

RCU101

1:1 Converter Protection Switch

Installation and Operation Manual

TM055 - Rev. 2.2

May, 2002

- NOTICE -

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Phone: (602) 437-9620 Fax: (602) 437-4811

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RCU101 1:1 Protection Switch
Installation and Operation Manual
TM055 - Record of Revisions

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Revision Level	Date	Reason for Change
1	7-15-96	Initial Release
2	11-28-96	Added Illustrations of front and rear panels, new interconnection diagram, added schematics, updated Operation and Maintenance
2.1	2-7-97	Updated Fault Status connector, updated specifications
2.2	5-31-02	Added Appendix B

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Section 1 - RCU101 1:1 Protection Switch Description

1.0 Introduction

The Radyne ComStream RCU101 1:1 Protection Switch Unit provides automatic circuit restoration for one online frequency Up or Downconverter. The switch provides complete isolation of primary and backup converters by providing transfer switching of both the RF and IF signal paths. Converter fault and circuit restoration is initiated from the summary fault contacts of the online converter. Upon clearing of the fault in the online converter, or after replacement of the online converter, the switch can be directed to restore the operation to the online converter (or the converter that is selected as the 'online' unit). An RS485 Equipment interface between the converters allows the backup converter to 'learn' the gain and frequency settings of the online unit.

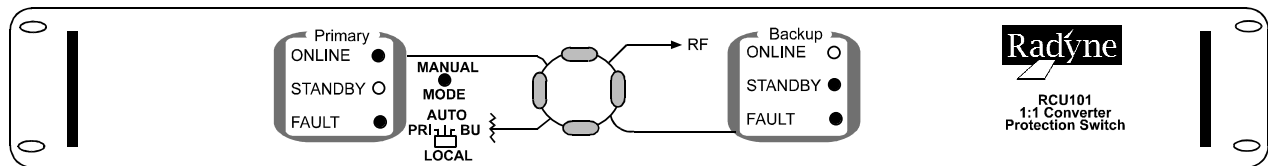


Figure 1-1. RCU101 1:1 Protection Switch Front Panel

Section 2 - Installation

2.0 Installation Requirements

The RCU101 is designed to be installed within any standard 19-inch equipment cabinet or rack, and requires 1 rack unit of mounting space (1.75 inches) vertically, and 17-inches of depth. Including cabling, a minimum of 20-inches of rack depth is required. The unit can be placed on a table or suitable surface if required.



There are no user-serviceable parts or configuration settings located inside the RCU101 chassis. There is a potential shock hazard internally at the power supply module. DO NOT open the RCU101 chassis under any circumstances.

⇒ **CAUTION:** Before initially applying power to the unit, it is a good idea to disconnect the transmit output from the operating satellite ground station equipment. This is especially true if the current RCU101 configuration settings are unknown, where incorrect setting could disrupt existing communications traffic.

2.1 Unpacking

The RCU101 was carefully packaged to avoid damage and should arrive complete with the following items for proper installation:

1. RCU101 1:1 Protection Switch
2. One cable set per paragraph 2.3.
3. Installation and Operation Manual.

2.1.1 Removal and Assembly

If using a knife or cutting blade to open the carton, exercise caution to ensure that the blade does not extend into the carton, but only cuts the tape holding the carton closed. Carefully unpack the unit and ensure that all of the above items are in the carton. The RCU101 is shipped fully-assembled and does not require removal of the covers for any purpose in installation.

2.2 Mounting Considerations

When mounted in an equipment rack, adequate ventilation must be provided. The ambient temperature in the rack should be between 10° and 35° C, and held constant for best equipment operation. The air available to the rack should be clean and relatively dry.

2.3 Cabling

The RCU101 comes complete with all the cabling required to interface with two Upconverters or Downconverters. Refer to Figure 2-1 to become familiar with the rear panel connectors on the RCU101. Figure 2-2 shows a typical interconnection between two Upconverters and the RCU101. The list of supplied cables is as follows:

<u>P/N</u>	<u>Description</u>	<u>QTY</u>
CA/3291	RS485 Equipment Interface Cable	1
CA/3292	B/U Switch Interface Cable	2

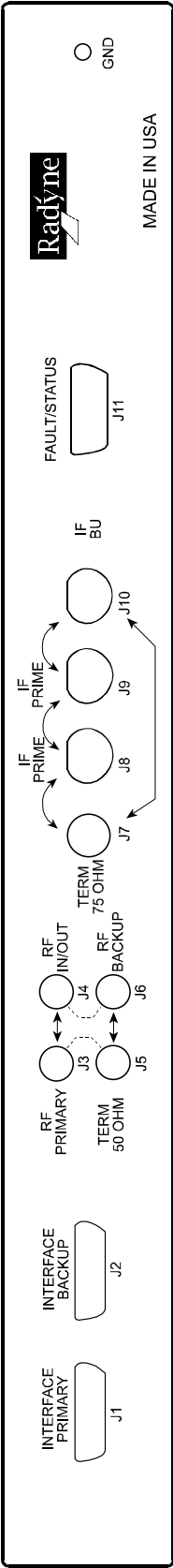


Figure 2-1. RCU101 Rear Panel Interconnection Points

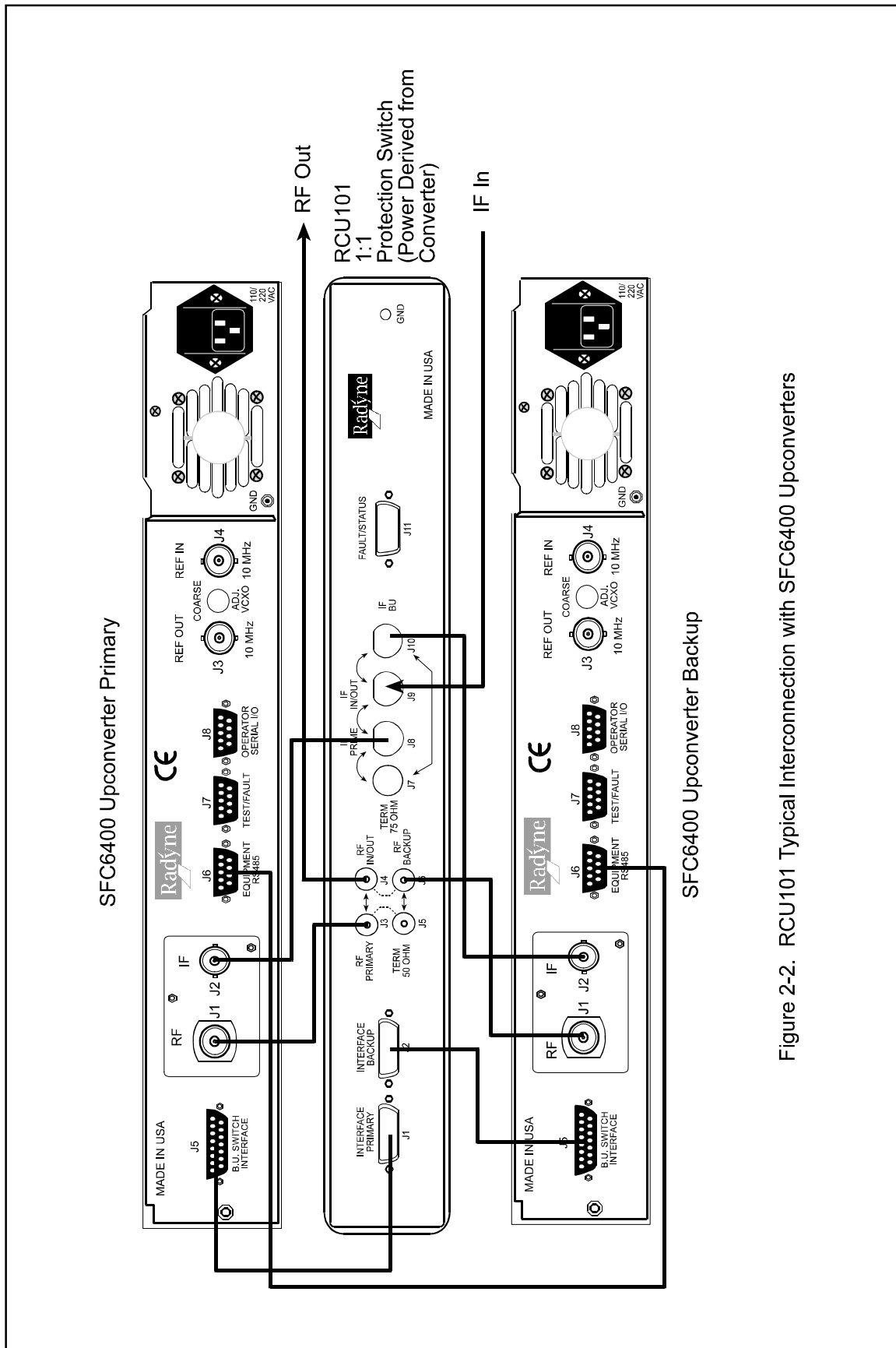


Figure 2-2. RCU101 Typical Interconnection with SFC6400 Upconverters

CA/3293	RF Cable, 1:1 Switch	2
CA/1961-003	IF Cable, 1:1 Switch	2

Routing of the cables between the two converters and the switch is depicted in Figure 2-2. Note that the RF/IF cabling included with the switch does not include cables to other panels in the rack.

2.4 Hardware Interfaces

Hardware interfaces between the online and backup converter and the switch equipment include the RF interface, IF interface, Switch Interface, and Equipment RS-485 interface. In addition to the above, the operator has access to all converter equipment in the system including the switch via the operator RS-232 interface on the converter.

2.4.1 Protection Switch Interface (Primary & Backup) Connector (J1 & J2)

The protection switch interface connector is a DB 15-pin connector that connects each converter with the backup switch unit. This cable is not daisy-chained between converters but serves as a direct link for each converter in the configuration whether they are the primary converter or the backup unit. This interface finds use in both the 1:1 and 1:N configuration type switches. The pinout of the switch is as follows:

J1 B/U Switch Interface

<u>J1 Pin#</u>	<u>DB 15</u>	<u>Nomenclature</u>	<u>Description</u>	<u>Controller AS/3048 J7</u>
1		N.O	Form-C contact summary fault normally open contact	1
5		N.C.	Form-C contact summary fault normally closed contact	9
9		COM	Form-C contact summary fault common contact	2
13		GND		10
2		+15V Or'd	Diode Or'd +15 Vdc from converter	3
6		FCB1	Fault Code bit 1	11
10		FCB2	Fault Code bit 2	4
14		FCB3	Fault Code bit 3	12
3		FCB4	Fault Code bit 4	5
7		IDB1	ID Bit 1	13
11		IDB2	ID Bit 2	6
15		IDB3	ID Bit 3	14
4		IDB4	ID Bit 4	7
8		INT O	Interrupt	15
12		RMT		8

The ID Bits provide information to the converter that tells the converter which slot (either primary or backup) the converter is plugged into. The addresses are as follows:

<u>IDB4</u>	<u>IDB3</u>	<u>IDB2</u>	<u>IDB1</u>	<u>Position</u>
1	0	1	0	Backup
1	0	1	1	Primary

2.4.2 Switch Fault/Status Connector (J11)

The RCU101 Redundancy Control Unit contains a summary Fault/Status connector that is available to the equipment operator for the purpose of monitoring the summary fault status of both converters as well as the individual status of the converters. The pinouts of this 15-pin D SUB connector are as follows:

<u>J11 DB15</u>	<u>Description</u>
1	Primary Converter Summary Fault Relay Com.
2	Primary Converter Summary Fault Relay N.C.
3	Primary Converter Summary Fault Relay N.O.
9	Backup Converter Summary Fault Relay Com.
4	Backup Converter Summary Fault Relay N.C.
5	Backup Converter Summary Fault Relay N.O.
10	Switch Online Status Com. (B active/A inactive)
11	Switch Online Status N.C. (Primary Online) - continuity
12	Switch Online Status N.O. (Backup Online) - continuity
13	Remote Primary (Active Low)
14	Remote Backup (Active Low)
6	Switch Summary Fault Relay Com. (Active on OK/Inactive on Fault)
7	Switch Summary Fault Relay N.C.
8	Switch Summary Fault Relay N.O.
15	Ground

The primary and backup summary fault relay contacts provide fault indications to flow through the switch into one common connector. In addition, the two Form-C summary fault contacts on the test fault connector on the rear of the RCU101 provide a Form-C closure to indicate which converter is presently online. Continuity of these contact closures implies online status for the indicated converter.

2.4.3 RCU101 RF and IF Rear Panel Connectors

The following paragraphs describe the RF and IF connectors located on the rear panel of the RCU101.

2.4.3.1 J3 RF Primary

The RF Primary connector goes to the RF port of the primary converter. This connection is made via the supplied semi-rigid cable with the RCU101 system. If the primary converter is online, this port will be connected to the RF In/Out port (J4).

2.4.3.2 J4 RF In/Out

The RF In/Out port is the user interface to the RCU101 protection switch system. This connection is an SMA F-type. The conversion to the N-type connector should be made at the rack interface panel. If the system requires interface to an N-connector cable, an SMA-to-N adapter is recommended.

2.4.3.3 J5 RF Termination 50-Ohm

The 50-ohm RF termination terminates the RF output of a redundant upconverter system or the input of a redundant downconverter system for the converter that is in standby or faulted mode. By removing the termination, access to the RF port of the standby converter can be obtained.

2.4.3.4 J6 RF Backup

The RF Backup connector is a type SMA-F that routes the RF signal of the backup converter to the transfer switch in the RCU101. This connection is made via the supplied semi-rigid cable assembly that is included with the RCU101.

2.4.3.5 J7 IF Termination 75-Ohm

The IF Termination is a 75-Ohm BNC type termination for the IF port of the converter that is in standby mode. By removing the 75-Ohm termination, the operator can gain access to the IF port of the converter that is currently in standby mode.

2.4.3.6 J8 IF Prime

This BNC-F connector goes to the IF connector of the primary converter. This connection is made via the supplied IF cable assembly with the RCU101.

2.4.3.7 J9 IF In/Out

This BNC-F connector is the user IF interface to the redundant converter system.

2.4.3.8 J10 IF Backup

The IF Backup BNC-F connector connects to the IF port of the backup converter. This connection is made with the IF cable assembly supplied with the RCU101 System.

2.4.4 Interfaces Common to the Converters

The RS485 equipment interface and the operator serial I/O interface found on the converter hardware both play a role in the operation of the switch and are included here for continuity. For further information, please refer to the converter manual for more information on these two interfaces.

2.4.5 Operator Serial I/O (J8 on Converter Rear Panel)

Through the Operator Serial Port, the operator can gain access to all of the control features of the converter. This enables the remote operator to configure the switch, set the gain and frequency of the converter and interrogate status of the converter.

The Operator Serial Port is a DB 9-pin female connector at the rear of the converter. This port provides serial interface that can be configured as either a RS232, RS422 or RS485 interface. This port allows the user to remotely control all of the features outlined in the Serial Protocol (Appendix B). The serial port comes configured as an RS-232 Serial port for DCE unless indicated otherwise. The pinout of the D sub 9-pin socket connector configured for RS232 or RS422/485 is as follows:

Operator Serial I/O Connector (Rear Panel)

<u>J8 DB 9 Pin#</u>	<u>RS232</u>	<u>RS422/485</u>	<u>AS/3048 J10</u>
1	N/C	RXData\	1
2	TXData	TXData	3
3	RXData	RXData	5
4	DTR -- to pin 6	DTR -- to pin 6	7
5	GND	Gnd	9
6	DSR -- to pin 4	DSR -- to pin 4	2
7	RTS -- to Pin 8	RTS -- to Pin 8	4
8	CTS -- to pin 7	CTS -- to pin 7	6
9	N/C	TXData\	8

NOTE: In order to obtain these signals at the output connector, the jumper configuration on the AS/3048 Controller PWB must have been performed as outlined in Appendix C. A summary of jumper selections is as follows:

Configuration	JP4-1	JP4-2	JP4-3	JP4-4	JP4-5	JP4-6	JP3	JP5	JP6	JP7	JP8
RS232	OUT	OUT	OUT	OUT	IN	IN	OUT	OUT	IN	OUT	OUT
RS422	IN	IN	IN	IN	OUT	OUT	OUT*	OUT	OUT	OUT	IN
RS485	IN	IN	IN	IN	OUT	OUT	OUT*	OUT	OUT	OUT	IN
485 1/2 DPLX	IN	OUT	OUT	IN	OUT	OUT	OUT*	IN	OUT	IN	IN

*Receiver terminations for twisted pair RS422/485 can be optionally terminated at 120 ohms by installing JP3. Factory-supplied cables for multiple converter "daisy chain" operation are terminated at the cable ends.

2.4.6 Up/Downconverter Equipment RS485 Port (J6 on Converter Rear Panel)

An equipment multi-drop, full-duplex, bi-directional RS485 Interface allows communication between converters. Because the RS485 interface uses a master/slave (talker/listener) configuration, the converter that is designated the backup converter will automatically be established as the master. Under normal RS485 protocol, the master will poll a specific slave by address and only then will the slave unit respond. The swapping of Transmit Data and Receive Data is accomplished in the inter-converter cable as the hardware interface is identical for all converters.

<u>J6 DB 9-Pin</u>	<u>Description</u>	<u>10 Pin AS/3048</u>
1	GND	1
2	SRCLK	3
3	No Connect	5
4	TX Not	7
5	TX	9
6	SRDAT	2
7	No Connect	4
8	RX Not	6
9	RX	8

The signals on pins 2 and 6 of the DB9 connector are the clock and data of the I-squared bus which is an optional interface employed in the 1:8 (RCU108) protection systems only.

Section 3 - Operation

3.0 Definitions

The nomenclature used throughout this manual is meant to imply various roles that each (up or down) converter assumes depending upon the state of the converters and the settings of the protected converter system. These descriptions are as follows:

A **Protected Converter System** consists of the primary converter, backup converter, and the RCU101 switch and required interface cables.

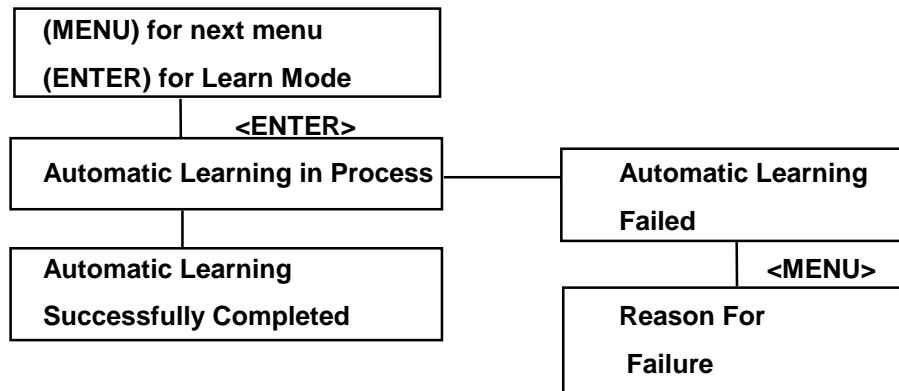
The **Primary Converter** is the converter that is connected to the Primary Port on the Switch.

The **Backup Converter** is the converter that is connected to the Backup Port on the Switch

The **Online Converter** can be either the primary or backup converter.

3.1 Operation

The 1:1 protection switch unit provides automatic restoration for one online converter. An RS485 equipment interface allows the backup converter to 'learn' the frequency and gain settings of the primary converter. The learning process is initiated by the user, via the backup converter. By entering the Utilities menu from the front panel of the backup converter, it will allow the user to initiate the learning process. The backup converter will indicate whether the learning process was successful. If the process was not successful, the converter will indicate the learning process failed. Refer to the converter manual for more details.



3.1 Switch Logic

The RCU101 uses the output of the Form-C relay in the converter to determine what action to take. In the following descriptions, it is assumed that the switch is in Auto mode and that the other converter is not faulted. (If the switch were in Manual mode, no switching would take place).

The Fault N.O logic level is derived from the normally open contact of the summary fault Form-C relay in the converter. The converter, when clear of any and all faults, asserts the summary fault relay to the not faulted state and the contact is open. A fault in the converter, turning the converter off, failure of the converter power supply, or disconnecting the switch interface cable will cause the relay to close. Upon detection of this event, the switch will toggle control and data to the other converter.

Once the fault in the faulted converter is cleared, the converter will reset the summary fault relay and the contact will again be open. Upon detection of this event, the switch will place the converter in standby, so that it can be placed online in the event that the other converter fails. The switch will not automatically switch back to the original online converter.

The following truth table illustrates this switching logic. A '1' in this table indicates that the corresponding converter is faulted.

<u>Primary</u>	<u>Backup</u>	<u>Action</u>
0	0	No action. Whoever was online, stays online.
1	0	Backup converter is placed online.
0	1	Primary converter is placed online.
1	1	No action. Whoever was online, stays online.

In addition to providing the switching logic, the RCU101 provides each converter with 4 ID bits that tell the particular converter whether it is the primary or backup converter. The ID bits are as follows:

<u>ID Bits</u>	<u>Meaning</u>
1010	Backup
1011	Primary

3.2 Manual/Auto Mode Selection Switch

The Manual/Auto mode selection switch is located on the front of the RCU101 and is used in the following manner:

When the switch is placed to the far left (PRI), the primary converter is placed online and will stay online even if it faults.

When the switch is placed to the far right (BU), the backup converter is placed online and will stay online even if it faults.

When the switch is placed in the middle position, it will automatically switch to the backup when a fault is detected in the online converter.

If the front panel switch is accidentally left in the manual mode, the RCU101 can be placed in the auto mode remotely by sending a Manual Command followed by an Auto Command to the converter that was deselected by the front panel switch. (See the applicable converter manual for more details).

3.3 Switch LEDs

There are two sets of identical switch LEDs, one set for the primary converter and one for the backup converter. Their meanings are the same.

Online LED - The Online LED indicates that the corresponding converter has been placed online by the switch.

Standby LED - The Standby LED indicates that the corresponding converter is in Standby.

Fault LED - The Fault LED indicates that the corresponding converter is currently faulted.

Manual LED - The MANUAL LED indicates that the converter has been manually selected and will stay there.

3.4 Troubleshooting and/or Replacing a Faulted Converter

Prior to testing or replacing a faulted converter it is strongly recommended that the mode selection switch be set to manually select the converter that is currently online. Once the faults on the faulted converter have been cleared (or the converter has been replaced), the converter can be placed in the standby by moving the mode selection switch back to the center, thus placing the switch in auto mode.

Note: If the switch is left in the middle (auto) position while tests are being performed on a converter that is not faulted, and the online converter faults, the switch will automatically toggle control and data to the converter under test. This can result in unwanted operation when the converter under test is not at the same frequency or gain levels as the online converter.

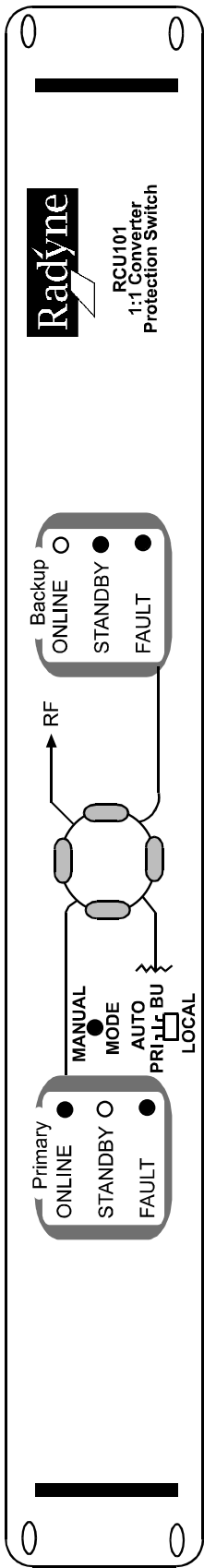


Figure 3-1. RCU101 Front Panel Controls and Indicators

Section 4 - Maintenance

4.0 Periodic Maintenance

The RCU101 requires no periodic field maintenance procedures. The unit contains no adjustments. Should a unit be suspected of a defect in field operations after all interface signals are verified, the proper procedure is to replace the unit with another known working unit. If this does not cure the problem, faulty cabling or power should be suspected.

A fault in the operation of the RCU101 should become evident through an illogical LED indication on the front panel. For example, failure of the RF transfer switch will become immediately obvious when all four LEDs of the graphical transfer switch display on the front panel illuminate. In this case, the RCU101 logic has commanded the transfer switch to a certain position. This will illuminate the new position but the relay remains stuck in the old position.

Verification of the operation of the IF and RF transfer switches can be verified through a DC continuity check at the BNC and RF connectors at the rear of the RCU101. The RF and IF cables will need to be removed to perform this test. Failure of either the IF or RF transfer switch can be verified by checking the voltage to the coils on either relay assembly. The IF transfer switch coil should have 4.5 Vdc and the RF transfer switch Coil should have 14.0 Vdc across the coil (not to ground). If a fault in either the RF or IF transfer switch module is suspected, these assemblies can be changed in the field.

Appendix A

Technical Specifications

Remote Monitor and Control (via Backup or Online Converter front panel or serial port):

Rear Panel:

RF Ports:	SMA -F	QTY: 2
IF Ports:	BNC-F	QTY: 2
Converter Interface:	DB15-F	QTY: 1
Summary Status:	DB15-F	QTY: 1

Switch RF Specifications:

Switched RF Ports:

Bandwidth:	DC-18 GHz
Insertion Loss:	0.4 dB (C-band), 0.5 dB (Ku-band)
Impedance:	50 Ohms
VSWR:	1.5:1 Max.
Isolation:	70 dB min. (C-Band), 60 dB min. (Ku-Band)

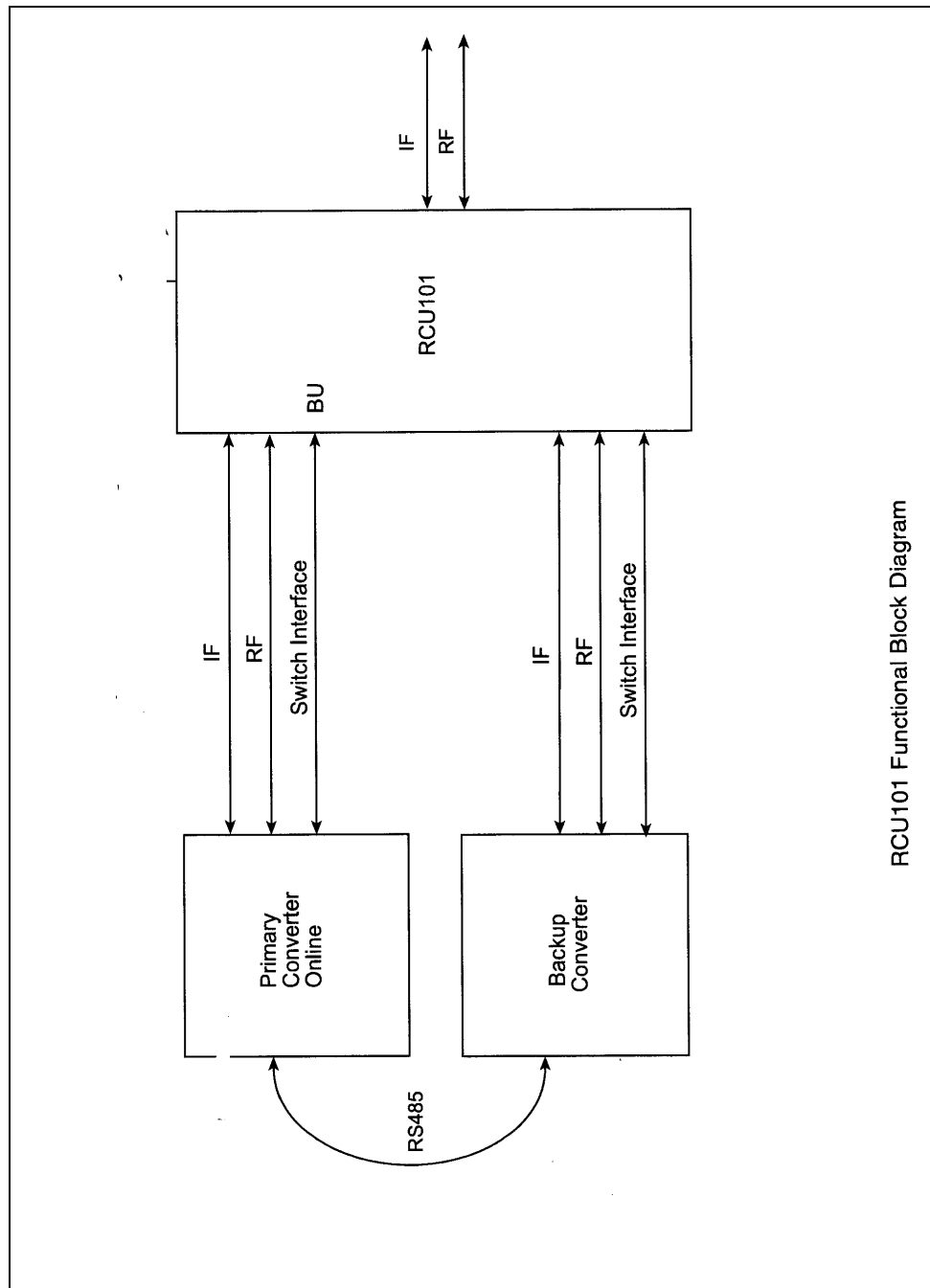
Switch IF Ports:

Bandwidth:	50 - 180 MHz
Insertion Loss:	1.0 dB Max.
Impedance:	75 ohms
VSWR:	1.5:1 Max.
Isolation:	65 dB Min.

Front Panel Control & Indicators

Power, Online, Off-line, Manual Backup, Fault LEDs
Backup, Primary, Online converter selection

**- Appendix B -
RCU101 Block Diagram,
Configuration Drawings
and Schematics**



RCU101 Functional Block Diagram

Figure B-1. Functional Block Diagram

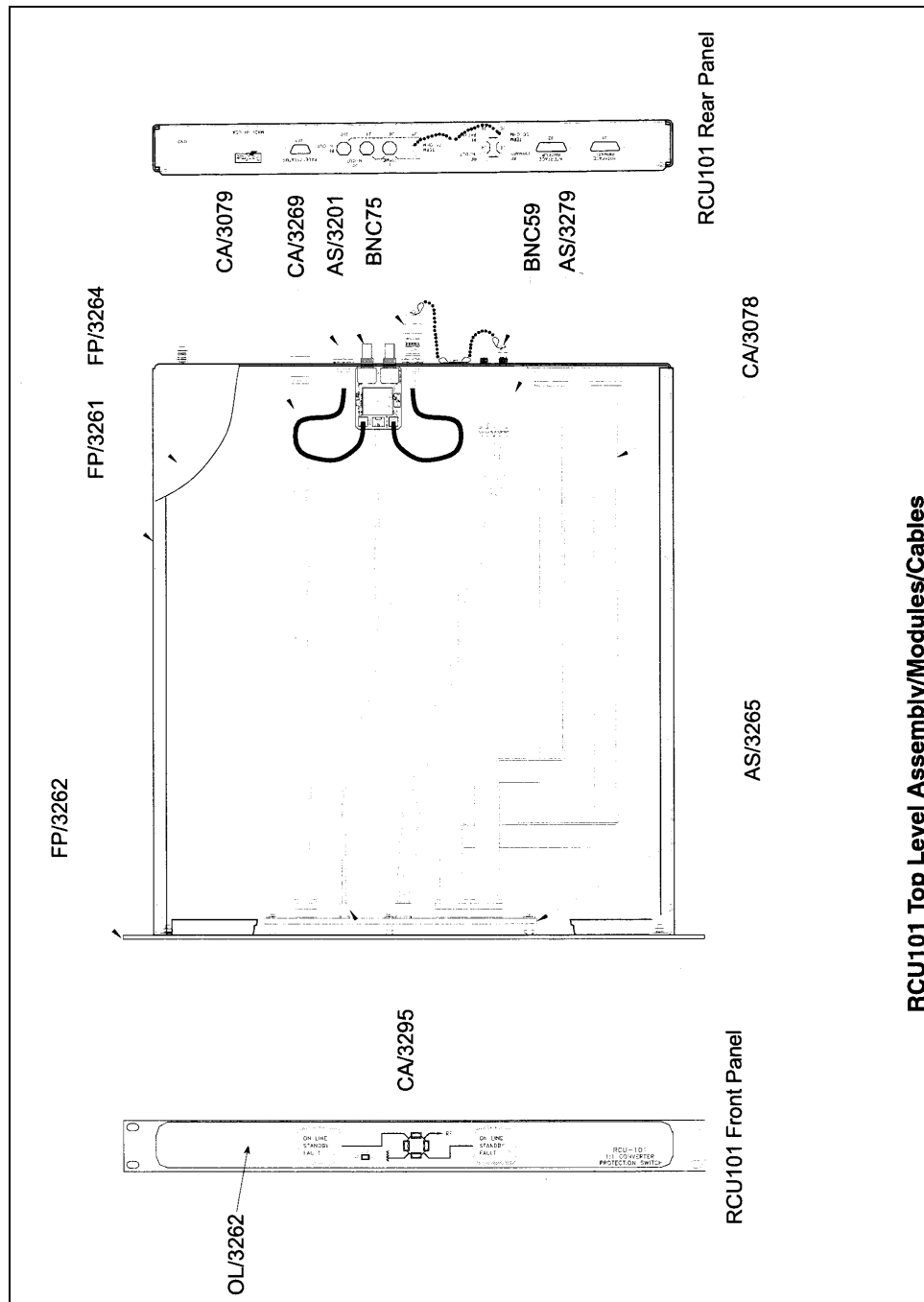
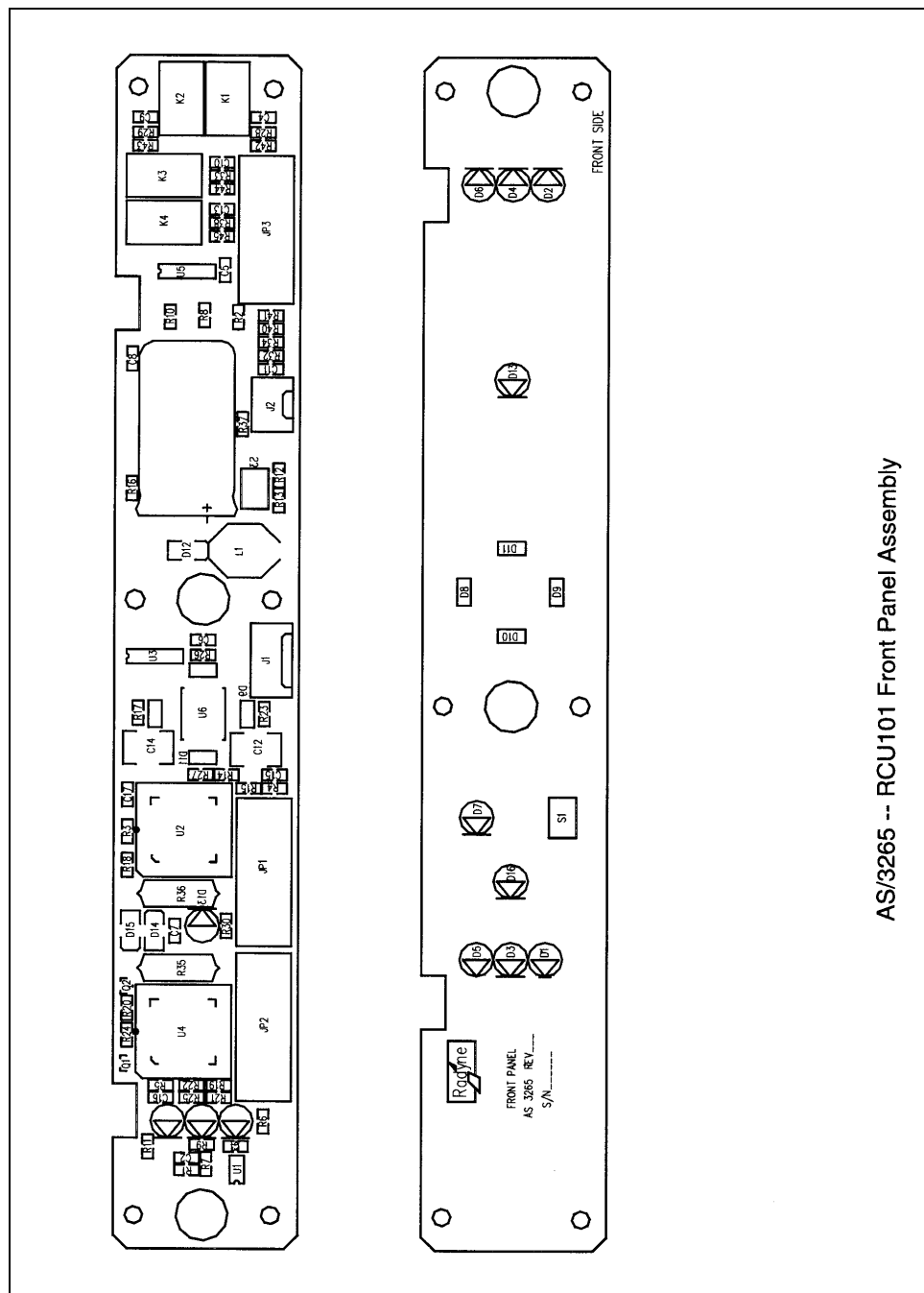


Figure B-2. Top Level Assembly



AS/3265 -- RCU101 Front Panel Assembly

Figure B-3. AS/3265 Front Panel Assembly

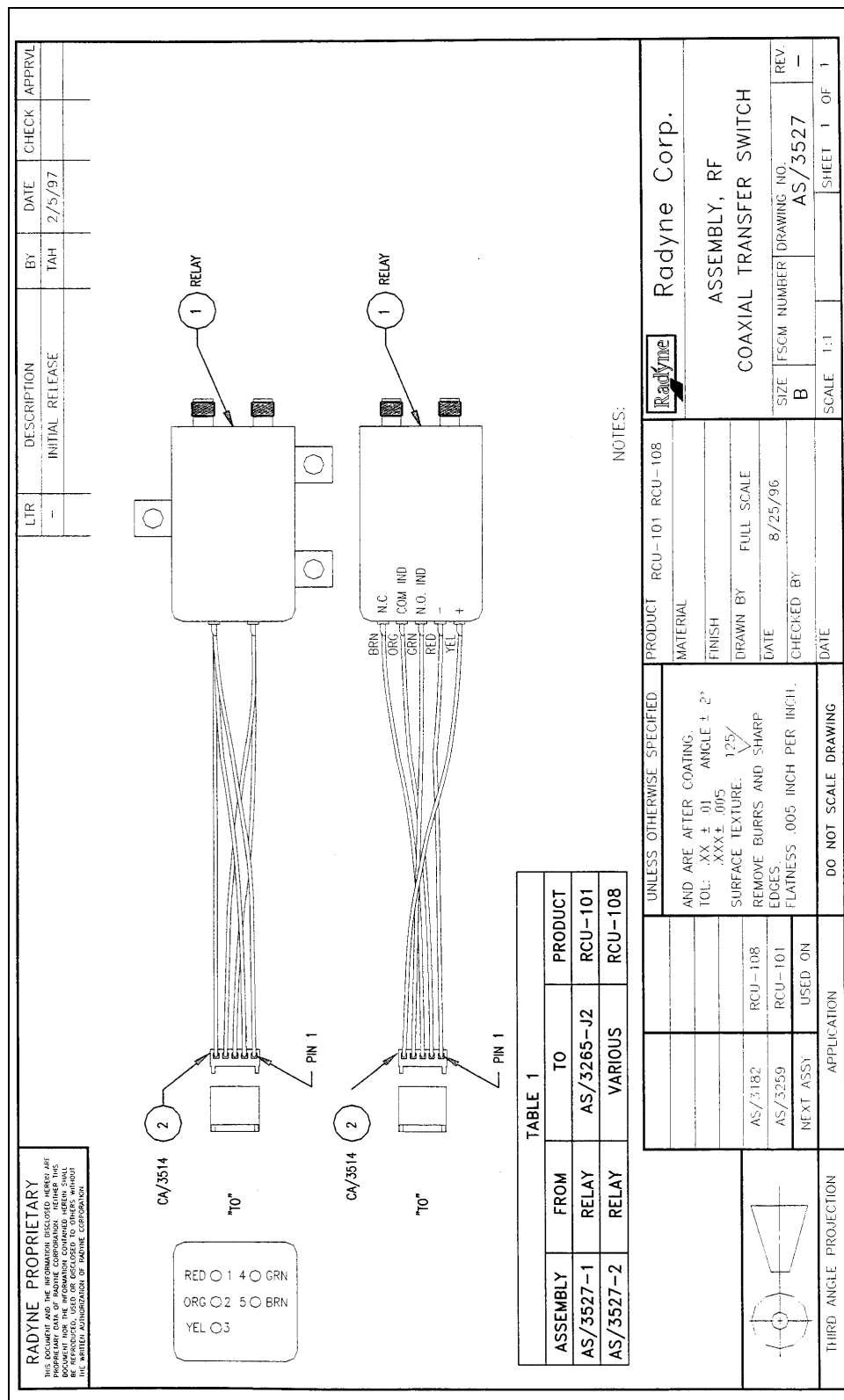


Figure B-4. AS/3527 Switch Assembly



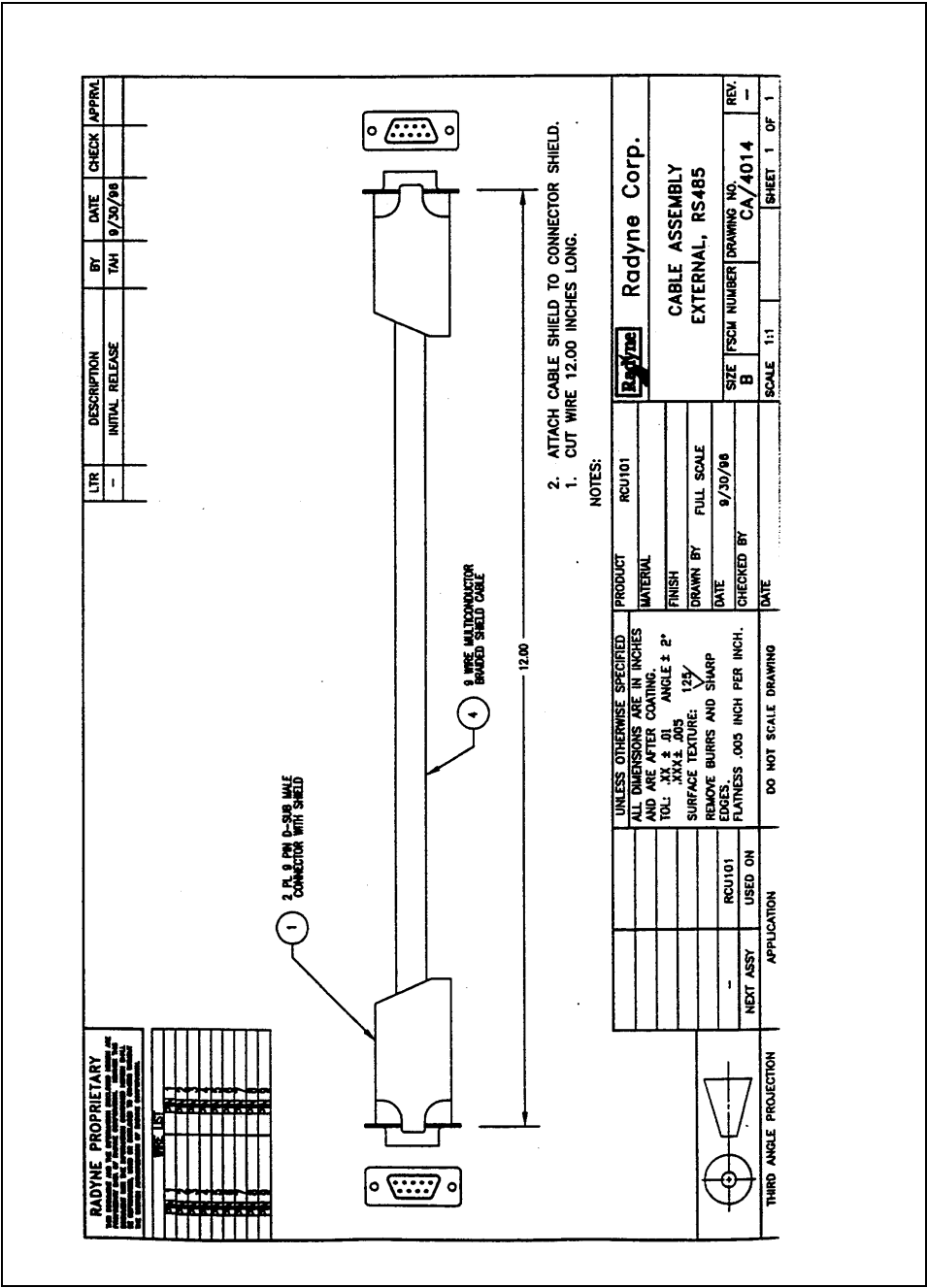


Figure B-6. CA/4014 Cable Assembly