34 kg (25 lbs)

Temperature

    Operating   0°C to +50°C
    Gradient   2°C/minute maximum
    Nonoperating   -20°C to +70°C

Humidity

    Operating   5% to 95% noncondensing
    Nonoperating   0% to 100% noncondensing

Power

    AC input   90 to 264 V, 47 to 63 Hz, autoranging
    Usage   48 W, standard configuration

Regulatory Compliance Safety and emissions   UL 1950; CSA 950; TUV EN 60950;
FCC Part 15B Class A; VDEO 871 Class B;
CISPIR 22 Class B; BZT Certified

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1 Operation below 9.6 kbps may have reduced performance
2 Maximum number of bits equals the maximum number of blocks times the selected block length

Operating Parameters for CX801/101 Protection Switches

B

Throughout this appendix, references to the CX801 also apply to the CX801A and CX801M modem protection switches.

Redundant Configuration

The CM701 modem can be operated in a redundant configuration using the CX801 or CX101 modem protection switch. The CX801 and CX101 continuously monitor the status of their protected modems. Upon detection of a primary modem failure, these protection switches automatically substitute the spare modem for the failed primary modem. Data interface and IF signals are switched by the CX801 and CX101.

Setting Operational Parameters

The CX801 is compatible with all currently available CM701 cards, including option cards. The CX101 is compatible with the standard-speed modulator and demodulator cards and the Low-Speed Modem card.

The CX101 can be used with CM701 option cards providing the user manually configures the spare modem to match all parameters in the primary modem. The CX101 shadowing function is limited to the standard modulator and demodulator parameters.

The CX101RS, a special version of the CX101, is compatible with high-speed modulator and demodulator cards and the DVB Reed-Solomon card. The user interface for the CX101RS is significantly different from the CX101.

When operating the CX801 or CX101 modem protection switch with a CM701 modem, particular firmware revision levels and CM701 parameters must be used.

Firmware Revision Levels

The required minimum firmware revision levels are listed in Table B-1.

Table B-1   Minimum Firmware Revision Levels

Unit	Minimum Revision Level
CM701 M&C Card	4.9
CM701 Framing Unit (supported with CX801 only)	4.4
CM701 Framing Unit FPGA	4.3
CM701 SCC Card (supported with CX801 only)	5.0
CM701 DVB Reed-Solomon (supported with CX801 only)	4.5
CM701 DVB Reed-Solomon FPGA	4.5
CX101	3.1
CX801	4.5

CM701 Parameters

It is important to note the following operational requirements:

- The CX801/CX101 switch must be changed from manual to automatic mode in order to recognize any parameter changes made from the CM701 front panel.

- In mixed modem applications in which a CM701 modem is used with earlier generations of ComStream modems, such as the CV101, CM401, CM121, and so on, the spare modem must be a CM701.

To establish communications between the CM701 and the CX801 or CX101, set the parameters as described in Table B-2.

Table B-2   CM701 Parameters

Switch	Interface	Parameters
CX801	CM701 front panel	■ Remote control: `RS485` ■ Packet address: a primary modem packet address must be the same as the CX801 data interface and IF connector numbers to which the CM701 and its associated DTE are connected. Addresses are: ■ Primary modems: `1` through `8` ■ Spare modem: `9` ■ Protocol: `PACKET` ■ Baud rate: `9600`
	Remote terminal	■ Set DRM to `1` (standard default value)
	Remote terminal or CM701 front panel	■ Set SM to a parameter other than 0 ■ Verify that the PTD and PRD values are valid (that is, ensure they are *not* set to 0) prior to placing the CX801 in Automatic mode
CX101	CM701 front panel	■ Remote control: `RS485` ■ Packet address ■ Primary modem: `1` ■ Spare modem: `2` ■ Protocol: `PACKET` ■ Baud rate: `9600`
	Remote terminal	■ Set DRM to `0`
	Remote terminal or CM701 front panel	■ Set SM to a parameter other than 0

CX101 Front Panel Limitations There are limitations on the modem functions that can be issued from the CX101 front panel. When it is necessary to bypass these limitations, issue the required commands from a remote terminal attached to the switch or from the CM701 front panel.

There are no front panel limitations when using the CX801.

CX101 Front Panel Limitations

The following limitations exist when using the CX101 front panel to select or display certain CM701 parameters:

- Viterbi encoding and decoding rates are *not* supported.

- Transmit and receive data rates are not accurately displayed when Viterbi encoding and decoding rates are selected.

- TS and RS values are limited to 25-kHz steps; 1-Hz steps are *not* supported.

- Symbol rates above 2048000 sps are *not* supported.

These limitations are restricted to the operation of the CX101 front panel. They do *not* affect the switchover process or the commands sent to the CM701 through the CX101 remote control port.

For example, a TC 4 command (Viterbi-compatible, rate ¾) is issued to a primary modem through the CX101 remote control port or the modem front panel. During the switchover process, the command is sent to the spare modem. However, the CX101 front panel will not indicate that Viterbi rate ¾ is selected as the transmit code rate, nor will it display a valid data transmit rate.

Bypassing CX101 Front Panel Limitations

To bypass the CX101 front panel limitations, issue the commands through the CX101 remote control port or use the modem front panel as follows:

1. At the CM701 front panel, enter the required parameters.

2. At the CX101 front panel, switch from manual to automatic mode. This will cause the CX101 to update the modem configuration information that it uses for shadowing.

Switchover Time Specifications

The total time required to perform an automatic switchover is measured from the occurrence of the failure until the spare modulator or demodulator is online.

The CX801/CX101 is capable of performing an automatic switchover within 0.5 seconds after it detects a primary modem failure. However, the switchover for a standard CM701 *without* any option cards cannot be performed until the following occur:

- Error is reported by the CM701 (typically 1.5 sec)

- Spare CM701 is reconfigured (0 sec if all operational parameters match; 13 sec if no operational parameters match)

- User-selected, modulator time-out period has expired (0 to 9.9 sec)

- Spare demodulator acquires the signal (typically 1 to 4 sec)

- User-selected, demodulator time-out period has expired (2 to 255 sec)

For example, the switchover time for a modulator failure can take from a minimum of 2 sec plus the modulator time-out period when *all* parameters match to a maximum of 15 sec plus the modulator time-out period when *no* parameters match.

For a demodulator failure, the switchover time can take a minimum of 2 sec plus the acquisition and demodulator time-out period when *all* parameters match to a maximum of 15 sec plus the acquisition and demodulator time-out period when *no* parameters match.

The switchover times presented in this section are based on CM701 modems configured with only the basic cards. Several more seconds must be added to the switchover time when an option card is installed in the CM701. Since the switchover time varies greatly and is dependent upon the parameters that must be matched, the actual switchover time should be experimentally determined for each application.

Additional Information

For additional information on the installation or operation of CX801 or CX101 modem protection switches, refer to the appropriate ComStream manual that accompanies these products, or contact ComStream Customer Service.

ComStream Packet Protocol

C

This chapter presents an overview of the ComStream Packet Protocol and includes:

- Packet protocol interface, messaging, and communication modes

- Packet format and content

- Address selection and extended addressing

- Control command syntax

- ComStream-specific control commands

- External connections

In addition, specifications for ComStream Packet Protocol and the physical interface connectors are described.

Packet Protocol Interface

ComStream Packet Protocol uses the RS-485 bus interface to control devices that reside on the bus. The RS-485 interface allows for a maximum of 32 devices to be connected to a single bus and is configured as a party-line. Each device on the bus is given an address from 1 to 31 and responds to commands and messages containing its specific address.

Packet Protocol Messaging

Commands and messages are sent between a controller and individually addressable devices, referred to as slaves, in information packets.

Acknowledgment Packets

Some packets sent from the controller may request a return acknowledgment packet from the slave. This acknowledgment packet:

- Indicates if the command has been executed

- Replies with the appropriate error and/or status messages

- Signals that the slave can receive and process another packet

The rate at which the controller can send messages to *one* specific slave is determined either implicitly by the slave's message handling rate specification, or explicitly by acknowledgment packets sent from the slave back to the controller.

The rate at which the controller can send messages to *different* slaves is determined by the baud rate of the communication channel.

Packet Protocol Communication Modes

Two communication modes are supported by ComStream Packet Protocol:

- One-way communication consisting of controller-to-slave transmission with no slave response requested

- Two-way communication consisting of controller-to-slave transmission with slave-to-controller acknowledgment response

The controller can indicate which communication mode is to be followed on a packet-by-packet basis by transmitting the appropriate control byte to the slave.

One-Way Communication

In one-way communication, information is sent one way only, from the controller to the slave. In this mode, the controller receives no information from the slave and is operating in an *open loop* mode. The slave does not respond to the controller, nor does it send any type of messages informing the controller of commands received, nonexecuted commands, or error conditions.

Two-Way Communication

Operating in two-way communication, the controller receives a response packet from the slave for every packet transmitted. The data portion of the slave response packet depends on the command issued by the controller.

The slave's response to a configuration or control command will be one of the following:

- Empty packet (no data field) if the command was successfully completed

- Error sequence if the slave was not able to execute the requested modification

The slave's response to a status query will be one of the following:

- Message packet containing status information consisting of the queried parameter and the parameter value or status information

- Error sequence if the slave was unable to obtain the queried parameter information

Packet Format and Content

ComStream Packet Protocol runs under the standard, asynchronous ASCII format with a standard default of 1 start bit, 7 data bits, odd parity, and 1 stop bit. The 7/odd and 8/none options can be selected using the MDP command. (For more information, refer to the chapter on command descriptions.) Each packet must conform to the format shown in Figure C-1.

STX	Byte Count	Device Address	Control Byte	Data		Checksum	ETX
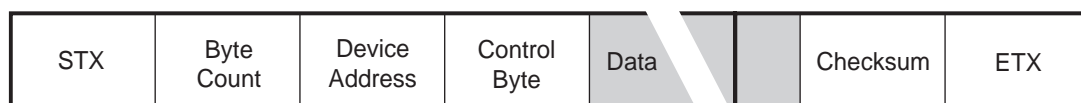
F205-01

Figure C-1   Packet Format

Each byte within the packet is defined in Table C-1.

Table C-1   ComStream Packet Protocol Byte Descriptions

Item	Description	Bit Map Information		
STX	Signifies beginning of a packet. ASCII value: STX=02$_H$.	—		
Byte Count	Represents total number of bytes in the packet including STX and ETX. ■ Minimum count – 6 ■ Maximum count – 127	—		
Device Address	Indicates packet destination. Although each slave recognizes only those packets that are addressed to it, all slaves will also respond to but not acknowledge packets addressed to device address zero. Bit 6 allows a packet to be addressed to a nonprimary device, a device that is not directly connected to the primary RS-485 bus. When set, additional address fields will follow. For a more detailed explanation, refer to the "Extended Addressing" section in this appendix.	Bits 0-4 Bit 5 Bit 6	slave address 1 address extension 0 no extension 1 extension exists	
Control Byte	Provides control information to the receiving device. It is bit mapped differently for controller-to-slave or slave-to-controller communication. ■ Controller-to-slave: ■ Slave-to-controller:	Bit 0 Bits 1-6 Bits 0-5 Bit 6	when packet is received: 0 no response required 1 response required 0 0 1	
Data	Used to transfer information from one device to another, such as commands from the controller to the slave or response information from the slave to the controller. Data format varies depending on message content.	—		
Checksum	Verifies the integrity of characters contained within a message. The Checksum is the sum (modulo 128) of the packet bytes, beginning with the device address (byte) and ending with the last byte of the data field.	—		
ETX	Signifies end of a packet. ASCII value: ETX=03$_H$.	—		

All controller or slave-generated packets have:

■ Minimum length of six bytes (minimum packet format omits the data field and consists of STX, Byte Count, Address, Control, Checksum, ETX)

■ Maximum length of 127 bytes including delimiters and checksum

All packets with a length exceeding 127 bytes or that fail to meet the prescribed format are discarded.

Address Selection

To select the remote address of a CM701 for ComStream Packet Protocol mode, use the remote MPA or front panel Packet Address command, and select the appropriate address for that modem.

Extended Addressing

ComStream Packet Protocol allows hierarchical addressing. Any device within the packet network may be addressed by providing a full address path.

The address field of a packet may be extended indefinitely under the following conditions:

- Appropriate address extension bits are set

- Maximum packet length is not exceeded

Intermediate ComStream devices in the addressing chain automatically forward the packet to the next device in the chain. Response packets, originating from the last device in the chain, are forwarded until they reach the controller.

If an acknowledgment packet is required, the controller must adjust its time-out period to account for the packet forwarding delay encountered within the device hierarchy.

Packet Protocol Command Syntax

All commands are initiated by a controller that sends addressed packets to the slave units on the packet party-line interface. Types of controller commands include configuration, control, and status query commands.

The syntax of packet protocol data is as follows:

```
<command mnemonic> <parameter>
```

where:

- `<command mnemonic>` represents a two- or three-letter command mnemonic

- Single space separates the mnemonic and its parameter

- `<parameter>` represents an ASCII parameter string as required for the command; for query commands, the parameter is a question mark (?)

For a standard CM701 modem setup, all commands are issued by the controller as odd parity, 7 data bits. All responses are returned as odd parity, 7 data bits, with the exception of BD command responses.

Packet Protocol Command Execution

Commands are executed when the following conditions are met:

- Command is valid

- Parameter value, when required, is within the valid range

- Parameter value or command is compatible with the present modem configuration

- Command or query can be executed immediately

Commands that do not follow these guidelines are not executed and produce an error code.

Controller Packet Command Example

To assist you in creating and sending viable packets, a byte-by-byte packet construction for the query command EM ? is presented in this section. This query packet is constructed by the controller and issued to a slave modem. The following assumptions are made for this example:

- Slave address is 1

- Extended addressing is not required

- Acknowledgment packet is required

- ASCII codes used in this example include:

  - E is 45_H

  - M is $4D_H$

  - space character is 20_H

  - ? is $3F_H$

The packet used to issue an EM ? command is constructed as shown in Table C-2.

Table C-2   Packet Protocol EM Query Command Example

Byte Description	STX	Byte Count	Device Address	Control Byte	Data Byte				Checksum	ETX
					E	M	space	?		
Before Parity	02_H	$0A_H$	21_H	01_H	45_H	$4D_H$	20_H	$3F_H$	113_H	03_H
After Odd Parity	82_H	$0A_H$	21_H	81_H	$C5_H$	CD_H	$A0_H$	$3F_H$	113_H	03_H

ComStream-Specific Packet Control Commands

Most standard monitor and control commands are supported by ComStream Packet Protocol. However, any commands that result in a response exceeding the maximum packet byte count of 127 bytes are not supported. ComStream has developed packet versions of the DP and DC commands. These packet versions are status query commands, referred to as binary dump (BD) commands.

BD commands are described in Table C-3.

Table C-3   Binary Dump Commands

Not Supported	Packet Protocol Version	Function
Display Parameters (DP)	Binary Dump (BD)	Provides summary configuration and status information.
		Use this command to obtain configuration, status, and modem performance summary information including parameters for almost all remote commands supported by the modem. The ASCII command mnemonic BD must be included in the data portion of the command packet. The BD mnemonic is not followed by a space or parameter.
Display Configuration (DC)	Binary Dump 1 (BD 1)	Establishes symbol rates of a multirate modem as well as various other configuration information.
		Use this command to obtain symbol rate information for the modulator, demodulator, and type identifiers indicating fixed, quad, or variable rate support. The command mnemonic provided in the data portion of a command packet is a BD ASCII string, an ASCII space, and an ASCII 1.

Both BD commands, which are supported only by packet protocol, result in a slave response packet containing various parameter information. Responses to BD commands are no parity, 8 data bit format instead of the normal response format of odd parity, 7 data bits.

The BD command responses currently use less than the available 127 bytes. However, to support future modem enhancements or expansions, additional character fields may be appended and fill the available 127 bytes. This information should be considered when any BD command is used in the development of packet-based, modem control software.

BD Command Response Packet

The BD response packet consists of the byte sequence described in Table C-4. The byte sequence is located in the data field. The pin number, when applicable, is enclosed in brackets.

Table C-4　　BD Byte Sequence

Byte #	Field	Description		
1 char	type	Type of BD packet	1 5	modem Other modems
2 char	software_rev	Software revision number		
Demodulator Information				
3 char	demod_config	Bit map to define demodulator configuration	0 1 2 3 4 5 6 7	V.35 interface present Data control Reserved Reserved Modulator present Reserved DS-1 interface present Reserved
4:5 int	demod_sym_rate	Demodulator symbol rate/100		
6 char	aq	Acquisition	0 1	Disabled Enabled
7:8 int	ao	Start frequency for acquisition (-30000 to +30000)		
9 char[1]	be	BER threshold ([93-19] parameter xy implies x times 10^{-y})		
10:11 int	br	remote baud (available user-selectable baud rates: 300, 1200, 2400, 4800, 9600)		
12 char	ce	Provides channel error rate (query-only)		
13 char	dd	Differential decoding	0 1 2	Disabled Enabled QPSK/uncoded

[1] Currently not supported and reserved for future enhancements.

[2] Supported by the DT7000 Earth Station only.

[3] Other scrambling/descrambling options may be available depending upon the installed option cards.

Table C-4   BD Byte Sequence (continued)

Byte #	Field	Description		
14 char	eb	Provides E_b/N_0 (query-only)		
15:16 int	fl	Provides accumulated fault status (2 or 3 bit-mapped fault bytes; query-only)		
17 char	lb	Loopback modes	0 1 2 3	Disabled IF Near Far
18 char[1]	rb	Provides BER estimate (query-only)		
19 char	rc	Set receive code rate	0 1 2 3 4 5	Uncoded SEQ R $\frac{1}{2}$ SEQ R $\frac{3}{4}$ VIT R $\frac{1}{2}$ VIT R $\frac{3}{4}$ VIT R $\frac{7}{8}$
20 char	rm	Set receive modulation type	0 1	BPSK QPSK
21:24 long	rs	Set receive synthesizer frequency (in kHz)		
25:26 int	ro	Displays receive frequency offset (in Hz)		
27:28 int[2]	rf	Set downlink frequency (11700 to 12200 MHz)		
29[3] char	sd	Descrambling	0 1 2	Disabled ComStream IDR
30:31 int	st	Provides fault status (second of three bit-mapped status bytes; query only)		
32 char[1]	ag	Provides AGC reading (0 to 255)		
33 char[1]	bt	Bit time freq register (demod) (0 to 255)		
34:35 int[1]	rv	Carrier tracking value		
36 char[1]	sa	Remote set address		
Modulator Information				
37 char[1]	mod_config	Bit map to define modulator configuration		
38:39 int	mod_sym_rate	Modulator symbol rate/100		
40 char	dm	Differential encoding	0 1 2	Disabled Enabled QPSK/uncoded
41 char	em	Modulator	0 1	Disabled Enabled
42 char[1]	fm	Flag mode	0 1	Disabled Enabled

[1] Currently not supported and reserved for future enhancements.
[2] Supported by the DT7000 Earth Station only.
[3] Other scrambling/descrambling options may be available depending upon the installed option cards.

Table C-4   BD Byte Sequence (continued)

Byte #	Field	Description		
43 char[1]	pm	Preamble length (48,64)		
44 char[3]	sm	Scrambling	0 1 2	Disabled ComStream IDR
45 char	pc	Forces the modulator to transmit an unmodulated carrier	0 1	Disabled Enabled
46 char	tc	Transmit code rate and type	0 1 2 3 4 5	Uncoded SEQ R $\frac{1}{2}$ SEQ R $\frac{3}{4}$ VIT R $\frac{1}{2}$ VIT R $\frac{3}{4}$ VIT R $\frac{7}{8}$
47 char	tm	Transmit modulation type	0 1	BPSK QPSK
48:49 int	to	Transmit frequency offset desired (in Hz)		
50:51 int[1]	to_measured	Transmit frequency offset measured		
52 char	tp	Output power level of Mod TxIF (250 to 50)		
53:56 long	ts	Transmit synthesizer frequency (in kHz)		
57:58[2] int	tf	Uplink frequency (14000 to 14500 MHz)		
59:60 char[1]	tv	Transmit VCXO value		
61 char	fl3	Provides fault status (third of three bit-mapped fault bytes)		
62 char	st3	Provides fault status (third of three bit-mapped status bytes)		
63:69[1]	dummy [9]	Provided for expansion		
70[1]	db	Doppler buffer length		
71[1]	—	Doppler options		
72:75 long	demod_sym_rate	Actual current active demodulator rate		
76:79 long	mod_sym_rate	Actual current active modulator rate		

[1] Currently not supported and reserved for future enhancements.
[2] Supported by the DT7000 Earth Station only.
[3] Other scrambling/descrambling options may be available depending upon the installed option cards.

BD 1 Command Response Packet

The BD 1 response packet consists of the byte sequence described in Table C-5. The byte sequence is located in the data field. The pin number, when applicable, is enclosed in brackets.

The available rates in Table C-5 are filled only to the extent required by the modem type—one rate for fixed rate, four rates for quad rates, and no rates for variable rate. All unused rate entries are set to 0.

Table C-5   BD 1 Byte Sequence

Byte #	Field	Description		
1 char	type	Binary dump packet type		
Demodulator Information				
2 char	demod_type	Modem demodulator type	0 1 2	Quad rate Variable rate Fixed rate
3:6 long	demod_in_use	Demodulator rate in use		
7:10 long	demod_rate [1]	Demodulator rate available		
11:14 long	demod_rate [2]	Demodulator rate available		
15:18 long	demod_rate [3]	Demodulator rate available		
19:22	demod_rate [4]	Demodulator rate available		
23:26 long	demod_rate [5]	Demodulator rate available		
27:30 long	demod_rate [6]	Demodulator rate available		
31:34 long	demod_rate [7]	Demodulator rate available		
35:38 long	demod_rate [8]	Demodulator rate available		
Modulator Information				
39 char	mod_type	Modem modulator type	0 1 2	Quad rate Variable rate Fixed rate
40:43 long	mod_in_use	Modulator rate in use		
44:47 long	mod_rate [1]	Modulator rate available		
48:51 long	mod_rate [2]	Modulator rate available		
52:55 long	mod_rate [3]	Modulator rate available		
56:59 long	mod_rate [4]	Modulator rate available		
60:63 long	mod_rate [5]	Modulator rate available		
64:67 long	mod_rate [6]	Modulator rate available		
68:71 long	mod_rate [7]	Modulator rate available		
72:75 long	mod_rate [8]	Modulator rate available		

External Connections   The interface signal levels and electrical characteristics are in accordance with the EIA RS-485, full duplex, tristate interface bus standards. The bus is configured as a party-line with a maximum of 32 devices connected to a single bus.

The physical interface connector is a 9-pin D connector. Table C-6 lists the pinout specifications for an RS-485 device.

Table C-6   RS-485 Device Pinout Specifications

Pin	Signal	Direction
1	Signal Ground	Gnd
3	Xmit+	Input
5	RCV+	Output
7	Xmit-	Input
9	RCV-	Output
2, 4, 6, 8	—	No connection

A positive differential at the RCV outputs [Vrcv+ > Vrcv-], also known as a space, is intended as TTL 0, which is considered a start bit per EIA specifications.

A positive differential at the Xmit inputs [Vxmit+ > Vxmit-], also known as a space, will be interpreted as TTL 0, which is considered a start bit per EIA specifications.

Glossary

±	plus or minus
µs	microsecond
acquisition	process by which the demodulator adjusts frequency, phase, gain, and code-word synchronization to match that of the incoming carrier
A/D	analog-to-digital
AFC	automatic frequency control
AGC	automatic gain control
AO	acquisition offset; refers to a CM701 command
AR	acquisition range; refers to a CM701 command
ASCII	American Standard Code for Information Interchange; type of data/file format. An eight-bit compatible code adopted to facilitate the transfer of data between data processing and communications equipment.
ASIC	application-specific integrated circuit
attenuation	decrease in signal power absolutely or as a fraction of a reference value; received signal is lower in volume than the transmitted signal due to losses in the transmission medium; measured in decibels; opposite of gain
az/el	azimuth/elevation
BER	bit error rate; the percentage of received bits that are in error relative to a specific amount of bits received; usually expressed as a number referenced to a power of 10 (for example, 1 in 105)
BERT	bit-error-rate-tester; reports BER, errors, number of bits, blocks, and block error rates with programmable data patterns
bin	area of frequency searched during acquisition

binary dump command	status query command used in reference to ComStream packet protocol
block error rate	the number of blocks with errors divided by the number of blocks of received data
BNC	I/O connector type
bps	bits per second
BPSK	bi-phase shift keying; in BPSK modulation, zeroes and ones are represented by two phases of the RF carrier signal which differ by 180 degrees. Such a signal may be produced by mixing an RF carrier with a clocked data stream in a double-balanced mixer.
CCA	circuit card assembly
clocking	use of clock pulses to control synchronization of data and control characters
CM701	ComStream PSK Digital Satellite Modem; a high-performance PSK digital modem for single-channel per carrier communications with variable data rates, forward-error and sequential-error correction, three types of framing, various digital filter shapes, and autoranging power supply.
coaxial cable	1) cable consisting of one or more tubes, each of which has a wire contained within and insulated from a surrounding conductor. Large numbers of individual circuits can be derived from a coaxial cable by means of carrier and multiplexing techniques. 2) an IF/RF transmission line consisting of a central conductor and a concentric outer conductor separated by a dielectric (nonconducting) material
codec	coder-decoder
C.O.E.	ComStream customer order entry number
CW	continuous wave – refers to transmission of an unmodulated carrier
CX801	ComStream modem protection switch; monitors the status of up to eight operating modems and automatically changes to an offline or spare modem when a failure is detected in the online modem.
D/A	digital-to-analog
DAMA	demand assigned multiple access; a network operating mode
dB	decibel
DCE	data communications equipment

DDS	direct digital synthesizer
demod	demodulator
Doppler buffer	used to smooth out the periodic frequency variation in the received data rate caused by satellite motion
Doppler shift	condition resulting from the slight drifting of satellites which occurs; the effect is a slight difference in data rate clocks at the receive and transmit sites
drop and insert multiplexing	feature of CM701 with installed Framing Unit that allows selection of specific channels in a data stream
DTE	data terminal equipment; any piece of equipment at which a communications path begins or ends
DVB	digital-video-broadcast
E_b/N_0	energy-per-bit with respect to noise, also known as signal-to-noise level; when displayed on the CM701 front panel LCD or a remote terminal, E_b/N_0 appears as Eb/No
ER	error; typically followed by a number to signify a specific error message
Eutelsat	intergovernmental organization that provides and operates a space segment for European telecommunications services
FEC	forward error correction
FIFO	first-in-first-out
framing unit	option card that provides all international overhead functions
FRU	field replaceable unit; a circuit card containing a microcontroller that communicates with another on the monitor and control card; referred to as option cards
Gaussian noise	white noise uniform across the entire range of frequencies that is introduced into a transmission channel from the environment; may interfere with a carrier signal. Also referred to as background electrical noise. May be abbreviated as WGN (white Gaussian noise).
GHz	gigahertz
GND	ground

hot-swap	process of installing or swapping option module cards into the CM701 while the modem is not turned off and the power is not removed; *only* cards containing the label "Hot Plug/Pull" on their filler plate can be swapped in this manner.
Hz	hertz
I&Q channels	in-phase and quadrature-phase channels
IBS	INTELSAT Business Services; an INTELSAT service for general satellite data communications
IDR	intermediate data rate; an INTELSAT service for digital telephony over satellite
IF	intermediate frequency - the frequency to which a carrier is converted locally as an intermediate step in transmission or reception
IFL	interfacility link
independently timed system	system using two different clock sources that independently drive either end of a point-to-point satellite link
INTELSAT	Intelsat is an international consortium, established by a treaty between countries, which owns and operates an extensive system of satellites for international communications services.
I/O	input/output; refers to user equipment interface
I and Q channels	in-phase and quadrature-phase channels
kbps	thousand bits per second
kHz	Kilohertz
ksps	thousand symbols per second
LCD	liquid crystal display
LED	light-emitting diode
lock	proper carrier is located and is being received
loopback	test in which the routing signal is directed only through the designated equipment or portions of the satellite link to isolate setup problems

loop timed system	system using a single clock source for the entire point-to-point, round-trip circuit. This circuit extends from the master station through a satellite relay to a slave station and then back through a satellite to the master station.
Mbps	million bits per second
M&C	monitor and control; refers to the CM701 M&C card
MCPC	multiple channels per carrier
MHz	megahertz
mod	modulator
ms or msec	millisecond
Msps	million symbols per second
MTBF	mean time between failures
N/A	not available
nonvolatile	nonvolatile memory - The parameters of most configuration commands are stored in nonvolatile memory, which means they are remembered by the CM701 even after power is cycled or the CM701 is reset. For this reason these commands need not be reissued unless a change to a particular operating characteristic is required.
NV	abbreviation for nonvolatile memory
open loop	mode in which communication is sent in one direction only from the controller to the slave; in this mode, the slave does not respond to the controller, nor does it send any type of messages informing the controller of commands received, nonexecuted commands, or error conditions
open network	operations in which Intelsat or Eutelsat standards are followed
PN	pseudonoise
propagation delay	the delay from the time a signal is sent until it is received; caused by distance to and from the satellite
PSK	phase shift keying; form of modulation used to impress information onto an RF carrier for transmission from one location to another

QPSK	quadrature phase shift keying; quaternary (or quadrature) phase shift keying, phase shift keying in which four discrete phases of the carrier are used. In QPSK modulation, four phases of the RF carrier, each differing by 90 degrees from the next, are employed to represent two consecutive bits of the data stream. Such a signal may be practically produced by using two double-balanced mixers and summing their outputs in quadrature. In QPSK modulation, two information bits are encoded at one time.
RD	receive data
Reed-Solomon codec	block-oriented coding system that is applied on top of standard Viterbi coding to correct the bulk of the data errors that are not detected by the other coding systems, significantly reducing the bit error rates. Available as an option module card.
RF	radio frequency
RO	receive offset; refers to a CM701 command
RR	receiver ready
RS	receive synthesizer; refers to a CM701 command
RT	receive timing
Rx or RX	abbreviation for receive
SCC	satellite control channel; generally used for monitoring purposes. Main application is monitoring and controlling remote earth station equipment from a central hub facility.
SCPC	single channel per carrier
SD	send data; also referred to as transmit data
SMS	Satellite Multiservice System; a Eutelsat service for general satellite data communications
SNMS	ComStream's Star Network Management System
spectral inversion	condition typically caused by RF equipment that uses the image of the modem's output spectrum instead of the true spectrum. (Note: There is nothing wrong with systems that do this; simply compensate for the condition.) Example: A 70 MHz modem IF output also contains a mirror-like image at -70 MHz. If the RF equipment is designed to use the -70 MHz image and the receive RF does not similarly invert the signal (that is, undo the inversion), then there is a spectral inversion and the signal cannot be recognized by the receiver.

sps	symbols per second
ST	station timing clock; set by modem
TCXO	temperature-compensated crystal oscillator
TT	transmit timing clock; set by DTE
Tx or TX	abbreviation for transmit
V	abbreviation for volatile memory
Viterbi	a standard form of FEC decoding; the other standard form of FEC decoding is Sequential
volatile	volatile memory; command parameters that direct the modem to perform a real-time function or enter a test mode are stored in volatile memory and are not remembered by the CM701 after power is cycled or a reset

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