

# SFC4200/SFC1275G

## Synthesized Frequency Downconverter

### Installation and Operation Manual

TM054 - Rev. 4.0  
March, 2002

**- NOTICE -**

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## SFC4200/SFC1275G Synthesized Frequency Downconverter Installation and Operation Manual TM054 – Record of Revisions

Radyne ComStream Corporation is constantly improving its products and therefore the information in this document is subject to change without prior notice. Radyne ComStream Corporation makes no warranty of any kind with regard to this material, Including but not limited to the implied warranties of merchantability and fitness for a particular purpose. No responsibility for any errors or omissions that may pertain to the material herein is assumed. Radyne ComStream Corporation makes no commitment to update nor to keep current the information contained in this document. Radyne ComStream Corporation assumes no responsibility for use of any circuitry other than the circuitry employed in Radyne ComStream Corporation systems and equipment.

| Revision Level | Date     | Reason for Change   |
|----------------|----------|---|
| 1.0            | 7-15-96  | Initial Release   |
| 2.0            | 12-01-96 | Added interconnection diagram, redefined connector pinouts, updated serial protocol, enhanced operation section, added remote serial I/O operation. |
| 2.1            | 12-16-96 | Updated Operation Section, updated Serial Protocol and added additional figures to Appendix C.  |
| 3.0            | 2-03-97  | Updated Operation Section, added 1:1 and 1:8 Serial Protocol data.  |
| 3.1            | 4-24-97  | Added Extended Band data, additional 1:8 operation data and backup 1:8 flow chart   |
| 4.0            | 3-4-02   | Merged with Rev. 4.0, TM062, SFC1275G Global Ku-Band Synthesized Frequency Downconverter.   |

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## Section 1 - Introduction

### 1.0 Description

This manual discusses the Radyne ComStream Corporation SFC Synthesized Frequency Downconverter family of products (Figure 1-1). These include the SFC4200 C-Band, and the SFC1275G Ku-Band Synthesized Frequency Downconverters. They are high quality, rack mounted satellite Downconverters that are intended for use in medium-to-large earth station installations where multiple carrier uplinks need to be established. The SFC Downconverters are ready to be configured into a variety of backup switch configurations which include 1:1, and 1:N (to a maximum of N = 8) configurations.

The SFC4200 Downconverter is a C-Band, 125 kHz resolution synthesized satellite downconverter capable of converting a C-band downlink in the range of 3.620 to 4.2 GHz or 3.400 to 4.2 GHz extended band, to either a 40 MHz bandwidth 70 MHz IF output or optionally to an 80 MHz bandwidth 140 MHz carrier.

The SFC1275G Downconverter is a Ku-Band 125 KHz resolution synthesized satellite downconverter capable of converting a Ku-Band downlink in the range of 10.95 to 12.75 GHz to either a 40 MHz bandwidth 70 MHz IF output or optionally to an 80 MHz bandwidth 140 MHz carrier.

Gain can be controlled to 0.1 dB step resolution. Control of frequency and gain can be accomplished through the Front Panel Controls or remotely via an RS-232 Serial Interface.

The units monitor local oscillator (LO) phase-locked loop faults in the converter at all times during operation. If a fault is detected, the converter immediately goes into the Off Line Mode. If multiple converters are configured to provide backup protection switching, a summary fault will signal the backup and put itself online thus restoring the failed circuit.

The RF Hardware consists of a broadband synthesizer, a fixed frequency phase locked oscillator, and the first and second converter modules. The broadband synthesizer provides the synthesized local oscillator for the conversion from RF to L-Band. The LO that tunes from 4.6645 – 5.2425 GHz or 4.485 – 5.335 GHz (SFC4200), or from 8.88 – 10.68 GHz (SFC1275G) performs this conversion. The second mixer converts the L-Band Signal to either the 70 or 140 MHz IF Output. A fixed frequency IFLO performs this frequency conversion.

A 40 dB gain control output attenuator at the IF controls the power out of the converter. This attenuator is capable of 0.1 dB resolution through a software linear interpolation of 1 dB calibration values.

The internal IF is converted by the second mixer LO to 70 or 140 MHz. The 70/140 MHz IF chain also performs filtering and phase equalization via an all-pass network. The gain calibration process also provides gain slope across all bands to be within the specified  $\pm 0.5$  dB. Additional gain compensation due to changes in ambient temperature provide for high gain stability over various operating conditions.

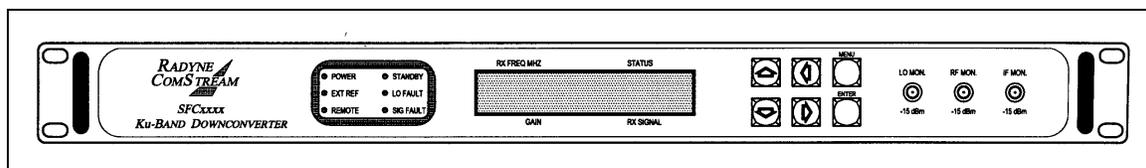


Figure 1-1. SFC Downconverter Front Panel

The SFC Downconverters have been designed to provide performance that meets or exceeds all industry standards in effect today for satellite communications earth station frequency converter equipment found worldwide. In addition to providing robust performance, the SFC Downconverters are loaded with features that will provide ease of integration and operation.

## **1.1 Protection Switch Versatility**

Radyne ComStream Corporation SFC family of Converter Products feature 'plug-and-play' ease of installation with the RCU101 1:1 or the RCU108 1:8 Redundancy Control Units. All converters can be plugged into the backup slot and assume the role of protection switch controller. The backup converter learns and stores the frequency, gain and channel settings of the primary converters. If the stored setting of the primary converter is changed, the backup converter will notify the user via the front panel and the RS-232/RS-485 interface.

All circuits are protected upon installation of the switch and completion of the learning process. This eliminates the need for complicated software configurations that might otherwise leave a circuit vulnerable. Likewise, replacing a failed converter is as simple as plugging in a replacement.

## Section 2 - Installation

### 2.0 Installation Requirements

SFC Downconverters are designed to be installed within any standard 19 inch equipment cabinet or rack, and requires 1 Rack Unit (RU) mounting space (1.75 inches) vertically and 19 inches of depth. Including cabling, a minimum of 20 inches of rack depth is required. The rear panel is designed to have power enter from the right and cabling enter from the center and left when viewed from the rear of the unit. Data and control cabling can enter from either side. The unit can be placed on a table or suitable stable surface if required.



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

### 2.1 Unpacking

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

- SFC Downconverter Unit
- Power Cord, 6 foot with applicable AC Connector
- Installation and Operation Manual

### 2.2 Removal and Assembly

Carefully unpack the unit and ensure that all of the above items are in the carton. If the Prime AC power available at the installation site requires a different power cord/AC connector, then arrangements to receive the proper device will be necessary before proceeding with the installation.

SFC Downconverters are shipped fully assembled and do not require removal of the covers for any purpose in installation. Should the AC Power Connector Cable be of the wrong type for the installation, either the cable or the power connector end should be replaced. The power supply itself is designed for universal application using from 100 to 240 VAC, 50 – 60 Hz.

### 2.3 Mounting Considerations

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

### 2.4 Initial Power-Up

Turn the unit 'ON' by placing the rear panel switch (above the power entry connector) to the 'ON' position. Upon initial and subsequent power-ups, the SFC Downconverters will test themselves and several of its components before beginning its main Monitor/Control program. These power-up diagnostics show no results if successful. If a failure is detected, the Fault LED is illuminated.

## 2.5 SFC Downconverter Interconnections

Figure 2-1 illustrates a typical interconnection of a SFC Downconverter with an RCU101 1:1 Protection Switch.

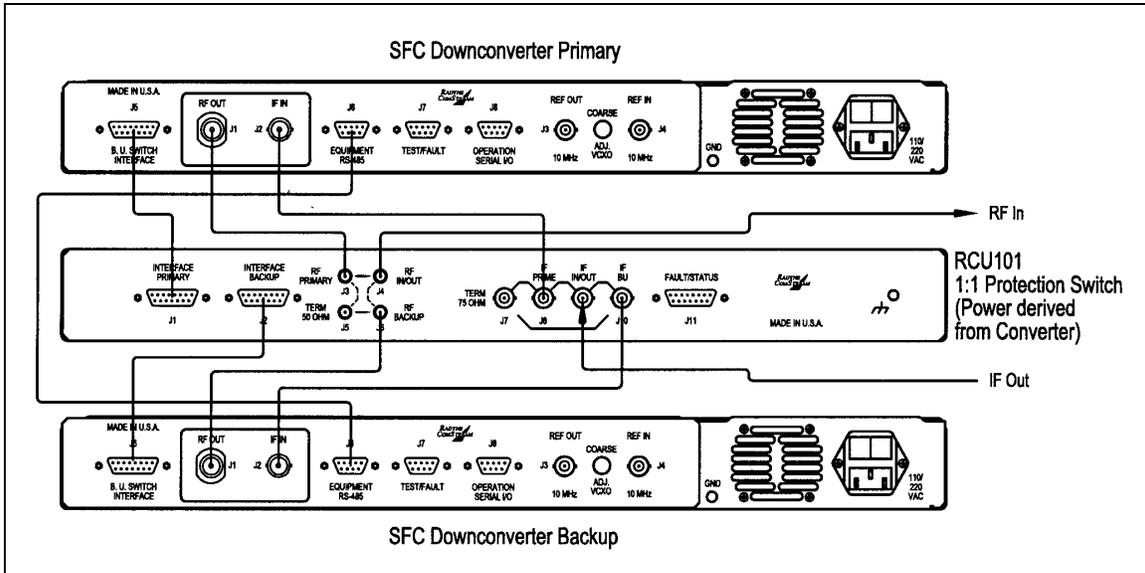


Figure 2-1. RCU101 Typical Interconnection with SFC Downconverters

## Section 3 - Operation

### 3.0 Theory of Operation

The SFC Downconverters have been designed to minimize the amount of hardware in the system while maximizing performance. Spurious performance in the Downconverter is critical and in particular, LO related spurious In-Band is nonexistent.

The SFC Downconverters are double conversion microwave Downconverters. The block diagram (Figure 3-1) of the system includes the Signal RF Assembly, the Synthesizer Assembly, the Reference Assembly, the Monitor and Control (M&C) Microcontroller, and Power Supply Subsystem.

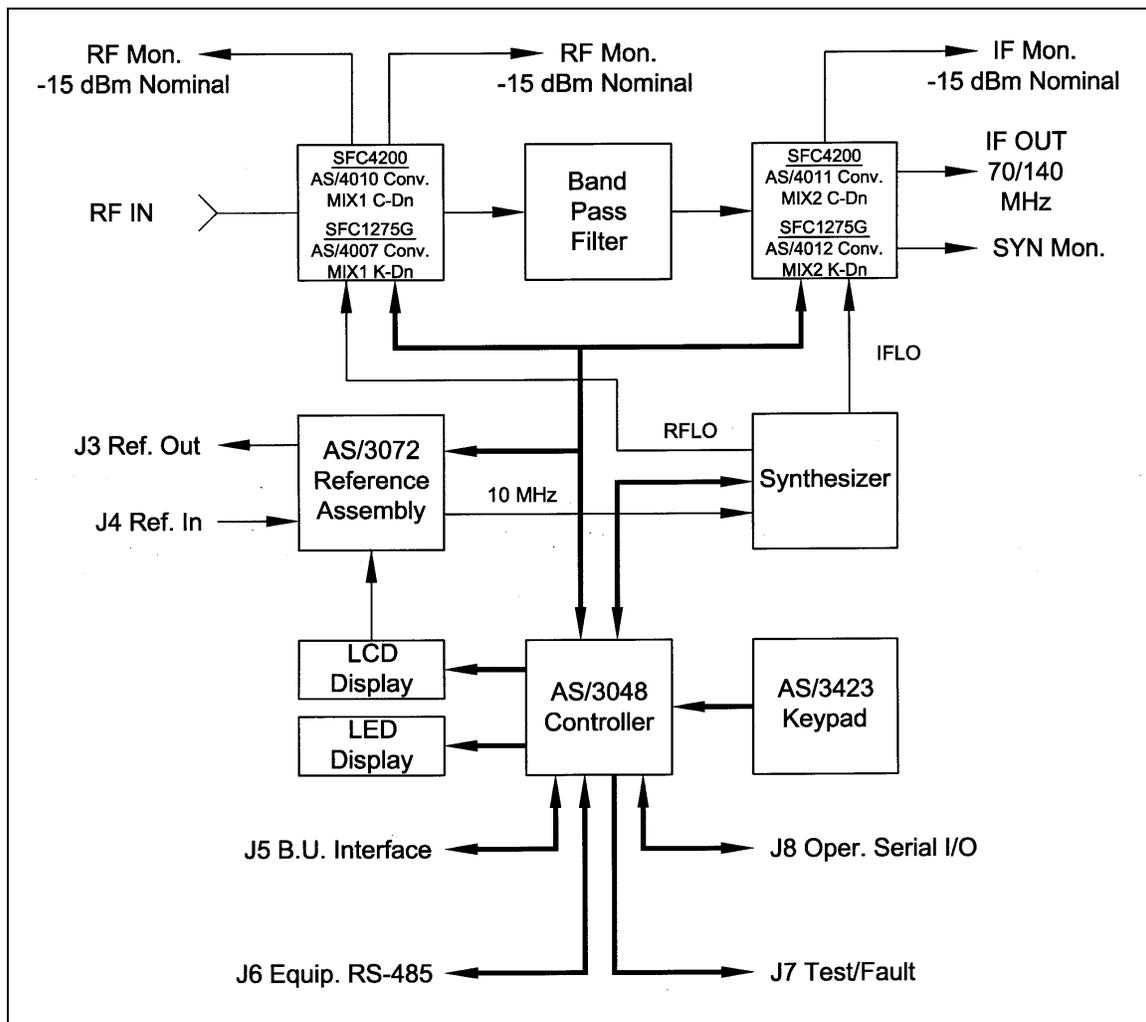


Figure 3-1. SFC Downconverter Block Diagram

### 3.1 Signal RF Assembly

The Signal RF Assembly is a subassembly that holds the first and second mixer converter modules, and the IF Cavity Filter. The first and second mixer modules for the SFC4200 and SFC1275G Downconverters are described below.

### 3.1.1 AS/4010 Converter First Mixer C-Band Downconverter (SFC4200)

The First Mixer module of the C-Band Downconverter accepts the input and has 30 dB of digital gain control. Performance specifications for the First Mixer are listed on Table 3-1.

| <b>Table 3-1. AS/4010 Converter First Mixer C-Band Downconverter (SFC4200)</b> |   |   |
|--|---|---|
|  | <b>Standard Band</b>  | <b>Extended Band</b>  |
| Input Frequency  | 3.62 – 4.2 GHz  | 3.400 – 4.200 GHz   |
| Input Power  | -40 dB Nominal  | -40 dB Nominal  |
| Input Return Loss  | ≥ -20 dB  | ≥ -20 dB  |
| Input Impedance  | 50Ω   | 50Ω   |
| Gain   | 8 – 10 dB   | 8 – 10 dB   |
| Gain Control   | None  | None  |
| Output Frequency   | 1.0225 – 1.0626 GHz<br>(70 MHz)<br>0.9325 – 1.0125 GHz<br>(140 MHz)                               | 1.135 – 1.175 GHz<br>(70 MHz)<br>1.045 – 1.125 GHz<br>(140 MHz)                               |
| P <sub>out</sub> Nominal   | -30 to -32 dBm  | -30 to -32 dBm  |
| Output Impedance   | 50Ω   | 50Ω   |
| LO Input   | 4.6625 – 5.2425 GHz @<br>+13 dBm for 70 MHz IF<br>4.5925 – 5.1725 GHz @<br>+13 dBm for 140 MHz IF | 4.555 – 5.355 GHz @<br>+13 dBm for 70 MHz IF<br>4.485 – 5.285 GHz @<br>+13 dBm for 140 MHz IF |

### 3.1.2 AS/4011 Converter Second Mixer C-Band Downconverter (SFC4200)

The Second Mixer module of the C-Band Downconverter accepts the IF from the First Mixer and converts and amplifies it to the 70/140 MHz, 75Ω IF Output. The Second Mixer has 40 dB of gain control. Performance of this converter assembly is listed in Table 3-2.

| <b>Table 3-2. AS/4011 Converter Second Mixer C-Band Downconverter (SFC4200)</b> |   |   |
|---|---|---|
|   | <b>Standard Band</b>  | <b>Extended Band</b>                                      |
| Output Frequency  | 50 – 90 MHz Standard<br>(100 – 180 MHz [Option 01])           | 50 – 90 MHz Standard<br>(100 – 180 MHz [Option 01])       |
| Impedance   | 75Ω   | 75Ω   |
| Output Return Loss  | ≥ 23 dB   | ≥ 23 dB   |
| P <sub>out</sub> P1 dB  | +20 dBm   | +20 dBm   |
| Gain  | 30 – 32 dB  | 30 – 32 dB  |
| Input Frequency   | 1.0225 – 1.0625 GHz (70 MHz)<br>0.9325 – 1.0125 GHz (140 MHz) | 1.135 – 1.175 GHz (70 MHz)<br>1.045 – 1.125 GHz (140 MHz) |
| Detected Output   | 0 - 10 VDC<br>(10 VDC @ -10 dBm Out)                          | 0 - 10 VDC<br>(10 VDC @ -10 dBm Out)                      |

|    |                     |                    |
|----|---------------------|--------------------|
| LO | 1.1125 GHz @ +13 dB | 1.225 GHz @ +13 dB |
|----|---------------------|--------------------|

### 3.1.3 AS/4007 Converter First Mixer Ku-Band Downconverter (SFC1275G)

The First Mixer module of the Ku-Band Downconverter accepts the 10.95 – 12.75 GHz Downlink and converts it to L-Band IF. Performance specifications for the First Mixer are listed on Table 3-3.

| Table 3-3. AS/4007 Converter First Mixer Ku-Band Downconverter (SFC1275G) |   |
|---|---|
| Input Frequency   | 10.95 – 12.75 GHz   |
| Input Power   | -40 dBm   |
| Input Return Loss   | > -18 dB  |
| Input Impedance   | 50 $\Omega$   |
| Gain  | -5 to 6 dB  |
| Gain Control  | None  |
| Output Frequency  | 2.050 – 2.070 GHz (70 MHz) 2.100 – 2.180 GHz (140 MHz)                                |
| P <sub>out</sub> Nominal  | -34 to -35 dBm  |
| Output Impedance  | 50 $\Omega$   |
| LO Input  | 8.88 – 10.68 GHz @ +13 dBm for 70 MHz IF<br>8.81 – 10.61 GHz @ +13 dBm for 140 MHz IF |

### 3.1.4 AS/4012 Converter Second Mixer Ku-Band Downconverter (SFC1275G)

The Second Mixer module of the Ku-Band Downconverter accepts the IF from the First Mixer and converts and amplifies it to the 70 MHz, 75 $\Omega$  IF Output. The Second Mixer has 40 dB of gain control. Performance of this converter assembly is listed in Table 3-4.

| Table 3-4. AS/4012 Converter Second Mixer Ku-Band Downconverter (SFC1275G) |  |
|--|--|
| Output Frequency   | 50 – 90 MHz Standard (100 – 180 MHz [Option 01]) |
| Impedance  | 75 $\Omega$                                      |
| Output Return Loss   | < -23 dB   |
| P <sub>out</sub> P1 dB   | +20 dBm  |
| Gain   | 34 – 35 dB                                       |
| Input Frequency  | 2.050 – 2.090 GHz (70 MHz)                       |
| P <sub>in</sub> Nominal  | -34 to 35 dBm                                    |
| Detected Output  | 0 – 10 VDC (10 VDC @ -10 dBm In with             |

|    |                   |
|----|-------------------|
|    | 0 dB Attenuation) |
| LO | 2.0 GHz @ +13 dB  |

### 3.2 AS/3048 M&C Controller Assembly

The Controller PWB Assembly is the controller, which monitors the Operator Front Panel, and Remote Input used to control the frequency, gain and provide the fault detection functions of the converter. The AS/3048 hardware features an Intel 80C32 microprocessor (Refer to Figure 5-2). Peripherals on the controller include the following:

- 12 Bit Digital to Analog Converter (DAC)
- 8 Channel/8 Bit Analog to Digital Converter (A/D)
- RS-485 UART
- RS-232, -422, -485 UART
- LCD Port
- 8 Bit Addressable Synthesizer Bus
- 5 Bit Addressable Converter Bus
- Static Memory
- Nonvolatile Memory
- Serial Nonvolatile Memory
- Read-Only Memory (ROM)

The 12 Bit DAC provides the precise current to the PIN Diode Attenuators in the converter. The value of attenuation is determined through look-up of calibration data stored in non-volatile memory. 000 to FFF written to the DAC provides an output voltage of 0.3 V – 8.50 V respectively.

The 8-channel A/D Converter allows the AS/3048 to monitor various voltages within the converter. The input to the A/D is 0 to 5 VDC. Voltages monitored by the A/D include the square-law voltages from the IF and Fault of the synthesizer which allows the controller to calculate signal strengths.

The Equipment RS-485 UART is independent from the Operator UART. Dual UARTS allow equipment to be tied together as a system while giving the operator a single remote point of contact. The operator serial interface is configurable via jumpers found on the AS/3048. Refer to Figure 5-3 for the location of the jumpers.

The various memories found in the AS/3048 provide for program storage and calibration value storage. In the event that the operator is requested to perform a software revision, replacement of the PROM (U11) will be required. This operation should be performed with the power off and in a static-free environment.

### 3.3 Synthesizer Modules

The Synthesizer module used in SFC Downconverters are stand-alone modules that provide the synthesized local oscillator and the fixed IF local oscillator for the first and second mixers in the converter.

### 3.3.1 Synthesizer Module (SFC4200)

The 10 MHz reference to the synthesizer is provided by the AS/3072 Reference Assembly. Performance of the synthesizer is listed in Table 3-5.

| Table 3-5. Synthesizer Module (SFC4200)                                       |  |  |
|---|--|--|
|   | Standard   | Extended   |
| RF LO Output Frequency  | 4592.5 - 5242.5 MHz  | 4.48 – 5.355 GHz   |
| Step Size   | 125 kHz  | 125 kHz  |
| Power Out   | +13 dBm  | +13 dBm  |
| Spurious  | -70 dBc  | -70 dBc  |
| Harmonics   | -20 dBc  | -20 dBc  |
| Phase Noise<br><i>Note: Typical readings are 3 to 8 dB better than shown.</i> | -70 dBc @ 100 Hz<br>-80 dBc @ 1 kHz<br>-88 dBc @ 10 kHz<br>-95 dBc @ 100 kHz<br>-110 dBc @ 1 MHz | -70 dBc @ 100 Hz<br>-80 dBc @ 1 kHz<br>-88 dBc @ 10 kHz<br>-95 dBc @ 100 kHz<br>-110 dBc @ 1 MHz |
| IF LO Output Frequency  | 1112.5 MHz   | 1.225 GHz  |
| Spurious  | -70 dBc  | -70 dBc  |
| Harmonics   | -20 dBc  | -20 dBc  |

### 3.3.2 Synthesizer Module (SFC1275G)

The 10 MHz reference to the synthesizer is provided by the AS/3072 Reference Assembly. Performance of the synthesizer is listed in Table 3-6.

| Table 3-6. Synthesizer Module (SFC1275G)                                      |  |
|---|--|
| RF LO Output Frequency  | 11.91 – 12.73 GHz  |
| Step Size   | 125 kHz  |
| Power Out   | 13 – 15 dBm  |
| Spurious  | -70 dBc In-Band<br>-82 dBc Out-of Band   |
| Harmonics   | -20 dBc  |
| Phase Noise<br><i>Note: Typical readings are 3 to 5 dB better than shown.</i> | -60 dBc @ 100 Hz<br>-80 dBc @ 1 kHz<br>-84 dBc @ 10 kHz<br>-94 dBc @ 100 kHz<br>-110 dBc @ 1 MHz |
| IF LO Output Frequency  | 2.0 GHz  |
| Spurious  | -70 dBc  |
| Harmonics   | -20 dBc  |

As shown in Figure 3-2, the phase noise plots showing synthesized and IF LO SSB Phase Noise are representative of the actual phase noise of the SFC4200.

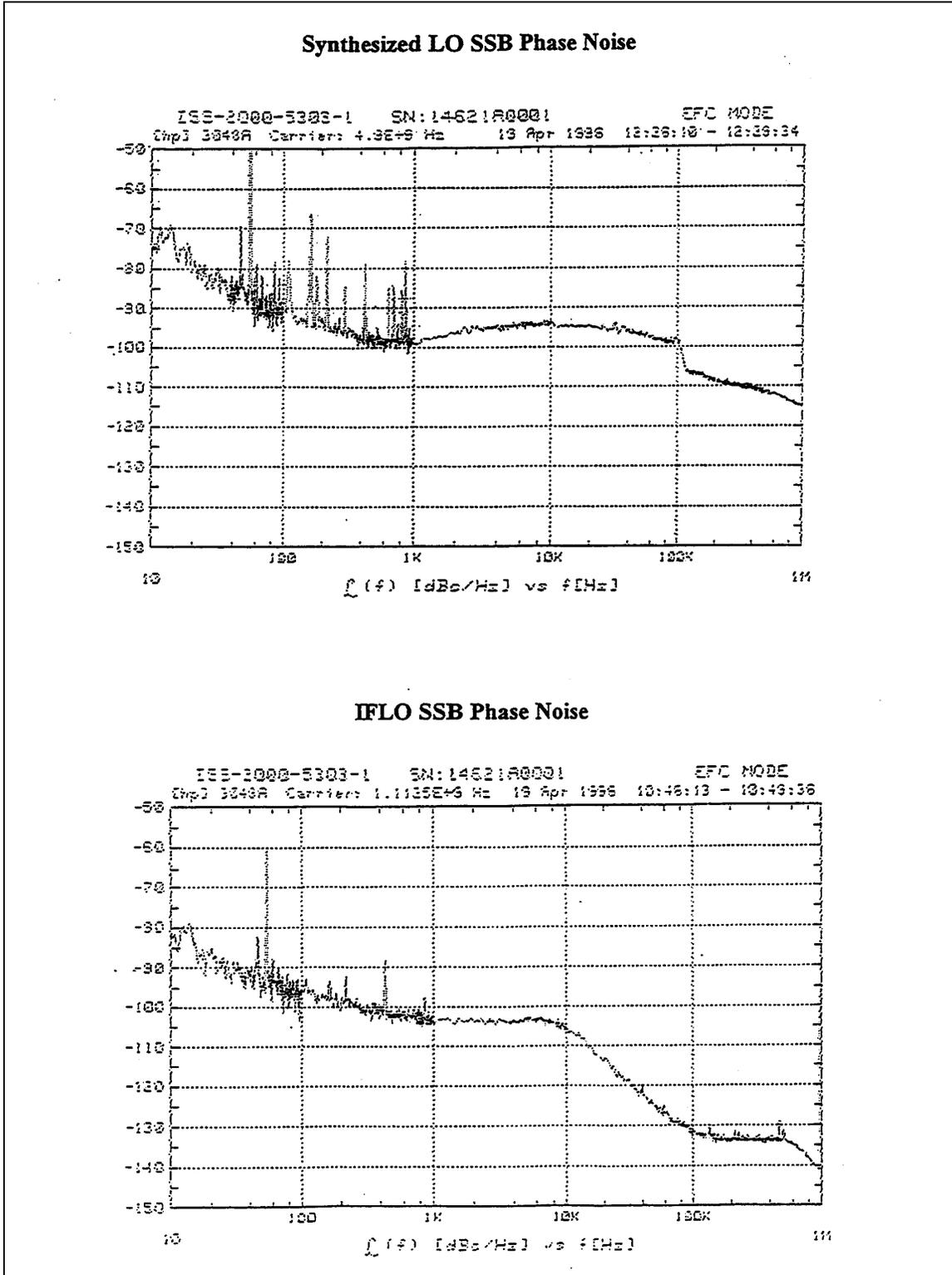


Figure 3-2. Phase Noise Plots

### 3.4 AS/3072 Frequency Reference Assembly

The Frequency Reference Assembly provides high-stability, low-noise reference signals to the synthesizer in the converter system. The assembly also provides a reference output signal and a means of synchronizing the internal synthesizer to an external 10 MHz source.

Contained within the reference assembly is a 10 MHz SC-cut overtone ovenized frequency standard. When an external reference is applied to the reference assembly, the internal oscillator is turned off and the synthesizer attempts to phase-lock to the external 10 MHz.

The RF Signal to the reference assembly includes the following:

|                               |  |
|-------------------------------|--|
| <b>EXT REF IN:</b>            | 10 MHz external reference signal input.  |
| <b>REF-OUT:</b>               | 10 MHz OXO signal out, or when an external reference is present, the external reference signal is available for daisy chaining. In this manner, a single 10 MHz reference can be supplied to the external reference of one converter. In turn, the externally supplied 10 MHz becomes available at the RF Output Port where it can be supplied to the Reference Input of the next converter. |
| <b>Int 10 MHz:</b>            | 10 MHz signal for the synthesizer. Analog & Digital Signal to the reference assembly includes the following:   |
| <b>Synthesizer Interface:</b> | 16-Pin Synthesizer Bus provides control of serial DAC for the purpose of fine-tuning the 10 MHz Frequency Reference.   |
| <b>Power Connector:</b>       | 10-Pin Synthesizer Power Bus provides voltage for operating the reference assembly.  |

### 3.5 AS/3228 Power Supply System

Power for the converter system is derived from a single 75-Watt 15 V switching regulator. With 15 VDC as the secondary voltage for the entire system, it is possible to operate the converter from a wide range of primary voltages especially DC or battery supplies. In addition, the 15 VDC can be heavily filtered with a single computer-grade capacitor. This will allow a high degree of isolation from dirty primary power systems.

#### 3.5.1 AS/3228 Output Board

The other voltages that are required in the system include +9 VDC and +5 VDC. All of these voltages are filtered but unregulated. The +9 VDC, and -9.5 VDC are all derived from the +15 VDC supply through DC/DC converters.

Power budgets in the converter are listed in Table 3-7.

| <b>Table 3-7. SFC 1275G/SFC4200 Power Supply</b>  |               |                |               |
|---|---------------|----------------|---------------|
|   | <b>+9 VDC</b> | <b>+15 VDC</b> | <b>+5 VDC</b> |
| 3048 Controller   | 300 ma        | 50 ma          |               |
| 3072 Ref. Assy  | 100 ma        | 300 ma         |               |
| 1 <sup>st</sup> Mix U/C   | 120 ma        | 150 ma         |               |
| 2 <sup>nd</sup> Mix U/C   | 350 ma        | 90 ma          |               |
| Synthesizer   |               | 500 ma         | 850 ma        |
| LCD Display   | 180 ma        |                |               |
| Total Current   | 1.05 A        | 1.09 A         | 850 ma        |
| Power   | 9.45 Watts    | 16.35 Watts    | 4.25 Watts    |
| <b>Total Power: 28 Watts * 85% Conversion Efficiency = 33 Watts Primary Consumption</b> |               |                |               |

### 3.6 Frequency Accuracy

The 10 MHz reference in the SFC4200 was factory set for an accuracy of  $1 \times 10^{-9}$ . The aging specification of the reference is  $5 \times 10^{-10}$  per day. In one year, the frequency may drift as much as  $6 \times 10^{-9}$ .

To correct an error in frequency, the operator should use the Reference Menu and adjust the Frequency Offset in PPB. Scaling of the PPB Offset allows for  $\pm 999$  PPB of adjustment. An increment of 1 PPB of the Reference Menu Offset will provide approximately 4.6 Hz correction in the synthesizer frequency.

### 3.7 Amplitude Accuracy

The frequency response stability of the converter is not expected to vary more than the specified accuracy of the converter over its normal life. In the event that the accuracy of the converter gain should exceed an acceptable level, it is recommended that the unit be returned to the factory for gain calibration. Calibration of the converter is performed under computer control. Manually performing a calibration in the field is possible but may be considered impractical.

## Section 4 – User Interfaces

### 4.0 User Interfaces

The Front Panel may be used to monitor and control the SFC Downconverters.

#### 4.1 Front Panel User Interface

The Front Panel of the SFC Downconverters allows for complete M&C (including but not limited to operation, calibration, and testing) of all parameters and functions via a Keypad, LCD Display and Status LEDs.

The front panel layout is shown in Figure 4-1, showing the location and labeling of the front panel. The front panel is divided into four functional areas: Front Panel LED Indicators, Front Panel LCD Display, Front Panel Keypad, and Monitoring Ports, each described in Table 4-1.

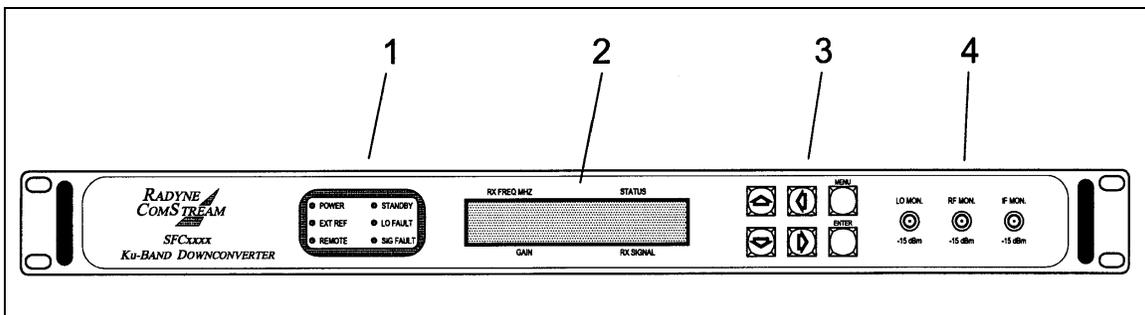


Figure 4-1. SFC Downconverters Front Panel Controls and Indicators

| Table 4-1. Front Panel User Interface |                            |   |
|---------------------------------------|----------------------------|---|
| Item No.                              | Description                | Function  |
| 1                                     | Front Panel LED Indicators | Refer to Section 4.1.1 for an itemized description of these LEDs.                             |
| 2                                     | Front Panel LCD Display    | Displays SFC Downconverter operating parameters and configuration data.                       |
| 3                                     | Front Panel Keypad         | Controls the up, down, left, and right movement of the cursor in the Front Panel LCD Display. |
| 4                                     | Monitoring Ports           | Allows the monitoring of the LO, and RF and IF Signals.                                       |

#### 4.1.1 Front Panel LED Indicators

There are six LEDs on the SFC Downconverter Front Panel to indicate the operation status (Table 4-2). The LED colors maintain a consistent meaning. Green signifies that the indication is appropriate for normal operation, Yellow indicates operation status, and Red indicates a fault condition that will result in lost communications.

| Table 4-2. Front Panel LED Indicators |        |   |
|---------------------------------------|--------|---|
| LED                                   | Color  | Function  |
| POWER                                 | Green  | Indicates the presence of primary power and that the On/Off Switch located on the rear of the chassis is in the On Position.  |
| EXT REF                               | Green  | This LED indicates that an external 10 MHz reference signal has been applied to the converter. A LO fault may occur when the external reference is applied or removed. This indicates that a change in the reference has occurred. This fault can be cleared with a soft reset.   |
| REMOTE                                | Green  | The Remote LED indicates that the converter has been addressed via the operator RS-232 Serial Interface, and that a command has been received.  |
| STANDBY                               | Yellow | This LED, when illuminated, indicates that the converter is waiting to be off-line.   |
| LO FAULT                              | Red    | If the Synthesized LO or IFLO System of the converter indicates an out-of-lock condition, the LO Fault LED will illuminate. At this time, the Summary Fault Relay Contacts will latch. If the LO Fault was due to an Intermittent Fault Condition, the LO Fault will flash at one second intervals, and fault checked may be reset. |
| SIG FAULT                             | Yellow | Signal Faults are used in switch configuration to indicate switch status (when in the Backup Mode).   |

### 4.1.2 Front Panel LCD Display

The front panel display is a 2 line by 24-character LCD display that is capable of displaying five fields of information in each menu window. While at the Root Menu, the Front Panel LCD Display displays five fields, which are depicted by text captions around the display bezel. These fields are listed below. The LCD display is a single entry window into the large matrix of parameters that can be monitored and set from the front panel.

#### **RX Frequency:**

The RX Frequency Field shows the frequency of the selected input signal that will be converted to 70/140 MHz. When the cursor is placed in the Frequency Field, and the Converter is in 'SETUP' Mode, the frequency operation can be modified.

#### **STATUS:**

The Status Field indicates the Mode of Operation or Status of the Converter. The Modes of Operation include 'SINGLE', 'PRIMARY', 'BACKUP', 'SETUP', and 'OFF LINE'. The Single, Primary or Backup Status indicates that there are no faults. It also identifies the current configuration of the Converter. The Off Line Status indicates that the Converter is off line due to a fault condition.

**Note:** Because the backup 'Learns' the Frequency, Channel and Gain from the Prime, changes to these fields are not allowed in the Backup converter.

---

|                   |  |
|-------------------|--|
| <b>CHANNEL:</b>   | The Channel Field indicates which of 30 User-Programmable (frequency and gain) Channels is currently active.   |
| <b>GAIN:</b>      | The Gain Field indicates the gain of the Converter. By placing the cursor in the Gain Field, the gain can be changed. Gain can be varied from +40 dB to 0 dB, and may also be adjusted when the Converter is online.   |
| <b>RX SIGNAL:</b> | The Received Signal Field in the lower right-hand corner of the display represents the signal strength of the RF Input. The signal strength is displayed in dBm. The Received Signal Strength Display is active when the display is locked. Received signal strength accuracy is $\pm 3$ dB. |

**Online Menus:**

|                 |   |
|-----------------|---|
| <b>Single:</b>  | Indicates that the converter is a standalone converter.   |
| <b>Backup:</b>  | Indicates that the converter is the backup converter in a redundancy system, either a 1:1 or a 1:8 system.  |
| <b>Primary:</b> | Indicates that the converter is the primary converter in a redundancy system, either a 1:1 or a 1:8 system. |

**Note:** *The online menus indicate no faults.*

**Other Menus:**

|               |  |
|---------------|--|
| <b>Setup:</b> | Allows the user to modify the fields from the Front Panel Display. To accomplish this: <ol style="list-style-type: none"><li>1. Press &lt;Enter&gt; to obtain the cursor.</li><li>2. Move the cursor to the desired field.</li><li>3. Make the necessary modification.</li><li>4. Depress &lt;Enter&gt; to store the data.</li><li>5. Depress the &lt;↑&gt; Key to bring the converter to an online status</li><li>6. Depress &lt;Enter&gt; again to turn the RF On.</li></ol> |
|---------------|--|

**Note:** *A faulted condition does not allow the converter to be placed online. To access the Fault Menu, press the Menu Button until the Converter Status Menu is displayed.*

|                 |   |
|-----------------|---|
| <b>Offline:</b> | Indicates that the converter is offline as a result of a fault condition. |
|-----------------|---|

|              |   |
|--------------|---|
| <b>Gain:</b> | The Gain Field indicates the gain of the converter. By placing the cursor in the Gain Field, the gain can be changed. Gain can be varied from +40 dB to 0 dB. |
|--------------|---|

**Note:** Because the backup converter 'Learns' the Frequency, Channel, Gain and Input Attenuation from the Prime Converter, changes to these fields are not allowed for the Backup Converter.

### 4.1.3 Front Panel Keypad

The pushbutton keypad consists of (↑), (↓), (→), (←) keys, a Menu, and an Enter Key. Use of these buttons is listed on Table 4-3.

| Table 4-3. Front Panel Keypad  |  |
|--------------------------------|--|
| Key                            | Function   |
| Left/Right Arrow Keys (→), (←) | The Left/Right Arrow Keys are used to place the cursor in the desired field or under the specific digit when moved to a number field. No changes in the values or status can be executed from the left/right cursor movement.  |
| Up/Down Arrow Keys (↑), (↓)    | The Up/Down Arrow Keys execute changes to numeric digits and can scroll the status fields. To execute an actual change in status, gain or frequency, the new number must be entered by depressing the enter pushbutton. Actual operation to control frequency gain and status will be covered in detail below. |
| ENTER                          | The Enter Key will cause changes to Frequency, Status, and other operator-selected parameters to be executed. <Enter> also causes the status of the converter to be saved into non-volatile memory.  |
| MENU                           | The Menu Key toggles the screens of the Front Panel LCD Display through the various menus (refer to Section 4.2).  |

#### 4.1.3.1 Soft Reset

The microprocessor can be reset from the front panel by simultaneously depressing the <MENU> and <ENTER>. This will cause the controller to reinitialize. The previously stored Frequency, Gain and Input Attenuation information will be used during initialization.

### 4.1.4 Monitoring Ports

Refer to Section 5.11.

## 4.2 Menu Screens

The following Menu Screens are available on the SFC Downconverters (refer to Figure 4-2 through 4-4).

**Root Menu:** The Root Menu is the default screen showing Frequency, Status, Gain, Rx Signal, and Current Channel.

**Converter Type:** Displays Converter Model Number, Software Revision and Serial Number.

**Fault Menu:** This menu shows latched fault conditions. It is this menu that must be accessed to clear a stored fault.

|   |  |
|---|--|
| <b>Utility Menu:</b>                              | Allows the operator to access the various utility submenus described below:  |
| <b>Learn Menu (Backup Converter Only):</b>        | Allows the operator to tell the Backup Converter to 'Learn' about the Primary Converter.   |
| <b>Learn Status Menu (Backup Converter Only):</b> | Informs the operator of the status of the learning process; successful or failed. If failed, additional submenus inform the operator why.  |
| <b>Unit Configuration Menu:</b>                   | Allows operator selection of unit address (1 - 99), serial port baud rate (1200, 2400, 4800, and 9600 baud), Echo On/Off, specifies converter configuration (Single, 1:1 or 1:8) and indicates backup/primary configuration. |
| <b>Reference Menu:</b>                            | This menu allows the operator to adjust the reference source in PPB and to view the number of hours the converter has been in operation.   |
| <b>Output Attenuator Calibration Menu:</b>        | The calibration menu allows a qualified operator to calibrate the 20 dB output attenuator.   |

***Note: Access to the Service Menu and the Calibration menus is denied when the converter is online, as these submenus allow direct access to the synthesizer tuning.***

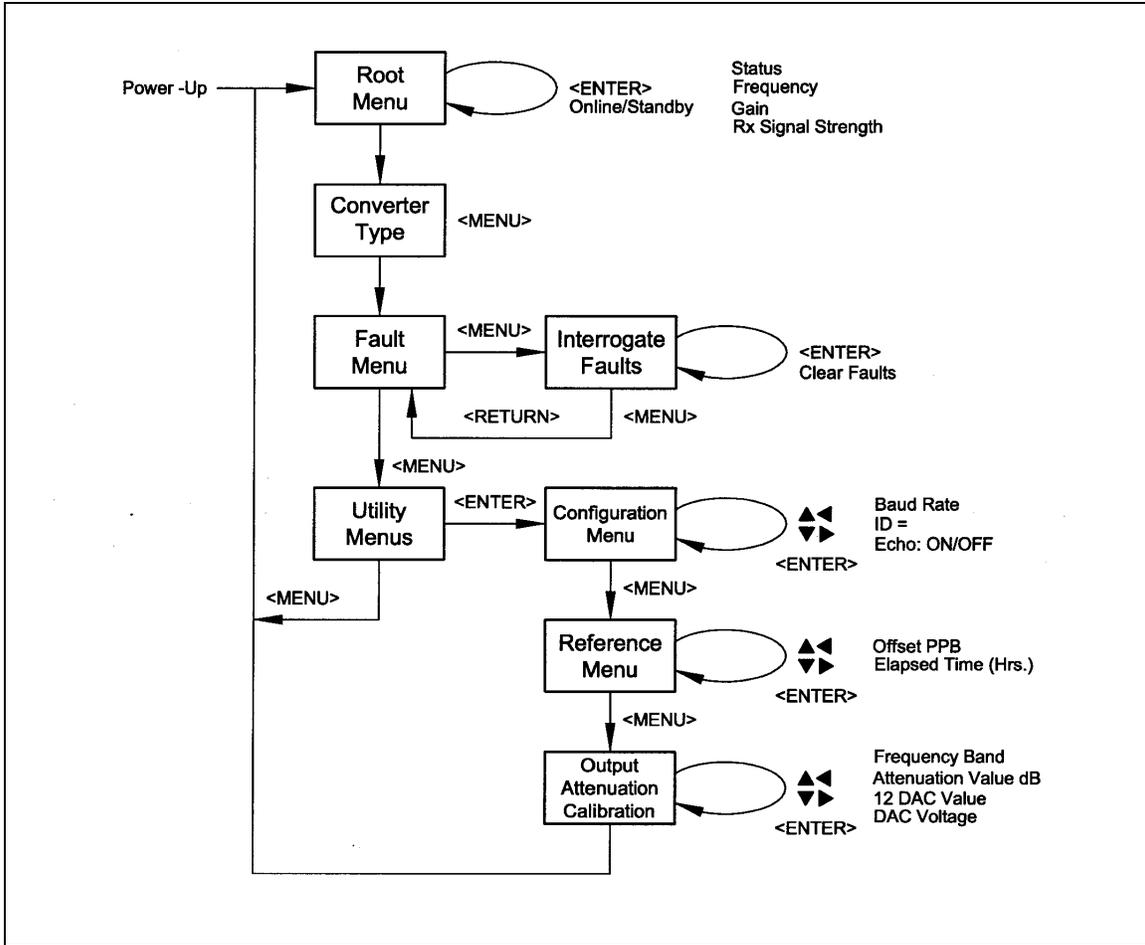


Figure 4-2. Prime and Single SFC Downconverter Front Panel Menu Flowchart. SFC Downconverter Menu Flow Charts (Prime and Single, Backup 1:1, and Backup 1:8)

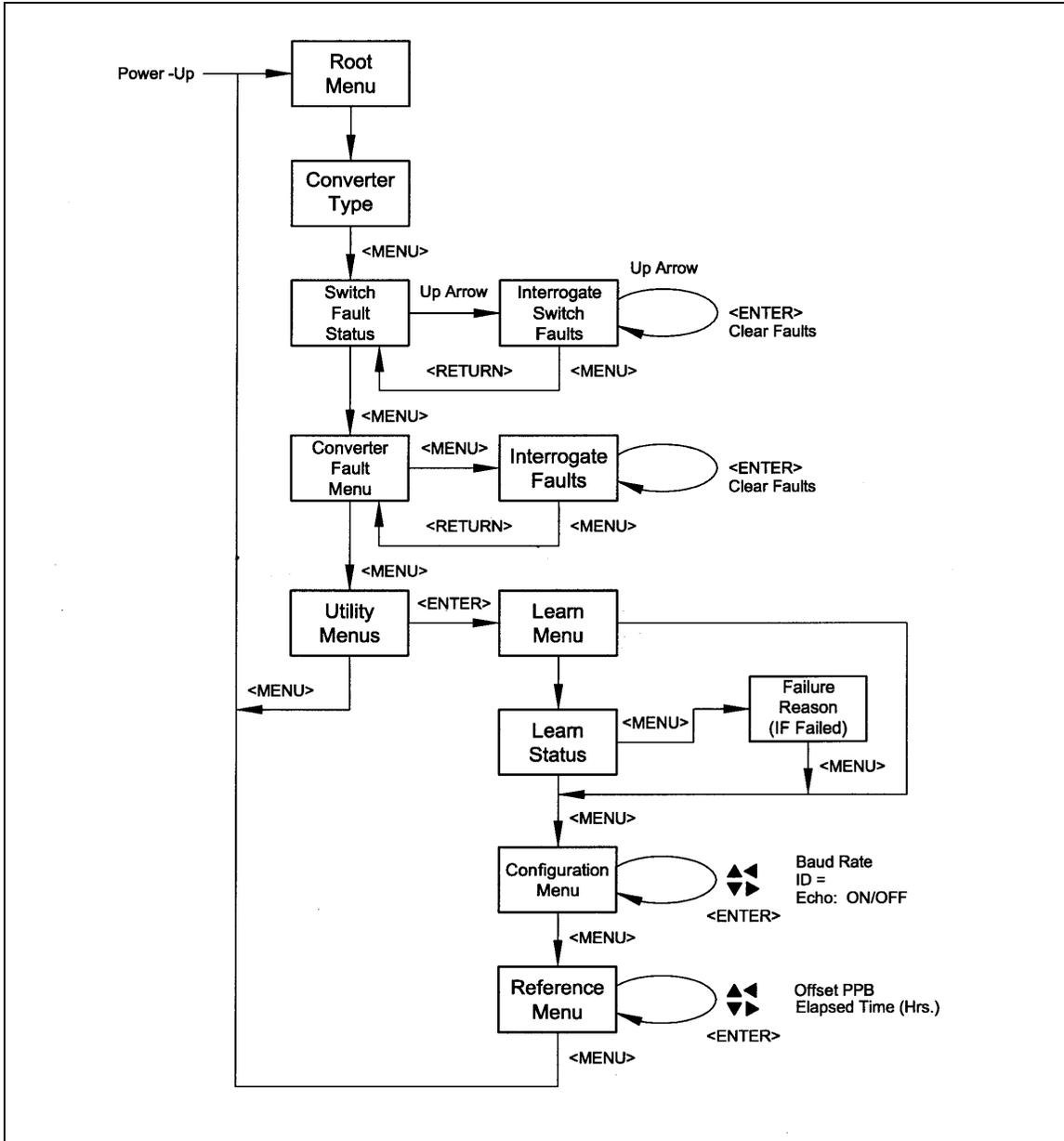


Figure 4-3. Backup 1:1 SFC Downconverter Front Panel Menu Flowchart

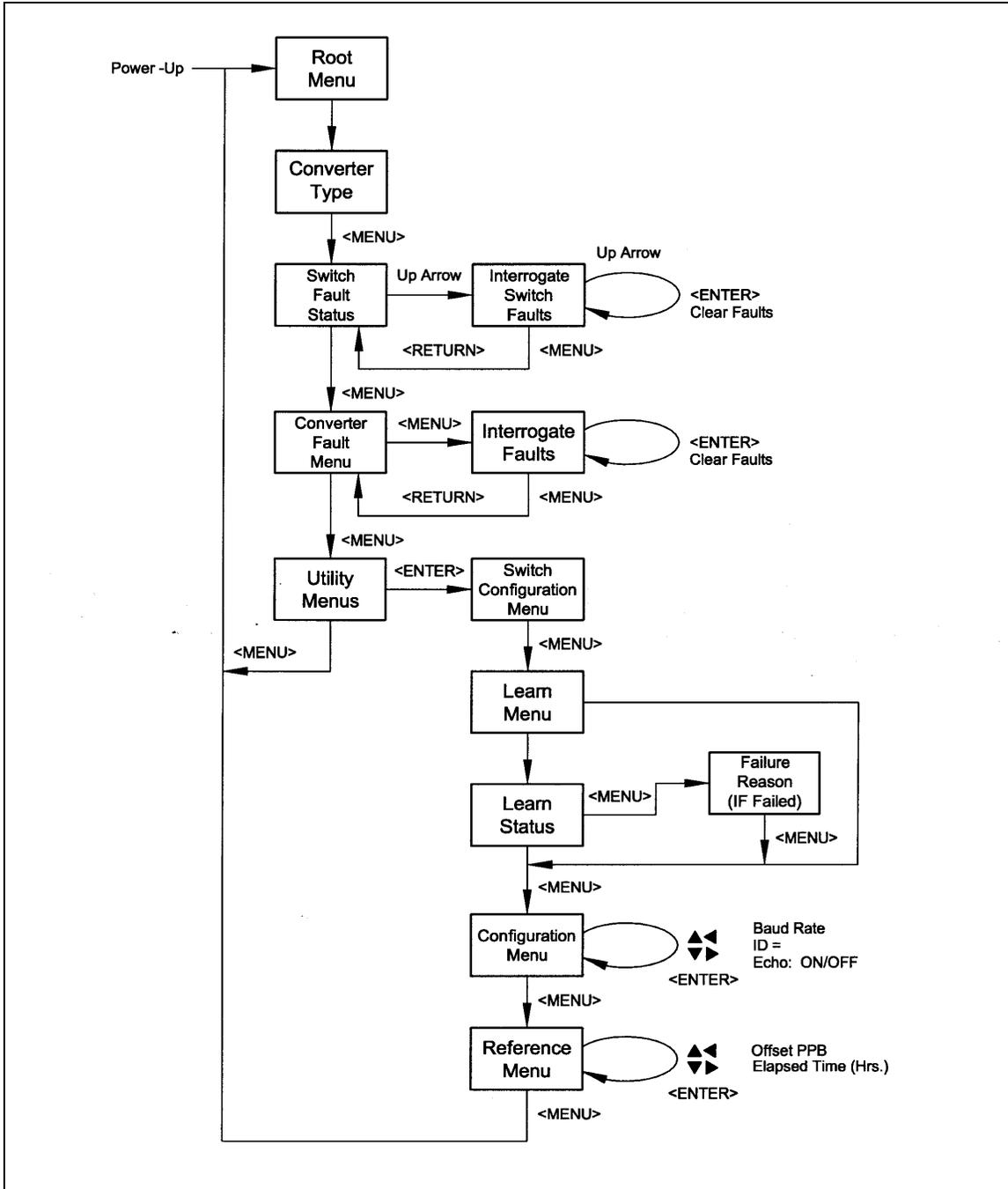


Figure 4-4. Backup 1:8 SFC Downconverter Front Panel Menu Flowchart

### 4.2.1 Root Menu

The Root Menu appears after the Model Identification Screen, after power-up of the converter. The four fields of this menu include Receive Frequency, Status, Gain Receive Signal (refer to Figure 4-5).

| RX FREQ. MHZ | STATUS    |       |
|--------------|-----------|-------|
| 4200.000     | SINGLE    | Ch 01 |
| 35.0 dB      | 00 dBm    |       |
| GAIN         | RX SIGNAL |       |

**Figure 4-5. Root Menu**

The operation of these four fields is as follows:

#### 4.2.1.1 Status

The Status field in the Root Menu provides an indication of the status of the selected channel. The Status fields indicate the converter's configuration (Single, Primary, Backup) if the converter is Online; Setup, if the converter is in setup mode; or Offline if there is a fault in the converter which would prevent it from being placed online. The Status field also indicates under which channel number the Frequency and Gain information is being stored.

The Root Menu will appear by default upon power-up. Prior to putting a converter online, the correct frequency should have been selected. A properly functioning converter that has no faults and is ready to be placed online will have the status indicated at 'Setup.' The structure of the Status prompt is as follows:

**{Status}{Channel No.}**

|                  |   |
|------------------|---|
| <b>SINGLE:</b>   | Indicates that the converter is in a standalone configuration and that when presented with an input signal of the specified frequency, will generate an output signal with the specified conversion gain. |
| <b>PRIMARY:</b>  | Indicates that the converter is in a switched configuration, and that when presented with an input signal of the specified frequency, is capable of generating an output.                                 |
| <b>BACKUP:</b>   | Indicates that the converter is in a switched configuration, and that when presented with an input signal of the specified frequency, is capable of generating an output.                                 |
| <b>SETUP:</b>    | Indicates that the front panel is unlocked and the operator has free control of the Gain and Frequency fields.  |
| <b>OFF LINE:</b> | The converter has experienced a fault and has placed itself off line. Off Line Status is the same as out-of-service. The fault will have to be cleared and/or the failed component replaced.              |

The 'Channel No.' field of the Status prompt includes the numbers from 01 to 30 to indicate which stored channel is being programmed or recalled with Frequency and Gain information.

### 4.2.1.2 Set/Change Status

Status manipulation is performed via the cursor position and the <ENTER> Key. To modify the operating status of the converter, first determine if the cursor is blinking. If the cursor is not blinking, press <ENTER> to turn on the blinking cursor and position it under the first letter of the status field. This is the 'home' position in which the cursor is placed in order to execute a change in status.

For example, to place the converter online (single) from setup, insure that the cursor is present. Press either the (↑) or (↓) Keys and scroll through the selections which will include Single Indicator or Setup. When the selection for Single Indicator has been reached, depress <ENTER>. The flashing cursor will turn off, and the Standby LED will turn off and the unit placed in service.

The gain of the online converter can be changed by depressing <ENTER>, using the (→) or (←) Keys to position the blinking cursor in the Gain Field and then using the (↑) or (↓) Keys to change the gain. Once the cursor is in the Gain Field, it cannot move into any other field. This prevents a change of frequency while online. Depressing <ENTER> will save the selected gain, turn the cursor off, and lock the front panel.

To place a single or a primary converter in setup, from online and front panel locked (no blinking cursor visible), depress <ENTER>. A blinking cursor will be positioned in the Status Field. Use the (↑) or (↓) Keys to select 'SETUP' (the Standby LED is on). Use the (↑) or (↓), and the (→) or (←) Keys to select and change the desired control field. Depress <ENTER>. The Standby Indicator will be turned off, the changed parameter will be stored to memory, and the cursor will be placed in the Status Field. Use the (↑) or (↓) Keys to select the online indicator and depress <ENTER>. The new converter settings will be executed, the RF will be turned back On, and the front panel will be locked.

**Note: The Backup Converter 'Learns' about the Prime(s) and therefore cannot be placed in Setup Mode.**

An optional method of changing the Frequency and Gain is to use the programmed channels. To select a programmed channel, move the cursor to the Channel Number part of the field after the unit has been placed into Setup, and scroll through the selections. As the number changes, the Frequency and Gain Fields will change to indicate the stored values (Note that no changes to the Frequency or Gain will take place unless the operator depresses the <ENTER> Key). If <ENTER> is depressed, the new channel will be selected as the default channel. To modify or to program the stored values, move the cursor to the appropriate field and make the change. To store the value to non-volatile memory, depress <ENTER>. An asterisk (\*) will be displayed to the right of the channel field to indicate a Channel Store Operation has taken place. In case of a power failure, the current operating parameters are stored in non-volatile memory for automatic Downconverter configuration, which takes place upon power restoration.

### 4.2.1.3 Frequency

To set or to change the Frequency, perform the steps listed in Section 4.2.1.2 to place the converter into Setup Mode. Select the Channel Number that contains the programmed frequency, or is the channel for which a previously programmed frequency needs to be changed. While at the desired channel number, move the cursor to the Frequency Field. Position the cursor under the desired digit to be changed and make the change with the (↑) or (↓) Keys. To store the new frequency into memory for the selected channel, depress <ENTER>.

The cursor will move to the Status Field. Place the unit back in service by selecting the Single Indicator in the Status Field and then depressing <ENTER>. An asterisk (\*) will be displayed to the right of the Channel Field to indicate a Channel Store Operation has taken place. Otherwise, upon power-up or recalling the desired channel will cause the frequency to revert to the stored frequency value. The frequency selection to the synthesizer is executed when <ENTER> is depressed. The LO Fault Circuitry is active so that an LO Fault associated with a specific frequency of operation can be determined while the converter is in Setup Mode.

#### 4.2.1.4 Gain

The Gain of a single or primary converter can be changed while the converter is both Online and in Setup mode. To change the Gain at any time, position the cursor under the digit to be changed in the Gain field and increment or decrement the number using the (↑) or (↓) Keys. The Gain change will be made at this time. To store the new Gain into the non-volatile memory for the currently selected channel number, depress <ENTER>. An asterisk (\*) will be displayed to the right-hand corner of the Channel Field to indicate a Channel Store operation has taken place. Otherwise, upon power-up, or recalling the desired channel causes the Gain to revert to the Stored Gain value. To prevent data errors while the unit is online, changes as directed from the front panel are dampened in execution to the actual hardware so as not to generate an abrupt jump in power.

### 4.2.2 Converter Type Menu

The Converter Type Menu (Figure 4-6) displays the Converter Type, Software Revision Level.

| RX FREQ. MHZ   | STATUS    |
|----------------|-----------|
| CONVERTER TYPE | 4200A100  |
| F/W F01234-A   | S/N 1234  |
| GAIN           | RX SIGNAL |

Figure 4-6. Converter Type Menu

### 4.2.3 Switch Fault Menu

This menu is applicable to the Backup 1:1 and Backup 1:8 Converters. If there are no switch-related faults, the menu will say so. If there are switch-related faults, using the (↑) Key will scroll through the various reasons for the Switch Fault (refer to Figure 4-7).

| RX FREQ. MHZ           | STATUS    |
|------------------------|-----------|
| SWITCH FAULT STATUS    |           |
| HIT UP ARROW TO SCROLL |           |
| GAIN                   | RX SIGNAL |

Figure 4-7. Switch Fault Menu

These include the following:

**Prime Not Learned:** The Backup has not learned about the Prime(s).

**Prime Polling Error:** Either the Prime did not respond to the Backup's periodic polling, or something in the Prime's configuration has changed since the last time the backup was told to 'Learn.'

**Note:** *Changing the Prime after the Backup has 'Learned It' will cause a Switch Fault until the Backup is told to 'Relearn' the Prime(s).*

**Prime Relay Fault:** The Backup has detected that the Switching Relay did not switch when told to do so.

**Note:** *Any Switch Fault will cause the Signal Fault LED on the Backup to illuminate. It will also cause the Error LED on the 1:8 Switch to illuminate.*

#### 4.2.4 Converter Faults Menu

To access the Converter Faults Menu, depress <ENTER>. If there are no stored faults, the fault menu will indicate 'Stored Faults, None.' If there are stored faults, the menu will indicate that stored faults have been recorded.

To interrogate the nature of the stored faults, depress <ENTER> again. The stored fault screen format is as shown in Figure 4-8.

| RX FREQ. MHZ     | STATUS    |
|------------------|-----------|
| SIG = #          | LO = #    |
| <ENTER> to clear |           |
| GAIN             | RX SIGNAL |

**Figure 4-8. Stored Faults Menu**

The Fault descriptions are indicated as follows:

**LO:** Indicates a fault in the synthesizer and the number of fault detections (up to 255).

**SIG:** N/A

To clear the faults, depress <ENTER>.

## 4.2.5 Utility Access Menu

Depress <Menu> from the Fault Menu to access the Utility Access Menu. To gain access to the various utility menus of the converter, depress <ENTER>. The Utility Access Menu will appear as shown in Figure 4-9.

| RX FREQ. MHZ          | STATUS    |
|-----------------------|-----------|
| {MENU } for Main Menu |           |
| {ENTER} for Utilities |           |
| GAIN                  | RX SIGNAL |

**Figure 4-9. Utility Access Menu**

Pressing <ENTER> will scroll to the first Utility Menu which is the Configuration Menu for Primary and Single Converters, or the Learn Menu for Backup Converters. Depressing <MENU> again will scroll to the second Configuration Menu. Use <MENU> to scroll through the Reference Menu, Status Menu, and Output Attenuator Calibration Menu. Calibration Menus represent those alignments, settings and various operating parameters that are set in non-volatile memory. Most calibration is done via the RS-232 Interface, but those same parameters can be accessed via calibration menus.

**Note: The Calibration Menu is denied when the converter is online, as these submenus allow direct access to the synthesizer tuning.**

For a 1:1 Backup, the menu will appear as shown below in Figure 4-10.

| RX FREQ. MHZ           | STATUS    |
|------------------------|-----------|
| {MENU } for Main Menu  |           |
| {ENTER} for Learn Menu |           |
| GAIN                   | RX SIGNAL |

**Figure 4-10. Menu for a 1:1 Backup**

For a 1:8 Backup Converter, the Menu will appear as shown below in Figure 4-11.

| RX FREQ. MHZ            | STATUS    |
|-------------------------|-----------|
| {MENU } for Main Menu   |           |
| {ENTER} for Switch Menu |           |
| GAIN                    | RX SIGNAL |

**Figure 4-11. Menu for a 1:8 Backup**

## 4.2.6 Switch Configuration Menu

This Menu (refer to Figure 4-12) is applicable for a 1:8 Backup Converter. It allows the operator to specify the priority of the various converters. The priority is as follows: 1 (Highest Priority) through 8 (Lowest Priority), and 0 (No Priority, the Backup will ignore the Prime).

|      | RX FREQ. MHZ |   |   |   |   |   |   |   | STATUS    |  |  |  |  |  |  |  |  |  |
|------|--------------|---|---|---|---|---|---|---|-----------|--|--|--|--|--|--|--|--|--|
| CONV | 1            | 2 | 3 | 4 | 5 | 6 | 7 | 8 |           |  |  |  |  |  |  |  |  |  |
| PRI  | 0            | 0 | 0 | 0 | 0 | 0 | 0 | 0 |           |  |  |  |  |  |  |  |  |  |
|      | GAIN         |   |   |   |   |   |   |   | RX SIGNAL |  |  |  |  |  |  |  |  |  |

**Figure 4-12. Switch Configuration Menu**

The Arrow Keys are used to move left and right, and increase or decrease a converter's priority. When all of the priorities have been set, pressing the <ENTER> causes the Backup to accept the entries and store them in Non-Volatile RAM. Pressing <MENU> will scroll to the next menu.

## 4.2.7 Learn Menu (Backup Converter Only)

Depressing <MENU> will scroll to the Configuration Menu. Depressing <ENTER> will cause the Backup Converter to 'Learn' about the Primary Converter (Figure 4-13).

|  | RX FREQ. MHZ           |  |  |  |  |  |  |  | STATUS    |  |  |  |  |  |  |  |
|--|------------------------|--|--|--|--|--|--|--|-----------|--|--|--|--|--|--|--|
|  | {MENU } for next menu  |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |
|  | {ENTER} for Learn Mode |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |
|  | GAIN                   |  |  |  |  |  |  |  | RX SIGNAL |  |  |  |  |  |  |  |

**Figure 4-13. Learn Menu**

The screen automatically scrolls to the Learn Status Menu

## 4.2.8 Learn Status Menus (Backup Converter Only)

The Automatic Learning in Progress Window (Figure 4-14) indicates that the Backup Converter is polling the Prime Converter in order to learn about it.

|  | RX FREQ. MHZ                      |  |  |  |  |  |  |  | STATUS    |  |  |  |  |  |  |  |
|--|-----------------------------------|--|--|--|--|--|--|--|-----------|--|--|--|--|--|--|--|
|  | Automatic Learning<br>In Progress |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |
|  | GAIN                              |  |  |  |  |  |  |  | RX SIGNAL |  |  |  |  |  |  |  |

**Figure 4-14. Automatic Learning in Progress Window**

The window shown in Figure 4-15 indicates that the Backup Converter was successfully able to 'Learn' about the Primary Converter.



**Figure 4-15. Automatic Learning Successfully Completed Window**

The following window (Figure 4-16) indicates that the Backup Converter was not able to learn about the Prime Converter.



**Figure 4-16. Automatic Learning Failed Window**

When the <Menu> key is pressed, the Backup Converter will provide more information about the failure. This information includes the following:

- |                                |  |
|--------------------------------|--|
| <b>No Response:</b>            | The Prime Converter did not respond.   |
| <b>Invalid Response:</b>       | The Prime Converter responded, but the Backup Converter did not receive the message clearly. |
| <b>Incompatible Converter:</b> | The Backup Converter is not capable of backing up the Prime Converter.                       |

### 4.2.9 Configuration Menu

The ID # Field allows the operator to establish an ID Number for the Operator Serial Interface. Move the cursor to this field and increment or decrement to change the ID Number. Press <ENTER> to store the value.

The field for Baud Rate allows the operator to select baud rates from 1200 to 9600 bps. Move the cursor to this field and increment or decrement the value. Depress <ENTER> to store the value and reinitialize the serial port.

**Note: Serial data format is fixed to provide 8 data bits, 1 start bit, 1 stop bit, no parity.**

The Echo Field is for the Operator Serial Port Interface. When the Echo is in the On State, the converter will echo all the data it receives back to the Host Terminal. When more than one converter is connected to the same bus (RS-485), the Echo must be Off. Move the cursor to this field to change the Echo On/Off Status. Press <ENTER> to store the value.

The Config Field (Configuration) indicates the status of the converter and is defined as follows:

|              |  |
|--------------|--|
| <b>SNGL:</b> | Indicates that the converter is a standalone unit.                       |
| <b>1:1:</b>  | Indicates that the converter is in a one-for-one backup configuration.   |
| <b>1:8:</b>  | Indicates that the converter is in a one-for-eight backup configuration. |

| RX FREQ. MHZ |                                | STATUS       |  |
|--------------|--------------------------------|--------------|--|
| PRIMARY      |                                | CONFIG: SNGL |  |
| ID: 01       | ECHO: <input type="checkbox"/> | BAUD: 9600   |  |
| GAIN         |                                | RX SIGNAL    |  |

**Figure 4-17. Configuration Menu**

#### 4.2.10 Reference Menu

The Reference Menu (Figure 4-18) allows the operator to fine-tune the 10 MHz ovenized frequency standard over a range of  $\pm 999$  PPB. This menu also contains a clock that indicates the total number of hours the unit has been in operation since the reference oscillator was first installed.

The Reference Menu is as follows:

| RX FREQ. MHZ          |  | STATUS    |  |
|-----------------------|--|-----------|--|
| Elapsed Hours = 99999 |  |           |  |
| OPP B = +000          |  |           |  |
| GAIN                  |  | RX SIGNAL |  |

**Figure 4-18. Reference Menu**

|                       |  |
|-----------------------|--|
| <b>OPP B:</b>         | This field contains the offset of the 10 MHz frequency standard in PPB. When the oscillator is first installed, or when the oscillator has been coarse-calibrated, this value will first be set to 000 PPB offset. The operator can change the offset manually by placing the cursor in this field and incrementing or decrementing the value. Press <ENTER> to store the value. |
| <b>ELAPSED HOURS:</b> | This field indicates the number of hours the converter has been in operation since the frequency standard was first installed.   |

### 4.2.10.1 Reference Offset

The Reference Offset Field of the Reference Menu allows the operator to adjust the frequency of the 10 MHz High Stability Internal Reference and vary the output of the Synthesized RF LO by  $\pm 999$  Parts per Billion (PPB). One part per billion represents a change of 1 Hz per GHz (1 billion Hz) of output frequency. Measured at the LO MON port, 1 PPB represents 4.6 Hz change in frequency for a LO Output of 4.6625 GHz. Note that 1 PPB changes the frequency of the LO MON or Converted IF or RF Output by 4.6 Hz as well. Thus, each unit of PPB will allow a change in accuracy of the converter of  $1 \times 10^{-9}$ .

The exact frequency of the LO Output can be calculated from the displayed frequency on the converter front panel as follows:

|   |                                |
|---|--------------------------------|
| C-Band Downconverter (70 MHz IF):           | LO MON = Rx Freq. + 1042.5 MHz |
| C-Band Downconverter (140 MHz IF):          | LO MON = Rx Freq. + 972.5 MHz  |
| C-Band Downconverter Extended (70 MHz IF):  | LO MON = Rx Freq. + 1155 MHz   |
| C-Band Downconverter Extended (140 MHz IF): | LO MON = Rx Freq. + 1085 MHz   |
| Ku-Band Downconverter (70 MHz IF):          | LO MON = Rx Freq. - 2070.0 MHz |
| Ku-Band Downconverter (140 MHz IF):         | LO MON = Rx Freq. - 2140.0 MHz |

The RF Monitor output can be measured with a frequency counter of known calibration.

### 4.2.10.2 Reference Stability

The stability of the 10 MHz Reference is related to the temperature of 10 MHz crystal inside the unit. A proportionally controlled oven around the crystal maintains the temperature in the oven to 0.1°C. In addition, the precise temperature that the oven maintains has been determined empirically for each crystal during manufacturing. As long as the ambient temperature stays within limits (0 - 50°C) the reference will maintain stability of greater than  $1 \times 10^{-8}$  (refer to Figure 4-18).

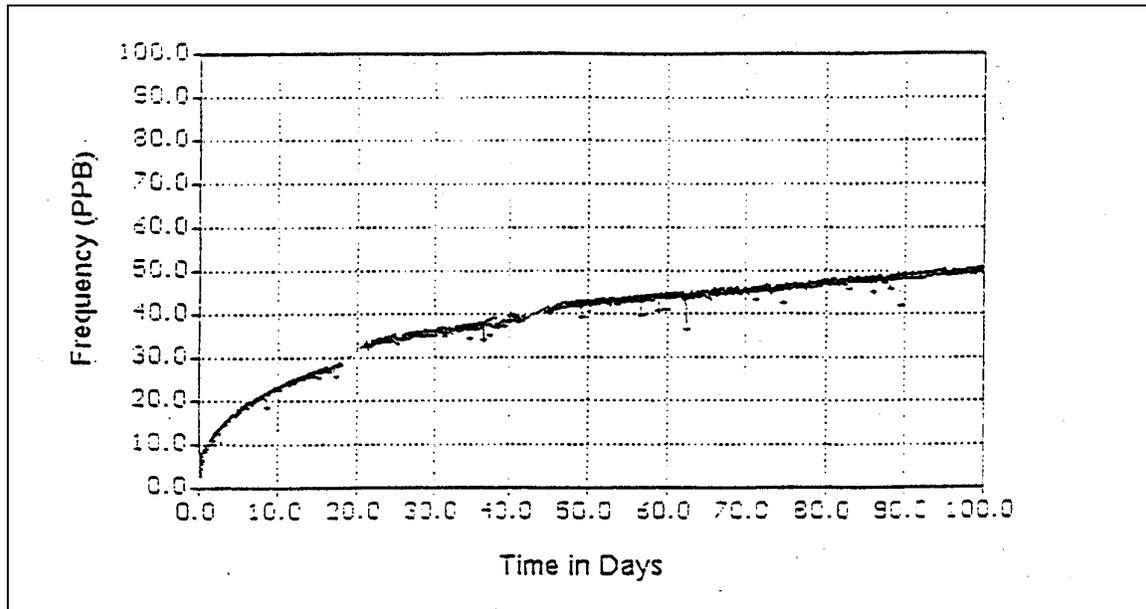


Figure 4-19. Typical Reference Aging vs. Time

Long term stability of the reference is affected by factors other than temperature. Over days and months, the frequency of the reference will drift at a rate specified as aging. Typical aging rates of 1 to 5 parts in  $10^{-10}$  per day are typical in a crystal that has been stabilized for a few weeks. The first month of operation for any crystal is a time where drift due to aging can be excessive. The typical aging curve provides insight into the exponential decay in aging rate for a 10 MHz Reference. Converters shipped from the factory have had their reference oscillator aged for a minimum of 30 days and in addition, the aging rate has been verified in the final week to within tolerance. However, converters that have been in storage or powered off for a period of several weeks will exhibit a phenomenon whereby the aging curve return to the slope shown for zero days of aging. This aging reset is not well understood but the manufacturers of crystals believe it to be related to a gradual relaxation of the molecular makeup of the quartz substrates and the conductive films deposited on the quartz.

The rule of thumb when checking the frequency accuracy of the converter is to make sure that the crystal has stabilized before attempting any adjustment. For units that have been in storage or shipment for more than a week, allow several days of operation before verifying the accuracy. For this reason, converters shipped from Radyne ComStream Corporation are typically powered-up until the final day before shipment. In addition, the accuracy and aging rate are verified immediately prior to shipment.

For a converter that has been powered-up for several months, the operator can assume an aging rate of several PPB per month. If the aging rate has been established, the station operator can make calculated adjustments from the reference offset menu at timed intervals.

#### 4.2.11 Output Attenuator Calibration Menu (locked, not user accessible)

The Output Attenuator (Figure 4-20) can be calibrated over 0 – 40 dB of attenuation in 1 dB increments over frequency bands centered 50 MHz apart.

| RX FREQ. MHZ   | STATUS       |
|----------------|--------------|
| FREQ: 3910     | ATTEN: 00 dB |
| DAC VALUE: FFF | DACV: 8, 50V |
| GAIN           | RX SIGNAL    |

Figure 4-20. Output Attenuator Calibration Menu

- Freq:** Shows the 50 MHz Frequency Band that is currently being calibrated. While in this menu, selecting or changing a Frequency Cal Band will cause the synthesizer to change to that center frequency. The frequency band selection can be incremented or decremented by placing the cursor on the current frequency and depressing the Up or Down cursor buttons.
- Atten:** This number, located under the Status Field nomenclature, indicates the location for or value of attenuation for which the operator is calibrating the Digital-to-Analog Converter (DAC) Value. The Atten value can be increased by depressing <ENTER>. When <ENTER> is depressed, the DAC Value displayed is stored into non-volatile memory and the Atten digit is increased to the next value. At 20, this digit rolls over to 0.

**DAC Value:**

Place the cursor in the DAC Value Field and use the (↑) and (↓) Keys to increment or decrement the DAC Value. Simultaneously, the display will indicate the DAC Voltage. In a normal calibration arrangement, the operator will be monitoring the power output of the converter with a Spectrum Analyzer. When the desired value of calibration is reached, the operator will depress <ENTER> which stores the value and increments the Atten Level to the next number. The DAC value will revert to the stored value for that location. This keypad arrangement is designed to allow for manual calibration with limited wear-and-tear on the operator who may be attempting manual calibration of the attenuator in the field.

To perform the calibration, the technician needs to apply an RF signal to the Downconverter at the frequency indicated in the Freq. Field. A spectrum analyzer or power meter is connected to the output and the DAC Value is incremented up or down until the required gain is indicated by the spectrum analyzer. Finally, the correct DAC is stored by depressing <ENTER>. The attenuator setting is incremented to the next location, or in this case, 01 dB. The process is repeated until 20 dB is reached and then the next frequency is selected. The frequency of the signal generator must be changed and the process repeated. This menu is not displayed when the converter is online.

### 4.3 Serial Protocol

The SFC Downconverter Serial Protocol allows a remote operator to gain control the converter. Through the serial protocol described, the remote operator can control gain, frequency, calibration, status and fault isolation. The Serial Port is factory-set to communicate as the DCE at 9600 baud with 8 data bits, 1 start bit, 1 stop bit and no parity bits.

### 4.4 Command Structure

The serial command structure uses an ASCII character string format that enables serial control through the use of a 'dumb terminal.' To differentiate a proper command string from noise, all serial commands have a header followed by the specific command characters, followed by numeric values where required, and are terminated by a character return <cr>. The basic command structure is as follows:

**@{Unit Address}{command}{numerical value(s)}<cr>**

For the following examples, a unit address of 01 is assumed.

## 4.5 Control Commands

Control Commands are those commands that alter the setup or operating parameters of the converter. These commands primarily control Frequency and Gain. Frequency and Gain can be altered on the current channel number that is indicated on the front panel, or the other channels 0-30 which are not selected can be programmed without affecting the current operating channel. The final method to change Frequency and Gain is by remotely recalling the Gain and Frequency Settings that have been programmed in another channel. The various Control Commands are applicable for a variety of converter configurations. After each of the following control commands appears an abbreviation in parenthesis that identifies which converter configurations are valid for that particular control command. The applicable converter configurations are as follows:

|              |                              |
|--------------|------------------------------|
| <b>S:</b>    | Single Converters            |
| <b>P1:1:</b> | Primary Converter 1:1 Switch |
| <b>B1:1:</b> | Backup Converter 1:1 Switch  |
| <b>P1:8:</b> | Primary Converter 1:8 Switch |
| <b>B1:8:</b> | Backup Converter 1:8 Switch  |
| <b>ALL:</b>  | All Converters               |

### 4.5.1 Set Current Channel Frequency Command (S, P1:1, P1:8)

The Set Current Channel Frequency Command alters the stored frequency of the current channel. The set frequency command is as follows:

**@01/SETFREQffff.t<cr>**

The frequency numerical values include four digits for MHz and one digit "t" which indicates the resolution in 125 kHz steps. The values of "t" are as follows:

| <b>t</b> | <b>Frequency</b> |
|----------|------------------|
| 0        | 000 kHz          |
| 1        | 125 kHz          |
| 2        | 250 kHz          |
| 3        | 375 kHz          |
| 4        | 500 kHz          |
| 5        | 625 kHz          |
| 6        | 750 kHz          |
| 7        | 875 kHz          |

Valid frequency ranges are 3400.000 through 4200.000 kHz (SFC4200), and 10950.000 MHz through 12750 MHz (SFC1275G). Frequencies outside this range, or frequencies that are of an invalid form will be responded to by the 'illegal frequency' prompt. If the synthesizer is unable to tune to the desired in-band frequency, the converter will indicate a LO Fault Condition status indication and will change to an off-line or out-of-service indication.

### 4.5.2 Set Current Channel Gain Command (S, P1:1, P1:8)

To permanently change the programmed gain of the current channel, use the Set Current Channel Gain Command. The command is as follows:

**@01/SETGAINsgg.g<cr>**

The numeric value 's' indicates the 'plus' sign (+). The numeric value 'g' consists of three digits indicating gain from 0 to 40 dB.

### 4.5.3 Set Channel Command (S, P1:1, P1:8)

The Set Channel Command allows the remote operator to change the Channel and thus the Gain and Frequency of the converter to one of the 30 preprogrammed channels. To change channels, use the following format:

**@01/SETCHANcc<cr>**

Where 'cc' represents a channel number from 01 through 30.

### 4.5.4 Store Current Channel Settings (S, P1:1, P1:8)

After altering the Frequency or Gain of the currently selected channel, the remote operator can store these settings into non-volatile memory by issuing the Store command as follows:

**@01/STORE<cr>**

### 4.5.5 Remote Help Menu (All)

All serial commands and serial protocol can be listed for the remote operator by entering the Help command as follows:

**@01/HELP<cr>**

### 4.5.6 Status Command

Prior to issuing a remote command, the remote operator may first wish to determine the current status of the converter. To request status, issue the following command:

**@01/STATUS<cr>**

A single converter will issue the following string of information:

|                |                          |
|----------------|--------------------------|
| Configuration: | {Single}                 |
| Status:        | {Online, Faulted, Setup} |
| Channel:       | {Current Channel No.}    |
| Frequency:     | {Current Frequency}      |
| Gain:          | {Current Gain}           |
| RSS:           | {Text, Signal Value}     |
| Stored Fault:  | {None, Faulted}          |
| Reference:     | {Internal/External}      |

A Converter in a 1:1 Switch Configuration will issue the following string of information:

|                          |   |
|--------------------------|---|
| Converter Configuration: | {One for One Primary, One for One Backup}       |
| Switch Configuration:    | {Auto, Manually Selected, Manually De-selected} |
| Status:                  | {Standby, Online, Faulted}                      |
| Channel:                 | {Current Channel}                               |
| Frequency:               | {Current Frequency}                             |
| Gain:                    | {Current Gain}                                  |
| RSS:                     | {Text, Signal Value}                            |
| Stored Fault:            | {None, Faulted}                                 |
| Reference:               | {Internal/External}                             |

A Primary Converter in a 1:8 Switch configuration will issue the following string of information:

|                           |   |
|---------------------------|---|
| Switch Configuration:     | {Auto, Manually Selected, Manually De-selected} |
| Primary Converter Number: | {01, 02, 03, 04, 05, 06, 07, 08}                |
| Status:                   | {Available, Faulted}                            |
| Channel:                  | {Current Channel}                               |
| Frequency:                | {Current Frequency}                             |
| Gain:                     | {Current Gain}                                  |
| RSS:                      | {Text, Signal Value}                            |
| Stored Fault:             | {None, Faulted}                                 |
| Reference:                | {Internal/External}                             |

A Backup Converter in a 1:8 Switch Configuration will issue the following string of information:

|                              |  |
|------------------------------|--|
| Hot Converter:               | {Identifies the Converter number with the highest priority in reference to the Switch} |
| Frequency:                   | {Current Frequency}  |
| Gain:                        | {Current Gain}   |
| RSS:                         | {Text, Signal Value}   |
| Stored Faults:               | {None or Faulted}  |
| One For Eight Switch Status: | {Indicates the status of each prime converter}   |
| Switch is in:                | {Manual Mode, Auto Mode}   |
|                              | Prime 1  |
|                              | Prime 2  |
|                              | Prime 3  |
|                              | Prime 3  |
|                              | Prime 4  |
|                              | Prime 5  |
|                              | Prime 6  |
|                              | Prime 7  |
|                              | Prime 8  |
| Backup is:                   | {Available, Online for Converter [1...8]}  |

**Notes:** *If none of the converters are faulted, the 'Hot Converter' will be the converter for which the backup is in hot standby.*

*If one or more of the converters have faulted, the 'Hot Converter' will be the converter that the backup is currently replacing.*

*If the status indicates that the backup is available, then the backup is not currently replacing any of the primes.*

#### 4.5.7 Clear Faults Command (All)

The operator may wish to remotely clear any stored faults. Issue the following command:

```
@01/CLRFAULT<cr>
```

#### 4.5.8 Auto Mode Command (P1:1, B1:1, B1:8)

This command allows the operator to put the switch back into Auto Mode. Issue the following command:

```
@01/AUTO<cr>
```

**Note:** For a 1:1 Switch configuration, if the front panel switch is accidentally left in Manual Mode, then the following action should be performed: from the Remote Port, send a manual command to the converter that is 'Manually Deselected,' i.e.; the one that is NOT selected. Then send an Auto Command to the same converter and the switch change back to Auto Mode.

For a 1:8 Switch configuration, send the Auto Mode command to the backup converter.

#### 4.5.9 Manual Mode Command (P1:1, B1:1)

This command allows the operator to force the switch to put the converter online and keep it there. This command simulates the manual selection switch on the front panel. Issue the following command:

```
@01/MANUAL<CR>
```

**Note:** For a 1:1 Switch configuration, if the front panel switch is accidentally left in Manual Mode, then the following action should be performed: from the Remote Port, send a manual command to the converter that is 'Manually Deselected,' i.e.; the one that is NOT selected. Then send an Auto Command to the same converter and the switch change back to Auto Mode.

#### 4.5.10 Manual Backup Command (B1:8)

This command allows the operator to force the switch to put the Backup online for the specified converter and keeps it there. This command simulates the manual backup selection switches on the front panel of the 1:8 Switch. Issue the following command:

```
@01/MANBACKn<cr>
```

Where:

- n = 0 Forces the Backup to Standby Mode, all Primes are online
- n = 1 – 8 Specifies the converter that the Backup is to replace

#### 4.5.11 Set Stored Gain For a Specified Channel (S, P1:1, P1:8)

This command allows the user to set the Stored Gain for a specified channel other than the current one.

```
@01/RAMGAINccsgg.g<cr>
```

#### 4.5.12 Set Stored Frequency For a Specified Channel (S, P1:1, P1:8)

This command allows the user to set the Stored Frequency for a specified channel other than the current one.

```
@01/RAMFREQccffff.t<cr>
```

#### 4.5.13 Erase (All)

This command allows the user to erase the Stored Status, Frequency and Gain Information the next time the unit is reset.

```
@01/ERASE<cr>
```

#### 4.5.14 Restart (All)

This command allows the user to reset/restart the converter.

**@01/RESTART<cr>**

#### 4.5.15 Data (All)

This command will cause the converter to display the applicable data formats for the various commands.

**@01/DATA**

#### 4.5.16 Learn (B1:1, B1:8)

In a 1:1 Switch configuration, this command will cause the backup converter to 'Learn' about the Prime converter.

In a 1:8 configuration, the Backup converter will 'Learn' about the Prime converters that have a priority > 0. As the Backup converter polls the Prime(s), the learning status will be output via the serial port.

**@01/LEARN**

#### 4.5.17 Show Priority (B1:8)

This command causes the backup converter to display the priority settings for all 8 of the prime converters.

**@01/SHOW PRI (1:8 configuration only)**

#### 4.5.18 Set Priority (B1:8)

This command is used to set the priorities of converters 1 to 8 respectively where:

0 = No priority (the converter will be ignored)  
1 = Highest priority  
8 = Lowest Priority

**@01/SETPRIabcdefgh (1:8 configuration only)**

For example: **@01/SETPRI47300000** will cause the following to occur:

Converter 1 will have priority 4;  
Converter 2 will have priority 7;  
Converter 3 will have priority 3;  
Converters 4 through 8 will be ignored.

## 4.6 SFC Downconverter Operator Quick Reference Guide

Table 4-4 lists all of the SFC Downconverter Commands.

**Note:** *In all cases the commands are preceded by a valid address “@01/”.*

| Table 4-4. SFC Downconverter Operator Quick Reference Guide |   |
|---|---|
| @01/HELP  | Displays all available user commands.   |
| @01/DATA  | Displays data formats associated with commands.   |
| @01/STATUS  | Displays converter status.  |
| @01/SHOWRSS   | Display received signal strength.   |
| @01/CLRFAULT  | Clears latched faults.  |
| @01/ERASE   | Erases stored status, frequency, and gain data upon the next reset.   |
| @01/RESTART   | Restarts the converter.   |
| @01/SETGAIN   | Sets the gain for the current channel.  |
| @01/SETCHAN   | Sets the current channel.   |
| @01/SETFREQ   | Sets the frequency for the current channel.   |
| @01/STORE   | Saves all data under the current channel.   |
| @01/RAMGAIN   | Sets the gain for another/alternate channel.  |
| @01/SETATTN   | Sets the input attenuator for the current channel.  |
| @01/RAMFREQ   | Sets the frequency for another/alternate channel.   |
| @01/AUTO  | Puts the switch back into Auto Mode. Simulates the middle position of the front panel switch (1:1, 1:8 only).                                 |
| @01/MANUAL  | Forces the switch to place the converter online and keeps it there. Simulates the manual selection switch on the front panel (1:1, 1:8 only). |
| @01/SHOWPRI   | Displays priority settings for the 8 prime converters (1:8 only).   |
| @01/SETPRIabcdefgh  | Sets priorities of converters 1 through 8 respectively (1:8 only).  |
| @01/LEARN   | Causes the backup converter to learn about the prime converter(s) (1:1, 1:8 only).  |
| @01/MANBACKn  | Forces the backup to replace the specified converter (1:8 only).  |



## Section 5 – Electrical Interfaces

### 5.0 SFC Downconverter Connections

All SFC Downconverter connections are made to labeled connectors. Any connection interfacing to SFC Downconverters must be the appropriate mating connector. Refer to Figure 5-1 below for the various connector locations.

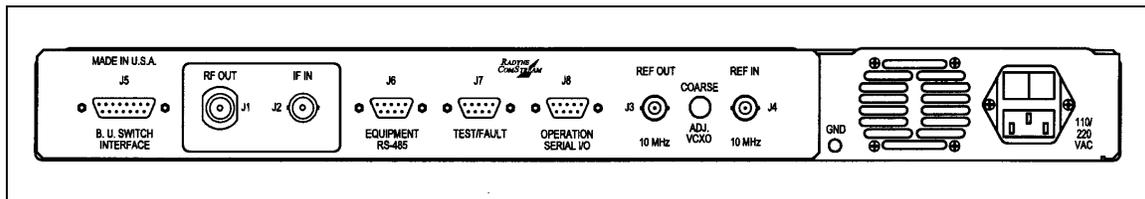


Figure 5-1. SFC Downconverter Rear Panel

#### 5.1 Power

Located on the right-rear side of the SFC Downconverter Rear Panel is the AC Power Input Connector. This connector is an IEC 320/C13 Power Entry Module. The unit is powered from a 100 – 240 VAC, 50 – 60 Hz source. Maximum unit power consumption is 50 W. The switch turns power on and off to the unit. A chassis ground connection can be made at the #10 size stud located to the lower left of the AC Power Connector.

The power cord/connector for the SFC Downconverter is a supplied item.

#### 5.2 RF In (J1)

The RF In (J1) is the Primary RF Input of the SFC Downconverters. It is an N-Type Female Connector for the SFC4200, and an SMA Female Connector for the SFC1275G.

#### 5.3 IF Out (J2)

The IF Out Connector (J2) is the 75 Ohm BNC-F Connector. Outputs are within 50 – 90 MHz for standard units and 100 – 180 MHz for units equipped with 140 MHz.

#### 5.4 10 MHz Ref Out (J3)

The 10 MHz Reference Out (J3) is the 50 Ohm BNC-F Connector that provides a 10 MHz squarewave, 50 Ohm AC coupled reference output signal at 0 dBm. In normal operation (no external reference) this output is synchronous with the internal high stability 10 MHz reference.

#### 5.5 10 MHz Ref In (J4)

The Reference Input BNC-F connector (J4) at the rear of the converter allows the operator to synchronize the synthesizer of the converter to an external 10 MHz reference. When an external reference is properly applied to the reference input, the external reference LED will illuminate on the front panel.

#### 5.6 B. U. Switch Interface (J5)

The Backup Switch Interface (J5) is a D Sub 15 Pin Connector that connects each converter with the RCU101 or RCU108 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 individual online converters or the backup unit. This interface finds use in both the 1:1 and 1:N configuration type switches. The pinouts of the switch is listed in Table 5-1.

| <b>Table 5-1. J5 – Backup Switch Interface – D Sub 15-Pin Connector</b> |               |  |                                |
|---|---------------|--|--------------------------------|
| <b>Pin No.</b>  | <b>Signal</b> | <b>Description</b>                                   | <b>Controller AS/3048 (J7)</b> |
| 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           | Ground   | 10                             |
| 2   | +15 V 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                              |

## 5.7 Equipment RS-485 (J6)

The Equipment Multi-Drop, Full-Duplex, Bi-directional RS-485 Interface (J6) allows communication between converters. Because the RS-485 Interface uses a master/slave (talker/listener) configuration, the converter that is designated as the backup will automatically be established as the master. Under normal RS-485 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. Refer to Table 5-2 for pinouts.

|   | Description   | 10 Pin AS/3048 (J14) |
|---|---------------|----------------------|
| 1 | GND           | 1                    |
| 2 | SRCLK         | 3                    |
| 3 | Not Connected | 5                    |
| 4 | Tx Not        | 7                    |
| 5 | Tx            | 9                    |
| 6 | SR DAT        | 2                    |
| 7 | Not Connected | 4                    |
| 8 | Rx Not        | 6                    |
| 9 | Rx            | 8                    |

### 5.8 Test/Fault (J7)

The Test Port/High-Speed Switch Interface (J7) provides a port where all analog voltages used in determining fault status by the microprocessor are made directly available to the rear panel of the converter. Synthesizer and signal path faults can be verified with a voltmeter using the following test points. The pinouts of this connector are listed in Table 5-3.

| Pin No. | Signal   | Description  | Controller AS/3048 (J5) A/D Chan. |
|---------|----------|--|-----------------------------------|
| 1       | N/C      |  | 1                                 |
| 2       | LOFLT    | Open Collector                                       | 3                                 |
| 3       | GND      |  | 5                                 |
| 4       | IFSIGDET | IF Signal Detected Power Level (0 – 10 VDC)          | 7                                 |
| 5       | N/C      |  | 9                                 |
| 6       | N/C      |  | 2                                 |
| 7       | TEMP     | N/A  | 4                                 |
| 8       | N/C      |  | 6                                 |
| 9       | RFSIGDET | RF Signal Power Level Detect (0 – 10 VDC) (U/C Only) | 8                                 |

## 5.9 Operation Serial I/O (J8)

The Operation Serial I/O Port (J8) is a D Sub 9-Pin Female Connector. This port provides a serial interface that can be configured as either an RS-232, RS-422 or RS-485 interface and allows the user to remotely control all of the features outlined in the Serial Protocol. The serial port comes configured as an RS-232 Serial Port for DCE unless indicated otherwise. The pinouts of the D-Sub 9-Pin Socket Connector configured for RS-232 or RS-422/-485 is listed in Table 5-4.

| Table 5-4. J8 – Operation Serial I/O Port – D Sub 9-Pin Connector |              |              |               |
|---|--------------|--------------|---------------|
| Pin No.   | RS-232       | RS-422/-485  | AS/3048 (J10) |
| 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 illustrated in Figures 5-4 through 5-7. A summary of the jumper selections is as follows:

| Configuration   | JP4-1 | JP4-2 | JP4-3 | JP4-4 | JP4-5 | JP4-6 | JP3   | JP5 | JP6 | JP7 | JP8 |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-----|-----|
| RS-232          | OUT   | OUT   | OUT   | OUT   | IN    | IN    | OUT   | OUT | IN  | OUT | OUT |
| RS-422          | IN    | IN    | IN    | IN    | OUT   | OUT   | OUT * | OUT | OUT | OUT | IN  |
| RS-485          | IN    | IN    | IN    | IN    | OUT   | OUT   | OUT * | OUT | OUT | OUT | IN  |
| RS-485 1/2 DPLX | IN    | OUT   | OUT   | IN    | OUT   | OUT   | OUT * | IN  | OUT | IN  | IN  |

\* Receiver terminations for twisted pair RS-422/-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.

The serial protocol is designed to provide DTE-to-DCE Point-to-Point Communications. The converter is wired as the DCE to provide an interface to a dumb terminal (DTE) without a null modem connection. Because the serial protocol uses unique addressable commands, the converters are capable of providing multipoint communications between a number of converters and a customer-supplied serial interface. The typical multipoint communications configurations include full- and half-duplex RS-485. In addition, a multipoint RS-232 interface is also possible.

Figure 5-2 shows the AS/3048 Controller. Figure 5-3 shows the locations on the controller of the various jumpers required to configure the hardware for RS-232, RS-422, Full-Duplex RS-485 and Half-Duplex RS-485 (Figures 5-3 through 5-6). To make these changes, remove the top cover and locate the AS/3048 Controller. Some software configuration changes must also be made by the operator to implement the RS-422/-485 or multipoint RS-232 modes of serial operation. The theory of operation for multipoint requires that the M&C Computer Transmit Port be connected in parallel to all of the Receive Data Ports of the various converters. Likewise, the transmit ports of the various converters must all be connected in parallel and tied to the Receive Data Port of the M&C Computer. To prevent any one Converter Transmit Port from acting as a low impedance, thus hanging the bus, each transmit port of each converter remains in a high impedance state until asked by the M&C computer to transmit.

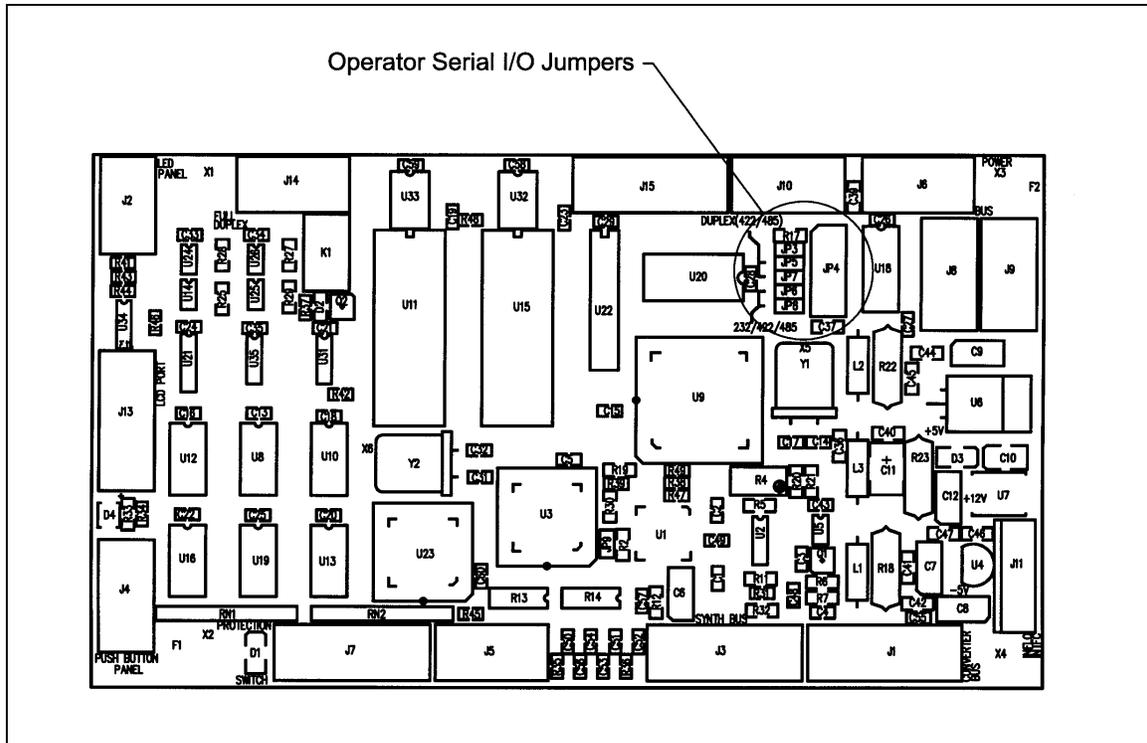


Figure 5-2. AS/3048 Controller

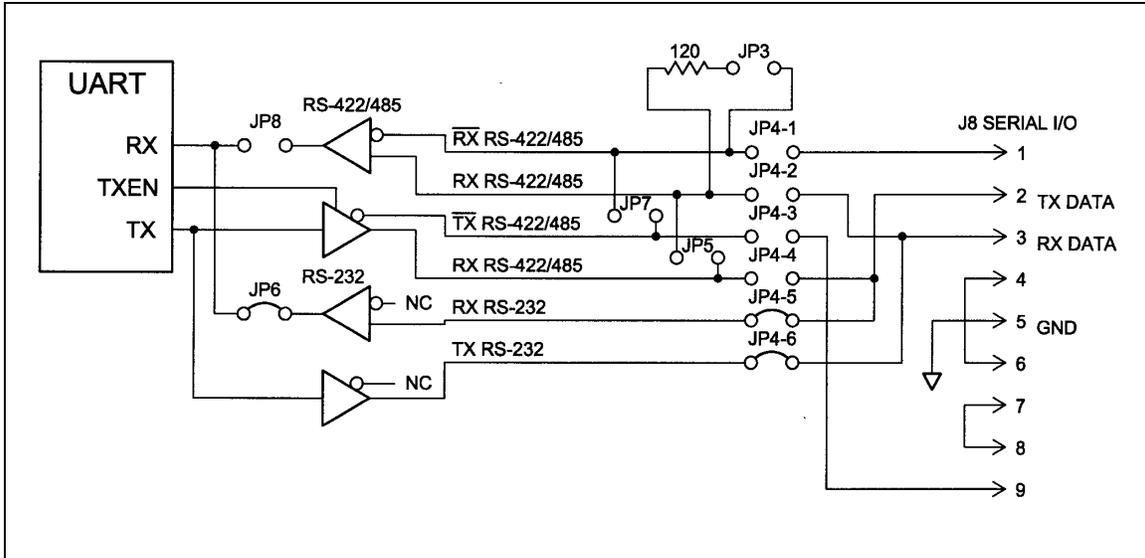


Figure 5-3. RS-232 Operator Serial I/O Configuration

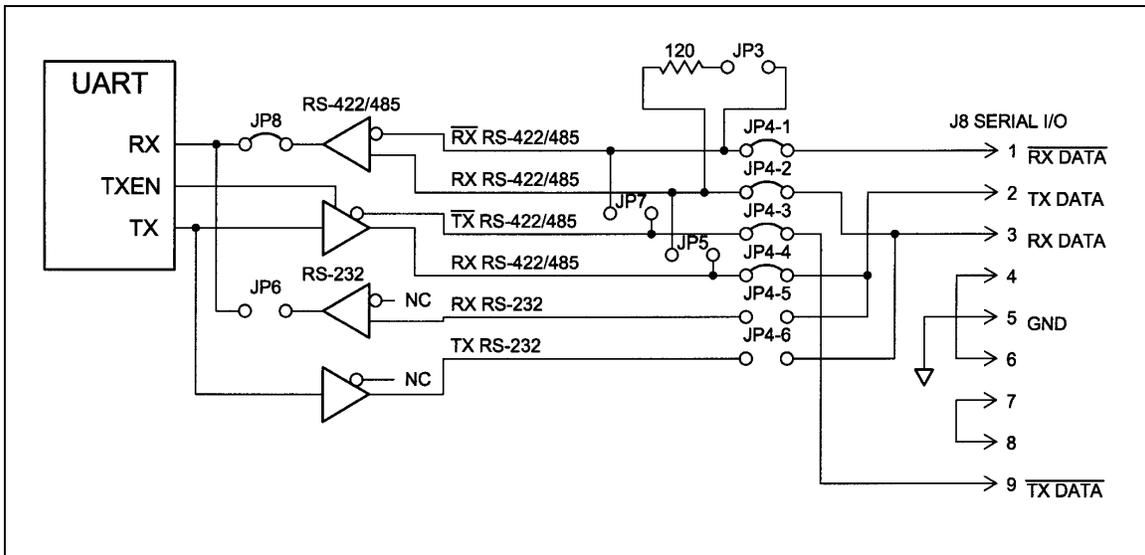


Figure 5-4. RS-422 Operator Serial I/O Configuration

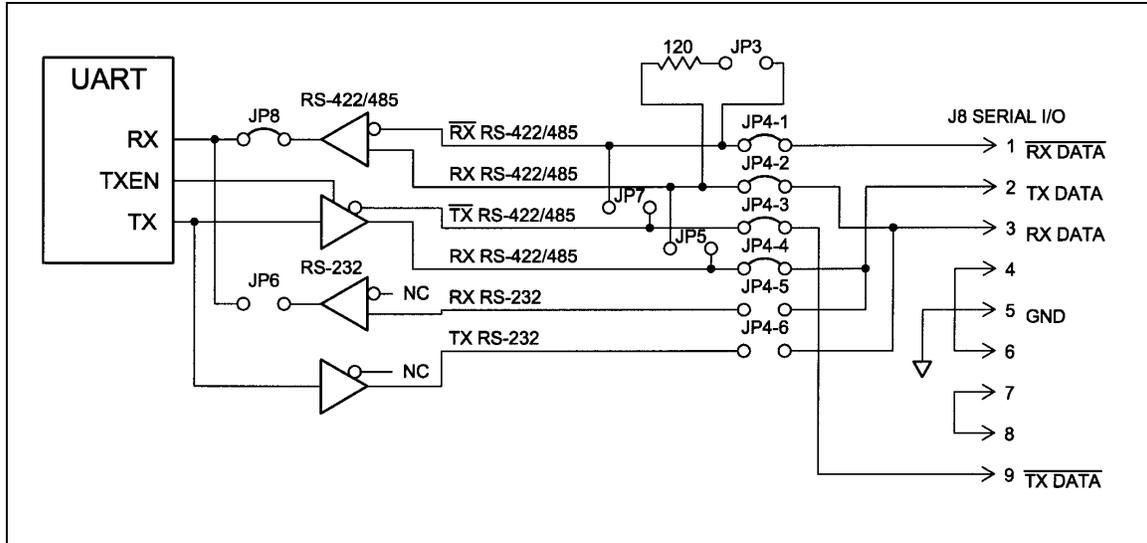


Figure 5-5. Full-Duplex RS-485 Serial I/O Configuration

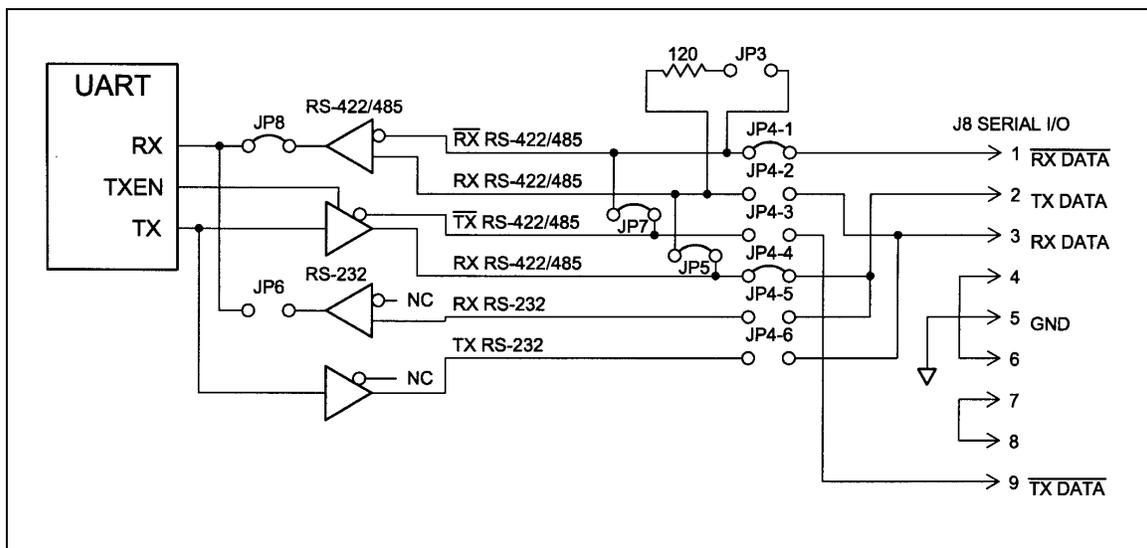


Figure 5-6. Half-Duplex RS-485 Serial I/O Configuration

To prevent data collisions from all the converters responding at once, each converter must be software configured for 'echo off' in the Configuration Menu. If the converters are being linked to a dumb terminal, the echo should be turned on locally.

## 5.10 Coarse VCXO Adjustment

This adjustment at the rear panel is used to set the initial accuracy of the 10 MHz reference. The coarse adjustment was factory-set to  $1 \times 10^{-9}$  accuracy with the software offset set to 000 PPB. Refer to Section 4.2.10.2 for the software fine adjustment feature. When the fine adjustment approaches  $\pm 999$  PPB, a coarse adjustment may be necessary.

## 5.11 Monitor Ports

The SFC Downconverters have Monitor Ports located on the Front Panel (Figure 5-7) that allow the operator to monitor the IF Input, RF Input and Synthesized LO.

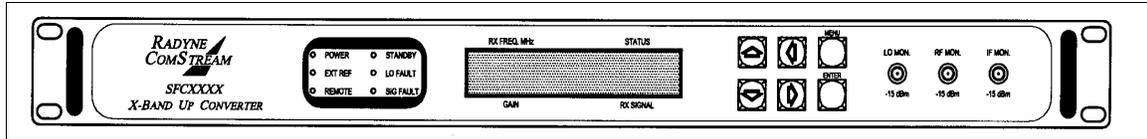


Figure 5-7. SFC Downconverter Front Panel with Monitor Ports

### 5.11.1 RF Monitor Port

The RF Monitor port is an SMA (F) Type Connector located on the front panel. Signals present at the RF Input of the SFC Downconverter (J1) can be monitored at the RF Monitor Port. The power level of the monitored signal will be -15 dB nominal below the level present at J1.

### 5.11.2 IF Monitor Port

The IF Monitor Port is an SMA (F) Type Connector located on the front panel. Signals present at the IF Output of the Converter (J2) can be monitored at the IF Monitor Port. The power level of the monitored signal will be -15 dB nominal below the level present at J2.

### 5.11.3 LO Monitor

The LO Monitor allows the operator to monitor the Synthesized or Second Mixer Local Oscillator using the SMA LO Monitor Connector at the front of the converter. The power level of the signal measured will be -15 dBm nominal. The frequency of the synthesizer LO in the SFC Downconverters can be determined by subtracting the IFLO Frequency (Table 5-5) from the displayed transmit frequency on the LCD display.

The LO Monitor can be used to set the 10 MHz Reference with a high degree of accuracy unobtainable by just measuring the 10 MHz Output. See Section 6, Maintenance, for more details on setting the reference oscillator accuracy. Also, the SSB Phase Noise performance of the LO monitor is an accurate representation of the phase noise of the entire converter. Refer to Figure 5-9 for a Single Sideband Phase Noise Plot.

| Table 5-5. IF LO Frequency |            |           |           |          |          |
|----------------------------|------------|-----------|-----------|----------|----------|
| SFC4200                    |            |           |           | SFC1275G |          |
| Standard                   |            | Extended  |           | 70 MHz   | 140 MHz  |
| 70 MHz                     | 140 MHz    | 70 MHz    | 140 MHz   |          |          |
| 1.1825 MHz                 | 1.8525 MHz | 1.295 MHz | 1.365 MHz | 2.07 GHz | 2.14 GHz |

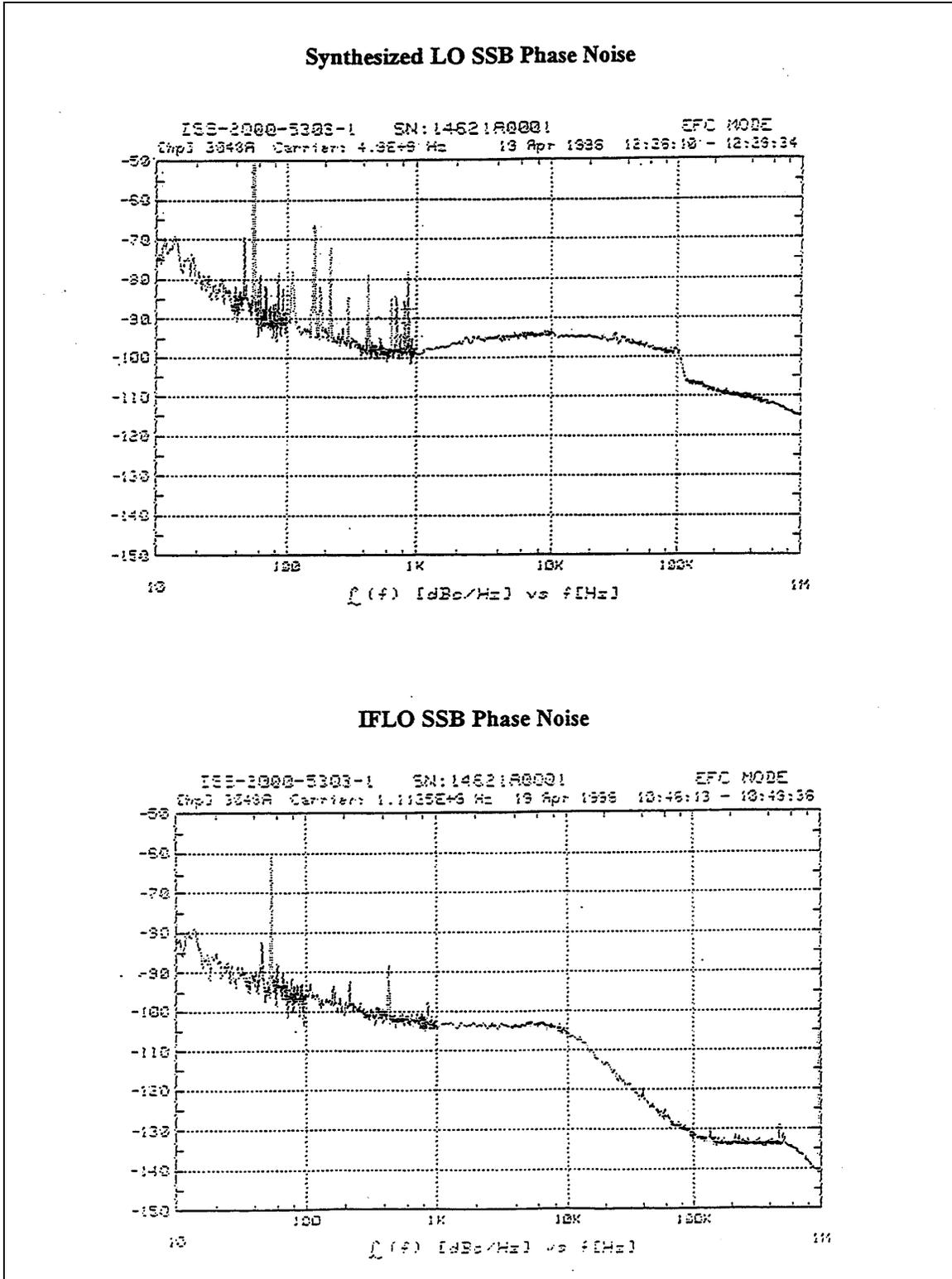


Figure 5-9. Phase Noise Plot

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## **Section 6 - Maintenance**

### **6.0 Periodic Maintenance**

Radyne ComStream Corporation SFC Downconverters are designed to provide many thousands of hours of continuous operation. Normal aging and drifting of electronic components can cause the accuracy of the converter to change over time. As with any converter, these changes will affect the frequency accuracy and frequency conversion amplitude accuracy over time.

### **6.1 Failure Analysis**

Faults in the converter are limited in scope to either a LO Fault or a Signal Fault. Other faults may or may not provide an indication such as a failure of the microcontroller.

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## Section 7 - Technical Specifications

### 7.0 Introduction

This section defines the technical performance parameters and specifications for the SFC Synthesized Frequency Downconverters

### 7.1 Input Characteristics

|                       |   |
|-----------------------|---|
| SFC4200 Frequency:    | 3.625 – 4.20 GHz Standard<br>3.40 – 4.20 GHz Extended Band (Optional) |
| SFC1275G Frequency:   | 10.95 – 12.75   |
| Impedance:            | 50 $\Omega$   |
| SFC4200 Return Loss:  | $\geq 20$ dB  |
| SFC1275G Return Loss: | $\geq 19$ dB  |
| Input Dynamic Range:  | -25 dBm Aggregate Signal Power to –110 dBm Carrier Level              |
| SFC4200 Connector:    | N-Type F  |
| SFC1275G Connector:   | SMA-Type F  |

### 7.2 Output Characteristics

|                |   |
|----------------|---|
| Frequency:     | 70 MHz $\pm$ 18 MHz Standard<br>140 MHz $\pm$ 36 MHz Extended Band (Optional) |
| Impedance:     | 75 $\Omega$   |
| Return Loss:   | $\geq 23$ dB  |
| P1 dBm Output: | +19 dBm   |

**Note:** Performance specifications guaranteed at nominal levels only.

|            |            |
|------------|------------|
| Connector: | BNC Type F |
|------------|------------|

### 7.3 Transfer Characteristics

|                                |   |
|--------------------------------|---|
| Type:                          | Double-Conversion, No Spectral Inversion  |
| Gain:                          | 40 dB Maximum @ 0 dB Total Attenuation (Options to 60 dB)   |
| Gain Control:                  | 40 dB, 0.1 dB Increments (0 dB to 40 dB Conversion Gain)  |
| SFC4200 Gain Ripple:           | $\pm 0.25$ dB/36 MHz Typical $\pm 0.50$ dB/76 MHz   |
| SFC1275G Gain Ripple:          | $\pm 0.50$ dB/36 MHz typical $\pm 0.75$ dB Maximum  |
| Gain Slope:                    | $\pm 0.05$ dB/MHz   |
| Gain Stability:                | $\pm 0.25$ dB/24 hr., $\pm 1.0$ dB, 0 to 50°C   |
| Noise Figure:                  | 12 dB Maximum   |
| SFC4200 Spurious:              | -80 dBm LO Related Spurious (In-Band) at Minimum Attenuation (+5 dBm out)<br>-60 dBc Signal Related Spurious (In-Band) at Minimum Attenuation |
| SFC1275G Spurious:             | -80 dBm LO Related Spurious (In-Band) at Minimum Attenuation (+5 dBm out)<br>-50 dBc Signal Related Spurious (In-Band) at Minimum Attenuation |
| Line Frequency Spurious:       | < -50 dBc @ 60 Hz   |
| SFC4200 Third Order Intercept: | +30 dBm -60 dBc IMD Two Tones with 0 dBm Combined Output Power  |

SFC1275G Third Order Intercept: +30 dBm -48 dBc IMD two tones with 0 dBm combined output power  
 AM/PM Conversion: 0.1°/dB  
 Image Rejection: > 80 dB  
 Group delay:  
 Linear: 0.025 nsec/MHz  
 Parabolic: 0.005 Nsec/MHz<sup>2</sup>  
 Ripple: 1 nsec p-p for ± 18 MHz

### 7.4 Frequency Synthesizer

Resolution: 125 kHz Step Size  
 Accuracy: ± 5 x 10<sup>-9</sup> After 20 Minutes  
 Stability: ± 5 x 10<sup>-9</sup> Over Temperature (0 to 50°C)  
 5 x 10<sup>10</sup>/24 hours

### 7.5 Single Side Band Phase Noise

| <u>Offset</u>       | <u>Standard SFC4200</u> | <u>Standard SFC1275G</u> |
|---------------------|-------------------------|--------------------------|
| 10 Hz:              | -50 dBc/Hz              | -50 dBc/Hz               |
| 100 Hz:             | -70 dBc/Hz              | -60 dBc/Hz               |
| 1 kHz:              | -80 dBc/Hz              | -80 dBc/Hz               |
| 10 kHz:             | -88 dBc/Hz              | -84 dBc/Hz               |
| 100 kHz:            | -95 dBc/Hz              | -94 dBc/Hz               |
| 1 MHz:              | -110 dBc/Hz             | -110 dBc/Hz              |
| External Reference: | (5 MHz Optional)        |                          |

### 7.6 Rx Signal Strength Detection

SFC4200 Sensitivity (TSS): 80 dBm @ 40 dB Gain Referenced to the RF Input Connector  
 -40 dBm @ 0 dB Gain Referenced to the RF Input Connector  
 SFC1275G Sensitivity (TSS): 80 dBm @ 40 dB Gain Referenced to the RF Input Connector  
 -40 dBm @ 0 dB Gain Referenced to the RF Input Connector  
 Dynamic Range: 30 dB @ Any Gain Setting  
 Absolute Accuracy: ± 3 dB  
 Relative Accuracy: ± 1 dB LCD Display, ± 0.2 dB (8-Bit Serial Data)  
 Maximum Detectable Signal: -20 dBm Referenced to RF Port @ 10 dB Gain  
 -10 dBm Referenced to IF Output Port  
 (IF Power – Gain = Rx Signal)

### 7.7 Mechanical

Size: 19" x 1.73" x 21" Deep  
 Weight: 12 lb.  
 Primary Power: 100 - 240 VAC, 50 - 60 Hz, 1.0 A  
 Power Consumption: 50 Watts

Front Panel Test Ports: Operator Serial Port D Sub 9 Pin  
10 MHz REF In (BNC),  
REF Out (BNC)  
Fault/Test D Sub 9 Pin  
Switch Interface D Sub15 Pin  
Equipment RS-485 Interface D Sub 9 Pin  
IEC 320/C13 Power Entry Module  
Module Switch, #10 Ground Lug  
LO Monitor -15 dBm SMA-F  
RF Monitor -15 dB SMA-F  
IF Monitor -15 dB SMA-F

## 7.9 Environmental Characteristics

Temperature: 0 to 50°C  
Humidity: To 95% Non-Condensing  
Altitude: To 8,000 Feet AMSL  
Shock & Vibration: No loss of frame synchronization at the BER Test Set due to a standard hammer drop test on any outside surface of the converter. Likewise, no loss of frame synchronization for temperature gradients of  $\pm 22^{\circ}\text{C}/\text{Hr}$ .  
Storage Temperature: -32 to +65°C

**Note: These specifications are subject to change.**

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