

CODAN
COMMUNICATIONS



LMR Product Catalog

Transportables

ET TRANSPORTABLE SERIES

TRANSPORTABLE CASES



Our transportable repeaters consist of a full-function Codan LMR radio repeater specially packaged for portability with all the accessories required to instantly create a local repeater site.

Capable of interfacing to first responders' handsets and mobiles, it creates a relay between first responder units and opens communications lines back to existing infrastructure, receivers and base stations. Transportable repeaters are available for VHF, UHF and 700/800 MHz operation in either analog or digital P25 modes.



ET-1 LARGE SYSTEM CASE



ET-3 ALUMINUM TRANSPORTABLE CASE



ET-4 RUGGEDIZED SYSTEM CASE

LARGE SYSTEM CASE

Codan's ET-1 case supports a standard 19" Codan subrack and has an internal mounting height of 6, 9, 12 or 15 RU. The case is weatherproof and constructed from high-density polyethylene with reinforced walls. It has recessed handles, smooth latches, anodized valances and a pressure relief valve. The rack is shock mounted and the lid gasket is watertight. Racks can be mounted inside the front and back of the case.

The ET-1 case is optimal for crossbanding applications. It is often used by public safety organizations for crossbanding between all of the frequency bands used by First Responders. Configurations are available that can support Lowband, VHF, UHF and 800 MHz crossbanding from one or all bands, providing the ultimate interoperability solution.

ALUMINUM TRANSPORTABLE CASE

Codan's ET-3 case is a rugged, pressurized, waterproof, aluminum 19" transportable case accommodating one subrack. It features spring-retracted handles, smooth latches, a pressure-relief valve and desiccant. It is available in high visibility orange. Any standard 19" Codan subrack can be mounted inside. In addition to the space for a 3U high subrack, the transportable case has a 2U space free for optional modules. The lid has a steel plate to magnetically mount an antenna.

The ET-3 is perfect for deployment in extreme environments, mountaintops, fighting forest fires.

RUGGEDIZED SYSTEM CASE

Codan's ET-4 Briefcase Repeater is a compact polyethylene case that accommodates standard Codan LMR radio modules as well as an optional battery backup, duplexer and accessory storage box. The case is rugged, waterproof, and easily deployed by one person.

An interface connection on the side of the case provides access to the RF, DC and AC inputs. The case is made of high performance resin offering impact resistance. Press and Pull latches offer secure case closure and are padlock-able. Soft grip handles, in-line wheels and a telescoping handle provide ease of transportation by individuals.

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

DATASHEET: Codan ET Transportable Cases, 12-20369-EN, Issue 1, © 2018

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ET TRANSPORTABLE SERIES

ET-1 LARGE SYSTEM CASE



KEY FEATURES

- Optimal for cross-banding applications
- Compact and impact resistant
- Weatherproof
- Safe and secure casing
- Easy and comfortable to transport

Codan's ET-1 Large System Case supports a standard 19" Codan subrack and has an internal mounting height of 6, 9, 12 or 15 RU. The case is weatherproof and constructed from high-density polyethylene with reinforced walls. It has recessed handles, smooth latches, anodized valances and a pressure relief valve. The rack is shock mounted and the lid gasket is watertight. Racks can be mounted inside the front and back of the case.

Codan's subracks can be mounted back to back on both front and back racks. Optional duplexers can also be mounted inside the case.

APPLICATION

The ET-1 case is optimal for crossbanding applications. It is often used by public safety organizations for crossbanding between all of the frequency bands used by First Responders. Configurations are available that can support Low-band, VHF, UHF and 800 MHz crossbanding from one or all bands, providing the ultimate interoperability solution.

SPECIFICATIONS

Dimensions	ET-1-A06-00 (6 RU)	ET-1-A09-00 (9 RU)	ET-1-A12-00 (12 RU)	ET-1-A15-00 (15 RU)
Outside depth	32"	32"	32"	32"
Outside width	26.5"	26.5"	26.5"	26.5"
Outside height	18.5"	23.5"	28.5"	33.5"
Internal rack depth	20"	20"	20"	20"
Internal rack width (standard mounting)	19"	19"	19"	19"
Internal rack height	10.625"	15.875"	21.125"	26.375"
Weight (case only)	20 lbs (9.07 kg)	27 lbs (12.25 kg)	34 lbs (15.42 kg)	41 lbs (18.60 kg)

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

ET TRANSPORTABLE SERIES

ET-3 ALUMINUM CASE



Note: antenna not included.

The Codan ET-3 case is a rugged, pressurized, waterproof, aluminum 19" transportable case that can accommodate one subrack.

The ET-3 aluminum transportable case features spring-retracted handles, smooth latches, a pressure-relief valve and desiccant. It is available in high visibility orange. Any standard 19" Codan subrack can be mounted inside. In addition to the space for a 3U high subrack, the transportable case has a 2U space free for optional modules. The lid has a steel plate to magnetically mount an antenna.

KEY FEATURES

- 19" internal mounting frame for subrack and duplexers
- Smooth tamper proof and lockable latches
- Desiccant holder
- Pressure relief valve
- Pressure sealed RF and power inputs
- Metal cover on lid for magnetic mount antennas
- Optional internal AC to DC power supply

SPECIFICATIONS

FREQUENCY BAND	RF POWER OUTPUT	INTERNAL DUPLEXER FREQUENCY SEPARATION
Highband VHF	0.5 – 8.0 or 30 Watts	≥ 2.0 MHz separation
400 MHz UHF	0.5 – 8.0 or 30 Watts	≥ 4.5 MHz separation
700 MHz UHF	0.5 – 3.0 Watts	≥ 30 MHz separation
800 MHz UHF	0.5 – 3.0 Watts	≥ 45 MHz separation

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.



ET TRANSPORTABLE SERIES

ET-4 RUGGEDIZED SYSTEM



Codan's ET-4 Ruggedized system is a compact, impact resistant polyethylene case that accommodates the MT-4E series base station/repeater equipment, as well as an optional battery backup, duplexer and accessory storage box. The case is rugged, waterproof, and easily deployed by one person.

An interface connection on the side of the case provides access to the RF, DC and AC inputs. Press and pull latches offer secure case closure that can be padlocked. Soft grip handles, in-line wheels and a telescoping handle provide ease of transportation by individuals.



SPECIFICATIONS

Frequency bands supported	VHF, UHF, 700, 800, 900 MHz
Encryption passed/decode-encode	All P25 types (AES or DES-OFB)
Size	11.75" H x 25" W x 20" D 29.8 cm H x 63.5 cm W x 50.8 cm D
Weight (fully equipped with batteries)	50 lbs (22.6 kg)
Operating temperature	-30°C to +60°C (100% Duty Cycle – lid open) -30°C to +40°C (50% Duty Cycle – lid closed) -30°C to +55°C (5% Duty Cycle – lid closed)
Minimum duplexer separation	4.5 MHz, 2 MHz (VHF) 5 MHz (UHF) 30 MHz (700 MHz) 45 MHz (800 MHz) 24, 39 MHz (900 MHz)
RF Output power	0.5–8 W or 20–30 W (VHF, UHF) 0.5–3 W (700, 800, 900 MHz)
Battery life (10% duty cycle, 30 W output)	2 hours (10.5 AH)
Type of batteries supported	Sealed Lead-Acid (Rechargeable)

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

DATASHEET: Codan ET-4 Ruggedized System, 12-20272-EN, Issue 6, © 2018

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ET TRANSPORTABLE SERIES

ET-5 TACTICAL REPEATER



Codan's ET-5 provides the smallest footprint of any transportable P25 repeater supporting transparent encryption in VHF/UHF, or 800 MHz bands. It operates with standard alkaline D-Cell batteries available everywhere, or a rechargeable lead acid battery.

The ET-5 Repeater is specifically designed to meet the needs of body wire repeating for undercover operations and other surveillance operations where radio communications providing stealth, compact size for unobtrusiveness and rapid deployment are vital.

SPECIFICATIONS

Frequency Bands Supported	VHF, UHF, 800 MHz
Modes of operation	Analog, P25, mixed mode
Encryption passed / decode-encode	All P25 types (AES or DES-OFB)
Size	14" H x 11" W x 6.5" D (36 cm H x 29 cm W x 16 cm D)
Weight (fully equipped with batteries)	20 lbs. (9 kg)
Operating Temperature	-30°C to +60°C*
Minimum Duplexer Separation	4.5 MHz (VHF, UHF) 30 MHz (700 MHz) 45 MHz (800 MHz)
RF Output Power	0.5-8 W (VHF, UHF) 0.5-3 W (700, 800 MHz)
D-Cell Battery Life (20% duty cycle)	19 hours
Types of Batteries Supported	D-Cell Alkaline batteries Or Sealed Lead Acid Rechargeable

*Specific operating conditions may apply.

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

KEY FEATURES

- Smallest footprint of any transportable P25 repeater
- Compact size
- Supports standard Alkaline D-Cell batteries
- Rapidly deployable

ACCESSORIES

SOLAR PANEL



Codan offers a compact solar panel package for use with its transportable radio repeater family or for use in any application requiring rapidly deployable DC power that is compact and easy to carry and set up.

The solar panel kit is shown below and consists of the following assemblies:

- 6' x 4' solar panel that folds up to 8" x 10"
- Optional second solar panel can be stored in the same case while offering 120W output
- Cables for direct connection to the Codan battery box and transportable radio repeaters
- Tent pegs to secure the solar panel to the ground
- Bungee cords to hang the solar panel in a tree
- Rubber mallet
- 50" rope
- Compass
- Rugged Pelican (16" x 12" x 6") case for ease of storage and transport
- Total assembly weighs 12 lbs

The solar panel is made of a rugged flexible material and is rated for 60W with a 3.6A output. Optionally a second solar panel can be tandemed together and stored in the same Pelican case. For a Codan transportable repeater this provides sufficient power to charge the battery pack enabling continuous radio operation at 30W with a 5% duty cycle.



KEY FEATURES

- 60 Watt Solar Panel
- Solar Panel carrying case (houses charge controller)
- 35Ah or 100Ah battery case
- Codan Transportable Repeater or any other device operating on 12VDC

TN790 Transportable Radio System Accessories

Codan 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.

**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

 **STRATUS**

THE BEST OF BOTH WORLDS



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CHALLENGING REQUIREMENTS? NO PROBLEM

CODAN Stratus™ is the first P25/LTE (FirstNet-ready) hybrid solution that leverages the strengths of both technologies to provide secure mobile and fixed voice networks. With the power of P25 and LTE, Stratus integrates a VHF/UHF/700-800 MHz P25 repeater, Universal Interface Card (UIC) and LTE modem, linking instantaneously into established networks or creating a new communications network without requiring a hard wired ethernet connection.

Stratus is available as a Fixed Site solution or a rugged tactical Repeater. The deployable Stratus Tactical Repeater has the mobility of a subscriber unit in a lightweight, easily transportable infrastructure solution, ensuring complete system and network coverage from any location. The Stratus Fixed Site solution is a 2RU unit that seamlessly integrates into a fixed network to save on costly leased lines and T1 connections.

In just minutes you can deploy a Stratus network solution consisting of a Stratus repeater, power center and rapid antenna. The Stratus network automatically establishes connections with P25 subscribers, the Stratus server and P25 DFSI consoles ensuring your teams are connected and up to date.



P25 WIDE AREA COVERAGE

Provides reliable P25 network connectivity anywhere with cellular coverage on all major telecommunications networks, ensuring you're never isolated from the network.



DOUBLE ENCRYPTION

Provides double encryption with P25 AES-DES and a highly secure VPN connection into your local area connection.



FIXED SITE SAVINGS

Save on the costs of leased lines and T1 connections for fixed site repeaters and base stations with the Stratus fixed site.



P25 & PROPRIETARY NETWORK INTEGRATION

The open standard P25 interface enables interoperability with P25 vendor subscribers and integration, including OTAR.



QUICK DEPLOYMENT

The Stratus repeater, power center and rapid antenna are optimized for transportability.

YOUR CODAN STRATUS SOLUTION

CONFIGURATIONS



REPEATER

Instantly expand local tactical coverage with the deployment of a 30W Stratus repeater. Cellular backhaul allows for situational monitoring from a remote DFSI console virtually anywhere in the world.



BASE STATION

Setup a tactical command with the deployment of a 30W Stratus base station. Console can be located on-site or virtually anywhere in the world via secure VPN gateway.



LITE REPEATER

Benefit from the repeater functionality of the Stratus today, with an upgrade path to LTE connectivity tomorrow.



ACCESSORIES



RAPID ANTENNA

Compact, lightweight, robust and rapidly deployable antenna transports easily and expands in seconds.



SOLAR POWER KITS

Extend the deployment time of your Stratus with a portable solar kit. It comes complete with 60W solar panel, cables, a battery charger and everything you need.



POWER CENTER

The Stratus power center is comprised of a transportable 35 A/hr battery and optional 110/220 VAC power supply in a rugged polypropylene transportable case.



QUICK SWAP DUPLEXERS

The Stratus transportable allows for the quick swapping of tactical duplexers for multi-channel operation on a single antenna. Optional polypropylene tactical case for transporting up to three duplexers.

WARRANTY AND WORLDWIDE SUPPORT

Codan products are backed by an extensive distribution and support network, and include a three-year extendable warranty.

INTERNAL COMPONENTS



MT-4E SERIES TRANSCIVER MODULES

The Stratus product is based on our legendary MT-4E RF modules, delivering true infrastructure grade reliability and performance in a transportable case.



3G/4G LTE/FIRSTNET MODEM

The Stratus offers an integrated commercial or public safety cellular modem, with options for most major carriers.



UIC CONTROL INTERFACE

Our IP Interface control card is at the heart of every Stratus transportable, providing P25 Digital Fixed Station Interface (DFSI) connectivity between consoles and/or network controllers and the repeater/base.



RELATED PRODUCTS



STRATUS RECEIVER

Smaller, receive-only case that accommodates either a cellular modem or a RIC-M V.24 conversion module; ideal for deploying tactical, on-the-fly receiver voting networks.



STRATUS FIXED CONTROLLER

Using Codan's innovated Digital Link Controller (DLC) technology, the Stratus fixed site controller connects multiple LMR networks together using the P25 Digital Fixed Station Interface (DFSI) protocol.



STRATUS TACTICAL CONTROLLER

The Stratus DLC allows for independent and connected rapidly deployable LMR networks.



STRATUS FIXED SITE

Add Stratus LTE capability to a 19" rack mounted Codan MT-4E system to provide an innovative backhaul alternative to leased lines or T1 at your fixed radio site.

TECHNICAL SPECIFICATIONS

FREQUENCY RANGES	136-174, 380-520, 768-869, 896-960 MHz
CHANNEL CAPACITY	32
CHANNEL SPACING	12.5/15/25/30 kHz
PRIMARY INPUT POWER	13.8 VDC
DIMENSIONS	21" H x 19" W x 20" D
WEIGHT	18 lbs
SIGNALLING OPTIONS	CTCSS, NAC, TGID
INTERFACES	4-Wire, P25 Digital FSI, ISSI, CSSI options available
TRANSMITTER	
RF OUTPUT POWER	0.5W-8W EXCITER. 30W, 60-110W
MAX DUTY CYCLE	100%
TRANSMITTER CURRENT DRAIN	< 2.5A
FREQUENCY STABILITY -30°C TO 60°C (PPM)	VHF: 1ppm UHF: 0.5ppm 700/800/900: 0.1ppm
MODULATION	ANALOG FM, C4FM
SPURIOUS/HARMONICS	-70 dBc
FM HUM AND NOISE	> 38 dB
AUDIO DISTORTION	VHF/UHF: <2% 700/800/900: <3%
RECEIVER	
RX CLASS A CURRENT DRAIN	≤ 250 mA
RX CLASS B CURRENT DRAIN	≤ 115 mA
RX FREQUENCY STABILITY @ -30° TO 60° C (PPM)	VHF: ± 1ppm UHF: ± 0.5ppm 700/800/900: ± 0.1ppm
SENSITIVITY	< -118 dBm
SELECTIVITY	>75 dB
SPURIOUS/IMAGE REJECTION	> 90 dB
INTERMODULATION	> 80 dB
SQUELCH SENSITIVITY	-121 to -115 dBm
AUDIO RESPONSE	+1, -3 dB
AUDIO DISTORTION	2%

STRATUS REPEATER



KEY FEATURES

- Deployable P25 Repeater with optional 4G LTE interface (with fallback to 3G)
- Secure mobile voice network
- IP linking over LTE to P25 DFSI consoles and other Stratus™ repeaters
- No hardwired Ethernet connection required
- VHF/UHF coverage in buildings and any outdoor location
- Quickly add and remove repeaters on the network
- Rugged, transportable case
- Rapidly deployable
- IP 65 Rated

Codan's Stratus is the first deployable P25/LTE hybrid solution that leverages the strengths of public safety and cellular technologies to provide secure mobile voice networks. The Stratus P25 repeaters support transparent end-to-end encryption across an entire communications network.

P25 COMMUNICATIONS OVER LTE

Housed in a rugged Pelican case, Stratus integrates a VHF, UHF, 700 MHz, or 800 MHz repeater, Universal Interface Card (UIC) and LTE modem, linking instantaneously into established communications networks without requiring a hard wired Ethernet connection.

IN-BUILDING COVERAGE WITH EXTERNAL COMMUNICATIONS LINK

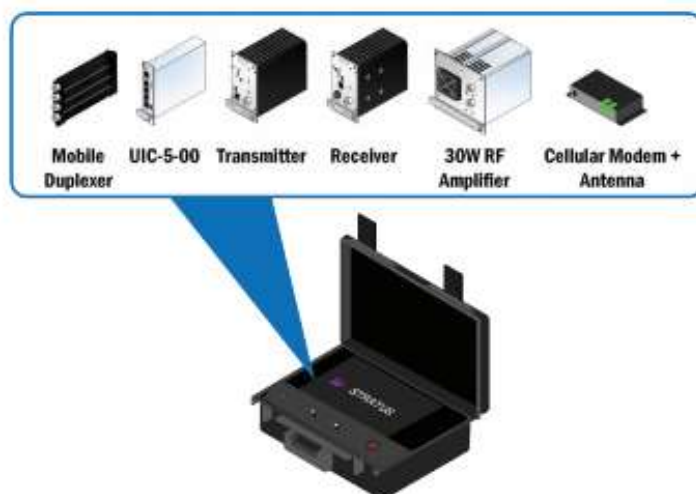
The P25 repeater provides reliable communications coverage within a building while the LTE modem provides a reliable and secure bridge to an existing P25 communications network. This ensures the repeater is not isolated from the external P25 network.

RAPID VOICE NETWORK DEPLOYMENT

The Stratus enables a stand-up, secure voice network to be deployed in an instant. A lightweight and transportable design, multiple Stratus repeaters can be deployed at a site by simply locating the repeaters in the required coverage area. The Stratus repeaters will automatically link with each other over LTE and to the P25 console via the Stratus Controller on a private or public network anywhere in the world.

QUICK NETWORK EXPANSION

A Stratus repeater can be quickly added to an established network without any setup required by the user. A Stratus will automatically connect into the network over the LTE connection and establish a link with the dispatch console for immediate tracking and control and instant communications for the user.



STRATUS LITE REPEATER



KEY FEATURES

- Secure mobile voice network
- VHF/UHF coverage in buildings and any outdoor location
- Quickly add and remove repeaters on a P25 network
- Rugged, transportable case
- Rapidly deployable
- IP 65 Rated
- MIL-STD-810G pending
- Upgrade path to 4G LTE backhaul interface (with fallback to 3G)

For agencies that require compact, easily deployable P25 repeaters with encryption in VHF or UHF bands, Codan's Stratus Lite provides a compact 30 Watt repeater/base station solution. The system can be configured as a repeater, a base station or a repeater/base station combination.

Stratus Lite includes an optional expansion to a full Stratus repeater for a P25/LTE hybrid solution that leverages the strengths of both technologies to provide secure mobile voice networks and integration into an existing P25 network.

UPGRADE PATH FOR P25 COMMUNICATIONS OVER LTE/4G/3G/FIRSTNET

The optional upgrade of a Stratus Lite repeater to a full Stratus repeater provides the capability for P25 communications over cellular. This enables Stratus repeaters to automatically link over cellular and to the P25 console via the Stratus Controller on a public or private network anywhere in the world.

QUICK-SWAP DUPLEXERS

The Stratus Lite repeater includes a duplexer module mounted on a swappable quick-swap plate that easily enables a user or technician to change the operating channel of the repeater in the field by quickly swapping out the internal duplexer. An optional antenna relay kit may also be installed instead of a duplexer.

STRATUS POWER CENTER



KEY FEATURES

- 35 Ah battery case
- Houses charge controller
- Will power any CODAN Transportable Repeater or any other device operating on 12VDC
- On-board battery status display
- Optional 60W Solar Panel

Codan's Stratus Power Center is a 35Ah battery housed in a compact and rugged polypropylene copolymer transportable case for power support of the CODAN Stratus Repeater. The Power Center provides a 12VDC power source that is charged by a 15VDC input from an AC/DC 15VDC power supply or optional solar panel.

BATTERY MANAGEMENT ON THE GO

Extend your Stratus Repeater with the Stratus Power Center. It has an internal battery charger and 35Ah battery. The Stratus Power Center has an on-board power battery percent status indicator and current meter for quick battery management. The Power Center also includes internal breakers for short-circuit protection, charging over-current protection and custom storage for your Stratus External AC Power adapter. All this in a compact and rugged polypropylene copolymer transportable with a pull out handle and wheels for easy transportability.

OPTIONAL SOLAR POWER

Codan offers an optional 60W compact solar panel package for use with its transportable radio repeater network or for use in any application requiring rapidly deployable DC power that is compact and easy to carry and set up. The solar panel is made of a rugged flexible material. The 6' x 4' solar panel folds up to 8" x 10" for convenient storage inside the folio in the Stratus™ Power Center lid.

For a Codan transportable repeater this provides sufficient power to charge the battery pack enabling continuous radio operation at 30 W with a five percent duty cycle.

SPECIFICATIONS

Size	21.7" L x 14.1" W x 8.9" D (55.1 cm L x 35.8 cm W x 22.6 cm D)
Weight (fully equipped)	48 lbs (21.8 kg) (fully loaded)
Operating temperature	-30°C to +60°C
Power center output	20 A @ 12 VDC
Power center charging inputs	External 110/220 V AC External 8 to 16 VDC power (nominal 12VDC)
Battery life	Stratus Repeater: 20 hours @ 10% duty cycle

OPTIONAL ACCESSORIES

Optional external power adaptor	Input 110/340 V AC, 3.5A Output 15 VDC, 19 A max
Optional solar panel	6' x 4' solar panel that folds up to 8" x 10" for storage in top lid folder. Rated for 60W with a 3.6A output. Includes tent pegs to secure the solar panel to the ground.

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

STRATUS CONTROLLER



KEY FEATURES

- Quickly add and remove repeaters on the network
- Supports VHF, UHF, 700, or 800 MHz band repeaters and base stations
- Compatible with TIA-102.BAHA (DFS) devices
- Designed for management of Codan UIC DFSI-capable control interfaces
- Network requirements are <100 kbps of bandwidth (per connection)
- All digital P25/LTE/ IP connectivity between CODAN Repeater and Base Stations

Utilizing Codan Digital Link Controller (DLC) technology, Codan's Stratus Tactical or Fixed Controller provides management of DFSI-capable equipment anywhere in the world with a network connection.

STRATUS TACTICAL CONTROLLER

The Stratus Tactical Controller is housed in a rapidly deployable, rugged, transportable case which can be used anywhere in the world with a cellular or satellite connection. The portable network connection is achieved using the same LTE modem found in all Stratus Repeaters. The Stratus Tactical Controller provides secure AES128 or 256 bit VPN encryption to all radio traffic including encrypted P25 voice for double encrypted mission critical communications.

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

STRATUS FIXED CONTROLLER

The Stratus Fixed Controller is the system controller situated at a fixed location anywhere in the world with an Ethernet connection. Software functionality as the Stratus Tactical Controller but with greater processing capabilities.

The Stratus Fixed Controller is an Industrial PC in a 1U package running the same Codan DLC software functionality as the Stratus Tactical Controller. The DLC can connect multiple sites via the P25 IP Digital Fixed Station Interface (DFS) from each Codan Base Station.

GRAPHICAL USER INTERFACE

DLC programming is managed by a password protected, web-based GUI which also provides online diagnostics.

Software programming of the following capabilities is offered for:

- IP Addresses
- Base Station/Repeater IP Address
- Routing based on NAC or TGID
- Display of call type — analog, P25 clear, P25 encrypted
- Configuration import and export

The web-based GUI also provides the following self-diagnostics:

- Remote site monitoring
- Logs of calls and errors
- Notification of lost IP links
- Software updating from the Codan software download

Repeaters

MT-4E SERIES



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CHALLENGING REQUIREMENTS?

NO PROBLEM

Codan's MT-4E Series analog and P25 infrastructure platform continues to offer industry-leading reliability, flexibility and performance.

Features:

- Environmentally and Mechanically Robust
- Low-Current Operation
- Modular and Customizable
- Flexible configuration and interface paths
- Standards based, vendor-neutral operation

Since the launch of the Daniels Electronics Ltd. MT-4E Series platform over a decade ago to address the needs of a growing P25 Digital market, the application of the MT-4E product has grown to creatively solve radio communications infrastructure challenges from the most simple to the most complex.

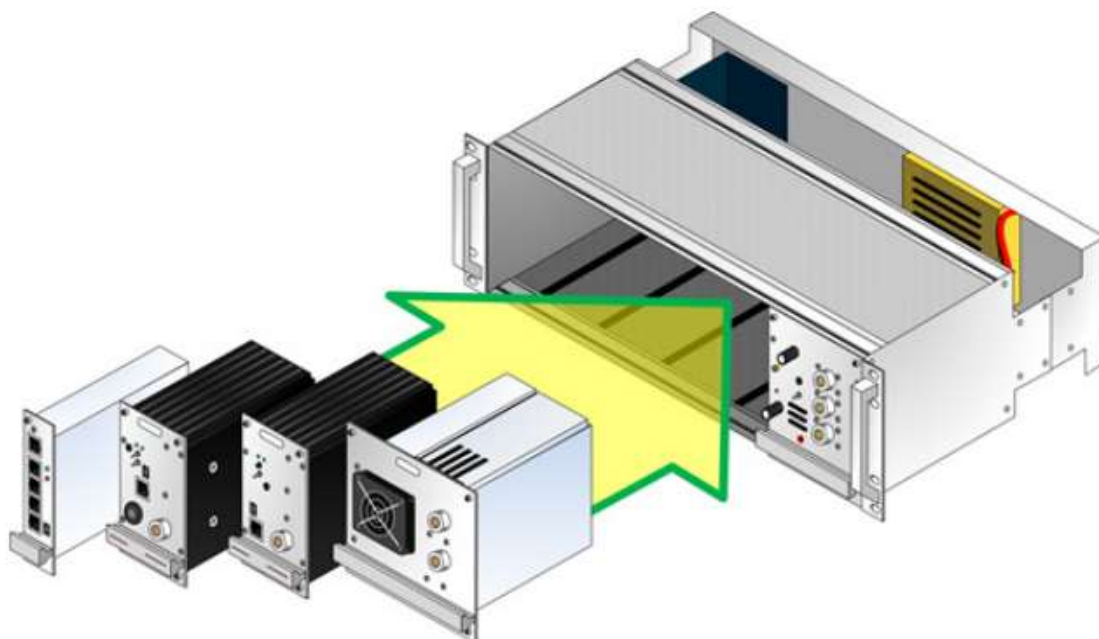
The MT-4E Series is the foundation for thousands of radio sites, either as standalone repeaters/base stations, or providing coverage into the most challenging environments. From remote mountaintop base stations and repeaters, to voting and simulcast solutions, to trunked radio systems, thousands of users across the globe trust their business and their safety to the MT-4E's seamless and problem-free operation.

HOW THE MT-4E PLATFORM WORKS

The MT-4E Series is a modular system based on a 19 inch subrack platform consisting of a signal routing motherboard and 3RU rack mounting chassis. Hot-swap capable RF and control modules are arranged in the subrack housing to create a multitude of different repeater and base station system configurations to suit any communications need.

- RF modules are available in UHF, VHF, 700/800/9000 MHz bands. Available in analog or P25 operation.
- Control modules are added to an MT-4E system to provide various additional functionality, including:
 - o Flexible external interfaces into an MT-4E system including RoIP via the APCO P25 DFSI open standard, paging controller, and 2/4-Wire E&M.
 - o Signal routing and steering to create any combination of drop-link, multilink or crossband system.
 - o External discipline of the transmitter for increased stability or for modulation of digital paging signals.
- A selection of amplifier products can be added to increase the built in 8W exciter power from 30W up to 100W, depending on application power and rack spacing requirements.
- The subrack chassis has an optional wrap-around panel with a built-in AC/DC power supply, and provides a terminal block that gives access to pertinent audio and control signaling for interface into external controllers.
- An optional 1U remote site monitoring option provides live site data and logging capabilities for predictive trending and alarm/trigger notification.

The MT-4E Receiver and Transmitter modules, as well as select control interfaces, are supported by easy-to-use software applications that allow for easy setup, configuration and testing. All MT-4E firmware and software updates are available on the Codan website at no additional cost.



FIXED APPLICATIONS

Codan's (Daniels Electronics Ltd.) MT-4E Series have been the industry benchmark for low power environments, making it the gold standard for solar powered repeater applications. Codan continues to be the top choice for critical systems operating in hard-to-access locations. Listed below are some of the typical fixed applications for MT-4E infrastructure:

- Remote Solar Repeaters and Base Stations
- Commercially Powered Repeaters and Base Stations
- RoIP enabled Base Stations and Networks of Repeaters
- Crossband Repeaters, Drop-Link Repeaters and custom Multi-link solutions

The flexible nature of the MT-4E platform allows for simple integration with external controllers, which has allowed the applications of this dependable product to expand far beyond simple remote, solar installations. Codan is proud to offer the following advanced-feature solutions using the MT-4E product as a foundation:

- P25 Digital and Analog Conventional networking of LMR infrastructure
- P25 Digital and Analog Conventional Voting and Simulcast.
- Multi-Site P25 Digital Trunking

Both Conventional and Trunked solutions offer the following advantages:

- APCO P25 Compliant, vendor-neutral solution
- Distributed network control and fallback modes for maximum redundancy
- Scalability without Tiered Pricing
- Fully IP Based Core

TRANSPORTABLE APPLICATIONS

The durable, low-current benefits of the MT-4E Series provide the foundation for our line of transportable products that address a variety of applications, from harsh environments, to tactical deployments. Unlike many products available in the LMR industry, the Codan MT-4E based transportable solutions are among the only offerings that use infrastructure-grade equipment; this means greater reliability, and broader functionality, particularly in P25 Digital applications.

LMR REPEATER

CASCADE



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BE HEARD

CODAN CASCADE

LMR BASE STATION/REPEATER PLATFORM

The Codan Cascade is our new software-defined Base Station/Repeater platform that has been engineered from the ground up with a focus on IP-networked radio solutions. This all-inclusive package features two variable-power 100W P25 repeaters mounted inside a 4RU subrack complete with network interface and power supply.

Key Features:

- Networked product ideal for conventional Voting and Simulcast applications. Designs for Linear Simulcast Modulation (LSM) for improving performance in Simulcast environments
- Hardware ready for future support of P25 Phase I and Phase II trunked radio
- Rack space efficient: 2x 100W only occupies 4RU
- Supports P25 Digital, analog narrowband and mixed operating modes
- Built-in IP-based remote configuration and remote site monitoring
- Built-in logging and alarming, with user-definable automated failure mitigation behaviors
- Built-in testing and calibration functionality
- Supports open standard P25 CAI and IP Protocols
- Meets or exceeds industry standard regulatory guidelines for performance in a Public Safety LMR system



Hardware Performance

The Codan Cascade is engineered to deliver the same exceptional performance that has become synonymous with the Codan LMR name.



Software Innovation

The software at the heart of the Codan Cascade has been developed by analyzing and addressing the fundamental challenges faced by today's Public Safety communications customers.

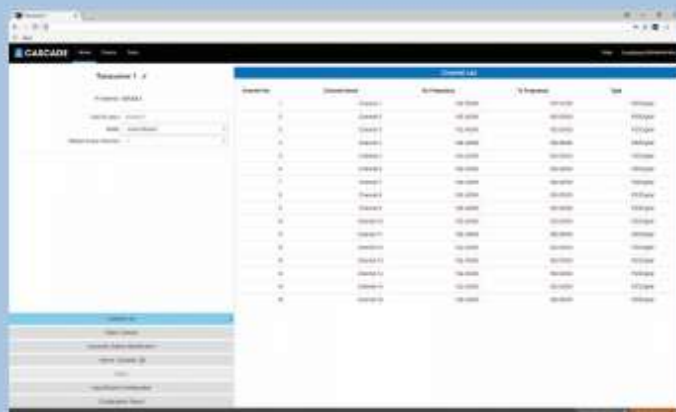
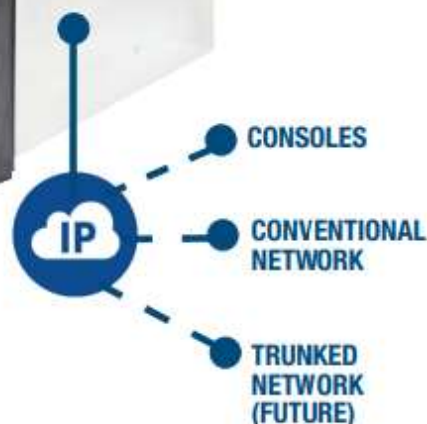
P25 Compliant

Codan's commitment to open standards and vendor neutrality is maintained with full support of P25 CAI and IP Protocols, allowing for interoperability with other Codan and Third Party equipment.



Support and Services

The Codan Cascade is supported by our comprehensive professional services and support programs.



Remote Programming and Monitoring

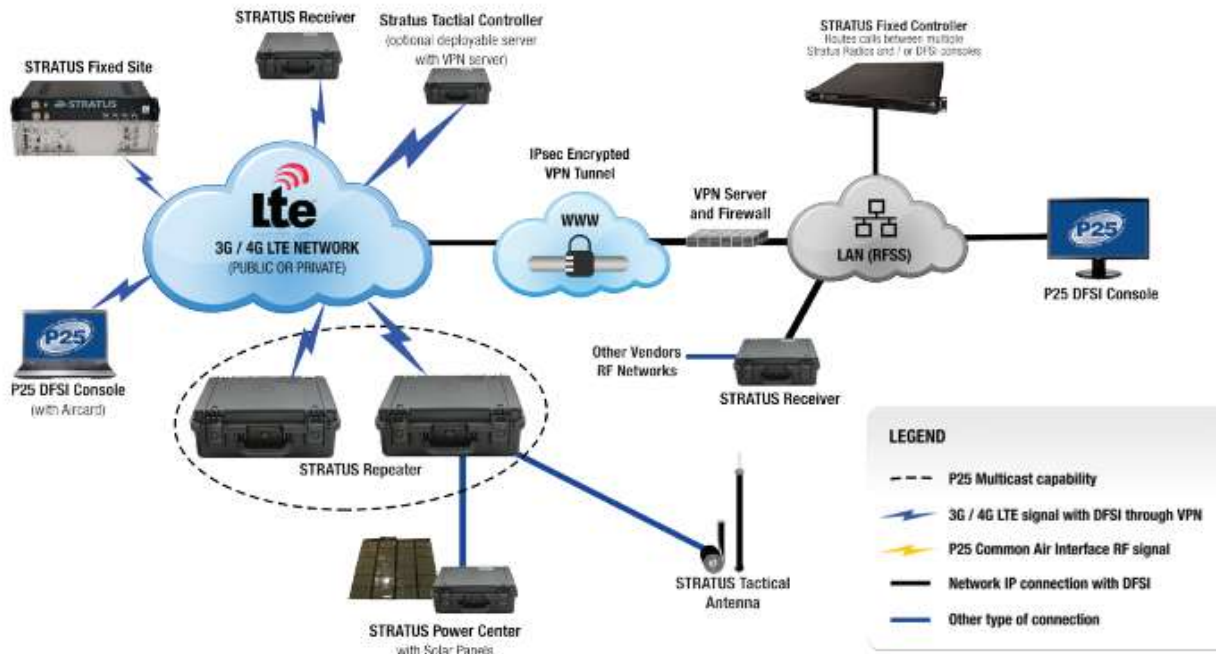
The Cascade provides browser-based monitoring of equipment health and performance. Operators have the ability to remotely make system modifications or take critical action without visiting the site.

TECHNOLOGY COMPARISON

	CODAN STRATUS	MOTOROLA APX 7000L HANDHELD	MOTOROLA/HARRIS/TAIT GATEWAY
USES LTE AND P25	✓	ONLY IN COVERAGE AREA	REQUIRES MULTIPLE DEVICES
OPERATES ON ALL PUBLIC CELLULAR NETWORKS	✓	✗	✗
FALLS BACK TO 3G MODE	✓	✗	✗
VOICE COMMUNICATION OVER LTE	✓	✗	✗
OPERATES ON FIRSTNET	OPTIONAL	✓	✗
USES EXISTING CUSTOMER SUBSCRIBERS	✓	✗	NOT STANDARD
INTEROPERABILITY WITH A VARIETY OF VENDOR CONSOLES	✓	✓	NOT STANDARD
OPERATION IN POOR/NO LMR COVERAGE AREAS	✓	✗	✗
QUICK DEPLOYMENT ANYWHERE, ANYTIME	✓	✗	✗

*Chart comparisons based on leading competitors in the LMR industry. All information is accurate at time of publishing.

STRATUS NETWORK



THE CODAN COMMUNICATIONS PROCESS

Solving challenging requirements is what we do best



ASSESS

Our technical consultants will conduct a detailed on-the-ground assessment of:

- System Requirements
- Operational environment
- Opportunities and challenges
- Scenario planning



DESIGN

Our field service team will then design a custom solution for those challenges, using the right hardware and software from Codan or one of our technology partners.



DEPLOY

Our specialist logistics team gets the hardware and the resources to wherever you are, getting your system up and running fast.



TRAIN

We'll train operators and communications staff on how to use the system – which will be a short process, thanks to our easy-to-use interfaces and interoperability.



SUPPORT

We're available to be deployed within 24 hours for any support required. And we're always on hand for any advice you require.

AN400 CROSSBAND REPEATER

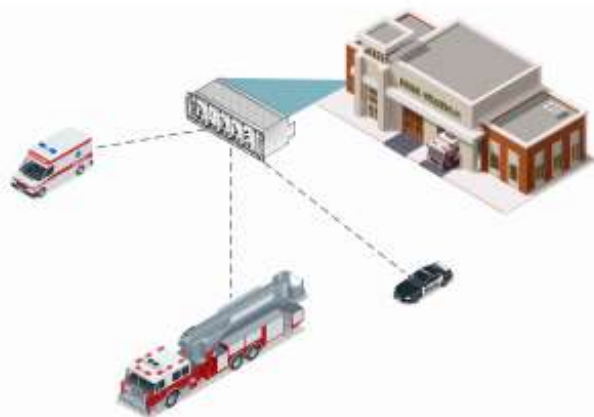
THE BENEFITS

A typical crossband repeater system offers robust construction, low current consumption and extreme temperature tolerance (-30° to $+60^{\circ}\text{C}$) enabling them to be deployed in some of the world's harshest environments such as Alaska and Siberia. Redundancy switching is available as an option.

KEY FEATURES OF THE SOLUTION

- Capable of receiving and transmitting on any combination of frequency bands, including VHF, UHF, 700 MHz and 800 MHz
- Robust construction, low current consumption and extreme temperature tolerance (-30° to $+60^{\circ}\text{C}$)
- Redundancy switching is available as an option

CROSSBAND LINK REPEATER SYSTEM INTEROPERABILITY



THE CUSTOMER

A crossband repeater has the ability to transmit and receive on different bands. For example, if the crossband repeater received a VHF signal, it could retransmit the signal on UHF, and if the crossband repeater received a UHF signal, it could retransmit the signal on VHF. The system can also be configured to retransmit on UHF to its own users at the same time it retransmits on VHF and vice versa. This system does not need to use different frequency bands, only different frequencies within that band (see diagram). Codan crossband repeaters are capable of receiving and transmitting on any combination of frequency bands, including VHF, UHF, 700 MHz and 800 MHz.

An elaborate example of crossbanding is shown in the photo to the right. This system is being used by an emergency response organization that had a need to be able to communicate with multiple agencies in an emergency. In the event of a regional emergency this multi cross band system can be quickly deployed to enable all agencies to talk to each other as they jointly respond to the regional emergency. Other examples of cross band radios include emergency response organizations:

- **Search and Rescue** – Similarly in a search and rescue operation a cross band repeater allows the ground commander to coordinate search operations between the various agencies assisting in the search.
- **Fire Departments** – Fire departments can benefit from a cross band repeater in two ways. First they can cross band between their fire fighters (using UHF radios) and supporting helicopters (using VHF radios) that are being used in rescues from the tops of buildings. Secondly, it is possible to create tri-band cross banding to also allow the fire department to communicate with the police department (VHF radios).
- **Military** – the military will use crossbanded radios for non-combatant applications such as coordinating movement of equipment in the field or for firing range communications.

Base Stations

BASE STATION/REPEATER

CASCADE



KEY FEATURES

- Remote programming and diagnostics allow for system flexibility
- Designed for small-to-medium markets to help build affordable networks
- System-in-a-box solution providing voting, simulcast, and P25 trunking network control
- Ultimate solution for controlling system redundancy
- Remote site monitoring allows operators to always be aware of their system's health and operations

Codan's Cascade is a next-generation P25 base station/repeater integrated system-in-a-box. This all-inclusive package features a modular design allowing for two 100W P25 repeaters mounted inside a 4RU subrack complete with P25 DFSI network interface and power supply.

BUILT-IN CONTROLLER

It's never been easier or more affordable to build your own network. Each Cascade repeater contains a built-in network and is upgradeable for simulcast/voting.

REMOTE PROGRAMMING AND DIAGNOSTICS

Integrated into the Cascade repeater are the networking control modules that allow for remote monitoring via web browser. Cascade's diagnostics, alarming, and logging functions are built-in, allowing for a wide range of system health parameters to be monitored remotely.

OPEN STANDARDS INTERFACE

Only open P25 standards are used for external interfaces to a Cascade network, including DFSI (Voice and Data). Built around standards requirements from FCC, TIA, IC, ETSI and ACMA, the Cascade repeater provides the extremely high performance expected from a Public Safety LMR system.

Cascade is available as a base station or repeater, or base station/repeater combination. Cascade can be configured for operation in VHF frequency bands. The standard Cascade configuration comes with a 10-100 W power output, 48V DC power inputs, and P25 DFSI interface.

STRATUS FIXED SITE



KEY FEATURES

- Analog and P25 communications over LTE
- Robust cellular connection for up to four radio stations
- IP linking over LTE to P25 DFSI consoles
- Integration with existing infrastructure
- Upgrade path to 4G LTE backhaul interface (with fallback to 3G)
- AES Encrypted IPSEC VPN tunnel to protect all radio traffic

Stratus Fixed Site provides P25 communications backhaul to dispatch over an LTE/3G cellular connection, providing a robust and reliable communications link at a fraction of the cost of leased lines.

For organizations that have fixed site base stations and/or repeaters, Stratus Fixed Site provides the opportunity to remove the dependence on costly leased telco lines and T1 connections.

Up to four base stations and/or repeaters can be linked to a single Stratus Fixed Site, enabling flexibility in the system configured with a Codan UIC-5 control and further reduction in monthly costs. The only change required to already installed infrastructure is the addition of a UIC card to the Codan repeater or base station for connection to DFSI.

UPGRADE PATH FOR EXISTING CODAN REPEATERS AND BASE STATIONS

A Stratus Fixed Site can be added to current Codan/Daniels P25 communications infrastructure, instantly reducing ongoing monthly costs. Requiring only two rack units of space, the Stratus Fixed Site easily installs into current fixed systems and can easily be configured using Codan's custom designed software.

SPECIFICATIONS

Voltage Input	6VDC–34VDC
Current Draw	500mA–750mA @ 13.8VDC (Typical LMR Application) Maximum 1.5A for higher data rate applications.
Operating Temperature	–30°C to + 70°C
RF Connections	2 x N Type Antenna Connections (LTE, LTE Diversity) 1 x TNC Type Antenna Connection (GPS) 1 x SMA Type Antenna Connection (Wi-Fi)
Communications	10/100 Base-T (4 x RJ45 connectors)
Height	2RU (3.5") (8.8CM)
Weight	10.5lbs (4.6Kg)
Depth from front plate	7.5" (19cm)
LTE Modem Options*	North American and international bands available
Carrier Approvals	Verizon, AT&T, Sprint, Rogers, Bell, Telus, Telstra**
Ethernet Ports	4 RJ45 Ethernet ports
VPN/Security	IKE Encryption - AES-256 capable IPsec, SSL and GRE VPN Client Up to 5 VPN Tunnels Trusted IP MAC Address Filtering

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

*Various modem options support, please contact Codan for details.

**Other international carriers supported, please contact Codan for details.

STRATUS VOTING RECEIVER



Codan's Stratus Voting Receiver is the next generation of rapidly deployable repeater infrastructure. The Voting Receiver can be connected to Codan and other networks.

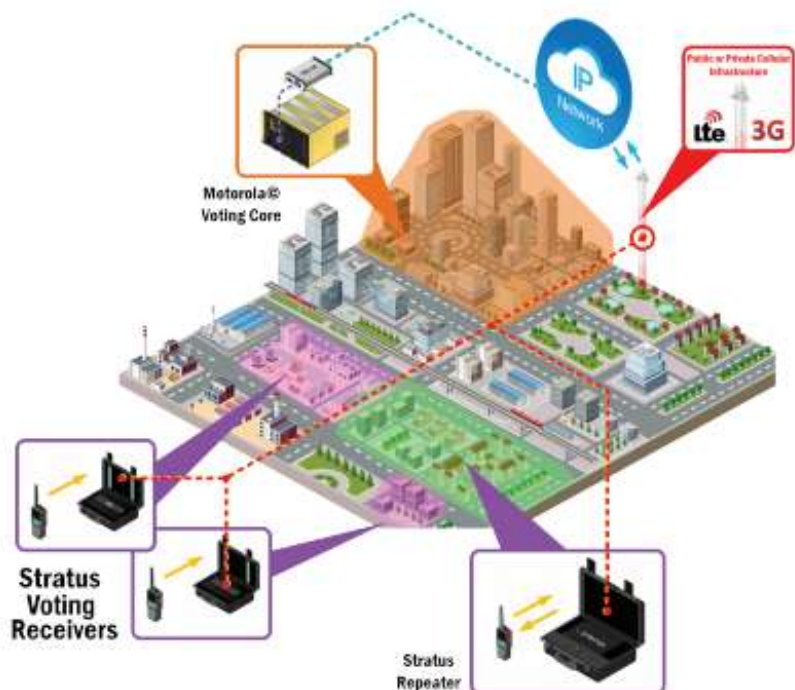
The Stratus Receiver is the latest advancement in the Stratus product line that allows users to rapidly deploy a voting receiver that use LTE infrastructure to backhaul to a centrally located voting controller via P25 open-standard communication. Augmenting an existing LMR network with Stratus voted receivers provides greater in-fill coverage while using a limited number of frequencies.

BUILT-IN DFSI INTERFACE

The Stratus Voting Receiver uses existing P25 Interface standards to provide the digital connection between a voting comparator and the receiver itself. Coupled with the optional LTE backhaul and it has never been easier to connect a receiver to a comparator.

KEY FEATURES

- Rapidly deployable design with built-in battery makes for extremely quick network set-up
- Optional Motorola V.24 interface for connection to third party comparator
- Optional built-in LTE modem with IPSec VPN for automatic backhaul of calls to a remote core
- 12-20 hour battery runtime (option dependant)
- Supports analog and P25 voice



BASE STATION SYSTEM

APPLICATION

A Base Station is a radio typically controlled by a console that provides RF communications to portables and mobiles within a jurisdictional area either in analog or P25 digital mode. A simplistic example is shown in the diagram below.

THE PROBLEM

When the dispatch office is located in an area where the radio coverage is not large enough (e.g. a valley or in an urban area) to reach all the portables and mobiles, it is desirable to remote the Base Station to a better transmitter site.

KEY FEATURES OF THE SOLUTION

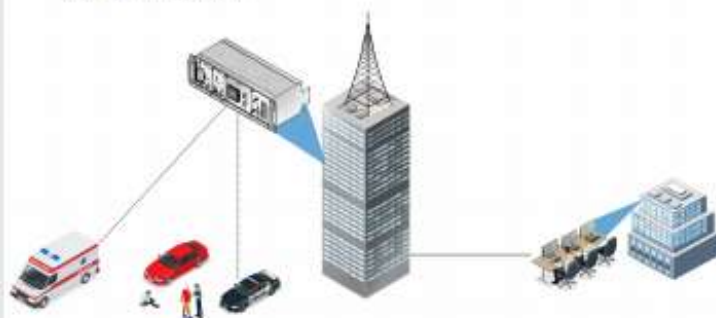
- 8, 30, 80/100W Base Station Systems
- Digital platform
- Analog Mode
 - P25 upgradeable
 - 32 channel capacity
- Modular configurable system
- Full remote control capability
- IP/RF link or wireline connectivity
- Operational -30° to +60°C
- Ability to monitor multiple channels simultaneously with additional receivers

THE SOLUTION

To extend the coverage, the Base Station must be located on higher ground such as an office tower (as shown on the following page).

Remote control of the Base Station via a console at the dispatch office can be accomplished in two ways:

- An RF link can be used if the remote site is not accessible or is too distant for wireline connection.
- An alternative for short distances is using a tone or IP remote adapter. Tone remotes use PTT, guard, monitor and function tones to control the station.



THE BENEFITS

A typical Base Station is a modular radio that can be configured for a variety of different applications in a standard 19" subrack. Such systems offer robust construction, low current consumption and extreme temperature tolerance (-30° to +60°C) enabling them to be deployed in some of the world's harshest environments such as Alaska and Death Valley.

The Base Station can operate on more than one frequency. This can be accomplished either by remotely switching channels through tones or by locally switching channels manually. Codan's electronics transmitters and receivers each have a 32 channel capacity. Communications between the base and mobile/portables can be selected from the Base Station to go to specific users in the field. The Base Station is operated by tone remote and CTCSS tones are used for selecting users.

A Base Station can also be equipped with monitor receivers allowing the operator to monitor more than one channel at the same time in order to ensure communications are not missed by the dispatch office.

THE CUSTOMER

Typical Base Station customers include: Police, Fire and Ambulance agencies. In many instances they share a common 911 dispatch center that then communicates to individuals on their portables or mobiles via a Base Station. Depending on the geography some of these systems will deploy remote Base Stations. The diagram below illustrates several different Base Station architectures that Codan radios can support. For details on IP interfaces to consoles, refer to Application Note AN550.

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

APPLICATION

Base Stations and Dispatch Consoles are routinely linked together. Currently this is done via analog interfaces (E&M or tone remotes). Using an IP connection can significantly enhance the features supported, improve the network design and enable interoperability with other IP devices.

THE PROBLEM

It is desired that the Dispatch Console and Base Station be cost effectively interconnected while maintaining digital signaling and digital encrypted audio integrity to facilitate interoperability with other IP communication devices.

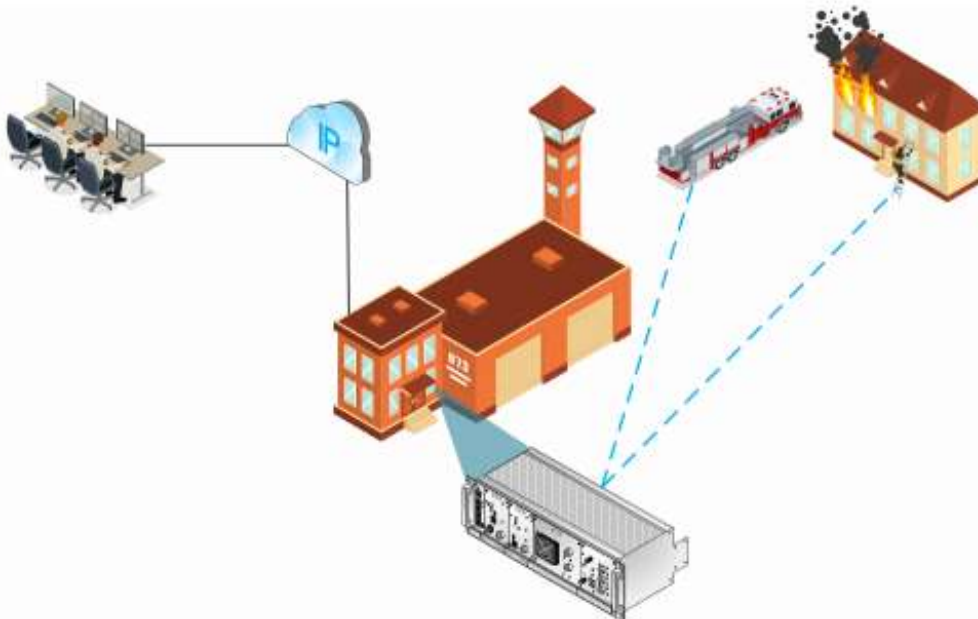
KEY FEATURES OF THE SOLUTION

- IP connection from Base Station to the dispatch console
- Digital connections over LAN/WAN for End-to-End Digital Audio
- Encryption over IP connection using P25 Station Interface standard
- Interconnection of LMR radio to other IP based communication devices (cell phones, telephones etc.)

THE SOLUTION

An IP connection from the Base Station to the Dispatch Console addresses the above requirements by providing a digital connection using an existing LAN/WAN that maintains the integrity of the audio and signaling information end-to-end. As shown in the diagram below the Base Station supports a direct IP connection using an interface such as the P25 Fixed Station Interface (FSI) Standard. Digital Audio and signaling are received via the Air interface from a handheld and then passed through the radio in a digital format for incorporation into the IP frames. No analog to digital conversion occurs, digital encrypted audio integrity is maintained and the digital signals are maintained (NAC, Unit ID, Emergency Bit, PTT and COR).

A second approach that is limited in its functionality is the use of an E&M to IP converter box at both ends of the LAN/WAN. This does not maintain digital audio integrity, does not support encryption and only supports basic connectivity signaling. However, it does eliminate the need for leased lines or microwave circuits which are expensive to own and operate and, as such has been a very popular advancement over an all analog solution. PTT/COR and audio signals are sent across the LAN/WAN to and from the IP Tone Radio Gateway (in IP format).



APPLICATION

The world's marine environments have been hubs of industry since people first ventured out onto the waters. However this source of prosperity is also host to some of the most dangerous conditions on earth, Marine radio systems provide an essential life-line for the coastal patrols, commercial fisherman, and off-shore oil refiners who must deal with the challenges of this adverse environment.

Marine FM communications equipment operates on select standard frequencies in the VHF band (between 156–162 MHz) and is used for summoning rescue services, monitoring weather, and communicating with other vessels and land based entities.

THE PROBLEM

Marine environments consist of very large, weather-intense areas that need coverage for general safety and weather reporting radio traffic. Hand-held equipment on vessels often provide poor range, and typical radio systems might not be suitable for operation in harsh sea-faring conditions where moisture, movement and power consumption are limiting factors. Marine radio equipment only functions on a very specific set of frequencies, limiting interconnectivity with other land or air based communication systems.

KEY FEATURES OF THE SOLUTION

- 8W to 100W systems available
- VHF Band (156–162 MHz)
- Extreme temperature tolerance (–30°C to +60°C)
- Low power consumption
- Extended coverage area
- Crossband communication with FM equipment
- FCC and Industry Canada certified
- Proven with Digital Selective Calling (DSC) as part of Global Maritime Distress Safety System (GMDSS)

THE SOLUTION

New product innovations provide more ways than ever to expand your radio communications coverage on the water. Codan's VHF base stations can be implemented to establish new points of communications with sea craft from ports or other points on land. Alternately, repeaters can be used to extend the coverage area of existing land-to-sea communications systems or to crossband existing equipment to marine frequencies.

On the vessels themselves, robust Codan ET transportable repeaters can be deployed to greatly extend the range of hand-held radios, ensuring that crucial communication links with land and other ships are always available. Off-shore sites using intrinsically safe radio VHF hand-held equipment can extend effective coverage by implementing Codan's crossband repeaters to allow communication with users operating non-intrinsic FM equipment on different frequency bands.

Codan systems can be configured from 8 W to 100 W depending on how much coverage is needed. More extensive or complex networks can be created using chains of solar-powered repeaters or HF satellite links to connect multiple sites.



AN1300 PAGING SYSTEM

APPLICATION

In an emergency or whenever there is a need to contact a group of individuals simultaneously, a Paging system can be an effective solution.

THE PROBLEM

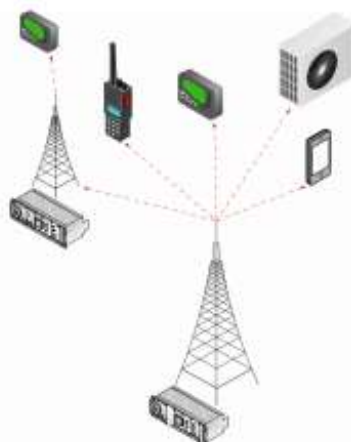
In an emergency there is a need to summon all your staff to respond to the situation. Regular communications may be congested or too slow to contact a large group of people individually.

KEY FEATURES OF THE SOLUTION

- Effectively contact a group instantly in all situations
- Optional high power amplifiers are available to extend coverage

THE SOLUTION

Paging can provide an effective, alternative means to alert staff instantaneously. The receiver displays information to the recipient/s.



TYPES OF PAGING

Three types of paging systems can be provided to best meet your requirements: Base Station Paging, Simulcast Paging and Remote Paging.

BASE STATION PAGING

Base Station Paging is the simplest configuration with the paging encoder connected to the Codan radio for broadcast over the local coverage area. Optional high power amplifiers are available to extend the coverage area. A third party paging encoder generates the paging format for either analog (tone and voice) or digital display (numeric output). The Codan radio then relays the radio signal to the hand-held pager.

SIMULCAST PAGING

A simulcast system enables a message to be sent to all pagers in an overlapping coverage region simultaneously. High stability frequencies are required to time synchronize the multiple paging transmitters for simulcast.

REMOTE PAGING

A remotely operated paging transmitter can be connected back to the base paging transmitter through a Codan RF link for greater paging coverage. The paging encoder generates the desired analog or digital formats which are transmitted to a remote paging site through a radio link.

THE BENEFITS

Codan radios support narrowband (12.5 kHz – NTIA compliant) and wideband (25 kHz) paging for base station, simulcast and remote paging applications. Optional high power amplifiers are available to extend the coverage area.

A 3rd party paging encoder generates the paging format for analog (tone and voice) or digital display (numeric/ alphanumeric output) pages.

A variety of transmission standards are supported including:

- POCSAG at data transfer rates of 512, 1200, and 2400 Baud
- Motorola's FLEX™ 2 and 4-level modulation Paging Protocol at data transfer rates up to 1600 bit/s
- PURC controller signal

The Paging Modulator card interfaces the paging encoder to the Codan radio module(s). It is designed for low power consumption, typically drawing less than 300 mA in steady state. It can also be configured for use as a data repeater whereby 2-level paging data is recovered, re-shaped and then retransmitted to an additional repeater/paging transmitter. In its standard configuration, the Paging card uses an on-board 10 MHz high stability OCXO frequency reference source. For high stability applications such as Simulcast, the Paging Modulator may also be configured to use an external high stability reference source.

Values noted are typical. Equipment descriptions and specifications subject to change without notice or obligation.

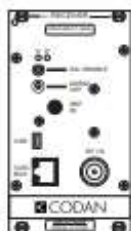
APPLICATION NOTE: Codan AN1300 Paging System, 12-20282-EN, Issue 2, © 2018

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Modules

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

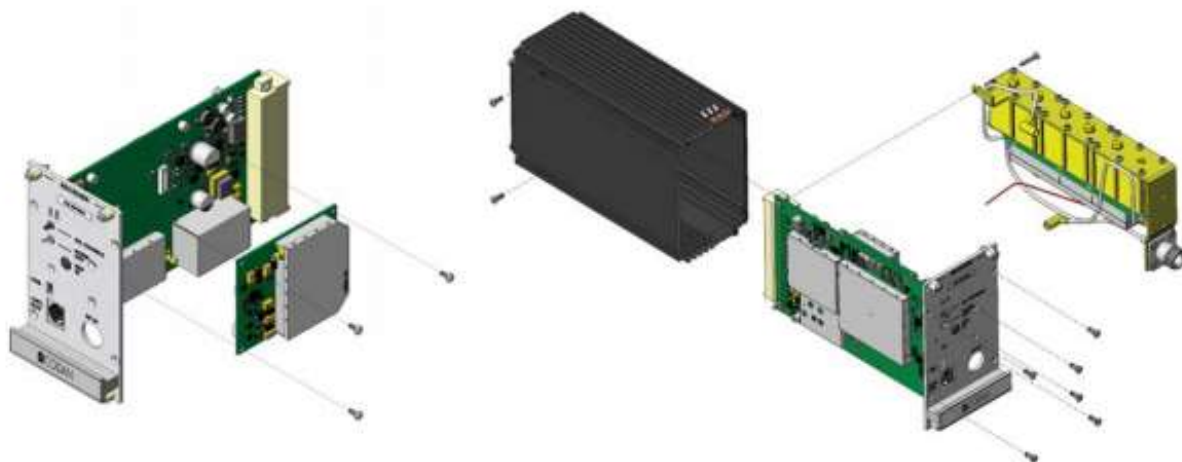
Frequency Band	136 - 174 MHz
Channel Spacing	12.5, 15, 25 and 30 KHz
Frequency Switching Range	± 2 MHz
Reference Sensitivity (12 dB SINAD and 5% BER)	≤ -118 dBm (.280 µV)
Adjacent Channel Rejection (Class A)	≥ 45 dB; NB Analog / ≥ 75 dB; WB Analog / ≥ 60 dB; Digital
Adjacent Channel Rejection (Class B)	≥ 40 dB; NB Analog / ≥ 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 (\leq -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.

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

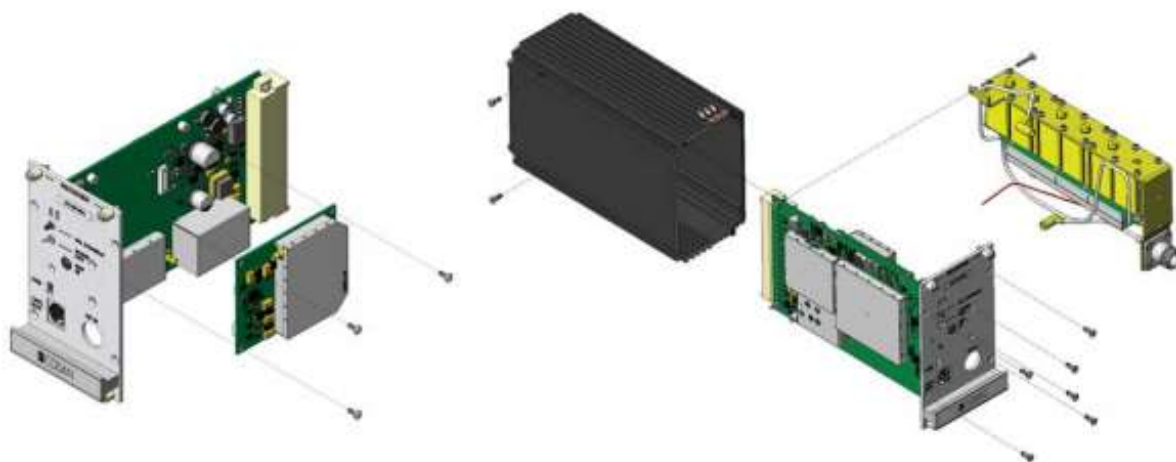
Frequency Bands	380 - 406 / 406 - 430 / 430 - 450 / 450 - 470 / 470 - 520 MHz
Channel Spacing	12.5 and 25 KHz
Frequency Switching Range	± 2 MHz
Reference Sensitivity (12 dB SINAD and 5% BER)	≤ -116 dBm (.350 µV) 380 & 440 & 500 ≤ -118 dBm (.280 µV) 420 & 460
Adjacent Channel Rejection (Class A)	≥ 45 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.

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.

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 μ V)
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)	$\leq +3.0$ 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.

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

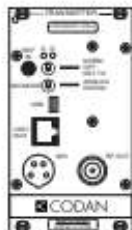
The UR-4E UHF 700 / 800 / 900 MHz receiver is primarily software-controlled, allowing tuning, programming and maintenance to be done via software service with few hardware adjustments required.

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

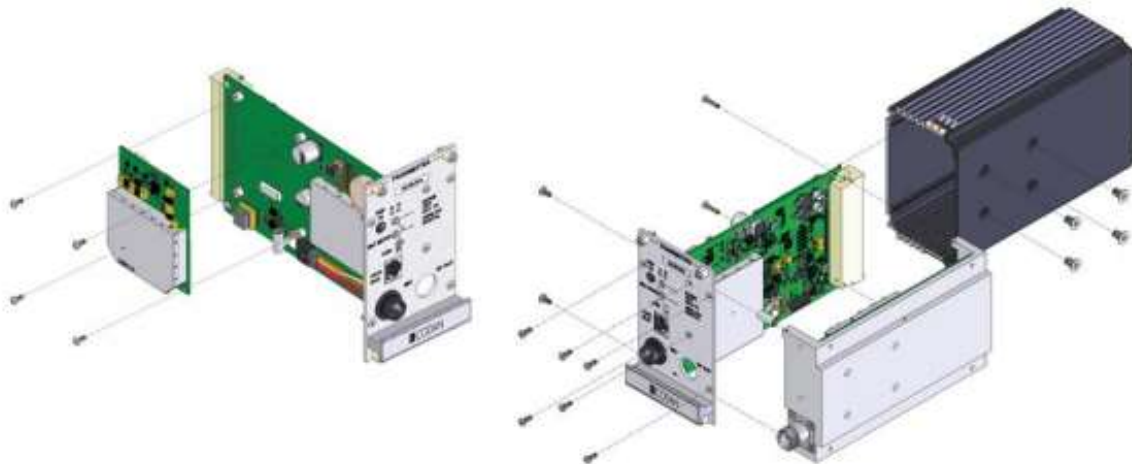
Frequency Band	136 - 174 MHz
Channel Spacing	12.5, 15, 25 and 30 KHz
Frequency Switching Range	Full Band; ± 0.5 MHz for VSWR alarm
RF Output Power	0.5 to 8.0 Watts adjustable
Duty Cycle	100% (-30°C to +60°C)
Undesired Emissions (Conducted Spurious)	≤ -70 dBc @ 8.0 Watts
Undesired Emissions (Adjacent Channel Power Ratio)	≤ -60 dBc; Narrowband Analog / ≤ -70 dBc; Wideband Analog
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)	$\leq 3.0\%$ (-30°C to +60°C)
VSWR Protection	$\leq 20:1$ 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.

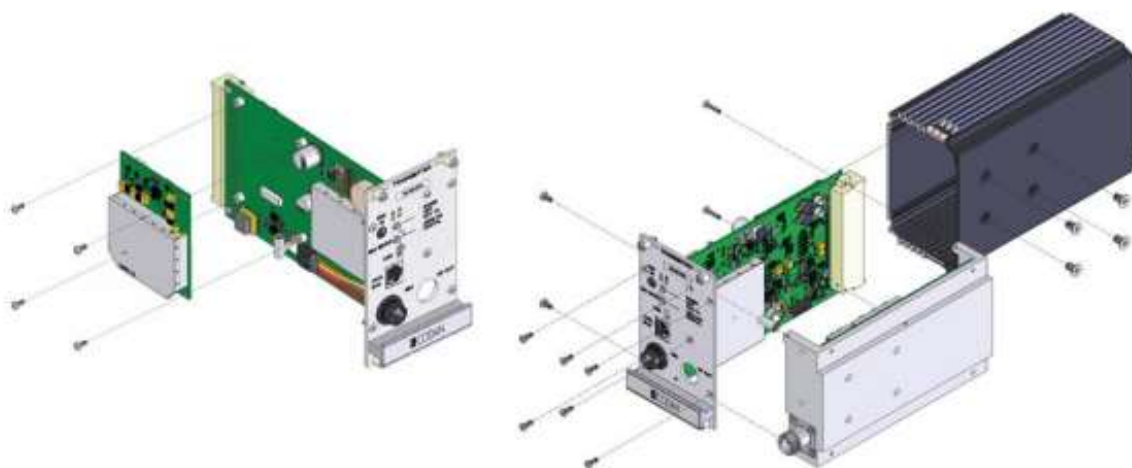
To set the VSWR alarm / overload circuit properly, the RF power level must be set to the desired RF power output first. After the RF power level is properly set, rotate the VSWR alarm adjust potentiometer (RV3) fully counter clockwise. Terminate the transmitter with a 3:1 mismatch load and connect a 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.

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.

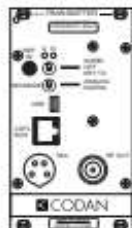
RSS Service Mode:

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.

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

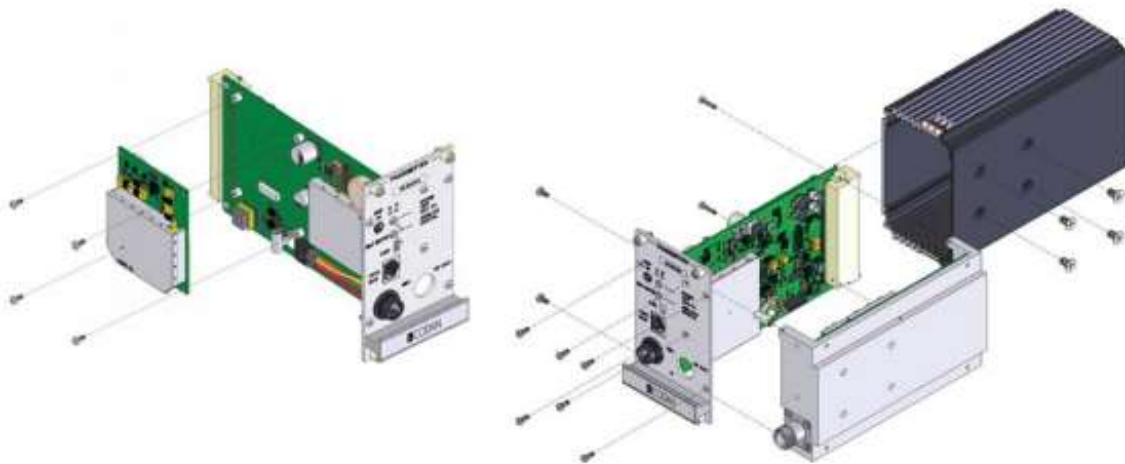
Frequency Bands	380 - 406 / 406 - 470 MHz / 470 - 520 MHz
Channel Spacing	12.5 and 25 KHz
Frequency Switching Range	Full Band; ± 0.5 MHz for VSWR alarm
RF Output Power	0.5 to 8.0 Watts adjustable or 0.5 to 6.0 Watts adjustable
Duty Cycle	100% (-30°C to +60°C)
Undesired Emissions (Conducted Spurious)	≤ -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
Intermodulation Attenuation	≤ -67 dBc; Digital
FM Hum & Noise Ratio	≥ 40 dB (380) / ≥ 45 dB (450 & 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)	$\leq 3.0\%$ (-30°C to +60°C)
VSWR Protection	$\leq 20:1$ 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.

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

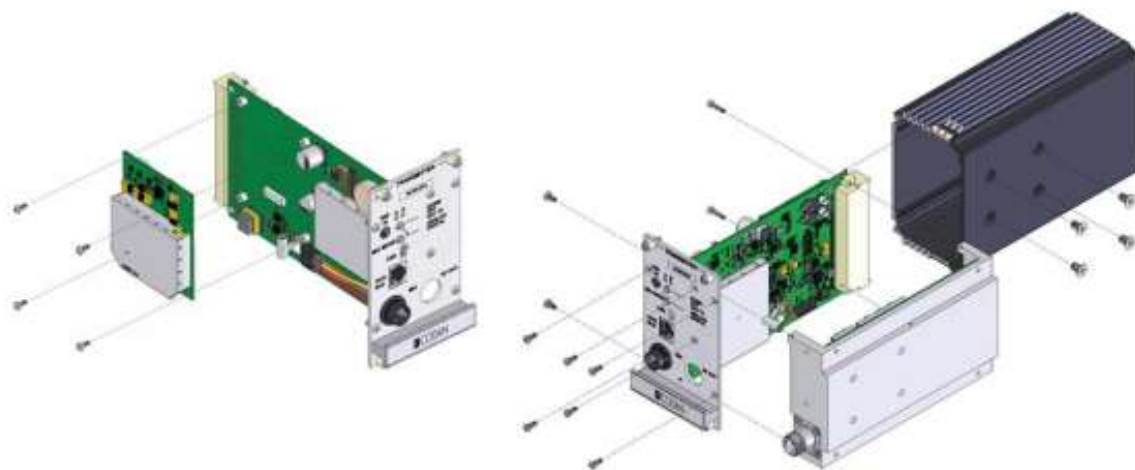
Frequency Bands	768 - 869 MHz / 896 - 960 MHz
Channel Spacing	12.5 and 25 KHz (20 KHz NPSPAC; 850 only)
Frequency Switching Range	Full Band; ± 0.5 MHz for VSWR alarm
RF Output Power	0.5 to 3.0 Watts adjustable
Duty Cycle	100% (-30°C to +60°C)
Undesired Emissions (Conducted Spurious)	≤ -80 dBc (-45 dBm @ 3.0 Watts) 850 ≤ -65 dBc (-30 dBm @ 3.0 Watts) 900
Undesired Emissions (Adjacent Channel Power Ratio)	≤ -50 dBc; Narrowband Analog / ≤ -60 dBc; Wideband Analog ≤ -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)	$\leq 3.0\%$ (-30°C to +60°C)
VSWR Protection	$\leq 20:1$ 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.

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.

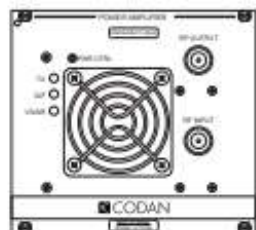
RSS Service Mode:

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.

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 - 520 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".

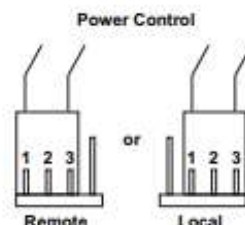
MT-3/4 Radio Systems**TN441 AMP-4 VHF and UHF 30 Watt Power Amplifiers****Power Amplifier Alignment:**

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 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 collector 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.

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.

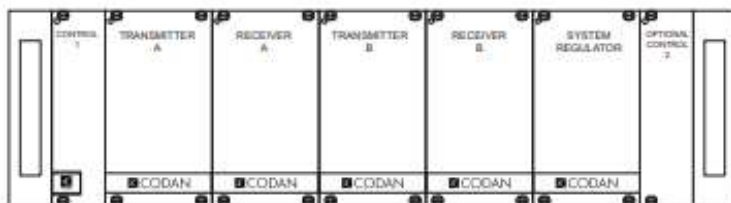


Figure 1: Standard Subrack

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.

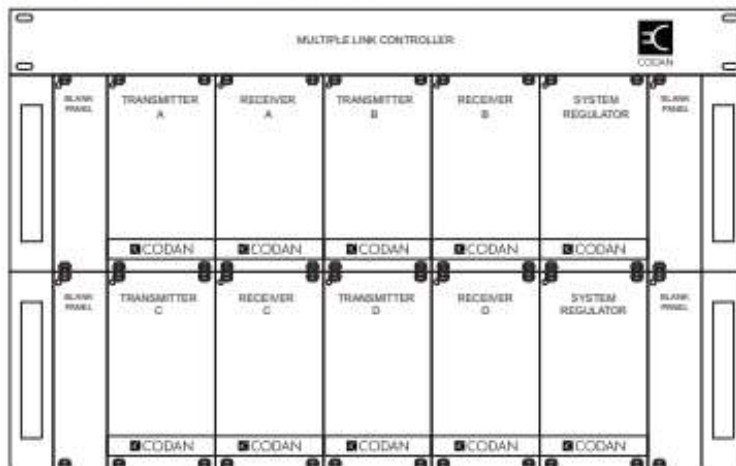


Figure 2: Dual Subracks for Multiple Link Configuration

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.

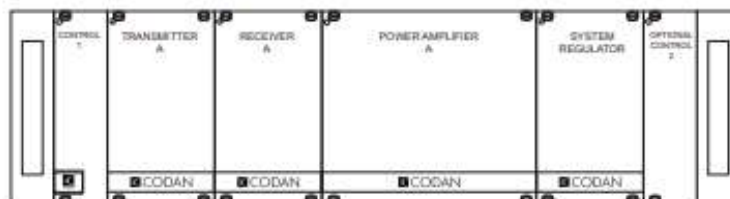


Figure 3: Subrack with Power Amplifier

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 multiple link controller are not required for this configuration.

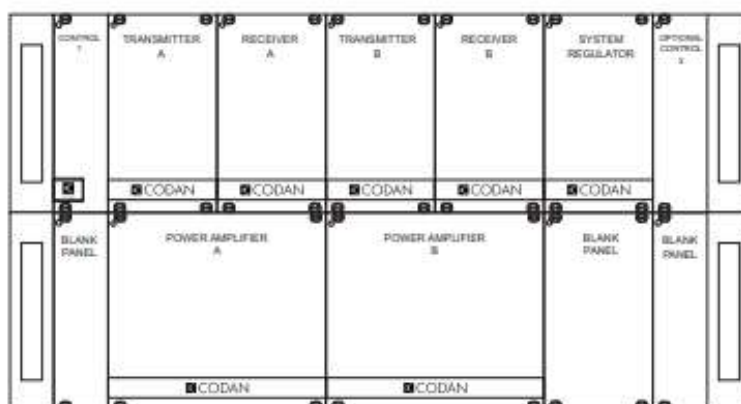


Figure 4: Dual Subracks with Two Power Amplifiers

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.

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

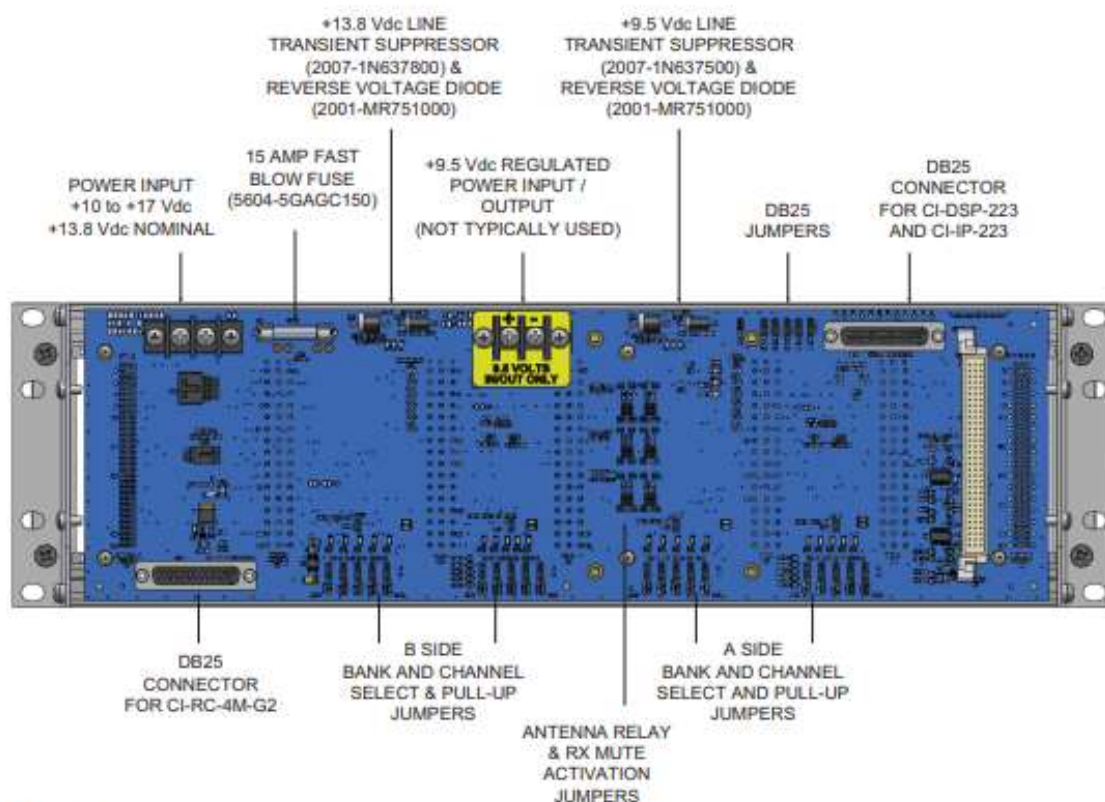


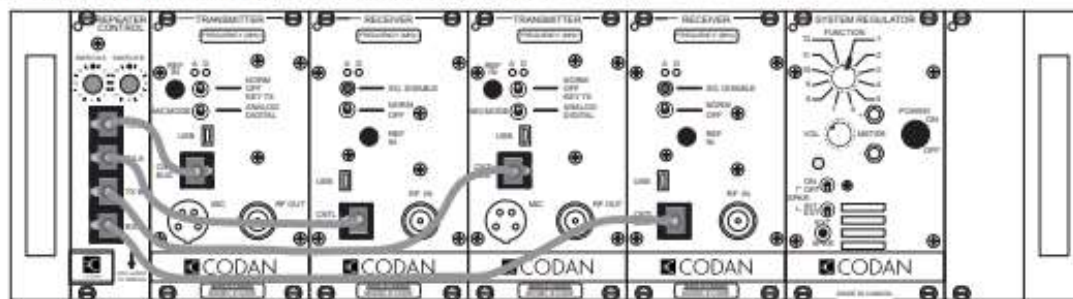
Figure 5: Rear View of Subrack

TN650 CI-RC-4L Repeater Control Card

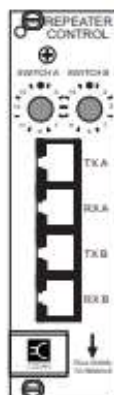
The CI-RC-4L repeater control card is a plug-in module which provides LVDS Serial Data routing, COR-PTT routing, and receiver priority settings for an MT-4 repeater radio system. The repeater control card includes the following features:

- 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 A side with Link B side) Set RXA priority for Simplex Links	RXA -> TXA RXA -> TXB RXB -> TXA	In	In	Out
* Drop-Link on B side (Repeater B side with Link A side) Set RXB priority for Simplex Links	RXA -> TXB RXB -> TXA RXB -> TXB	Out	Out	In
Crossband System (No Simplex)	RXA -> TXB RXB -> TXA	In	Out	In
Crossband System with Simplex frequencies on A or B side (First receiver has priority always)	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.

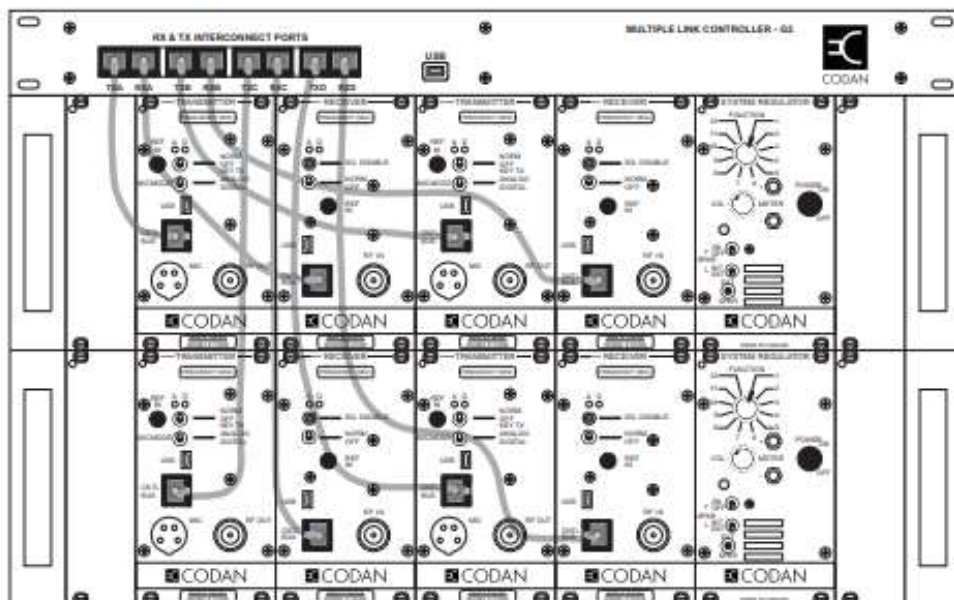
Receiver Priority	JU9	JU10	JU11
First receiver active has priority	Out	Out	Out
RXA priority	In	Out	Out
RXB priority	Out	In	Out

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 receiver and 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.



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.

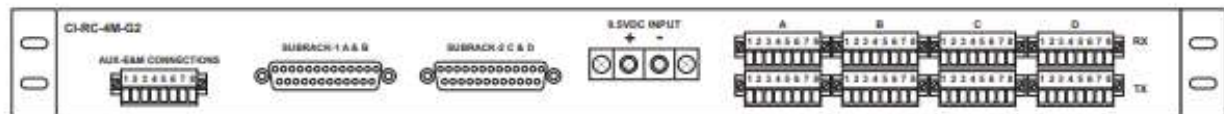


Figure 1: CI-RC-4M-G2 Back Panel

A female DB25 connector on the back of the subrack (J12) can be used for connection 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.

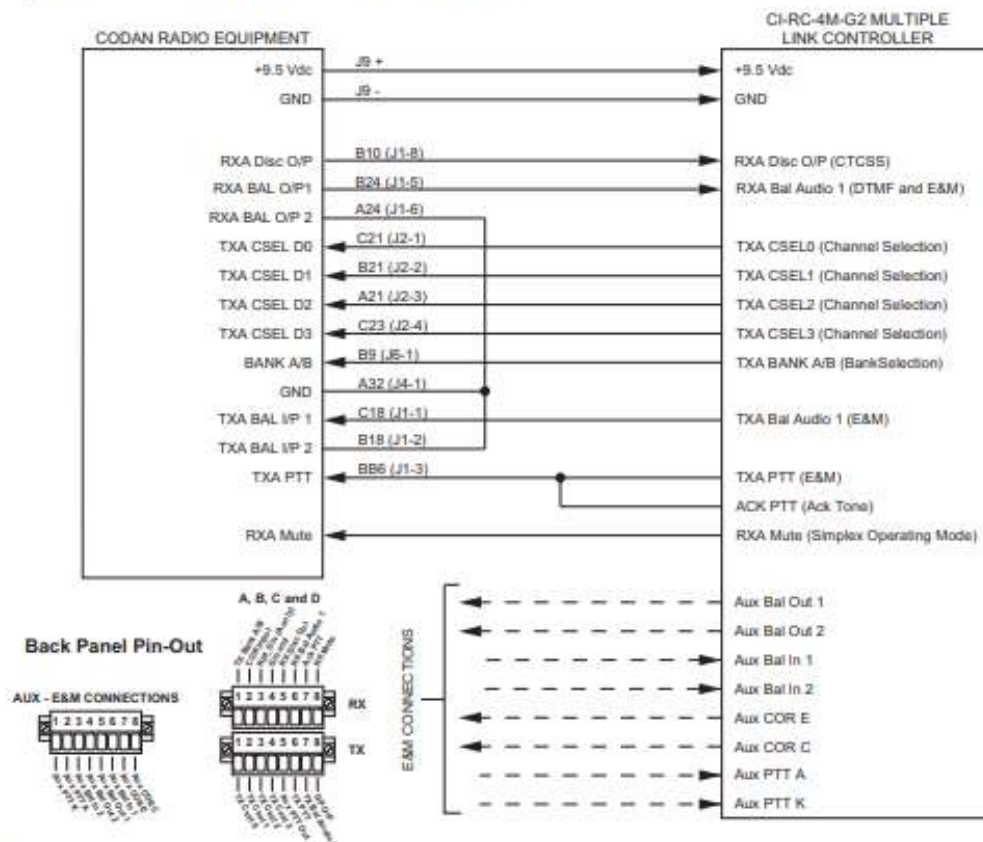


Figure 2: CI-RC-4M-G2 Connection Diagram

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.

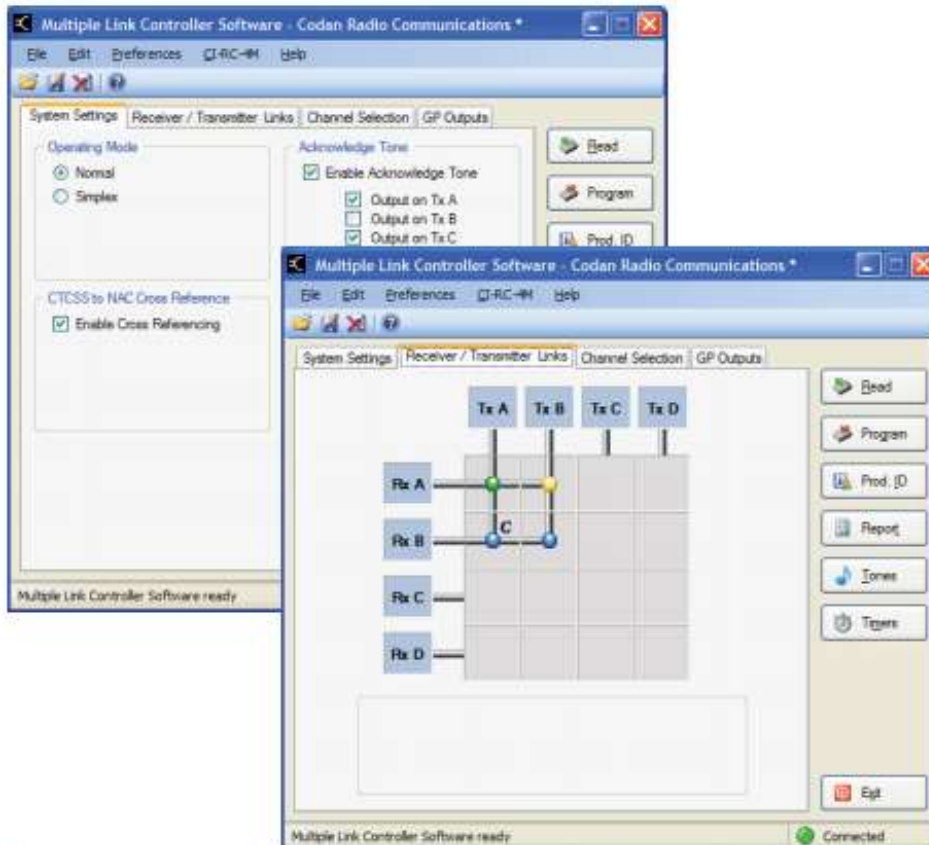


Figure 3: System Settings and Receiver / Transmitter Links

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).

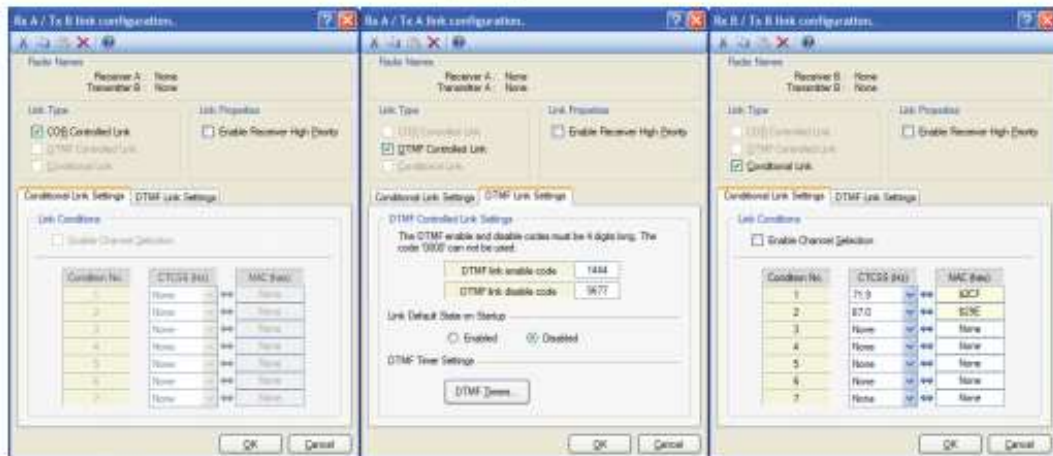


Figure 4: Link Configurations

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

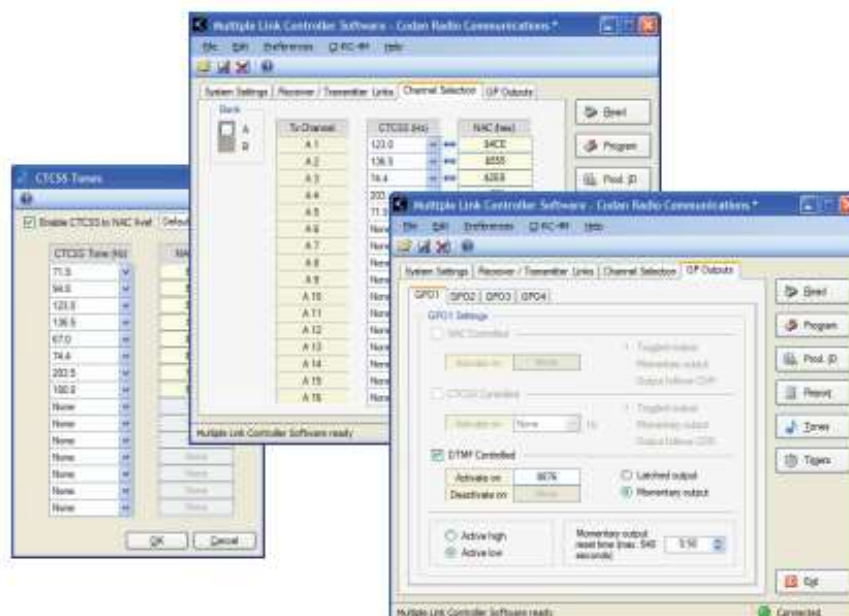


Figure 5: CTCSS Tones, Channel Select and General Purpose Outputs

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 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 removed. 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 signal, the following jumpers must be installed:

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

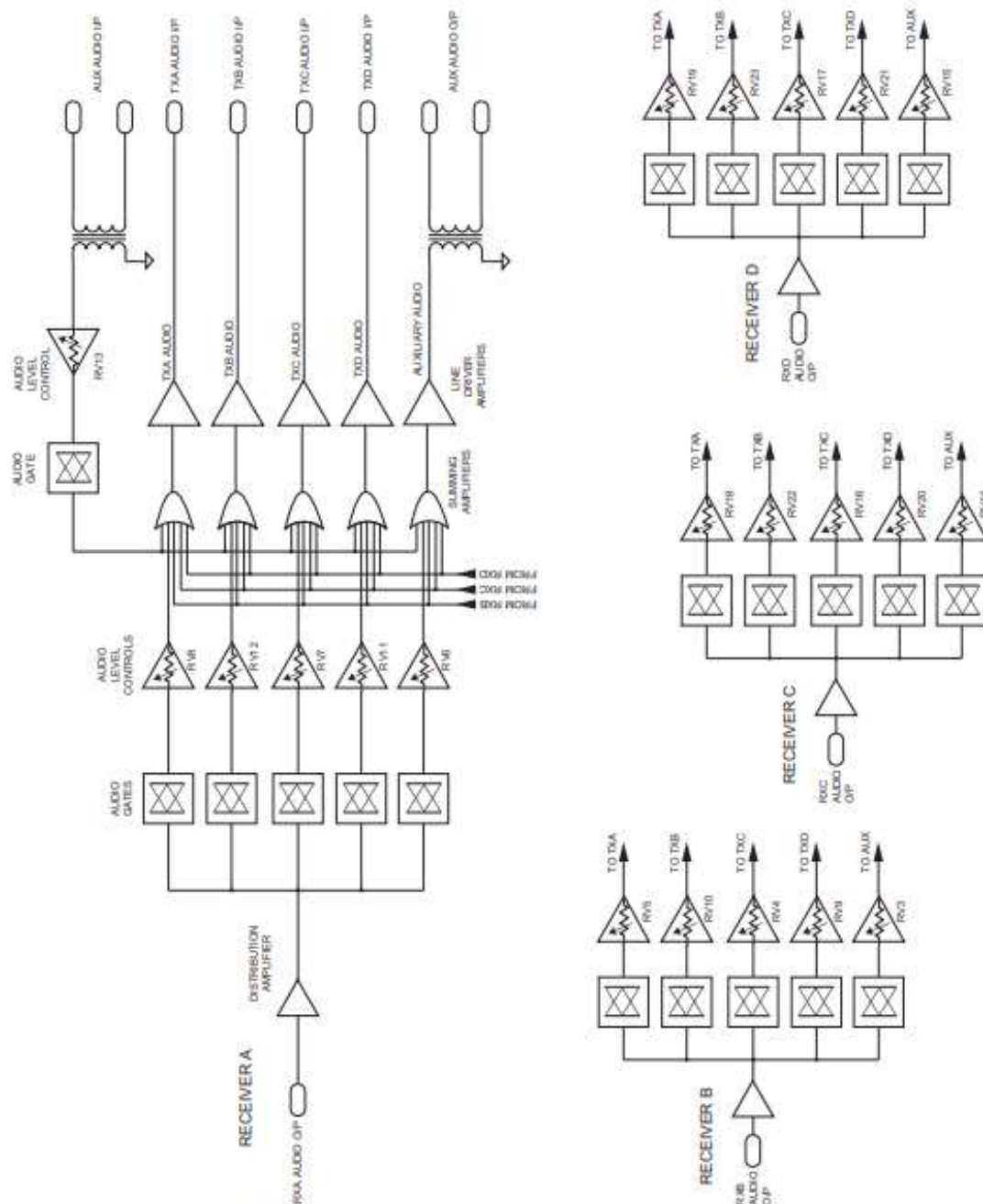


Figure 6: Audio Routing and Audio Pot adjustments

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

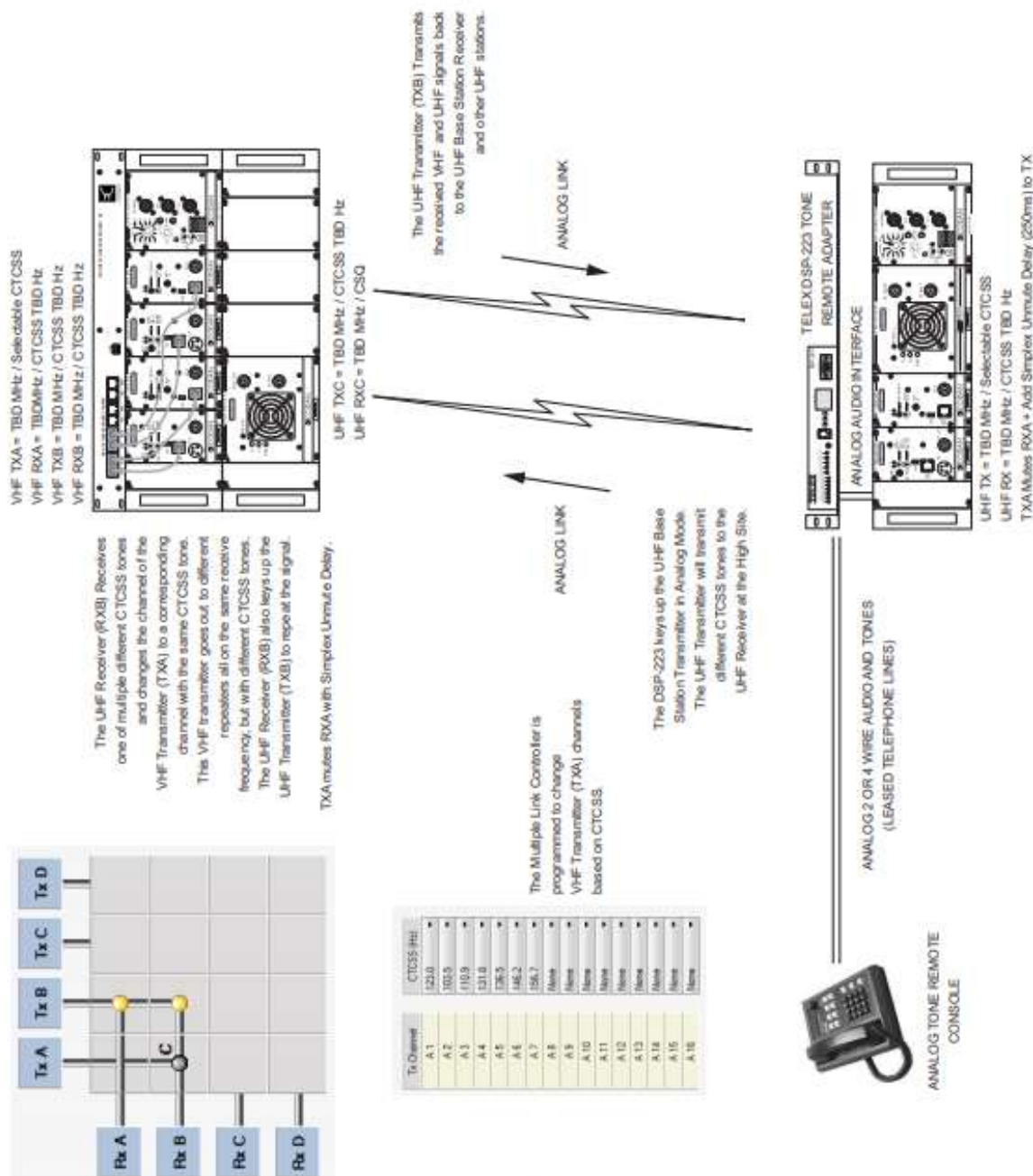
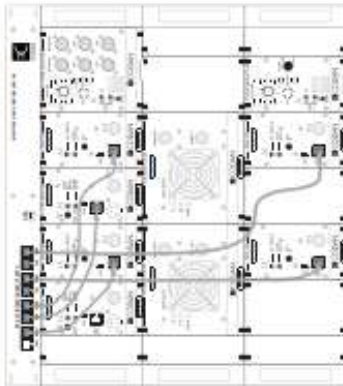


Figure 7: Example Multiple Link Controller System with analog links



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

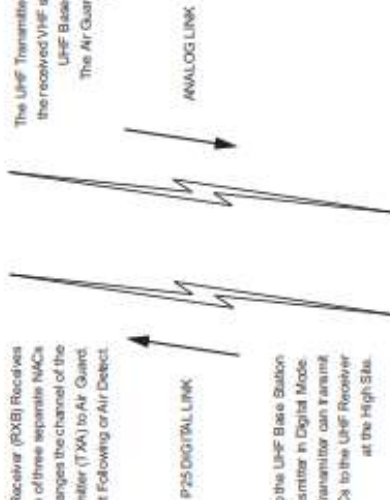
VHF TXA Ch. 1 = 168.650 MHz / CTCSS 110.9 Hz = Flight Following
VHF TXA Ch. 2 = 168.625 MHz / CTCSS 110.9 Hz = Air Guard
VHF TXA Ch. 3 = 168.750 MHz / CTCSS TBD = Air Detect



The VHF Receiver (RXB) needs to be 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 VHF Receiver (RXB) decodes 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 VHF Transmitter (TXB).

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



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



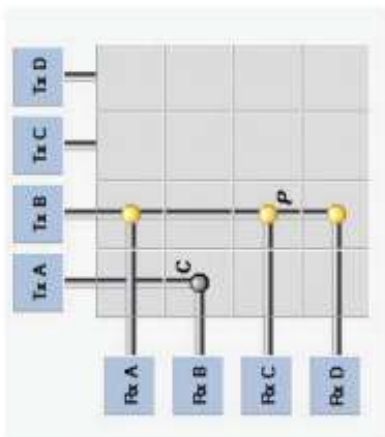
TELEX IP-223 OR IP-224

IP REMOTE ADAPTER

ANALOG AUDIO INTERFACE

LAN / WAN

TELEX PROPRIETARY DIGITAL IP INTERFACE



System Settings / Receiver / Transmitter Links / Channel Selection / Of Details

Link	Tr Channel	CTCSS FHS	NAC Key
1	A.1	123.4	100
2	A.2	123.5	101
3	A.3	123.6	102
4	A.4	123.7	103
5	A.5	123.8	104
6	A.6	123.9	105
7	A.7	124.0	106
8	A.8	124.1	107
9	A.9	124.2	108
10	A.10	124.3	109
11	A.11	124.4	110
12	A.12	124.5	111
13	A.13	124.6	112
14	A.14	124.7	113
15	A.15	124.8	114
16	A.16	124.9	115

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

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

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

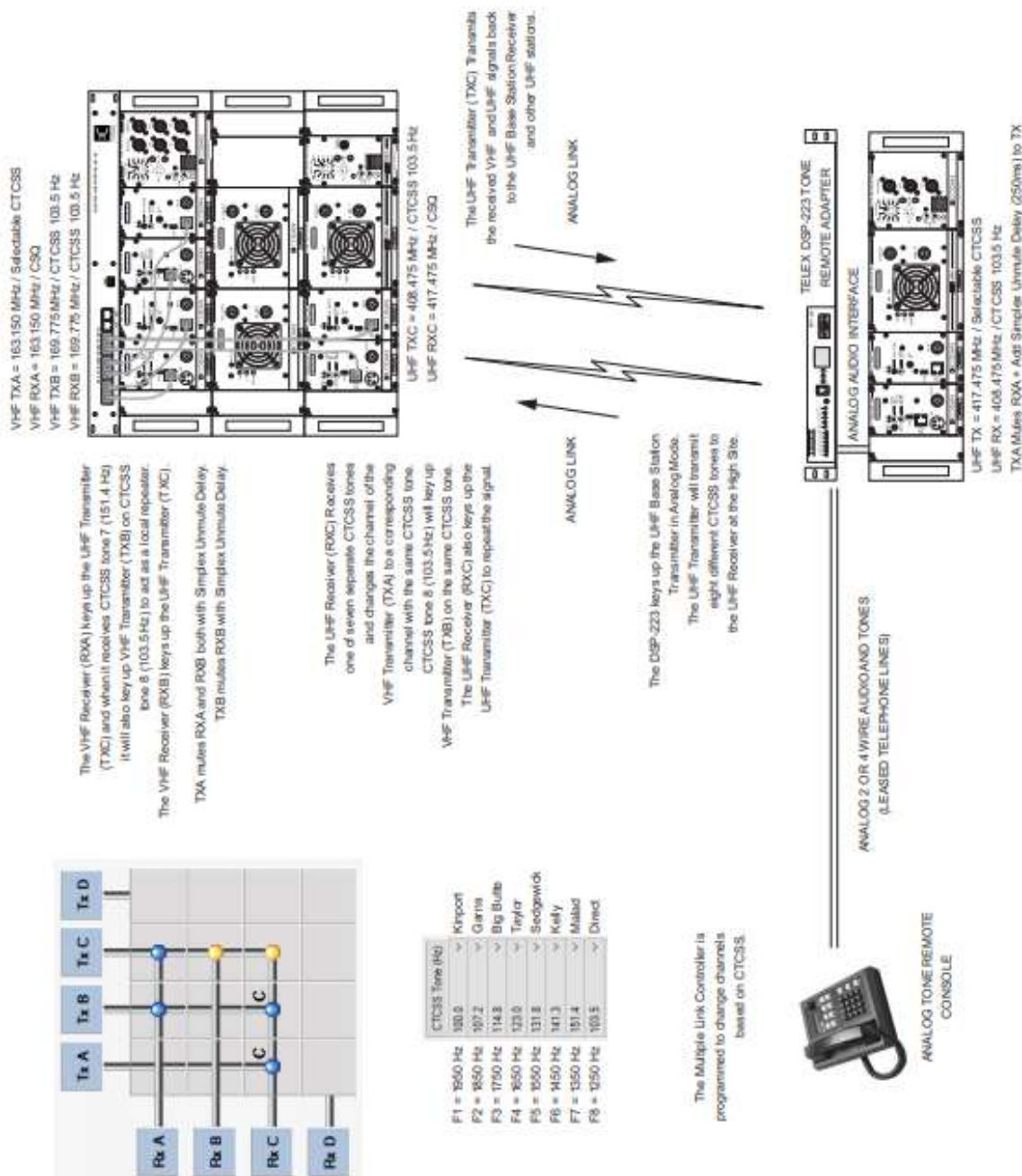


Figure 9: Example Multiple Link Controller System with co-located repeater

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

Multiple Link Controller Conditional Linking and Channel Change Programming:

The Multiple Link Controller can be configured to operate as a Conditional Link. If the Conditional Link is selected the path from Rx to Tx will only be active if the received signal contains one of the programmed CTCSS tones or NACs. Up to 7 CTCSS tones or NACs may be programmed into a Conditional Link.

The Multiple Link Controller can also be programmed to allow for Channel Selection of the transmitter, based on the received CTCSS tone or NAC. To activate the Channel Selection for a link, the link needs to be programmed as follows:

- Open the Rx / Tx Link configuration window for the link required.
- Select the Conditional Link check box.
- Select the Enable Channel Selection check box.
- CTCSS tones / NACs are not required to be programmed into the Rx / Tx Link configuration window. Programming CTCSS tones / NACs in the Rx / TX Link configuration window limits Channel Selection to ONLY these 1 to 7 codes. Leaving these selections as "none" will pass ALL CTCSS tones / NACs to the Channel Selection tab.
- A grey dot with the C (for Channel Selection enabled) will show on the grid (the dot will be blue if CTCSS tones / NACs were programmed into the Conditional Link).
- The CTCSS tones / NACs used to change the channels should be programmed in the Channel Selection tab.

Note that the Multiple Link Controller will ONLY allow up to 15 Channels changed based on CTCSS tones, as it can only allow up to 15 CTCSS tones programmed globally for the entire controller. An unlimited number of NACs can be used for Channel Selection as the NACs are not required to be programmed globally

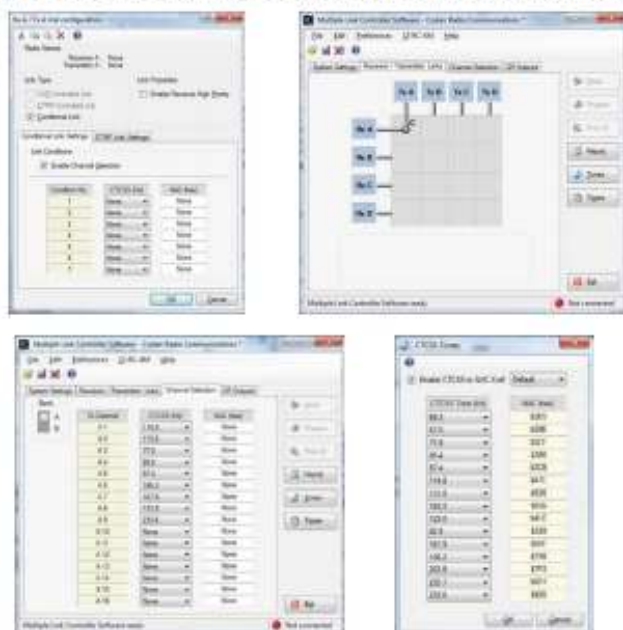


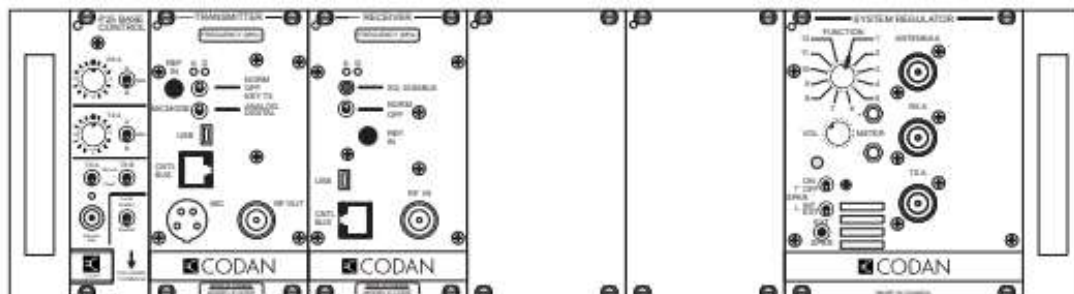
Figure 10: Example Programming for Channel Selection with CTCSS tones / NACs

TN655 CI-BC-4E Base Control Card

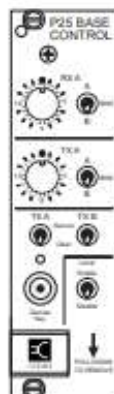
The CI-BC-4E base control card is a plug-in module which provides audio routing, COR and PTT routing and front panel control for an MT-4 base station radio system. The base control card includes the following features:

- 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 K Ω , -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:

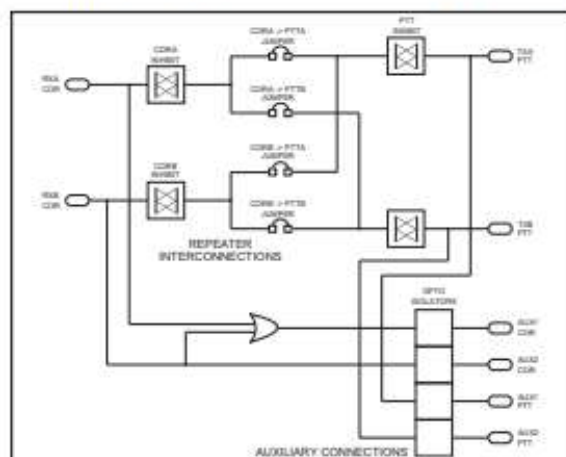


Figure 1: Repeater Control

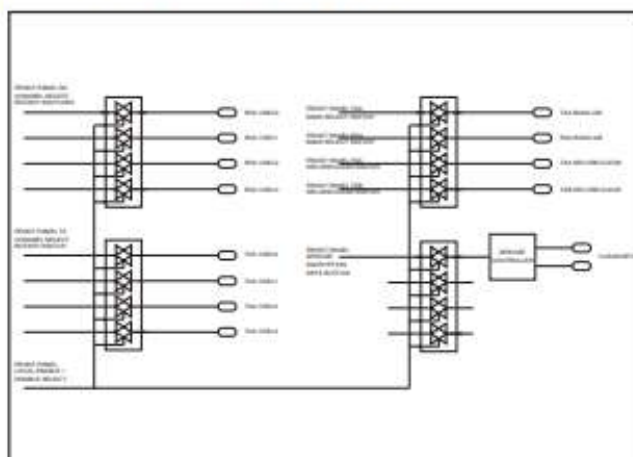


Figure 2: Front Panel Interface

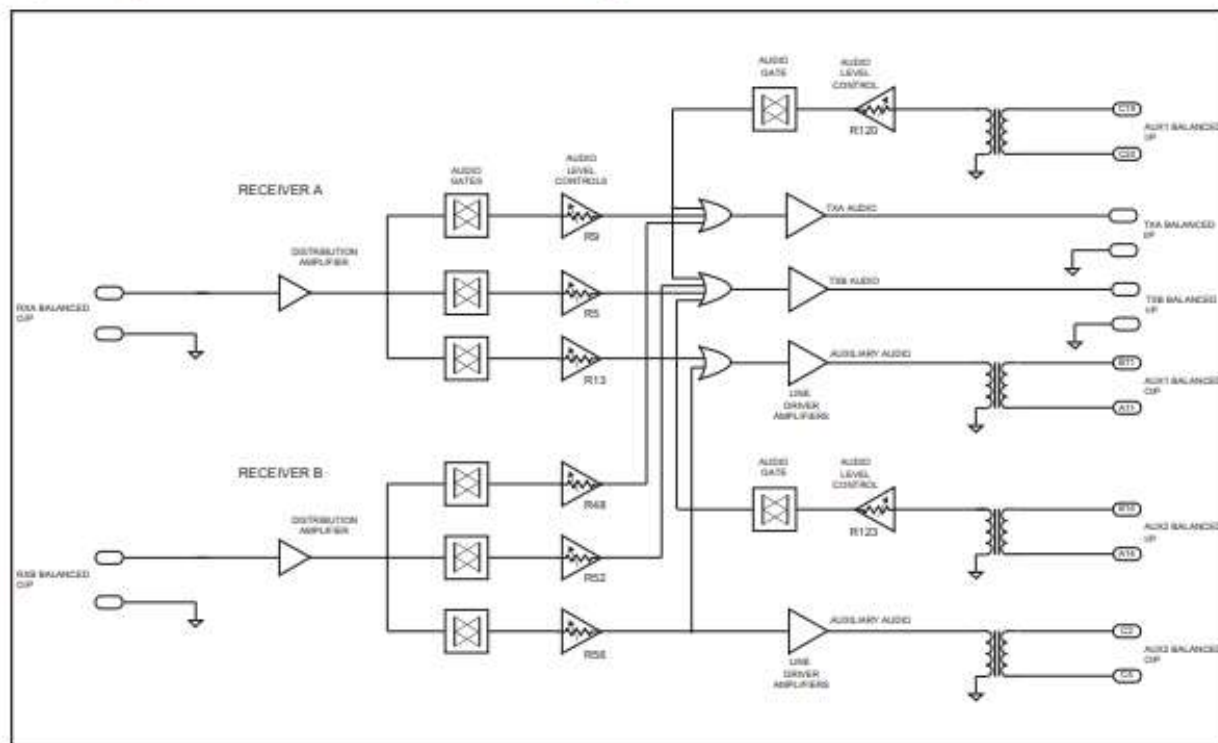
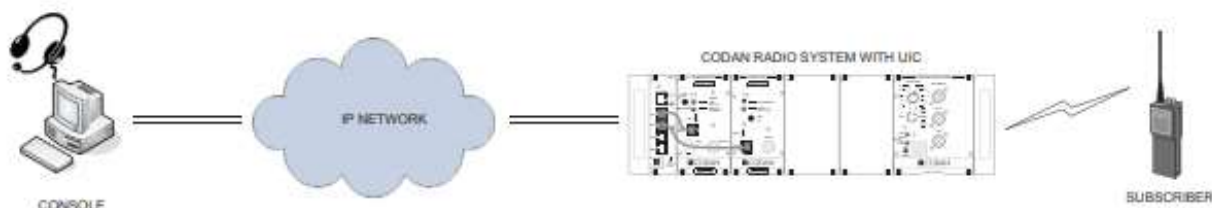


Figure 3: Audio Routing

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.



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 k Ω impedance. The 4 outputs are 20 mA max., 0 to +3.3 Vdc. Analog I/O resolution is 10 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.
- supports DFSI v2 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

Transmitter and Receiver Firmware Requirements

The UIC-5 requires that the MT-4E transmitter be firmware version 2.10.1 or later. The UIC-5 will work with any MT-4E receiver firmware.

TN661 UIC-5 Universal Interface Card

Programming and Networking

Ethernet Port	10/100 Base-T, 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.

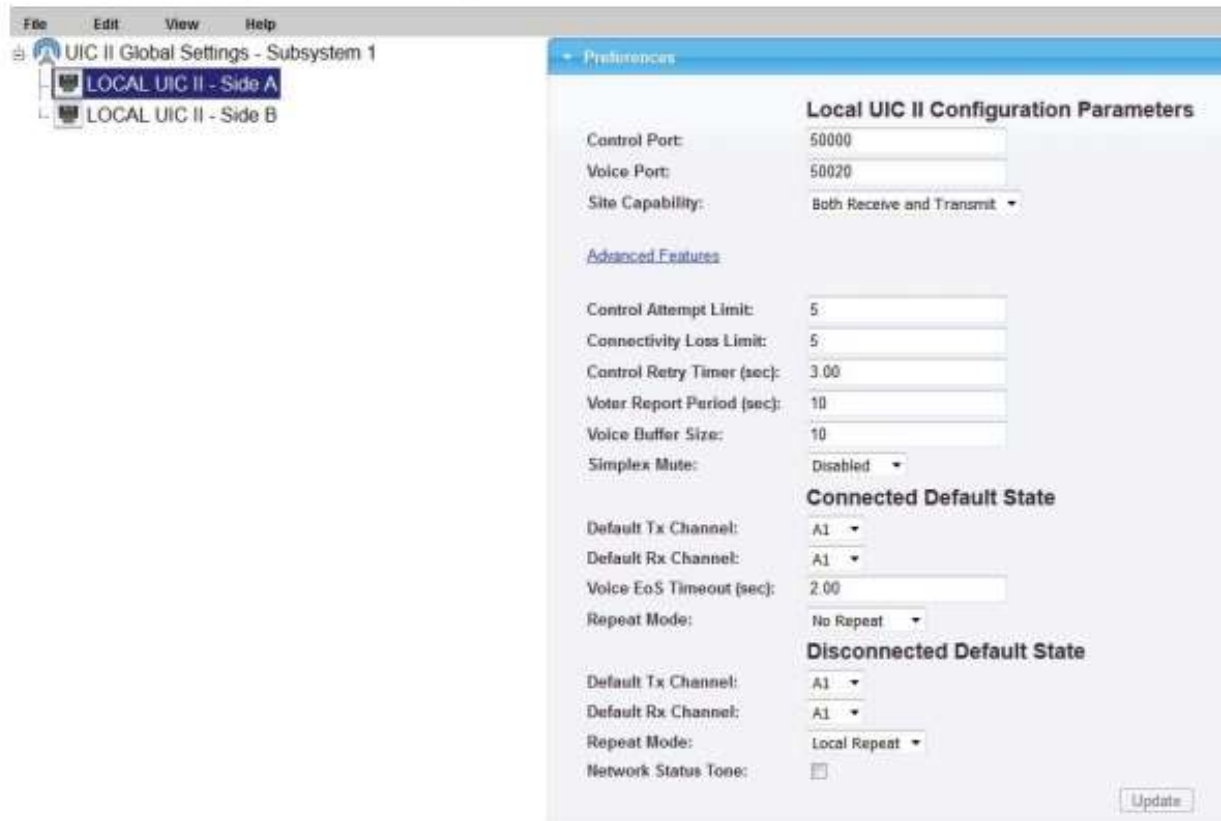
UIC MAC Address

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.

TN661 UIC-5 Universal Interface Card

UIC Web GUI Configuration Parameters

The UIC Web GUI can also be used to set the individual configuration parameters for each of the radio pairs connected to the UIC (Side 'A' and Side 'B').



The screenshot displays the UIC Web GUI configuration interface. On the left, a tree view shows the hierarchy: 'UIC II Global Settings - Subsystem 1' expanded, with 'LOCAL UIC II - Side A' selected. The main panel is titled 'Preferences' and contains the following configuration sections:

- Local UIC II Configuration Parameters**
 - Control Port: 50000
 - Voice Port: 50020
 - Site Capability: Both Receive and Transmit
- Advanced Features**
 - Control Attempt Limit: 5
 - Connectivity Loss Limit: 5
 - Control Retry Timer (sec): 3.00
 - Voter Report Period (sec): 10
 - Voice Buffer Size: 10
 - Simplex Mute: Disabled
- Connected Default State**
 - Default Tx Channel: A1
 - Default Rx Channel: A1
 - Voice EoS Timeout (sec): 2.00
 - Repeat Mode: No Repeat
- Disconnected Default State**
 - Default Tx Channel: A1
 - Default Rx Channel: A1
 - Repeat Mode: Local Repeat
 - Network Status Tone: ☐

An 'Update' button is located at the bottom right of the configuration panel.

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 70kbps 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

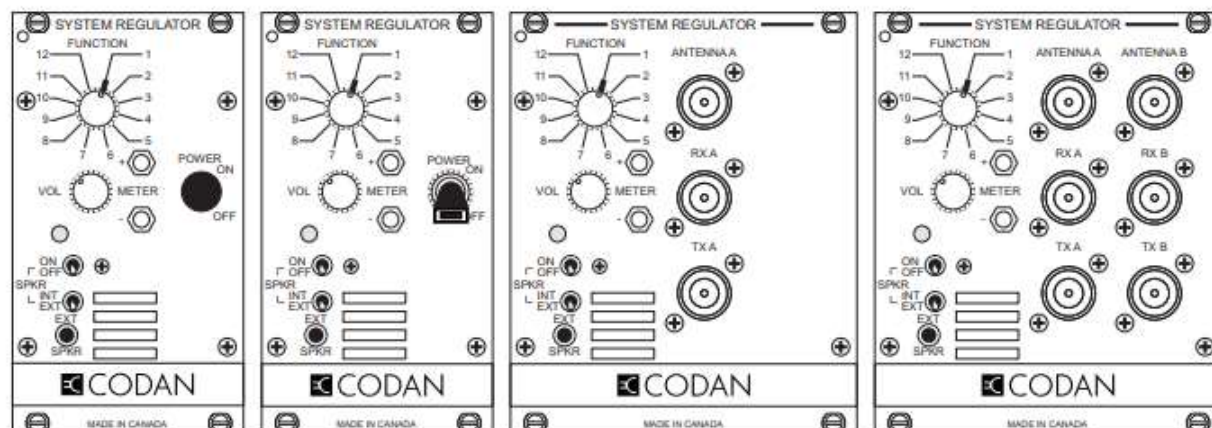
The UIC-4 is more sensitive to jitter and packet loss, the maximum specifications shown for a 3G / LTE network may result in less than ideal performance.

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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.

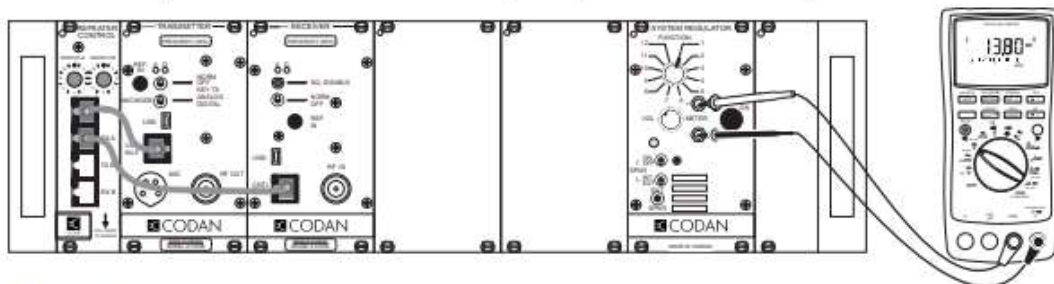


Figure 1: System Regulator Testing

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

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- Phone-based setup and configuration assistance
- Complimentary upgrades to new software features
- Version management tracking your configurations and releases
- Alerts to available Codan software patches and maintenance updates
- Troubleshooting of 3rd-party technology purchased as part of a Codan solution
- A factory training session with a three+ year contract
- Discounts on system design and on-site services
- Additional savings on future CodanCare contracts and system upgrades



ADDITIONAL OPTIONS

- Advanced replacements in event of failure
- 24/7 Tier 2+ Phone Support
- Onsite Troubleshooting and Preventive Maintenance
- Security patching where Information Assurance compliance is a requirement

	Basic Warranty	CodanCare
Helpdesk Support	While under warranty	Yes
Priority Troubleshooting	No	Yes
Phone-based Setup and Configuration Assistance	No	Yes
Complimentary upgrades to future software features	No	Yes
Version Management of Your Configurations	No	Yes
Alerts to Updates	No	Yes
Troubleshooting of 3rd-party Technology	No	Yes
Factory Training with 3+ Year Contract	No	Yes
Discounts on System Design and On-site Services	No	Yes
Savings on Future CodanCare Contracts	No	Yes
Additional Savings on System Upgrades	No	Yes
CodanCare Add-Ons		
Advanced RMAs	NA	Optional
On-site Preventive Maintenance	NA	Optional
On-site Troubleshooting	NA	Optional
24/7 Tier 2+ Helpdesk with SLA	NA	Optional
Information Assurance	NA	Optional


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