ΞC CODAN

RADIO COMMUNICATIONS

TECHNICAL NOTES

Technical Notes for
Tuning, Installing,
Maintaining and Servicing
MT-3 and MT-4 Radio Systems

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TN105 Dual Subrack Interconnection

The SR-39-1 subrack is designed to hold and interconnect the MT-3 and MT-4 series of receiver, transmitter and control modules on one universal motherboard. This motherboard distributes audio, control and power signals between the separate modules plugged into the subrack. The two main power signals used by the MT-3 and MT-4 modules are the +13.8 Vdc (power input) and +9.5 Vdc (regulated) power.

The +13.8 Vdc power input (+13.8 Vdc nominal, +10 to +17 Vdc range) is connected to the motherboard by a terminal strip mounted on the back of the subrack. The +13.8 Vdc signal line is routed through the System Regulator (SM-3) module and then distributed across the motherboard to the other modules. This allows the user to un-plug the SM-3 module and turn off all power supplied to the other modules. This feature is not used very often as all Codan modules are capable of being hot swapped.

The +9.5 Vdc regulated power is generated in the System Regulator module by the internal +9.5 Vdc voltage regulator built into the SM-3. This +9.5 Vdc regulated voltage is then distributed across the motherboard to the other modules. The voltage regulator is designed to source enough current to operate all modules in the subrack.

If a Codan radio system is designed so that a second subrack is required, the configuration is dependent on the modules in the second subrack:

a) If the second subrack requires receiver, transmitter or control cards, a system regulator is required in the second subrack to source enough current for the +9.5 Vdc regulated voltage to these modules.

b) If the second subrack contains only Codan 30 Watt power amplifier modules (see Figure 1), the +9.5 Vdc regulated voltage current draw for these modules is very low, and the SM-3 in the first subrack can source enough current for the power amplifiers in the second subrack. In this case, a second SM-3 module is not required, and the +9.5 Vdc regulated voltage is jumpered from the first subrack with the SM-3 to the second subrack with no SM-3 module.

The +9.5 Vdc regulated voltage is jumpered from one subrack to the other, using the +9.5 Vdc input / output connector on the motherboard. This connector is the same type as the +13.8 Vdc power input connector, but is used to connect +9.5 Vdc between a subrack with an SM-3 and a subrack with no SM-3.

The +13.8 Vdc power input is also connected to both subracks, but the second subrack has no SM-3 module installed (the +13.8 Vdc is typically routed through the SM-3). Jumper JU1 is required to be installed in the second subrack to allow +13.8 Vdc power input to be connected directly to the 30 Watt power amplifiers. Jumper JU1 is typically a 16 AWG wire soldered across the jumper points (see Figure 2 for jumper wires and JU1 placement). On older motherboards (Serial # 123125 and earlier) the jumper is in the same location, but is labelled as JU40.

If a radio system is ordered from the factory with this configuration, the jumper wires are included in the shipment and jumper JU1 is installed at the factory.

TN105 Dual Subrack Interconnection
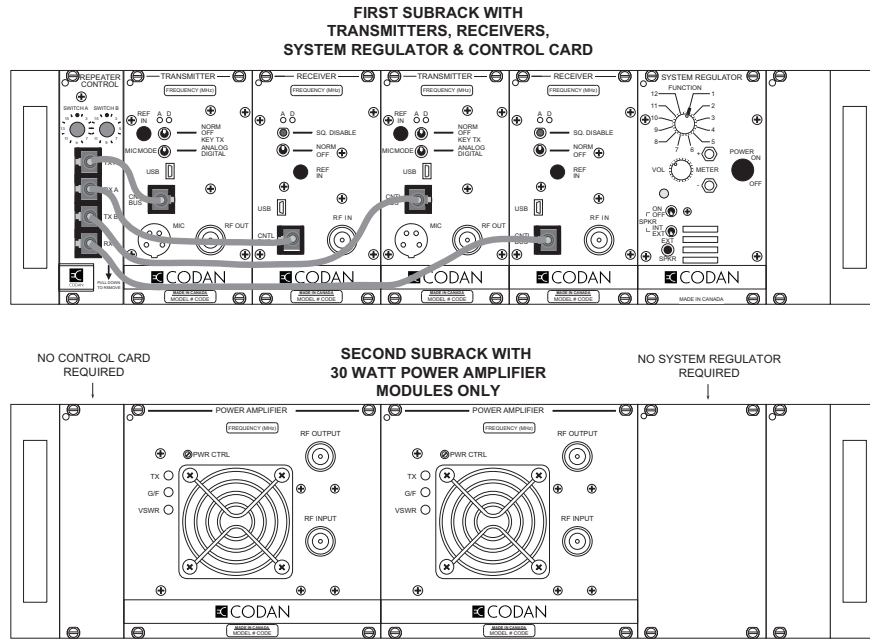
Figure 1 - Front View of Dual Subracks; Second Subrack has only Power Amplifiers
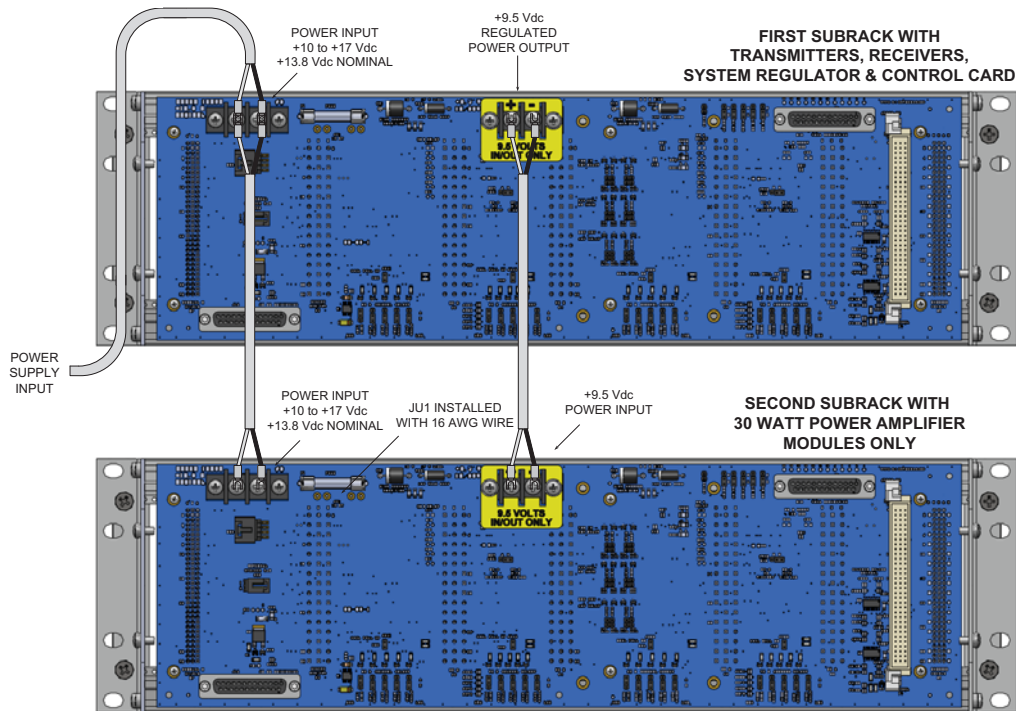
Figure 2 - Rear View of Dual Subracks; Jumper wires between first and second subrack

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TN110 Channel and Frequency Selection

MT-4E Channel and Bank Selection

MT-4E radio modules are capable of 16 channel operation in 2 banks (32 channels total).

The 16 channels are controlled via four CSEL signal lines connected to each receiver and transmitter module. The CSEL signal lines are set as either a 0 (0 Vdc) or a 1 (+9.5 Vdc). Table 1 shows the channel selected for the CSEL input settings.

Table 1: Channel Selection Settings

Channel	Decimal	CSEL3	CSEL2	CSEL1	CSEL0
1	0	0	0	0	0
2	1	0	0	0	1
3	2	0	0	1	0
4	3	0	0	1	1
5	4	0	1	0	0
6	5	0	1	0	1
7	6	0	1	1	0
8	7	0	1	1	1
9	8	1	0	0	0
10	9	1	0	0	1
11	10	1	0	1	0
12	11	1	0	1	1
13	12	1	1	0	0
14	13	1	1	0	1
15	14	1	1	1	0
16	15	1	1	1	1

The Receiver and Transmitter Bank A/B select lines are set as either a B (0 Vdc) or an A (+9.5 Vdc). The logic for the Bank A/B select lines is different from the CSEL signal lines. If the Bank A/B select line is pulled high (+9.5 Vdc), or left floating, Bank A is selected. If the Bank A/B select line is pulled low (0 Vdc), Bank B is selected.

On older motherboards (Serial # 123125 and earlier), the Receiver Bank A/B select line uses the same line as the MT-3 Receiver ISO COR K and the Transmitter Bank A/B select line uses the same line as the MT-3 Transmitter Standby. No jumpers are available for the Bank select.

TN110 Channel and Frequency Selection

There are 3 different ways to change the channel and bank of a transmitter / receiver module:

1 The user can set jumpers mounted on the motherboard for each Channel Select signal line (set of four for each Tx / Rx module) and Bank A/B select line. These jumpers can be used to permanently set a subrack slot at a specific channel and bank.
   • Jumpers can be set for 0 (0 Vdc) "down" or 1 (+9.5 Vdc) "up".
   • Pull-up resistor jumpers to +9.5 Vdc must be installed.

2 CSEL signal lines and Bank A/B select lines can be controlled externally by a tone remote adapter, a CI-RC-4M-G2 multiple link controller, or other third party devices.

3 Sixteen-position rotary select switches mounted on the CI-BC-4E base controller can control the CSEL lines and toggle switches can control the Bank A/B select line. Optionally the CI-RC-4L repeater controller or AC-3E control card can have a rotary switch added for control of the CSEL signal lines. The control lines can also be controlled by selecting the channel through a UIC control card.

The Pull-up resistor jumpers to +9.5 Vdc must be removed and all channel select and bank select jumpers must be installed in the 1 or "up" position for both external control and rotary switch control of channel selection.

MT-4 Modules Frequency Selection

The MT-4 modules operating frequency is selected in standard channel increments through the Radio Service Software (RSS). Frequencies can be directly entered or selected through the use of a spin button that cycles through valid frequencies.

Transmitter A Channel Select Switching Control Option

The motherboard can be jumper configured to allow switching control of the TXA CSEL lines between a control card and an external connection such as a tone remote.

Jumpers JU86 to JU93 are installed by default to allow either the A-PNL-AUX96-3 auxiliary connector, or AC-3E / CI-BC-4E / UIC-4 control cards to have control of the Transmitter A channel select lines. This will cause contention if both a control card and auxiliary connection attempt to change the channel select lines.

Switching control of the Channel Select lines can be selected by use of two General Purpose Inputs. GPIO22 and GPIO23 allow for the use of a connection to Ground to enable or disable local control.

GPIO22 - Ground disables local (AC-3E / CI-BC-4E / UIC-4) control & enables auxiliary control.
GPIO23 - Ground enables local (AC-3E / CI-BC-4E / UIC-4) control & disables auxiliary control.

To allow switching control of the channel select lines remotely, remove jumpers JU86 to JU93, and install jumpers JU94 to JU101, then install jumper JU102 or JU103 to determine if an active low will enable or disable the local control of the channel select control.

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TN110 Channel and Frequency Selection

Transmitter A Channel Select Switching Control Option Diagram
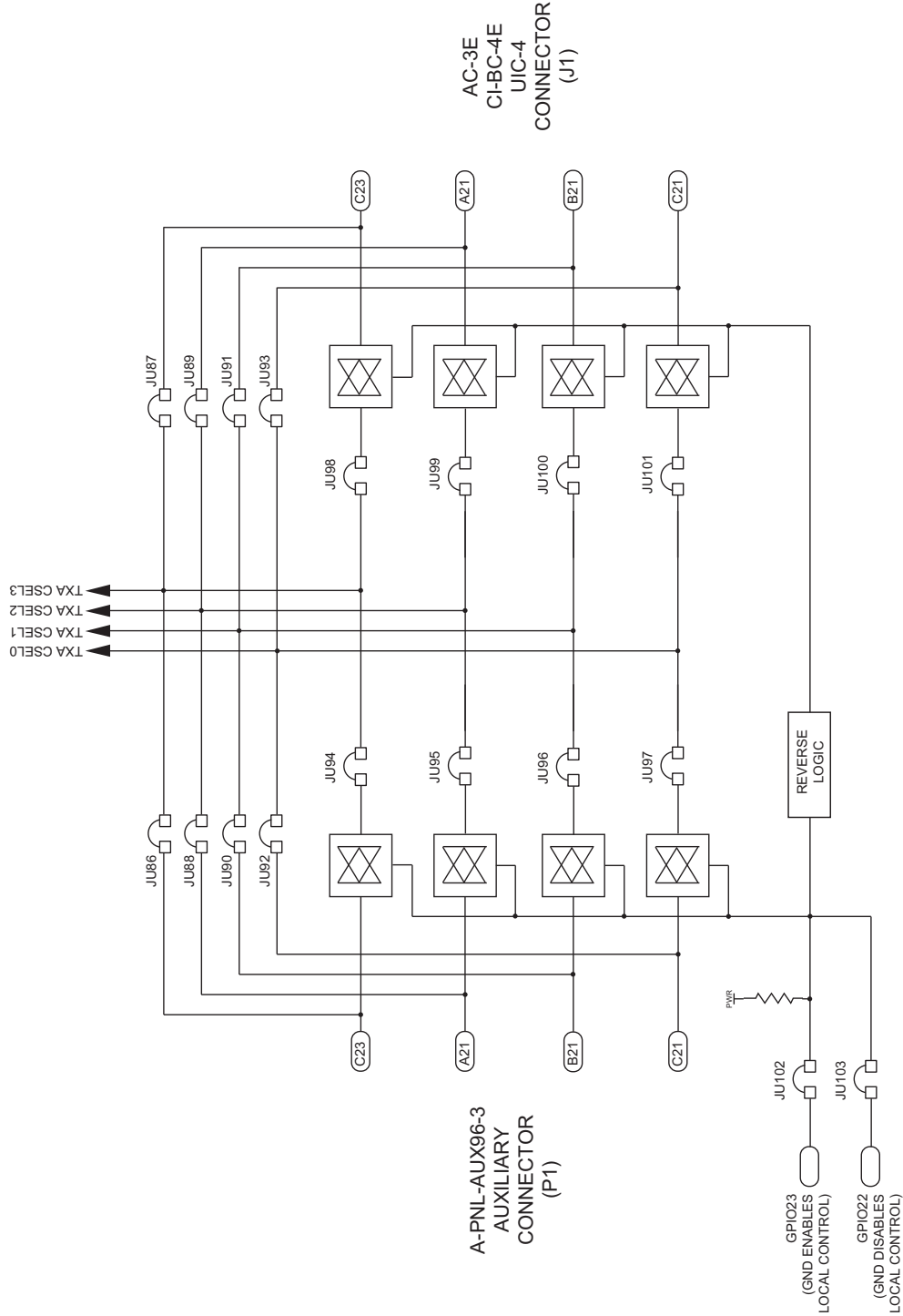
TN110 Channel and Frequency Selection

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CODAN
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TN150 Repeater / Tone Remote Controlled Base Station

A Codan radio system can be configured for a wide variety of radio system solutions. The large number of varied solutions and the customizability of the radio system makes for a wide variety of audio, serial data and COR-PTT routing configurations.

A repeater / analog controlled base station uses the LVDS serial data cable to allow full mixed mode (analog and P25 digital) repeating, while the analog audio is sent to and from the tone remote adapter via the AC-3E or CI-BC-4E control cards. This system can be configured as a "repeater only" by removing the control card or tone remote adapter. It can also be configured as a "tone remote controlled base only" by removing the LVDS serial data cable. If used as an analog repeater only, jumpers can be set in the control card to repeat audio and the LVDS serial data cable can be disconnected.

Connections to the tone remote adapter are typically made from the receiver and transmitter, through the control card to the adapter. Physical connections can be made on the A-PNL-AUX96-3 auxilairy connector, or the DB-25 connector (J10), both located on the back of the subrack.

Optionally, the receiver and transmitter can be connected directly to the tone remote adapter and bypass the control card. The control card should be removed from the subrack or unwanted loading could occur. The A-PNL-AUX96-3 auxiliary connector supports connection directly to the receiver and transmitter, and the DB-25 (J10) can be jumper selected to change the pins from Auxiliary Audio to Receiver / Transmitter Audio.

The tone remote adapter may also be replaced by an IP adapter, such as a Telex IP-223 or IP-224

DB25 Connector (J10)

Connector J10 is a female DB25 connector which can be used for basic base connections. When connected to a Telex DSP-223 or IP-223 / IP-224, a standard straight-through male-to-male DB25 cable can be used with some motherboard jumper changes. The IP-224 requires a female DB25 to male DB37 adapter. The IP-223 / IP-224 also requires that 2 pins on the DB25 (PTT COM - pin2 and MON COM - pin 16) are wired to ground for proper operation. The DB25 can also be jumpered for Balanced Audio direct to / from the receiver / transmitter or Auxiliary Audio (recommended) through the controller.

WARNING: JU108 must be configured correctly for DSP-223 or IP-223 / IP-224 or damage can occur.

JU104	A = RX A Bal O/P2 or B = AUX 1 AUD O/P2	JU107	A = RX A Bal O/P1 or B = AUX AUD O/P1
JU105	A = TX A Bal I/P2 or B = AUX 1 AUD I/P2	JU108	A = DSP-223 / +13.8 V or B = IP-223 & IP-224/ RX A COR
JU106	A = TX A Bal I/P1 or B = AUX 1 AUD I/P1	JU109	TX A SEC / CLR I/P (installed to enable TX A SEC / CLR I/P)

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TN150 Repeater / Tone Remote Controlled Base Station

1 KHz Tone @
60% of Max. Modulation
(1.5 KHz Narrowband
3.0 KHz Wideband)

RJ45 Cable
LVDS Serial Data +
Analog and Digital
COR-PTT Routing
(Required for P25
Digital Repeater)

1 KHz Tone @
60% of Max. Modulation
(1.5 KHz Narrowband
3.0 KHz Wideband)

TRANSMITTER

ANALOG LVDS
LEVEL ADJUST

RECEIVER

ANALOG LVDS
LEVEL ADJUST

PTT

COR

ALL INTERNAL CONNECTIONS
AVAILABLE ON A-PNL-AUX96-3
(TYPICALLY USED FOR TEST PURPOSES)
OPTIONALLY AVAILABLE ON DB-25
CONNECTOR (VIA JUMPER SELECT)

TX PTT INPUT

TX BALANCED
AUDIO INPUT

-8.0 dBm
(307 mVrms)

RX COR OUTPUT

RX BALANCED
AUDIO OUTPUT

-8.0 dBm
(307 mVrms)

AC-3E or CI-BC-4E

OPTICAL
ISOLATOR

COR->PTT
Jumper
(Must NOT
be used
with RJ45
Cable
Installed)

Jumper Installed
to Disable
Audio Path
(Must be used
with RJ45 Cable
Installed)

AUXILIARY
PTT (K) INPUT

AUXILIARY
BALANCED
AUDIO INPUT

0 dBm
(775 mVrms)

AUXILIARY
BALANCED
OUTPUT

0 dBm
(775 mVrms)

ALL AUXILIARY CONNECTIONS
AVAILABLE ON A-PNL-AUX96-3
and DB-25 CONNECTOR

TELEX (VEGA) DSP-223
TONE REMOTE ADAPTER

PTT

RADIO
TX

LINE
RX

RADIO
RX

LINE
TX

2 or 4 WIRE
LINE
INPUT / OUTPUT

TO / FROM
TONE REMOTE
CONSOLE

TN151 Base Station Interface Connections

Base Stations can be interfaced to a console, or console network through a variety of technologies that have changed considerably over the years.

Analog Tone Remote Interface

An Analog Tone Remote Interface provides a means of remotely controlling base stations by any voice grade transmission medium such as a microwave link, a leased telephone line, or a twisted-pair 600-ohm line. An industry-standard sequential tone keying format is generated by the console and is sent over the transmission medium to a tone remote adapter that is capable of decoding the PTT tone sequence and the voice-plus-tone signals. The tone portion of the voice-plus-tone signal is removed from the transmitted voice by the adapter. A tone remote base station interface is shown in Figure 1.
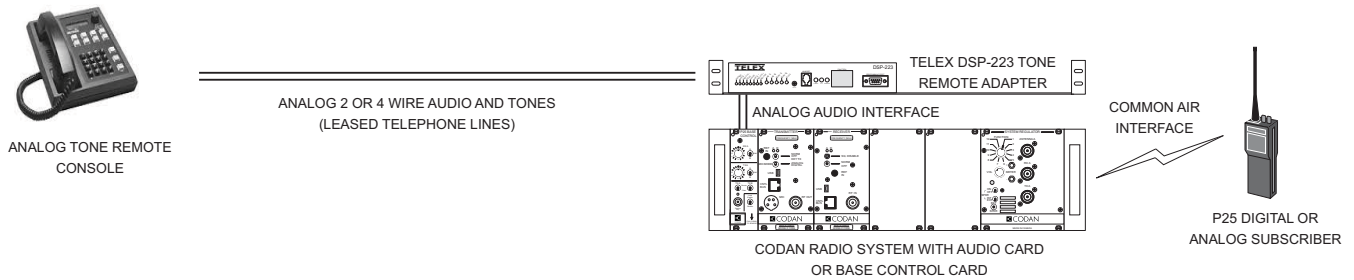
Figure 1: Analog Tone Remote Interface

IP Network Remote Interface

An IP Network Remote Interface provides a means of remotely controlling base stations by any available Wide Area Network (WAN) or Local Area Network (LAN) IP connection. This creates a Radio over IP (RoIP) network to allow any Telex IP based console to communicate with the Telex IP Network adapter. Audio and control information is encoded and decoded in a proprietary format over the network and converted back to analog audio and control information (PTT) at the interface between the base station and adapter. The Telex IP network solution provides voice and control over IP, but it is not end-to-end digital, or open standard. An IP network remote base station interface is shown in Figure 2.

Figure 2: IP Network Remote Interface

In an analog tone remote and IP network remote, all P25 Digital communications are vocoded and de-vocoded at the base station. This means that the interface does not support end-to-end encryption, P25 Digital ID's or packet data, to or from the console and base station.

TN151 Base Station Interface Connections
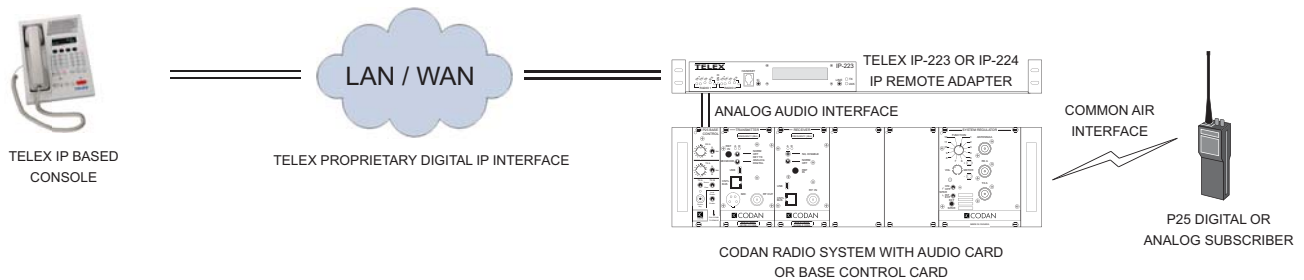
Proprietary IP Network Interface

A Proprietary IP Network Interface provides a means of remotely controlling **one manufacturer's** base stations by any available WAN or LAN IP connection. This creates a single vendor end-to-end digital RoIP network that restricts interoperability, system flexibility and competition. A proprietary IP network remote base station interface is shown in Figure 3.

MOTOROLA CENTRACOM
GOLD ELITE CONSOLE

MOTOROLA PROPRIETARY DIGITAL IP INTERFACE

LAN / WAN

MOTOROLA QUANTAR

COMMON AIR
INTERFACE

P25 DIGITAL OR
ANALOG SUBSCRIBER
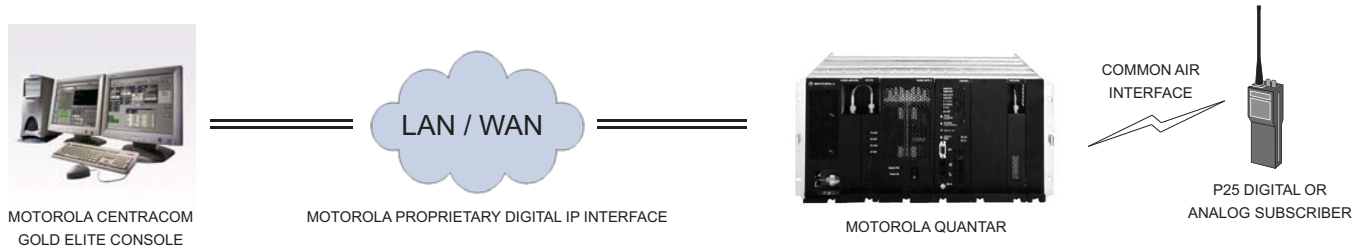
Figure 3: Proprietary IP Network Interface

P25 Open Standard Digital Fixed Station Interface (DFSI)

A P25 Open Standard Digital Fixed Station Interface (DFSI) provides a means of remotely controlling base stations by any available WAN or LAN IP connection. This creates a multi-vendor platform end-to-end digital RoIP network that supports full interoperability, system flexibility and competitive pricing between vendors. A DFSI interface fully supports end-to-end encryption, P25 Digital ID's and packet data, to or from the console and base station. A DFSI network remote base station interface is shown in Figure 4.

P25 DFSI CONSOLE

LAN / WAN

P25 DIGITAL FIXED STATION INTERFACE

CODAN RADIO SYSTEM WITH UIC

COMMON AIR
INTERFACE

P25 DIGITAL OR
ANALOG SUBSCRIBER

Figure 4: P25 Open Standard Digital Fixed Station Interface (DFSI)

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TN160 Base Station or Link Configuration Settings

When configuring a Codan radio system for base station operation or for a linked configuration, certain settings, such as jumpers, may need to be installed to allow the base station or link to operate properly.

The receiver and transmitter modules are used with specific control cards to facilitate the external connections of a base station, or to allow the complex connectivity of a linked system. The MT-3 modules are connected to an AC-3E Audio Control Card and the MT-4 modules are connected to a CI-BC-4E Base Controller for base station operation, or a CI-RC-4L Repeater Controller or CI-RC-4M-G2 Multiple Link Controller for a linked system. The A-PNL-AUX96-3 auxiliary connector is recommended for facilitating all external connections in a base configuration.

Antenna Relay Activation

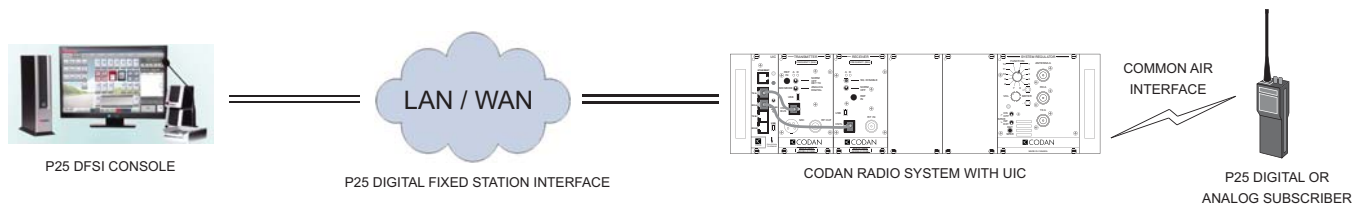The System Regulator module may have up to two optional antenna relays installed that can be used for a base station or simplex / half-duplex link configuration. The antenna relays are labeled as Relay A and Relay B (if only one relay is installed, it is Relay A). The motherboard on the subrack contains a set of jumpers that are used to activate the optional antenna relays in the System Regulator module. The relays are typically set with the PTT IN and PTT OUT signal lines activating the relays.

Jumpers function as follows:

JU36	Tx A PTT OUT activates Relay A	JU37	Tx A PTT IN activates Relay A
JU39	Tx A PTT OUT activates Relay B	JU40	Tx A PTT IN activates Relay B
JU42	Tx B PTT OUT activates Relay A	JU43	Tx B PTT IN activates Relay A
JU45	Tx B PTT OUT activates Relay B	JU46	Tx B PTT IN activates Relay B

On older motherboards (Serial # 123125 and earlier) the jumpers were as follows:

JU16	Tx A PTT OUT activates Relay A	JU12	Tx A PTT IN activates Relay A
JU14	Tx A PTT OUT activates Relay B	JU10	Tx A PTT IN activates Relay B
JU15	Tx B PTT OUT activates Relay A	JU11	Tx B PTT IN activates Relay A
JU13	Tx B PTT OUT activates Relay B	JU9	Tx B PTT IN activates Relay B

Simplex Operation

The motherboard on the subrack contains a set of jumpers that are enabled when the radio system is operated in simplex mode (simplex base station or simplex links). The jumper connects the Transmitter PTT OUT signal line to the RX MUTE. This jumper will cause the receiver to mute when the transmitter is keyed.

JU38	Tx A PTT OUT mutes Rx A	JU41	Tx A PTT OUT mutes Rx B
JU44	Tx B PTT OUT mutes Rx A	JU47	Tx B PTT OUT mutes Rx B

The new System Regulators also have the same simplex mode jumpers for backwards compatibility with older motherboards that did not have these jumpers. The jumpers were located on the old System Monitor as follows:

JU12	Tx A PTT OUT mutes Rx A	JU13	Tx B PTT OUT mutes Rx B

TN160 Base Station or Link Configuration Settings

CI-RC-4M-G2 Simplex Operation

The CI-RC-4M-G2 Multiple Link Controller can also be set for simplex link operation in the software under the System Settings tab, but requires the MUTE line to be connected from the subrack to the controller.

Simplex Operation Improvement

On some simplex base or link systems, the Rx MUTE line may be released too quickly after the Tx PTT is deactivated. The RF signal has not had enough time to decay before the receiver is un-muted and this can produce an audible noise burst or blip at the end of each transmission.

MT-3 Systems require that two resistors within the receivers be replaced with 47K ohm resistors (1150-4B1002FP). R95 and R96 require replacement in FM receivers. AM receivers require that R35 and R83 are replaced.

MT-4E Systems have a software selectable Simplex Unmute Delay jumper setting that can be enabled in the RSS software Service section.

MT-4D Systems require that JU33 is installed in the Y position in the receivers.

MT-4R Systems require a 4.7 uF capacitor (1055-5B475K16) to be added to the PTT OUT signal line. This modification was part of ECO 758. Any transmitters that were sold before, and have not been returned to the factory since March 2003, will require this modification for simplex operation.

MT-4R or MT-4D Base Station with Telex (Vega) DSP-223 Control

If an MT-4R or MT-4D base station is operated by a console other than a Telex product, through a Telex DSP-223 tone remote adapter, there is a possibility the transmitter may not change channels properly (only changing channels every second time the PTT is activated at the console).

If the MT-4R or MT-4D system is being controlled by a CI-BC-4E Base Controller, JU125 is required to be installed in the controller.

If the MT-4R or MT-4D system is being controlled by an AC-3E Audio Control Card (not recommended), a 22 uF capacitor (1054-6G226M20) is required to be added by soldering the positive lead to J23 and the negative lead to ground.

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Victoria, B.C.	Phone:	1-800-664-4066		Phone:	250-382-8268	Email:	LMRsales@codanradio.com
Canada V8V 1P8	Fax:	1-877-750-0004		Fax:	250-382-6139	Web:	www.codanradio.com

TN175 MT-4E Firmware Upgrading

Codan Radio Communications allows customers to upgrade the firmware of their MT-4E Receivers and Transmitters via the Firmware Flashing Software and Firmware Upgrade files. The Firmware Flashing Software and Firmware upgrade files are all available at the Codan website www.codanradio.com under Support - Software & Firmware.

It is not necessary to upgrade the firmware if the equipment is installed and is operating satisfactory. A firmware upgrade is typically only needed to fix minor software bugs or to upgrade the functionality of the equipment.

Firmware versions earlier than 1.6.0 must be returned to the factory for upgrading. Firmware version 1.6.0 and 1.7.0 may need to be returned to the factory for minor hardware upgrades. Contact the Codan service department for more information.

Instructions

Please read all of these instructions before beginning the Firmware Flashing process.

Download the Firmware Flashing Software and appropriate Firmware upgrading files to a PC running a Windows XP (or higher) operating system before beginning the upgrading procedure.

Choosing the Appropriate Firmware Upgrading Files

MT-4E Receivers and Transmitters can be purchased as an analog radio, or they can be purchased with the P25 Digital radio firmware package. If the radio is Analog only, download the Analog firmware upgrade, if it is P25 Digital (and Analog) capable, download the Digital firmware upgrade. To determine if the MT-4E Receiver or Transmitter is Analog only or P25 Digital, read the firmware version of the module using the Firmware Flashing Software or the Radio Service Software as shown in Figure 1. If the last digit of the firmware version is an "a" or "0", the firmware is Analog only, if the last digit is a "d" or "1", the firmware is P25 Digital and Analog.

NOTE: The Firmware Flashing Software will not allow you to program an MT-4E Receiver or Transmitter with the wrong firmware upgrade

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Figure 1: Version Number Examples

TN175 MT-4E Firmware Upgrading

Download the latest firmware version (Analog or Digital) from the website for both the receiver and transmitter. If the current firmware version of the MT-4E Receiver or Transmitter is 1.6.0 or 1.7.0, an additional Bootloader and Version 2.0.0 firmware (Analog or Digital) will also need to be downloaded.

Using the Firmware Flashing Software

Start the Firmware Flashing Software application and turn on the MT-4E Receiver or Transmitter. Using a USB type A to 5 pin mini-type B cable (the same USB cable used to program the modules), connect the USB port of the PC to the USB port on the front panel of the MT-4E Receiver or Transmitter module as shown in Figure 2.
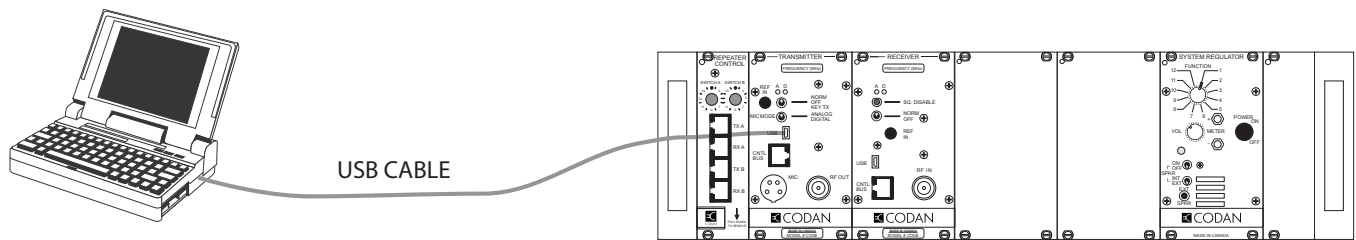
Figure 2: PC to Radio USB Connection

An information window will appear stating that the existing firmware in the radio is out of date and needs to be upgraded. Click OK to close this window.

If the current firmware version of the MT-4E Receiver or Transmitter is 1.6.0 or 1.7.0 a Bootloader dialog box will appear. See the section on upgrading Firmware version 1.6.0 and 1.7.0. If the current firmware version is 2.1.0 or higher, the Firmware Flashing Software can upgrade the firmware immediately to the next firmware version without the Bootloader.

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Victoria, B.C.	Phone:	1-800-664-4066	Phone:	250-382-8268	Email:	LMRsales@codanradio.com
Canada V8V 1P8	Fax:	1-877-750-0004	Fax:	250-382-6139	Web:	www.codanradio.com

TN175 MT-4E Firmware Upgrading

Flashing the Firmware

To apply the firmware upgrade (or Bootloader), click on File - Open and navigate to the directory where the firmware upgrades are stored on your PC. Load the appropriate update file (Transmitter / Receiver; Analog only / Digital and Analog; Bootloader / Firmware Version) as shown in Figure 3.
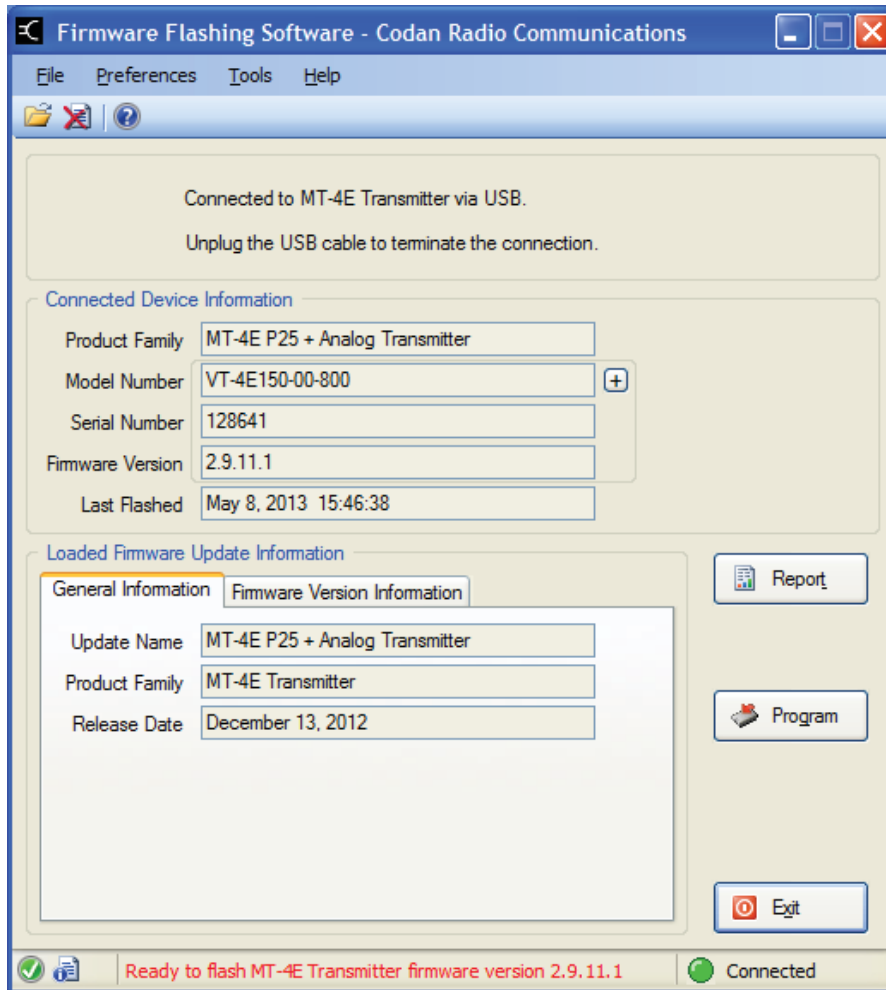

Figure 3: Firmware Flashing Software Example.

Click on the Program button to start the firmware update process. A dialog box will appear asking confirmation to proceed with the firmware update. A dialog box will also appear cautioning against interrupting the flashing process in any way while the firmware is being updated. This is very important as any interruptions could cause the firmware in the radio to be corrupted. Click on OK to proceed with the firmware update.

At the conclusion of the update the radio may need to be manually reset by cycling power to the module.

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RADIO COMMUNICATIONS

TN175 MT-4E Firmware Upgrading

Upgrading Firmware version 1.6.0 and 1.7.0

If the current firmware version of the MT-4E Receiver or Transmitter is 1.6.0 or 1.7.0, a dialog box will appear as shown in Figure 4, warning that the firmware is out of date and will require the Bootloader.

Figure 4: Version 1.6.0 and 1.7.0 Warning Dialog Box

Once the Bootloader is applied, the module's firmware will appear as version 0.0.0. Firmware Version 2.0.0 is required to be installed next and a dialog box will appear as shown in Figure 5.

Figure 5: Bootloader Warning Dialog Box

When installing Version 2.0.0, another dialog box will appear as shown in Figure 6, warning that the Bootloader must have been applied before proceeding.

Figure 6: Version 2.0.0 Warning Dialog Box

Bringing the MT-4E Receiver or Transmitter module up to Firmware Version 2.0.0 is a two-step process, which is required in order to apply any further firmware upgrades. Once this two-step process is completed, it will not be required again. Firmware Version 2.0.0 is a "blank" firmware version and must be upgraded to the latest firmware in order for the module to operate.

TN180 P25 Digital Ping Feature

A conventional radio system requires the users to set the subscriber radio on the frequency pair of the nearest repeater by manually turning the channel selector knob. This requires more training and attention on the part of the radio user.

Subscriber radios can be programmed to scan the repeater transmit frequencies to lock onto the repeater when it is transmitting. Standard scanning results in the subscriber selecting and using the first channel in the scan list it finds an active (transmitted) signal. Since the repeater talk-out range is generally greater than the subscriber talk-in range, standard scanning does not always result in the optimal channel (typically the closest repeater) for the subscriber to operate on.

In Vote Scan operation, each channel is qualified by measuring the received signal strength of each repeater at the subscriber radio. The subscriber then votes from the repeater sites, selecting either the best signal or the first signal that exceeds a pre-programmed received level threshold.

In order to keep the subscriber locked onto the best (typically closest) repeater site when the subscriber is keyed, the repeaters need to have traffic on the transmitter regularly. Since the radio users may not have consistent radio traffic, a Codan repeater can be programmed to ping after an inactive time interval allowing the vote-scanning subscriber radios to lock onto the best repeater. The ping uses the P25 standard "silent" message, so that users will not hear the radio traffic, but it will activate the vote-scan capability in the subscriber.

The optional digital ping software timer is configured to key the transmitter after a specified time (interval) with no activity, with a message of programmable duration (length) as shown in Figure 1.
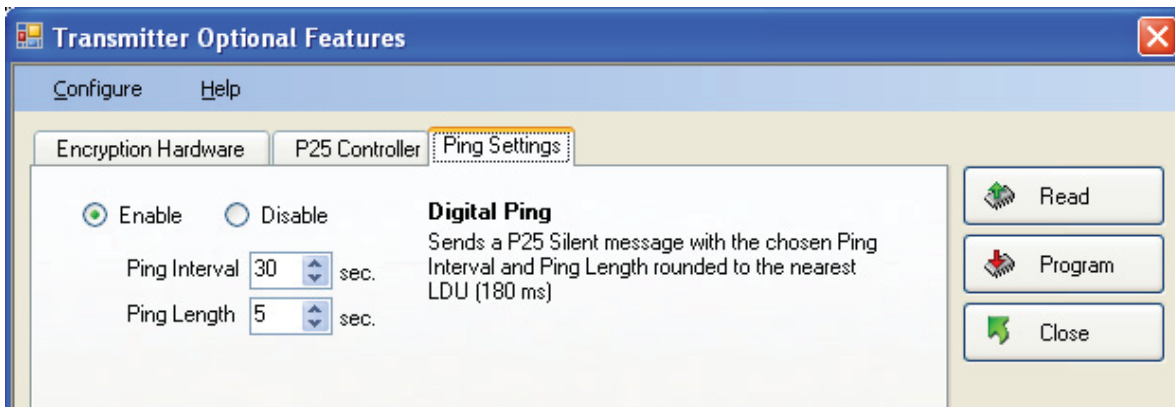

Figure 1: Optional P25 Digital Ping Feature

Ping Interval range: 10 sec to 120 secs.
Ping Length: 1 sec to 15 secs (rounded to nearest LDU length – 180 mS)
The maximum Ping Length is less than 50% Ping Interval. e.g. Ping length < 5s if Ping interval set to 10s.

Setting the Ping Interval to a small value and the Ping Length to a large value will cause excessive network traffic.

TN180 P25 Digital Ping Feature

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EC CODAN
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TN181 Adjustable Courtesy Tone

An Adjustable Courtesy Tone option allows customization of the courtesy tone transmitted at the end of an analog or P25 Digital transmission. The Adjustable Courtesy Tone is available in addition to the Fixed Courtesy Tone implementation. The Radio Service Software (RSS) allows selection of either the fixed or Adjustable Courtesy Tone. If the Adjustable Courtesy Tone feature is disabed, the hang timer / courtesy tone will revert to it's previous (older firmware) method of programming and operation. This selection is made under Service->Courtesy Tone.

The Adjustable Courtesy Tone feature requires transmitter firmware version 2.10.9 (or higher) and RSS version 1.7.6 (or higher).
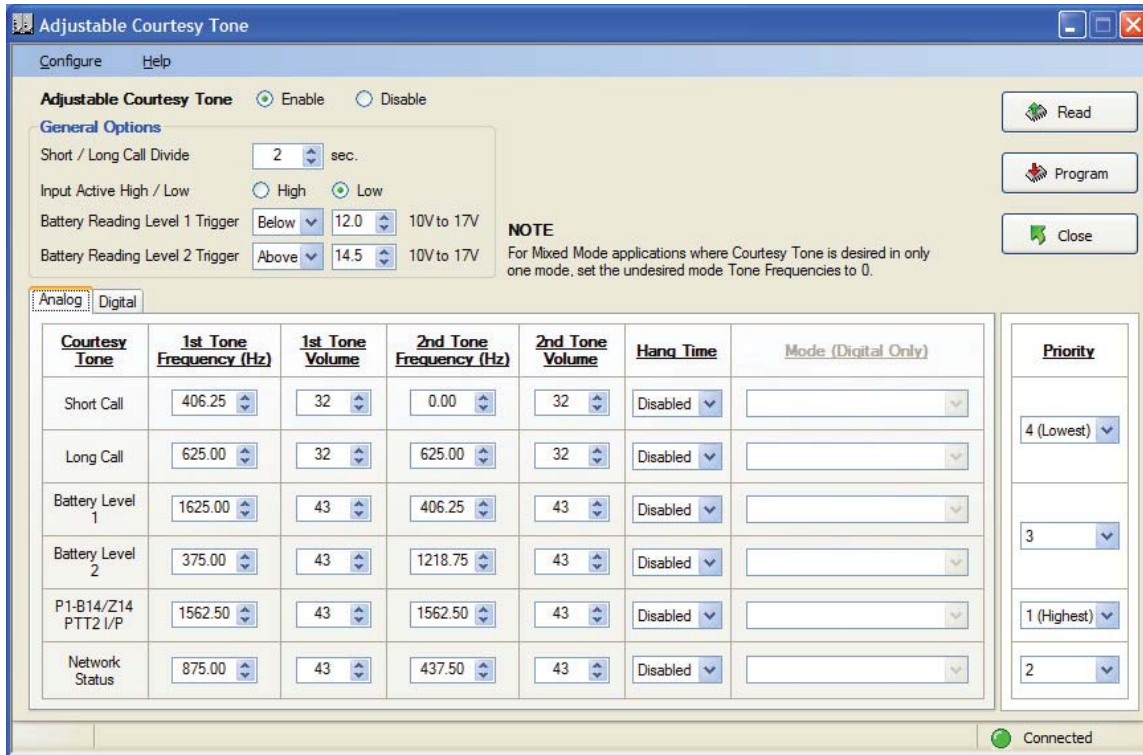

Figure 1: Adjustable Courtesy Tone

With the Adjustable Courtesy Tone, users may set different courtesy tone settings for the following scenarios:

• transmission is shorter than a user programmable length
• transmission is longer than a user programmable length
• 13.8 Volt line (Supply Voltage) is below (or above) user programmable threshold #1.
• 13.8 Volt line (Supply Voltage) is below (or above) user programmable threshold #2.
• Courtesy Tone when input pin B14 or Z14 on the Transmitter module is asserted.
   This is the MT-3 PTT NTO pin. Accessible as J1-3 (TX A PTT) for TXA and J1-11 (TX B PTT) for TXB on the back panel Auxiliary connector (P1). Also, JU21 must be installed in the A position for TXA and JU20 must be installed in the A position for TXB.
• Loss of Network condition

TN181 Adjustable Courtesy Tone

Setting the Adjustable Courtesy Tone

The priority level of each scenario can be independantly selected, or any scenarios can be individually disabled. The priority arrangement must be the same for both analog and P25 digital mode.

The courtesy tone operation consists of 2 tones. Both tones can be programmed the same or differently or as silent.

To have a silent tone in analog mode, simply set the volume of the tone to "0" or set the tone to 0 Hz. To have a silent tone in P25 digital mode, set the tone frequency to 0 Hz.

The courtesy tone generated in analog mode is done after the pre-emphasis stage of the signal processing chain of the transmitter. Therefore it will always come out as flat audio response. Separate volumes controls are provided for the first and second tones in cases where the listening receiver is using de-emphasis.

In P25 mode, the following hang time behaviors are offered:

• Silent Voice Frame Only
• Silent Voice Frame + Tone
• Simple Terminator Data Unit only (typically used for P25 encrypted calls)
• Simple Terminator Data Unit + Tone (typically used for P25 encrypted calls)

Sample tone setup for the Adjustable Courtesy Tone:

- Set the "Adjustable Courtesy Tone" option to 'Enable'.
- Set the "Battery Reading Level 1 Trigger" to the low voltage trigger point. Such as 10 Vdc
- Set the "Battery Reading Level 2 Trigger" to the High voltage trigger point. Such as 17 Vdc
- In the Analog table set the two tones and level for the Battery Level 1 and 2.
- Set the Priority to 1 and all other priorities to 0 if the other settings are not used.

The transmitter will now send a two tone at the end of a transmission if the voltage goes below or above the indicated voltage trigger point.

TN182 Battery Level Reporting and Remote P25 Test Tone

Battery Level Reporting is a method of activating a repeater remotely to have it transmit a signal that reports the battery voltage level over RF. The Remote P25 Test Tone is a remotely activated Standard 1011 Hz P25 test tone transmitted out of a repeater that allows a mobile coverage test to be done with a receiver performing a P25 Bit Error Rate test.

Both the Battery Level Reporting and Remote P25 Test Tone are only available in a repeater configuration with a receiver connected to a transmitter through the front panel RJ45 Control bus. It can be a direct connection, or through a CI-RC-4L repeater controller or a CI-RC-4M-G2 Multiple Link Controller. The Battery Level Reporting and Remote P25 Test Tone are activated by a DTMF signal sent over RF to the repeater receiver.

The Battery Level Reporting and Remote P25 Test Tone features requires transmitter firmware version 2.10.9 (or higher), receiver firmware version 2.9.8 (or higher) and RSS version 1.7.6 (or higher).

Battery Level Reporting

When the receiver receives a DTMF code of ##**123** (or any three-digit programmed ID code), it will initiate the transmitter with the corresponding three digit value (ID code of **123)** to key up and transmit the battery level.

• The battery level is measured internally by the transmitter every two seconds.

• The battery reporting transmission can be stopped by another PTT from a subscriber radio.

• A DC offset adjustment (of the 13.8V line reading) is required for each transmitter. The procedure of this adjustment is described in Battery Level Reporting DC Offset Adjustment Procedures.

Analog Mode

In analog mode, an audio tone that corresponds to the battery level of the repeater system is transmitted. For example, a 1380 Hz tone transmitted over the air corresponds to a battery level of 13.80 Vdc.

• The duration of the reporting transmission is user programmable but has to be at least ten seconds.

• The deviation of the analog tone can be adjusted in the software as the tone volume.

P25 Digital Mode

In P25 digital mode a DTMF tone sequence that corresponds to the battery level of the repeater system is transmitted. The battery level reporting is a DTMF tone sequence in the following format (in P25):

• Example - **B125A123**

• **B** marks the beginning of the battery level.

• The three 0 to 9 digits make up the battery level reporting.

• **B125** means battery level of 12.5 Vdc

• **A** marks the beginning of the ID code of the transmitter reporting the battery level.

• The three 0 to 9 plus A, B, C, D digits is the ID code of the transmitter that reported the battery level.

• The number of times the battery report string transmits is user programmable but has to be at least two times.

• The duration of the silent P25 frame gap between each DTMF sequence is user programmable.

• The P25 Digital DTMF tone sequence volume can be adjusted in the tone volume.

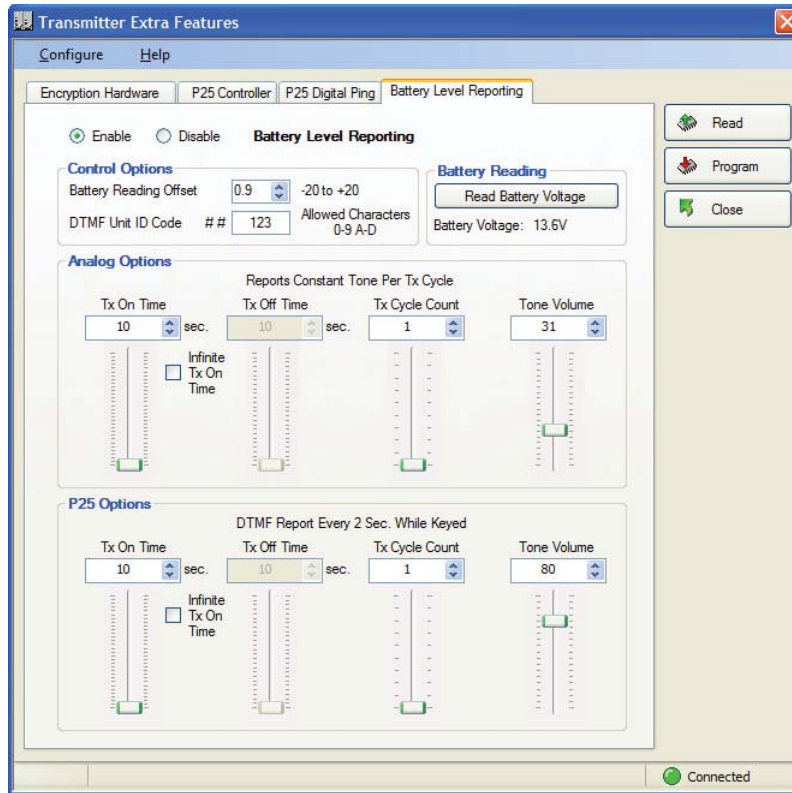# TN182 Battery Level Reporting and Remote P25 Test Tone

Figure 1: Transmitter Battery Level Reporting

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TN182 Battery Level Reporting and Remote P25 Test Tone

Remote Keying of 1011 Hz P25 Test Tone

This feature is only applicable to P25 digital mode. When the receiver receives a DTMF code of ****123** (or any three-digit programmed ID code), it will initiate the transmitter with the corresponding three digit value (ID code of **123)** to key up and transmit the 1011 Hz P25 Test Tone.

• ** marks the beginning of a DTMF command code for requesting remote keying of 1011 Hz test tone in P25 mode.
• The three 0 to 9 plus A, B, C, D digits is the ID code of the transmitter being requesting to do the remote keying of 1011 test tone.
• The duration of the 1011 Hz P25 test tone transmission is user programmable (can be set to infinite).
• The 1011 Hz P25 test tone transmission can be stopped by another PTT from a subscriber radio.
• The pattern being generate is the Standard Tone Test Pattern as per TIA-102.CAAA Section 1.3.3.7 a).
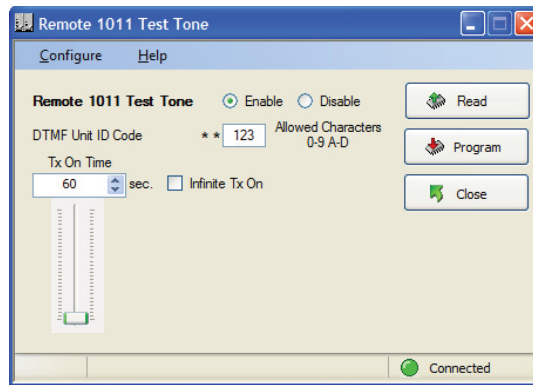• This feature must be enabled via RSS for both the receiver and transmitter.

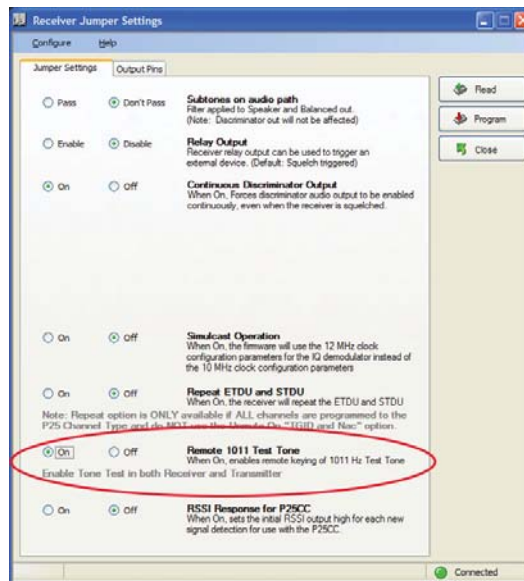*Figure 2: Transmitter Remote 1011 Test Tone*

Figure 3: Receiver Remote 1011 Test Tone

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TN182 Battery Level Reporting and Remote P25 Test Tone

Subscriber DTMF Requirements

In P25 digital mode, the subscriber is required to have the capability to generate DTMF in P25 Digital mode (not all P25 equipment supports this capability).

In analog mode the DTMF implementation can vary between different models of subscriber. As a consequence, the analog DTMF decoder of each repeater receiver is required to be tuned to work with a particular subscriber model. The procedure for this adjustment is described in the Receiver Analog DTMF Decoder Alignment Procedures.

More than one subscriber manufacturer / model may work, but to guarantee the best operation the most common subscriber should be used to tune this feature. This is an issue with subscribers that Codan tries best to accommodate.

The subscriber and repeater also need to match the use of pre/de-emphasis or flat audio.

Battery Level Reporting DC Offset Adjustment Procedures

Tools Required:

DC volt meter
RSS version 1.7.6 or later

Steps:

1. Power up the transmitter.
2. Make sure the transmitter is not transmitting (keyed).
3. Connect to RSS via a USB cable.
4. Navigate to Service -> Extra Feature -> Battery Level Reporting (Tab)
5. Enable (and program) Battery Level Reporting if it is not already enabled.
6. Have the DC volt meter monitor the 13.8V line of the transmitter. Monitor this voltage where you would like the battery reading to be taken from, for example, via the System Regulator (Monitor).
7. Click Read 13.8V line Button.
8. Adjust the Battery Reading Offset Adjustment field until the Battery Reading in the RSS matches the battery level on the DC voltmeter.
9. Repeat Steps 7 and 8 until the reading matches that of the DC voltmeter. (Allow 3 seconds between each click of the Read Battery Voltage button. The transmitter internally only takes a reading every 2 seconds.)
10. Click Program to save the value.
11. Exit out of RSS.
Note: The calibration procedure is done with the transmitter under very little load. When the transmitter is transmitting, the reading will be lower in comparison with the reading at the system regulator.

TN182 Battery Level Reporting and Remote P25 Test Tone

Receiver Analog DTMF Decoder Alignment Procedures:

<u>Tools Required:</u>

Oscilloscope

Optional: Analog communication test set (eg. Marconi 2955)

RSS version 1.7.6 or later

Extender card

The subscriber model to be used with the receiver

<u>Steps:</u>

1. Connect the receiver to the sub-rack with the extender card or cable in between.

2. Have the Oscilloscope monitor Pin Z24 out of the back 48 pin connector of the receiver via the extender card. J4-10 (RX A MODE) for RXA and J4-14 (RX B MODE) for RXB.

3. Do NOT connect a transmitter to the receiver via the front panel CNTL BUS.

4. Use RSS to program the repeater receiver to match the bandwidth and de-emphasis settings of the subscriber (this is typically done for radio operation).

5. Navigate to Service -> Jumper Settings -> Output Pins.

6. Note the current selection for Pin Z24. You will need to program it back after tuning.

7. Select and Program "Analog DTMF Decode (High)" for Pin Z24 as shown in Figure 4.
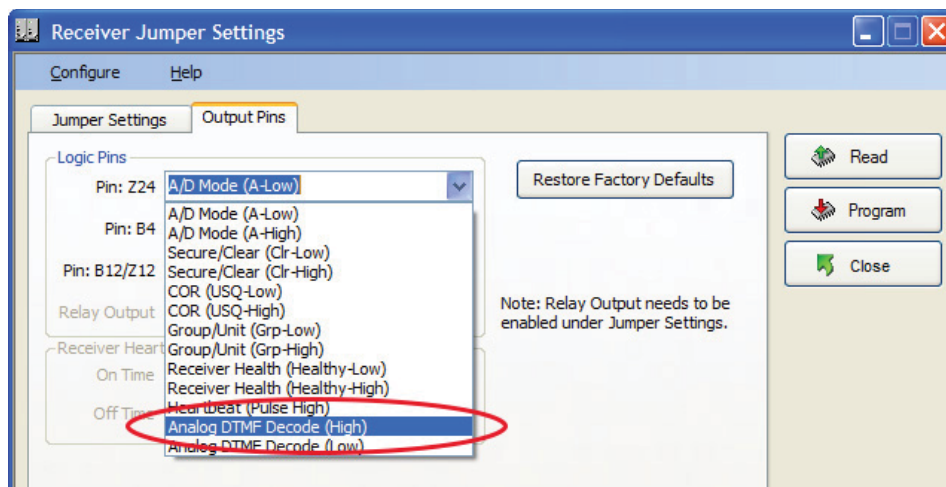

Figure 4: DTMF Setup Output Pin Selection

8. Exit back to Service Window.

9. Select Extra Features.

10. Select Battery Level Reporting Tab

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TN182 Battery Level Reporting and Remote P25 Test Tone

12. Turn on the Battery Level Reporting and click program if it is not already on.
    The following values are a good starting point
    5 : Detection Threshold for First Harmonics
    100: Input Audio Sample Gain (Narrow Band)
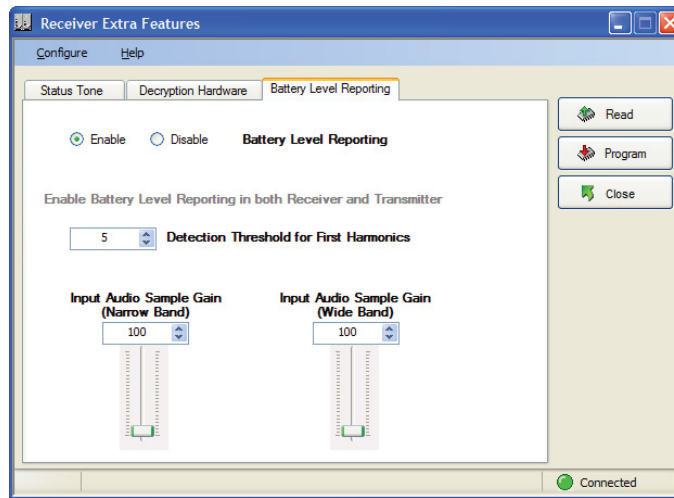   100: Input Audio Sample Gain (Wide Band)

Figure 5: Receiver Battery Level Reporting

13. Use the subscriber to transmit each DTMF tone. As an Option you can have an analog communication test monitor the subscriber at the same time with the demod output connected to one of the oscilloscope channels.
14. Figure 6 shows what the output at Pin Z24 looks like when it is tuned correctly for a particular subscriber.
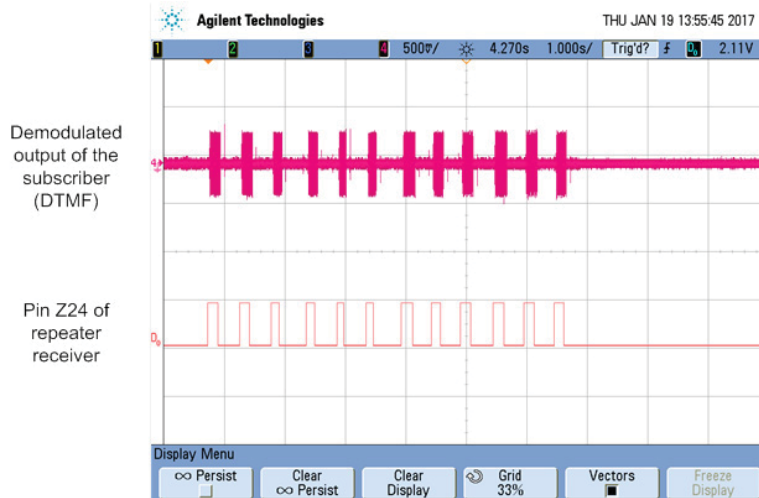   A single pulse will correspond to each burst of different DTMF tone.

Figure 6: Oscilloscope showing DTMF output on Pin Z24 (Good Tune)

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TN182 Battery Level Reporting and Remote P25 Test Tone

15. Figure 7 shows what the output at Pin Z24 may look like when it is not tuned correctly for a particular subscriber.

    More than a single pulse will correspond to some of the bursts of different DTMF tones.
    You will sometimes see no pulse corresponding to some of the burst of different DTMF tones.

Figure 7: Oscilloscope showing DTMF output on Pin Z24 (Bad Tune)

16. Make the adjustment to the Detection Threshold for First Harmonics and/or the Input Audio Sample Gain so that the result looks like Figure 6. Be sure to go through all possible DTMF tones.
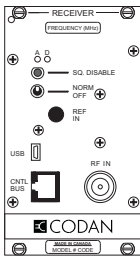
17. Click Program to save the adjustment value.

18. Navigate to Service -> Jumper Settings -> Output Pins

19. Program back the previous setting for Pin Z24.

20. Exit RSS.

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TN247 VR-4E VHF MT-4E Receiver

The VR-4E VHF receiver is an FM radio module capable of analog operation in 12.5 KHz (narrowband) or 25 KHz (wideband) channels. A firmware upgrade may be purchased to allow P25 digital operation. The VR-4E VHF receiver operates over the frequency band from 136 to 174 MHz. A modular design allows each of the receiver's internal modules to be individually assembled and tested. This facilitates construction, tuning and maintenance as well as troubleshooting procedures. The receiver can be programmed with up to 2 banks of 16 channels each.

Specifications

Frequency Band	136 - 174 MHz
Channel Spacing	12.5, 15, 25 and 30 KHz
Frequency Switching Range	± 2 MHz
Reference Sensitivity (12 dB SINAD and 5% BER)	≤ -118 dBm (.280 µV)
Adjacent Channel Rejection (Class A)	≥ 45 dB; NB Analog / ≥ 75 dB; WB Analog / ≥ 60 dB; Digital
Adjacent Channel Rejection (Class B)	≥ 40 dB; NBAnalog / ≥ 70 dB; WB Analog / ≥ 60 dB; Digital
Conducted Spurious Output Power (Analog)	≤ -95 dBm (Class A) / ≤ -57 dBm (Class B)
Intermodulation Rejection	≥ 75 dB Analog / ≥ 80 dB Digital (Class A)
	≥ 70 dB Analog / ≥ 70 dB Digital (Class B)
Hum & Noise Ratio	≥ 34 dB Narrowband / ≥ 40 dB Wideband
L.O. Frequency Stability	± 1.0 ppm (-30°C to +60°C)
Audio Distortion (Analog and Digital)	≤ 2.0 % (25°C); ≤ 3.0 % (-30°C to +60°C)
Audio Output Level (600 Ω Balanced)	≤ +3.0 dBm
Operating Temperature	-30°C to +60°C
Supply Current (Class A)	≤ 250 mA / ≤ 280 mA with encryption module
Supply Current (Class B)	≤ 115 mA / ≤ 145 mA with encryption module

Models Available

VR-4E150-A0-000   12.5 / 25 KHz Bandwidth, 136 - 174 MHz, Class A
VR-4E150-00-000   12.5 / 25 KHz Bandwidth, 136 - 174 MHz, Class B

Receiver Operating Frequency

The receiver is initially aligned at the factory for the frequency shown on the label on the front panel. For a small frequency change, no re-alignment of the receiver may be required. If the frequency change is greater than **±2 MHz** from the frequency at which the last complete receiver alignment was performed, the **RF Preselector** will need to be realigned. To align and / or adjust the receiver, the outer cover needs to be removed; the receiver needs to be plugged into the subrack via a cable and / or extender card; and power must be applied to the system.
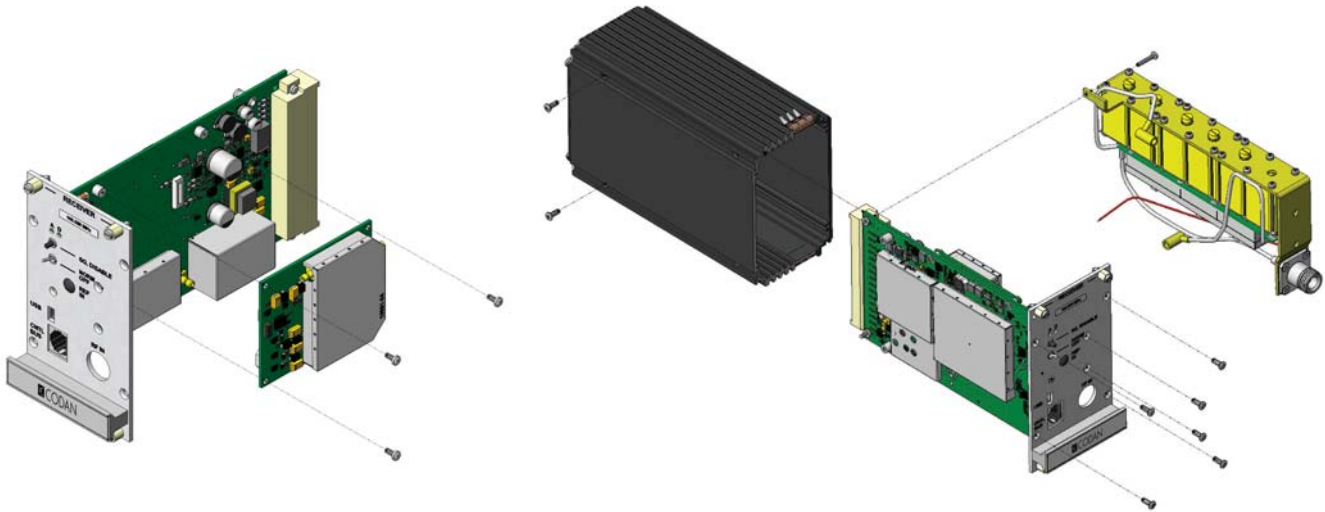
TN247 VR-4E VHF MT-4E Receiver

The VR-4E VHF receiver is primarily software-controlled, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

RF Preselector Alignment:

Alignment for the RF Preselector consists of tuning the five-section helical filter only. There are two methods of tuning the RF Preselector. The preferred method of tuning the RF Preselector is to use a Spectrum Analyzer with a Tracking Generator. Ensure that the +9.5 Vdc supply is connected to the RF Preselector (red wire). Connect the Tracking Generator output at a level of -20 dBm to the Receiver's RF input. Connect the Spectrum Analyzer input to the RF Preselector's IF output (SMB cable normally connected to the Receiver Mainboard). Adjust the helical filter trimmer capacitors for a flat response at a level typically -40 dBm to -65 dBm, centred at the desired RF frequency. The alternate method of tuning the RF Preselector is to monitor receiver SINAD. Inject the desired RF signal to the RF input connector at a level of -118 dBm and adjust the helical filter trimmer capacitors for best receiver SINAD (≤ -118 dBm).

RSS Service Mode:

The RSS has the ability to put a receiver into Service Mode, where the Reference Oscillator may be aligned, Audio Levels may be set, Jumper Settings may be selected, a BER test can be performed, and an RSSI meter can be monitored. To put the receiver into Service Mode, it must be connected to a PC running the Radio Service Software (RSS) using a type A to 5-pin mini-type B USB cable. From the RSS Receiver Configuration window, click on the Service button. Note that you must not remove power to the radio or swap radios during servicing. When any required Service functions have been completed, the radio can be taken out of Service Mode by clicking on the Quit button in the Service window.

Note: For complete alignment procedures, refer to the instruction manual. These notes are for reference only.
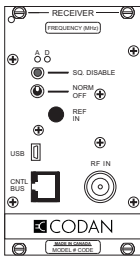
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TN267 UR-4E UHF MT-4E Receiver

The UR-4E UHF receiver is an FM radio module capable of analog operation in 12.5 KHz (narrowband) or 25 KHz (wideband) channels. A firmware upgrade may be purchased to allow P25 digital operation. The UR-4E UHF receiver operates in one of five frequency bands: 380 to 406 MHz, 406 to 430 MHz, 430 to 450 MHz, 450 to 470 MHz or 470 to 520 MHz. A modular design allows each of the receiver's internal modules to be individually assembled and tested. This facilitates construction, tuning and maintenance as well as troubleshooting procedures. The receiver can be programmed with up to 2 banks of 16 channels each.

Specifications

Frequency Bands	380 - 406 / 406 - 430 / 430 - 450 / 450 - 470 / 470 - 520 MHz
Channel Spacing	12.5 and 25 KHz
Frequency Switching Range	± 2 MHz
Reference Sensitivity	≤ -116 dBm (.350 µV) 380 & 440 & 500
(12 dB SINAD and 5% BER)	≤ -118 dBm (.280 µV) 420 & 460
Adjacent Channel Rejection (Class A)	≥ 45 dB; NB Analog / ≥ 75 dB; WB Analog / ≥ 60 dB; Digital
Adjacent Channel Rejection (Class B)	≥ 40 dB; NB Analog / ≥ 70 dB; WB Analog / ≥ 60 dB; Digital
Conducted Spurious Output Power (Analog)	≤ -95 dBm (Class A & 380 & 440) / ≤ -80 dBm (500)
	≤ -57 dBm (Class B)
Intermodulation Rejection	≥ 75 dB Analog / ≥ 80 dB Digital (Class A & 380 & 440)
	≥ 70 dB Analog / ≥ 70 dB Digital (Class B)
Hum & Noise Ratio	≥ 34 dB Narrowband / ≥ 40 dB Wideband
L.O. Frequency Stability	± 0.5 ppm (-30°C to +60°C)
Audio Distortion (Analog and Digital)	≤ 2.0 % (25°C); ≤ 3.0 % (-30°C to +60°C)
Audio Output Level (600 Ω Balanced)	≤ +3.0 dBm
Operating Temperature	-30°C to +60°C
Supply Current (Class A)	≤ 250 mA / ≤ 280 mA with encryption module
Supply Current (Class B)	≤ 115 mA / ≤ 145 mA with encryption module
Supply Current (380 & 440)	≤ 270 mA / ≤ 300 mA with encryption module

Models Available

UR-4E380-00-000	12.5 / 25 KHz Bandwidth, 380 - 406 MHz, Class B
UR-4E420-A0-000	12.5 / 25 KHz Bandwidth, 406 - 430 MHz, Class A
UR-4E420-00-000	12.5 / 25 KHz Bandwidth, 406 - 430 MHz, Class B
UR-4E440-00-000	12.5 / 25 KHz Bandwidth, 430 - 450 MHz, Class B
UR-4E460-A0-000	12.5 / 25 KHz Bandwidth, 450 - 470 MHz, Class A
UR-4E460-00-000	12.5 / 25 KHz Bandwidth, 450 - 470 MHz, Class B
UR-4E500-00-000	12.5 / 25 KHz Bandwidth, 470 - 520 MHz, Class B * Not available in Canada

Receiver Operating Frequency

The receiver is initially aligned at the factory for the frequency shown on the label on the front panel. For a small frequency change, no re-alignment of the receiver may be required. If the frequency change is greater than **±2 MHz** from the frequency at which the last complete receiver alignment was performed, the **RF Preselector** will need to be realigned. To align and / or adjust the receiver, the outer cover needs to be removed; the receiver needs to be plugged into the subrack via a cable and / or extender card; and power must be applied to the system.
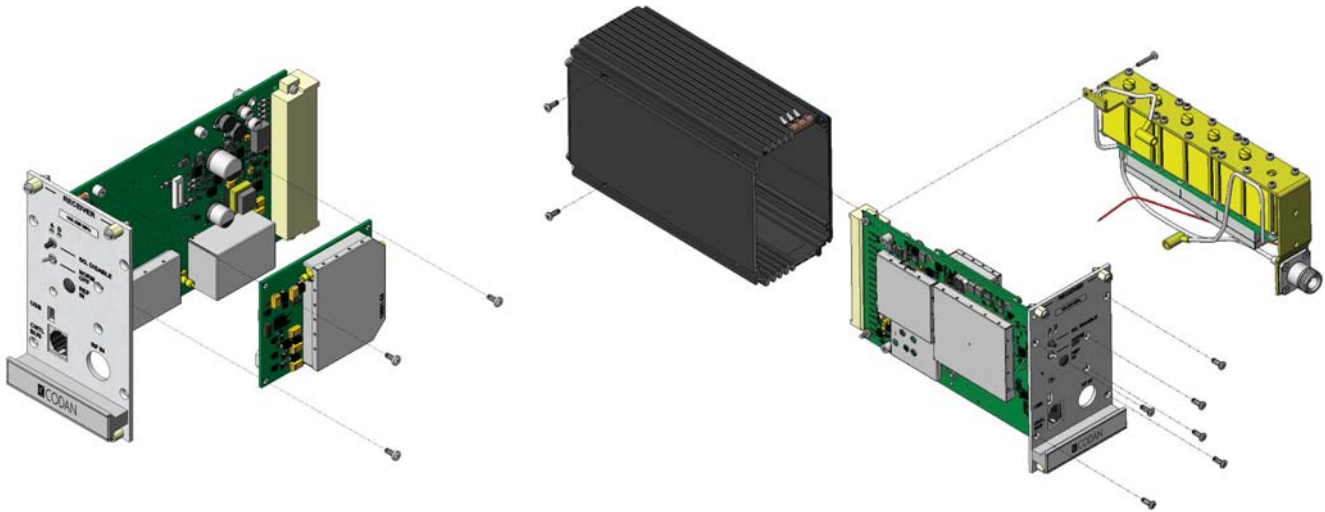
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TN267 UR-4E UHF MT-4E Receiver

The UR-4E UHF receiver is primarily software-controlled, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

RF Preselector Alignment:

Alignment for the RF Preselector consists of tuning the five-section helical filter only. There are two methods of tuning the RF Preselector. The preferred method of tuning the RF Preselector is to use a Spectrum Analyzer with a Tracking Generator. Ensure that the +9.5 Vdc supply is connected to the RF Preselector (red wire). Connect the Tracking Generator output at a level of -20 dBm to the Receiver's RF input. Connect the Spectrum Analyzer input to the RF Preselector's IF output (SMB cable normally connected to the Receiver Mainboard). Adjust the helical filter trimmer capacitors for a flat response at a level typically -40 dBm to -65 dBm (-20 dBm to -40 dBm for Class B), centred at the desired RF frequency. The alternate method of tuning the RF Preselector is to monitor receiver SINAD. Inject the desired RF signal to the RF input connector at a level of -118 dBm and adjust the helical filter trimmer capacitors for best receiver SINAD (≤ -118 dBm).

RSS Service Mode:

The RSS has the ability to put a receiver into Service Mode, where the Reference Oscillator may be aligned, Audio Levels may be set, Jumper Settings may be selected, a BER test can be performed, and an RSSI meter can be monitored. To put the receiver into Service Mode, it must be connected to a PC running the Radio Service Software (RSS) using a type A to 5-pin mini-type B USB cable. From the RSS Receiver Configuration window, click on the Service button. Note that you must not remove power to the radio or swap radios during servicing. When any required Service functions have been completed, the radio can be taken out of Service Mode by clicking on the Quit button in the Service window.
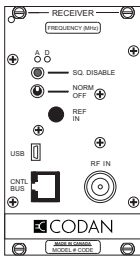
Note: For complete alignment procedures, refer to the instruction manual. These notes are for reference only.

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TN287 UR-4E UHF 700 / 800 / 900 MHz MT-4E Receiver

The UR-4E UHF 700 / 800 / 900 MHz receiver is an FM radio module capable of analog operation in 12.5 KHz (narrowband) or 25 KHz (wideband) channels. A firmware upgrade may be purchased to allow P25 digital operation. The UR-4E UHF 700 / 800 / 900 MHz receiver operates in one of five frequency bands: 768 to 776 MHz, 798 to 824 MHz, 851 to 869 MHz, 896 to 902 MHz or 930 to 960 MHz. A modular design allows each of the receiver's internal modules to be individually assembled and tested. This facilitates construction, tuning and maintenance as well as troubleshooting procedures. The receiver can be programmed with up to 2 banks of 16 channels each.

Specifications

Frequency Bands	768 - 776 / 798 - 824 / 851 - 869 / 896 - 902 / 930 - 960 MHz
Channel Spacing	12.5 and 25 KHz
Frequency Switching Range	Full Band
Reference Sensitivity (12 dB SINAD and 5% BER)	≤ -116 dBm (.350 µV)
Adjacent Channel Rejection	≥ 45 dB; NB Analog / ≥ 70 dB; WB Analog / ≥ 60 dB; Digital
Conducted Spurious Output Power (Analog)	≤ -80 dBm
Intermodulation Rejection	≥ 70 dB
Hum & Noise Ratio	≥ 31 dB Narrowband / ≥ 37 dB Wideband
L.O. Frequency Stability	± 0.1 ppm (-30°C to +60°C)
Audio Distortion (Analog and Digital)	≤ 3.0 % (25°C); ≤ 5.0 % (-30°C to +60°C)
Audio Output Level (600 Ω Balanced)	≤ +3.0 dBm
Operating Temperature	-30°C to +60°C
Supply Current	≤ 200 mA / ≤ 230 mA with encryption module

Models Available

UR-4E768-00-000	12.5 / 25 KHz Bandwidth, 768 - 776 MHz, Class B
UR-4E800-00-000	12.5 / 25 KHz Bandwidth, 798 - 824 MHz, Class B
UR-4E850-00-000	12.5 / 25 KHz Bandwidth, 851 - 869 MHz, Class B
UR-4E900-00-000	12.5 / 25 KHz Bandwidth, 896 - 902 MHz, Class B
UR-4E950-00-000	12.5 / 25 KHz Bandwidth, 930 - 960 MHz, Class B

Receiver Operating Frequency

The receiver is initially aligned at the factory for the center of the frequency range and is programmed for the frequency shown on the label on the front panel. No re-alignment of the receiver is required to change frequencies.

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TN287 UR-4E UHF 700 / 800 / 900 MHz MT-4E Receiver
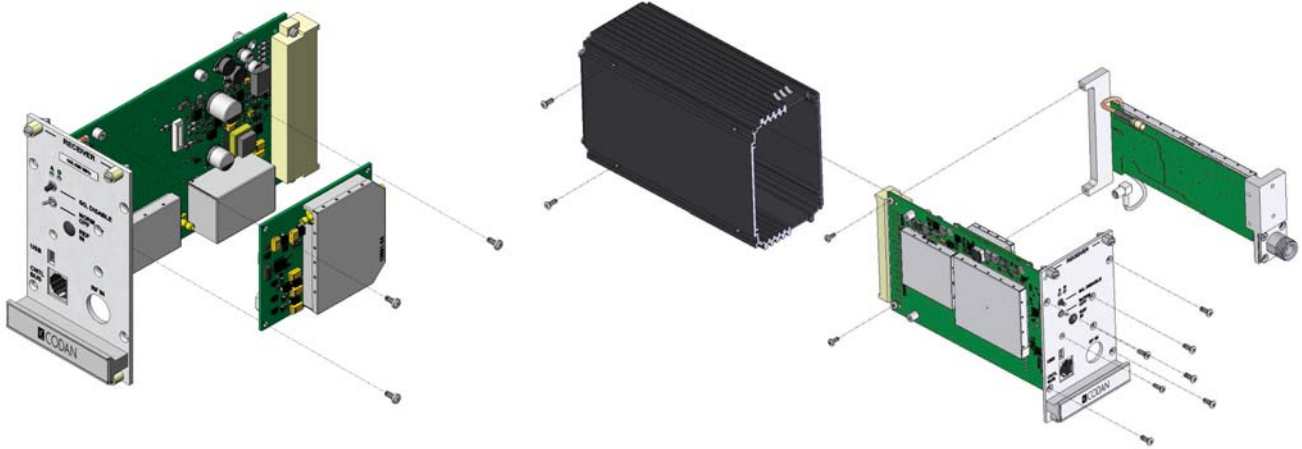
The UR-4E UHF 700 / 800 / 900 MHz receiver is primarily software-controlled, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

RSS Service Mode:

The RSS has the ability to put a receiver into Service Mode, where the Reference Oscillator may be aligned, Audio Levels may be set, Jumper Settings may be selected, a BER test can be performed, and an RSSI meter can be monitored. To put the receiver into Service Mode, it must be connected to a PC running the Radio Service Software (RSS) using a type A to 5-pin mini-type B USB cable. From the RSS Receiver Configuration window, click on the Service button. Note that you must not remove power to the radio or swap radios during servicing. When any required Service functions have been completed, the radio can be taken out of Service Mode by clicking on the Quit button in the Service window.

Note: For complete alignment procedures, refer to the instruction manual. These notes are for reference only.
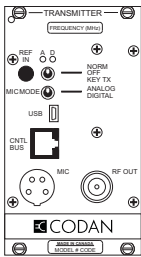
TN347 VT-4E VHF MT-4E Transmitter

The VT-4E VHF transmitter is an FM radio module capable of analog operation in 12.5 KHz (narrowband) or 25 KHz (wideband) channels. A firmware upgrade may be purchased to allow P25 digital operation. The VT-4E VHF transmitter operates over the frequency band from 136 to 174 MHz. A modular design allows each of the transmitter's internal modules to be individually assembled and tested. This facilitates construction, tuning and maintenance as well as troubleshooting procedures. The transmitter can be programmed with up to 2 banks of 16 channels each.

Specifications

Frequency Band	136 - 174 MHz
Channel Spacing	12.5, 15, 25 and 30 KHz
Frequency Switching Range	Full Band; ± 0.5 MHz for VSWR alarm
RF Output Power	0.5 to 8.0 Watts adjustable
Duty Cycle	100% (-30°C to +60°C)
Undesired Emissions (Conducted Spurious)	≤ -70 dBc @ 8.0 Watts
Undesired Emissions (Adjacent Channel Power Ratio)	≤ -60 dBc; Narrowband Analog / ≤ -70 dBc; Wideband Analog ≤ -70 dBc; Digital
Intermodulation Attenuation	≥ 45 dB
FM Hum & Noise Ratio	≥ 42 dB; Narrowband / ≥ 48 dB; Wideband
Carrier Frequency Stability	± 1.0 ppm (-30°C to +60°C)
Emission Designators	Analog: 11K0F3E (Narrowband); 16K0F3E (Wideband) Paging: 9K20F1D P25 Digital: 8K10F1E (Digital Voice); 8K10F1D (Digital Data)
Audio Distortion (60% of maximum deviation)	≤ 3.0% (-30°C to +60°C)
VSWR Protection	≤ 20:1 VSWR (All Phase Angles)
Operating Temperature	-30°C to +60°C
Standby Current	≤ 50 mA / ≤ 80 mA with encryption module
Transmit Current (8.0 W)	≤ 2.80 A

Models Available

VT-4E150-00-800   12.5 / 25 KHz Bandwidth, 0.5 - 8.0 W, 136 - 174 MHz

Transmitter Operating Frequency

The transmitter is initially aligned at the factory for the frequency shown on the label on the front panel. For a small frequency change, no re-alignment of the transmitter may be required. If the frequency change is greater than **±0.5 MHz** from the frequency at which the last complete transmitter alignment was performed, the **VSWR alarm / overload** (if used) will need to be realigned. To align and / or adjust the transmitter, the outer cover needs to be removed; the transmitter needs to be plugged into the subrack via a cable and / or extender card; and power must be applied to the system. A 50 Ω dummy load should be connected to the RF output when transmitting.
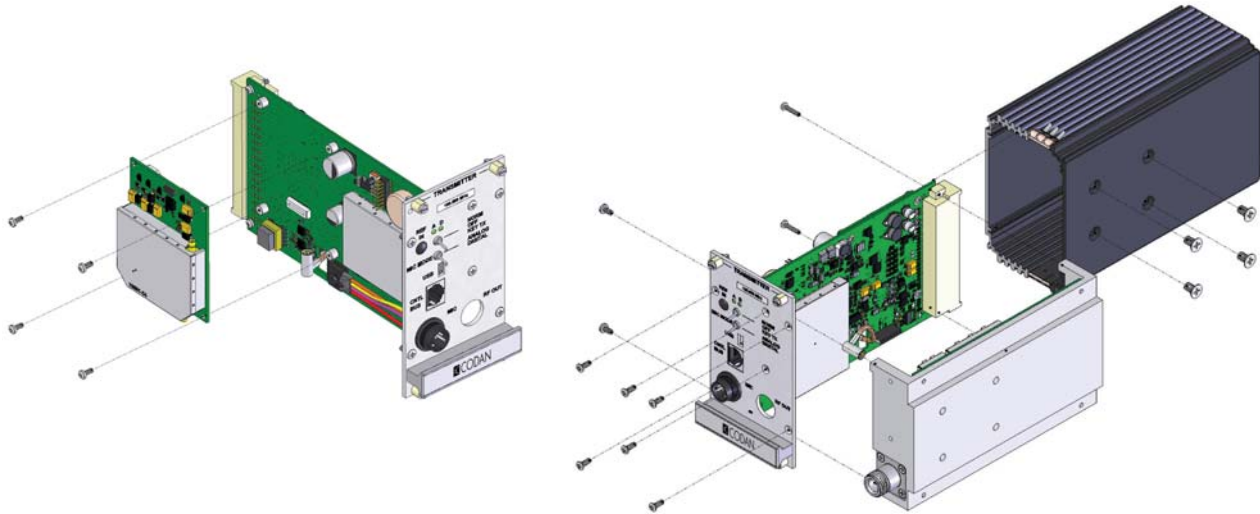
TN347 VT-4E VHF MT-4E Transmitter

The VT-4E VHF transmitter is primarily software controlled, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

VSWR Alarm / Overload Adjustment:

The VSWR alarm / overload only requires adjustment if the VSWR Alarm is being used. When the VSWR alarm / overload circuit is properly set, the Amplifier is protected from excessive antenna VSWR by reducing the amplifier's gain when an overload condition occurs. If the VSWR alarm is not set, the amplifier is still protected by a current limiter circuit. The circuit limits Amplifier current draw to 2.0 Amps and protects the Amplifier from damage.

To set the VSWR alarm / overload circuit properly, the RF power level must be set to the desired RF power output first. After the RF power level is properly set, rotate the VSWR alarm adjust potentiometer (RV3) fully counter clockwise. Terminate the transmitter with a 3:1 mismatch load and connect a voltmeter to Pin 5 of connector J1 in the transmitter. Slowly adjust the VSWR alarm adjust potentiometer (RV3) clockwise until Pin 5 reads +2.5 Vdc, or a noticeable drop (10% of total current or more) in current on the +13.8 Vdc line occurs.

RSS Service Mode:

The RSS has the ability to put a transmitter into Service Mode, where the Reference Oscillator may be aligned, Audio Levels, Subtone Deviation Levels and RF Power Levels may be set, Jumper Settings may be selected, and Test Patterns can be generated. To put the transmitter into Service Mode, it must be connected to a PC running the Radio Service Software (RSS) using a type A to 5 pin mini-type B USB cable. From the RSS Transmitter Configuration window, click on the Service button. When any required Service functions have been completed, the radio can be taken out of Service Mode by clicking on the Quit button in the Service window.

NOTE: Do not remove power to the radio or swap radios during servicing.

Note: For complete alignment procedures, refer to the instruction manual. These notes are for reference only.

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Canada V8V 1P8	**Fax:**	1-877-750-0004	**Fax:**	250-382-6139	**Web:** www.codanradio.com

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TN367 UT-4E UHF MT-4E Transmitter

The UT-4E UHF transmitter is an FM radio module capable of analog operation in 12.5 KHz (narrowband) or 25 KHz (wideband) channels. A firmware upgrade may be purchased to allow P25 digital operation. The UT-4E UHF transmitter operates in one of three frequency bands: 380 to 406 MHz, 406 to 470 MHz or 470 to 520 MHz. A modular design allows each of the transmitter's internal modules to be individually assembled and tested. This facilitates construction, tuning and maintenance as well as troubleshooting procedures. The transmitter can be programmed with up to 2 banks of 16 channels each.

Specifications

Frequency Bands	380 - 406 / 406 - 470 MHz / 470 - 520 MHz
Channel Spacing	12.5 and 25 KHz
Frequency Switching Range	Full Band; ± 0.5 MHz for VSWR alarm
RF Output Power	0.5 to 8.0 Watts adjustable or 0.5 to 6.0 Watts adjustable
Duty Cycle	100% (-30°C to +60°C)
Undesired Emissions (Conducted Spurious)	≤ -70 dBc (-31 dBm @ 6 / 8 W) 380 & 450; (-32 dBm @ 6W) 500
Undesired Emissions (Adjacent Channel Power Ratio)	≤ -60 dBc; Narrowband Analog / ≤ -70 dBc; Wideband Analog ≤ -67 dBc; Digital
Intermodulation Attenuation	≥ 40 dB (380) / ≥ 45 dB (450 & 500)
FM Hum & Noise Ratio	≥ 40 dB NB ; ≥ 46 dB WB (380) / ≥ 38 dB NB ; ≥ 44 dB WB (450) ≥ 34 dB; NB ; ≥ 40 dB; WB (500)
Carrier Frequency Stability	± 0.5 ppm (-30°C to +60°C)
Emission Designators	Analog: 11K0F3E (Narrowband); 16K0F3E (Wideband) Paging: 9K20F1D P25 Digital: 8K10F1E (Digital Voice); 8K10F1D (Digital Data)
Audio Distortion (60% of maximum deviation)	≤ 3.0% (-30°C to +60°C)
VSWR Protection	≤ 20:1 VSWR (All Phase Angles)
Operating Temperature	-30°C to +60°C
Standby Current	≤ 50 mA / ≤ 80 mA with encryption module
Transmit Current (8.0 W)	≤ 2.80 A

Models Available

UT-4E380-00-800	12.5 / 25 KHz Bandwidth, 0.5 - 6.0 W, 380 - 406 MHz
UT-4E450-00-800	12.5 / 25 KHz Bandwidth, 0.5 - 8.0 W, 406 - 470 MHz
UT-4E500-00-800	12.5 / 25 KHz Bandwidth, 0.5 - 6.0 W, 470 - 520 MHz *Not available in Canada

Transmitter Operating Frequency

The transmitter is initially aligned at the factory for the frequency shown on the label on the front panel. For a small frequency change, no re-alignment of the transmitter may be required. If the frequency change is greater than **±0.5 MHz** from the frequency at which the last complete transmitter alignment was performed, the **VSWR alarm / overload** (if used) will need to be realigned. To align and / or adjust the transmitter, the outer cover needs to be removed; the transmitter needs to be plugged into the subrack via a cable and / or extender card; and power must be applied to the system. A 50 Ω dummy load should be connected to the RF output when transmitting.
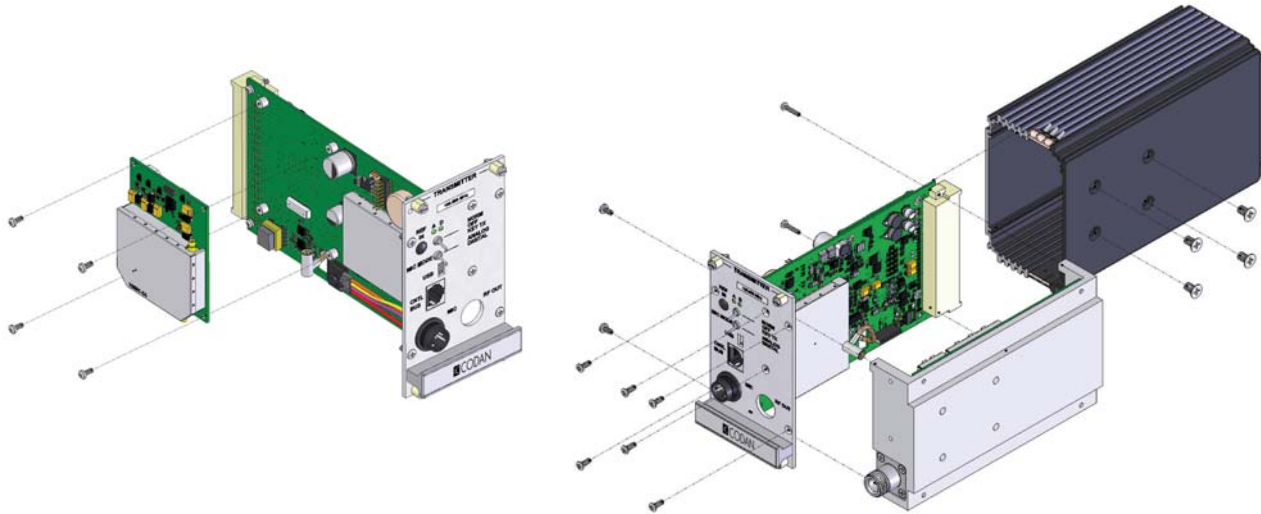
TN367 UT-4E UHF MT-4E Transmitter

The UT-4E UHF transmitter is primarily software controlled, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

VSWR Alarm / Overload Adjustment:

The VSWR alarm / overload only requires adjustment if the VSWR Alarm is being used. When the VSWR alarm / overload circuit is properly set, the Amplifier is protected from excessive antenna VSWR by reducing the amplifier's gain when an overload condition occurs. If the VSWR alarm is not set, the amplifier is still protected by a current limiter circuit. The circuit limits Amplifier current draw to 2.0 Amps and protects the Amplifier from damage.

To set the VSWR alarm / overload circuit properly, the RF power level must be set to the desired RF power output first. After the RF power level is properly set, rotate the VSWR alarm adjust potentiometer (RV3) fully counter clockwise. Terminate the transmitter with a 3:1 mismatch load and connect a voltmeter to Pin 5 of connector J1 in the transmitter. Slowly adjust the VSWR alarm adjust potentiometer (RV3) clockwise until Pin 5 reads +2.5 Vdc, or a noticeable drop (10% of total current or more) in current on the +13.8 Vdc line occurs.

RSS Service Mode:

The RSS has the ability to put a transmitter into Service Mode, where the Reference Oscillator may be aligned, Audio Levels, Subtone Deviation Levels and RF Power Levels may be set, Jumper Settings may be selected, and Test Patterns can be generated. To put the transmitter into Service Mode, it must be connected to a PC running the Radio Service Software (RSS) using a type A to 5 pin mini-type B USB cable. From the RSS Transmitter Configuration window, click on the Service button. When any required Service functions have been completed, the radio can be taken out of Service Mode by clicking on the Quit button in the Service window.

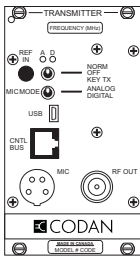**NOTE:** Do not remove power to the radio or swap radios during servicing.

Note: For complete alignment procedures, refer to the instruction manual. These notes are for reference only.

CODAN
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TN387 UT-4E UHF 700 / 800 / 900 MHz MT-4E Transmitter

The UT-4E UHF 700 / 800 / 900 MHz transmitter is an FM radio module capable of analog operation in 12.5 KHz (narrowband), 25 KHz (wideband) or 20 KHz (NPSPAC) channels. A firmware upgrade may be purchased to allow P25 digital operation. The UT-4E UHF 700 / 800 / 900 MHz transmitter operates in one of two frequency bands: 768 to 869 MHz or 896 to 960 MHz. A modular design allows each of the transmitter's internal modules to be individually assembled and tested. This facilitates construction, tuning and maintenance as well as troubleshooting procedures. The transmitter can be programmed with up to 2 banks of 16 channels each.

Specifications

Frequency Bands	768 - 869 MHz / 896 - 960 MHz
Channel Spacing	12.5 and 25 KHz (20 KHz NPSPAC; 850 only)
Frequency Switching Range	Full Band; ± 0.5 MHz for VSWR alarm
RF Output Power	0.5 to 3.0 Watts adjustable
Duty Cycle	100% (-30°C to +60°C)
Undesired Emissions (Conducted Spurious)	≤ -80 dBc (-45 dBm @ 3.0 Watts) 850
	≤ -65 dBc (-30 dBm @ 3.0 Watts) 900
Undesired Emissions	≤ -50 dBc; Narrowband Analog / ≤ -60 dBc; Wideband Analog
(Adjacent Channel Power Ratio)	≤ -67 dBc; Digital
Intermodulation Attenuation	≥ 40 dB
FM Hum & Noise Ratio	≥ 34 dB; NB ; ≥ 40 dB; WB ; ≥ 35 dB; NPSPAC (850)
	≥ 31 dB; NB ; ≥ 37 dB; WB ; ≥ 35 dB; NPSPAC (900)
Carrier Frequency Stability	± 0.1 ppm (-30°C to +60°C)
Emission Designators	Analog: 11K0F3E (Narrowband); 16K0F3E (Wideband)
	Analog: 14K0F3E (20 KHz NPSPAC 850 only)
	Paging: 9K20F1D (Narrowband); 16K0F1D (Wideband)
	P25 Digital: 8K10F1E (Digital Voice); 8K10F1D (Digital Data)
Audio Distortion (60% of maximum deviation)	≤ 3.0% (-30°C to +60°C)
VSWR Protection	≤ 20:1 VSWR (All Phase Angles)
Operating Temperature	-30°C to +60°C
Standby Current	≤ 115 mA / ≤ 145 mA with encryption module
Transmit Current (3.0 W)	≤ 1.80 A

Models Available

UT-4E850-00-300	12.5 / 25 KHz Bandwidth, 0.5 - 3.0 W, 768 - 869 MHz
UT-4E900-00-300	12.5 / 25 KHz Bandwidth, 0.5 - 3.0 W, 896 - 960 MHz

Transmitter Operating Frequency

The transmitter is initially aligned at the factory for the frequency shown on the label on the front panel. For a small frequency change, no re-alignment of the transmitter may be required. If the frequency change is greater than **±0.5 MHz** from the frequency at which the last complete transmitter alignment was performed, the **VSWR alarm / overload** (if used) will need to be realigned. To align and / or adjust the transmitter the outer cover needs to be removed, the transmitter needs to be plugged into the subrack via a cable and / or extender card and power must be applied to the system. A 50 Ω dummy load should be connected to the RF output when transmitting.
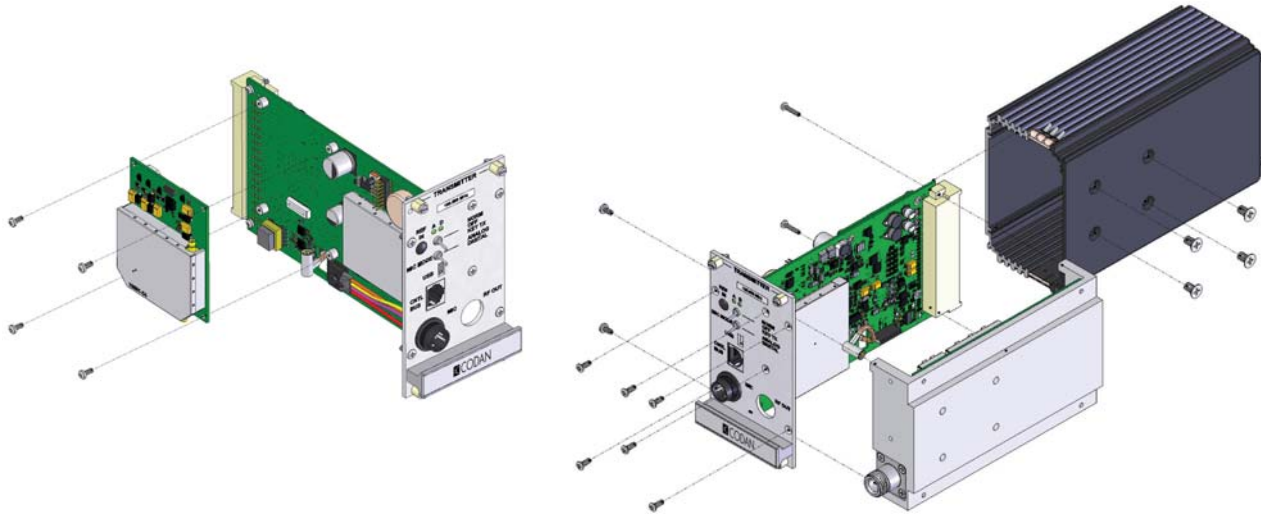
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CODAN
RADIO COMMUNICATIONS

TN387 UT-4E UHF 700 / 800 / 900 MHz MT-4E Transmitter

The UT-4E UHF 700 / 800 / 900 MHz transmitter is primarily software controlled, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

VSWR Alarm / Overload Adjustment:

The VSWR alarm / overload only requires adjustment if the VSWR Alarm is being used. When the VSWR alarm / overload circuit is properly set, the Amplifier is protected from excessive antenna VSWR by reducing the amplifier's gain when an overload condition occurs. If the VSWR alarm is not set, the amplifier is still protected by a current limiter circuit. The circuit limits Amplifier current draw to 2.0 Amps and protects the Amplifier from damage.

To set the VSWR alarm / overload circuit properly, the RF power level must be set to the desired RF power output first. After the RF power level is properly set, rotate the VSWR alarm adjust potentiometer (RV3) fully counter clockwise. Terminate the transmitter with a 3:1 mismatch load and connect a voltmeter to Pin 5 of connector J1 in the transmitter. Slowly adjust the VSWR alarm adjust potentiometer (RV3) clockwise until Pin 5 reads +2.5 Vdc, or a noticeable drop (10% of total current or more) in current on the +13.8 Vdc line occurs.

RSS Service Mode:

The RSS has the ability to put a transmitter into Service Mode, where the Reference Oscillator may be aligned, Audio Levels, Subtone Deviation Levels and RF Power Levels may be set, Jumper Settings may be selected, and Test Patterns can be generated. To put the transmitter into Service Mode, it must be connected to a PC running the Radio Service Software (RSS) using a type A to 5 pin mini-type B USB cable. From the RSS Transmitter Configuration window, click on the Service button. When any required Service functions have been completed, the radio can be taken out of Service Mode by clicking on the Quit button in the Service window.

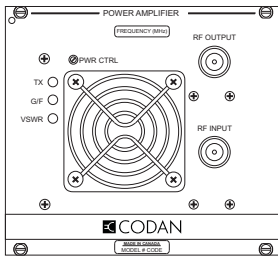**NOTE:** Do not remove power to the radio or swap radios during servicing.

Note: For complete alignment procedures, refer to the instruction manual. These notes are for reference only.

CODAN
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TN441 AMP-4 VHF and UHF 30 Watt Power Amplifiers

The AMP-4 30 Watt power amplifier operates in one of three frequency bands: 136 to 174 MHz, 380 to 430 MHz or 450 to 520 MHz. The power amplifier is rated for continuous duty at an adjustable RF output power of 20 to 30 Watts. The output power is adjusted either using the front panel potentiometer (local mode) or by a voltage via the rear panel connector (remote mode). The local and remote mode output power control is determined by a hardware jumper on the inside of the power amplifier. The AMP-4 was designed to mate with any of the MT-3 / MT-4 transmitter exciter modules.. The input to the power amplifier cannot exceed 8.0 Watts.

Specifications

Frequency Band	136 - 174 MHz / 380 - 430 MHz / 450 - 520 MHz
RF Output Power	20 to 30 Watts adjustable
RF Input Power Range (from exciter)	6.4 to 8.0 Watts (VHF) / 6.0 to 8.0 Watts (UHF)
Duty Cycle	100% (-30°C to +60°C)
Undesired Emissions: Conducted Spurious (Includes Harmonics)	≤ -70 dBc
Undesired Emissions: Radiated Spurious	≤ -13 dBm (≤ 57.8 dBc)
Intermodulation Attenuation	≥ 40 dB
Thermal	Thermal interlock disables @ +80°C (± 5°C) / +176°F Resets at +70°C (± 7°C) / +158°F
Fan	Fan activates @ +60°C (± 5°C) / +140°F Resets @ +40°C / +104°F
VSWR Protection	≤ 20:1 VSWR (All Phase Angles)
Operating Temperature	-30°C to +60°C
Output Impedance	50 Ω
Standby Current Drain	≤ 5 mA
Transmit Current Drain	≤ 7.00 A

Models Available

AMP-4-150-30-00	FM, 20 - 30 Watts continuous duty, 136 - 174 MHz
AMP-4-410-30-00	FM, 20 - 30 Watts continuous duty, 380 - 430 MHz
AMP-4-470-30-00	FM, 20 - 30 Watts continuous duty, 450 - 470 MHz

Guide Rails in Subrack for Power Amplifier:

The AMP-4 is installed in the subrack (taking up a transmitter and receiver slot) and is mated with a transmitter exciter. Additional guide rails are required to be mounted in the subrack to support the AMP-4 properly. The amplifier can be mounted in slot "A" or slot "B" in the subrack. A guide strip at the top of the subrack will help to place the guide rails in the proper position by following the numbers on the guide strip. Only the top portion of the subrack is labeled. Guide rails must be added or removed in the same position on the bottom as on the top.

Remove any guide rails that were used to hold the AMP-2 amplifier. These guide rails will be located at number 20/21 for slot "A" and number 48/49 for slot "B". Install guide rails at number 11/12 and 34/35 for slot "A" and number 39/40 and 62/63 for slot "B".

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Canada V8V 1P8	**Fax:** 1-877-750-0004	**Fax:** 250-382-6139	**Web:** www.codanradio.com

# TN441 AMP-4 VHF and UHF 30 Watt Power Amplifiers

Power Amplifier Alignment:

Before aligning the 30 Watt Power Amplifier, the Transmitter Exciter should be tuned properly following the alignment procedures in the Technical Notes or Instruction Manual for the transmitter. **Disable the output power alarm, VSWR alarm, and VSWR overload** by turning the adjustment pots fully counter clockwise (if applicable, depending on use and model). Set the RF output power at **6.4 Watts. Do not exceed 8.0 Watts** at any time into the power amplifier.

Connect the transmitter exciter RF output to the power amplifier input using the 37 cm cable supplied with the power amplifier. Connect the Wattmeter to the power amplifier output and key the exciter by flipping the switch on the front panel to KEY TX.

If jumper J1 on the amplifier is set for Local Mode (default), adjust the front panel PWR CTRL (Power Control) pot to obtain the desired RF output power on the wattmeter.

If jumper J1 is set for Remote Mode, set the voltage on Pin Z22, on the rear connector of the power amplifier, to obtain the desired RF output power on the wattmeter. Pin Z22 can be accessed on an auxiliary panel on the back of the subrack. The Remote Power Control Voltage range is 0 to 9.5 Vdc.

Power Control

or

1 2 3   1 2 3

Remote   Local
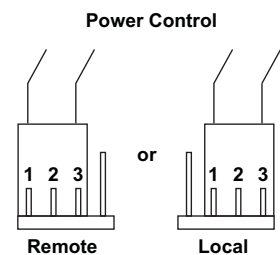
Power Amplifier LEDs and Alarms:

The AMP-4 has a heavy duty and a thermally switched cooling fan. The power amplifier has three LEDs on the front panel and three open connector alarm outputs at the rear connector.

The green TX LED illuminates when the power amplifier is transmitting greater than 20 Watts. When the output power is less than 20 Watts, the "Low TX Output" open collector alarm on Pin B26 will activate.

The red G/F (General Fault) LED is a combination of two alarms: the heatsink temperature and the supply voltage.

The G/F LED will illuminate in standby mode when the heatsink temperature exceeds 80°C (176°F) and will reset when the temperature falls below 70°C (158°F).

The G/F LED will illuminate in active mode (transmit) when the supply voltage exceeds +17.8 Vdc and will reset when the supply voltage is reduced to +17.3 Vdc.

When the G/F LED illuminates, the "General Fault" open collector alarm on Pin B24 will activate, and the power amplifier turns off the voltage regulator to the RF and main control circuits to enter a low power mode

The red VSWR LED illuminates when the power amplifier has a VSWR of 2.1:1 to 4.0:1. When the VSWR LED illuminates, the "VSWR" open collector alarm on Pin Z26 will activate.

Note: For complete alignment procedures, refer to the instruction manual. These notes are for reference only.

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Canada V8V 1P8	Fax:	1-877-750-0004	Fax:	250-382-6139	Web:	www.codanradio.com

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TN490 19" Rack Mount High Power Amplifiers

FRONT VIEW

○ DC ON
○ LOW OUTPUT
○ HIGH VSWR
○ HIGH TEMP

CODAN

REAR VIEW
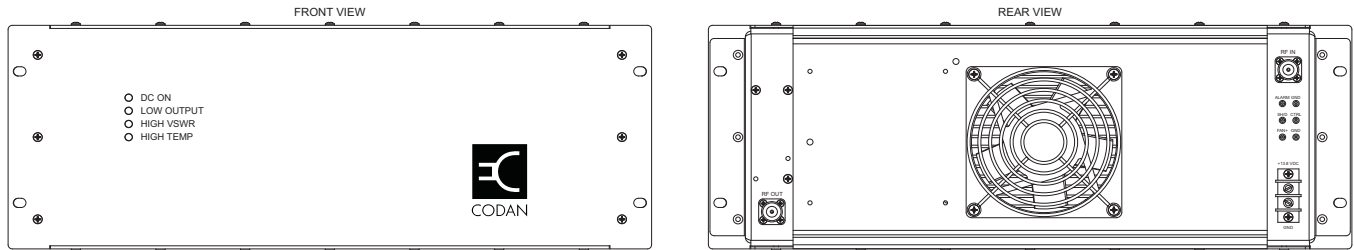
The 19" rack mount high power amplifiers are available in VHF, UHF and 700 / 800 MHz frequency bands. The power amplifiers are rated for continuous duty at an RF output power of 60 - 110, 80 or 100 Watts and is designed to fit in 7" (4 RU) of rack space.

Specifications

Frequency Bands	136 - 144 MHz / 144 - 152 MHz (VHF)
	152 - 162 MHz / 162 - 174 MHz (VHF)
	406 - 450 MHz / 450 - 512 MHz (UHF)
	768 - 869 MHz (700 / 800 MHz)
RF Output Power (factory set)	60 - 110 Watts (VHF)
	100 Watts (UHF)
	80 Watts (700 / 800 MHz)
RF Input Power Range (from exciter)	5.0 to 10.0 Watts (VHF and UHF)
	2.0 to 5.0 Watts (700 / 800 MHz)
Spurious & Harmonics	≤ -63 dBc @ 60 Watts RF output (VHF)
	≤ -65 dBc @ 110 Watts RF output (VHF)
	≤ -70 dBc @ 100 Watts RF output (UHF)
	≤ -70 dBc @ 80 Watts RF output (700 / 800 MHz)
Duty Cycle	100% (-30°C to +60°C)
Load VSWR Tolerance	VSWR Protected above 2.5:1
Output Impedance	50 Ω
Tx Current Drain @ 60 W (VHF)	17 A (typical) / 22 A (maximum)
Tx Current Drain @ 110 W (VHF)	22 A (typical) / 25 A (maximum)
Tx Current Drain @ 100 W (UHF)	21 A (typical) / 25 A (maximum)
Tx Current Drain @ 80 W (700 / 800 MHz)	20 A (typical) / 24 A (maximum)
Weight	10 lbs
Depth	19.0 inches
Vertical Rack Space	7.0 inches (4 RU)
Horizontal Mounting	3.4 inches

43 Erie Street **Victoria, B.C.** **Canada V8V 1P8**	**Toll Free Canada & U.S.A.** **Phone:** 1-800-664-4066 **Fax:** 1-877-750-0004	**International** **Phone:** 250-382-8268 **Fax:** 250-382-6139	**Internet** **Email:** LMRsales@codanradio.com **Web:** www.codanradio.com

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CODAN

RADIO COMMUNICATIONS

TN490 19" Rack Mount High Power Amplifiers

VHF Rear Panel Mount
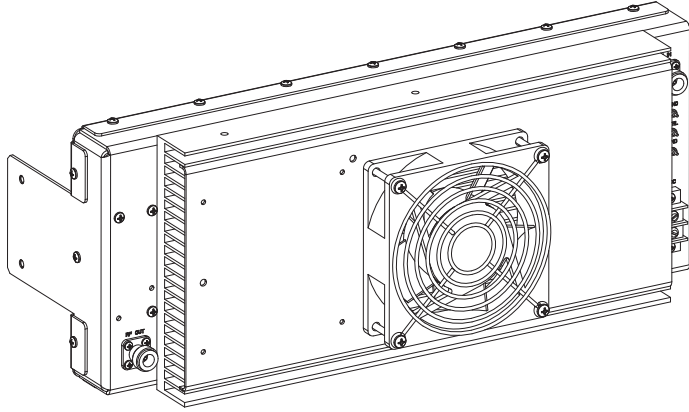
The VHF power amplifier is available in both a 19" rack mount package and a rear panel mount that attaches to the back of the Codan subrack. The rear panel mount cannot be used with an A-PNL-AUX96-3 Auxiliary Connector or the rear panel mount AC to DC or DC to DC Power Supplies. The rear panel mount amplifier does not come with the LED indicators but does maintain the ALARM, CTRL and SH/D pins.

Models Available

AMP-140-110-D1P	Rear Panel Mount, 60 - 110 Watts continuous duty, 136 - 144 MHz
AMP-140-110-D1R	Rack Mount, 60 - 110 Watts continuous duty, 136 - 144 MHz
AMP-148-110-D1P	Rear Panel Mount, 60 - 110 Watts continuous duty, 144 - 152 MHz
AMP-148-110-D1R	Rack Mount, 60 - 110 Watts continuous duty, 144 - 152 MHz
AMP-157-110-D1P	Rear Panel Mount, 60 - 110 Watts continuous duty, 152 - 162 MHz
AMP-157-110-D1R	Rack Mount, 60 - 110 Watts continuous duty, 152 - 162 MHz
AMP-168-110-D1P	Rear Panel Mount, 60 - 110 Watts continuous duty, 162 - 174 MHz
AMP-168-110-D1R	Rack Mount, 60 - 110 Watts continuous duty, 162 - 174 MHz
AMP-428-100-D1R	Rack Mount, 100 Watts continuous duty, 406 - 450 MHz
AMP-481-100-D1R	Rack Mount, 100 Watts continuous duty, 450 - 512 MHz
AMP-817-080-D1R	Rack Mount, 80 Watts continuous duty, 768 - 869 MHz

 TN490   Rev 2-0-0   Aug 16

TN490 19" Rack Mount High Power Amplifiers

Power Amplifier Operation

The 19" rack mount high power amplifer has a heavy duty heatsink and an RF switched cooling fan. The power amplifier has four standard LEDs (not available on the VHF rear panel mount), and a summary alarm pin.

The LEDs operate as follows:

Label	Color	Description
DC ON	Green	Activates when DC power is connected.
LOW OUTPUT	Red	Activates when the output power drops to 80-85% of output power.
HIGH VSWR	Red	Activates when VSWR exceeds 2.5:1.
HIGH TEMP	Red	Activates when the amplifier exceeds safe operating temperature.

The three pins on the rear of the amplifier operate as follows:

Pin	Description
ALARM	A summary alarm that activates (< 1 Vdc) when any of three alarm conditions activate (Low Output, High VSWR or High Temp).
CTRL	When this pin is pulled to ground, the output power is reduced by 1 to 1.5 dB.
SH/D	When this pin is pulled to ground through a 0 to 50 K Ohm resistor, the output power is reduced by up to 4 dB.

TN490 19" Rack Mount High Power Amplifiers

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TN491 Modular 5-Pack Series High Power Amplifiers
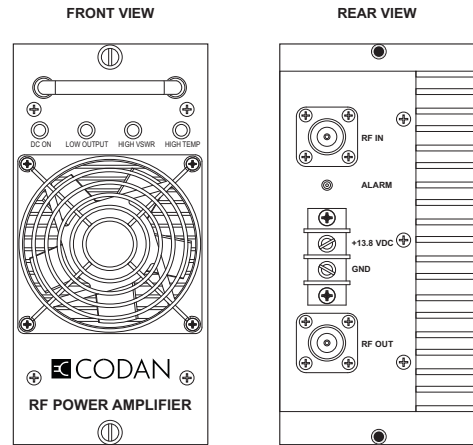
FRONT VIEW REAR VIEW

The modular 5-pack series high power amplifiers are available in VHF, UHF and 700 / 800 MHz frequency bands. The power amplifiers are rated for continuous duty at an RF output power of 80 or 100 Watts. Designed to be fully modular and space efficient, the 5-pack series allows for 5 amplifiers in 4 RU of rack space using a 19" subrack.

Specifications

Frequency Bands	136 - 144 MHz / 144 - 152 MHz (VHF)
	152 - 162 MHz / 162 - 174 MHz (VHF)
	406 - 450 MHz / 450 - 512 MHz (UHF)
	764 - 870 MHz (700 / 800 MHz)
RF Output Power (factory set)	100 Watts (VHF and UHF)
	80 Watts (700 / 800 MHz)
RF Input Power Range (from exciter)	5.0 to 10.0 Watts (VHF and UHF)
	2.0 to 5.0 Watts (700 / 800 MHz)
Spurious & Harmonics	≤ -65 dBc @ 100 Watts RF output (VHF)
	≤ -70 dBc @ 100 Watts RF output (UHF)
	≤ -70 dBc @ 80 Watts RF output (700 / 800 MHz)
Duty Cycle	100% (-30°C to +60°C)
Load VSWR Tolerance	VSWR Protected above 2.5:1
Output Impedance	50 Ω
Tx Current Drain @ 100 W (VHF)	18 A (typical) / 23 A (maximum)
Tx Current Drain @ 100 W (UHF)	21 A (typical) / 25 A (maximum)
Tx Current Drain @ 80 W (700 / 800 MHz)	20 A (typical) / 24 A (maximum)
Weight	10 lbs
Depth	19.0 inches
Vertical Rack Space	7.0 inches (4 RU)
Horizontal Mounting	3.4 inches

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RADIO COMMUNICATIONS

TN491 Modular 5-Pack Series High Power Amplifiers

Models Available

A-RACK19-AMP-02   19" Subrack for 5-Pack Series Amplifiers, holds up to 5 amps

AMP-140-100-D1M   5 Pack Series, 100 Watts continuous duty, 136 - 144 MHz
AMP-148-100-D1M   5 Pack Series, 100 Watts continuous duty, 144 - 152 MHz
AMP-157-100-D1M   5 Pack Series, 100 Watts continuous duty, 152 - 162 MHz
AMP-168-100-D1M   5 Pack Series, 100 Watts continuous duty, 162 - 174 MHz
AMP-428-100-D1M   5 Pack Series, 100 Watts continuous duty, 406 - 450 MHz
AMP-481-100-D1M   5 Pack Series, 100 Watts continuous duty, 450 - 512 MHz
AMP-817-080-D1M   5 Pack Series, 100 Watts continuous duty, 768 - 869 MHz

Power Amplifier Operation

The Modular 5-pack Series high power amplifer has a heavy duty heatsink and an RF switched cooling fan. The power amplifier has four standard LEDs, and a summary alarm pin.

The LEDs operate as follows:

Label	Color	Description
DC ON	Green	Activates when DC power is connected.
LOW OUTPUT	Red	Activates when the output power drops to 80-85% of output power.
HIGH VSWR	Red	Activates when VSWR exceeds 2.5:1.
HIGH TEMP	Red	Activates when the amplifier exceeds safe operating temperature.

The ALARM pin on the rear of the amplifier operates as follows:

Pin	Description
ALARM	A summary alarm that activates (< 1 Vdc)when any of three alarm conditions activate (Low Output, High VSWR or High Temp).

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TN500 SR-39-1 Subrack

The SR-39-1 subrack is designed to hold and interconnect the MT-3 and MT-4 series of receiver, transmitter and control modules on one universal motherboard. This Type 84 motherboard makes extensive use of cage jacks to interconnect the A and B systems supporting a number of field configurations. Additional auxiliary control connectors provide easy access to virtually all control and audio lines, simplifying many standard base / repeater configurations. Modules may be inserted in the subrack in many various configurations as shown in Figure 1. The Control 1 connector is used for the base or repeater control card or paging modulator. The Optional Control 2 card is for custom systems requiring specialized paging / data / audio interconnections and is not normally used. If the radio system is ordered with antenna relays, the system regulator with the relays is housed in a larger module that encompasses the area for the Control 2 module. The subrack has room for two transmitter and receiver pairs. The left side connectors are reserved for transmitter and receiver A (C in second subrack) respectively, while the right side connectors are reserved for transmitter and receiver B (D in second subrack). Although any transmitter and receiver can be placed in either of the respective slots, convention usually follows that the lower frequency radios will go in slots A and the higher in slots B to D.
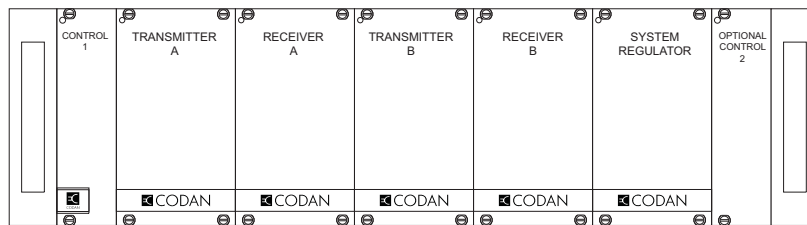

Figure 1: Standard Subrack

A quadruple system is shown in Figure 2 with A and B pairs in the first rack, and C and D pairs in the second rack. This system requires a multiple link controller and two system regulators.
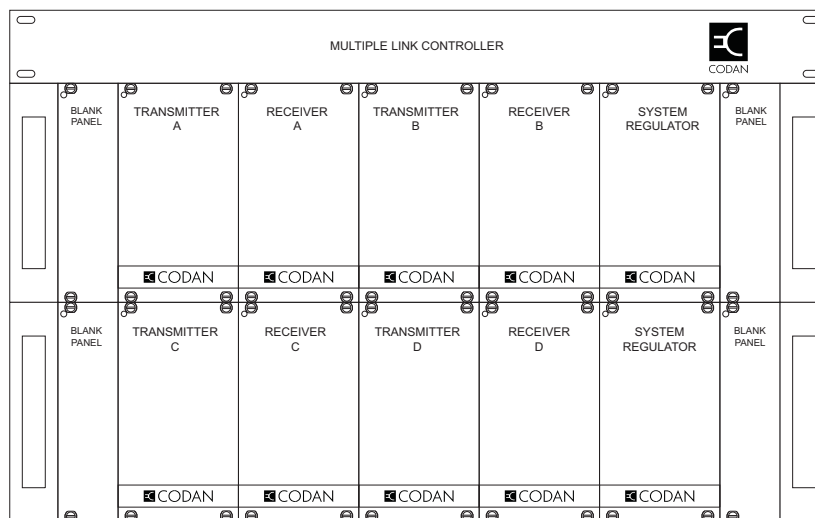

Figure 2: Dual Subracks for Multiple Link Configuration

TN500 SR-39-1 Subrack

If a VHF or UHF power amplifier is installed, only one transmitter and receiver pair can be installed since the power amplifier takes up two slots, as shown in Figure 3.
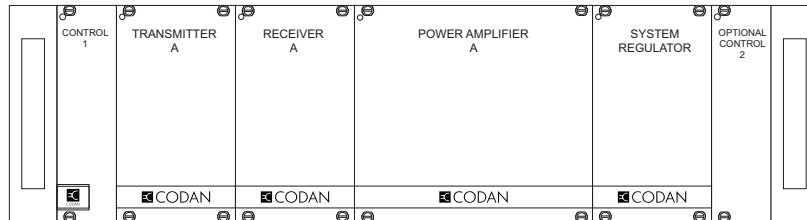

Figure 3: Subrack with Power Amplifier

If two transceivers are used with power amplifiers, the power amplifiers are normally installed in a second subrack as shown in Figure 4. This keeps all of the audio and control signal routing to a single subrack, simplifying the system. A second system regulator and the mulitiple link controller are not required for this configuration.
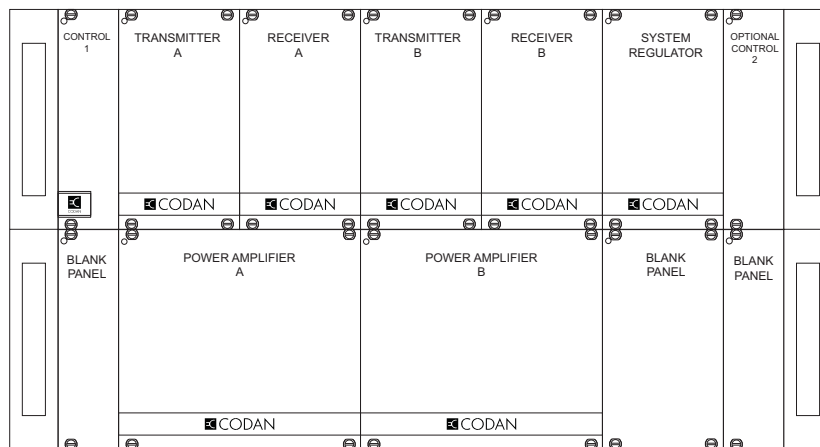

Figure 4: Dual Subracks with Two Power Amplifiers

The 96 pin auxiliary control connector, located on the back of the motherboard (facing rear of the subrack), has 96 pins and provides access to virtually all signal and power lines on the motherboard. Many repeater configurations can be implemented by interconnecting some of these lines through a mating 96 pin connector. Additionally, external equipment can also be connected to the repeater through the auxiliary control connector, allowing for more extensive radio control (i.e., DC remotes, tone remotes etc.). Note: The + and - DC lines from the auxiliary control connector are not fused. Use caution with these lines so that interconnect cables are not overloaded.

DB25 Connector to CI-RC-4M-G2

Connector J12 is a female DB25 connector which can be used for connecting audio, channel select and control signal lines to a CI-RC-4M-G2 (second generation) multiple link controller. When connecting to a CI-RC-4M-G2, a standard straight-through male-to-male DB25 cable can be used.

43 Erie Street Victoria, B.C. Canada V8V 1P8	**Toll Free Canada & U.S.A.** Phone: 1-800-664-4066 Fax: 1-877-750-0004	**International** Phone: 250-382-8268 Fax: 250-382-6139	**Internet** Email: LMRsales@codanradio.com Web: www.codanradio.com

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TN500 SR-39-1 Subrack

Power Input

The main power input (+10 to +17 Vdc; +13.8 Vdc nominal) connector is located at the back of the subrack, on the motherboard. There is an identical +9.5 Vdc power output connector on the motherboard that is used to power other Codan equipment at +9.5 Vdc (the CI-RC-4M-G2 controller, for example).

NOTE: Do not connect the main power input to the +9.5 Vdc power output connector, as a transient suppressor (over voltage protection) will short to ground to protect the equipment.

Reverse voltage protection and over voltage protection (transient suppressor) is provided at the main power input as well as the +9.5 Vdc line. The main power input is protected with a standard fast-blow 15 amp fuse. These components may require replacing if the power supply is not connected properly, or even after a power surge or a lightning strike. The two transient suppressors have different voltage ratings for the main power input and +9.5 Vdc lines. Figure 5 shows the subrack / motherboard rear view.

Antenna Relay Activation

The motherboard on the subrack contains a set of jumpers that are used to activate the optional antenna relays in the System Regulator module from the Transmitter PTT IN and PTT OUT signal lines.

JU36	TXA PTT OUT activates Relay A	JU37	TXA PTT IN activates Relay A
JU39	TXA PTT OUT activates Relay B	JU40	TXA PTT IN activates Relay B
JU42	TXB PTT OUT activates Relay A	JU43	TXB PTT IN activates Relay A
JU45	TXB PTT OUT activates Relay B	JU46	TXB PTT IN activates Relay B

Simplex Operation

The motherboard on the subrack contains a set of jumpers that are enabled when the radio system is operated in simplex mode (simplex base station or simplex links). The jumper connects the Transmitter PTT OUT signal line to the RX MUTE. This jumper will cause the receiver to mute when the transmitter is keyed.

JU38	TXA PTT OUT mutes RXA	JU41	TXA PTT OUT mutes RXB
JU44	TXB PTT OUT mutes RXA	JU47	TXB PTT OUT mutes RXB

DB25 Connector to DSP-223 and IP-223 / IP-224

Connector J10 is a female DB25 connector which can be used for basic base connections. When connected to a Telex DSP-223 or IP-223 / IP-224, a standard straight-through male-to-male DB25 cable can be used with some motherboard jumper changes. The IP-224 requires a female DB25 to male DB37 adapter. The IP-223 / IP-224 also requires that 2 pins on the DB25 (PTT COM - pin2 and MON COM - pin 16) are wired to ground for proper operation. The DB25 can also be jumpered for Balanced Audio direct to / from the receiver / transmitter or Auxiliary Audio (recommended) through the controller.

WARNING: JU108 must be configured correctly for DSP-223 or IP-223 / IP-224 or damage can occur.

JU104	A = RX A Bal O/P2 or B = AUX 1 AUD O/P2	JU107	A = RX A Bal O/P1 or B = AUX AUD O/P1
JU105	A = TX A Bal I/P2 or B = AUX 1 AUD I/P2	JU108	A = DSP-223 / +13.8 V or B = IP-223 & IP-224 / RX A COR
JU106	A = TX A Bal I/P1 or B = AUX 1 AUD I/P1	JU109	TX A SEC / CLR I/P (installed to enable TX A SEC / CLR I/P)

TN500 SR-39-1 Subrack

Channel and Bank Select

MT-4E radio modules are capable of 16 channel operation in 2 banks (32 channels total). The 16 channels are controlled via four CSEL signal lines connected to each receiver and transmitter module. The CSEL signal lines are set as either a 0 (0 Vdc) or a 1 (+9.5 Vdc).

JU48	TX A Channel select lines +9.5 V pullup enable	JU49	RX A Channel select lines +9.5 V pullup enable
JU50	TX A CSEL 0	JU51	TX A CSEL 1
JU52	TX A CSEL 2	JU53	TX A CSEL 3
JU54	TX A Bank select A = Bank A, B = Bank B	JU55	RX A CSEL 0
JU56	RX A CSEL 1	JU57	RX A CSEL 2
JU58	RX A CSEL 3	JU59	RX A Bank select A = Bank A, B = Bank B
JU60	TX B Channel select lines +9.5 V pullup enable	JU61	RX B Channel select lines +9.5 V pullup enable
JU62	TX B CSEL 0	JU63	TX B CSEL 1
JU64	TX B CSEL 2	JU65	TX B CSEL 3
JU66	TX B Bank select A = Bank A, B = Bank B	JU67	RX B CSEL 0
JU68	RX B CSEL 1	JU69	RX B CSEL 2
JU70	RX B CSEL 3	JU71	RX B Bank select A = Bank A, B = Bank B
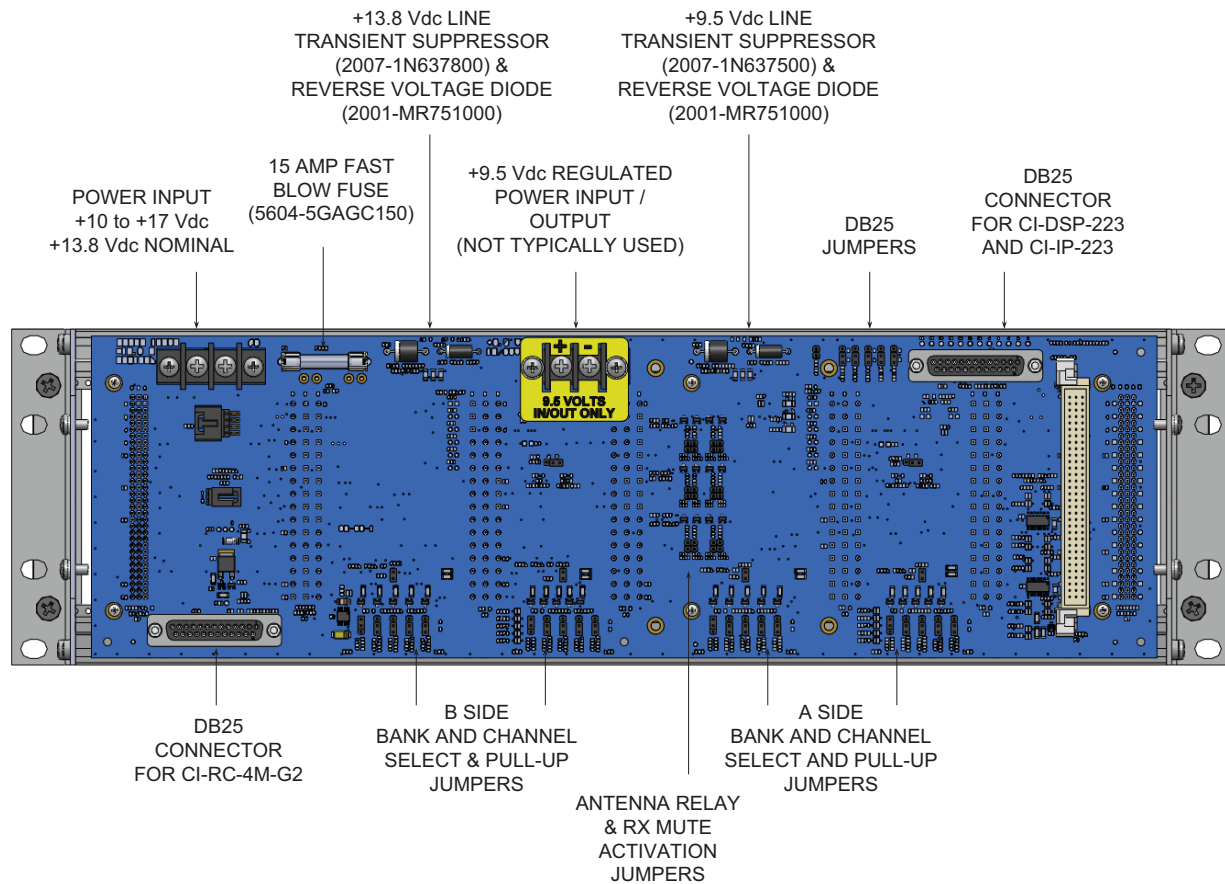
Figure 5: Rear View of Subrack

TN500   Rev 5-0-0   Aug 16

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TN520 SR-39-3 Multiple Receiver Subrack

The SR-39-3 subrack is designed to hold and interconnect the MT-3 and MT-4 series of receivers on one universal motherboard. The SR-39-3 subrack holds up to five receiver modules and one system regulator (the system regulator will require jumpers JU15 to JU24 installed for multiple receiver subrack compatibility) as shown in Figure 1.

The multiple receiver subrack is ideal for voting receivers or with the mutliple transmitter subrack for multi-channel trunking systems.
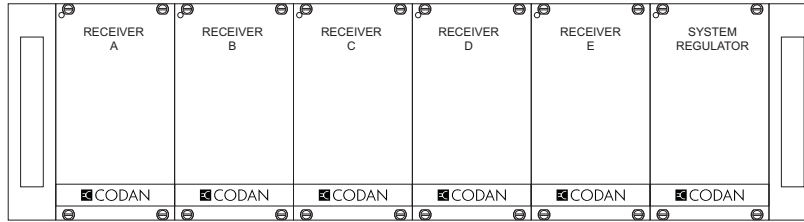

Figure 1: Multiple Receiver Subrack

The multiple receiver subrack does not interconnect the different receivers but brings control lines and audio out to connection points on the rear of the subrack. The external control connectors allow access to the following signals on each receiver:

Pin No.	Name	Function
1	RX CSEL 3	Receiver channel select line No. 3
2	RX CSEL 2	Receiver channel select line No. 2
3	RX CSEL 1	Receiver channel select line No. 1
4	RX CSEL 0	Receiver channel select line No. 0
5	RX COR RLY COM1	Receiver Carrier Operated Relay Common 1
6	RX RLY NC1/NO1	Receiver Relay Normally Open / Normally Closed
7	RX COR	Receiver Carrier Operated Relay output
8	RX DISC/FL/DE	Receiver Disc or Flat or De-emphasis audio output (MT-3)
		Receiver Disc or SM-3 Speaker audio output (MT-4E)
9	RX SQL OVER	Receiver squelch override input
10	RX SYN LOCK DET (Spare)	Receiver Spare I/O
11	RX PRIORITY COR	Receiver Priority COR output (MT-3)
		Receiver A/D Mode (MT-4E)
12	RX RSSI	Receiver Signal Strength Indicator
13	RX BAL O/P 2	Receiver balanced audio output, side 2
14	RX BAL O/P 1	Receiver balanced audio output, side 1
15	RX MUTE	Receiver mute input
16	GND	Circuit common

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TN530 SR-39-4 Multiple Transmitter Subrack

The SR-39-4 subrack is designed to hold and interconnect the MT-3 and MT-4 series of transmitters on one universal motherboard. The SR-39-4 subrack holds up to five transmitter modules as shown in Figure 1. The SR-39-4 has a built in voltage regulator mounted behind the blank panel on the right side of the subrack.

The multiple transmitter subrack is ideal for multi-channel trunking systems with the mutliple receiver subrack.
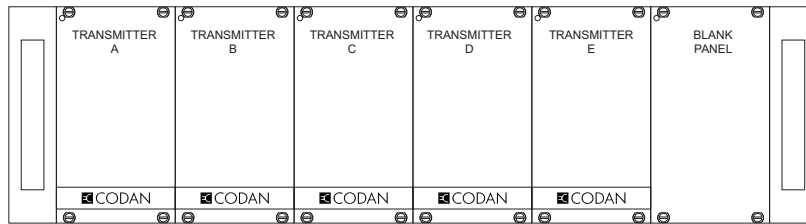

Figure 1: Multiple Transmitter Subrack

The multiple transmitter subrack does not interconnect the different transmitters but brings control lines and audio out to connection points on the rear of the subrack. The external control connectors allow access to the following signals on each transmitter:

| Pin No.	Name	Function
1	TX CSEL 3	Transmitter channel select line No. 3
2	TX CSEL 2	Transmitter channel select line No. 2
3	TX CSEL 1	Transmitter channel select line No. 1
4	TX CSEL 0	Transmitter channel select line No. 0
5	TX MIC OUT	Transmitter microphone output
6	TX STANDBY	Transmitter Standby (MT-3)
		Transmitter Bank A / B Select input (MT-4E)
7	TX PTT	Transmitter Push To Talk input
8	TX BAL I/P 1	Transmitter balanced audio input, side 1
9	TX BAL I/P 2	Transmitter balanced audio input, side 2
10	TX SQL FLAT I/P	Transmitter Squelch flat audio input (MT-3 Only)
11	TX SQL DE-EMP	Transmitter Squelch De-emphasis input (MT-3)
		Transmitter SM-3 Speaker audio input (MT-4E)
12	TX SUBT I/P 1	Transmitter Subtone input 1
13	TX SUBT I/P 2	Transmitter Subtone input 2 (MT-3)
		Transmitter Secure / Clear input (MT-4E)
14	TX PTT OUT	Transmitter Push To Talk output
15	TX DIR MOD	Transmitter Direct Modulation input (MT-3)
		Transmitter A / D Mode Control input (MT-4E)
16	GND	Circuit common

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CODAN
RADIO COMMUNICATIONS

TN600 AC-3E Audio Control Card

The AC-3E audio control card is a plug-in module which provides audio routing, PTT routing, and muting control for MT-3 and MT-4 radio systems. The audio control card includes the following features:

• jumper selectable audio routing, PTT, and muting.
• two independently adjustable hang timers adjustable from 50 milliseconds to 10 seconds.
• sockets for optional CTCSS decoders and encoders.
• low power analog and CMOS control circuitry.
• maximum standby current of 30 mA.
• true balanced 600 Ω inputs and outputs for external equipment connection.
• optically isolated inputs and outputs for control by external equipment.
• suitable for Type 2 E&M signalling.
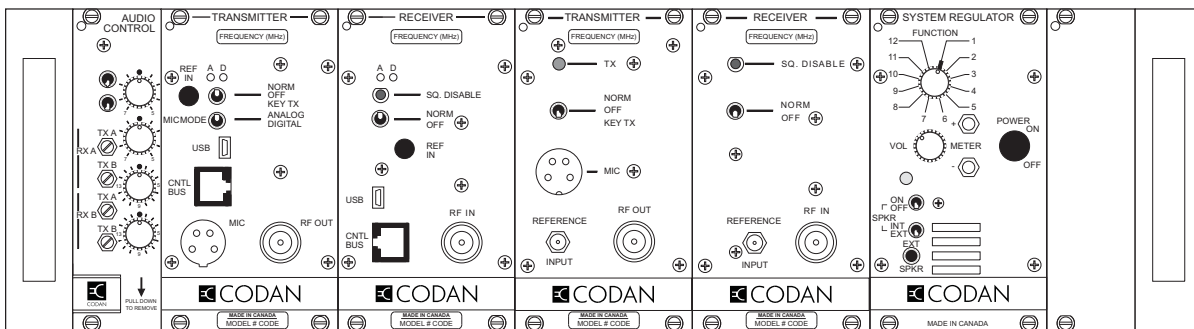
The AC-3E audio control card is fully configurable and can be used for all repeater and base station applications. The audio control card module circuitry consists of three main functional blocks:
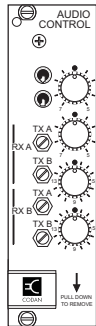
(1) The repeater control circuit, which allows all COR / PTT routing combinations for all repeaters.

(2) Optional CTCSS modules that can be installed at the factory or in the field.

(3) Audio routing circuitry for active level control and distribution of receiver to transmitter audio signals. The AC-3E is designed for applications where interface to external equipment is required. All audio and control inputs/outputs are isolated by transformers and opto-isolators on the AC-3E.

External Audio Input:	600 Ω, -25 dBm to 0 dBm adjustable
External Audio Output:	600 Ω, -20 dBm to +3 dBm adjustable
Internal Audio Input:	4.7 KΩ, -25 dBm to +3 dBm adjustable

The AC-3E audio control card includes four potentiometers on the front panel for adjusting internal audio levels. Optional frequency select rotary switches can also be mounted on the front panel of the audio control cards, giving easy access to 16 pre-programmed receiver and transmitter operating frequencies. Two switches are mounted on the front of the audio control cards that can be configured to control CTCSS on / off or repeat disable. Configuration of all switches on the audio control card is set up at the factory at the time of order.

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TN600 AC-3E Audio Control Card

Although the Audio Control Card can be configured to work in various configurations with add-in options and functionality, the three main functions of the AC-3E Audio Control Card are shown in Figures 1, 2 and 3:
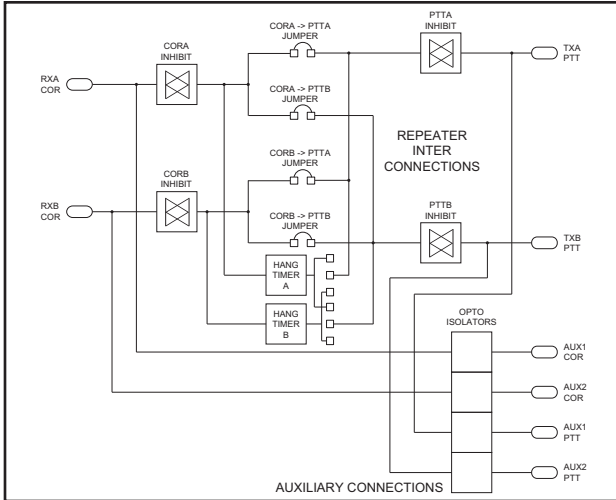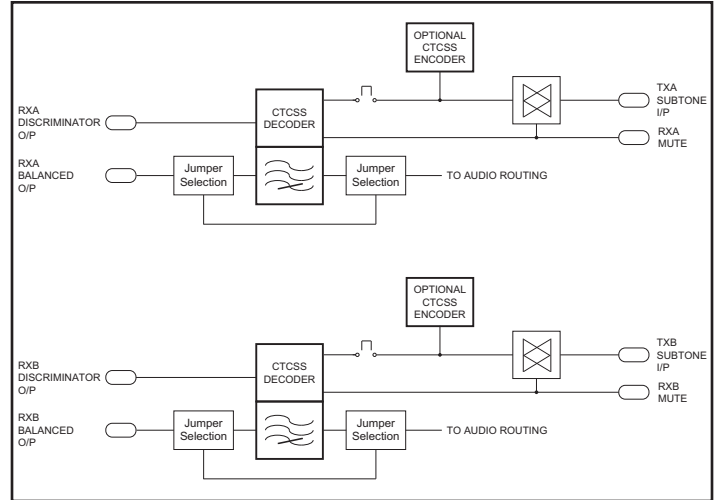
Figure 1: Repeater Control
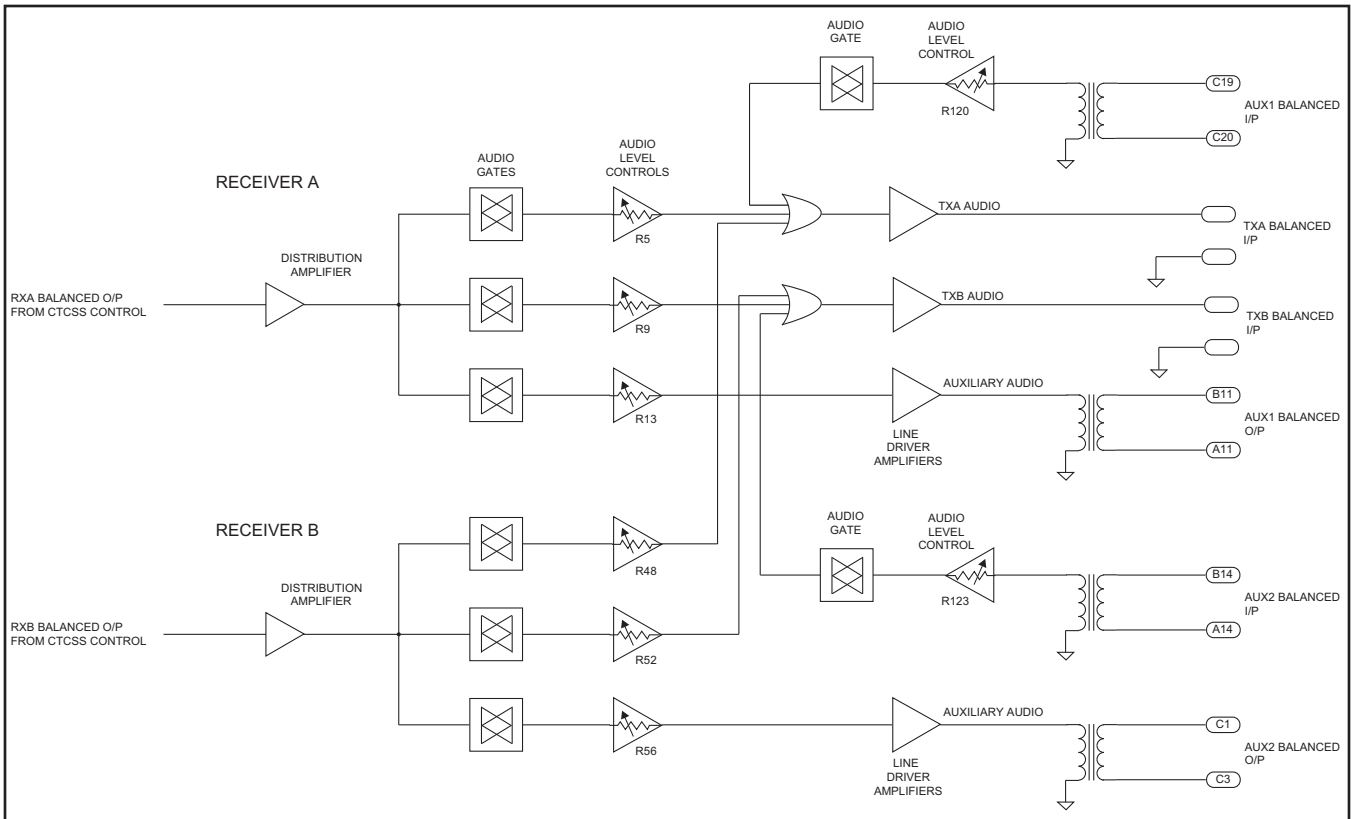
Figure 2: CTCSS Control

Figure 3: Audio Routing

TN600   Rev 6-0-0   May 14

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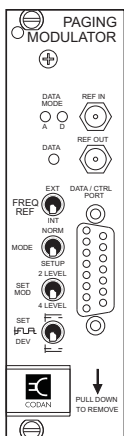
TN640 CI-PM-3 Paging Modulator

The Paging Modulator is a plug-in module which provides digital and/or analog paging capability, such as base station paging, remote paging or simulcast paging, for MT-3 and MT-4 radio systems. The CI-PM-3 is configured via the front panel switches and internal jumper settings.

The CI-PM-3 paging modulator supports both analog and digital paging formats, and can transmit POCSAG and other 2-level modulation schemes at transfer rates of 512, 1200 and 2400 baud. It can also be configured for use as a data repeater, whereby 2-level paging data is recovered, re-shaped and then re-transmitted to an additional repeater/paging transmitter.

The CI-PM-3 supports 4-level modulation formats at data transfer rates up to 6400 bps. Each of the four modulation deviation levels can be independently set, making the CI-PM-3 suitable for use in such pager signaling schemes as Motorola's FLEX™ paging protocol.
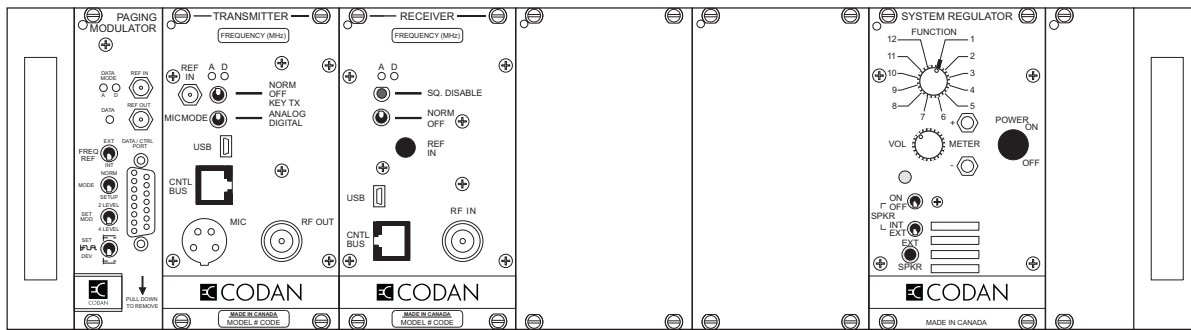
The CI-PM-3 uses an on-board frequency reference source consisting of a 10 MHz OCXO, with a frequency stability of ± 0.35 ppm from -30°C to +60°C. For high stability applications (such as Simulcast), the CI-PM-3 paging modulator may be configured to use an external high stability reference source (i.e., rubidium, GPS or WWV) with a standard stability greater than or equal to 0.002 ppm, to discipline the on-board phase-locked loop OCXO oscillator.

The CI-PM-3 Paging Modulator includes the following standard features:

• low power analog and CMOS control circuitry (current draw of less than 250 mA).
• extended operating temperature range.
• jumper selectable repeater/paging transmitter configuration.
• on-board 10 MHz OCXO.
• front panel selection of PLL OCXO using external high stability frequency reference.
• jumper and line selectable analog/digital paging configuration.
• connection for optional CTCSS encoder/decoder.
• balanced 600 Ω / single-ended microphone input.
• selectable digital delay for simulcast operation.

FLEX™ is a trademark of Motorola, Inc.

	Toll Free Canada & U.S.A.	International	Internet
43 Erie Street			
Victoria, B.C.	**Phone:** 1-800-664-4066	**Phone:** 250-382-8268	**Email:** LMRsales@codanradio.com
Canada V8V 1P8	**Fax:** 1-877-750-0004	**Fax:** 250-382-6139	**Web:** www.codanradio.com

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TN640 CI-PM-3 Paging Modulator

Installation:

Figure 1 shows a generic connection between the Codan subrack with A-PNL-AUX96-3 auxiliary connector to the Zetron Model 66 for analog and/or digital 2 level paging.
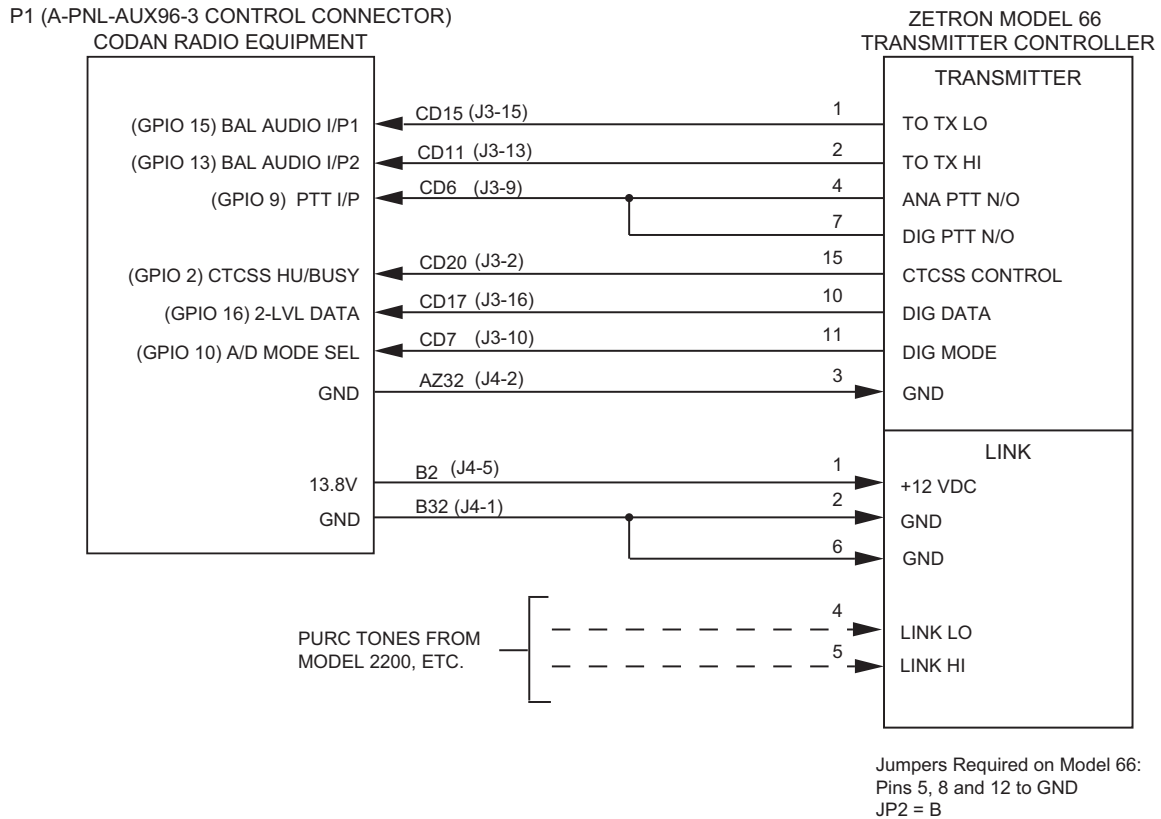

Figure 1: CI-PM-3 Connection Diagram

EC CODAN
### RADIO COMMUNICATIONS

TN650 CI-RC-4L Repeater Control Card

The CI-RC-4L repeater control card is a plug-in module which provides LVDS Serial Data routing, COR-PTT routing, and receiver priority settings for an MT-4 repeater radio system. The repeater control card includes the following features:

• jumper selectable LVDS Serial Data and COR-PTT routing (repeater configuration).
• receiver priority setting jumpers for certain configurations (where required).
• jumpers for disabling LVDS Serial Data and COR-PTT routing on simplex links.
• optional CTCSS interface board for 1 of 10 CTCSS tone decode selection (used for custom systems only).

The MT-4 receiver and transmitter modules all plug into the CI-RC-4L repeater controller via cables that plug in to the RJ45 jacks on the front panel of all the modules. The CI-RC-4L comes with four different cable lengths to plug into the four repeater receiver and repeater transmitter modules. If the system only uses two of the cables, the other cables can be kept for future system expansion or as spare cables.
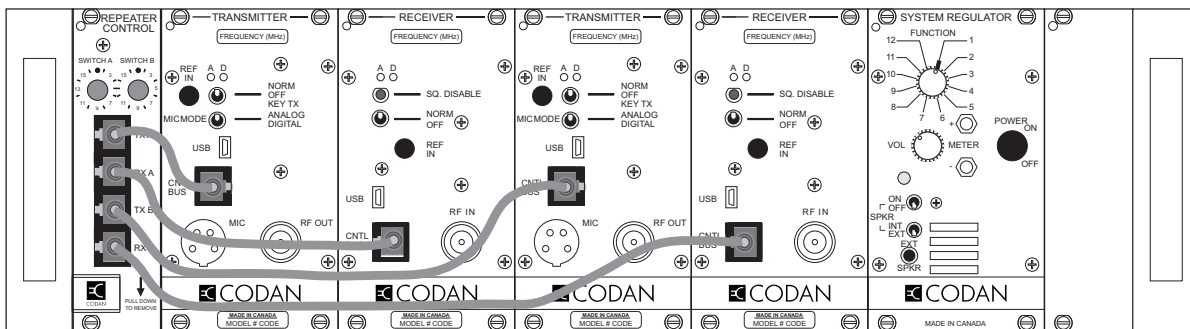
Optional frequency select rotary switches can also be mounted on the front panel of the repeater control card, giving easy access to 16 pre-programmed receiver and transmitter operating frequencies. The CI-RC-4L has no external audio or serial data and is used only for controlling repeater configurations. The repeater control card module circuitry consists of three main jumper functions:
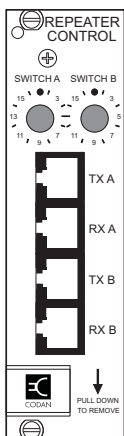
(1) Repeater Configuration jumpers used to determine which receiver keys and routes data to which transmitter.

(2) Receiver priority settings used to set receiver priority for certain repeater configurations.

(3) Additional jumpers for the CTCSS interface board and other miscellaneous functions.

TN650 CI-RC-4L Repeater Control Card

Repeater Configuration Jumpers

Repeater Configuration	Keying	JU1	JU2	JU3
Repeater in A side of subrack	RXA -> TXA	Out	Out	Out
Repeater in B side of subrack	RXB -> TXB	In	Out	Out
Two independant repeaters in each side of subrack	RXA -> TXA RXB -> TXB	Out	In	Out
* Drop-Link on A side (Repeater in the A side with a link on the B side)	RXA -> TXA RXA -> TXB RXB -> TXA	In	In	Out
* Drop-Link on B side (Repeater in the B side with a link on the A side)	RXA -> TXB RXB -> TXA RXB -> TXB	Out	Out	In
Crossband System	RXA -> TXB RXB -> TXA	In	Out	In
Crossband System with Simplex frequencies on A or B side (First receiver has priority)	RXA -> TXB RXB -> TXA	In	In	In
* Drop-Repeating Link (Repeater in A or B side with repeating link in A or B side)	RXA -> TXA RXA -> TXB RXB -> TXA RXB -> TXB	Out	In	In

Receiver Priority Jumper Settings

These jumpers are only used for the Drop-Link configurations noted with an * above. For Drop-Links with Simplex links, set the receiver priority to the local repeater receiver.

Receiver Priority	JU9	JU10	JU11
First receiver active has priority	Out	Out	Out
RXA priority	In	Out	Out
RXB priority	Out	In	Out

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CODAN
RADIO COMMUNICATIONS

TN652 CI-RC-4M-G2 Multiple Link Controller

The CI-RC-4M-G2 Multiple Link Controller provides control capability for up to four receiver / transmitter pairs in an MT-4E repeater radio system. The CI-RC-4M-G2 controller provides the following features:

• interconnection (LVDS Serial Data routing, COR-PTT routing, Audio routing) of up to four receiver and four transmitter modules in any configuration (repeater, repeater with links, crossband systems, etc.).
• four-way analog audio bridge allowing analog to digital and digital to analog conversions with up to four pairs of radios (with adjustable audio levels).
• multiple CTCSS tones and NAC codes may be selected to operate each connection between receivers and transmitters (up to seven CTCSS/NAC for each link).
• DTMF control of receiver to transmitter links.
• setting of receiver priorities.
• transmitter channel switching based on received CTCSS or NAC.
• auxiliary E&M connection.
• acknowledge tones for each transmitter on DTMF disable / enable.
• custom jumperable Repeat Disable line for controlling analog bridging (links) and E&M connections.
• current draw of 8 mA to 72 mA dependant on system configuration (17 mA to 27 mA without audio bridging).
• 2 independent general purpose outputs that can be controlled by NAC, CTCSS or DTMF
(open collector 750 mA / 30 Vdc max).

The MT-4E receiver and transmitter modules all plug into the CI-RC-4M-G2 repeater controller via cables that plug into the RJ45 jacks on the front panel of all the modules. The CI-RC-4M-G2 comes with eight different cable lengths to plug into the eight repeater receiver and repeater transmitter modules. If the system only uses some of the cables, the other cables can be kept for future system expansion or as spare cables. The CI-RC-4M-G2 is 19" rack mountable in 1 RU of rack space.
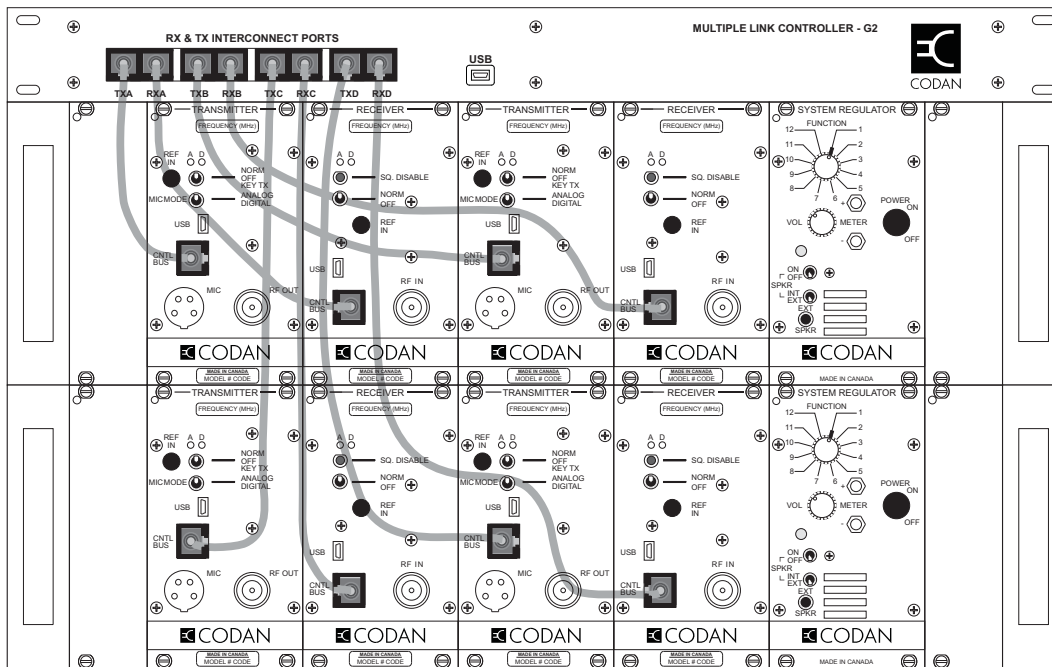
43 Erie Street
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Phone: 1-800-664-4066
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Phone: 250-382-8268
Fax: 250-382-6139

Internet
Email: LMRsales@codanradio.com
Web: www.codanradio.com

TN652 CI-RC-4M-G2 Multiple Link Controller

Installation:

In addition to the RJ45 interconnect cables on the front panel, the +9.5 Vdc power and ground must be connected on the back panel. Figure 1 shows a diagram of the back panel of the CI-RC-4M-G2.
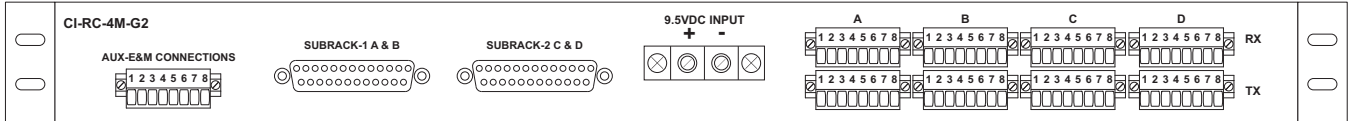
Figure 1:CI-RC-4M-G2 Back Panel

A female DB25 connector on the back of the subrack (J12) can be used for connecting to the CI-RC-4M-G2 using a standard straight-through male-to-male DB25 cable. The A-PNL-AUX96-3 auxiliary connector can also be used to connect to the CI-RC-4M-G2, as shown in Figure 2. The information in brackets is the function that uses that particular connection. For example, if you are using CTCSS tones, the Rx Disc O/P must be connected. The diagram only shows connections for Receiver and Transmitter A.
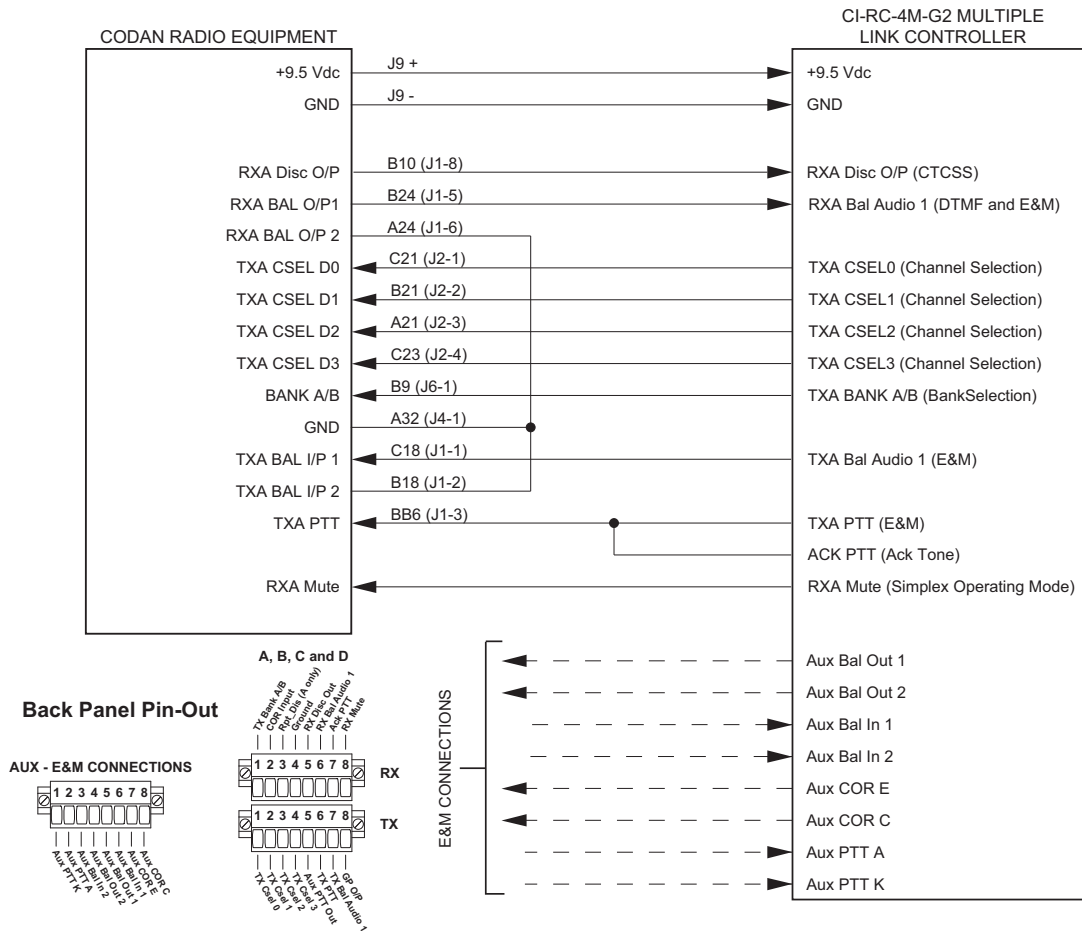
Figure 2: CI-RC-4M-G2 Connection Diagram

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TN652 CI-RC-4M-G2 Multiple Link Controller

Multiple Link Controller Programming:

The CI-RC-4M-G2 multiple link controller is software programmable using the MLCS (Multiple Link Controller Software). The MLCS allows flexible programming options for the radio system. A type A to 5 pin mini-type B USB cable is used to connect the USB port of the computer to the USB port on the front panel of the controller. The System Settings and Receiver / Transmitter Links windows are shown in Figure 3.
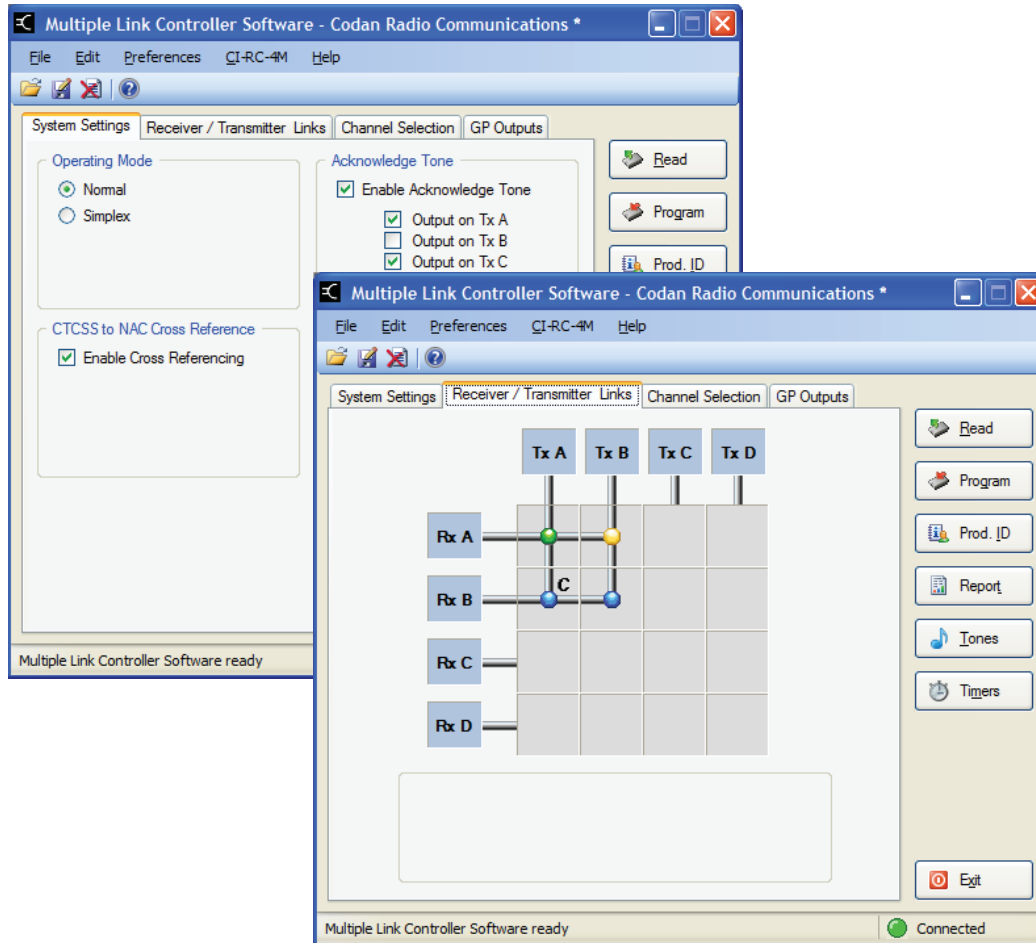
Figure 3: Sysytem Settings and Receiver / Transmitter Links

The Receiver / Transmitter Links window allows for a wide variety of complex repeater configurations using a link configuration grid. The grid uses color coding to indicate different connection settings.

TN652 CI-RC-4M-G2 Multiple Link Controller

Each link on the grid can be programmed separately for a different configuration. Three different link configurations are shown in Figure 4: COR Controlled Link, DTMF Controlled Link and a Conditional Link (with both CTCSS and NAC conditions, as well as Channel Selection capability).
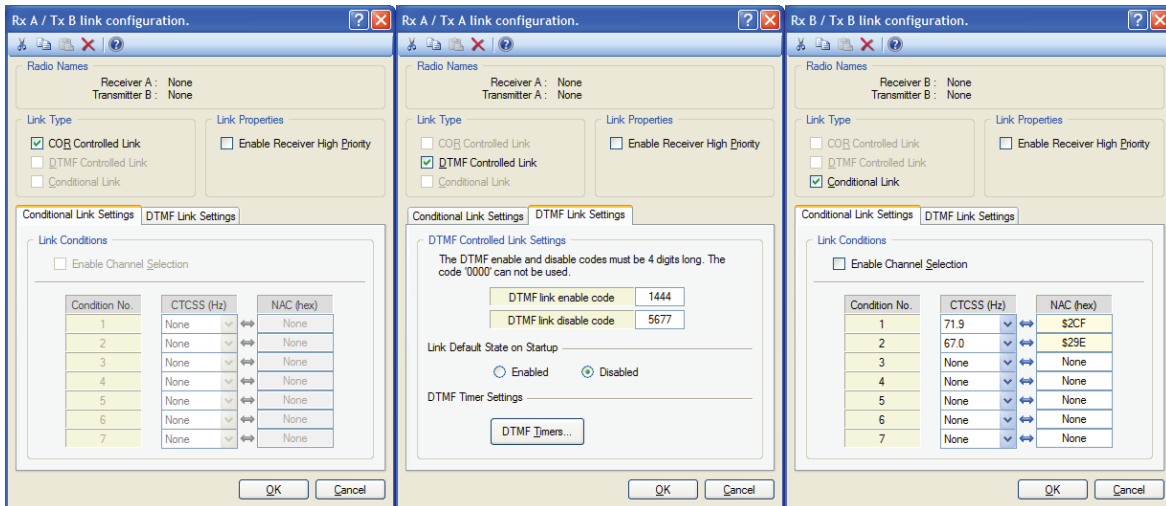
Figure 4: Link Configurations

Figure 5 shows the CTCSS selection window (CTCSS tones need to selected globally for the CI-RC-4M-G2), Channel Selection window and General Purpose Output window.
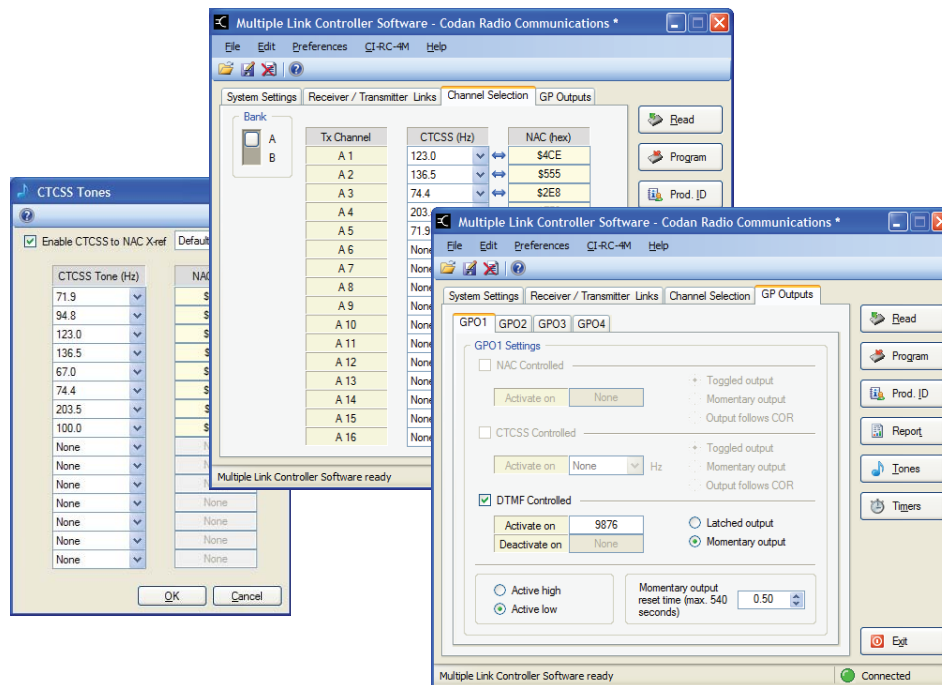
Figure 5: CTCSS Tones, Channel Select and General Purpose Outputs

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TN652 CI-RC-4M-G2 Multiple Link Controller

Analog Audio Bridging Circuit:

The CI-RC-4M-G2 controller is equipped with a 4 way analog audio bridge. This audio bridge allows the user to interconnect RF modules using an analog audio interface similar to the AC-3E and BC-4E products. It allows the user to interconnect up to four RF modules modules as well as an auxiliary audio input and output.

On the multi-link controller there is an audio adjustment pot for each audio path available. The block diagram on the next page (see Figure 6) shows the audio routing and audio pot adjustments.

To enable a specific audio path, the appropriate audio jumper must be <u>removed</u>. For the specific audio jumper required for enabling the appropriate audio path, refer to the jumper table below:

JU53	RXA to TXA Audio Disable	JU63	RXC to TXA Audio Disable
JU59	RXA to TXB Audio Disable	JU70	RXC to TXB Audio Disable
JU54	RXA to TXC Audio Disable	JU64	RXC to TXC Audio Disable
JU58	RXA to TXD Audio Disable	JU68	RXC to TXD Audio Disable
JU52	RXB to TXA Audio Disable	JU65	RXD to TXA Audio Disable
JU57	RXB to TXB Audio Disable	JU71	RXD to TXB Audio Disable
JU51	RXB to TXC Audio Disable	JU66	RXD to TXC Audio Disable
JU56	RXB to TXD Audio Disable	JU69	RXD to TXD Audio Disable
JU55	RXA to Aux Audio O/P Disable		
JU50	RXB to Aux Audio O/P Disable		
JU62	RXC to Aux Audio O/P Disable		
JU67	RXD to Aux Audio O/P Disable		

To enable COR-PTT routing of the signla, the following jumpers must be <u>installed</u>:

|			
JU23A	COR A to PTT A Enable	JU25A	COR A to PTT C Enable
JU23B	COR B to PTT A Enable	JU25B	COR B to PTT C Enable
JU23C	COR C to PTT A Enable	JU25C	COR C to PTT C Enable
JU23D	COR D to PTT A Enable	JU25D	COR D to PTT C Enable
JU24A	COR A to PTT B Enable	JU26A	COR A to PTT D Enable
JU24B	COR B to PTT B Enable	JU26B	COR B to PTT D Enable
JU24C	COR C to PTT B Enable	JU26C	COR C to PTT D Enable
JU24D	COR D to PTT B Enable	JU26D	COR D to PTT D Enable

TN652 CI-RC-4M-G2 Multiple Link Controller
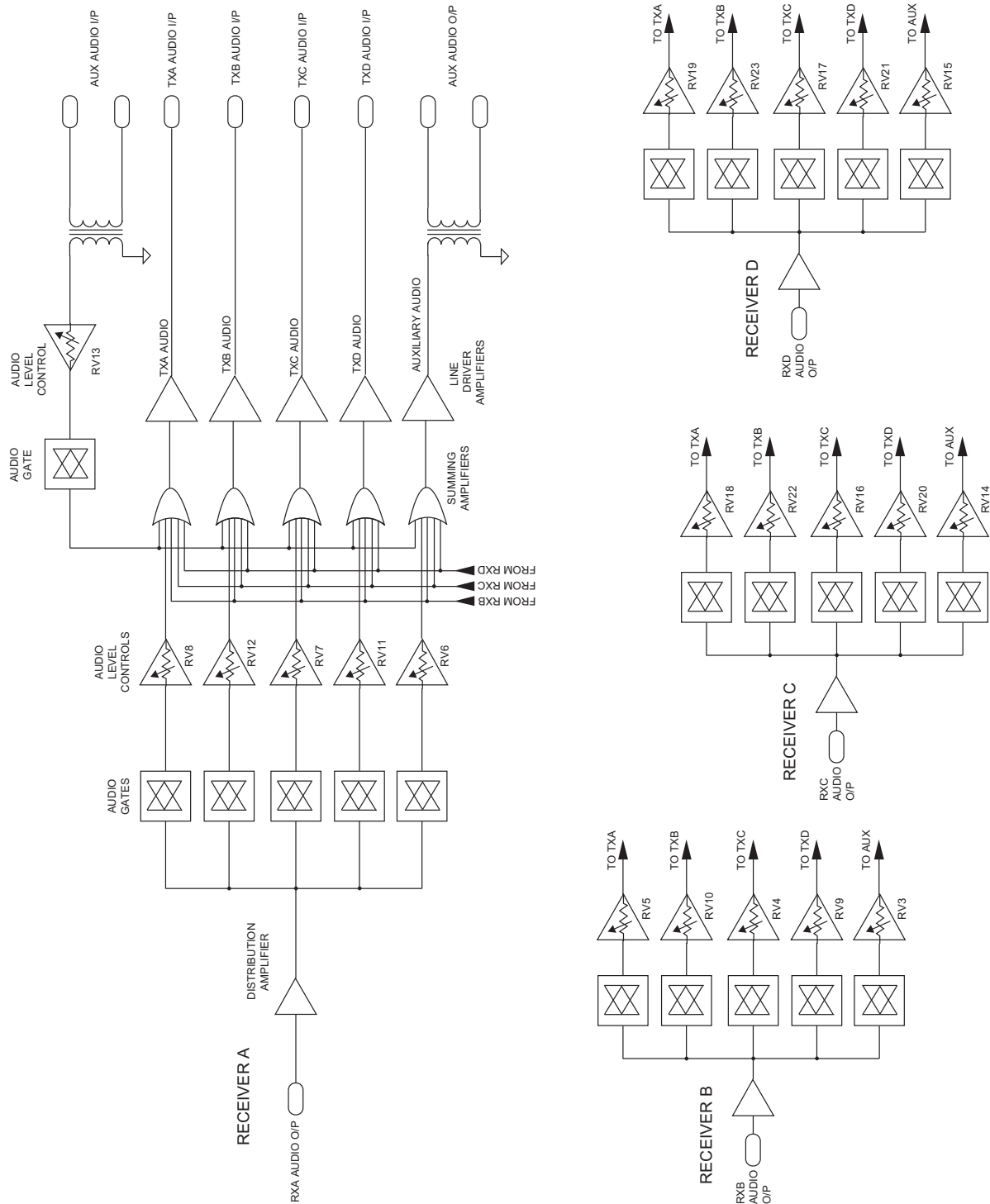
Figure 6: Audio Routing and Audio Pot adjustments

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TN652 CI-RC-4M-G2 Multiple Link Controller

VHF TXA = TBD MHz / Selectable CTCSS
VHF RXA = TBDMHz / CTCSS TBD Hz
VHF TXB = TBD MHz / CTCSS TBD Hz
VHF RXB = TBD MHz / CTCSS TBD Hz
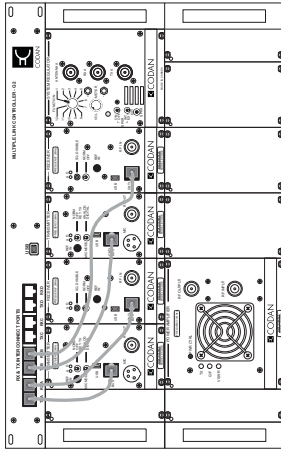
UHF TXC = TBD MHz / CTCSS TBD Hz
UHF RXC = TBD MHz / CSQ

The UHF Transmitter (TXB) Transmits the received VHF and UHF signals back to the UHF Base Station Receiver and other UHF stations.

ANALOG LINK

The UHF Receiver (RXB) Receives one of multiple different CTCSS tones and changes the channel of the VHF Transmitter (TXA) to a corresponding channel with the same CTCSS tone. This VHF transmitter goes out to different repeaters all on the same receive frequency, but with different CTCSS tones. The UHF Receiver (RXB) also keys up the UHF Transmitter (TXB) to repeat the signal.

TXA mutes RXA with Simplex Unmute Delay.

ANALOG LINK

The Multiple Link Controller is programmed to change VHF Transmitter (TXA) channels based on CTCSS.

The DSP-223 keys up the UHF Base Station Transmitter in Analog Mode. The UHF Transmitter will transmit different CTCSS tones to the UHF Receiver at the High Site.

TELEX DSP-223 TONE REMOTE ADAPTER

ANALOG AUDIO INTERFACE

UHF TX = TBD MHz / Selectable CTCSS
UHF RX = TBD MHz / CTCSS TBD Hz
TXA Mutes RXA + Add Simplex Unmute Delay (250ms) to TX

ANALOG 2 OR 4 WIRE AUDIO AND TONES
(LEASED TELEPHONE LINES)

ANALOG TONE REMOTE CONSOLE

Tx Channel	CTCSS (Hz)
A 1	123.0
A 2	103.5
A 3	110.9
A 4	131.8
A 5	136.5
A 6	146.2
A 7	156.7
A 8	None
A 9	None
A 10	None
A 11	None
A 12	None
A 13	None
A 14	None
A 15	None
A 16	None

Figure 7: Example Multiple Link Controller System with analog links

TN652 CI-RC-4M-G2 Multiple Link Controller

VHF TXA Ch. 1 = 168.650 MHz / CTCSS 110.9 Hz = Flight Following
VHF TXA Ch. 2 = 168.625 MHz / CTCSS 110.9 Hz = Air Guard
VHF TXA Ch. 3 = 168.750 MHz / CTCSS TBD = Air Detect
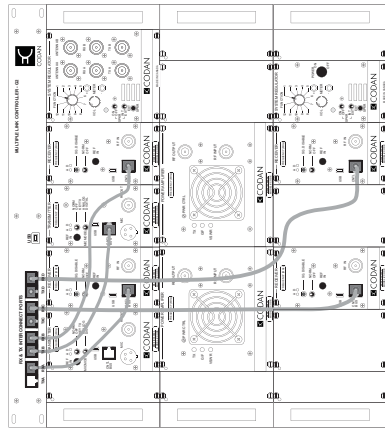
The UHF Receiver (RXB) needs to connected via LVDS serial data for the NAC detect and also through the audio routing circuitry in order to allow the P25 Digital to Analog conversion. The UHF Receiver (RXB) de-vocodes the P25 Digital signal and outputs audio that is routed to the audio input of the VHF Transmitter (TXA).

Three VHF Receivers receive on Flight Following (RXA), Air Guard (RXC), or Air Detect (RXD) and Transmit the Received signal on the UHF Transmitter (TXB).

The UHF Receiver (RXB) Receives one of three separate NACs and changes the channel of the VHF Transmitter (TXA) to Air Guard, Flight Following or Air Detect.

The UHF Transmitter (TXB) Transmits the received VHF signals back to the UHF Base Station Receiver. The Air Guard Receiver (RXC) has High Priority.

ANALOG LINK

P25 DIGITAL LINK

The IP-223 keys up the UHF Base Station Transmitter in Digital Mode. The UHF Transmitter can transmit three different NACs to the UHF Receiver at the High Site.

TELEX IP-223 OR IP-224
IP REMOTE ADAPTER

ANALOG AUDIO INTERFACE

TELEX PROPRIETARY DIGITAL IP INTERFACE

LAN / WAN

The Multiple Link Controller can be programmed to change channels based on CTCSS (for an analog link) or NAC (for a digital link).

TELEX IP BASED CONSOLE

Tx A | Tx B | Tx C | Tx D
Rx A | Rx B | Rx C | Rx D

P
C
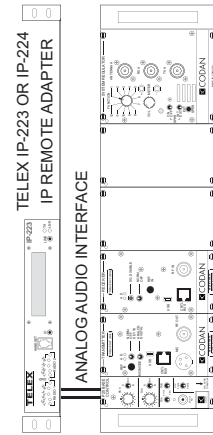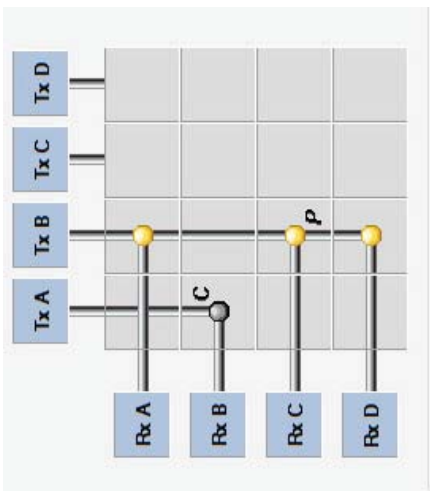
Bank	Tx Channel	CTCSS (Hz)	NAC (hex)
A	A 1	110.9	$455
B	A 2	123.0	$4CE
	A 3	131.8	$526
	A 4	None	None
	A 5	None	None
	A 6	None	None
	A 7	None	None
	A 8	None	None
	A 9	None	None
	A 10	None	None
	A 11	None	None
	A 12	None	None
	A 13	None	None
	A 14	None	None
	A 15	None	None
	A 16	None	None

System Settings | Receiver / Transmitter | Links | Channel Selection | GP Outputs

Figure 8: Example Multiple Link Controller System with P25 Digital uplink

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RADIO COMMUNICATIONS

TN652 CI-RC-4M-G2 Multiple Link Controller

VHF TXA = 163.150 MHz / Selectable CTCSS
VHF RXA = 163.150 MHz / CTCSS 179.9 Hz
VHF TXB = 169.775 MHz / CTCSS 103.5 Hz
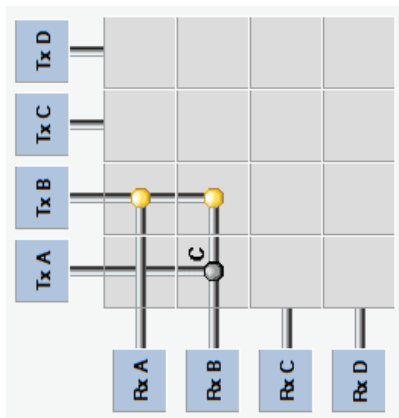VHF RXB = 169.775 MHz / CTCSS 103.5 Hz

UHF TXC = 408.475 MHz / CTCSS 103.5 Hz
UHF RXC = 417.475 MHz / CSQ

The UHF Transmitter (TXC) Transmits
the received VHF and UHF signals back
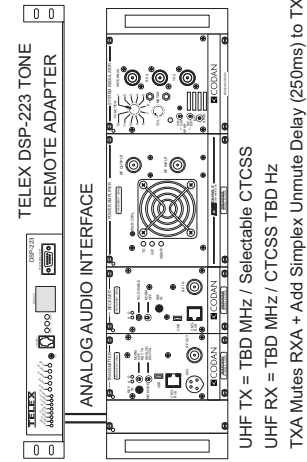to the UHF Base Station Receiver
and other UHF stations.

ANALOG LINK

The VHF Receiver (RXA) keys up the UHF Transmitter
(TXC) and when it receives CTCSS tone 11 (179.9 Hz)
it will also key up VHF Transmitter (TXB) on CTCSS
tone 9 (103.5 Hz) to act as a local repeater.
The VHF Receiver (RXB) keys up the UHF Transmitter (TXC).

TXA mutes RXA and RXB both with Simplex Unmute Delay.
TXB mutes RXB with Simplex Unmute Delay.

The UHF Receiver (RXC) Receives
one of ten separate CTCSS tones
and changes the channel of the
VHF Transmitter (TXA) to a corresponding
channel with the same CTCSS tone.
CTCSS tone 9 (103.5 Hz) or 11 (179.9 Hz) will key up
VHF Transmitter (TXB) on the same CTCSS tone.
The UHF Receiver (RXC) also keys up the
UHF Transmitter (TXC) to repeat the signal.

ANALOG LINK

The DSP-223 keys up the UHF Base Station
Transmitter in Analog Mode.
The UHF Transmitter will transmit
twelve different CTCSS tones to
the UHF Receiver at the High Site.
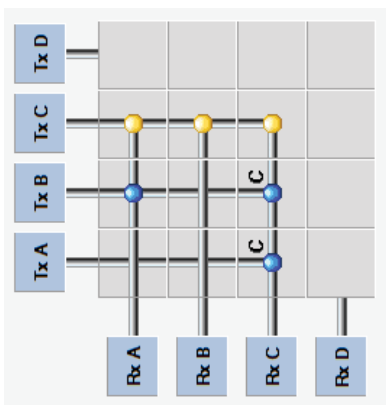
TELEX DSP-223 TONE
REMOTE ADAPTER

ANALOG AUDIO INTERFACE
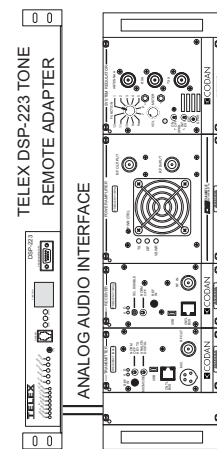
UHF TX = 417.475 MHz / Selectable CTCSS
UHF RX = 408.475 MHz / CTCSS 103.5 Hz
TXA Mutes RXA + Add Simplex Unmute Delay (250ms) to TX

ANALOG 2 OR 4 WIRE AUDIO AND TONES
(LEASED TELEPHONE LINES)

ANALOG TONE REMOTE
CONSOLE

CTCSS Tone (Hz)	
100.0 ▸	Kinport
107.2 ▸	Garns
114.8 ▸	Big Butte
123.0 ▸	Taylor
131.8 ▸	Sedgewick
141.3 ▸	Kelly
151.4 ▸	Malad
162.2 ▸	Rockland
103.5 ▸	Direct
167.9 ▸	Fire Rptr.
179.9 ▸	Jumpoff
192.8 ▸	Spare

F1 = 1950 Hz
F2 = 1850 Hz
F3 = 1750 Hz
F4 = 1650 Hz
F5 = 1550 Hz
F6 = 1450 Hz
F7 = 1350 Hz
F8 = 1250 Hz
F9 = 1150 Hz
F10 = 1050 Hz
F11 = 950 Hz
F12 = 850 Hz

The Multiple Link Controller is
programmed to change channels
based on CTCSS.

Tx D   Tx C   Tx B   Tx A

Rx A   Rx B   Rx C   Rx D

Figure 9: Example Multiple Link Controller System with co-located repeater

CODAN
RADIO COMMUNICATIONS

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CODAN
RADIO COMMUNICATIONS

TN655 CI-BC-4E Base Control Card

The CI-BC-4E base control card is a plug-in module which provides audio routing, COR and PTT routing and front panel control for an MT-4 base station radio system. The base control card includes the following features:

- jumper selectable audio routing, PTT, and muting.
- low power analog and CMOS control circuitry.
- true balanced 600 Ω inputs and outputs for external equipment connection.
- optically isolated inputs and outputs for control by external equipment.
- front panel control of channel and bank select for receiver and transmitter.
- front panel selection of clear / secure (encrypted) operation and clear keys operation.
- front panel selection of local or remote control of base station functions.
- suitable for Type 2 E&M signalling.

The MT-4 receiver and transmitter modules all connect to the CI-BC-4E base control card via the back panel motherboard. There is no front panel RJ45 connection between the MT-4 receivers, transmitters and base control card.
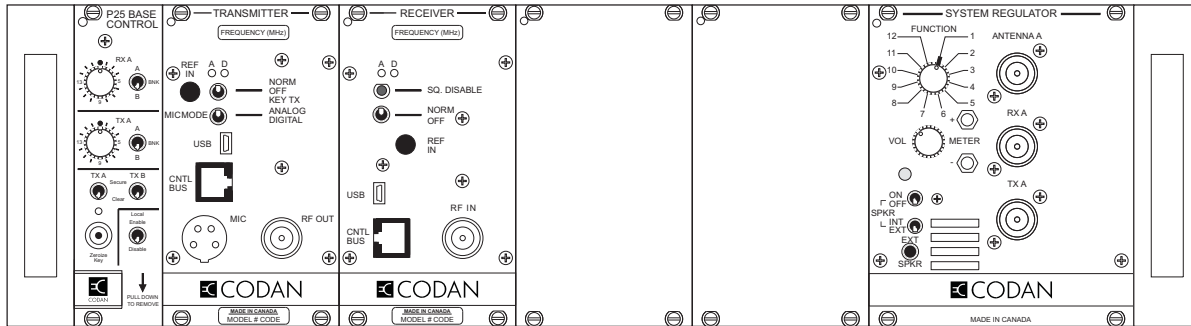
The CI-BC-4E base control card module circuitry consists of three main functional blocks:
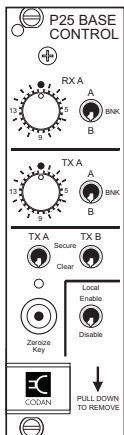
(1) The repeater control circuit allows all the common COR / PTT routing combinations for dual base-repeater systems.

(2) Front panel interface allows for user control of transmitter and receiver functions, including encryption operation.

(3) Audio routing circuitry is for the active level control and distribution of receiver and transmitter audio signals. The CI-BC-4E is designed for applications where interface to external equipment is required. All audio and control inputs/outputs are isolated by transformers and opto-isolators on the CI-BC-4E.

CI-BC-4E External Audio Input:	600 Ω, -25 dBm to 0 dBm adjustable
CI-BC-4E External Audio Output:	600 Ω, -20 dBm to +3 dBm adjustable
CI-BC-4E Internal Audio Input:	4.7 KΩ, -25 dBm to +3 dBm adjustable

TN655 CI-BC-4E Base Control Card

The three main functions of the CI-BC-4E Base Control Card are shown in Figures 1, 2 and 3:
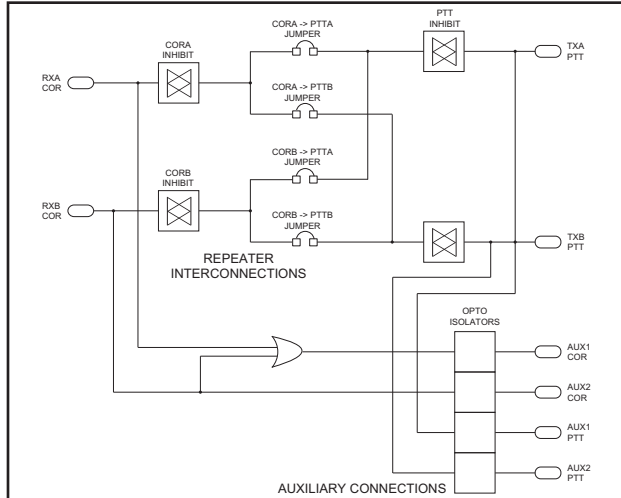
Figure 1: Repeater Control
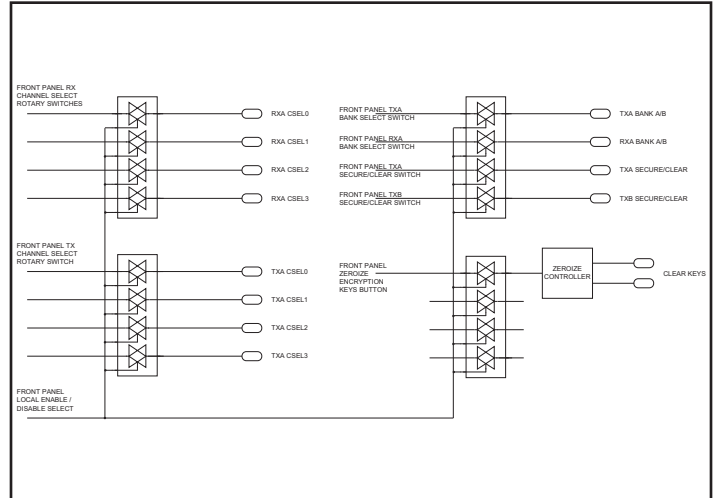
Figure 2: Front Panel Interface
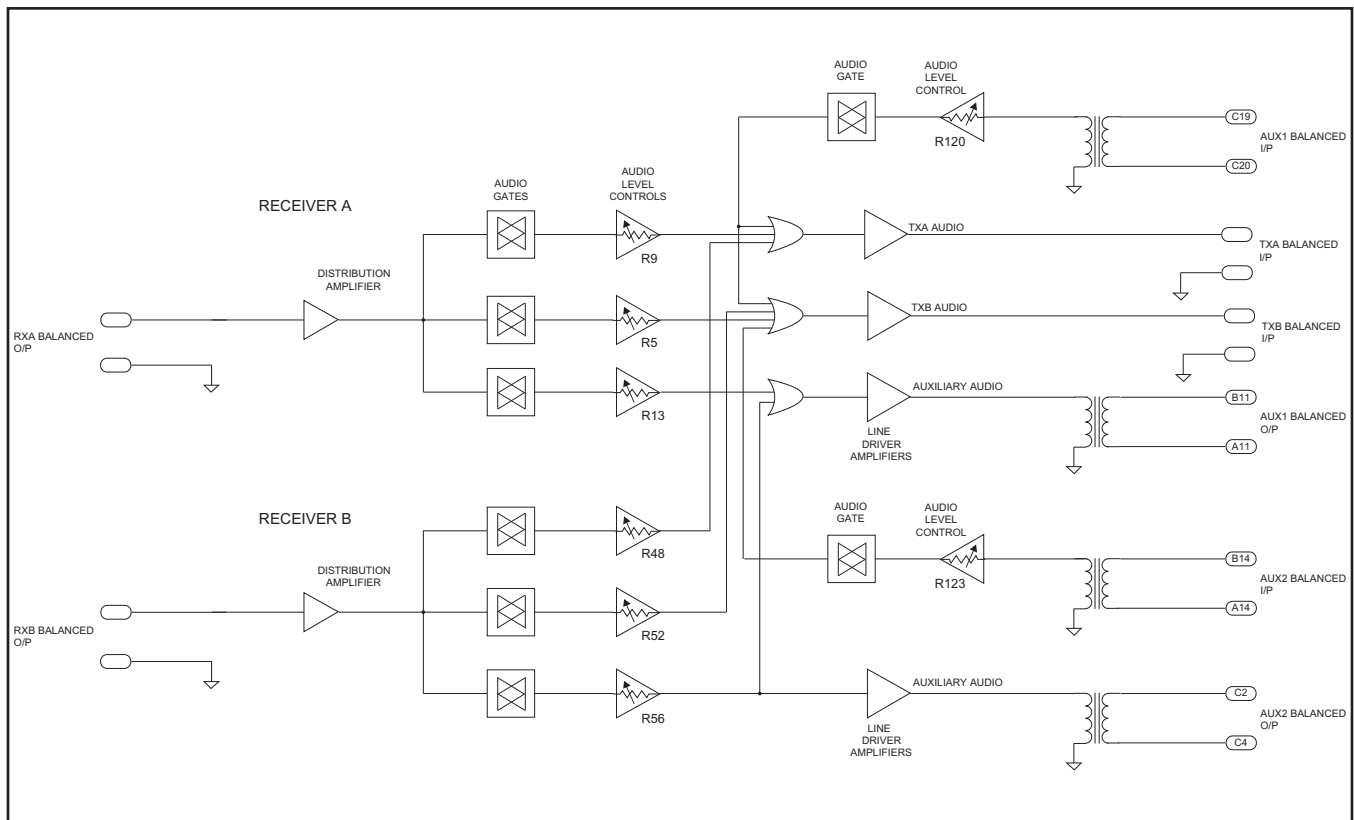
Figure 3: Audio Routing

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TN660 UIC-4 Universal Interface Card

The UIC-4-00 Universal Interface Card (UIC) is a plug-in module which provides an IP-based Ethernet network connection between MT-4 radio systems and other Land Mobile Radio (LMR) subsystems.
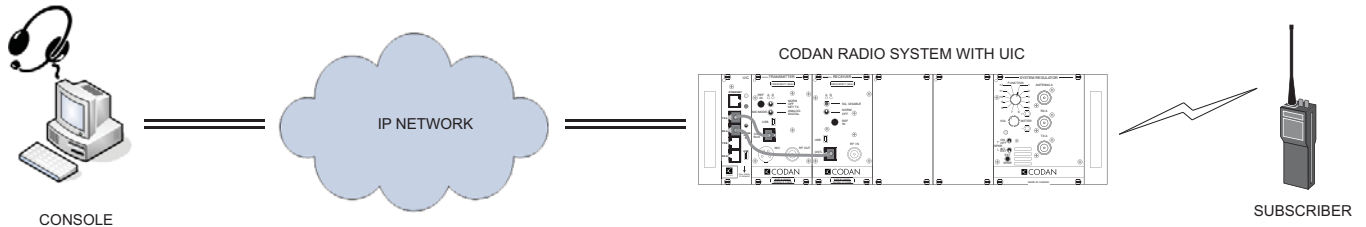
The UIC is programmable to support the TIA P25 Digital Fixed Station Interface (DFSI) standard via its network connection. The UIC can control and monitor radio modules installed in both the A-side (left) and B-side (right) of the subrack. An additional firmware purchase is required for B-side operation.

TIA P25 DFSI Operation

The UIC supports the DFSI as published in the P25 standard document TIA-102.BAHA. The UIC provides a fully end-to-end digital link between consoles and subscriber units and supports analog-mode calls as well as P25 calls. The UIC transports digital P25 audio data packets (IMBE™) between the console and the transmitter and receiver radio modules without any conversion to or from baseband audio. The UIC uses Codan LVDS serial data to transport digital information between the UIC and the receiver and transmitter modules. This preserves a fully end-to-end digital link, including audio encryption. Analog voice is carried via the DFSI as digitized u-law pulse-code modulation (PCM) audio data.

Console Controlled / Software Programmable Features

Some of the UIC functions (eg. call start/end, channel selection, etc.) are dynamically controlled by the console. The console that is used in a system with the UIC may not implement or provide access to all of the functions. See the console's documentation for more information on which UIC features are accessible from the console.

Other UIC functions (eg. IP address programming, interface mode selection, etc.) are controlled by static programmable configuration settings. These settings can be viewed and modified using the UIC Configuration Software.

Part Numbers

UIC-4-00	Universal Interface Card
APP-UIC-4-01	UIC Configuration Software (available for free on the Codan LMR website)
APP-UIC-4-02	Firmware for DFSI Operation

TN660 UIC-4 Universal Interface Card

The UIC supports all of the following features:

• Channel and Bank control of receiver and transmitter modules (2 banks of 16 channels each).
• Detect the mode (analog or P25) of an inbound call on the receiver and report to the console.
• Receiver squelch selection (muted or unsquelched) controlled by the console.
• Monitors the states of the transmitter's forward and reverse alarm signals and report to the console.
• Clear the encryption keys from all encryption-equipped radio modules through the UIC's front panel Zeroize Key push button or from the console.
• Control and monitoring of 8 digital general purpose input and output (GPIO) signals from the console. The 4 inputs are 10 mA max., 0 to +1 Vdc low / +2 to +13.8 Vdc high. The 4 outputs are 20 mA max., 0 Vdc low / +5 Vdc high.
• Control and monitoring of 8 analog GPIOs for use with external equipment. The 4 inputs are 0 to +3.3 Vdc, 3 kΩ impedance. The 4 outputs are 20 mA max., 0 to +3.3 Vdc.
• Monitoring power supply voltage levels and reporting to the console.
• Programmable simplex mode operation.
• Local repeating under the control of the console, or automatically when the UIC is not connected to a console.
• Current draw of 128 mA maximum.

The DFSI also supports the following features:

• Audio Reception and Transmission using IMBE™ (P25) or u-law PCM (analog).
• Passes all received P25 data to the console (NAC, TGID, MFID, ALGID, KID, etc.).
• Full end-to-end digital encryption if supported by the console and subscribers.
• Outbound audio buffering when transmitting P25 mode calls, with a programmable buffer length (200 ms max.).

Console Systems

The UIC will interface with the following P25 DFSI consoles:

Avtec Scout
Catalyst IP FSI Gateway
Moducom UltraCom IP
Bosch / Telex C-Soft (P25 version)
Zetron Acom

| 43 Erie Street Victoria, B.C. Canada V8V 1P8	Toll Free Phone: Fax:	Canada & U.S.A. 1-800-664-4066 1-877-750-0004	International Phone: 250-382-8268 Fax: 250-382-6139	Internet Email: LMRsales@codanradio.com Web: www.codanradio.com

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TN660 UIC-4 Universal Interface Card

UIC Configuration Software

The UIC Configuration Software is used to read and to modify various static configuration settings in the UIC. The application can be used to configure the UIC locally by connecting to it via its USB port, or remotely by connecting via Ethernet (using either the DE-UIC or DFSI interface).
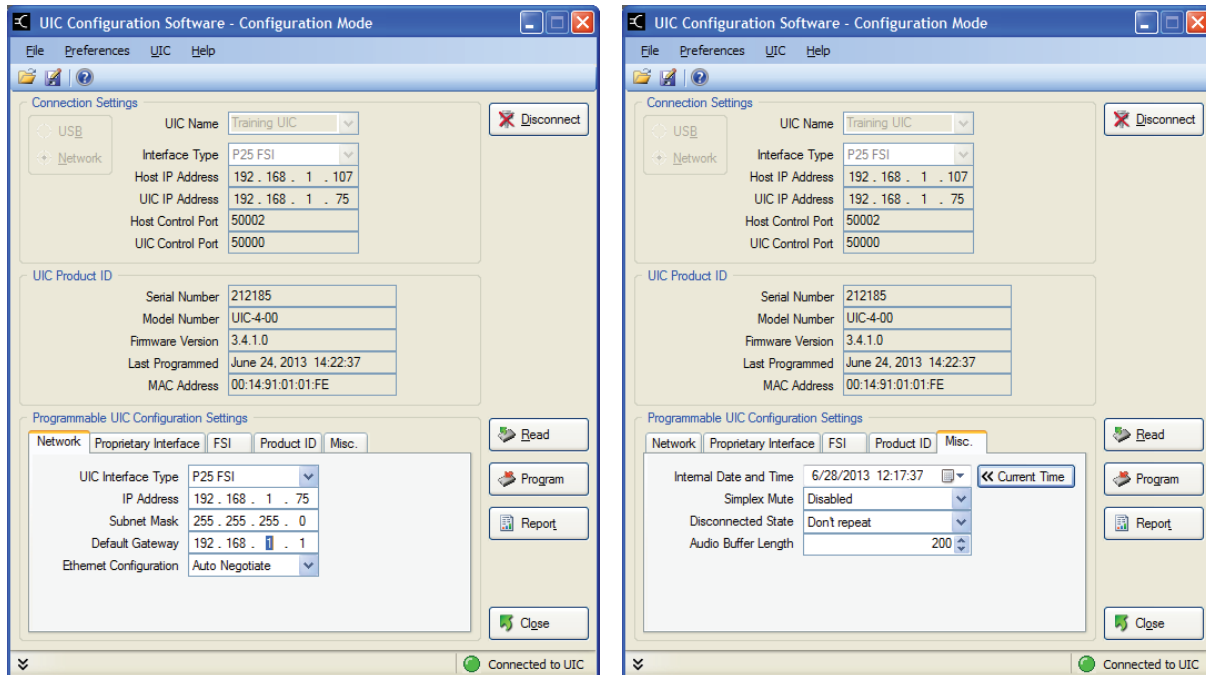
UIC MAC Address

The UIC has a factory-assigned unique Ethernet MAC address that cannot be modified. This unique address is stored in non-volatile memory and is not affected by changes to any of the UIC's configuration settings.

TN660 UIC-4 Universal Interface Card

Radio Functions and General purpose Inputs / Outputs

The UIC Configuration Software can also be used to test Radio Functions and General Purpose Inputs / Outputs when connected via Ethernet.

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TN661 UIC-5 Universal Interface Card

The UIC-5-00 Universal Interface Card (UIC) is a plug-in module which provides an IP-based Ethernet network connection between MT-4 radio systems and other Land Mobile Radio (LMR) subsystems.

CODAN RADIO SYSTEM WITH UIC

CONSOLE

IP NETWORK

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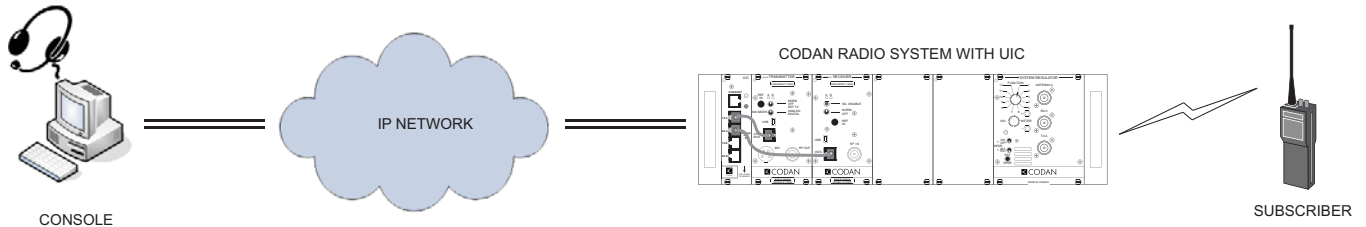
The UIC is programmable to support the TIA P25 Digital Fixed Station Interface (DFSI) standard via its network connection. The UIC can control and monitor radio modules installed in both the A-side (left) and B-side (right) of the subrack. An additional firmware purchase is required for B-side operation. The UIC-5-00 Card is a generational upgrade from the UIC-4-00, adding DFSI Packet Data as well as a number of significant performance improvements for running P25 over non-dedicated networks that may be shared with commercial or non-related users

TIA P25 DFSI Operation

The UIC supports the DFSI as published in the P25 standard document TIA-102.BAHA-A. The UIC provides a fully end-to-end digital link between consoles and subscriber units and supports analog-mode calls as well as P25 calls. The UIC transports digital P25 audio data packets (IMBE™or AMBE+2™) between the console and the transmitter and receiver radio modules without any conversion to or from baseband audio. The UIC uses Codan LVDS serial data to transport digital information between the UIC and the receiver and transmitter modules. This preserves a fully end-to-end digital link, including audio encryption. Analog voice is carried via the DFSI as digitized u-law pulse-code modulation (PCM) audio data.

The UIC-5 supports two different types of interfaces via its network connection:
• TIA Fixed Station Interface, Version 1 (Voice only)
• TIA Fixed Station Interface, Version 2 (Voice and/or Packet Data)

Console Controlled / Software Programmable Features

Some of the UIC functions (eg. call start/end, channel selection, etc.) are dynamically controlled by the console. The console that is used in a system with the UIC may not implement or provide access to all of the functions. See the console's documentation for more information on which UIC features are accessible from the console.

Other UIC functions (eg. IP address programming, interface mode selection, etc.) are controlled by static programmable configuration settings. These settings can be viewed and modified using a website GUI (Graphical User Interface) interface to the UIC.
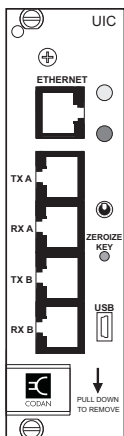
TN661 UIC-5 Universal Interface Card

The UIC supports all of the following features:

• Channel and Bank control of receiver and transmitter modules (2 banks of 16 channels each).
• Detect the mode (analog or P25) of an inbound call on the receiver and report to the console.
• Receiver squelch selection (muted or unsquelched) controlled by the console.
• Clear the encryption keys from all encryption-equipped radio modules through the UIC's front panel Zeroize Key push button.
• Control and monitoring of 8 digital general purpose input and output (GPIO) signals from the console. The 4 inputs are 10 mA max., 0 to +1 Vdc low / +2 to +13.8 Vdc high. The 4 outputs are 20 mA max., 0 Vdc low / +5 Vdc high.
• Control and monitoring of 8 analog GPIOs for use with external equipment. The 4 inputs are 0 to +3.3 Vdc, 3 kΩ impedance. The 4 outputs are 20 mA max., 0 to +3.3 Vdc. Analog I/O resolution is10 bits (3.22 mv / bit = 1 LSB).
• Programmable simplex mode operation.
• Local repeating under the control of the console, or automatically when the UIC is not connected to a console.
• Current draw of 200 mA maximum.
• Audio Reception and Transmission using IMBE™ (P25) or u-law PCM (analog).
• Passes all received P25 LCW and ESW data to the console (NAC, TGID, MFID, ALGID, KID, etc.).
• Full end-to-end digital encryption if supported by the console and subscribers.
• Outbound audio buffering when transmitting P25 mode calls, with a programmable buffer length.
• DFSI v2 supports P25 Packet Data.

Console Systems
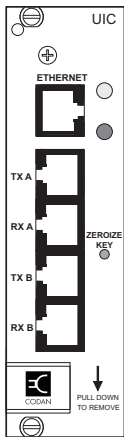
The UIC will interface with the following P25 DFSI consoles:

Avtec Scout
Catalyst IP FSI Gateway
InterTalk (Pantel)
Moducom UltraCom IP
Bosch / Telex C-Soft (P25 version)
Zetron Acom

Part Numbers

UIC-5-00	Universal Interface Card
APP-UIC-5-A1	Firmware for DFSI Operation on the A side of the Codan subrack
APP-UIC-5-B1	Firmware for DFSI Operation on the B side of the Codan subrack
APP-UIC-5-D1	DFSI v2 Packet Data Option

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TN661 UIC-5 Universal Interface Card

Programming and Networking

Ethernet Port	10/100 Base-T, full / half duplex, auto-sensing
Default IP Address	192.168.123.66
Rescue IP Address	172.23.123.2
Default Username and Password	p25admin (for both)

Maximum Network Bandwidth Requirement:

• Analog PCM Voice Call	100 Kbps
• Digital P25 Voice Call	70 Kbps

Default A-side UDP Port for Control Connection	50000
Default A-side RTP Port for Voice Conveyance Connection	50020
Default B-side UDP Port for Control Connection	50002
Default B-side RTP Port for Voice Conveyance Connection	50022
Default A-side Packet Data Port	50010
Default B-side Packet Data Port	50012

UIC Web GUI Global Settings
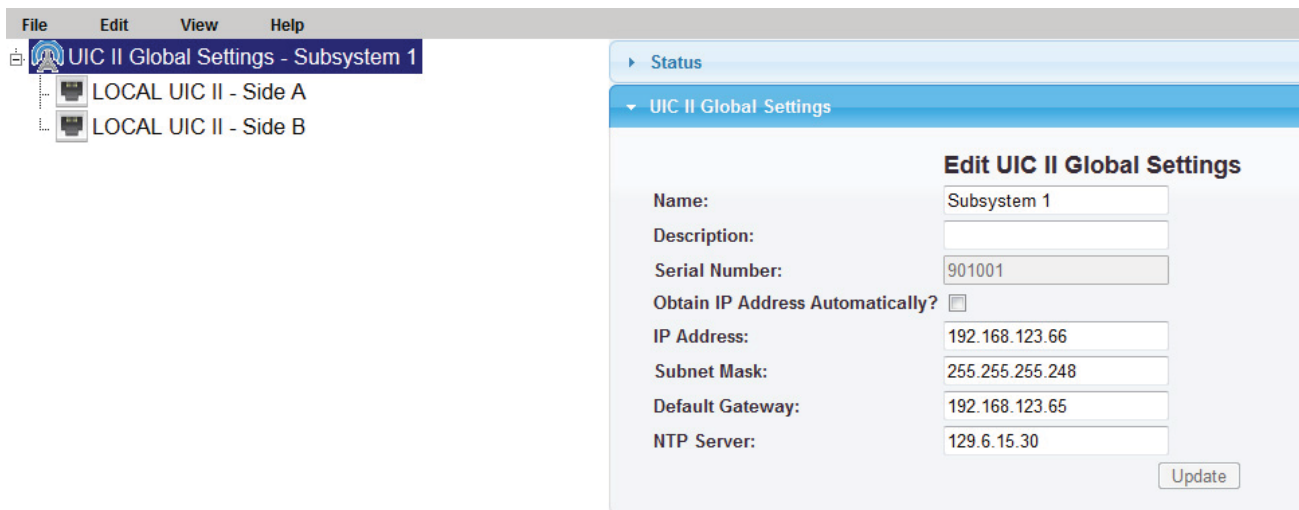
The UIC Web GUI is used to read and to modify various static configuration settings in the UIC. The Web GUI can be used to configure the UIC Global Settings such as the IP address.

UIC MAC Address

The UIC has a factory-assigned unique Ethernet MAC address that cannot be modified. This unique address is stored in non-volatile memory and is not affected by changes to any of the UIC's configuration settings.

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TN661 UIC-5 Universal Interface Card

UIC Web GUI Configuration Parameters

The UIC Web GUI can also be used to set the indivicual configuration parameters for each of the radio pairs connected to the UIC (Side 'A' and Side 'B').
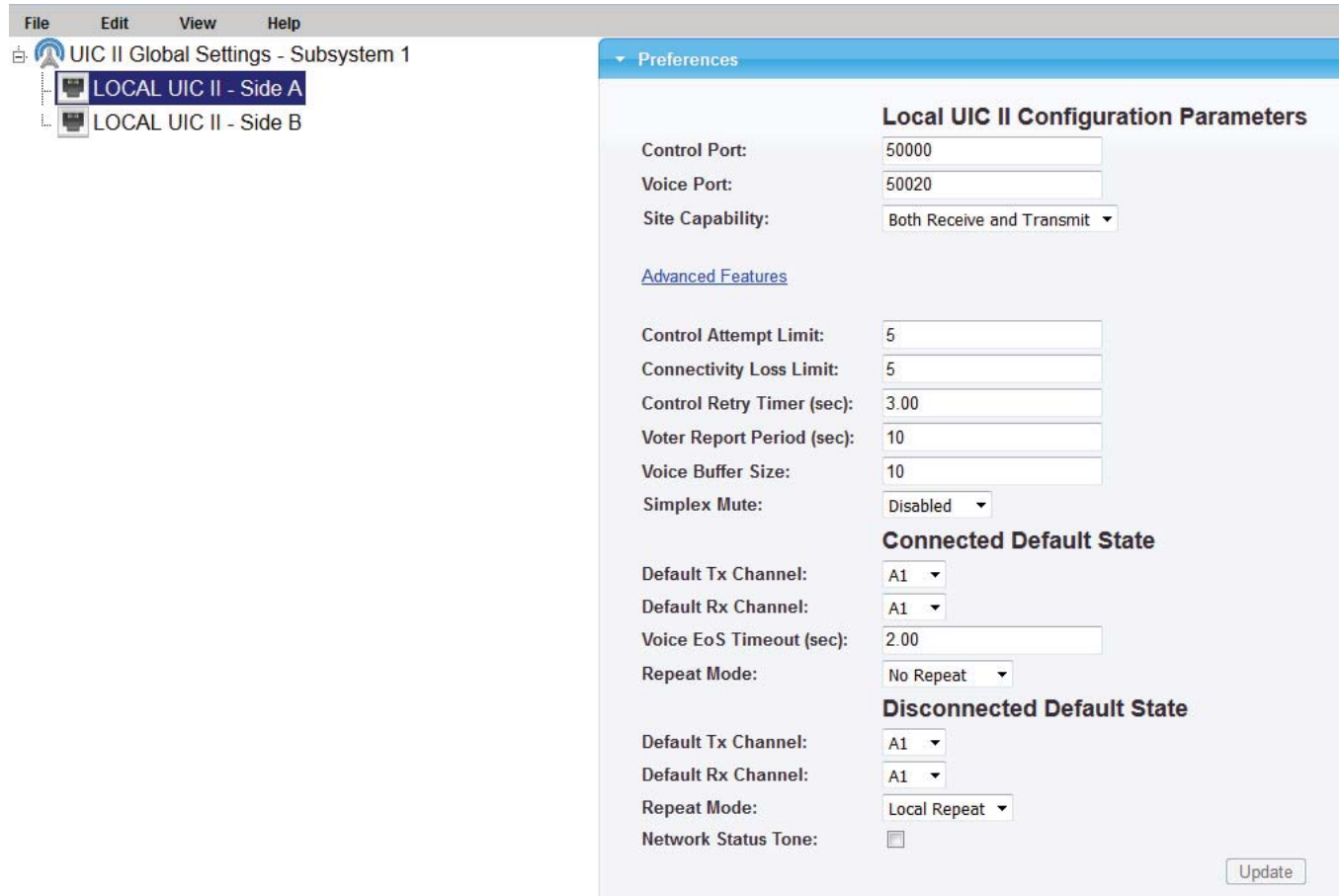
TN661 UIC-5 Universal Interface Card

Recommended Network Requirements for P25 DFSI with Codan UIC

Following is a list of recommended network requirements for both the Codan UIC-4 and UIC-5 cards for P25 Digital Fixed Station Interface connection (in both P25 and analog mode).

These recommended values are for the Codan equipment. Other P25 DFSI equipment (consoles / base stations) may have different network requirements.

Specification	Fixed Network	3G / LTE Network	Notes
Latency	< 20 ms	< 250 ms	Based on end user acceptable audio delay
Jitter (UIC-5)	< 8 ms	< 100 ms	*See Note below
Jitter (UIC-4)	< 4 ms	< 15 ms	
Packet Loss (UIC-5)	< 3%	< 6%	Better than DAQ 3.4 voice reproduction
Packet Loss (UIC-4)	< 0.5%	< 1%	
Bandwidth	250 kbps or better (full duplex)		Minimum 80kbps for P25 voice and/or 100kbps for Analog

Note: For jitter conditions beyond the stated values (eg. satellite communications), increasing the audio buffer will account for these situations at the cost of additional voice latency.

The UIC configuration settings for the buffer are as follows:

UIC Configuration Setting	Default Value	Range
Audio Buffer Length (UIC-4)	200 ms	40 - 500 ms
Audio Buffer Length (UIC-5)	200 ms	20 - 10000 ms

The UIC-4 is more sensitive to jitter and packet loss, the maximum specifications shown for a 3G / LTE network may result in less than ideal performance.

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TN661 UIC-5 Universal Interface Card

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TN670 Stratus™ Controller

The Stratus™ Controller is a general-purpose controller for routing digital P25 communications over a Wide Area Network (WAN) or Local Area Network (LAN). The Stratus™ Controller will work in digital clear or digital secure mode; it is fully capable of all operation with encrypted calls. The Stratus™ Controller will also route analog communications, but only in a full broadcast mode (ie. Analog signal received at one site will automatically be transmitted at all sites). FSI (version 2) will support more analog routing (CTCSS and DCS) and will be incorporated into the Stratus™ Controller in the future.

The Stratus™ Controller uses the TIA-102 (P25) standard Digital Fixed Station Interface (DFSI) to link to FSI capable devices such as the Codan Universal Interface Card (UIC). The Stratus™ Controller can support both Fixed Station radios using the UIC, or emulate Fixed Station Radios allowing DFSI capable consoles to connect to the Stratus™ Controller. The Stratus™ Controller supports multivendor solutions for both radios and consoles through the FSI standard. The Stratus™ Controller is comprised of a server (located anywhere on the WAN / LAN) with embedded firmware.
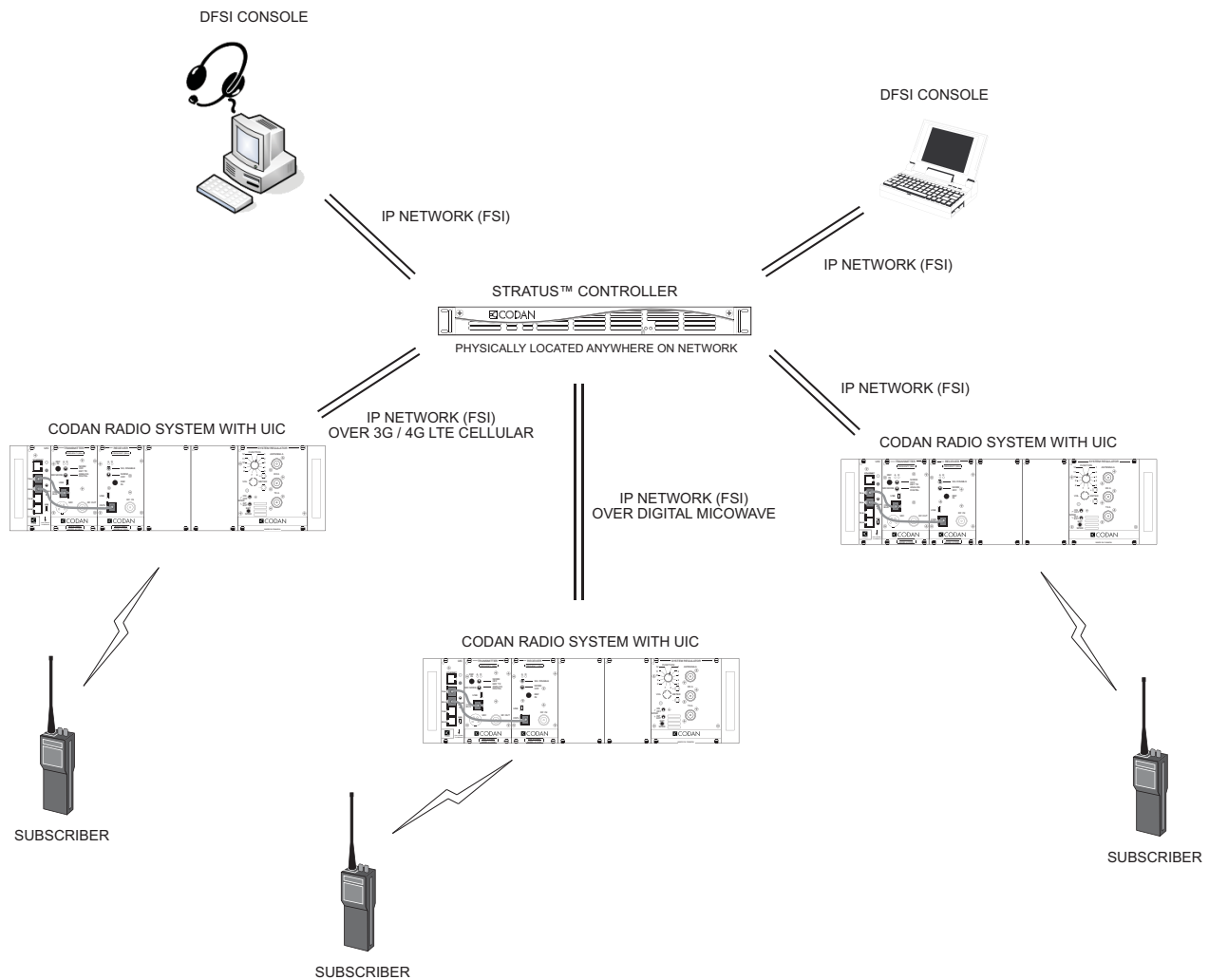
Figure 1: Sample Stratus™ Controller Application

TN670 Stratus™ Controller

The Stratus™ Controller listens to all incoming data from every connected radio site and every console. Each connection (from site to site or console to site) uses routing rules configured in the software to decide on the routing path. These routing paths are determined by NAC or Talk Group ID. Each connection can use different mapping.

The Stratus™ Controller has the capability to convert from any NAC to any Talk Group ID and vice versa. This allows for any combination of mapping (affiliating) between all sites using any type of P25 code.

Local repeating (at the repeater site) will repeat ALL NACs since the receiver is programmed for $F7F at all sites. Local Repeating can be done through the Stratus™ Controller however, latency (200 – 700 ms depending on complexity) can occur.

Each site can allow ALL Unit IDs, or can be programmed to allow specific Unit IDs per site. The Stratus™ Controller is not capable of routing based on Unit ID, but will block Units from sites.

The Stratus™ Controller has the following capabilities / features:

• Create an FSI Fixed Station connection
• Create an FSI Gateway connection
• Register P25 Talkgroups
• Register P25 Subscriber units

• Configure audio to be routed between specific FSI connections
      • Using NAC based routing
      • OR Talkgroup based routing

• Translate NAC codes for re-broadcast
• Log call activity and errors (playback not yet available)
• Forced remote reset
• Backup / Restore configuration files
• Update Firmware
• Buffer and correct network voice issues (with limitations)

• When used with a Codan UIC card
      • Control channel selection
      • Local repeat / No repeat / Stratus Controller repeat selection
      • Read 9.5 VDC and 13.8 VDC voltage inputs
      • Read 4 Analog and 4 Digital General Purpose I/O (GPIO) status
      • Report Rx / Tx Status (Active / Inactive)

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TN670 Stratus™ Controller

Stratus™ Controller Software Features

The Stratus™ Controller software allows for remote (IP) configuration and monitoring of the Stratus™ Controller using any web browser as the Graphical User Interface (GUI). This means that no software package is required for the Stratus™ Controller GUI.

The Stratus™ Controller GUI has a secure login screen as shown in Figure 2.
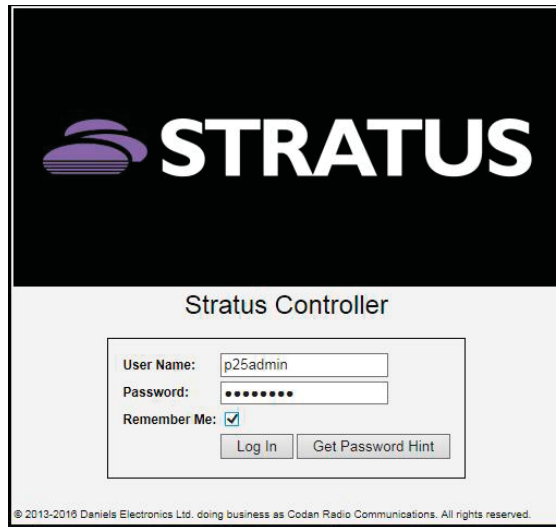
Figure 2: Stratus™ Controller GUI Secure Login

The Stratus™ Controller GUI allows the user to configure both DFSI parameters for each radio site as well as multiple console DFSI connections through Fixed Site emulation, as shown in Figure 3.
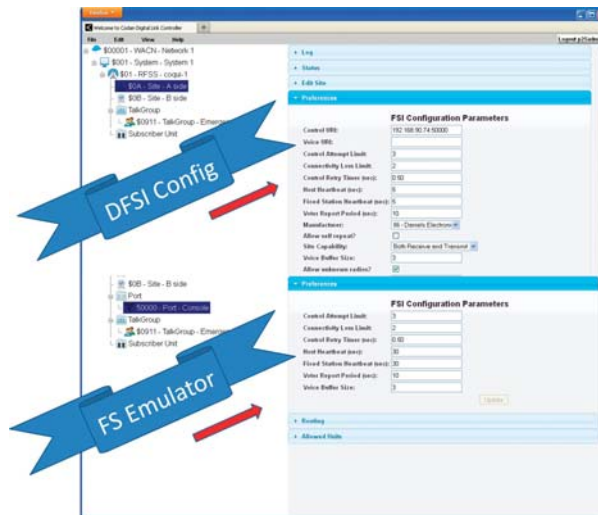
Figure 3: Stratus™ Controller GUI Configuration

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TN670 Stratus™ Controller

The Stratus™ Controller GUI shows the layout of the Stratus™ Controller system as a tree. Real-Time Site Monitoring is available through the GUI that can display frequently updated (< 5 seconds) system status as shown in Figure 4. The Stratus™ Controller GUI also has General purpose I/O (4 digital, 4 analog) and voltage monitoring capability for each radio site.
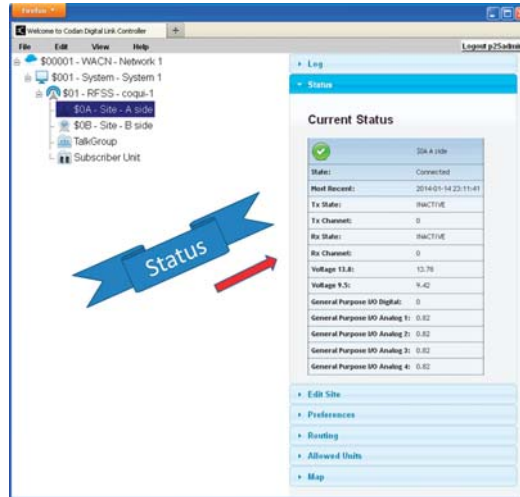
Figure 4: Stratus™ Controller GUI Status

The Stratus™ Controller GUI allows for NAC (Normal Squelch) OR Talk Group ID (Selective Squelch) routing, configurable at each site as shown in Figure 5. Priorities can also be set per site, for each NAC or TGID, to allow different users or groups higher or lower routing priority if a signaling conflict occurs. See Figure 6.
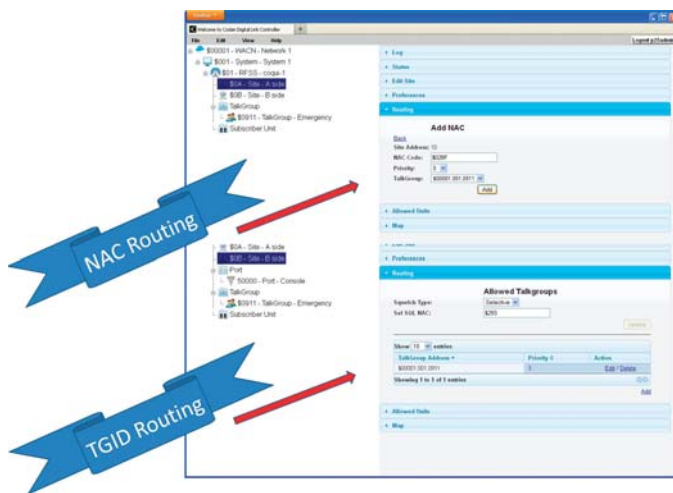
Figure 5: Stratus™ Controller GUI NAC and TGID Routing   *Figure 6: Stratus™ Controller GUI Priorities*
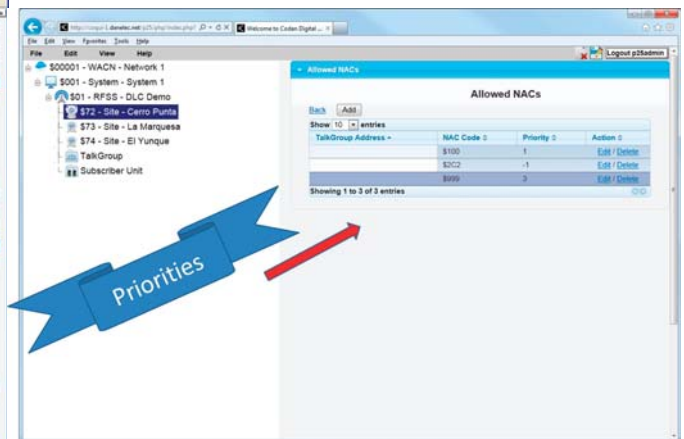
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TN710 ET-3 Transportable Radio System Case

The ET-3 transportable radio system case is a rugged, waterproof aluminum case. Any standard 19" Codan subrack can be mounted inside for repeater, crossband or base configurations.

The ET-3-03-00 Orange Transportable Case includes the following:

• 19" internal mounting frame for subrack and duplexers.
• smooth tamperproof and lockable latches.
• spring retracted stainless steel handles.
• pressure relief valve.
• pressure sealed RF and power inputs.
• metal cover on lid for magnetic mount antennas.
• optional internal AC to DC power supply.

The transportable radio case is 21" (53.3 cm) wide, 11" (27.9 cm) high and 15" (38.1 cm) deep, and weighs 35 lbs. (15.88 kg) with typical radio package installed (10 lbs. or 4.54 kg empty).

Frequency band	RF Power Output	Internal duplexer frequency separation
AM	1.0 - 3.0 Watts	No duplexer available
Lowband VHF	0.5 - 3.0 Watts	No duplexer available
Highband VHF	0.5 - 8.0 or 30 Watts	≥ 2.0 MHz or ≥ 4.5 MHz separation
400 MHz UHF	0.5 - 8.0 or 30 Watts	≥ 5.0 MHz separation
700 MHz UHF	0.5 - 3.0 Watts	≥ 30 MHz separation
800 MHz UHF	0.5 - 3.0 Watts	≥ 45 MHz separation
900 MHz UHF	0.5 - 3.0 Watts	≥ 24 MHz or ≥ 39 MHz separation

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TN720 ET-4 Transportable Radio System Case and HiveNet

The ET-4 transportable radio system case is a compact watertight polyethylene case. Any standard 19" Codan subrack can be mounted inside for repeater, crossband or base configurations.

The ET-4 case includes the following:

• 19" internal mounting frame with 9 RU of rack space for equipment.
• soft grip handles, in-line wheels, press and pull latches and a telescoping handle.
• interface connectors for RF and power inputs (optional Ethernet RJ45 connector available).

The ET-4 tranportable radio system typically holds:

• Subrack (3 RU).
• Duplexer (2RU).
• PSA-12-15-RB-20 Power Module that includes a 6 W speaker, AC-DC (110/220 Vac to 12 Vdc) power converter and battery trickle charger for the internal 10.5 Ah Sealed Lead Acid (AGM) battery (2 RU).
• ET-4-A-ACC-BOX Accessory Storage Box case for tools, cables, microphone, etc. (2RU).

TN720 ET-4 Transportable Radio System Case and HiveNet

The transportable radio case is 24.6" (62.5 cm) wide, 11.7" (29.7 cm) high and 19.7" (50.0 cm) deep, and weighs approximately 50 lbs. (22.68 kg) with typical radio package installed. The maximum depth for equipment from the rack to the bottom of the case is 8.25" (20.96 cm).

Frequency band	RF Power Output	Internal duplexer frequency separation
Highband VHF	0.5 - 8.0 or 30 Watts	≥ 2.0 MHz or ≥ 4.5 MHz separation
400 MHz UHF	0.5 - 8.0 or 30 Watts	≥ 5.0 MHz separation
700 MHz UHF	0.5 - 3.0 Watts	≥ 30 MHz separation
800 MHz UHF	0.5 - 3.0 Watts	≥ 45 MHz separation
900 MHz UHF	0.5 - 3.0 Watts	≥ 24 MHz or ≥ 39 MHz separation

There are several different versions of the ET-4 case:

ET-4-A09-00	Black Polyethylene Transportable Case Only.
ET-4-A09-02	Black Polyethylene Transportable Case with Power Module and Accessory Storage Box.
ET-4-A09-10	Yellow Polyethylene Transportable Case Only.
ET-4-A09-12	Yellow Polyethylene Transportable Case with Power Module and Accessory Storage Box.

The ET-4 duty cycle and operating temperature is variable as follows:

Case Lid	Duty Cycle	Operating Temperature Range
Open	100%	-40°C to +60°C
Closed	100%	-40°C to +40°C
Closed	50%	-40°C to +50°C
Closed	10%	-40°C to +60°C

Typical battery capacity (@10% duty cycle with 30 Watts RF power output):

8 hours	(10.5 AHr internal battery)
30 hours	(35 AHr external battery)
90 hours	(100 AHr external battery)

TN720 ET-4 Transportable Radio System Case and HiveNet

HiveNet

HiveNet is a wide area conventional repeater network that is easily deployable and field agile.

Essentially, HiveNet is a network of repeaters that are linked together through RF links allowing the network to be self-healing (linked repeaters can be added or removed at any time). This allows for a widely configurable system with an expandable area of coverage for mobile and portable radios (subscribers).

HiveNet is available as an analog only or analog and P25 digital (mixed mode) repeater network giving the users full forwards and backwards compatibility with existing legacy equipment. In P25 Digital mode, HiveNet will pass all encrypted voice and data transparently through the repeater network. The HiveNet does not require or contain any encryption in order to pass the encryption through the repeater and links.

HiveNet repeaters and links can be any frequency band (VHF, UHF, 700/800/900 MHz). One common example is to have VHF repeaters with UHF links. HiveNet is based on a transportable repeater solution (ET-4) but can be installed as a fixed network infrastructure.
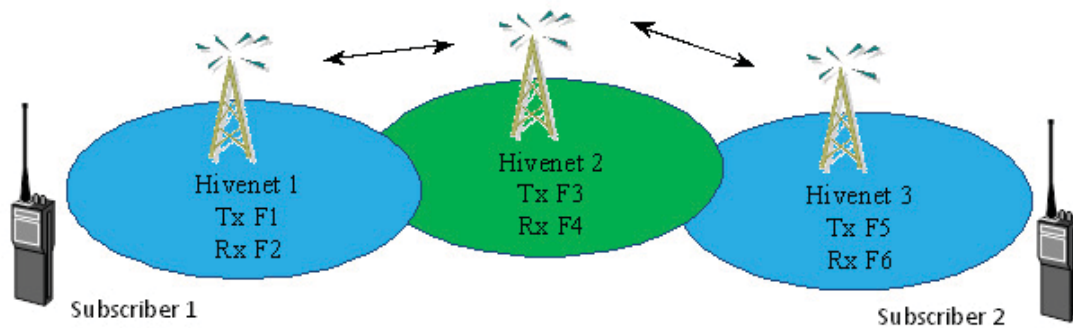
Figure 1: HiveNet Wide Area System

A HiveNet repeater network can be configured as two or more separate repeaters connected together. Figure 1 shows a system of three HiveNet repeaters in use. Each repeater provides radio coverage for a local geographic region utilizing a different transmit / receive frequency pair. The repeater sites are RF linked together such that transmitted information from Subscriber 1 is received at HiveNet 1, then linked to and rebroadcast from each HiveNet repeater in the system, allowing Subscriber 2 to receive the information from HiveNet 3. This allows each subscriber to transmit information to any other subscriber anywhere on the network

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TN720 ET-4 Transportable Radio System Case and HiveNet

Technical Description

HiveNet repeaters are made up of two transceivers, the repeater (sometimes referred to as the "Drop"), and the Link. The Drop repeaters are on separate frequencies, while the link frequencies are matched (and reversed). Figure 2 shows two HiveNet repeaters linked together with frequency pairs. The Link is referred to as a "Switched Link", meaning that the receiver and transmitter are never active at the same time.

A Switched Link is typically half-duplex, allowing use of a duplexer or antenna relay for the antenna connection.

• An antenna relay allows for a more frequency agile link, transceiver frequencies can be changed without the need for any duplexer retuning.

• A duplexer allows the Switched Link to be changed to a Repeating Link if the system needs to be expanded for more HiveNet repeaters.

• Simplex (same) frequencies can also be used on a two site Switched Link HiveNet with an antenna relay, but every HiveNet repeater must Link directly to each other (no "Chains" of links).

The use of different repeaters all transmitting at the same time on different frequencies is called multicasting.

To / From Subscribers			To / From Subscribers	
HiveNet 1			HiveNet 2	
Drop	Switched link		Switched link	Drop
Tx-F1	Tx-F3		Tx-F4	Tx-F5
Rx-F2	Rx-F4		Rx-F3	Rx-F6
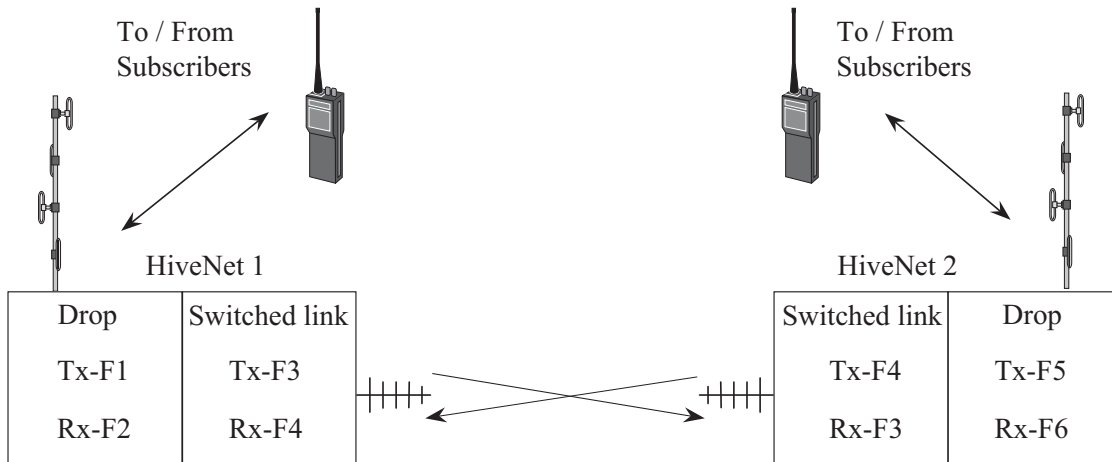
Figure 2: HiveNet Network of Two Repeaters

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TN720 ET-4 Transportable Radio System Case and HiveNet

HiveNet repeaters can be linked together to form different configurations depending on requirements. For larger systems a repeating link may be required as a centralized "hub" for the network as shown in Figure 3. Repeating Links are full duplex and require a duplexer for the antenna connection, and possibly multiple antennas with a power splitter or a multi-directional antenna.

HiveNet 1	
Drop	Switched link
Tx-F1	Tx-F3
Rx-F2	Rx-F4

HiveNet 2	
Switched link	Drop
Tx-F3	Tx-F5
Rx-F4	Rx-F6

HiveNet 3	
Drop	Switched link
Tx-F1	Tx-F3
Rx-F2	Rx-F4

HiveNet 4	
Repeating link	Drop
Tx-F4	Tx-F7
Rx-F3	Rx-F8
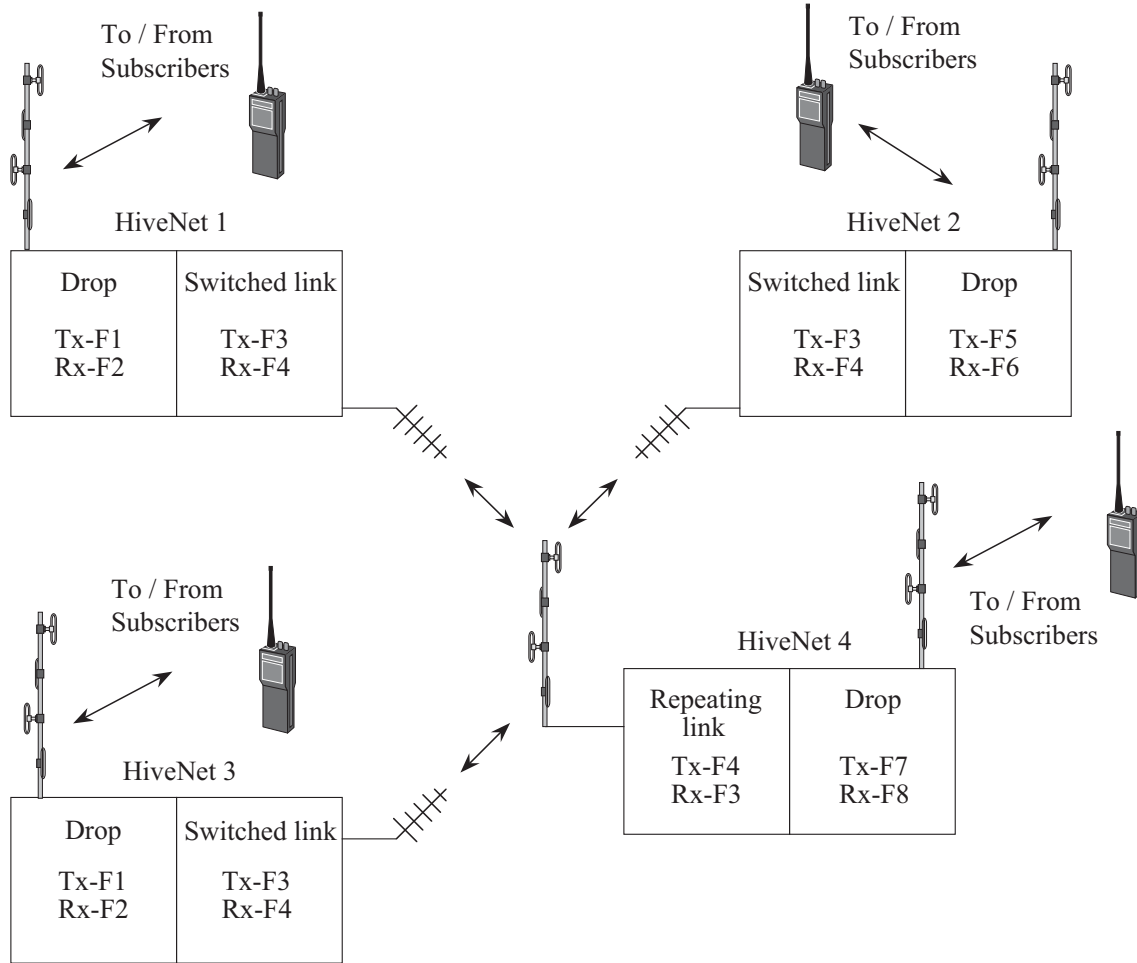
Figure 3: HiveNet Network of Four Repeaters

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TN720 ET-4 Transportable Radio System Case and HiveNet

Some HiveNet configurations may also require multiple switched links in order to former a "chain" of repeater links as shown in Figure 4. This requires another set of frequencies and another transceiver pair, but can allow more customizing of the configuration.

To / From Subscribers

To / From Subscribers

To / From Subscribers

HiveNet 1

Drop
Tx-F1
Rx-F2

Switched link
Tx-F7
Rx-F8

HiveNet 2

Drop
Tx-F3
Rx-F4

Switched link
Tx-F8
Rx-F7

Switched link
Tx-F10
Rx-F9

HiveNet 3

Drop
Tx-F5
Rx-F6

Switched link
Tx-F9
Rx-F10
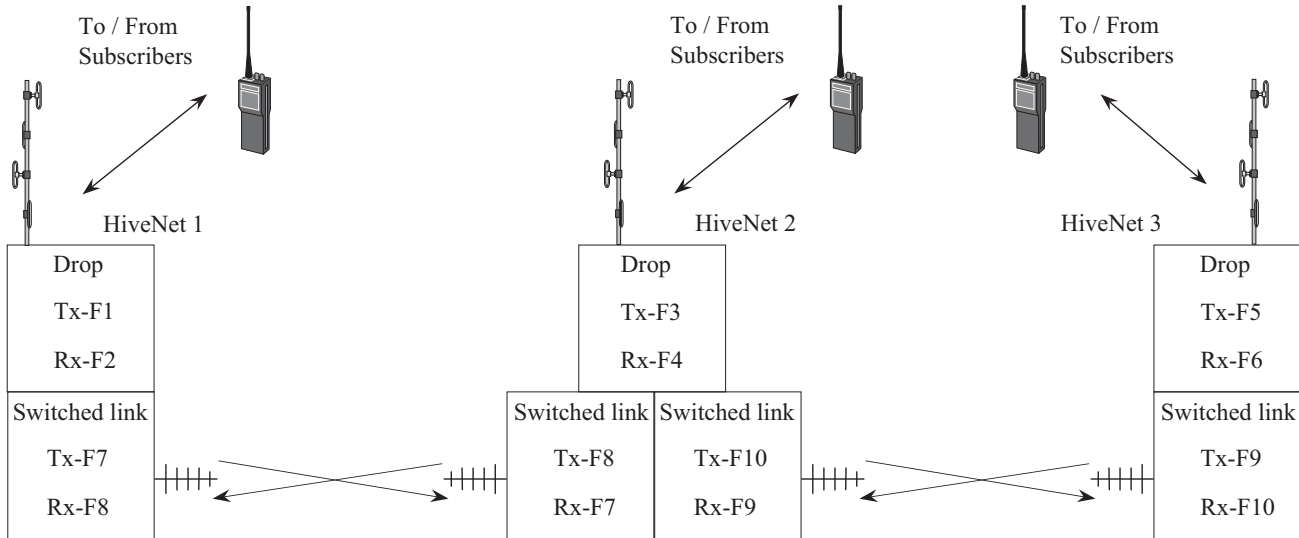
Figure 4: HiveNet with Multiple Links

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TN730 ET-5 Transportable Tactical Radio System

The ET-5 transportable tactical radio system is mounted in a compact watertight polyethylene case. Any Codan MT-4E receiver and transmitter can be mounted inside for repeater configurations. The ET-5 supports analog and transparent P25 digital (clear or secure) repeat capability.

The ET-5 includes the following:

• internal mounting frame for MT-4E receiver and transmitter.
• soft grip handle and press and pull latches.
• interface connectors for RF and power inputs.
• LED indicators for receive, transmit and power indication.
• internal duplexer mounting capability.
• USB type A to right angled 5 pin mini-type B programming cable (CBLC44-20904200)
• two switches to control the power input configuration (internal / external).

The ET-5 transportable tactical radio system can be powered by:

• a standard alkaline D-Cell battery pack (holding 16 batteries).
• a 10.5 Ah rechargeable lead acid battery.
• an external 12 Vdc power source (connector is located on the outside of the case).

TN730 ET-5 Transportable Tactical Radio System

The transportable radio case is 14.2" (36.1 cm) wide, 11.4" (29.0 cm) high and 6.5" (16.5 cm) deep, and weighs 20 lbs. (9.07 kg) fully equipped with batteries installed.

Frequency band	RF Power Output	Internal duplexer frequency separation
Highband VHF	0.5 - 6.0 Watts	≥ 4.5 MHz separation
400 MHz UHF	0.5 - 6.0 Watts	≥ 5.0 MHz separation
700 MHz UHF	0.5 - 3.0 Watts	≥ 30 MHz separation
800 MHz UHF	0.5 - 3.0 Watts	≥ 45 MHz separation
900 MHz UHF	0.5 - 3.0 Watts	≥ 24 MHz or ≥ 39 MHz separation

* The RF power output of the Highband VHF and 400 MHz UHF transmitter is rated at a maximum of 6.0 Watts when installed in the ET-5 case (typical power output of these transmitters is 8.0 Watts).

Typical battery capacity (@20% duty cycle with 6.0 Watts RF power output):

16 alkaline D-Cells batteries	19 hours
internal 10.5 Ah lead acid battery	20 hours
external 35 Ah lead acid battery	52 hours

The ET-5 operating temperature is rated at -20°C to +50°C when using the internal batteries. When using the external battery, the operating temperature is rated at -30°C to +60°C.

The ET-5 is rated for 100% continuous duty operation.

The ET-5 case with the inside panel removed is shown in Figure 1. This shows how the MT-4E receiver and transmitter are mounted inside of the ET-5 case.

RECEIVER
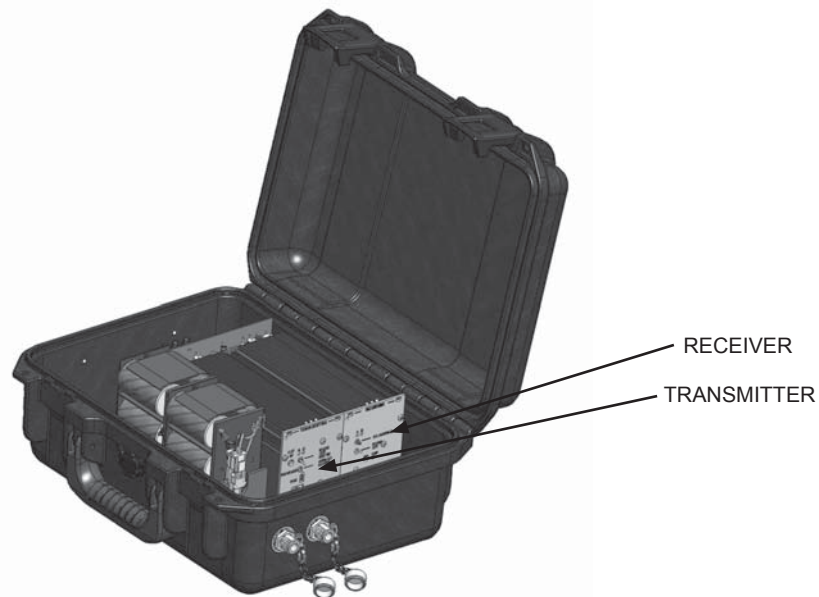
TRANSMITTER

Figure 1: ET-5 case with inside panel removed

CODAN

RADIO COMMUNICATIONS

TN735 Vizor™ (ET-6) Transportable Tactical Radio System

The Vizor™ (ET-6) transportable tactical radio system is mounted in a compact watertight polyethylene case. Any Codan receiver, transmitter and 30 Watt power amplifier can be mounted inside for repeater or base configurations. The Vizor™ (ET-6) supports analog and transparent P25 digital (clear or secure) repeat capability.

The Vizor™ (ET-6) includes the following:

• internal mounting frame for receiver, transmitter and 30 Watt power amplifier.
• soft grip handle and press and pull latches.
• interface connectors for RF and AC/DC power inputs (internal or external).
• internal "quick change" duplexer mounting capability.
• lightweight OTTO headset (A-HEADSET-01).
• USB type A to right angled 5 pin mini-type B programming cable (CBLC44-20904200)
• 15 Amp 110 / 220 VAC power supply with battery backup
• front panel control interface

The following options are available for the Vizor™ (ET-6):

• A-MIC-05 hand microphone compatible with the headset connector.
• A-PK-RELAY-02 Antenna Relay for base station operation.

There are two different versions of the Vizor™ (ET-6):

ET-6-M03-01	Standard external RF and power connectors.
ET-6-M03-02	Internal stealth RF and power connectors

TN735 Vizor™ (ET-6) Transportable Tactical Radio System

The Vizor™ (ET-6) tranportable radio system comes with a front panel control interface with the following features:

• internal interface connectors for RF and AC/DC power inputs (for stealth appearance with the lid closed).
• LED indicators for receive, transmit, power and speaker power indication.
• Clear / Secure select switch and Clear Keys button for encrypted base capability.
• 16 position channel select rotary switch.
• speaker / headset select, 12 pin Hirose connector for headset, volume control knob and main power switch.
• DB25 auxiliary connector for direct connection to a Telex DSP-223 or IP-223 / IP-224 (or another external device).

The transportable radio is 18.2" (46.2 cm) wide, 6.7" (17.0 cm) high and 13.4" (34.0 cm) deep, and weighs 28 lbs. (12.70 kg) fully equipped.

Frequency band	RF Power Output	Internal duplexer frequency separation
Highband VHF	0.5 - 8.0 or 30 Watts	≥ 4.5 MHz separation
400 MHz UHF	0.5 - 8.0 or 30 Watts	≥ 5.0 MHz separation
700 MHz UHF	0.5 - 3.0 Watts	≥ 30 MHz separation
800 MHz UHF	0.5 - 3.0 Watts	≥ 45 MHz separation
900 MHz UHF	0.5 - 3.0 Watts	≥ 24 MHz or ≥ 39 MHz separation

The Vizor™ (ET-6) duty cycle and operating temperature is variable as follows:

Case Lid	Duty Cycle	Operating Temperature Range
Open	100%	-30°C to +60°C (Optional -40°C to +60°C)
Closed	100%	-30°C to +10°C (Optional -40°C to +10°C)
Closed	50%	-30°C to +40°C (Optional -40°C to +40°C)
Closed	10%	-30°C to +60°C (Optional -40°C to +60°C)

TN735 Vizor™ (ET-6) Transportable Tactical Radio System

The Vizor™ (ET-6) case with the lid removed is shown in Figure 1. This shows how the receiver, transmitter and power amplifier are mounted inside of the Vizor™ (ET-6) case.

Figure 1: Vizor™ (ET-6) case with case lid removed

The DB25 auxiliary connector pinout is as follows:

Pin	Function	Notes
7	Ground	
8	Transmitter CSEL0	Jumper JU5A installed to operate
9	Transmitter CSEL2	Jumper JU5A installed to operate
12	Receiver Balanced O/P 2	
13	Transmitter Balanced I/P 2	
14	Transmitter PTT I/P	
17	Transmitter Secure / Clear I/P	Pull to ground for Clear mode
20	+13.8 Vdc / Receiver COR	Jumper JU1A (DSP-223) / Jumper JU1B (IP-223 / IP-224)
21	Transmitter CSEL1	Jumper JU5A installed to operate
22	Transmitter CSEL3	Jumper JU5A installed to operate
24	Receiver Balanced O/P 1	
25	Transmitter Balanced I/P 1	

The IP-223 / IP-224 also requires that 2 pins on the DB25 (PTT COM - pin2 and MON COM - pin 16) are wired to ground for proper operation.

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CODAN
RADIO COMMUNICATIONS

TN750 ET-1 Transportable Radio System Case

The ET-1 transportable radio system case is a rugged, weatherproof case constructed from high density polyethylene with reinforced walls. It has recessed handles, smooth latches, anodized valences and a pressure relief valve. The rack is shock mounted and the lid gasket is water tight. Any standard 19" Codan subrack can be mounted inside. Racks are mounted inside the front and back of the case. Codan subracks can be mounted back to back on both front and back racks. Optional duplexers can also be mounted inside the case in the 19" rack. Contact the factory for weight limitations.

The transportable radio case is available in four sizes, a 6 RU (Rack Unit) height, a 9 RU (Rack Unit) height., a 12 RU (Rack Unit) height, and a 15 RU (Rack Unit) height. Contact the factory for other heights available.

Dimensions for ET-1-A06-00 (6 RU Height Shelf)

Outside Depth:	31" (78.7 cm)	Internal Rack Depth:	20" (50.8 cm)
Outside Width:	26" (66 cm)	Internal Rack Width:	19" (standard mounting)
Outside Height:	18.4" (46.7 cm)	Internal Rack Height:	10.625" (27 cm)
Weight (Case Only):	44 lbs. (19.96 kg)		

Dimensions for ET-1-A09-00 (9 RU Height Shelf)

Outside Depth:	31" (78.7 cm)	Internal Rack Depth:	20" (50.8 cm)
Outside Width:	26" (66 cm)	Internal Rack Width:	19" (standard mounting)
Outside Height:	23.4" (59.4 cm)	Internal Rack Height:	15.875" (40.3 cm)
Weight (Case Only):	58 lbs. (26.31 kg)		

TN750 ET-1 Transportable Radio System Case

Dimensions for ET-1-A12-00 (12 RU Height Shelf)

Outside Depth:	31" (78.7 cm)	Internal Rack Depth:	20" (50.8 cm)
Outside Width:	26" (66 cm)	Internal Rack Width:	19" (standard mounting)
Outside Height:	29.2" (74.2 cm)	Internal Rack Height:	21.125" (53.8 cm)
Weight (Case Only):	73 lbs. (33.11 kg)		

Dimensions for ET-1-A15-00 (15 RU Height Shelf)

Outside Depth:	31" (78.7 cm)	Internal Rack Depth:	20" (50.8 cm)
Outside Width:	26" (66 cm)	Internal Rack Width:	19" (standard mounting)
Outside Height:	34.2" (86.9 cm)	Internal Rack Height:	26.375" (67 cm)
Weight (Case Only):	90 lbs. (40.82 kg)		

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CODAN
RADIO COMMUNICATIONS

TN760 Stratus™ Transportable Tactical Radio System

The Stratus™ transportable tactical radio system is mounted in a compact watertight polyethylene case. Any Codan receiver, transmitter and 30 Watt (or 25 Watt) power amplifier can be mounted inside for repeater or base configurations. The Stratus™ supports analog and transparent P25 digital (clear or secure) repeat capability. The Stratus™ repeater incorporates a Sierra Wireless cellular modem to backhaul P25 Digital Fixed Station Interface (DFSI) compliant signalling across existing cellular 3G or 4G Long Term Evolution (LTE) infrastructure. The cellular backhaul can be used to interconnect multiple Stratus™ repeaters / base stations to each other, or to P25 DFSI compliant consoles. This interconnectivity is achieved via a Stratus™ controller which acts as an arbitrator for multiple DFSI interconnects.

The Stratus™ tactical radio system includes the following:

• internal mounting frame for receiver, transmitter and 30 Watt (VHF/UHF) or 25 Watt (700/800 MHz) power amplifier.
• soft grip handle and press and pull latches.
• external interface connectors for RF and power inputs.
• duplexer with internal "quick change" duplexer mounting capability.
• cellular modem with internal "quick change" cellular modem mounting capability.
• lightweight OTTO headset (A-HEADSET-01).
• 110/220 VAC (auto-switching) to 12 VDC external power supply (22A)
• front panel control interface

The current draw of the Stratus™ transportable system is:

Standby	750 mA ±10%
Transmit (Active)	7.0 A ±10%

TN760 Stratus™ Transportable Tactical Radio System

There are two different versions of the Stratus™ transportable radio system:

LMR-STRATUS-CPXXX	Stratus™ with full cellular (3G / 4G LTE) capability (modem, antennas, UIC and firmware)
LMR-STRATUS-LPXXX	Stratus™ LiTE with no cellular, antennas or UIC and firmware capability (upgradeable - LMR-STRATUS-LITUP)

Stratus™ transportable radio system options include:

LMR-STRATUS-LITUP	Stratus™ LiTE upgrade to full cellular capability (modem, antennas, UIC and firmware)
STRATUS-LiTE-IPS-1	Stratus™ LiTE with internal 110/220 VAC (auto-switching) to 12 VDC power supply
STRATUS-EXTCBL-1 DC	DC power extension cable
A-PK-RELAY-03	Antenna relay with mounting bracket for base station operation
LMR-TRANSOP-EBAS1	AES-256 / DES-OFB 64-bit encryption hardware and firmware, with key loader cable and antenna relay with mounting bracket for base station operation

The Stratus™ tranportable radio system comes with a front panel control interface with the following features:

• LED indicators for receive, transmit, connect (to the network) and VSWR.
• power switch (acts as a 20 Amp breaker switch and lights up when powered).
• built in DC Voltmeter.
• Clear / Secure select switch and Clear Keys button for encrypted base capability.
• 16 position channel select rotary switch and A/B bank select switch (for up to 32 channels).
• speaker / headset select, 12 pin Hirose connector for headset and volume control knob.
• Local / Remote select switch for channel select control either through the front panel switches or network.
• Repeat / Base select switch for operation mode (Base is for Simplex operation only).
• High / Low power select switch for full power (30 Watts) or half power (15 Watts) selection (only VHF and UHF).

The Stratus™ transportable radio is 19.2" (48.8 cm) wide, 7.3" (18.5 cm) high and 15.2" (38.6 cm) deep, and weighs 32 lbs. (14.50 kg) fully equipped.

Frequency band	RF Power Output	Internal duplexer frequency separation
Highband VHF	0.5 - 8.0 or 15/30 Watts	≥ 4.5 MHz separation
400 MHz UHF	0.5 - 8.0 or 15/30 Watts	≥ 5.0 MHz separation
700 MHz UHF	0.5 - 3.0 or 25 Watts	≥ 30 MHz separation
800 MHz UHF	0.5 - 3.0 or 25 Watts	≥ 45 MHz separation
900 MHz UHF	0.5 - 3.0 Watts	≥ 24 MHz or ≥ 39 MHz separation

The Stratus™ duty cycle and operating temperature is variable as follows:

Case Lid	Duty Cycle	Operating Temperature Range
Open	100%	-40°C to +60°C
Closed	100%	-40°C to +40°C
Closed	50%	-40°C to +50°C

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TN760 Stratus™ Transportable Tactical Radio System

The Stratus™ case with the lid removed is shown in Figure 1. This shows how the receiver, transmitter, UIC, cellular modem, duplexer and power amplifier are mounted inside of the Stratus™ case.
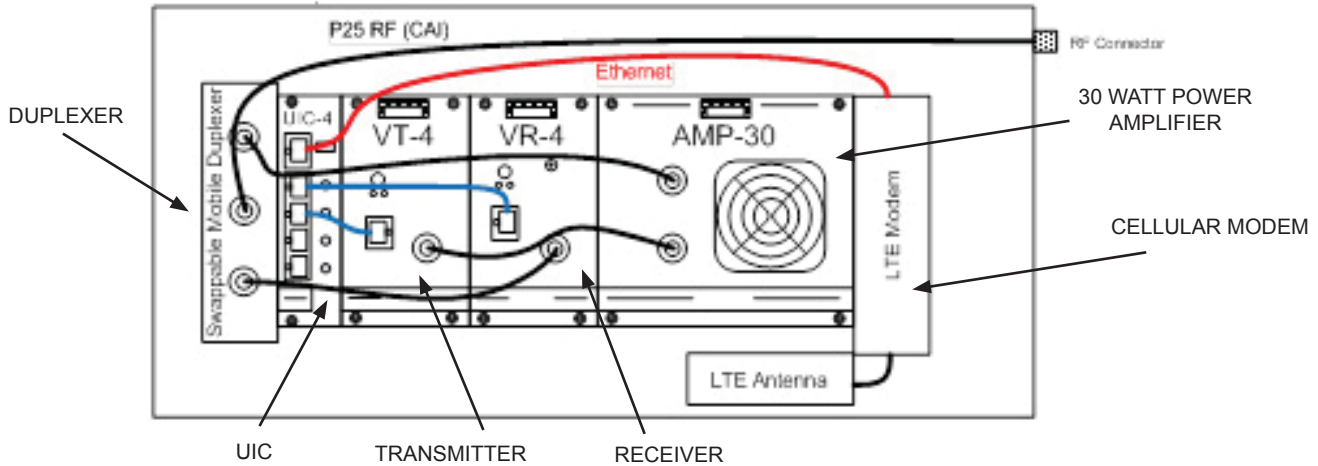
Figure 1: Stratus™ case with case lid removed

The Stratus™ cellular modem is carrier specific and is also available with optional Wi-Fi capability The modems operate on carriers and Wi-Fi as follows:

CI-MODEM-01	Telus / Bell / Rogers	CI-MODEM-W1	Telus / Bell / Rogers (Wi-Fi capable)
CI-MODEM-02	AT&T	CI-MODEM-W2	AT&T (Wi-Fi capable)
CI-MODEM-03	Verizon	CI-MODEM-W3	Verizon (Wi-Fi capable)
CI-MODEM-04	International	CI-MODEM-W4	International (Wi-Fi capable)
CI-MODEM-05	Sprint	CI-MODEM-W5	Sprint (Wi-Fi capable)

The Stratus™ also has an optional polyethylene case (18.2" (46.2 cm) wide, 6.7" (17.0 cm) high and 13.4" (34.0 cm) deep) with slotted foam to house spare mounting plates for duplexers and antenna relays (up to 3):

STRATUS-DUPCASE-1	Duplexer and antenna relay carrying case (3 slots)
3702-63608124	Duplexer mounting plate
DUP-144-174EKHB	VHF Duplexer, 144-174 MHz, ≥ 4.5 MHz separation
DUP-380-406EMEB	UHF Duplexer, 380-406 MHz, ≥ 5.0 MHz separation
DUP-406-512EMEB	UHF Duplexer, 406-512 MHz, ≥ 5.0 MHz separation
DUP-768-806EWAB	UHF Duplexer, 768-806 MHz, ≥ 30 MHz separation
DUP-806-896EYAB	UHF Duplexer, 806-896 MHz, ≥ 45 MHz separation
DUP-896-960EUCB	UHF Duplexer, 896-960 MHz, ≥ 24 MHz separation

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CODAN
RADIO COMMUNICATIONS

TN760 Stratus™ Transportable Tactical Radio System

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TN761 Stratus™ Fixed Infrastructure Radio System

A Stratus™ Fixed Infrastructure Radio System supports analog and transparent P25 digital (clear or secure) repeat capability and incorporates a Sierra Wireless cellular modem to backhaul P25 Digital Fixed Station Interface (DFSI) compliant signalling across existing cellular 3G or 4G Long Term Evolution (LTE) infrastructure. The cellular backhaul can be used to interconnect multiple Stratus™ repeaters / base stations to each other, or to P25 DFSI compliant consoles. This interconnectivity is achieved via a Stratus™ controller which acts as an arbitrator for multiple DFSI interconnects.
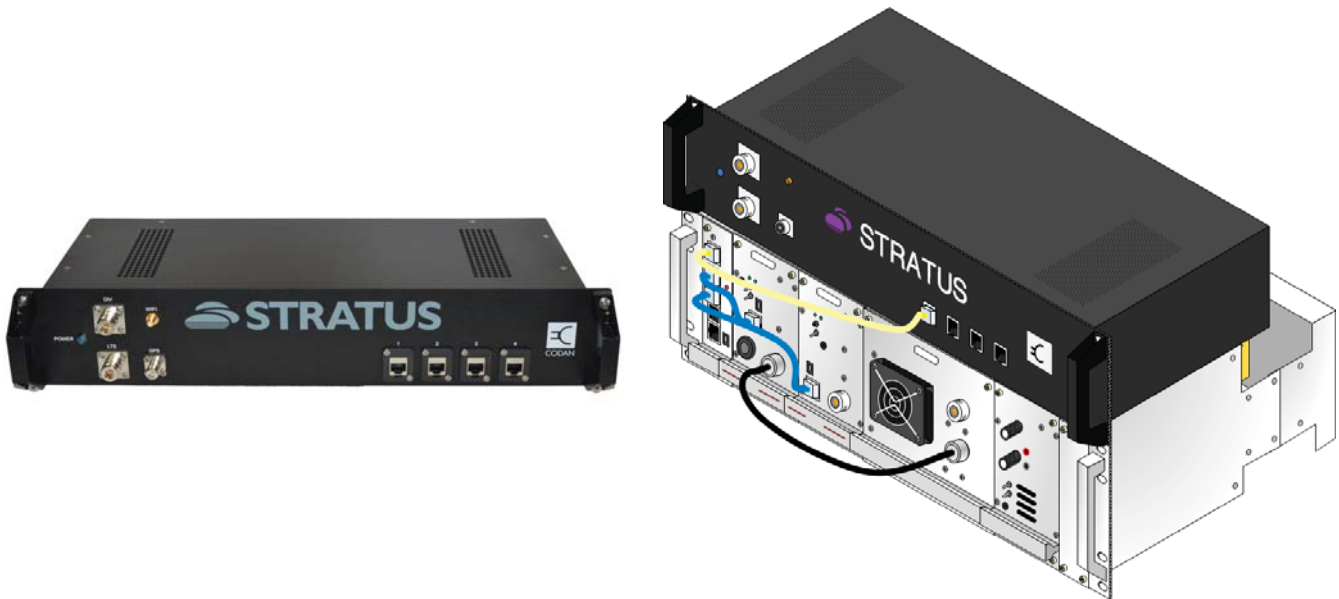
Up to four Codan UIC controllers can be linked to a single Stratus™ Fixed Link Infrastructure device at each site, enabling multiple systems to take advantage of the Stratus™ Fixed Infrastructure capabilities.

Stratus™ Fixed Infrastructure can be easily added to existing MT-4E equipment by the addition of a Stratus™ Fixed Infrastructure upgrade which includes the UIC card, DFSI firmware, and the Stratus™ Fixed Link Infrastructure equipment which includes full cellular capability (modem and antenna) and a 4-port ethernet switch.

Stratus™ Fixed Infrastructure provides the opportunity to remove the dependence on costly leased telco lines and T1 connections at a fraction of the cost.

The current draw of the Stratus™Fixed Link Infrastructure (not including MT-4E) is 500 mA to 750 mA @ 13.8 VDC

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TN761 Stratus™ Fixed Infrastructure Radio System

The Stratus™ Fixed Link Infrastructure includes the following:

- 2 RU (rack unit) harware mounting shelf.
- 6 to 34 VDC input power supply.
- 2 N-type 3G/4G LTE Antenna connectors (2nd connector is for a diversity antenna).
- 2 690 - 2700 MHz 3G / 4G LTE wall-mount omni-directional groundplane independant antennas (2 dBi gain).
- SMA connector for Wi-Fi antenna.
- BNC connector for GPS antenna (future capability).
- 4-port ethernet switch.
- cellular modem.
- front panel power LED.

Part numbers for the Stratus™ Fixed Infrastructure are as follows:

LMR-STRATUS-FPXXX	Stratus™ Fixed Link with MT-4E radio system (30 Watt P25 capable system)
LMR-STRATUS-FIXUP	Stratus™ Fixed Link upgrade to existing MT-4E radio system

The Stratus™ Fixed Link Infrastructure is 19" rack mountable, 2 RU (3.5" / 8.8 cm) high and 7.5" (19 cm) deep, and weighs 10.5 lbs. (4.6 kg).

The Stratus™ cellular modem is carrier specific and is also available with optional Wi-Fi capability The modems operate on carriers and Wi-Fi as follows:

CI-MODEM-01	Telus / Bell / Rogers	CI-MODEM-W1	Telus / Bell / Rogers (Wi-Fi capable)
CI-MODEM-02	AT&T	CI-MODEM-W2	AT&T (Wi-Fi capable)
CI-MODEM-03	Verizon	CI-MODEM-W3	Verizon (Wi-Fi capable)
CI-MODEM-04	International	CI-MODEM-W4	International (Wi-Fi capable)
CI-MODEM-05	Sprint	CI-MODEM-W5	Sprint (Wi-Fi capable)

TN761 Stratus™ Fixed Infrastructure Radio System

The Stratus™ Fixed Link case with the lid removed is shown in Figure 1. This shows how cellular modem, ethernet switch and power supply are mounted inside of the Stratus™ Fixed Link case.
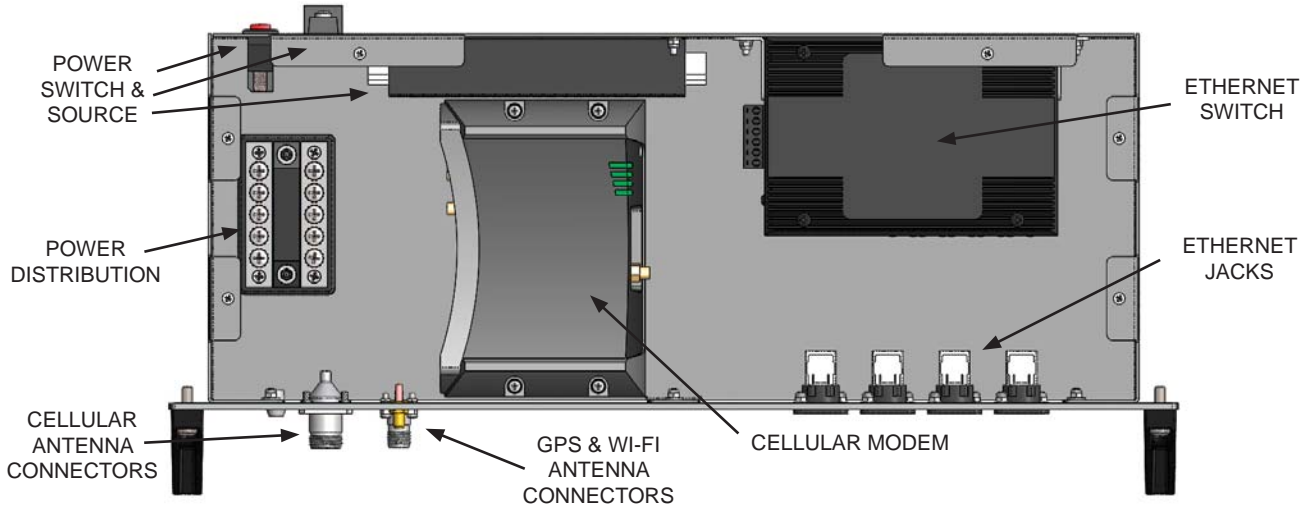
Figure 1: Stratus™ Fixed Link case with case lid removed

Stratus™ Fixed Link Infrastructure includes two 3G / 4G LTE waterproof omni-directional groundplane independant antennas with 2 dBi of gain. These antennas include a steel zinc plated finish L-Bracket for wall mounting. The antennas have N-Female connectors and a white UV-resistant sheath.
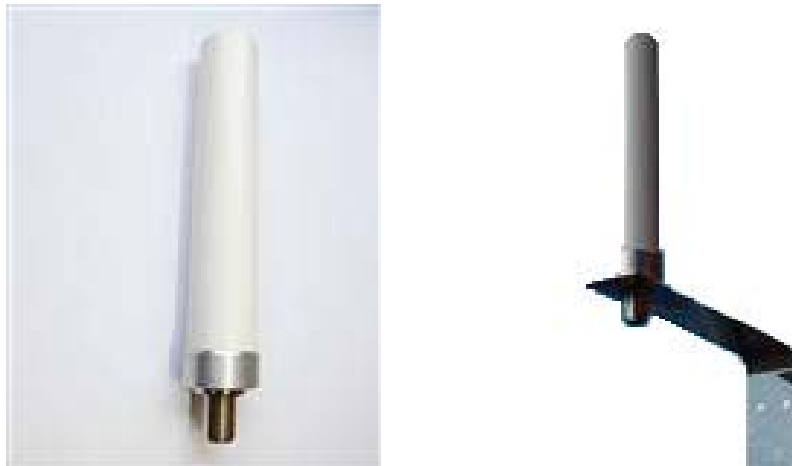
Figure 2: 3G / 4G LTE omni-directional antennas

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RADIO COMMUNICATIONS

TN761 Stratus™ Fixed Infrastructure Radio System

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CODAN
RADIO COMMUNICATIONS

TN765 Stratus™ Tactical Controller

The Stratus™ Tactical Controller is based on the Stratus™ Controller technology and is housed in a rapidly deployable, rugged, compact watertight polyethylene transportable case that can be located anywhere in the world with a cellular 3G or 4G Long Term Evolution (LTE) connection. The portable network connection is achieved using the same Sierra Wireless cellular modem found in all Stratus™ Repeaters.

The Stratus™ Tactical Controller will route calls between multiple Stratus™ Repeaters. The Controller receives the digital audio and control signals from the VHF/UHF repeaters via the cellular IP link and routes the P25 communications within the network, with all encrypted calls routed transparently.

The Stratus™ Tactical Controller has the same capabilities as the Stratus™ Controller except the VPN server has a limitation of 10 Stratus™ repeater / console connections. The Stratus™ Tactical Controller has the advantage of keeping all control and routing outside of the existing network, and IT organization. The VPN server encrypts all communications over the Stratus™ network.

The Stratus™ Tactical Controller includes the following:

• soft grip handle and press and pull latches.
• internal cellular modem.
• external interface connectors for DC power input.
• 110/220 VAC (auto-switching) to 12 VDC external power supply (22A).
• an RJ45 Ethernet connector for direct connection to network or console.

The Stratus™ Tactical Controller is 14.2" (36.1 cm) wide, 6.5" (16.5 cm) high and 11.4" (28.9 cm) deep, and weighs 15 lbs. (6.80 kg). The current draw of the Stratus™ Tactical Controller is 1.5 Amps (±10%)

The Stratus™ cellular modem ioperates on carriers as follows:

CI-MODEM-01	Telus / Bell / Rogers
CI-MODEM-02	AT&T
CI-MODEM-03	Verizon
CI-MODEM-04	International
CI-MODEM-05	Sprint

TN765 Stratus™ Tactical Controller

The Stratus™ Tactical Controller is shown below in a standard system configuration with two Stratus™ transportable repeaters and a Stratus™ fixed site. A DFSI console is connected directly into the RJ45 Ethernet connector on the side of the Stratus™ Tactical Controller case.
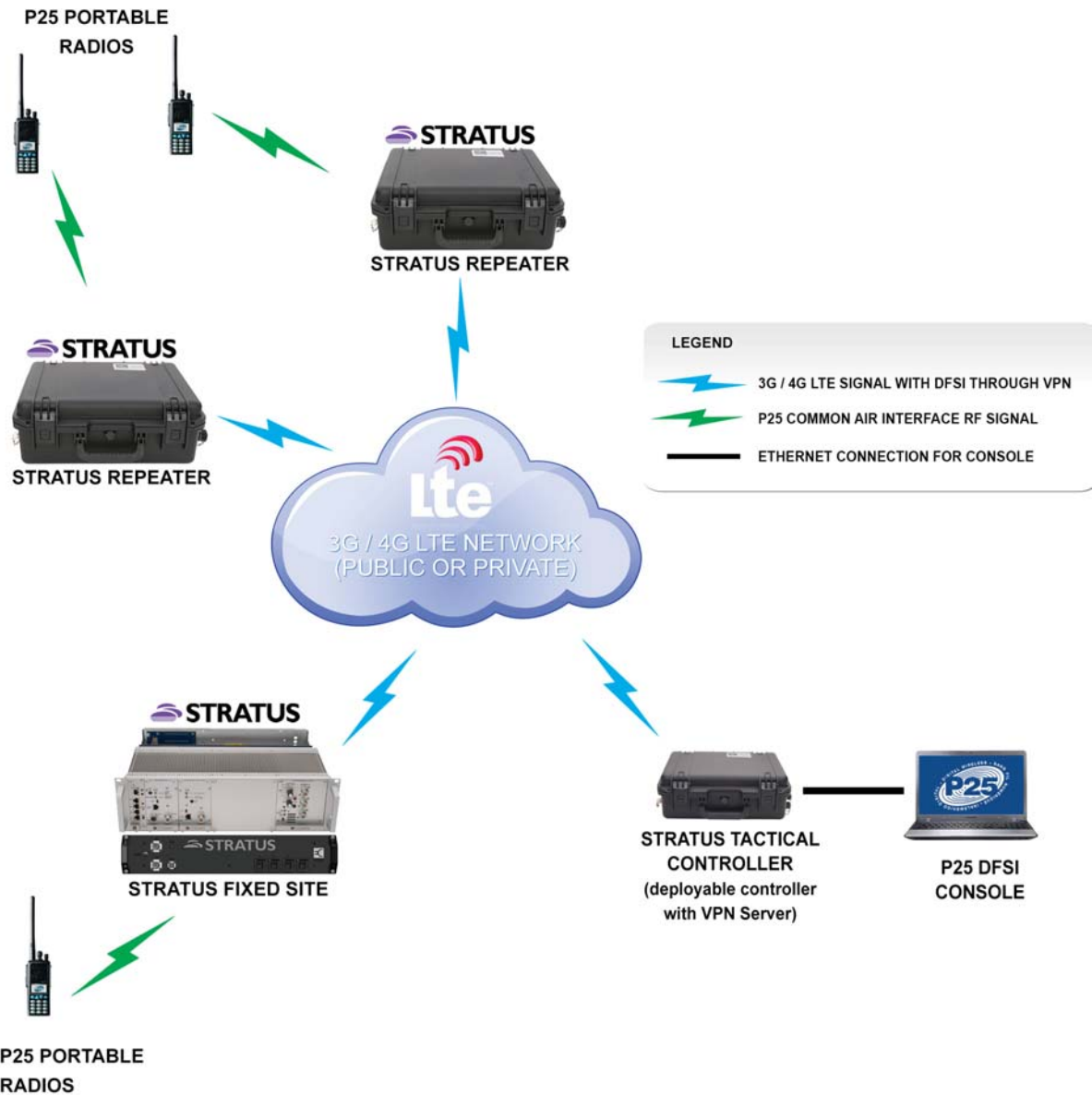
Stratus™ is a trademark of Codan Limited.

TN790 Transportable Radio System Accessories

Codan Radio Communications has a number of accessories available for the Transportable Radio System cases.

Tactical Antenna

- broadband 1/2 wave antenna.
- 2.0 dB of gain.
- no ground plane required.
- corrosion and weather resistant.
- VHF (138 - 174 MHz) ANT-TCANT-577
- UHF (406 - 470 MHz) ANT-F-33116

External Battery and Case

- 35 Ah external battery: PSBENC-002
- 100 Ah external battery: PSBENC-005
- Sealed Lead Acid 12 Vdc AGM in weatherproof case.
- comes with interconnect cable that connects to the transportable radio.
- PSBENC-002: 7.7" height; 11.8" width; 9.8" depth. weighs 28 lbs. (12.7 kg).
- PSBENC-005: 8.9" height; 21.7" width; 14.1" depth. weighs 75 lbs. (34.0 kg).
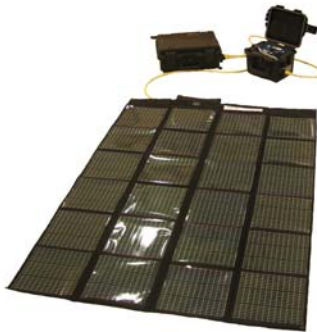
Solar Panel Kit (PSS-PS-60W-02)

- 60 Watt solar panel.
- comes in a sealed weatherproof case.
- comes with interconnect cable that connects to both the transportable radio or the external battery case.
- charge controller (regulator) included.
- dimensions: 0.06" height; 42" width; 60" depth.
- weighs 12 lbs. (5.4 kg).

Antenna Mast System

- available heights of 3, 7 or 10 meters
- made from 100% corrosive free alloys.
- stores in a rugged wheeled bag for easy transport.
- Mil-Spec 810F
- 3 meter (9' 10") kit: ANT-MASTSYS-01
- 7 meter (22' 11") kit: ANT-MASTSYS-02
- 10 meter (32' 9") kit: ANT-MASTSYS-03

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TN791 Stratus™ Power Center

The Stratus™ Power Center is a compact and rugged polycarbonate transportable case that provides a 12 V DC power source to the Stratus™ Transportable Tactical Radio System or other Codan transportable repeaters. The 35 A hour battery housed in the power center is charged and maintained by a 15 V DC input from an AC/DC power supply or optional solar panel.

The Stratus™ Power Center includes the following:

• internal custom foam for protection against daily bumps.
• soft grip handles, in-line wheels, press and pull latches and a telescoping handle.
• 35 A hour battery with an internal battery charger.
• on-board battery percent status indicator and current meter.
• internal 30 A breaker for short-circuit protection, and charging over-current protection.
• an external DC output connector for supplying power.
• an external DC input connector for AC/DC power supply or other DC inputs (vehicle cigarette lighter).
• an external DC input connector for optional solar panel.
• Meter Power switch and Charge Select switch for selection of DC input charging.

The Stratus™ Power Center can output 20 Amps maximum @ 12VDC and can power a Stratus™ repeater for 20 hours at a 10% duty cycle. Figure 1 shows the front panel meters and switches on the Stratus™ Power Center.

Figure 1: Stratus™ front panel meters and switches

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TN791 Stratus™ Power Center

Part numbers for the Stratus™ Power Center are as follows:

LMR-STRATUS-POWC1	Stratus™ Power Center
STRATUS-PSA-1	110/220 VAC (auto-switching) to 12 VDC power supply
STRATUS-EXTCBL-1 DC	DC power extension cable
LMR-STRATUS-SOLP3	60 Watt optional solar power kit

The Stratus™ Power Center is 14.1" (35.8 cm) wide, 8.9" (22.6 cm) high and 21.7" (55.1 cm) deep, and weighs 48 lbs. (21.80 kg) fully loaded.

The Stratus™ Power Center is also capable of powering the ET-1, ET-3, ET-4, ET-5, and Vizor™ (ET-6) transportable radio systems with the addition of these parts and labour:

7831-35502183	DC power cable
5076-P1611P25	Plug
STRATUS-PSA-1	110/220 VAC (auto-switching) to 12 VDC power supply (recommended for charging the Stratus™ Power Center)
One Hour Labour	Factory Labour

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Vizor™ is a trademark of Codan Limited.

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TN792 Stratus™ Rapid Antenna

The Stratus™ Rapid Antenna is a compact, lightweight and robust rapidly deployable antenna solution. The antenna is enclosed in a patented Rolatube mast made of thermoplastic reinforced composites that transports as a flat coil then rapidly expands into a rigid mast within seconds. The cable antenna is hooked inside of an end cap, which is slid securely onto the top of the Rolotube mast. The antenna is enclosed inside of the mast.

From a roll   to tubular   to a mast

The Stratus™ Rapid Antenna comes in a custom built backpack, and includes a base unit that stores the Rolotube mast. Two tensioning knobs on the base unit are used to allow the mast to expand easily through the top of the base.

The base unit can be secured to the ground using steel rock pegs and three additional guy wires may be used to give the mast additional stability.

The Stratus™ Rapid Antenna mast is 2" in diameter, will reach up to 4 meters (13 feet) in height, can withstand winds up to 100 km/h (62 mph), is corrosion and weather resistant to the MIL-STD-810G environmental standard, and does not require a ground plane.

TN792 Stratus™ Rapid Antenna

The Stratus™ Rapid Antenna ANT-TACSYSTEM includes the following:

• custom built backpack.
• base unit with tensioning knobs and built-in mast.
• 3" end cap and cable hook adapter for connectiing the antenna.
• 9 steel rock pegs (25 cm / 9.8") with green tops for securing antenna mast and guy wires.
• 3 sets of guy wires (7.5 m / 24.6 feet) for securing mast.
• tactical cable antenna (7.6 m / 25 feet).

Five different tactical antennas with 25 feet (7.6m) of LMR 195 coaxial cable are available for the Stratus™ Rapid Antenna:

Part Number	Frequency Range	Antenna Gain
ANT-TAC-VHF-06	138 - 174 MHz	2 dB
ANT-TAC-UHF-02	380 - 470 MHz	2 dB
ANT-TAC-UHF-03	450 - 520 MHz	2 dB
ANT-TAC-800-001	746 - 896 MHz	2 dB
ANT-TAC-800-002	806 - 960 MHz	2 dB

The Stratus™ Rapid Antenna is 15" (38.1 cm) wide, 23" (58.4cm) high and 13" (33.0 cm) deep, and weighs 31 lbs. (14.1 kg) in the custom backpack.

Stratus Rapid Antenna Kit   Custom Backpack   Base Unit

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TN800 A-PNL-AUX96-3 Auxiliary Connector
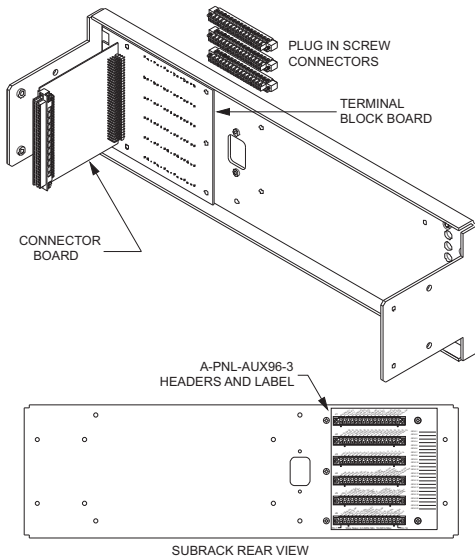
The A-PNL-AUX96-3 option provides convenient access to all signals on the motherboard auxiliary control connector. This is accomplished with two circuit boards: the Terminal Block board and the Connector board. The Terminal Block board mounts to the subrack rear panel and has six 16 pin headers that mate with 16 position plug-in screw connectors. The plug-in screw connectors use a clamping action to secure stranded or solid conductor wires from 22 AWG to 16 AWG and have locking screws to ensure the connector does not loosen due to vibration. A label on the back of the subrack rear panel lists the signals at their respective positions. The Connector board is soldered to the Terminal Block board and provides the interconnection between the auxiliary control connector on the motherboard and the Terminal Block board.
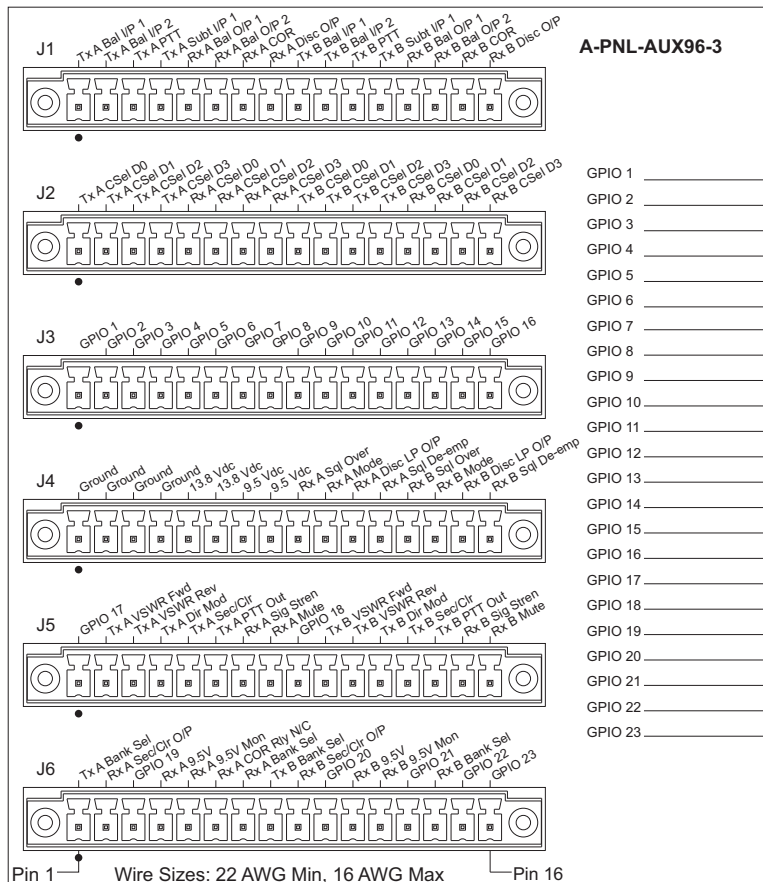
A close-up view of the auxiliary connector label shows the short signal name for each connection point. Definitions for these signals can be found in the SR-39-1 subrack manual. Extra General Purpose Input / Output connectors (GPIO) that can be used for different functions depending on the control card are listed to the right of the connectors. For example, the AC-3E audio control card uses these lines for auxiliary audio inputs / outputs and auxiliary COR / PTT connections. The CI-PM-3 paging modulator uses these signal lines for connecting A/D select lines, 2-level and 4-level data, etc. The custom functions of these connectors will be marked in the blank space next to the signal name.

See Table 1 and Table 2 for a list of connector names by control card and by transmitter and receiver series.

CODAN
RADIO COMMUNICATIONS

TN800 A-PNL-AUX96-3 Auxiliary Connector

Table 1: Auxiliary Control Connector Definitions for Control Cards

Name	Old Name	Pin #	AC-3E	CI-BC-4E	CI-PM-3	UIC-4
GPIO 1	Spare 1	J3-1	AUX 1 AUDIO I/P 1	AUX 1 AUDIO I/P 1	DATA OUT	GPAI2 I/P
GPIO 2	Spare 2	J3-2	AUX 1 AUDIO I/P 2	AUX 1 AUDIO I/P 2	CTCSS HU/BUSY	GPAI3 I/P
GPIO 3	Spare 3	J3-3	AUX 2 AUDIO I/P 1	AUX 2 AUDIO I/P 1	REF FAIL ALARM***	GPAI0 I/P
GPIO 4	Spare 4	J3-4	AUX 2 AUDIO I/P 2	AUX 2 AUDIO I/P 2	N/C	GPAI1 I/P
GPIO 5	Spare 5	J3-5	AUX 1 AUDIO O/P 1	AUX 1 AUDIO O/P 1	EXT B/W SEL****	GPAO2 O/P
GPIO 6	Spare 6	J3-6	AUX 1 AUDIO O/P 2	AUX 1 AUDIO O/P 2	N/C	GPAO3 O/P
GPIO 7	IMC 1	J3-7	AUX 2 AUDIO O/P 1	CLEAR KEYS 1	N/C	CLEAR KEYS 1
GPIO 8	IMC 2	J3-8	AUX 2 AUDIO O/P 2	CLEAR KEYS 2	N/C	CLEAR KEYS 2
GPIO 9	Alarm 1	J3-9	AUX 1 COR C	AUX 1 COR C	PTT	GPDO0 O/P
GPIO 10	Alarm 2	J3-10	AUX 1 COR E	AUX 1 COR E	A/D MODE SEL	GPDO1 O/P
GPIO 11	Alarm 3	J3-11	AUX 2 COR C	AUX 2 COR C	2-LVL/4-LVL SEL	GPDO2 O/P
GPIO 12	Alarm 4	J3-12	AUX 2 COR E	AUX 2 COR E	EXT CLOCK	GPDO3 O/P
GPIO 13	Alarm 5	J3-13	AUX 1 PTT A	AUX 1 PTT A	BAL AUDIO 2	GPDI0 I/P
GPIO 14	Alarm 6	J3-14	AUX 1 PTT K	AUX 1 PTT K	4-LVL DATA	GPDI1 I/P
GPIO 15	Alarm 7	J3-15	AUX 2 PTT A	AUX 2 PTT A	BAL AUDIO 1	GPDI2 I/P
GPIO 16	Alarm 8	J3-16	AUX 2 PTT K	AUX 2 PTT K	2-LVL DATA	GPDI3 I/P
GPIO 17	Tx A Audio Cntl	J5-1	N/C*	AUX 2 AUDIO O/P 1	TX A A/D MODE CTRL	GPAO0 O/P
GPIO 18	Tx B Audio Cntl	J5-9	N/C**	AUX 2 AUDIO O/P 2	TX B A/D MODE CTRL	GPAO1 O/P
GPIO 19	Rx A Sql Flat Aud	J6-3	N/C	N/C	N/C	N/C
GPIO 20	Rx B Sql Flat Aud	J6-10	N/C	N/C	N/C	N/C
GPIO 21	N/A	J6-13	N/C	N/C	N/C	RX B MODE I/P
GPIO 22	N/A	J6-15	N/C	N/C	N/C	N/C
GPIO 23	IMC 3	J6-16	N/C	EXT RPT DISABLE	N/C	N/C

* Install SR-39-1 motherboard jumper JU6 for TX A A/D MODE I/P
** Install SR-39-1 motherboard jumper JU7 for TX B A/D MODE I/P.
*** REF FAIL ALARM requires SCARB
**** EXT B/W SEL requires custom modification

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TN800 A-PNL-AUX96-3 Auxiliary Connector

Table 2: Auxiliary Control Connector Definitions for Transmitter / Receiver Series

Connector Name	Pin #	MT-3 Module	MT-4E Module
Tx A Bank Sel	J6-1	TX A STANDBY	TX A BANK A/B SEL
Tx B Bank Sel	J6-8	TX B STANDBY	TX B BANK A/B SEL
Rx A Bank Sel	J6-7	RX A ISO COR K	RX A BANK A/B SEL
Rx B Bank Sel	J6-14	RX B ISO COR K	RX B BANK A/B SEL
Tx A Sec/Clr	J5-5	TX A SUBT I/P 2	TX A SEC/CLR I/P
Tx B Sec/Clr	J5-13	TX B SUBT I/P 2	TX B SEC/CLR I/P
Rx A Sec/Clr	J6-2	RX A AMP AUD	RX A SEC/CLR O/P
Rx B Sec/Clr	J6-9	RX B AMP AUD	RX B SEC/CLR O/P
Rx A Mode	J4-10	RX A PRIOR COR	RX A A/D MODE O/P
Rx B Mode	J4-14	RX B PRIOR COR	RX B A/D MODE O/P

TN800 A-PNL-AUX96-3 Auxiliary Connector

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TN811 SM-3 System Regulator

The SM-3 system regulator is a plug-in module which provides voltage regulation, system metering and audio monitoring for an MT-3 or MT-4 radio system. The SM-3 includes the following features:

• High current +9.5 Vdc voltage regulator with an anti-latchup hysteresis circuit.
• Front panel switch selectable meter outputs to check supply voltages, carrier strengths, etc.
• Audio amplifier and loudspeaker.
• Relay drivers for optional antenna relays.
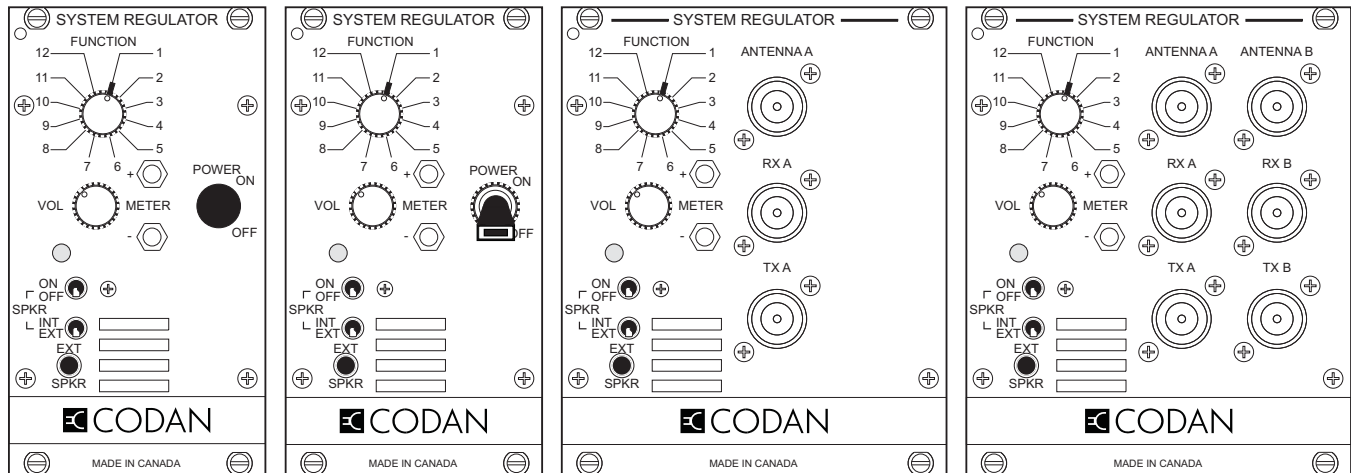
There are four different versions of the system regulator.

SM-3-H0-014-00	Standard SM-3 with no relays or switches (14 HP width)
SM-3-H0-014-01	SM-3 with main power switch (14 HP width)
SM-3-H0-R1N-00	SM-3 with single antenna relay on the front panel (21 HP width)
SM-3-H0-R2N-00	SM-3 with dual antenna relays on the front panel (21 HP width)

The System Regulators have a rotary switch on the front panel allowing the various functions to be selected for monitoring. Two front panel jacks are provided for monitoring of selected functions. An audio amplifier and loudspeaker allow for audio monitoring. Front panel controls allow for audio volume adjustment. Select the Receiver audio for monitoring using the rotary switch (position 3 for Receiver A, position 5 for Receiver B), and turn the speaker ON. An external speaker jack is also available. An LED indicator illuminates when the audio circuits are on. Receiver C, D and E can also be monitored when using the System Regulator in a Multiple Receiver Subrack. Jumpers JU15 - JU24 are installed for Multiple Receiver Subrack compatibility.

Backwards Compatibility
The SM-3 System Regulator is a direct replacement for the SM-3 System Monitor, however, the rotary switch positions for the front panel test points have been changed.

The simplex mode jumpers to connect the Transmitter PTT OUT signal line to the RX MUTE are now located on the new motherboard, but the System Regulators still contain the simplex mode jumpers for backwards compatibility with older motherboards.

TN811 SM-3 System Regulator

System Regulator Testing

The System Regulator module is designed with a convenient and easy test point built in to the front panel. This test point allows a technician access to the DC supply and regulated voltages. Simply connect a standard Digital Volt Meter (DVM) to the METER jacks on the front panel of the System Regulator as shown in Figure 1. Turn the rotary switch to the desired position to measure the supply voltage, regulated voltage or audio output as shown in Table 1. Note that the RSSI requires a carrier and the audio output requires an audio tone injected into the receiver.
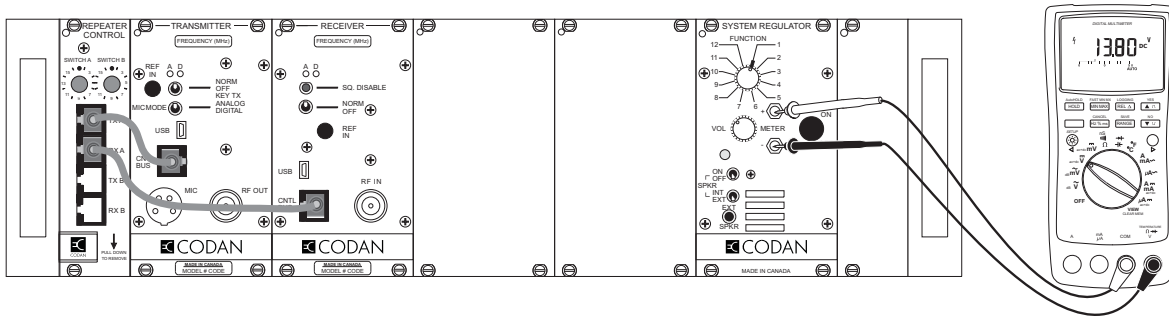
Figure 1: System Regulator Testing

Table 1: System Regulator Rotary Switch Functions

Position	Function	Parameter
1	Supply Voltage	+10 Vdc to +17 Vdc (+13.8 Vdc nominal)
2	+9.5 Volts Regulated	+9.5 Vdc (± 0.1 Vdc)
3	Rx A Audio	Receiver A Audio (NOT Rx Balanced Output)
4	Rx A Carrier Strength	0 Vdc to +5.0 Vdc based on received signal strength
5	Rx B Audio	Receiver B Audio (NOT Rx Balanced Output)
6	Rx B Carrier Strength	0 Vdc to +5.0 Vdc based on received signal strength
7	Rx C Audio	Receiver C Audio (NOT Rx Balanced Output)
8	Rx C Carrier Strength	0 Vdc to +5.0 Vdc based on received signal strength
9	Rx D Audio	Receiver D Audio (NOT Rx Balanced Output)
10	Rx D Carrier Strength	0 Vdc to +5.0 Vdc based on received signal strength
11	Rx E Audio	Receiver E Audio (NOT Rx Balanced Output)
12	Rx E Carrier Strength	0 Vdc to +5.0 Vdc based on received signal strength

TN830 AC to DC and DC to DC Power Supplies
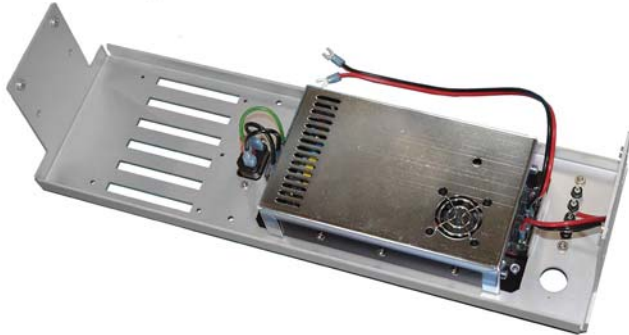
The PSA-4P-1 and PSA-4U-1 AC switching power supplies provide a regulated +13.8 Vdc to the output terminals. Valuable rack space has been saved by mounting the "P" version AC power supply inside the rear panel frame that attaches to the rear of the subrack. The "U" version is sold unmounted. An AC power socket is located on the outside of the subrack rear panel and accepts standard IEC320 type cordsets.

Input Voltage Range	100–265 Vac Universal
Input Frequency Range	50 / 60 Hz
Output Voltage	+13.8 Vdc ± 70 mV
Output Current	20 Amps continuous
AC Fuse	4.0 Amps
Efficiency	90%
Operating Temperature	-45°C to +50°C (-50°F to +125°F)

Features:

Float Charger and Battery Backup:
  A 12V battery terminal connector, conveniently routed to the back of the auxiliary panel for ease of access, allows connection of a Lead Acid battery for float charging. During a power failure the Lead-Acid battery provides backup power to the primary output. This terminal is fused protected from excessive current draw and reverse polarity connections.

Voltage Adjust:
  Output voltage may be adjusted slightly by turning an internal potentiometer. The potentiometer may be accessed through an opening on the top of the lid.

Active Current Limiting:
  In the event of a short circuit condition, the output will shut down in order to protect the power supply from overheating. Once the load is returned to within specification, the output will be reset automatically.

Overvoltage Protection:
  The output is limited to a pre-determined voltage level, in the event of a fault condition.

Input Voltage Surge:
  The power supply is protected at the input by a transient voltage suppressor, which will limit any unwanted voltage surges. There is also an inline fuse present at the input for additional safety.

Output Isolation:
  A high power schottky diode at the output prevents any unwanted feedback into the power supply from the load.

![Codan Radio Communications logo]

TN830 AC to DC and DC to DC Power Supplies

FRAME

DC - DC CONVERTER

#12 WIRES TO
SUB-RACK
MOTHERBOARD
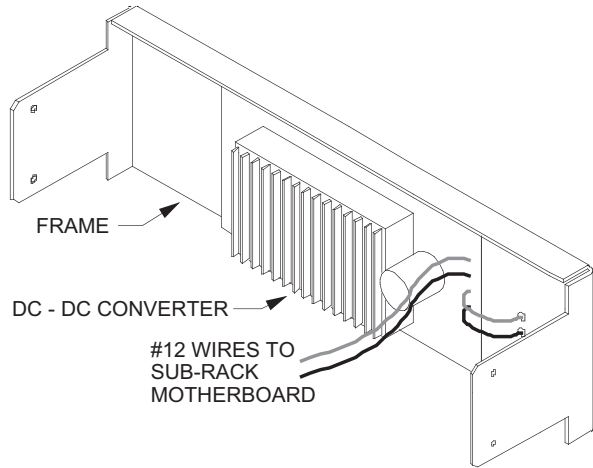
The DC to DC converters provide a regulated +13.8 Vdc to the output terminals over a wide range of DC input voltages. Valuable rack space has been saved by mounting the DC to DC converter inside the rear panel frame that attaches to the rear of the subrack. A terminal block is located on the outside of the subrack rear panel for the DC input voltage. The DC to DC converters comes in two different models.

Input Voltage Range	18 - 36 Vdc floating input **PSD-15-08-P0-80**
	36 - 72 Vdc floating input **PSD-15-08-P0-90**
Output Voltage	Factory set at +15 Vdc. Adjustable from +13.5 Vdc to +16.5 Vdc
Output Current	12 Amps continuous @ +15 Vdc
Operating Temperature	-25°C to +85°C
Input Current No Load	50 mA
Voltage Accuracy	±1% max
Remote On / Off Control	On: +5.5V min. or open circuit
	Off: +1.8V max.
Isolation Voltage	Input to Output: 100 Vdc min.
Efficiency	85%
Thermal Shut Down	100°C / ±5°C

Features:

• remote on/off control

• over voltage protection

• reverse voltage protection

• input surge protection

• short circuit protection specified for an indefinite period

• 100V input to output isolation

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TN835 High Current AC to DC Power Supplies

The PSA-12-40-RB-00 and PSA-12-60-RB-00 AC switching power supplies provide a regulated +13.8 Vdc to the output terminals. The power supplies are 19" rack mountable and include battery revert capability. An input fuse, electronic current limiting and voltage limiting protection, transient voltage suppressor and thermistor are built into the unit as standard protection to safeguard the unit from abnormal conditions. The power supply uses active current sharing technology to distribute the load current among two or three 20 Amp modules. This reduces stress on individual components and increases reliability.

For remote sensing, status signals are available on the rear of the power supply on a female DB25 connector.
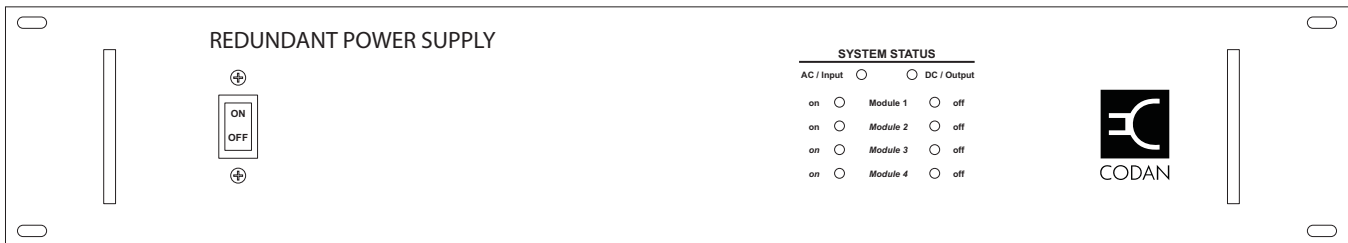
Specifications

Input Voltage Range	120 Vac or 220 Vac (Switch Selectable)
Input Frequency Range	50 / 60 Hz
Output Voltage	+13.8 Vdc
Output Current	40 Amps continuous @ +13.8 Vdc (+60°C) **PSA-12-40-RB-00**
	60 Amps continuous @ +13.8 Vdc (+60°C) **PSA-12-60-RB-00**
Operating Temperature	-40°C to +60°C continuous duty

Installation

1. Mount the unit to the 19" rack.
2. Select the input voltage by sliding both AC voltage select switches on the rear of the power supply. Be certain that both switches are on the same voltage setting.

WARNING: Damage to the unit and personal injury might occur if both the AC voltage select switches are not set on the same voltage setting.

3. Connect the load to the output terminal block connector marked "SYSTEM", with proper polarities in mind. Tighten the output terminal block screws to secure the wires.
4. Connect the backup battery (if applicable) to the output terminal block connector marked "BATT", with proper polarities in mind. Tighten the output terminal block screws to secure the wires.
5. While the switch is in the OFF position, connect the supplied AC power cord to the AC input socket.
6. Plug the unit into an AC source capable of handling the rated input current (7 Amps or 12 Amps).
7. Turn the AC switch (located on the front panel) to the ON position to operate the unit.

TN835 High Current AC to DC Power Supplies

Battery Backup

During normal operation, the power supply provides all of the necessary power to the output while float charging the battery that is connected at the battery backup output. In the event that the AC power source is interrupted, the battery will start to supply power to the load through an isolation diode; however, the load voltage will be 0.4 Vdc lower than the battery voltage. The power resistors used to float charge the battery limit the charging current to a value based on a 100Ah deep cycle battery.

Alarm and Status Signals

For remote monitoring, the power supply is equipped with a female DB25 connector (on the rear of the power supply behind a protective panel) that outputs various alarm and status signals such as:

Pin Number	Pin Description	Voltage Out
Pin 1	AC Good signal	+15 Vdc if AC Voltage present / 0 Vdc if AC voltage not available
Pin 2	+5 Vdc reference signal	+5 Vdc
Pin 3	No connection	N/C
Pin 4	Fan Good signal	+5 Vdc if both fans are good / 0 Vdc if one or both fans not functioning
Pin 5	No connection	N/C
Pin 6	Current signal	System current out analog signal (0 Vdc ~ +5 Vdc)
Pin 7	Module 1 Good signal	+5 Vdc If Module is Good
		0 Vdc If Module is not functioning or not present
Pin 8	Module 2 Good signal	
Pin 9	Module 3 Good signal	
Pin 10	Module 4 Good signal	
Pin 11	No connection	N/C
Pin 12	Temp warning signal	+5 Vdc if the temperature inside the unit is over 48°C
Pin 13	System VOUT Signal	+13.8 Vdc
Pin 14-15	Ground	Ground
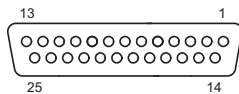
Figure 1: Pin Layout of the DB25 Connector

LED Status Display

An LED status indicator (located on the front panel) identifies how many modules are connected on the board and are working. The display also shows the status of the AC input and the DC output signals.

The green LED status indicator will be lit when:
• AC line voltage is preset
• DC output voltage is present
• Module voltage is present

The yellow LED status indicator will be lit when:
• Module is not present in the slot
• Module is not producing any output

TN836 High Current Digital Series AC to DC Power Supplies

The high current digital series power supplies provide 675 Watts (50 Amps @ +13.8 Vdc) or 1350 Watts (100 Amps @ +13.8 Vdc) of power and are 19" rack mountable in a 1 RU rack mount chassis and include battery backup capability.

The digital series power supply may include the following features:

• Front panel control of voltage, current limiting (optionally password protected).
• TCP/IP Ethernet connector for remote monitoring and control of power supply via a built-in web server.
• Battery backup and Low Voltage Disconnect (LVD) with adjustable setpoints.
• Connect up to 6 power supplies in parallel with load sharing control.
• Form C alarm contacts and remote on/off capability.
• Temperature controlled fans (front to rear airflow).

Specifications

Input Voltage Range	100 to 265 Vac (Automatic)
Frequency Range	50 / 60 Hz
Output Voltage Range	+12 Vdc (+11.5 - +15.5 Vdc)
Continuous Output Current	50 Amps or 100 Amps @ +12 Vdc (+60°C)
Operating Temperature Range	-20°C to +60°C
Typical Efficiency	90% @ 220 Vac
Output Ripple	15mV RMS

Models Available

PSA-12-50-R6-31	50 Amps with Battery Backup and Remote / Alarm Connector **(No Front Panel Display / Control and no Ethernet connector)**.
PSA-12-50-R5-11	50 Amps with Battery Backup, Remote / Alarm Connector, Front Panel Display / Control and Ethernet connector.
PSA-12-50-R5-12	50 Amps with Battery Backup, Remote / Alarm Connector, Front Panel Display / Control **(No Ethernet connector)**.
PSA-12-100-R5-11	100 Amps with Battery Backup, Remote / Alarm Connector, Front Panel Display / Control and Ethernet connector.
PSA-12-100-R5-12	100 Amps with Battery Backup, Remote / Alarm Connector, Front Panel Display / Control **(No Ethernet connector)**.

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TN836 High Current Digital Series AC to DC Power Supplies

Installation

1. Mount the unit to the 19" rack.
2. Connect the positive side of the load to the "POS" busbar and the negative side of the load to the "NEG" busbar. Tighten the busbar hardware to properly secure the wires.
3. Connect the backup battery (if applicable) positive side of the load to the "BAT" busbar, and the negative side of the load to the "NEG" busbar. Tighten the busbar hardware to properly secure the wires.
4. Connect a chassis bonding wire to the 1/4 inch ground stud located on the back panel (if required).
5. While the switch is in the OFF position, connect the supplied AC power cord to the AC input socket.
6. Plug the unit into an AC source capable of handling the rated input current.
7. Turn the AC switch (located on the front panel) to the ON position to operate the unit.

Front Panel Control

The Front Panel Display allows the following:

• View Input Voltage and Output Current
• View and Control Output Voltage (+11.5 - +15.5 Vdc) and Current Limit (25 A - 106 A)
• Turn the DC Output On or Off
• Set and Clear a password for the front panel control, including a lockout timer (0 - 60 min.)
• View the IP address, MAC address and device name
• Reset the password, IP address and port to factory default
• Configure parallel mode (Master and Slave setting), number of units paralleled, or set as standalone
• Set the LVD disconnect (+10 - +12.4 Vdc) and reconnect voltage (+10.6 - +13.8 Vdc), and view battery voltage

Battery Backup

The "BAT" terminal provides a current limited charge up to the maximum rated output of the supply. When AC fails, the load is automatically and seamlessly transferred to the battery so that the load is not interrupted. When AC returns, the power supply picks up the load, and resumes charging the battery to an optimal state of charge. A built-in Low Voltage Disconnect (LVD) protects the battery voltage from dropping too low, thereby avoiding damage to the battery.

AC Power Cords

The 50 Amp Power supply requires a NEMA 5-15 (15 Amp) socket for the power cord.
The 100 Amp Power supply requires a NEMA 5-20 (20 Amp) socket for the power cord.

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TN836 High Current Digital Series AC to DC Power Supplies

Remote Control and Alarm Connector
A REMOTE connector on the back panel of the power supply allows for the following functionality:

Pin Number	Pin Description	Functionality
Pin 1	REM SD+	Remote shutdown control lines (TTL compatible)
Pin 2	REM SD-	Hi = output off; Low = output on
Pin 3	REM SNS+	Remote voltage sense lines for tighter voltage regulation at load
Pin 4	REM SNS-	Default sense point is at busbars
Pin 5	Common	Alarm Output Common
Pin 6	NO	Alarm Output Normally Open contact (0.5 A 125 Vac max.)
Pin 7	NC	Alarm Output Normally Closed contact (0.5 A 125 Vac max.)

Alarms
Alarm Output activation setting is enabled or disabled through the TCP/IP web based utility (for units without the Ethernet option the form C relay output will always be activated for an alarm condition). Available alarms are as follows:

DC Output Voltage Failure Alarm	Output voltage rises above ≈ 110% of the maximum rated output. Alarm latches output off, clears when DC output manually re-enabled.
DC Overcurrent Shutdown Alarm	Output current rises above ≈ 115% of the maximum rated output. Alarm latches output off, clears when DC output manually re-enabled.
AC Input Voltage Failure Alarm	AC Input voltage falls below ≈ 90 Vac. Alarm latches output off, automatically clears when AC input rises . above ≈ 100 Vac for 3 seconds.
System Failure Alarm	Internal system failure. Alarm latches output off, clears when DC output manually re-enabled. and internal fault is no longer present.
Over-Temperature Alarm	Internal over-temperature limit exceeded. Alarm latches output off, automatically clears when temperature . returns to normal operating range.
Parallel Unit Offline Alarm	Communication is lost between parallel units. Output state unaffected. No effect if parallel operation is not active.

TN836 High Current Digital Series AC to DC Power Supplies

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TCP / IP Web Based Utility

The power supplies may be equipped with an embedded Web server that allows status monitoring and changing of the settings and configuration of the power supply. The embedded Web server provides an interface to the power supply that can be accessed through a standard web browser on a network connected computer. There is no additional software to install or configure. If the power supply is connected to a network with a DHCP server, it will be assigned an IP address automatically.

The web browser connection allows all of the configuration of the front panel (voltage control, current limiting, monitoring, password control, IP management parallel mode control and LVD setting), as well as Alarm Setup (independently selecting the alarms to activate the Form C relays and/or send e-mails).

The web browser also has remote reset capability, e-mail configuration, SNMP and other features. An example of the web browser is shown below.

43 Erie Street **Victoria, B.C.** **Canada V8V 1P8**	**Toll Free Canada & U.S.A.** **Phone:** 1-800-664-4066 **Fax:** 1-877-750-0004	**International** **Phone:** 250-382-8268 **Fax:** 250-382-6139	**Internet** **Email:** LMRsales@codanradio.com **Web:** www.codanradio.com

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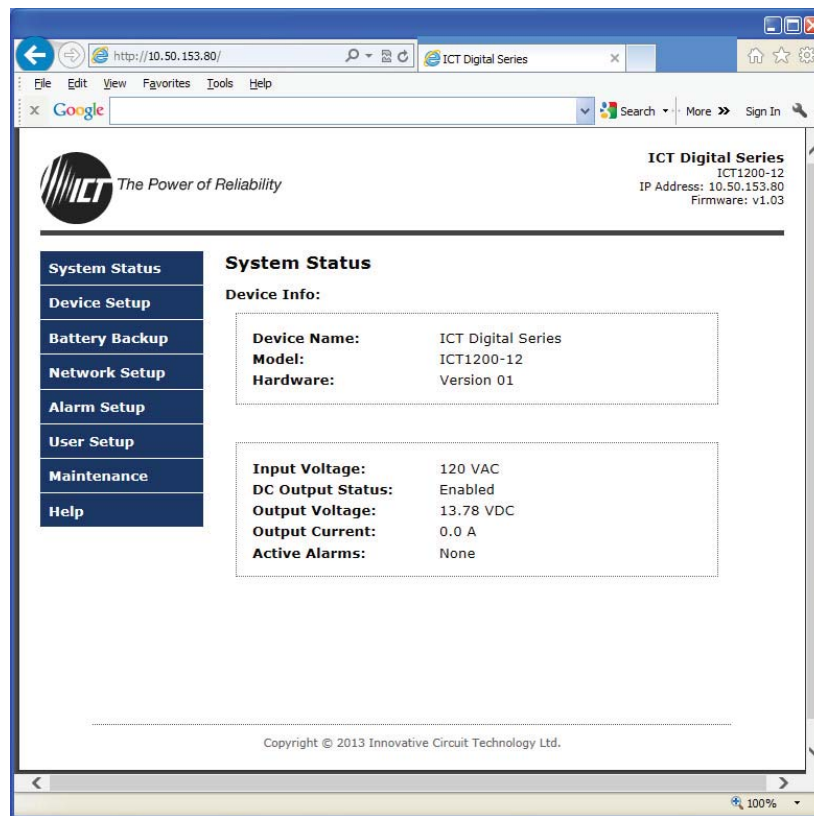
TN840 Extender Cards and Kits

To facilitate testing, alignment and maintenance for the MT-3 and MT-4 radio systems, extender cards and kits can be used to extend the individual modules out from the subrack.

Extender cards plug directly into the subrack, and are shown in Figure 1.
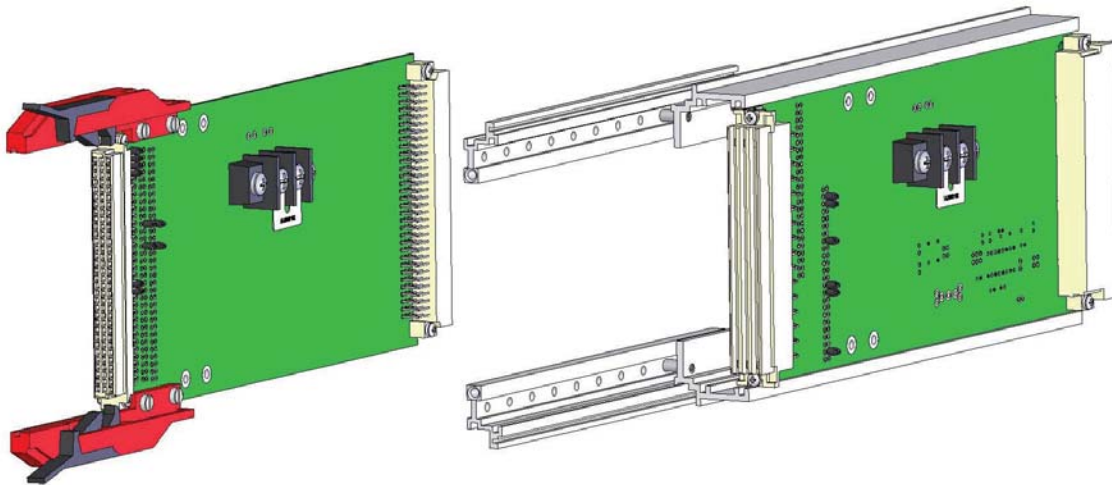
Figure 1: EC-96D1 and EC-48RD Extender Cards

Extender kits (extender card and a four foot cable) allow the modules to be extended out to a bench for servicing as shown in Figure 2.

Figure 2: Extender Kit

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Canada V8V 1P8	**Fax:** 1-877-750-0004	**Fax:** 250-382-6139	**Web:** www.codanradio.com

TN840 Extender Cards and Kits

The following extender cards and kits are available:

EC-48RD Extender Card
Used for all transmitter, receiver and system regulator modules.

Direct connect (no cables).

Extender card and adapter panel extrusion are mounted in the subrack in TX, RX or SM-3 slot.

Adapter panel supports the module outside the subrack and has different slots for each module.

EC-96D1 Extender Card
Used for the 96 pin control cards (AC-3E, CI-RC-4L, CI-BC-4E, UIC-4).

Direct connect (no cables).

Extender card is mounted in the subrack in the control card slot.

Control card is inserted into the red plastic rails on the end of the extender card and is locked into place using black locking levers.

EC-48RK-1.22 Extender Kit
Used for all transmitter, receiver and system regulator modules.

Extender card and four foot cable.

Extender card and adapter panel extrusion is mounted in the subrack in TX, RX or SM-3 slot and cable is used to attach to module.

EC-96K-1.22 Extender Kit
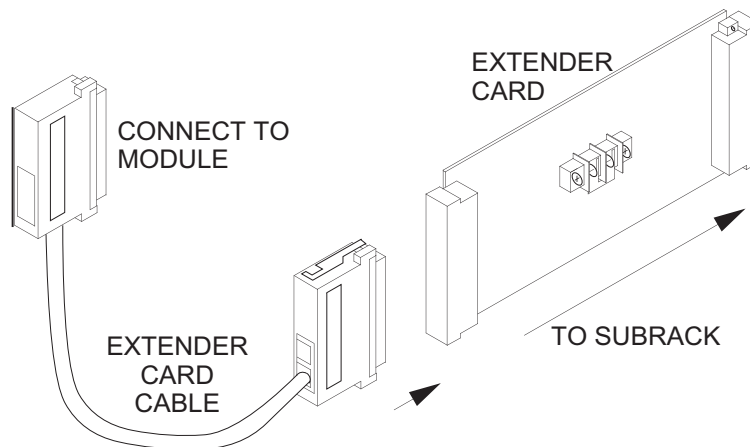Used for the 96 pin control cards (AC-3E, CI-RC-4L, CI-BC-4E, UIC-4).

Extender card and four foot cable.

Extender card is mounted in the subrack in the control card slot and cable is used to attach to module.

Test Points
The extender cards have solder points available on each signal line that can have a small test point (5059-TP110300), that is supplied with the extender card, soldered to them for easy connection with clip-on type clips.

Recommended Test Points are:

Audio Control Card and Base Control Card Extender Card pins (EC-96D1 and EC-96K-1.22):

Auxiliary 1 Audio Output = B11 & A11

Auxiliary 2 Audio Output = C1 & C3 (Audio Control Card); C2 & C4 (Base Control Card)

Auxiliary 1 Audio Input = C19 & C20

Auxiliary 2 Audio Input = B14 & A14

Receiver and Transmitter Extender Card pins (EC-48RD and EC-48RK-1.22):

Rx Balanced Audio Output = B26 & Z26

Tx Balanced Audio Input = B18 & Z18

Tx Subtone Input = B22 & Ground (B32)

TN855 CI-DSP-223 Telex (Vega) DSP Tone-Remote Adapter

The Telex DSP-223 tone-remote adapter provides a reliable means of remotely controlling Codan base stations and repeaters. The adapters can be used in conjunction with tone-remote control consoles which use the industry-standard sequential tone keying format. The DSP-223 adapters are interconnected to the distant remote control console(s) by any voice grade transmission medium such as a microwave link, a leased telephone line, or a twisted-pair 600-ohm line. All DSP-223 adapters are capable of decoding the PTT tone sequence and the voice-plus-tone signals during transmission. The tone portion of the voice-plus-tone signal is removed from the transmitted voice. All models are prepared for jumper-plug conversion from four-wire-line operation to two-wire-line operation. In the four-wire mode, the panels are full duplex capable.

The Telex DSP-223 tone-remote adapter provides the following features:
• PTT Relay and Monitor Relay
• 99 digit front panel display
• PTT, Monitor and Power LED indicators
• F1 and F2 Relays (programmable to any function tone)
• Digital outputs for channel selection of the Codan Tx and Rx modules (programmable to any function tone)
• CTCSS encode generation (64 frequencies available)
• Hardware and software gain controls
• Local handset port for monitoring activity through the unit and transmission back to the base or to the radio
• Front panel test points and level set pots
• RS-232C port on front panel for software configuration via Windows application
• Ability to pass through to a second tone adapter
• Single or Dual function tone recognition (16 or 100 function tones)
• Morse code encoder for Automatic station identification
• Voter / Ring Down Tone Generation

All models have been factory tuned to the following frequencies:
Guard Tone / PTT Tone: 2175 Hz
Monitor Function Tone: 2050 Hz
Frequency Select Function Tones (where used)

F1: 1950 Hz	F4: 1650 Hz	F7: 1350 Hz	F10: 1050 Hz	F13: 750 Hz	F16: 450 Hz
F2: 1850 Hz	F5: 1550 Hz	F8: 1250 Hz	F11: 950 Hz	F14: 650 Hz	
F3: 1750 Hz	F6: 1450 Hz	F9: 1150 Hz	F12: 850 Hz	F15: 550 Hz	

TN855 CI-DSP-223 Telex (Vega) DSP Tone-Remote Adapter

DB-25 Connector Table (Color coding for Codan Interconnect cables):

1	YEL/GRN (PTT NC)	10	RED/BLU (DIG4)	18	WHT/GRY (F2 NC)
2	YEL/BRN (PTT COM)	11	VIO/GRN (CTCSS)	19	WHT/ORG (F2 COM)
3	YEL/GRY (MON NO)	12	VIO/BRN (RX-)	20	WHT/BLU (+POWER)
4	YEL/ORG (F1 NC)	13	VIO/GRY (TX-)	21	BLK/GRN (DIG1)
5	YEL/BLU (F1 COM)	14	VIO/ORG (PTT NO)	22	BLK/BRN (DIG3)
6	RED/GRN (F2 NO)	15	VIO/BLU (MON NC)	23	BLK/GRY (DIG5)
7	RED/BRN (GND)	16	WHT/GRN (MON COM)	24	BLK/ORG (RX+)
8	RED/GRY (DIG0)	17	WHT/BRN (F1 NO)	25	BLK/BLU (TX+)
9	RED/ORG (DIG2)				

Installation:

A female DB25 connector on the back of the subrack (J10) can be used for basic base connections to a Telex DSP-223, using a standard straight-through male-to-male DB25 cable (CBLC40-04225092). (**WARNING: JU108 must be configured correctly or damage can occur. JU108 A for +13.8 Vdc / DSP-223)**. The A-PNL-AUX96-3 auxiliary connector can also be used to connect to the Telex board to a Codan Base Station with an AC-3E or CI-BC-4E, as shown in Figure 1. Select the two or four-wire-line operation and setup jumpers J20 and J21 on the Telex. For four-wire-line operation, set the jumpers in position 'B' and connect the four-wire leased line outgoing to Pins 4 and 5 and the receive to Pins 3 and 6 of the RJ45 modular connector. For two-wire-line operation, set the jumpers in position 'A' and connect the two-wire leased line to Pins 4 and 5 of the RJ45 modular connector. Ensure jumpers JU67A (or JU67X for CI-BC-4E) and JU68 are installed on the AC-3E and CI-BC-4E. On Codan MT-4R and MT-4D radio systems, the CTCSS to Subtone connection is not connected.
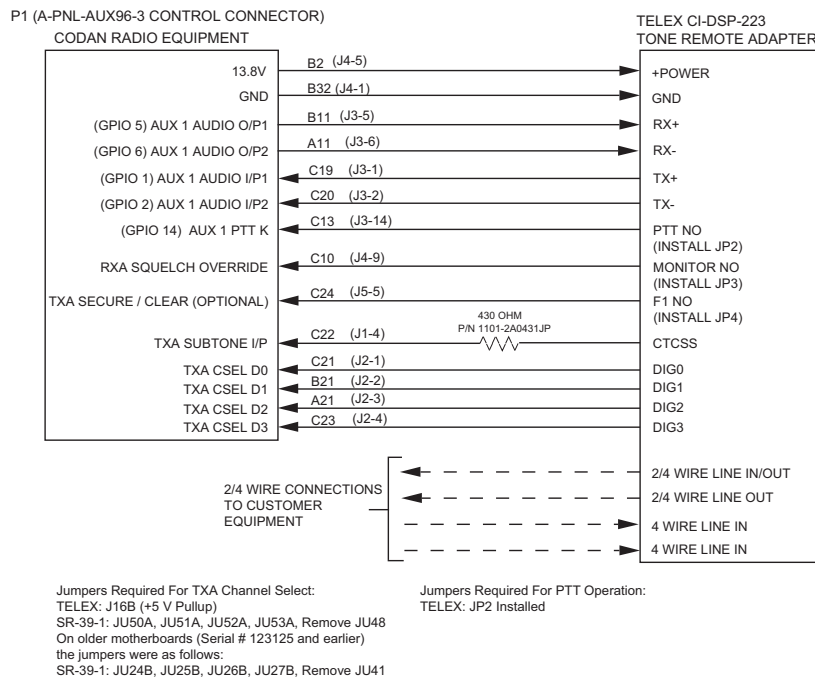

Figure 1: Codan Radio System to Telex DSP-223 connection

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TN855 CI-DSP-223 Telex (Vega) DSP Tone-Remote Adapter

Telex DSP Programming:

The Telex DSP-223 is typically factory programmed for the customers requirements, however, reprogramming of the Telex can be done with the Telex software contained on the CD that comes with the radio system. Ensure that the embedded firmware of the Telex is the same version as the software. To determine the embedded firmware version, turn the Telex on and the words DSP-223 will scroll across the display, then the firmware version will appear. Connect the PC to the Telex programming port on the front panel of the Telex tone remote adapter using the cable supplied with the Telex. New software and firmware for the Telex can be downloaded from www.telex.com.

The software shown in Figure 2 is version 2.8 and is programmed for channels 1 through 9 with CTCSS tones of 100.0 Hz on channel 1, 203.5 Hz on channel 2 and no CTCSS on channels 3 through 9. Codan radio systems do not require the "Set Gains" or "TX Filters" sections to be accessed on the Telex DSP-223 software. The CTCSS tone is shown as always on, to allowing CTCSS to be transmitted when testing, using the microphone on the front panel of the transmitter module. On Codan MT-4R and MT-4D P25 radio systems, the CTCSS to Subtone connection is not connected and CTCSS tones are generated internally in the transmitter.
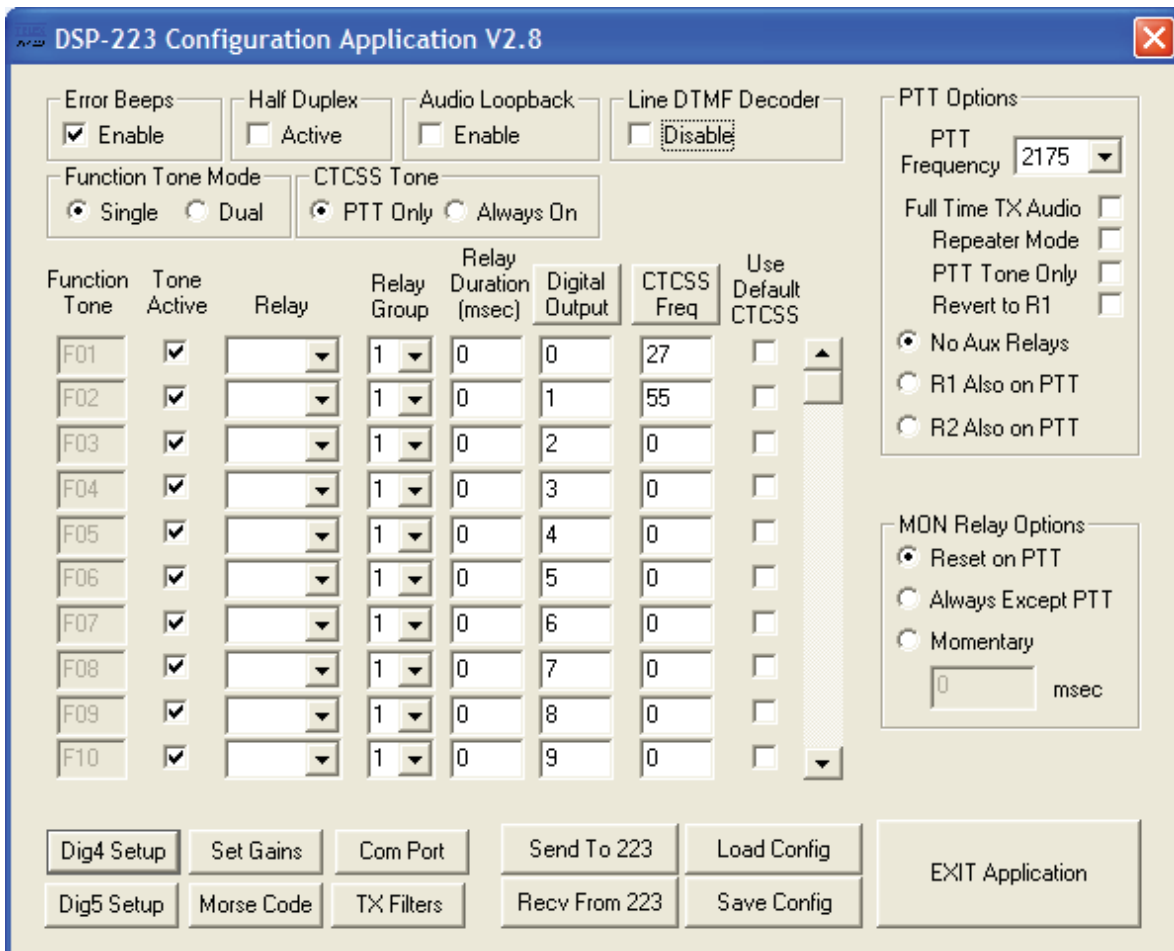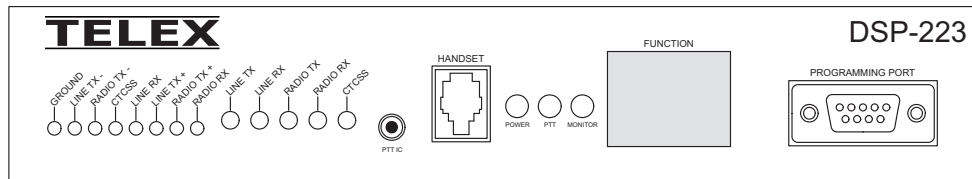

Figure 2: Telex DSP-223 Programming Software

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TN855 CI-DSP-223 Telex (Vega) DSP Tone-Remote Adapter

Telex DSP Alignment / Tuning Procedures:

Initial Setup

Step 1 - Program the Telex using the Telex programming software and ensure all jumpers are correctly installed.

AC-3E Audio Control Card and CI-BC-4E Base Control Card Tuning

Step 2 - Disconnect the Telex tone remote from the Codan radio system.

Step 3 - Apply a 1.0 KHz tone @ 0 dBm (775 mV) to the GPIO 1 (Aux 1 I/P 1) and GPIO 2 (Aux 1 I/P 2) balanced auxiliary audio input on the Codan radio system.

Step 4 - Adjust R120 (Aux In 1 to TXA) for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Step 5 - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into Receiver A.

Step 6 - Adjust R13 (RXA to Aux Out 1) for an audio level of 0 dBm (775 mV @ 600 ohms) across GPIO 5 (Aux 1 O/P 1) and GPIO 6 (Aux 1 O/P 2) on the Codan radio system. **Note:** MT-4R and MT-4D P25 Receiver modules have a higher audio level output when receiving a digital signal (as opposed to analog). When using these receiver modules in digital mode, adjust R13 for an audio level of -8.0 dBm (308 mV @ 600 ohms).

Step 7 - Connect the Telex tone remote to the Codan radio system.

Telex Line and Radio Level Tuning

Step 8 - Using an appropriate test set (Telex C-2002), apply a 1.0 KHz tone @ 0 dBm into the tone remote.

Step 9 - On the front panel of the Telex, monitor the receive line level (AC Voltmeter across LINE RX and GROUND) and adjust the LINE RX pot for 500 mV. This level can vary with the cable length between the console and the remote.

Step 10 - On the front panel of the Telex, monitor the transmit radio level (AC Voltmeter across RADIO TX+ and RADIO TX-) and adjust the RADIO TX pot for 0 dBm (775 mV) or a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Step 11 - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into Receiver A.

Step 12 - On the front panel of the Telex, monitor the receive radio level (AC Voltmeter across RADIO RX and GROUND) and adjust the RADIO RX pot for 0 dBm (775 mV). Note: When adjusting R13 in Step 6 for an audio level of -8.0 dBm (308 mV), adjust the RADIO RX pot for -8.0 dBm (308 mV).

Step 13 - On the front panel of the Telex, monitor the transmit line level (AC Voltmeter across LINE TX+ and LINE TX-) and adjust the LINE TX pot for 0 dBm (775 mV). This level can vary with the cable length between the console and the remote.

Step 14 - Set the Communications analyzer to monitor the deviation level of the transmitter CTCSS encode tone (enable 300 Hz Lowpass filter).

Step 15 - Key the Telex test set with a CTCSS tone programmed and adjust the CTCSS pot on the front panel of the Telex for a transmitter deviation of ± 500 Hz (WB), ± 350 Hz (NB).

TN855 CI-DSP-223 Telex (Vega) DSP Tone-Remote Adapter

Bypassing the AC-3E Audio Control Card and CI-BC-4E Base Control Card:

The AC-3E Audio Control Card and CI-BC-4E Base Control Card can be bypassed and the MT-4E Receiver and Transmitter can be connected directly to the Telex adapter. The control card needs to be removed from the subrack, or unwanted loading could occur.

<u>The following receiver and transmitter tuning changes would be required:</u>

Transmitter Setup - Apply a 1.0 KHz tone @ 0 dBm (775 mV) to the Tx A Bal I/P1 (J1-1) and Tx A Bal I/P 2 (J1-2) balanced audio input and adjust the RSS software Balanced Audio Deviation Level for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Receiver Setup - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into the receiver and adjust the RSS software Balanced Output Audio Level for an audio level of 0 dBm (775 mV @ 600 ohms) across Rx A Bal O/P 1 (J1-5) and Rx A Bal O/P 2 (J1-6).

<u>The DB25 (J10) can be jumpered for Balanced Audio direct to / from the receiver and transmitter as follows:</u>

JU104	A = RX A Bal O/P2	JU107	A = RX A Bal O/P1
JU105	A = TX A Bal I/P2	JU108	A = DSP-223 / +13.8 V
JU106	A = TX A Bal I/P1		

On the Wiring diagram for the A-PNLAUX96-3, the following connections change:

(GPIO 5) AUX 1 AUDIO O/P1(J3-5)	Rx A Bal O/P 1 (J1-5)
(GPIO 6) AUX 1 AUDIO O/P2 (J3-6)	Rx A Bal O/P 2 (J1-6)
(GPIO 1) AUX 1 AUDIO I/P1 (J3-1)	Tx A Bal I/P1 (J1-1)
(GPIO 2) AUX 1 AUDIO I/P2 (J3-2)	Tx A Bal I/P 2 (J1-2)
(GPIO 14) AUX 1 PTT K (J3-14)	Tx A PTT (J1-3)

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TN856 CI-IP-223 Telex (Vega) IP Network Remote Adapter

The Telex IP-223 IP Network remote adapter provides a reliable means of remotely controlling up to two Codan base stations. The adapter can be used in conjunction with Telex model C-6200, C-Soft, IP-1616, IP-2002 consoles. The IP-223 is interconnected to the distant remote control console(s) by means of any available Wide Area Network (WAN) or Local Area Network (LAN) connection.

The Telex CI-IP-223 is capable of operating in several distinct modes:

Local: The radio is connected to the CI-IP-223 directly using a similar connection pin-out as the CI-DSP-223 and is controlled by Telex VoIP consoles. This mode supports direct serial control of several radio models.

Tone: The CI-IP-223 decodes Ethernet traffic from Telex VoIP consoles and encodes industry standard tones for control of existing tone remote adapters. This allows a migration path to VoIP communications and keeps legacy equipment.

Console: The CI-IP-223 decodes industry standard tones from existing legacy consoles and converts it to Ethernet traffic to another CI-IP-223 that regenerates the industry standard tones for control of existing tone remote adapters.

Phone: Using the PIB223, a line on the CI-IP-223 is used to connect to a standard PSTN phone service.

Smart Repeater: In this mode, the CI-IP-223 can be made to link two repeaters together. The CI-IP-223's are effectively back-to-back on the network.

The Telex IP-223 Network remote adapter provides the following features:
• 2X16 LCD backlit Display
• PTT, Monitor and Power LED indications
• PTT, Monitor, F1 and F2 Relays (programmable to any function tone or Revert to F1)
• Two PTT modes and three monitor modes
• Eight selectable PTT frequencies
• Seven digital outputs for channel selection, completely programmable per function tone
• CTCSS generation (64 frequencies)
• Hardware and software gain control
• Local handset port for monitoring activity and transmission back to base or to radio
• Front panel test points and level set potentiometers
• RS-232C port on rear for initial configuration and direct radio control
• Single function tone recognition (16 function tones)
• Automatic Gain Control
• Function tone lock-out
• RX Audio Squelch
• Crosspatch capability
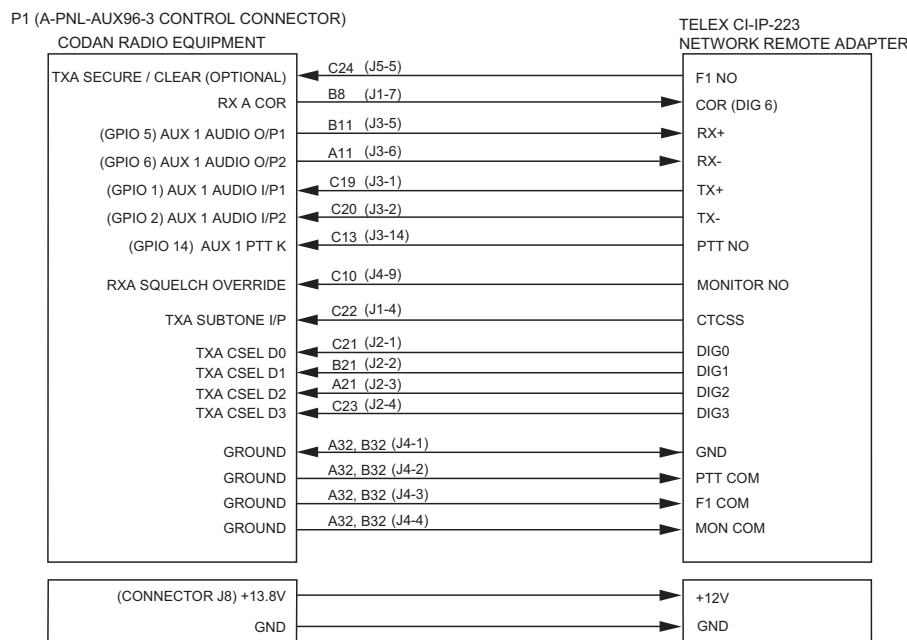• ANI Over the Air - Decode and Display

TN856 CI-IP-223 Telex (Vega) IP Network Remote Adapter

DB-25 Connector Table (Color coding for Codan Interconnect cables):

1	YEL/GRN (PTT NC)	10	RED/BLU (DIG4)	18	WHT/GRY (F2 NC)
2	YEL/BRN (PTT COM)	11	VIO/GRN (CTCSS)	19	WHT/ORG (F2 COM)
3	YEL/GRY (MON NO)	12	VIO/BRN (RX-)	20	WHT/BLU (DIG6/COR)
4	YEL/ORG (F1 NC)	13	VIO/GRY (TX-)	21	BLK/GRN (DIG1)
5	YEL/BLU (F1 COM)	14	VIO/ORG (PTT NO)	22	BLK/BRN (DIG3)
6	RED/GRN (F2 NO)	15	VIO/BLU (MON NC)	23	BLK/GRY (DIG5)
7	RED/BRN (GND)	16	WHT/GRN (MON COM)	24	BLK/ORG (RX+)
8	RED/GRY (DIG0)	17	WHT/BRN (F1 NO)	25	BLK/BLU (TX+)
9	RED/ORG (DIG2)				

Installation:

A female DB25 connector on the back of the subrack (J10) can be used for basic base connections to a Telex IP-223, using a standard straight-through male-to-male DB25 cable (CBLC40-04225092) (**WARNING: JU108 must be configured correctly or damage can occur. JU108 B for Rx A COR / IP-223**). The IP-223 also requires that 2 pins on the DB25 (PTT COM - pin2 and MON COM - pin 16) are wired to ground for proper operation. The A-PNL-AUX96-3 auxiliary connector can also be used to connect to the Telex board to a Codan Base Station with an AC-3E or CI-BC-4E, as shown in Figure 1. Ensure jumpers JU67A (or JU67X for CI-BC-4E) and JU68 are installed on the AC-3E and CI-BC-4E. On Codan MT-4R and MT-4D P25 radio systems, the CTCSS to Subtone connection is not connected.

Figure 1: Codan Radio System to Telex IP-223 connection

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TN856 CI-IP-223 Telex (Vega) IP Network Remote Adapter

Telex IP Alignment / Tuning Procedures:

Initial Setup
Step 1 - Program the Telex and ensure all jumpers are correctly installed.

AC-3E Audio Control Card and CI-BC-4E Base Control Card Tuning
Step 2 - Disconnect the Telex from the Codan radio system.

Step 3 - Apply a 1.0 KHz tone @ 0 dBm (775 mV) to the GPIO 1 (Aux1 I/P 1) and GPIO 2 (Aux1 I/P 2) balanced auxiliary audio input on the Codan radio system.

Step 4 - Adjust R120 (Aux In 1 to TXA) for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Step 5 - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into Receiver A.

Step 6 - Adjust R13 (RXA to Aux Out 1) for an audio level of 0 dBm (775 mV @ 600 ohms) across GPIO 5 (Aux 1 O/P 1) and GPIO 6 (Aux 1 O/P 2) on the Codan radio system. **Note:** MT-4R and MT-4D P25 Receiver modules have a higher audio level output when receiving a digital signal (as opposed to analog). When using these receiver modules in digital mode, adjust R13 for an audio level of -8.0 dBm (308 mV @ 600 ohms).

Step 7 - Connect the Telex to the Codan radio system.

Vega Line and Radio Level Tuning
Step 8 - Press and hold the LINE button on the front of the Telex and triple click the IC button so that "VU1 -50db / VU2 -50db" is displayed on the LCD display.

Step 9 - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into Receiver A.

Step 10 - Adjust the RX pot until VU1 reads 0.0 db.

Step 11 - Press and hold the LINE button on the front of the Telex and click the IC button to return to normal operation.

Step 12 - Press and hold the LINE button on the front of the Telex and double click the IC button so that "Tx Align" is displayed on the LCD display.

Step 13 - Key the Codan transmitter and adjust the TX pot for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Step 14 - Press and hold the LINE button on the front of the Telex and double click the IC button to return to normal operation.

Step 15 - Set the Communications analyzer to monitor the deviation level of the transmitter CTCSS encode tone (enable 300 Hz Lowpass filter).

Step 16 - Key the Telex test set with a CTCSS tone programmed and adjust the CTCSS LINE 1 pot on the top of the Telex for a transmitter deviation of ± 500 Hz (WB), ± 350 Hz (NB).

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TN856 CI-IP-223 Telex (Vega) IP Network Remote Adapter

Bypassing the AC-3E Audio Control Card and CI-BC-4E Base Control Card:

The AC-3E Audio Control Card and CI-BC-4E Base Control Card can be bypassed and the MT-4E Receiver and Transmitter can be connected directly to the Telex adapter. The control card needs to be removed from the subrack, or unwanted loading could occur.

The following receiver and transmitter tuning changes would be required:

Transmitter Setup - Apply a 1.0 KHz tone @ 0 dBm (775 mV) to the Tx A Bal I/P1 (J1-1) and Tx A Bal I/P 2 (J1-2) balanced audio input and adjust the RSS software Balanced Audio Deviation Level for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Receiver Setup - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into the receiver and adjust the RSS software Balanced Output Audio Level for an audio level of 0 dBm (775 mV @ 600 ohms) across Rx A Bal O/P 1 (J1-5) and Rx A Bal O/P 2 (J1-6).

The DB25 (J10) can be jumpered for Balanced Audio direct to / from the receiver and transmitter as follows:

WARNING: JU108 must be configured correctly for IP-223 or damage can occur.

JU104	A = RX A Bal O/P2	JU107	A = RX A Bal O/P1
JU105	A = TX A Bal I/P2	JU108	B = IP-223 & IP-224 / RX A COR
JU106	A = TX A Bal I/P1		

On the Wiring diagram for the A-PNLAUX96-3, the following connections change:

(GPIO 5) AUX 1 AUDIO O/P1(J3-5)	Rx A Bal O/P 1 (J1-5)
(GPIO 6) AUX 1 AUDIO O/P2 (J3-6)	Rx A Bal O/P 2 (J1-6)
(GPIO 1) AUX 1 AUDIO I/P1 (J3-1)	Tx A Bal I/P1 (J1-1)
(GPIO 2) AUX 1 AUDIO I/P2 (J3-2)	Tx A Bal I/P 2 (J1-2)
(GPIO 14) AUX 1 PTT K (J3-14)	Tx A PTT (J1-3)

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TN857 CI-IP-ADAPTER-1 Telex (Vega) IP-224 Ethernet Adapter

The Telex IP-224 Ethernet Adapter provides a reliable means of remotely controlling up to two Codan base stations remotely. The adapter can be used in conjunction with Telex model C-6200, C-Soft, IP-1616, IP-2002 consoles. The IP-223 is interconnected to the distant remote control console(s) by means of any available Wide Area Network (WAN) or Local Area Network (LAN) connection.

The IP-224 can be configured to operate in modes that allow it to connect to both digital and analog radios, and perform a variety of other tasks related to using radios on a digital network. The IP-224 can be rack mounted providing easy installation and service. A sleek LCD display provides user feedback when programming. VU meters are provided on the front of the display for alignment purposes. All other configurations are completed in the web browser configuration windows.

The Telex IP-224 Ethernet Adapter provides the following features:

Ethernet TX and LINK LEDs
PTT (Push To Talk) Monitor, F1 and F2 relays
Four (4) PTT Modes and Three (3) Monitor Modes
Nine (9) Selectable PTT Frequencies
Seven (7) Digital Outputs for Channel Selection
CTCSS (Continuous Tone Coded Squelch System) Generation(64 frequencies)
Software Gain Control
Direct Radio Control
Handset Port for Monitoring Activity and Transmission
Single Function Tone Recognition (16 Function Tones)
AGC (Automatic Gain Control)
RX (Receive) Audio Squelch
ANI (Automatic Number Identification) Over-the-Air Protocol
Up to 1000 function tones supported
MDC1 and FleetSync1 Encode/Decode
SOIP (Serial Over Internet Protocol)
Dual Ethernet Interface for Backup Solution
Supports RS485, CAN Bus, RS232 and TTL
Backwards Compatible with Telex Radio Dispatch Products
Secure Remote Web Browser Programming and Configuration
Single or Dual Function Tone Generation
Guard Tone User-Selectable for 2100Hz, 2175Hz, 2300Hz, 2325Hz,2400Hz, 2600Hz, 2800Hz, 2850Hz or 2900 Hz
Menu Driven Front Panel Control for TX, RX, Spare Audio, and CTCSS

TN857 CI-IP-ADAPTER-1 Telex (Vega) IP-224 Ethernet Adapter

Installation:

A female DB25 connector on the back of the subrack (J10) can be used for basic base connections to a Telex IP-224, using a standard straight-through male-to-male DB25 cable and a female DB25 to male DB37 adapter as follows:

CBLC40-04225092	straight-through male-to-male DB25 cable
CBLC46-TELEX-ADPTR	female DB25 to male DB37 adapter

WARNING: JU108 must be configured correctly or damage can occur. JU108 B for Rx A COR / IP-224. The IP-224 also requires that 2 pins on the DB25 (PTT COM - pin2 and MON COM - pin 16) are wired to ground for proper operation. The A-PNL-AUX96-3 auxiliary connector can also be used to connect to the Telex board to a Codan Base Station with an AC-3E or CI-BC-4E, as shown in Figure 1. Ensure jumpers JU67A (or JU67X for CI-BC-4E) and JU68 are installed on the AC-3E and CI-BC-4E. On Codan MT-4R and MT-4D P25 radio systems, the CTCSS to Subtone connection is not connected.

Figure 1: Codan Radio System to Telex IP-224 connection

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TN857 CI-IP-ADAPTER-1 Telex (Vega) IP-224 Ethernet Adapter

Telex IP Alignment / Tuning Procedures:

Initial Setup

Step 1 - Program the Telex IP-224 for your system. Codan makes the following changes from default:
- Ethernet Setup: IP Address, Subnet Mask and Default Gateway
- Multicast Setup: Set RX Mcast, TX Mcast and Mcast address at 224.0.0.13
- Per Line Setup: CTCSS Setup Always On, Digital Outputs set from 0 up, COR Enable, Hi-Pass RX, and PTT Notch Filter selected, Monitor Relay set to Timed 1000 ms.

AC-3E Audio Control Card and CI-BC-4E Base Control Card Tuning

Step 2 - Disconnect the Telex from the Codan radio system.

Step 3 - Apply a 1.0 KHz tone @ 0 dBm (775 mV) to the GPIO 1 (Aux1 I/P 1) and GPIO 2 (Aux1 I/P 2) balanced auxiliary audio input on the Codan radio system.

Step 4 - Adjust R120 (Aux In 1 to TXA) for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Step 5 - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into Receiver A.

Step 6 - Adjust R13 (RXA to Aux Out 1) for an audio level of 0 dBm (775 mV @ 600 ohms) across GPIO 5 (Aux 1 O/P 1) and GPIO 6 (Aux 1 O/P 2) on the Codan radio system. **Note:** MT-4R and MT-4D P25 Receiver modules have a higher audio level output when receiving a digital signal (as opposed to analog). When using these receiver modules in digital mode, adjust R13 for an audio level of -8.0 dBm (308 mV @ 600 ohms).

Step 7 - Connect the Telex to the Codan radio system.

Telex Line and Radio Level Tuning

Step 8 - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into Receiver A.

Step 9 - On the front of the Telex, go to Gain Adjustments - RX Inputs and adjust Line #1 (dB) until VU reads +0dB.

Step 10 - On the front of the Telex, go to Gain Adjustments - TX Outputs and select Tone as well as PTT. This will key the Transmitter

Step 11 - Adjust Line #1 (dB) for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Step 12 - Ensure the transmitter is de-keyed by unselecting the Tone and PTT.

Step 13 - On the front of the Telex, go to System Utilities - Reboot IP-224 and reboot the IP-224.

Step 14 - Connect a console and test the connection.

TN857 CI-IP-ADAPTER-1 Telex (Vega) IP-224 Ethernet Adapter

Bypassing the AC-3E Audio Control Card and CI-BC-4E Base Control Card:

The AC-3E Audio Control Card and CI-BC-4E Base Control Card can be bypassed and the MT-4E Receiver and Transmitter can be connected directly to the Telex adapter. The control card needs to be removed from the subrack, or unwanted loading could occur.

The following receiver and transmitter tuning changes would be required:

Transmitter Setup - Apply a 1.0 KHz tone @ 0 dBm (775 mV) to the Tx A Bal I/P1 (J1-1) and Tx A Bal I/P 2 (J1-2) balanced audio input and adjust the RSS software Balanced Audio Deviation Level for a transmitter deviation of ± 3 KHz (WB), ± 1.5 KHz (NB).

Receiver Setup - Inject a 1.0 KHz tone @ a deviation of ± 3 KHz (WB), ± 1.5 KHz (NB) into the receiver and adjust the RSS software Balanced Output Audio Level for an audio level of 0 dBm (775 mV @ 600 ohms) across Rx A Bal O/P 1 (J1-5) and Rx A Bal O/P 2 (J1-6).

The DB25 (J10) can be jumpered for Balanced Audio direct to / from the receiver and transmitter as follows:

WARNING: JU108 must be configured correctly for IP-224 or damage can occur.

JU104	A = RX A Bal O/P2	JU107	A = RX A Bal O/P1
JU105	A = TX A Bal I/P2	JU108	B = IP-223 & IP-224 / RX A COR
JU106	A = TX A Bal I/P1		

On the Wiring diagram for the A-PNLAUX96-3, the following connections change:

(GPIO 5) AUX 1 AUDIO O/P1(J3-5)	Rx A Bal O/P 1 (J1-5)
(GPIO 6) AUX 1 AUDIO O/P2 (J3-6)	Rx A Bal O/P 2 (J1-6)
(GPIO 1) AUX 1 AUDIO I/P1 (J3-1)	Tx A Bal I/P1 (J1-1)
(GPIO 2) AUX 1 AUDIO I/P2 (J3-2)	Tx A Bal I/P 2 (J1-2)
(GPIO 14) AUX 1 PTT K (J3-14)	Tx A PTT (J1-3)

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TN870 CI-RSWITCH Redundant Switch

The CI-RSWITCH is a low current, high reliability redundant switch capable of operating at extreme temperatures in remote locations. The CI-RSWITCH Redundant Switch Module provides a simple interface between two redundant radio systems composed of Codan receivers, transmitters, amplifiers and controllers.

The Redundant Switch Module allows the Main or Backup radio system to be selected for operation and can be connected to various alarm modules such as the Power Monitors to control the switching function. The Redundant Switch transfers voltage inputs between the Main and Backup systems, and connections to two high quality RF relays are provided to permit the two redundant radio systems to share single antenna systems. The Redundant Switch is 19" rack mounted (1 RU height) and provides DC power to the selected Main and Backup repeater systems.

The Redundant Switch provides the following features:
• average current draw of 19 mA .
• RF relay switching current of 200 mA for 15 ms maximum.
• input current distribution of up to 40 Amps.
• six active low momentary Alarm inputs.
• two active low momentary Reset inputs.
• one active low Backup Test enable input for testing / tuning purposes.
• two open collector Alarm outputs. Alarm 1 will short to ground to indicate Main operation and Alarm 2 will short to ground on Backup operation.

RF Relays, Backup Test switch, Main / Backup Indicator LEDs and the System Reset switch are all located on the front panel of the Redundant Switch as shown in Figure 1.
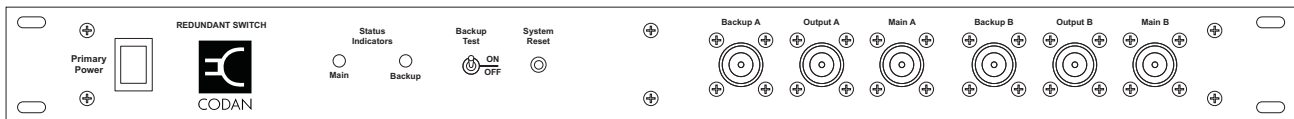
Figure 1: Redundant Switch Front Panel

Power connections, alarm inputs, reset inputs, backup test input and alarm outputs are all located on the back panel of the Redundant Switch as shown in Figure 2.

Figure 2: Redundant Switch Rear Panel

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EN100 Quality Management System

Codan Radio Communications (Victoria, BC, Canada) is very proud that our Quality Management System has been registered to the ISO international quality standard since October 1993. Our Quality Management System is currently registered to the expanded ISO 9001:2008 standard, and is part of our commitment to provide high quality products and services to our customers.

Why does Codan use a Quality Management System?

Codan Radio Communications is committed to maintaining and improving its Quality Management System:

for the benefit of the company, to:
* develop and manufacture reliable, specialized radio communications equipment
* attain and consistently maintain the desired quality at optimum cost
* plan and efficiently utilize technological, human and material resources available to the company, to maximize the quality of our products and service
* comply with any customer requirements or expectations that their suppliers have an ISO-registered Quality Management System

for the benefit of the customer, to:
* instill confidence in our ability to deliver the desired quality of product and service
* reliably maintain the desired level of quality and performance

What are the principles of a Quality Management System?

The ISO9001:2008 international quality standard is based on eight (8) quality management principles:
* Customer focus
* Leadership
* Involvement of people
* Process approach
* System approach to management
* Continual improvement
*Factual approach to decision making
*Mutually beneficial supplier relationships

By adopting these principles within its Quality Management System, management can lead their organization towards improved performance, products, services and customer satisfaction.

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EN100 Quality Management System

What is a process approach?

The "process approach" refers to the definition, implementation and management of interrelating and interacting activities. Each process is defined by its inputs, activities, decision points and outputs, to ensure adequate control and consistency of performance. Each process has associated resource, communication and record requirements. The advantage of the process approach is the control it provides over the links and interactions between related processes (e.g., the selling and manufacturing of radio systems).

What is the Codan Quality Management System?

The Codan Quality Management System defines processes for the design, development, marketing, sales, manufacture, testing, configuring and servicing of radio equipment. It also includes supporting processes for resource management, document and record control, measurement and analysis of data, nonconformance correction, corrective and preventive actions, internal quality audits, quality management review, and a commitment to continual improvement.

What does it all mean to our customer?

Our customers require highly reliable radio products with specifications and performance that will meet or exceed their expectations. The Codan Quality Management System allows us to analyze customer requirements, define the best process to meet those requirements, and keep those processes under control. It also provides a framework for continual improvement of our products and services, with a goal to improving customer satisfaction. Codan is committed to continually expanding and improving our product line to meet the needs of our customers.

Through our Quality Management System, we are better able to provide the high quality products and services our customers have come to expect.

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EN110 Equipment Calibration and Reference

As a high quality radio communications manufacturer, Codan Radio Communications uses a wide variety of electronic and mechanical test equipment in the production, design, service and support of our radio communications systems.

Codan test equipment is calibrated annually or semi-annually to ensure it is operating at a proper performance level and is capable of the high reliability and high performance required by the customer. Codan Radio Communications files calibration and maintenance records of all test equipment used in our factory and continuously updates these records to reliably control and record calibration of all equipment.

Codan Radio Communications calibrates all:

Communications Analyzers and Test Sets	Multimeters
Frequency Counters	Signal Generators
Spectrum Analyzers	SINAD meters
Power Supplies	Wattmeters
Torque Wrenches	Soldering Stations
Digital and Vernier Calipers	Environmental Chambers
Oscilloscopes	ESD Equipment
Temperature Probes and Sensors	Internal Test Jigs

and all other equipment used in the design and manufacture of Codan radio equipment.

The accuracy of Codan equipment has been determined by comparison to Standards which are directly traceable to the Canadian Institute for National Measurement Standards (NRC-INMS) or the US National Institute of Standards and Technology (NIST).

Codan uses two Spectracom model 8194 oven stabilized frequency references to provide a highly accurate frequency reference for the purpose of phase locking the internal oscillators of radio production test equipment factory wide. The outputs of the Spectracom frequency references are locked to the United States Naval Observatory via the NAVSTAR Global Positioning System (GPS).

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EN110 Equipment Calibration and Reference

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EN120 Equipment Soldering and ESD Procedures

Soldering

Codan Radio Communications follows industry guidelines for electronic assembly manufacture and trains all employees engaged in hand soldering, inspection and testing, rework and repair of our product line to meet the requirements of Codan acceptable manufacturing procedures.

Codan Radio Communications requires all printed circuit assemblies manufatured or sold by Codan to meet IPC-A-610, Class 2 (Acceptability for Electronic Assemblies) acceptance criteria. IPC (Association Connecting Electronics Industries) standards and publications have been developed by representatives of the electronics manufacturing industry and are designed to serve the public interest through eliminating misunderstandings between manufacturers and customers. IPC-A-610, Class 2 (Dedicated Service Electronic Components) includes communications equipment where high performance and extended life is required and for which uninterrupted service is desired.

By training our employees to meet these high quality soldering, ESD, and general workmanship standards, Codan ensures product reliability, eliminates the causes of defective soldering joints, and minimizes our production and servicing costs.

Certification in Codan hand soldering and rework program is required by all employees engaged in those aspects of product manufacture. Individual workmanship is reviewed on an ongoing basis, and re-certification may be required at any time. This soldering course is approximately one week in length and requires exceptional performance from the trainees to pass.

ESD

Static Electricity can damage electronic equipment, causing it to stop functioning immediately, or degrading it, leading to breakdown later. Codan Radio Communications policy requires that all employees use ESD safe practices when handling electronic components, and all employees attend ESD training of the acceptable procedures for handling of products in various stages of assembly at Codan.

Static sensitive parts are handled in ESD safe areas by employees grounded with wrist and/or two heel straps and employees working at workstations wear grounded wrist straps at all times. Codan also requires that all production/design and development personnel test their wrist straps and/or heel/foot straps at the start of every workday.

All ESD safe areas within the company use ESD safe workstations and static dissipative flooring. All workstations in the factory have a dissipative hard laminate surface and a common point ground where all conductive components of the workstation are connected. ESD hazards such as plastic cups, pens, bags, and other similar static generating items are kept well away from static sensitive devices. Transferring of ESD sensitive components to or from different areas of the company is conducted in ESD safe bags, tote boxes or carts.

EN120 Equipment Soldering and ESD Procedures

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EN130 Atacama Large Millimeter Array (ALMA)

What is ALMA?

The Atacama Large Millimeter Array (ALMA) will be one of astronomy's most powerful telescopes, providing unprecedented imaging capabilities and sensitivity many orders of magnitude greater than anything of its kind today.

ALMA will be an array of 66 radio antennas that will work together as one telescope to study millimetre- and submillimetre-wavelength electromagnetic waves from space. These wavelengths, which cross the critical boundary between infrared and microwave radiation, hold the key to understanding such processes as planet and star formation, the formation of early galaxies and galaxy clusters, and the formation of organic and other molecules in space.

A specialized computer, called a correlator – running at 16,000 million-million operations per second – will combine all of the data from the 66 antennas to make images of remarkable quality. The configuration of the 66 antennas will be variable, providing a sort of zoom capability. In its largest configuration, the image detail provided by the array will be comparable to that which a single radio telescope 14 km in diameter would provide.

Since atmospheric water vapour absorbs millimetre waves, ALMA will need to be constructed in a very dry area, preferably at a very high altitude. Extensive tests showed that the sky above the Atacama Desert of Chile has the unsurpassed clarity and stability essential for ALMA. That is why ALMA will be built in the Chilean Andes at 5,000 metres (16,500 feet) elevation.

View south from Cerro Chajnantor, Chile, of ALMA site.
Image courtesy of NRAO/AUI

An international partnership between North America and Europe funds and operates ALMA. The National Research Council of Canada has joined with the U.S. National Radio Astronomy Observatory to form the North American partnership, which is the largest ground-based astronomy endeavour ever undertaken.

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EN130 Atacama Large Millimeter Array (ALMA)

ALMA's ability to detect remarkably faint millimetre emission and to create highly detailed images of the sources of that emission, will give it capabilities not found in any other astronomical instrument. ALMA will therefore be able to observe phenomena previously out of reach to astronomers and astrophysicists. These capabilities include studying:

• The formation of galaxies (eg. the Milky Way) at the earliest times in cosmic history

• New planets forming around young stars in our galaxy

• The birth of new stars in spinning clouds of gas and dust

• The evolutionary stages of aging stars as they shed their outer atmospheres on the way to becoming white dwarfs

• Interstellar clouds of gas and dust that are chemical factories forming complex molecules and organic chemicals related to the building blocks of life.
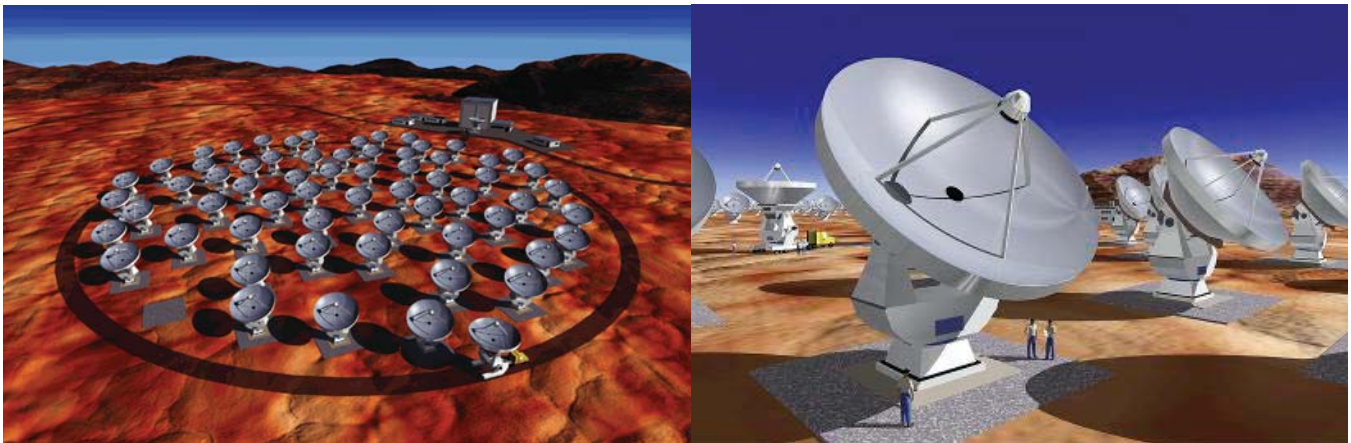
Artist's conception of the antennas and compact array for the Atacama Large Millimeter Array Image courtesy of NRAO/AUI and ESO

Codan and ALMA

The millimetre instrumentation laboratory of the National Research Council of Canada's Herzberg Institute of Astrophysics in Victoria, BC, is one of the few facilities in the world with expertise in superconducting detector technology for millimetre waves. This technology employs tiny switches about 50 times smaller than the width of a human hair, operating at liquid helium temperatures of -269 °C (just a few degrees above absolute zero, -273 °C) to detect and amplify the incredibly faint whispers of radiation that reach earth from the remotest parts of the cosmos. The physics of very cold temperatures implies that random noise in electronics circuits virtually disappears. This means that the receiver can detect very faint signals without interference.

Canada will supply 73 receivers (1 for each antenna and 7 spares) of unprecedented sensitivity for the 3-millimetre wavelength band - the ALMA Band 3 Receivers. Codan was contracted by the National Research Council of Canada's Herzberg Institute of Astrophysic to build portions of the 84 - 116 GHz ALMA Band 3 Receivers and completed the contract on March 31, 2011. Codan built a clean room that meets requirements for ISO Class 7 standards and MIL-STD-1686 static control standards.

Complete Receiver Assembly

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EN140 Restriction of Hazardous Substances (RoHS)

RoHS Directive

In order to expand sales into the European market, Codan Radio Communications is currently implementing the RoHS directive for some key products. The Restriction of Hazardous Substances (RoHS) directive—also known by its legislation number, Directive 2002/95/EC—is an important piece of European Legislation that must be complied with in order to sell electronic equipment in the European Union (EU).

The RoHS directive took effect in EU member states in July of 2006 and restricts use of the following substances to a specific maximum concentration value :

LEAD (0.1%) – Solder, brass alloys, and in electronic component lead plating

MERCURY (0.1%) – found in sensitive switches, thermostats

CADMIUM (0.01%) – used in some plastics, PVC, as well as some pigments

HEXAVALENT CHROMIUM (0.1%) – most commonly found in metal finishes

POLYBROMINATED BIPHENYLS or PBB (0.1%) – flame retardants

POLYBROMINATED DIPHENYL ETHERS or PBDE (0.1%) – flame retardants

These maximum concentration values are determined by a percentage of the weight of a "homogenous material". Homogenous material is defined by the directive as "a material that cannot be mechanically disjointed into different material." This includes anything that is of a uniform composition like a metallic alloy, plastics, resins and coatings. Every mechanically separate item inside a product must comply separately to the RoHS directive .

Codan and RoHS

All products, accessories and other items sold by Codan in the European market (including product, storage racks, containers, hardware and labels) will comply with the RoHS directive.

Codan is in the process of moving the manufacturing of all printed circuit boards (PCBs) to lead-free solder and ensuring that components of select products are certified as RoHS compliant. Codan PCBs that are RoHS compliant have board numbers beginning with 6- and will also bear the following RoHS logo if room on the board is available.

As future products are released, they will clearly show the RoHS logo to indicate that the entire unit is 100% RoHS compliant.

The primary difference between the solder connections created with lead-free solder and tin-lead solder is the visual appearance of the solder. Lead-free solder is more likely to have a grainy or dull appearance as opposed to tin-lead solder which has a generally smooth appearance.

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EN140 Restriction of Hazardous Substances (RoHS)

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