



# **CRS-170**

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## **1:1 Redundancy Switch**

Accessory Product for use only with  
Comtech EF Data CDM-600L and SDM-300L3 Modems  
(Modem Firmware and Hardware Requirements Apply)





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Comtech EF Data is an ISO 9001  
Registered Company.

Part Number MN/CRS170.IOM  
Revision 1  
October 4, 2004



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For more information regarding the warranty policies, see Warranty Policy, p. 13.

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## ABOUT THIS MANUAL

This manual provides installation and operation information for the Comtech EF Data CRS-170 1:1 Redundancy Switch. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the CRS-170 1:1 Redundancy Switch.

## RELATED DOCUMENTS

Comtech EF Data CDM-600 Satellite Modem Installation and Operation Manual

Comtech EF Data SDM-300L3 Satellite Modem Installation and Operation Manual

## CONVENTIONS AND REFERENCES

### CAUTIONS AND WARNINGS



Indicates information critical for proper equipment function.



Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

## METRIC CONVERSION

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing non-metric to metric conversions.

## RECOMMENDED STANDARD DESIGNATIONS

Recommended Standard (RS) Designations are equivalent to the Electronic Industries Association (EIA). Comtech EF Data will reference RS designator throughout the manual.

## TRADEMARKS

All product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

## **REPORTING COMMENTS OR SUGGESTIONS CONCERNING THIS MANUAL**

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Customer Support Department.

## **EMC COMPLIANCE**

This is a Class B product. In a domestic environment, it may cause radio interference that requires the user to take adequate protection measures.

## **EN55022 COMPLIANCE**

This equipment meets the radio disturbance characteristic specifications for information technology equipment as defined in EN55022.

## **EN50082-1 COMPLIANCE**

This equipment meets the electromagnetic compatibility/generic immunity standard as defined in EN50082-1.

In order that the CRS-170 continues to comply with these standards, observe the following instructions:

- ▶ Connections to the transmit and receive IF ports (BNC female connectors) should be made using a good quality coaxial cable; for example, RG58/U (50 $\Omega$ ) or RG59/U (75 $\Omega$ ).
- ▶ All 'D' type connectors attached to the unit must have back-shells that provide continuous metallic shielding. Cable with a continuous outer shield (either foil or braid, or both) must be used, and the shield must be bonded to the back-shell.
- ▶ The equipment must be operated with its cover on at all times. If it becomes necessary to remove the cover, the user should ensure that the cover is correctly re-fitted before normal operation commences.

## **FEDERAL COMMUNICATIONS COMMISSION (FCC)**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.



This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.

**Note:** To ensure compliance, properly shielded cables for DATA I/O shall be used. More specifically, these cables shall be shielded from end to end, ensuring a continuous shield.

## **SAFETY COMPLIANCE**

### **EN 60950**

Applicable testing is routinely performed as a condition of manufacturing on all units to ensure compliance with safety requirements of EN60950.

The equipment is rated for operation at +12 volts DC and -12 volts DC. It has a maximum power consumption of 4.5 Watts, and draws a maximum of 250 mA at +12 volts DC and 120 mA at -12 volts DC. The power supply current is, in all circumstances, supplied by either a single Comtech EF Data CDM-600 modem, or a pair of these modems.

This equipment meets the Safety of Information Technology Equipment specification as defined in EN60950.

## **EQUIPMENT CONNECTION**

The CRS-170 is designed for operation ONLY with Comtech EF Data modems. These modems supply DC operating current (electronically fused and protected) and control signals for the correct functioning of this unit. Connection to other manufacturer's equipment could result in damage to the unit. The CRS-170 is not compatible with other Comtech EF Data modems.

## ENVIRONMENTAL

The CRS-170 must not be operated in an environment where the unit is exposed to extremes of temperature outside the ambient range 0 to 50<sup>0</sup>C (32 to 122<sup>0</sup>F), precipitation, condensation, or humid atmospheres above 95% RH, altitudes (un-pressurized) greater than 2000 meters, excessive dust or vibration, flammable gases, corrosive or explosive atmospheres.


Operation in vehicles or other transportable installations that are equipped to provide a stable environment is permitted. If such vehicles do not provide a stable environment, safety of the equipment to EN60950 may not be guaranteed

## TELECOMMUNICATIONS TERMINAL EQUIPMENT DIRECTIVE


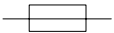
In accordance with the Telecommunications Terminal Equipment Directive 91/263/EEC, this equipment should not be directly connected to the Public Telecommunications Network.



## LOW VOLTAGE DIRECTIVE (LVD)

The following information is applicable for the European Low Voltage Directive (EN60950):

<HAR>	Type of power cord required for use in the European Community.
	CAUTION: Double-pole/Neutral Fusing. ACHTUNG: Zweipolige bzw. Neutralleiter-Sicherung.

International Symbols:

Symbol	Definition
	Alternating Current.
	Fuse.

Symbol	Definition
	Protective Earth.
	Chassis Ground.

**Note:** For additional symbols, refer to “Cautions” listed earlier in this preface.

## WARRANTY POLICY

This Comtech EF Data product is warranted against defects in material and workmanship for a period of two years from the date of shipment. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective.

For equipment under warranty, the customer is responsible for freight to Comtech EF Data and all related custom, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges **only** for return of the equipment from the factory to the customer. Comtech EF Data will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EF Data.

## LIMITATIONS OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper installation or maintenance, abuse, unauthorized modification, or operation outside of environmental specifications for the product, or, for damages that occur due to improper repackaging of equipment for return to Comtech EF Data.

*No other warranty is expressed or implied. Comtech EF Data specifically disclaims the implied warranties of merchantability and fitness for particular purpose.*

## EXCLUSIVE REMEDIES

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EF Data shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

## DISCLAIMER

Comtech EF Data has reviewed this manual thoroughly in order to provide an easy-to-use guide to the equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EF Data reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

If you have any questions regarding the equipment or the information in this manual, please contact the Comtech EF Data Customer Support Department.



# Chapter 1. INTRODUCTION

## CRS-170 L-Band 1:1 Switch Module



The CRS-170 L-Band 1:1 Switch Module is an L-Band Tx-Rx signal switch designed for use with L-Band satellite modems in a 1:1 configuration. The Tx side switches four modem output signals that are multiplexed onto the transmit coaxial cable:

- 950-1950 MHz L-band transmit RF
- 10 MHz BUC frequency reference
- 600 KHz BUC FSK control and status communication
- BUC DC power supply

The receive side of the switch uses both power dividers and relays to provide the redundant modem interface for three signals multiplexed onto the LNB coaxial cable:

- 950-1950 MHz L-Band RX RF from LNB
- 10 MHz frequency reference to LNB
- DC power supply to LNB

The CRS-170 is designed to support 1:1 redundancy for Comtech EF Data CDM-600L, SDM-300L3, SNM-1001L, and SNM-1010L modems. Table 1 summarizes the applications including requirements for supporting data switching hardware and software.

The CDM-600L and SDM-300L3 modems do not have built in switching capability for the terrestrial data side of the link. One-for-one redundancy for the CDM-600L requires both a CRS-150 switch to act as controller and terrestrial data switch, and a CRS-170 to perform the RF side switching.

The CRS-170 is required because the CRS-150 RF switching is limited to the 70/140 MHz band, and will not handle the high current BUC power supply multiplexed onto the transmit coaxial cable. Similarly, the SDM-300L3 requires an SMS-301 switch together with the CRS-170.

In both cases, the CRS-170 is controlled by the supporting data switch, and places the “A” or “B” modem RF on-line to match the data switch state. The CDM-600L modems supply redundant power to the CRS-170 through the CRS-150. The SMS-301 itself has redundant power supplies, and feeds power to the CRS-170 through the control cable. Online-standby modem configuration matching is provided by the CRS-150 controller communication with the CDM-600L modem. The SMS-301 does not automatically configure the standby modem.



**The CRS-150 is an accessory product designed specifically for the Comtech EF Data CDM-600 and CDM-600L modems, and must not be used with any other equipment.**



The SMS-301 is configured differently for use with the SDM-300L3 than for use with the SDM-300A. The configuration must be done at the factory and must be specified at the time of order.

For correct operation of the CRS-170, the CDM-600L modems **must** have installed:

**Firmware Version 1.1.4 (or higher)**

**Hardware Revision 3**

If the modem does not meet this requirement, please contact the factory. Flash firmware upgrades are free, and may be downloaded from the CEFD web page. Hardware revision upgrades must be performed at the factory.

Table 1. CRS-170 Application Summary

<b>Modem (see Note 1)</b>	<b>1:1 L-Band Switch</b>	<b>1:1 Data Switch (see Note 2)</b>	<b>Other Information (see Note 3)</b>
CDM-600L	CRS-170	CRS-150	Firmware 1.1.4 or higher. Hardware Rev. 3 or higher
SDM-300L3	CRS-170	SMS-301	L-Band version of SMS-301
SNM-1001L	CRS-170	SMS-301	L-Band version of SMS-301. Refer to SDM-300L3.
SNM-1010L	CRS-170	SMS-301	L-Band version of SMS-301. Refer to SDM-300L3.

**Notes:**

1. Separate manuals describe the operation of the Data Switches.
2. Read preceding section, Introduction, for details.
3. Order modems with Type N connectors.





## Chapter 2. INSTALLATION



For correct operation of the CRS-170 with CDM-600L, the CDM-600L modems **must** have installed:

**Firmware Version 1.1.4 (or higher)**

**Hardware Revision 3 (or higher)**

If the modems do not meet this requirement, contact the factory for further instructions.

### 2.1 UNPACKING

Inspect shipping containers for damage. If shipping containers are damaged, they should be kept until the contents of the shipment have been carefully inspected and checked for normal operation.

Remove the packing list from the outside of the shipping carton. Open the carton and remove the contents, checking the contents against the packing list. Verify completeness of the shipment and that the unit functions correctly. If damage is evident, contact the carrier and Comtech EF Data immediately and submit a damage report. Be sure to keep all shipping materials for the carrier's inspection.

If the unit needs to be returned to Comtech EF Data, use the original shipping container.

## 2.2 MOUNTING

The CRS-170 is designed to be mounted in the rear of a rack containing the modems. Because of the module's small size and weight, one installation option is to let the module hang freely supported by the interfacing cables. Alternatively, a rack mounting kit (KT/10254) is available that allows the module to be mounted to the rack horizontally or vertically as shown in Figure 1. In applications with the CDM-600L and the CRS-150, the CRS-170 is best mounted horizontally above or below the CRS-150.

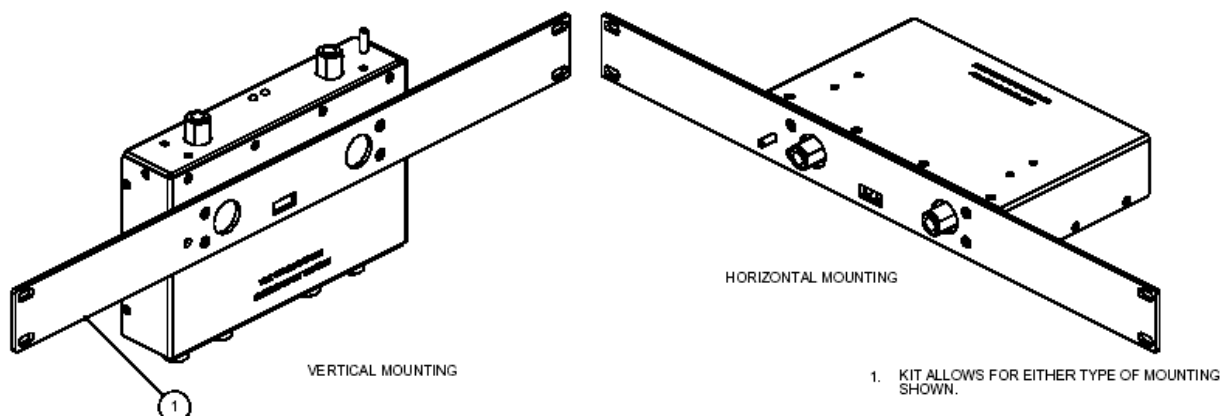
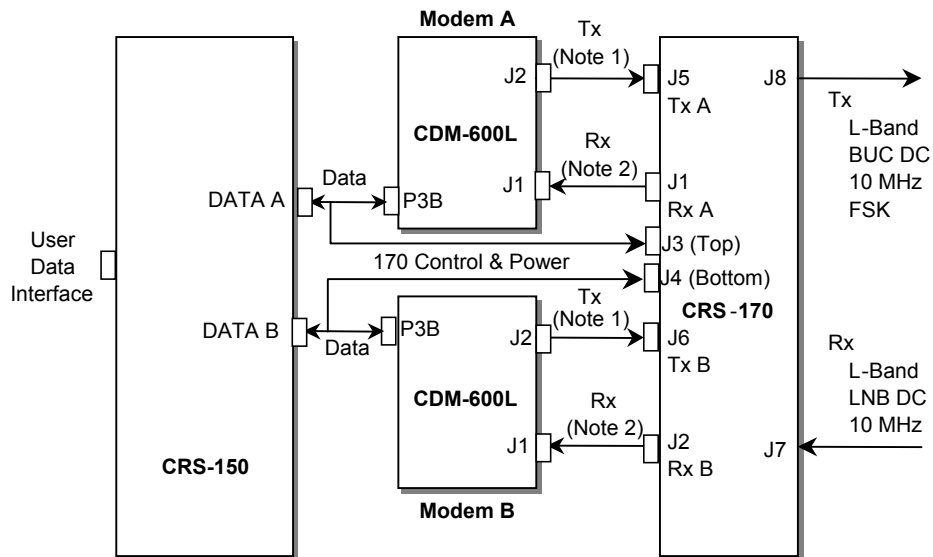


Figure 1. Rack Mounting Kits

## 2.3 CABLING WITH CDM-600L AND CRS-150

Figure 2 shows how to connect a pair of CDM-600L Modems together with the CRS-150 and CRS-170 switches.



Notes:

1. Carries Tx L - Band, BUC DC, 10 MHz and FSK
2. Carries Rx L - Band, LNB DC, 10 MHz

Figure 2. Connection Diagram, CDM-600L and CRS-150

The following table lists cable assemblies that may be supplied with the CRS-170 when used with the CDM-600L and CRS-150. Other cables between the CRS-150 and the CDM-600L modems are supplied with the CRS-150.

Quantity	Part #	Description
2	CA/WR10456-4	Data/Control Y Cable, DB25 Male to Male 4 ft, DB9 Male 1 ft
4	CA/6357-2	IF Coax Cable, 50Ω, length = 2 feet



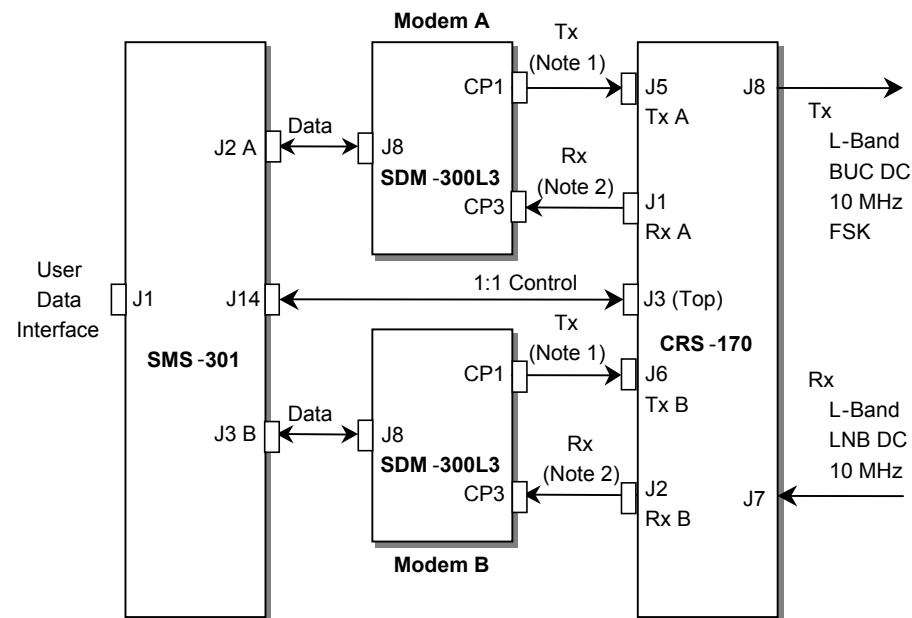
When connecting the Control cable between the CRS-170 and the modems, ensure that screw locks on the 'D' type connectors are securely fastened. This will prevent the accidental un-mating of the cable, particularly when a standby unit is being removed or replaced.

## 2.4 Cabling with SDM-300L3 and SMS-301

Figure 3 shows how to connect a pair of SDM-300L3 Modems together with the SMS-301 and CRS-170 switches. The same configuration applies to SNM-1001L and SNM-1010L.

The following table lists cable assemblies that may be supplied with the CRS-170 when used with the SDM-300L3 and SMS-301. The other cables between the SMS-301 and the SDM-300L3 are the same cables supplied with the SMS-301 in an SDM-300A application.

Quantity	Part #	Description
1	CA/WR10163-1	SMS-301 to CRS-170 Control, DB15 Male to DB9 Male 4 ft
4	CA/6357-2	IF Coax Cable, 50Ω, length = 2 feet



Notes:

1. Includes Tx L -Band, BUC DC, 10 MHz and FSK
2. Includes Rx L -Band, LNB DC, 10 MHz

Figure 3. Connection Diagram, SDM-300L3 and SMS-301



When connecting the Control cable between the CRS-170 and the SMS-301, ensure that screw locks on the 'D' type connectors are securely fastened. This will prevent the accidental un-mating of the cable, particularly when a standby unit is being removed or replaced.

## Chapter 3. FUNCTIONAL DESCRIPTION

The CRS-170 L Band 1:1 Switch module performs the transmit and receive coaxial switching required for redundant modem operation with an outdoor BUC and LNB. It switches all of the BUC and LNB interface signals that are multiplexed onto the transmit and receive coaxial cables:

- Tx and Rx L-Band signals
- 10 MHz reference to BUC and LNB
- DC Power to BUC and LNB
- FSK signaling to the BUC

Operation with two CDM-600L modems requires an additional CRS-150 1:1 switch for terrestrial data switching and 1:1 control, while operation with two SDM-300L3 modems requires an additional SMS-301 1:1 switch to handle terrestrial data and control. Thus, there are three functional configurations for the CRS-170.

### 3.1 OPERATION WITH CDM-600L AND CRS-150

The CRS-150 connects to two modems, an online unit, and a standby unit, monitors the fault status of these two units, and controls the routing of data to and from the two units. IF signals, 10MHz reference signals, DC power for the BUC and LNB, and FSK signaling to the BUC are switched in the CRS-170 under control of the CRS-150. In the case of an equipment failure, switching automatically takes place to protect the traffic circuit. At the heart of the CRS-150 is a Controller State Machine, which is responsible for fault monitoring and control of switching functions. It is implemented in a CPLD.

The CRS-150 redundancy switch derives its operating power from the two modems, online and standby, via extra power carrying wires in the data cable from each modem. Similarly, the CRS-170 derives its +12V power from both modems through Y-cable connection to the same cables. The required online and offline control signals are also included in these cables. A diode sharing arrangement with a current sharing circuit ensures that power is taken equally from the two modems in normal operation. In the event that one of the two units is removed, however, the remaining modem can supply all of the current requirement. The modems supply +12 volts DC (at a combined total of 400 mA max) and -12 volts DC (at a combined total of 120 mA max). Maximum power consumption occurs in a serial LVDS mode at maximum data rate (20 Mbps). Power consumption in EIA-232 modes is approximately 40% of the maximum values. The modem employs electronic fuses which prevent excessive current from being drawn by the CRS-150 should an anomalous condition occur.

Transmit Clock and Data signals entering the CRS-150 via the Data Interface are buffered and fed to both modems simultaneously. This parallel feed ensures that the standby unit sees the same traffic conditions as the online unit. Receive Data and Clock signals coming from the online modem are routed through signal relays to the Data Interface. In the event that a switchover occurs, these relays switch so the standby unit then supplies the Data and Clock signals.

As only one modem in the pair (the online unit) is permitted to transmit its IF carrier signal at any one instant, the standby unit is forced to disable its TX carrier by asserting the TX Carrier Off signal at the Data Interface. In addition, the CRS-170 provides further isolation (and security) by using an RF relay within the unit.

The Rx IF signal is fed to both modems simultaneously through the power divider in the CRS-170. This divider does introduce a loss of approximately 3.5 dB, but given the wide dynamic range of the demodulator in the CDM-600L, this is not considered to be a problem. The advantage of this scheme is that the demodulators in both online and standby units are locked, and therefore, if a switchover does occur, there will be no delay while waiting for the demodulator to acquire lock.

Fault status information is fed from each of the two modems via the Data Interface connector. The Controller State Machine in the CRS-150 decides, based on the fault status, whether the 'A' or 'B' unit is to be the online unit. It will assert a control signal to the standby unit, which mutes its Tx IF carrier, and simultaneously indicates to the microcontroller within the standby unit that the unit is no longer 'online'. Consequently, the 'online' LED on the front panel of the standby modem is extinguished, and the standby status is also reported over the remote control bus so an external M&C system can determine the state of the redundancy system. At the same time, a green LED will illuminate on the front of the CRS-150 to indicate whether the 'A' or 'B' unit is online, and a green LED on the antenna side of the CRS-170 will indicate the same status.

## **3.2 OPERATION WITH SDM-300L3 AND SMS-301**

The SMS-301 is modified from the standard version that operates with 70/140 MHz IF SDM-300A modems. The BNC IF connectors are removed since the connectors and internal switching are not suitable for L-Band operation. Signals on the Status/Faults connector (J14) are modified to provide +12VDC power output and A/B switch control outputs to the CRS-170. The SMS-301 has its own redundant power supplies, so the CRS-170 receives redundant power.

Operation here is similar to operation with two CDM-600L modems and a CRS-150 switch. The SMS-301 operates as the principal switch and controller with the CRS-170 providing the required switching for L-Band signals, references, and power supplies that the SMS-301 cannot handle. The SMS-301 connects to two modems, an online unit, and a standby unit, monitors the fault status of these two units, and controls the routing of data to and from the two units. IF signals, 10MHz reference signals, DC power for the BUC and LNB, and FSK signaling to the BUC are switched in the CRS-170 under control of the SMS-301. In the case of an equipment failure, switching automatically takes place to protect the traffic circuit. Consult the SMS-301 manual for detailed information on operation of the SMS-301. All operation as a 70/140 MHz modem switch applies except that the RF switching is done in the CRS-170.

For operation with the SNM-1001L or SNM-1010L, refer to sections pertaining to the SDM-300L3.





# Chapter 4. CONNECTOR PINOUTS

## 4.1 MODEM SIDE CONNECTORS

The modem side connectors provide all necessary external connections between the CRS-170 L-Band Switch Module and the CDM-600L/CRS-150, or SDM-300L3/SMS-301.



Name	Ref Des	Connector Type	Function
RX A	J1	Type N	RF Input to Modem A
RX B	J2	Type N	RF Input to Modem B
TX A	J5	Type N	RF Output from Modem A
TX B	J6	Type N	RF Output from Modem B
Control A	J3	9-pin D (female)	Control Interface with Modem A
Control B	J4	9-pin D (female)	Control Interface with Modem B



To maintain compliance with the European EMC Directive (EN55022, EN50082-1) properly shielded cables are required for data I/O.

Figure 4. Modem Side of Module

### 4.1.1 MODEM A CONTROL CONNECTOR

The Modem A Control connector is a 9-pin D female interface located on the modem side of the L-Band Switch Module. Refer to Table 2 for pin assignments. Pins 2, 3, and 4 carry signals looped through the switch module from Modem B to Modem A, while pins 6, 7, and 8 loop the same signals from Modem A through to Modem B. The 12VDC input, which is diode OR'ed with the corresponding 12VDC input from modem B, powers the switch module.

Table 2. J3A - Modem A Control Connector Pin Assignments

Pin #	Signal Function	Signal Name	Direction
1	Signal Ground	Ground	-
2	Modem B 232 Tx	AUX_SER_TX_B	Out
3	Modem B Online Indication	ONLINE_OUT_B	Out
4	Modem B Fault Indication	/FAIL_OUT_B	Out
5	Signal Ground	Ground	-
6	Modem A 232 Tx	AUX_SER_TX_A	In
7	Modem A Online Indication	ONLINE_OUT_A	In
8	Modem A Fault Indication	/FAIL_OUT_A	In
9	+12 VDC	+12VDC	In

## 4.1.2 MODEM B CONTROL CONNECTOR

The Modem B Control connector is a 9-pin D female interface located on the modem side of the L-Band Switch Module. Refer to Table 3 for pin assignments. Pins 2, 3, and 4 carry signals looped through the switch module from Modem A to Modem B, while pins 6, 7, and 8 loop the same signals from Modem B through to Modem A. The 12VDC input, which is diode OR'ed with the corresponding 12VDC input from modem A, powers the switch module.

Table 3. J3B - Modem B Control Connector Pin Assignments

Pin #	Signal Function	Signal Name	Direction
1	Signal Ground	Ground	-
2	Modem A 232 Tx	AUX_SER_TX_A	Out
3	Modem A Online Indication	ONLINE_OUT_A	Out
4	Modem A Fault Indication	/FAIL_OUT_A	Out
5	Signal Ground	Ground	-
6	Modem B 232 Tx	AUX_SER_TX_B	In
7	Modem B Online Indication	ONLINE_OUT_B	In
8	Modem B Fault Indication	/FAIL_OUT_B	In
9	+12 VDC	+12VDC	In

### 4.1.3 MODEM SIDE TYPE N CONNECTORS

There are four 50Ω Type N female connectors located on the modem side of the L-Band Switch Module. Refer to Table 4 for details.

Table 4. Modem Side Type N Connectors

Type N Connector	Reference	Description	Direction
RX A	J1	RX-IF signal LNB 10 MHz Ref LNB Power	Out In In
RX B	J2	RX-IF signal LNB 10 MHz Ref LNB Power	Out In In
TX A	J5	TX-IF signal BUC 10 MHz Ref BUC FSK Comm. BUC Power	In In In/Out In
TX B	J6	TX-IF signal BUC 10 MHz Ref BUC FSK Comm. BUC Power	In In In/Out In

## 4.2 ANTENNA SIDE CONNECTORS

Two 50Ω female Type N connectors on the antenna side of the CRS-170 L-Band Switch Module provide the coaxial cable connections to the outdoor transmit and receive equipment (BUC and LNB). Refer to Figure 5.



Type N Connector	Reference	Function	Direction
RX	J7	RF Input	In
		LNB 10 MHz Ref	Out
		LNB Power	Out
TX	J8	RF Output	Out
		BUC 10 MHz Ref	Out
		BUC FSK	In/Out
		Comm.	Out
		BUC Power	Out

Figure 5. Antenna Side Connectors and Ground Lug



# Chapter 5. SUMMARY OF SPECIFICATIONS

<b>Equipment Type</b>	L-Band 1:1 Redundancy Switch
<b>Manufacturer</b>	Comtech EF Data, Tempe, Arizona
<b>Modems Supported</b>	Comtech EF Data CDM-600L with CRS-150 1:1 Data Switch Comtech EF Data SDM-300L3 with SMS-301 1:1 Data Switch
<b>Operating Modes</b>	Fully Automatic under control of supporting 1:1 switch. Manual under control of supporting 1:1 switch.
<b>Architecture</b>	Full bridging architecture when supported by CRS-150, or SMS-301 data switching and control, with configuration synchronization. Tx redundancy supports all BUC interface signals (RF, 10 MHz reference, FSK communications, and power supply) Rx IF signal fed to both Online and Standby units. Rx switching supports all LNB interface signals (RF, 10 MHz reference, and power supply.)
<b>Switch Conditions</b>	Tx/Rx switching follows state of supporting data switching via control input from data switch.
<b>IF Switching/ Splitting</b>	Tx IF: Switched by RF relay (1 dB max loss, 40 dB min ON/OFF isolation) Rx IF: Passive power splitting (7 dB max loss)
<b>BUC Power Switching</b>	Switched by power relay (60VDC max, 4A max)
<b>BUC 10 MHz Reference Switching</b>	Switched by relay (1 dB max loss, 70dB min ON/OFF isolation)
<b>BUC FSK Comm Switching</b>	Switched by relay (70dB min ON/OFF isolation)
<b>LNB Power Switching</b>	Switched by power relay (28 VDC max, )
<b>LNB 10 MHz Reference Switching</b>	Switched by relay (1 dB max loss, 70dB min ON/OFF isolation)
<b>Tx-Rx Isolation</b>	90dB min, 950-1950 MHz
<b>IF Impedance</b>	Optimized for 50Ω (> 10 dB return loss on external IF ports)
<b>IF Connectors</b>	50Ω Type N Female
<b>IF Frequency range</b>	950-1950 MHz

<b>Weight</b>	1.75lbs (0.8kg)
<b>Dimensions</b>	1.75 H x 8.2 W x 5.3 inches (44.5H x 208.2W x 134.6 D mm (excluding connectors)) 19-inch rack mounting kit available.
<b>Power requirements</b>	1.5 Watts maximum + 12 volts DC @ 120 mA (max) (Power supplied by CDM-600L modems via CRS-150 data switch, or SMS-301 data switch)
<b>Approvals</b>	'CE' as follows: EMC Safety



## METRIC CONVERSIONS

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### Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	$6.214 \times 10^{-6}$	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	$1.578 \times 10^{-5}$	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	$1.893 \times 10^{-4}$	0.3048	—	—
1 yard	91.44	36.0	3.0	—	$5.679 \times 10^{-4}$	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	$6.214 \times 10^{-4}$	—	—	—
1 mile	$1.609 \times 10^5$	$6.336 \times 10^4$	$5.280 \times 10^3$	$1.760 \times 10^3$	—	$1.609 \times 10^3$	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

### Temperature Conversions

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

Formulas
$C = (F - 32) * 0.555$
$F = (C * 1.8) + 32$

### Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	$1.0 \times 10^3$	35.27	32.15	2.205	2.679	—



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