1:N REDUNDANT SWITCHING UNIT
BROADBAND SERIES

SECTION 1

INTRODUCTION

1.1 GENERAL DESCRIPTION

1.1.1 PHYSICAL

Figure 1-1. Front Panel, 1:N Redundant Switching Unit

Figure 1-2. Rear Panel, 1:N Redundant Switching Unit
Figure 1-3. Interior View, 1:N Redundant Switchover Unit
1.1.2 FUNCTIONAL

The Redundancy Switching Unit (RSU) monitors the status of up to eight on-line frequency converters and the standby converter. When a fault is detected, the defective converter is automatically taken off line and replaced by the standby synthesized frequency converter. The RSU is capable of prioritizing converters so that critical communication channels have access to the standby converter on a priority basis. Switchover from a defective on-line converter to the standby converter is achieved by connecting the converters to a switch matrix located on the rear panel of the RSU. The defective converter is replaced by physically removing its input/output signal lines and connecting them to the standby converter via the switch matrix. This ensures continuous operation while the fault is corrected or allows for routine maintenance without disrupting signal transmission. Since the input/output of the replaced converter is available at the rear panel "OFF LINE" connector, periodic testing of all converters may be performed.

To reduce operating costs the RSU may be placed in an unoccupied facility and be totally controlled and monitored from a system controller over a remote communications bus. All front panel controls and indications (except DC Voltage Monitor and Remote bus data format) are available to a controller over the remote bus.

All information is stored in non-volatile memory to protect against power interruptions. When power is restored the RSU will return to its previous settings.

FEATURES

- Redundant protection for up to eight converters (field expandable)
- Redundant power supplies
- Fault status indication for the on-line and standby converters
- Fault status indication for the RSU (power supply and switch matrix operation)
- Front panel digital display of RSU DC voltages
- Four converter operating modes (On-line, Off-line, Standby and Not Used)
- Individual priority levels for each converter
- Automatically updates frequency changes made to an on-line converter
- Compensation for attenuation differences between an on-line and standby converter when used with MITEQ synthesized converter
- Complete control and monitoring capability over a remote bus (RS232, RS422 and RS485)
- Control and status monitoring of the standby converter over the remote bus
1.2 EQUIPMENT CHARACTERISTICS

1.2.1 PHYSICAL

Weight ................................................................. 25 pounds nominal
Overall dimensions ................................................. 19” x 20” x 7” panel height
RF signal connectors (J1-J9, J1A-J9A) ......................... SMA female
IF signal connectors (J10-J18, J10A-J18A) ................. BNC female
Status connector (J19) ................................................ DB-25P
Remote interface connector (J20)
    RS485, RS422 .................................................. DE-9S
    RS232 .......................................................... DB-25P
Remote interface connector (J21) RS485, RS422 only .......... DE-9S
Local interface connector (J22) ................................. DE-9S
Alarm input connectors (J23-J31) ............................... DE-9P
Primary power input ............................................. IEC320

1.2.2 FUNCTIONAL

Primary power ....................................................... 90-250VAC
Fuse ................................................................. T3.15A (5 x 20mm)

RF specifications apply to a single switch. IF switches (50-180 MHz) are 75 Ohm impedance.
50 Ohm IF impedance is supplied with Option 15.

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>INSERTION LOSS (MAXIMUM)</th>
<th>AMPLITUDE FLATNESS/40 MHz (MAXIMUM)</th>
<th>RETURN LOSS (MINIMUM)</th>
<th>ISOLATION (MINIMUM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-180 MHz</td>
<td>0.2 dB</td>
<td>0.2 dB</td>
<td>23 dB</td>
<td>80 dB</td>
</tr>
<tr>
<td>0.95-6.5 GHz</td>
<td>0.3 dB</td>
<td>0.2 dB</td>
<td>18 dB</td>
<td>60 dB</td>
</tr>
<tr>
<td>6.5-8.4 GHz</td>
<td>0.4 dB</td>
<td>0.2 dB</td>
<td>18 dB</td>
<td>60 dB</td>
</tr>
<tr>
<td>8.4-14.8 GHz</td>
<td>0.45 dB</td>
<td>0.2 dB</td>
<td>16 dB</td>
<td>60 dB</td>
</tr>
<tr>
<td>14.8-18.4 GHz</td>
<td>0.6 dB</td>
<td>0.4 dB</td>
<td>12 dB</td>
<td>55 dB</td>
</tr>
</tbody>
</table>

Status connector, J19, pin designations are indicated in the following table.

<table>
<thead>
<tr>
<th>CONVERTER</th>
<th>NORMAL</th>
<th>STANDBY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CLOSED</td>
<td>OPEN</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
<td>2-3</td>
</tr>
<tr>
<td>2</td>
<td>4-5</td>
<td>5-6</td>
</tr>
<tr>
<td>3</td>
<td>7-8</td>
<td>8-9</td>
</tr>
<tr>
<td>4</td>
<td>10-11</td>
<td>11-12</td>
</tr>
<tr>
<td>5</td>
<td>13-14</td>
<td>14-15</td>
</tr>
<tr>
<td>6</td>
<td>16-17</td>
<td>17-18</td>
</tr>
<tr>
<td>7</td>
<td>20-21</td>
<td>21-22</td>
</tr>
<tr>
<td>8</td>
<td>23-24</td>
<td>24-25</td>
</tr>
</tbody>
</table>
Remote Interface connectors, J20 and J21, pin designations are indicated in the table below. Local Interface connector, J22, is per RS422 wiring.

For RS485 two-wire party line operation, DATA IN + must be externally wired to DATA OUT +, and DATA IN - externally wired to DATA OUT -.

Units equipped with RS232 (Option 17C) are shipped with a jumper connecting RTS and CTS. See Figure 3-2 for the location of the jumper.

<table>
<thead>
<tr>
<th>RS485 AND RS422</th>
<th>PIN</th>
<th>DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Data Out -</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Data In -</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Data Out +</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>Data In +</td>
</tr>
<tr>
<td>RS232</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Tx Data</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Rx Data</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>RTS</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>CTS</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Following is the interconnection between the RSU Local Interface and the Standby Converter.

<table>
<thead>
<tr>
<th>RSU TO STBY</th>
<th>RSU J22 PIN</th>
<th>STBY J6 PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

For the Alarm Input connectors, J23-J31, a fault consists of a contact closure applied between pins 1 and 2. If Option 1 is ordered, the fault input is a contact open between pins 1 and 2.

For most MITEQ converters the Redundancy Switch connector is J7. The connection between the RSU and the MITEQ converter is shown in the table below.

<table>
<thead>
<tr>
<th>RSU (J23-J31)</th>
<th>MITEQ Converter (J7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CLOSURE</td>
</tr>
<tr>
<td>1-2</td>
<td>1-2</td>
</tr>
</tbody>
</table>
SECTION 2
INSTALLATION

2.1 UNPACKING, STORAGE, RESHIPMENT

Carefully open the shipping container and remove the equipment. Inspect the equipment thoroughly and report any damage.

If the equipment is to be stored, it should be wrapped in plastic and kept in a clean, dry place.

If the equipment is to be reshipped for any reason, wrap in heavy plastic and ship in a heavy (275 lb. test) double wall carton. At least three inches of a solid packing material should be used on all sides of the equipment. The carton should be marked to indicate that it contains fragile electronic equipment.

2.2 MOUNTING

THIS EQUIPMENT IS NOT FOR USE IN A DOMESTIC ENVIRONMENT.

THIS EQUIPMENT IS INTENDED FOR RACK MOUNTING.

OPERATOR INJURY MAY OCCUR IF UNIT IS NOT PROPERLY MOUNTED.

THIS EQUIPMENT MUST BE SECURELY MOUNTED.

Slides are provided for mounting in a standard 19” equipment rack.

2.3 TURN-ON PROCEDURE

After mounting, make all external connections per Table 2-1.

Apply power to the RSU by depressing the front panel power On/Off switch(es).

System is now operational.

2.4 STANDBY CONVERTER REQUIREMENTS

The standby converter must conform to the MITEQ serial bus format and be set to the following:

- Remote Bus interface: RS422 or RS485
- Address: 64 decimal
- Data Format: Seven data bits, odd parity
- Baud Rate: 9600

These settings are for the local bus only and not related to the remote bus. For example, Address 64 may be used as an RSU or converter address on the remote bus.

Since communication over the local bus is critical to the RSU operation, the link is checked when power is turned on. A warning message will be displayed if the RSU cannot communicate with the standby converter or the converter is in Local mode.
**Table 2-1. External Connections**

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Lug</td>
<td>Connect the Ground Lug on the rear panel of the RSU to the Protective Earth connection of the building.</td>
</tr>
<tr>
<td>Power Cords</td>
<td>Attach power cords to the RSU rear panel AC power inlets marked “PSA” and “PSB”. Connect the other end to the power source. Refer to national wiring standards for the correct connection to the power source.</td>
</tr>
<tr>
<td>Status Connector (J19)</td>
<td>The Status connector is an optional connection. This allows the operator to monitor the status via a contact closure interface. See Paragraph 1.2.2 for wiring information.</td>
</tr>
<tr>
<td>Local Interface (J22)</td>
<td>Connect the Remote Interface of the Standby Converter (J6 for most MITEQ converters) to the RSU rear panel connector (J22). This is a standard RS422 interface. See Paragraph 1.2.2 for wiring information.</td>
</tr>
<tr>
<td>Alarm Input Connectors (J23-J31)</td>
<td>Connect the Redundancy Alarm outputs (J7 for most MITEQ converters) of Converters 1 through 8 to the RSU rear panel Alarm Input connectors J23 through J30 respectively. Connect the Standby converter to J31. See Paragraph 1.2.2 for wiring information.</td>
</tr>
<tr>
<td>Remote Interface Connector</td>
<td>The Remote Interface connector is an optional connection. This allows the operator to monitor and control the RSU from a remote location. See Paragraph 1.2.2 for wiring information.</td>
</tr>
<tr>
<td>RF Signal Connectors (J1-J9, J1A-J9A)</td>
<td>See Figure 2-1 for the recommended interconnection configuration.</td>
</tr>
<tr>
<td>IF Signal Connectors (J10-J18, J10A-J18A)</td>
<td>See Figure 2-1 for the recommended interconnection configuration.</td>
</tr>
</tbody>
</table>
Figure 2-1 shows the recommended interconnection diagram for upconverter and downconverter IF and RF signal paths. If the RSU is configured without RF switches (RSUN-B) simply omit the RF switches from the diagram.
2.5 FUNCTIONAL CONFIGURATIONS

The RSU will switchover when a converter alarm is detected and remain in this state even if the converter alarm clears. The RSU will not return the faulted converter to the on-line state unless an alarm from a converter with a higher priority rating is detected.

An RSU equipped with the Automatic/Switchback features (Option 3) supports stand-alone applications and does not require a dedicated monitor and control system. The RSU, not a host computer, will control the RS485 bus to poll the on-line converters. The frequency settings of each converter are monitored by the RSU and are updated when frequency changes are made at the front panel of a converter.

In addition, with the switchback feature enabled, the RSU will switch a converter back on-line after a fault has cleared. This allows an operator to switch a converter off-line by simulating a fault, then switching the converter back on-line by clearing the fault.

2.6 GAIN CONTROL CONFIGURATION OPTIONS

The Gain Control capability allows the RSU to compensate for the difference in path loss between an on-line converter and the standby converter when a switchover occurs. There are several procedures for configuring the system which depend on the options supplied with the RSU and on-line converters. In all cases, it is necessary for the standby converter to be equipped with the Remote Control Attenuation feature so that its output may be set to the proper level by the RSU.

Gain Control - Procedure 1

This procedure is used when the RSU and on-line converters are equipped with the following options:

- RSU: Standard
- On-line Converters: NOT equipped with remote controlled attenuation

Procedure -

- Set the RSU to Local mode
- Set RSU Converter 1 status to On-line
- Take a measurement at the output of the Converter 1 signal path
- Set RSU Converter 1 status to Standby
- Set the standby converter to Local mode
- Adjust the standby converter attenuation to obtain the same value measured for the Converter 1 signal path
- Enter the same value into the RSU attenuation field for Converter 1
- Repeat procedure for the remaining on-line converters
- Set the standby converter back to Remote mode
- Set the RSU to Remote mode
Gain Control - Procedure 2

This procedure is used when the RSU and on-line converters are equipped with the following options:

RSU: Standard

On-line Converters: Equipped with remote controlled attenuation

In this configuration a Monitor and Control (M&C) computer is connected to the RSU and on-line converters over a remote bus.

The procedure is similar to Procedure 1 except that the difference in the on-line and standby converter path loss must be accounted for in the M&C software. After completing this procedure, a table is constructed in the M&C program which contains the difference in path loss between the standby converter and each of the on-line converters. If a change is made to the attenuation setting of an on-line converter, the M&C computer must sense this change in its normal polling routine. The Attenuation setting in the RSU for Converter ‘n’ is then changed by sending the ‘In’ command. The RSU setting is equal to the converter setting plus the path loss value stored in the lookup table for Converter ‘n’.

Procedure -

- Set the RSU to Local mode
- Set RSU Converter 1 status to On-line
- Set Converter 1 to a nominal output level and measure the output of the Converter 1 signal path
- Set RSU Converter 1 status to Standby
- Set the standby converter to Local mode
- Adjust the standby converter attenuation to obtain the same value measured for the Converter 1 signal path
- Record the difference or offset between the on-line converter and standby converter attenuation settings
- Repeat procedure for the remaining on-line converters
- Store the offset values in the M&C Lookup Table corresponding to each on-line converter
- Set the standby converter back to Remote mode
- Set the RSU to Remote mode
Gain Control - Procedure 3

This procedure is used when the RSU and on-line converters are equipped with the following options:

RSU:  Option 3

On-line Converters:  Equipped with remote controlled attenuation

In this configuration the RSU is connected to the on-line converters over a remote bus. The procedure is similar to Procedure 2 except that the difference in the on-line and standby converter path loss is accounted for in the RSU. After completing this procedure a table is constructed in the RSU which contains the difference in path loss between the standby converter and each of the on-line converters. If a change is made to the attenuation setting of an on-line converter, the RSU senses this change in its normal polling routine. The attenuation setting in the RSU for Converter 'n' is then changed to the converter setting plus the path loss value stored in the RSU lookup table for Converter 'n'.

Procedure -

- Set the RSU to Local mode
- Set RSU Converter 1 status to On-line
- Set Converter 1 to a nominal output level and measure the output of the Converter 1 signal path
- Set RSU Converter 1 status to Standby
- Set the standby converter to Local mode
- Adjust the standby converter attenuation to obtain the same value measured for the Converter 1 signal path
- Record the difference or offset between the on-line converter and standby converter attenuation settings
- Repeat procedure for the remaining on-line converters
- Set the standby converter back to Remote mode
- Set the RSU to Remote mode

At this point in the procedure it is necessary to place the RSU in the Attenuation Offset mode in order to store the values obtained for the lookup table.

- Turn AC power off (both PSA and PSB switches)
- Press and hold the "ATTENUATION" key while turning on AC power
- The RSU is now in the Attenuation Offset mode
- Use the DATA ENTRY keys to enter the recorded data for each channel.
  In this mode the "REMOTE" key toggles the polarity from plus to minus.
  Press "ENT" to store data or use the UP or DOWN ARROW keys to scroll.
- When data for each converter has been entered and verified, turn AC power off.
- Turn AC power on for normal operation
SECTION 3
OPERATION

3.1 CONTROLS

3.1.1 EXTERNAL CONTROLS

For a description of the front panel keypad and select switches see Paragraph 3.2.1.

AC Power

Use the “PSA” and “PSB” power on/off switches to control AC power to the RSU.

Fuses

There is a separate fuse for both the “PSA” and “PSB” AC power inlets. The AC power cord must be removed to access the fuse which is located in the AC inlet assembly.

3.1.2 INTERNAL CONTROLS

Power Supply Output Voltage Adjustment

Power supply output voltages are adjusted from potentiometers located on the power supplies. See Figure 1-3 for the location of these adjustments. Any adjustment should be made using an insulated tuning tool. Voltage tolerances are $+20 \pm 0.5V$ and $+5.2 \pm 0.2V$.

View Adjustment

The contrast and viewing angle of the LCD display may be adjusted by turning the “VIEW ADJUST” potentiometer. The potentiometer is located on the printed circuit board directly behind the front panel. Remove the cover of the RSU and use Figure 1-3 to locate the Front Panel Control Board. Then use Figure 3-1 to locate the components.

RS485 Bus Termination

A jumper selectable 120 ohm termination resistor is connected across the DATA + and DATA - terminals. The resistor is installed by connecting a jumper across E1 which is located on the printed circuit board directly behind the front panel. Remove the cover of the RSU and use

![Figure 3-1. Internal Control Locations](image-url)
Figure 1-3 to locate the Front Panel Control Board. Then use Figure 3-1 to locate the components.

**RS422 Bus Termination (Option 17A Only)**

A jumper selectable 120 ohm termination resistor is connected across the DATA OUT + and DATA OUT - terminals and across the DATA IN + and DATA IN - terminals. The DATA OUT resistor is installed by connecting a jumper across E1 and the DATA IN resistor is installed by connecting a jumper across E2. The jumpers are located on the printed circuit board directly behind the front panel. Remove the cover of the RSU and use Figure 1-3 to locate the Front Panel Control Board. Then use Figure 3-1 to locate the components.

**RS232 RTS/CTS Jumper (Option 17C Only)**

The RTS/CTS jumper is located on an auxiliary printed circuit board assembly which is plugged into the main front panel circuit board (refer to Figure 1-3 for the location of this board). A jumper plug is installed which connects the RTS output and CTS input signals together. The jumper must be removed if it is necessary to use the RTS/CTS protocol. Remove the cover of the RSU and use Figure 1-3 to locate the RS232 Interface Board. Then use Figure 3-2 to locate the components.

![Figure 3-2. RS232 RTS/CTS Jumper](image)

**3.2 OPERATION**

**3.2.1 FRONT PANEL**

The front panel display and indicators have been organized so that important information is available at a glance. The keyboard is divided into functional groups which allow an operator to easily change any parameter from the front panel. See Figure 1-1 for the physical layout of the front panel.

**3.2.1.1 KEYPAD OPERATION**

A beep will acknowledge each valid keypress. The error tone will sound when an illegal key is pressed and in some cases, a warning message will temporarily appear on the LCD.
3.2.1.1.1 KEYPAD OPERATION, AUTOMATIC/SWITCHBACK (Option 3)

The Automatic/Switchback option is used in systems which have no remote Monitor and Control (M&C) computer capability. In this case the RSU takes the place of the system controller and polls the converters. Frequency changes and address selections are not allowed from the RSU front panel. Frequency changes are made only at the converter front panels and are reflected on the RSU display when a poll takes place. Converter addresses as well as the other requirements are as follows:

- RSU and converters configured for RS485 operation
- RSU Address set to 64
- Converter 1 set to Address 65, Converter 2 to 66, Converter 3 to 67, etc.
- Baud Rate and Data Format must be the same for the RSU and all converters

Priority and Attenuation functions are not affected by this option.

3.2.1.1.2 CONVERTER

Enter the converter number (1-8) to display data from the selected converter. The arrow keys may be used to scroll through the converters.

3.2.1.1.3 FREQUENCY

Enter the converter frequency in MHz. The arrow keys may be used to increment or decrement frequency in 1 kHz steps.

Changing frequency at the RSU does not set the frequency of the converter itself but only sets the frequency being displayed on the RSU front panel and in RSU memory. If a switchover occurs, the standby converter will be set to the frequency saved in the RSU's memory. Therefore, it is important that the frequency entered into RSU memory exactly matches the converter frequency.

If the RSU and converters are being controlled by a host computer over a remote bus, the RSU will automatically update any frequency changes made to the converters over the remote bus by monitoring bus communications. This feature will be discussed further in the "REMOTE OPERATIONS" section.

For systems that are configured with both 70 MHz and 140 MHz IF frequencies it is necessary to enter IF frequency information. Pressing FREQUENCY alternates the display between the RF frequency and the IF frequency. To change the IF frequency use the up and down arrow keys to toggle between the 70 MHz and 140 MHz IF settings.

3.2.1.1.4 PRIORITY

Enter the priority level of the converter or use the arrow keys to scroll. Priority level is from 0 to 7, with 7 the highest priority and 0 the lowest.

Priority switchover operates as follows. If more than one converter is in an alarm condition, the one with the highest priority will be replaced by the standby converter while the others remain on-line. A low priority converter already in Standby mode will be set back to on-line if a converter with a higher priority has an alarm. Two converters given the same priority level will be serviced on a first come/first served basis.
3.2.1.1.5 ADDRESS

Enter the address of the converter (64 to 95 and 0) or use the arrow keys to scroll. Each converter must have a unique address except for address 0 which may be used more than once. Trying to set two converters to the same address (except 0) will cause a warning message to appear and not be accepted. It is important that the address entered be identical to the actual address of the converter for the automatic frequency update feature to work. The frequency display for converters set to address 0 will not be updated by the automatic update feature.

3.2.1.1.6 ATTENUATION

Enter the converter attenuation in 0.2 dB steps. The arrow keys may be used to increment or decrement attenuation at the minimum attenuation step size (step size is a factory setting). When necessary, entries will be adjusted to the nearest step size. For example, an entry of 10.3 dB will be adjusted to 10.2 dB if the factory programmed step size was set to 0.2 dB.

3.2.1.1.7 STATUS

The status of the converter may be changed by selecting Status and using the arrow keys to select ON, OFF, STBY or N/A.

- **ON** - This is the normal operating mode for the on-line converters. The alarm output for each of the on-line converters is monitored by the RSU. An alarm condition will cause a switchover to take place replacing the faulty on-line converter with the standby converter.

- **OFF** - The alarm output from the converter is ignored and will not cause a switchover to take place. This mode is selected when maintenance work is being performed on a converter.

- **STBY** - When Standby is selected a switchover takes place and the converter is replaced by the standby converter. Maintenance may be performed on the faulted converter.

- **N/A** - This mode is used with systems which have less than eight converters being serviced by the RSU. Unused converter channels do not have any converters or switches, and should be placed in the N/A mode. To avoid problems with priority and address allocations the following default values are assigned to all converters set to N/A.
  
  - Frequency - Lowest allowable frequency setting
  - Priority - Level 0
  - Address - 0
  - Attenuation - Maximum allowable setting
3.2.1.1.8 VOLTAGE MONITOR/FORMAT

This key allows an operator to monitor the DC power supply settings and view the firmware revision number and serial bus data format of the RSU. While pressing and holding the key, an operator may read the +20V and +5V DC voltage levels on both power supplies. The switch is alternate action so that when it is pressed again the following information is displayed.

- RSU firmware revision number
- RSU Address
- Serial Data Format (Baud, Data Bits, Parity)

3.2.1.1.9 LOCAL/REMOTE SELECT

The Remote key is alternate action and switches the RSU between Local and Remote modes. When in Remote mode (LED On) the other front panel keys are locked out (except for Voltage Monitor/Format), and the RSU is controlled over the remote bus. Local mode unlocks the front panel and allows an operator to control the RSU. While in Local mode the RSU will still respond to commands over the remote bus but will not allow data to be changed.

3.2.1.1.10 DATA ENTRY KEYS

The Data Entry keys are used to enter or change numerical data. All key sequences must be completed by pressing "ENT" before data is entered into the RSU. A display time-out restores the LCD to the original display if a key sequence is not completed in seven seconds.

3.2.1.2 ALARM LEDS

The front panel Alarm LEDs indicate the alarm condition of the converters and the RSU.

- CONVERSTERS 1-8 - The alarm condition of all converters are indicated. LEDs associated with converters set to the N/A status mode are always turned off.

- STBY - The alarm condition of the standby converter is indicated by this LED.

- PS - The alarm condition of the RSU power supplies is indicated by this LED. Each of the two redundant power supplies deliver three voltages (+20V and +5V). A failure in any of the three outputs from either power supply (PSA or PSB) will cause the LED to turn on. An operator can determine which power supply is faulty by pressing the "VOLTAGE MONITOR" key and reading the voltages. Note that a power supply failure will also cause the RSU alarm LED to turn on.

- RSU - This LED will turn on when a switchover failure has been detected or a power supply failure has occurred. The RSU continuously monitors the position of the transfer switches and detects a failure when the switch position does not match the status of the converters.
3.2.1.3 CONVERTER STATUS LEDS

The converter status LEDs (dual color) indicate the status of each of the eight converters as follows:

- Green = On-line
- Red = Off-line
- Blinking = Standby
- Unlit = Not Applicable

3.2.1.4 SETTING THE SERIAL DATA FORMAT

The serial data format and RSU Address may be set from the front panel by entering the data format programming mode.

- Turn both power supplies off
- Press and hold the "VOLTAGE MONITOR/FORMAT" key while turning both power supplies on.
- The RSU is now in the data format programming mode.

While in this mode the RSU data format and address may be changed by moving the cursor to the desired field (using the "ENT" key). Once the field has been selected, the arrow keys are used to scroll through the allowable values.

- Address - 64 to 95 decimal (ASCII “@” through “_”)
- Baud Rate - 110, 300, 600, 1200, 2400, 4800, 9600 or 19.2K
- Data Format - Seven or eight bits
- Parity - Odd, Even, None

The number of stop bits is set to 1 and not programmable. To return the RSU to its normal operating mode, cycle power off and on without pressing any keys.

3.2.2 REMOTE OPERATION AND PROTOCOL

The RSU is connected to a remote bus along with the on-line converters. The standby converter is connected to the RSU over a local bus (see Interconnection Diagrams). In this configuration the RSU is able to monitor the bus communications between the system controller and the converters. It will detect a Frequency Set command from the system controller to a converter. In this way the RSU is able to update its memory with all frequency changes made to the converters over the remote bus. All the front panel features of the RSU can be set or monitored over the remote bus (except Voltage Monitor and Remote bus data format).

The RSU is supplied with a RS485 bus interface but as an option can be supplied with RS232 or RS422. When communicating over a RS485 bus, the RSU can monitor both the Frequency Set command to a converter as well as the converter’s Response to the Frequency Set command. When a valid Response from the converter is detected, the RSU will update its memory with the new frequency. If an invalid Response from the converter is detected, the RSU will ignore the Frequency Set command. When communicating over a RS422 or RS232 bus, the RSU can only monitor the Frequency Set command to the converter. It is not able to monitor the converter’s Response to the Frequency Set command. In this case, the RSU will assume that the Frequency Set command was valid and will update its memory with the new frequency.
The standby converter is connected to the RSU over a local bus and not connected directly to the remote bus. The system controller may, however, set and monitor frequency and status through the RSU by sending the "Y" and "A" commands. It is suggested that as part of its normal polling routine, the system controller send the "A" command to ensure that the RSU is communicating with the standby converter and that the converter is not in Local mode. Either condition will defeat the automatic switchover function.

All transmissions are multi-byte sequences beginning with a header byte and ending with a trailer byte and checksum byte. The transmitted bytes are all ASCII printable characters in the range of 20H to 7EH. Serial data format is programmable from the front panel (Baud Rate, Data Bits, Parity Bits and Address). If any character in a command message contains an error (parity, framing or overrun) or the checksum is incorrect, the command is ignored and no response is made.

3.2.2.1 MESSAGE FORMAT

The message format is as follows:

```
HEADER - RSU ADDRESS - COMMAND/ERROR CODE - PARAMETERS - TRAILER - CHECKSUM
```

The response time from command to acknowledge is 100 ms. maximum.

3.2.2.1.1 HEADER BYTE

The Header byte is 7BH, ASCII character "{".

3.2.2.1.2 RSU ADDRESS

The RSU may take on the address values from 64 to 95 (40H to 5FH).

3.2.2.1.3 COMMAND CODE SUMMARY

<table>
<thead>
<tr>
<th>CODE</th>
<th>ASCII CHARACTER(s)</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3FH</td>
<td>?</td>
<td>Return RSU/standby converter status</td>
</tr>
<tr>
<td>3FH, 30H</td>
<td>?0</td>
<td>Return RSU/standby converter status and mode</td>
</tr>
<tr>
<td>3FH, 3'n'H</td>
<td>?n</td>
<td>Return Converter ‘n’ parameters</td>
</tr>
<tr>
<td>41H</td>
<td>A</td>
<td>Return standby converter frequency and status</td>
</tr>
<tr>
<td>49H, 3'n'H</td>
<td>In</td>
<td>Set Converter ‘n’ parameters</td>
</tr>
<tr>
<td>4DH</td>
<td>M</td>
<td>Mute the standby converter</td>
</tr>
<tr>
<td>50H</td>
<td>P</td>
<td>Set switch matrix position</td>
</tr>
<tr>
<td>53H</td>
<td>S</td>
<td>Return switch matrix position</td>
</tr>
<tr>
<td>55H</td>
<td>U</td>
<td>Unmute the standby converter</td>
</tr>
<tr>
<td>59H</td>
<td>Y</td>
<td>Set standby converter frequency</td>
</tr>
<tr>
<td>52H</td>
<td>R</td>
<td>Return converter status</td>
</tr>
</tbody>
</table>
3.2.2.1.4 ERROR CODE SUMMARY

<table>
<thead>
<tr>
<th>CODE</th>
<th>CHARACTER</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>61H</td>
<td>a</td>
<td>Command not recognized</td>
</tr>
<tr>
<td>62H</td>
<td>b</td>
<td>Illegal parameter or parameter out of range</td>
</tr>
<tr>
<td>63H</td>
<td>c</td>
<td>RSU in Local mode</td>
</tr>
<tr>
<td>64H</td>
<td>d</td>
<td>RSU busy</td>
</tr>
</tbody>
</table>

3.2.2.1.5 PARAMETERS

Parameters are numeric ASCII characters. Non-numeric characters or values beyond the allowable range will be rejected and cause the RSU to respond with an error code.

3.2.2.1.6 TRAILER BYTE

The Trailer byte is 7DH, ASCII character "}".

3.2.2.1.7 CHECKSUM BYTE

The following checksum byte calculation insures that the checksum is an ASCII printable character.

Thirty-two is subtracted from each character value before taking the modulo 95 sum. Thirty-two is then added to the final sum to obtain the checksum character. All values are in decimal.

3.2.2.2 COMMAND CODE DESCRIPTION

The following paragraphs describe each of the command codes. For clarity the header, address, trailer and checksum characters are not shown. Upper case letters are the actual command or response characters. Lower case letters represent numeric characters.

3.2.2.2.1 RETURN RSU/STANDBY CONVERTER STATUS

The RSU responds in both Local and Remote mode with the RSU and Standby converter status. This command is included to be compatible with older RSU systems.

Remote Command:  ?

RSU Response:  ?pb

0 = Normal
1 = Fault

? = Command indicator
p = RSU status
b = Standby converter status
3.2.2.2 RETURN RSU/STANDBY CONVERTER STATUS AND MODE

The RSU responds in both Local and Remote mode with the RSU, Standby converter status, and RSU Local/Remote mode.

Remote Command Sequence: ?0

RSU Response: ?pbLI

0 = Normal
1 = Fault

? = Command indicator
p = RSU status
b = Standby converter status
L = RSU Local/Remote mode indicator
l = 0 (Local), = 1 (Remote)

3.2.2.2.3 RETURN CONVERTER 'n' PARAMETERS

The RSU responds in both Local and Remote mode with the following Converter 'n' parameters:

- Frequency
- Address
- Priority
- Attenuation
- IF

Remote Command Sequence: ?n

RSU Response: ?nlffffff(f)AaaPpTTtt(li)

? = Command indicator
n = Numeric character for Converter 1 to 8
l = Frequency indicator
ffffff(f) = Seven or eight digit numeric characters for frequency

A = Address indicator
aa = Two digit numeric character for address (64 to 95)

P = Priority indicator
p = Numeric character for priority level (0 to 7)

T = Attenuation indicator
TTTT = Three digit numeric characters for attenuation (LSD = tenths dB)

I = IF indicator (only with Dual IF option)
i = "0" = 70 MHz, "1" = 140 MHz
3.2.2.4 RETURN STANDBY CONVERTER FREQUENCY AND STATUS

The RSU responds in both Local and Remote mode with the frequency and status of the standby converter.

Remote Command: A

The RSU response depends on the model of the attached standby converter. Following are responses for various MITEQ converter models.

9400/9600: AFffffffffffTtttLLiiMm?abcdef
9300A: AFffffffffffTtttLLiMMm?abcdef
9300: AFffffff(f)LLiMM
9300 With Alarms: AFffffff(f)LLiMM?abcdef

3.2.2.5 SET CONVERTER 'n' PARAMETERS

The RSU accepts this command only while it is in Remote mode.

Remote Command Sequence: InFffffffffAaaPpTttti

RSU response: I

I = Command indicator
n = Numeric character for Converter 1 to 8
F = Frequency indicator
fffffff(f) = Seven or eight digit numeric characters for frequency
A = Address indicator
aa = Two digit numeric character for address (64 to 95)
P = Priority indicator
p = Numeric character for priority level (0 to 7)
T = Attenuation indicator
ttt = Three digit numeric characters for attenuation (LSD = tenths dB)
I = IF indicator
i = "0" = 70 MHz, "1" = 140 MHz

Frequency does not set the frequency of the converter itself but only sets the frequency being displayed on the RSU front panel and in RSU memory.

Address selection is from 64 to 95 and may not be used by the other converters or the RSU. It is also very important for the address to match the actual address setting on the converter for automatic updating to occur.

See "KEYPAD OPERATION" for a description of priority operation.
3.2.2.6 MUTE STANDBY CONVERTER

The RSU accepts this command only while it is in Remote mode. The output of the standby converter is muted until either a Unmute Standby Converter or Set Standby Converter Frequency command is received, or the Standby Converter is switched online.

Remote Command: M
RSU Response: M

3.2.2.7 SET SWITCH MATRIX POSITION

The RSU accepts this command only while it is in Remote mode.

Remote Command Sequence: Pabcdefgh
RSU Response: P

<table>
<thead>
<tr>
<th>0</th>
<th>Off-line</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On-line</td>
</tr>
<tr>
<td>2</td>
<td>Standby</td>
</tr>
<tr>
<td>3</td>
<td>Not Used</td>
</tr>
</tbody>
</table>

P = Command indicator
a = Numeric character for status of Converter 1
b = Numeric character for status of Converter 2
c = Numeric character for status of Converter 3
d = Numeric character for status of Converter 4
e = Numeric character for status of Converter 5
f = Numeric character for status of Converter 6
g = Numeric character for status of Converter 7
h = Numeric character for status of Converter 8

Only one converter may be set to the Standby mode.

3.2.2.8 RETURN SWITCH MATRIX POSITION

The RSU responds in both Local and Remote mode with the frequency and status of the standby converter.

Remote Command: S
RSU Response: Sabcdefgh

<table>
<thead>
<tr>
<th>0</th>
<th>Off-line</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On-line</td>
</tr>
<tr>
<td>2</td>
<td>Standby</td>
</tr>
<tr>
<td>3</td>
<td>Not Used</td>
</tr>
</tbody>
</table>
S = Command indicator

a = Numeric character for status of Converter 1
b = Numeric character for status of Converter 2
c = Numeric character for status of Converter 3
d = Numeric character for status of Converter 4
e = Numeric character for status of Converter 5
f = Numeric character for status of Converter 6
g = Numeric character for status of Converter 7
h = Numeric character for status of Converter 8

3.2.2.2.9 UNMUTE STANDBY CONVERTER

The RSU accepts this command only while it is in Remote mode. Assuming no error conditions, the output of the standby converter is unmuted.

Remote Command: U

RSU Response: U

3.2.2.2.10 SET STANDBY CONVERTER FREQUENCY

The RSU accepts this command only while it is in Remote mode. This command requires a seven or eight digit parameter which sets the frequency (in kHz) of the standby converter. Assuming no error conditions, the converter is set to the frequency and unmuted.

Remote Command Sequence: Yffffffff

Y = Command indicator

fffffff(f) = Seven or eight digit numeric characters for frequency. MSD transmitted first, LSD last.

3.2.2.2.11 SET STANDBY CONVERTER FREQUENCY, ATTENUATION AND IF

The RSU accepts this command only while it is in Remote mode. This command sets the frequency, attenuation and the IF (if applicable) with one command. The converter Mute status is not affected. If the Dual IF capability is not utilized, the IF indicator, will be ignored. The Attenuation and IF settings will be ignored.

Remote Command Sequence: YFfffffffTttt(Ii)

RSU Response: Y

Y = Command indicator

F = Frequency indicator

fffffff(f) = Seven or eight digit numeric character indicating frequency. MSD transmitted first, LSD last.
T = Attenuation indicator
   ttt = Three digit numeric character indicating attenuation. MSD transmitted first, LSD last.

I = IF indicator
   i = "0" = 70 MHz, "1" = 140 MHz

3.2.2.2.12 RETURN CONVERTER STATUS

The RSU responds in both Local and Remote mode with the converter status.

Remote Command: R

RSU Response: Rabcdefgh

   0 = No Alarm
   1 = Alarm condition (fault)

R = Command indicator

   a = Numeric character for status of Converter 1
   b = Numeric character for status of Converter 2
   c = Numeric character for status of Converter 3
   d = Numeric character for status of Converter 4
   e = Numeric character for status of Converter 5
   f = Numeric character for status of Converter 6
   g = Numeric character for status of Converter 7
   h = Numeric character for status of Converter 8