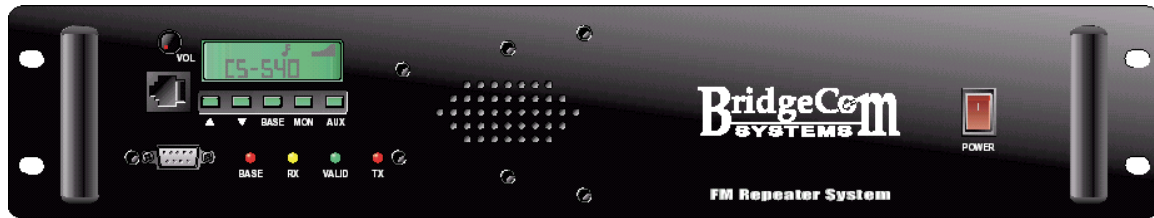


ComLink CS-540 Owner's Manual

Version 1.5, November 2006



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For Technical Support, please contact:
BridgeCom Systems, Inc.
617 Liberty Road
Smithville, MO 64089
Tel: (816)-532-8451
techsupport@BridgeComSystems.com

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CHAPTER 1: INTRODUCTION

Welcome

Thank you for purchasing the ComLink CS-540 FM Repeater System. As part of the ComLink series, the CS-540 has been developed to provide many of the features you, the communications user, have requested. The CS-540 gives you a feature rich scalable repeater platform to grow as your system needs grow. The CS-540 integrates the RF power of a dual fan-cooled 40-watt repeater with a high capacity 'tone panel' and a 16 channel base station. The CS-540 also provides a D-SUB 25pin accessory connector allowing for ease in interfacing your favorite external peripheral such as a Tone/DC Remote, Telephone Interconnect, SCADA, or Telemetry fixture. We would also like to say The CS-540 repeater is 100% LTR compatible and can be used with your favorite LTR trunking controller. This means the CS-540 provides DC access from the receiver to the controller and from the controller all the way to the RF transmitter without causing sub-audible signal degradation.

Features

- **High Performance Specs:** Temperature Compensation Oscillator (TCXO) ensures frequency stability and accuracy during ambient temperature changes.
- **Modular Design:** The modular design of the CS-540 allows for ease and quick replacement of the internal electronics at the site.
- **Rack style design:** The galvanized steel chassis construction provides for a Heavy Duty housing that can be mounted in a standard 19" rack or desktop configuration taking up 3.5" of rack space. Standard equipped rack handles provide for ease during 19" rack installation.
- **Internal duplexer (optional):** The design of the CS-540's chassis allows for an internal duplexer to be installed.
- **Front panel display and controls:** The front panel of the CS-540 includes a LCD display and four LED status indicators. Front panel controls include a five-button keypad and speaker volume control.
- **Windows-based programmer:** The CS-540 can be setup and maintained using the optional PGM-540 programming software. Programming is simple and easy – one DB9 cable connects your PC to the CS-540, no other interface modules are needed.
- **Signaling capability:** Built-in High capacity 'tone panel' that supports up to 64 users per channel with 50 CTCSS tones and 112 DCS codes available per channel. Cross tone/code encoding is available as well.
- **Battery Backup:** The CS-540 can be powered from a 12V battery and also provides a charging circuit for maintenance free operation.
- **External Speaker Out:** Operate a high powered external speaker by turning it on from the front panel.
- **Programmable I/O:** Incorporates programmable I/O lines that can be used to control external devices remotely. Perfect for SCADA or Telemetry applications. Doubles as programmable COS output.
- **Integrated High-Efficiency Power Supply:** The CS-540 includes an internal 10A power supply with MosFet-based switchmode technology for high reliability, high efficiency and minimum size and weight. It also provides 13.8V output for powering external controllers, thus saving valuable site resources.
- **Dual Cooling Fans:** The CS-540 incorporates two cooling fans that can be programmed for continuous operation or transmit only.
- **Variable channel spacing:** Each channel can be individually programmed to use 12.5 kHz or 25 kHz spacing making the CS-540 useful for years to come.
- **Remote Programming via DTMF tones:** In order to save a time consuming trip to the site, the CS-540 provides for remote programming and maintenance.
- **Accessory Connector and AUX Feature:** The internal controller can be disabled and the repeater placed in an auxiliary mode where it can be used as a slave to an external controller.
- **Air-Time Logging:** The CS-540 automatically logs cumulative airtime on a per use basis. The airtime is recorded in minutes and seconds and is accumulated on per second basis. The air-time data is then retrieved using the PGM-540 programming software.
- **Keypad Lock:** During operation at the site, the keypad can be locked to prevent tampering with the repeater settings.
- **LTR Decoder:** When the CS-540 is connected to an LTR controller, this feature decodes and displays the ID and home channel of the call being repeated

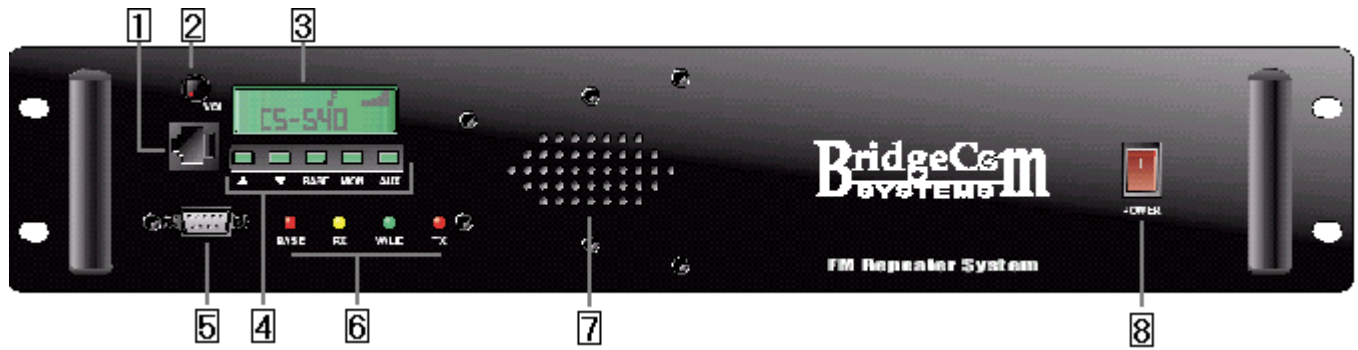
This Owner's Manual will acquaint you with the features and specifications of the CS-540. Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, please note that one of the many features of the CS-540 includes upgradable firmware. Firmware upgrades may modify existing features and/or introduce new features not available at the time of this manual's publication. Please read the accompanying documentation with any firmware upgrade for any changes to this manual's content.

CHAPTER 2: SPECIFICATIONS

General	CS-540U	CS-540V
Number of Channels:	16	
Operating Voltage:	11 V DC Min / 13.8 V DC Nominal / 15 V DC Max	
Channel Spacing:	5kHz/6.25KHz/Splinter	
Current Drain:	12A Max	
Weight:	18.5 lbs.	
Weight w/ duplexer:	19.5 lbs.	
Frequency Range:	450-480 MHz	148-174 MHz
Dimensions (W x H x D):	19.0" x 3.5" x 14.0"	
Frequency Stability:	+/- 1.0 ppm	+/- 2.5 ppm
Operating Temperature Range:	-22° F to +140° F (-30° C to +60° C)	
Local Oscillator:	Low-side injection	High-side injection
Sensitivity (12 dB SINAD)	< 0.25 μ V @ 12.5 kHz < 0.25 μ V @25.0 kHz	
Squelch Threshold:	Open 12dB SINAD/Close 8dB SINAD	
Selectivity:	62dB @ 12.5kHz 72dB @ 25.0kHz	
Spurious Rejection:	75dB	
Intermodulation Rejection:	72dB @ 12.5kHz 72dB @ 25.0kHz	
Antenna Connector:	N-Type	
Antenna Impedance:	50 Ω	
RF Output (w/o duplexer): Programmable	450-470 @ 0-40W 471-480 @ 0-35W	148-174 @ 0-40W
Modulation:	160K0F3E, 11K0F3E	
Maximum Deviation:	+/- 5kHz (25 kHz) +/- 2.5 kHz (12.5 kHz)	
FM Hum and Noise	36dB @ 12.5kHz 42dB @ 25.0kHz	
Antenna Connector:	N-Type	
Antenna Impedance:	50 Ω	

Specifications per EIA standards. In our on-going commitment to quality specifications are subject to change without notice.

Front Panel Description



- 1) Microphone input jack
- 2) Volume control knob
- 3) Alphanumeric and Icon LCD
- 4) 5 button keypad (▲, ▼, BASE, MON, AUX)
- 5) Computer port DB9 Female
- 6) LED status indicators (BASE, RX, VALID, TX)
- 7) Internal Speaker
- 8) Lighted power switch

Rear Panel Description



- 1) Fan
- 2) Accessory Port: DB25 female standard on CS-540
- 3) TX Antenna N-type female panel mount or duplexer out
- 4) RX Antenna N-type female panel mount or vacant
- 5) Detachable AC cord receptacle
- 6) BATTERY BACKUP/EXT DC IN
- 7) 13.8V output
- 8) EXTERNAL SPEAKER OUT

CHAPTER 3: INSTALLATION

Upon opening the shipping carton, the following items should be present and undamaged:

- CS-540 FM Repeater System
- This CS-540 Owner's Manual
- Detachable AC-line cord
- One strip of four rubber feet

The CS-540 is capable of producing HIGH-powered RF signals that require proper termination into a suitable load. It is highly recommended the CS-540 be installed by a qualified technician with experience installing FM repeaters and controller equipment.

Installation

The CS-540 provides 4 mounting holes on the front panel for installation into a 19" rack and 4 rubber feet for placement in a desktop configuration. If installing the CS-540 in a 19" rack, use 4 rack screws (not supplied) to securely fasten the CS-540's front panel flush with the rack's rails. If placed in a desktop configuration, it is recommended the rubber feet be placed close to the four corners of the bottom of the chassis.

Optional accessories include a base station microphone, internal duplexer, and the PGM-540 programmer. Please check with your dealer for more information about these optional accessories.

The CS-540 is shipped with or without an internal duplexer. If the unit is not equipped with an internal duplexer, there will be an N-type female connector for RX and another for TX located on the rear of the unit. If the unit is shipped with an internal duplexer, there will be one N-type female connector at the TX/Duplexer Out port.

The internal power supply of the CS-540 is factory pre-set for 120V AC 60HZ operation to deliver 13.8 Volts. To convert the internal power supply to 240V AC, see Appendix E. If the CS-540 did not come with a duplexer installed, connect the received signal to the RX antenna port and connect the TX antenna port's output to where the powered signal is to be transmitted. If the CS-540 came installed with a duplexer, attach the antenna cable to the duplexer out port on the rear of the unit.

Power Up

To power the unit, simply plug the detachable AC-line cord into the receptacle located on the back of the unit and then plug it into an AC line source. Pressing the lighted power switch to the up position turns on the CS-540. The power switch will illuminate indicating the unit is on. The CS-540 will cycle through a power-up sequence illuminating the LCD and the LED's. The model name will be displayed for approximately two seconds followed by the version of firmware. If the CS-540 was ordered without being custom programmed, the default personality will be loaded and HIGHPWR will be displayed for approximately 2 seconds and then dashed lines. If the unit was ordered custom programmed, the name given to the first channel will be displayed instead of HIGHPWR. If the CS-540 was ordered without being custom-programmed, you will have to purchase the PGM-540 repeater programmer. Please reference the PGM-540 User's Manual for learning how to program your CS-540. Once programmed, the CS-540 will be reset and cycle through its power-up sequence and default to repeater mode. Note: HIGHPWR is the name of the channel programmed. This channel is configured at the factory to transmit 40 watts. Keep this in mind prior to attaching the repeater to a service monitor. Depending on your test equipment setup, you may need to reduce the output power or pad the TX output so as not to damage your test equipment.

CHAPTER 4: OPERATION

Operating Modes

The CS-540 has three different modes of operation: repeater mode, base station mode, and auxiliary mode. By default, it operates in repeater mode unless you explicitly change modes. This chapter will give you a brief overview of each of the modes. The individual modes are covered in detail in the chapters that follow. Also in each of the various operating modes an external peripheral can be connected to the accessory connector located on the rear of the unit. Through programming, the external peripheral can be made to work in conjunction with the repeater. The CS-540 will 'remember' the mode it was in prior to powering the repeater down. When powered back up, it will revert to the mode it was in prior to power down.

Repeater Mode: The CS-540 is a full-featured community repeater with programmable settings for channel spacing, TX Timeout, and CWID broadcasting preferences. In repeater mode, the CS-540 will listen for calls from any user that belongs to the currently selected channel. If it detects a CTCSS tone or DCS code of a valid user, it will repeat the call with the appropriate CTCSS/DCS encoding. While in repeater mode, the CS-540 can also be remotely programmed using a two-way radio capable of generating DTMF tones. For more information on repeater mode, see "Chapter 5: Repeater Mode". For more information on remote programming, see "Chapter 8: Remote Programming".

If an external peripheral such as a phone patch is used in conjunction with repeater Mode, the external peripheral will gain control of the transmitter upon engaging the external PTT line. When the external PTT line is engaged, the circuit is designed to break the connection between the RX Module and the TX Module so that the external peripheral has control. **The transmit options of the user in Slot 1 will be utilized.** If necessary, the repeater supports a programmable COS output on pin 17 to be interfaced with the peripheral.

Base Station Mode: The CS-540 is a full-featured base station with programmable settings for busy queuing and busy channel lockout. By attaching an optional microphone, the CS-540 can communicate as any user on the selected channel. For more information, see "Chapter 6: Base Station Mode." If an external peripheral such as a DC Remote is used in base mode the **transmit options of the user in Slot 1 will be utilized when the external PTT line is engaged.**

Auxiliary Mode: AUX mode can serve many purposes. Placing the CS-540 in AUX mode disables the internal controller and allows for the unit to be **totally controlled** by an external peripheral. During AUX mode, the display illumination level may also be changed and the transmit RF power can be enabled/disabled, also, the composite input feature can be enabled/disabled. For more information, see "Chapter 7: Auxiliary Mode".

Channel and User Database

Before you begin reading about the various modes of the CS-540, it is helpful to know how the channel and user database is constructed. You may program up to 16 channels for the CS-540 to use. At any time, only one channel is active. You can select which channel you would like activated by scrolling through the list of channels using the up (▲) and down (▼) keys on the CS-540's front panel. Each of the 16 channels has unique settings for broadcast ID, broadcast interval, Morse code rate, receiver frequency, transmitter frequency, channel spacing, power, and TX Timeout time. These settings are explained in more detail in "Chapter 5: Repeater Mode." In addition, base station settings are determined on a per channel basis. Base station settings include busy lockout, busy queuing, busy queue timeout, system hold time, and marked idle. These settings are explained in more detail in "Chapter 6: Base Station Mode". Each channel can support up to 64 users. Each user is assigned a particular slot within the channel. User slots are numbered sequentially from 0 to 63. Slot 0 is the System Operator, which is the only user with remote programming privileges. This is explained in more detail in "Chapter 8: Remote Programming". The remaining slots (1 through 63) are for common users, and no preference is given to users based on their order within the slots.

Each of the 64 users has unique settings for user ID, status, RX signaling, TX signaling, courtesy tone, TX hold time, and tone-in-tail. These setting are explained in more detail in "Chapter 5: Repeater Mode".

CHAPTER 5: REPEATER MODE

Overview

In repeater mode, each of the CS-540's 16 channels is capable of supporting 64 individual users. Each subscriber may have one of 50 possible CTCSS tones or one of 112 possible DCS codes. While in repeater mode, the CS-540 can be placed in remote programming mode and the selected channel's properties and user database can be changed using transmitted DTMF tone command sequences.

Operation

To place the CS-540 on a programmed channel, simply press the up (▲) or down (▼) buttons on the front panel. This will allow for cycling through the possible channels. Once the desired channel is selected, the channel name will be displayed for approximately two seconds and the LCD will revert to displaying dashed lines. **If this is the first time this channel is used, you must restore the factory default settings for this frequency pair. See Chapter 9: Alignment.** At this point the CS-540 is in an idle state waiting to validate and repeat incoming calls. Upon receipt of carrier, the yellow RX LED will illuminate. When a valid user's signaling is decoded, the green VALID LED will illuminate and the user's name will be displayed on the LCD. The transmitter will then power up and repeat the call. At this point the red TX LED will illuminate and the cooling fan will engage. When the call expires, the green VALID LED will go off and if carrier is no longer present, the yellow RX LED will go off as well. The Transmitter may remain keyed for a programmed hang time. When done transmitting, the red TX LED will go off, and the cooling fan may stop depending on programming. At any point in time, the repeater audio traffic may be monitored. This is done by pressing the MON button. Pressing-and-releasing the MON button will sequence through the possible speaker output options. The sequence is thus: Internal Speaker, External Speaker, Both Internal and External, and both off. The NOTE icon will be visible to indicate internal, and the S icon will be visible to indicate external.

NOTE: During repeater mode operation, it is not recommended that a passive or mobile-type microphone be connected to the unit. A mobile-type microphone is always 'hot' and the repeater will mix the mic audio with the repeated audio. A base station-type microphone is preferred.

Channel Settings

The behavior of the CS-540 while in repeater mode depends on various channel and user settings. Channel and user settings are either pre-programmed by your dealer or by you using the PGM-540 programmer. Some channel and user settings can be modified via remote programming commands, as described in "Chapter 8: Remote Programming". The following lists all of the channel settings.

Channel Name: The Channel Name is an eight-character name. Legal characters are uppercase letters and numbers. It is also the name that appears in the CS-540's LCD display when that channel is active.

Broadcast ID: Like the Channel Name, the Broadcast ID is an eight-character name consisting of uppercase letters and numbers. The Broadcast ID is transmitted in Morse code at specified intervals to identify the repeater on the air. By default, the Broadcast ID is the same as the Channel Name. However, you have the option of choosing a Broadcast ID that is different from the Channel Name.

Broadcast Interval: The Broadcast Interval specifies how often the Broadcast ID will be transmitted. It has a range of 0 to 999 minutes. '0' disables this feature and the Broadcast ID will not be transmitted. The CS-540 is designed to broadcast the ID if and only if it has actively transmitted within the most recent time interval.

Morse Code Rate: Rate at which the Broadcast ID will be transmitted: either 11 or 22 WPM (Words Per Minute).

Receiver/Transmitter Frequency: You must specify a receive and transmit frequency, typically 5 MHz apart. If you are working with the CS-540U (UHF model), you may specify a frequency in the range of 450 to 480 MHz. If you are working with the CS-540V (VHF model), you may specify a frequency in the range of 148 to 174.5 MHz. The repeater also handles the amateur region in both 2M and 70cm.

Channel Spacing: Each channel can be programmed for either narrow (12.5kHz) or wide (25kHz) band. This setting is applied to both the transmitter and the receiver.

Power Setting: Each channel can be programmed for either high or low power. Low power starts at 5 watts and High power starts at 40 Watts. The TX power can be adjusted from the alignment menu. The RF PA can also be turned off. For more information about this feature, see "Chapter 7: Auxiliary Mode".

COS Enable: By enabling the COS output feature (Pin 17 of the Accessory Connector) you can customize how COS output will operate. The COS output can be made to toggle when carrier is present on the receiver or when valid signaling is determined. The polarity of the output is selectable to meet the needs of the external peripheral. If the COS is disabled, Pin 17 defaults as a general purpose I/O that can be controlled remotely.

Cooling FAN Operation: The cooling fans can be made to operate continuously or only during transmit.

CSQ Repeat: Selecting this option will cause the repeater to repeat every instance of valid carrier. The TX options transmitted will be that of those programmed in for Slot 1 of the User Settings.

Tx Timeout: TX Timeout controls how long the CS-540 will keep the transmitter continuously keyed before the RF Power Amp (RF PA) is automatically disengaged. The maximum value of the TX Timeout feature is 999 seconds. To disable the TX Timeout feature, enter 0 in the TX Timeout field.

Remote Access Code: The System Operator can remotely program and manage the CS-540 Community Repeater by using DTMF tone sequences. (See "Chapter 8: Remote Programming" for more information.) Before making any modifications, the System Operator must enter the Remote Access Code to gain access to the system. The Remote Access Code is a four-digit number that you specify on a per channel basis. The remote code "5555" is reserved for remote rebooting, but all other four-digit numbers are valid. If you want to disable the Remote Access feature, simply don't create a user in the System Operator slot. Without a designated System Operator, the Remote Access Code is irrelevant. For more information on the CS-540's remote programming features, see "Chapter 8: Remote Programming".

User Settings

User ID: The User ID is an eight-character name that will be displayed in the CS-540's LCD while that user's call is being repeated. Legal characters in the User ID include uppercase letters, numbers, dashes, and periods. By default, users are assigned the name "USER" plus a two digit number corresponding to the slot of that user. For example, the user in slot #8 will be assigned the name USER08 by default. The user in slot 0 is assigned the name "SYS-OP" to reflect its special role as the System Operator, but you can change its User ID as well if you prefer.

Status: Each user has a status of "Active" or "Inactive". By default, all users are "Active". If you mark a user as

"Inactive", their calls will not be repeated, although all their information will still be retained in the system. This option is useful if you want to suspend the repeater privileges of a user, without deleting that user entirely.

RX/TX Signaling: Each user must be assigned an Rx Signal and a TX Signal. You may specify either a CTCSS tone or a DCS code. If you select a CTCSS tone, you must also specify one of 50 tones ranging from 67.0 to 254.1 Hz. If you select DCS code, you must also specify one of 112 three-digit codes, inverted or non-inverted. The Rx Signal and TX Signal are selected separately. The per user TX signaling setting can also be made to transmit carrier only (CSQ). The CS-540 is capable of cross tone/code encoding. For example, if the CS-540 detects that it has received a transmit request with a 179.9 Hz CTCSS tone, it can then repeat the call with a 162.2 Hz CTCSS tone, or even with a DCS code. Cross tone/code encoding can be useful when setting up multiple repeaters at different locations that share the same frequency.

NOTE: If you employ both DCS and CTCSS RX squelch options for users on the same channel, we recommend that you do not use an RX CTCSS tone of 136.5 Hz for any users on that channel. Some transmitting mobiles use a DCS turnoff code of 136.5 Hz that the repeater could misinterpret as a valid incoming call.

Courtesy Tone: When a user has finished transmitting, the CS-540 can emit a courtesy tone. The courtesy tone can be set for 500 Hz, 1000 Hz, 1500 Hz, or no courtesy tone. The duration of the courtesy tone is fixed at 75 milliseconds.

TX Hold Time: After a user has finished transmitting, the repeater can continue to transmit for a programmed amount of hold time. TX Hold Time has a range of 0 to 65,535 ms. However, during remote programming, the max number that can be entered is 9,999 ms. If the user has a courtesy tone, it is recommended that you set the TX Hold Time to be at least 250 ms.

Tone-in-Tail: Without Tone-in-Tail enabled, the CS-540 will not encode the user's CTCSS tone or DCS code when that user has de-keyed, even though the repeater continues to transmit for the duration of the TX Hold Time. With Tone-In-Tail enabled, the CS-540 will encode the user's CTCSS tone or DCS code during the TX Hold Time. Whether or not Tone-in-Tail should be enabled or not depends on the requirements of your system configuration.

Error Alerts

PLL Lock Error: The CS-540 supports monitoring the status of the PLL/VCO circuitry in both the Receive and Transmit modules. In the event the receiver's PLL is unable to lock due to a hardware failure, the CS-540 will display RXPLLERR. If the transmitter's PLL circuitry should fail, TXPLLERR will be displayed. Upon detecting a PLL error, the CS-540 will enter an error state. While in error state, the CS-540 repeater operation will be suspended. The user may try to reprogram the channel by pressing the up/down buttons. In the event the problem is unsolvable, the repeater may require servicing. Please contact your dealer or BridgeCom Systems, Inc. technical support.

CHAPTER 6: BASE STATION MODE

Overview

In addition to its repeater features, the CS-540 can also be operated as a base station. While in base station mode, the system operator can communicate with any user on the selected channel.

Operation

To switch from repeater mode to base station mode, simply press and release the button on the front panel labeled BASE. The BASE LED will illuminate. The BASE LED will stay lit during base station operating mode. The first time that base station mode is entered, the CS-540 will default to the user in Slot 1. Any subsequent time that base station mode is entered, the user that was active the last time that the CS-540 was in base station mode will be selected. The CS-540 will turn on the front panel speaker by default. The received audio volume may be adjusted. The internal or external speaker may be turned on/off by pressing the MON button to sequence options. The CS-540 will now only validate signaling received from the selected user. When the base station operator initiates a transmission, it will be on the selected users transmit squelch option. Different users on the channel may be selected by pressing the up or down buttons to scroll through the user lists. Users deactivated in repeater mode will have the left-arrow icon (◀) illuminated in the upper left corner of the display, however, during Base Station mode, it is permissible to transmit using a deactivated user's tone/code. In order to exit base station mode, simply press the BASE button again. The CS-540 will then re-enter repeater mode.

Base Station Settings

The behavior of the CS-540 in base station mode depends on the various base station settings. Base station settings are programmed by using the PGM-540 programmer. Remote mode cannot be entered during Base station mode. It is also important to remember that all per user transmit options (courtesy tone, hang time, and Tone-in-Tail) are inherited when transmitting to that user.

CSQ Unmute: By default the CS-540 will unmute the speaker only when valid signaling is decoded. Enabling this feature defeats the selected squelch option so that sufficient carrier will cause the speaker to unmute.

Busy Lockout: This setting prevents the operator from transmitting while the selected channel is busy. If the operator attempts to transmit while receiving a call, the CS-540 will not acknowledge the attempt.

Busy Queuing: This setting will cause the CS-540 to queue the TX request if the operator attempts to transmit while the selected channel is busy. If the TX attempt is queued, the busy system queue alert (three 700 Hz tones) will sound and QUEUED will be displayed on the LCD. When the channel becomes free, the CS-540 will attempt to access the channel. If successful, the busy system access alert (five 700 Hz tones) will sound and the CS-540 will begin transmitting. The CS-540 will hold the channel for the programmed System Hold Time. If the operator fails to PTT before the System Hold Time expires, the CS-540 will stop transmitting and the system not accessed alert (a two second 500 Hz tone) will sound and QUEUED mode will be exited.

Busy Queue Timeout: If Busy Queuing is enabled, this timer determines how long a TX request will wait in queue. If Busy Queuing is not enabled, this timer has no relevance. The Busy Queue Timeout has a range of 0 to 65,535 milliseconds.

System Hold Time: If Busy Queuing is enabled, this timer determines how long the CS-540 will hold the channel once the transmit request is processed. If Busy Queuing is not enabled, this timer has no relevance and it will not be used. The System Hold Time has a range of 0 to 65,535 milliseconds.

Marked Idle: Marked Idle permits the operator to transmit even if the CS-540 is receiving a valid call. If valid signaling is not present, the call attempt will be either rejected or queued. This means Marked Idle must be used in conjunction with Busy Lockout, or both Busy Lockout and Busy Queuing. If Marked Idle is used with just Busy Lockout, the TX attempt will be rejected if the channel is busy but valid signaling is not present. If valid signaling is present, the user may transmit. If Marked Idle is used with Busy Lockout and Busy Queuing, the TX attempt will be queued if valid signaling is not present. Otherwise, the user may transmit.

CHAPTER 7: AUXILIARY MODE

Overview

By entering auxiliary (AUX) mode, the repeater's internal controller is disabled and the CS-540 may be controlled by an external peripheral. In addition, while in AUX mode, you can adjust the display illumination level, enable/disable the TX power amplifier, enable/disable the front panel speaker, enable/disable the internal LTR Decoder.

Auxiliary Settings

While in auxiliary mode, you have the option of adjusting the following settings:

LCD illumination level: To adjust the display illumination level simply press the up (▲) button to cycle through the varying degrees of illumination. Once the desired setting is achieved, press the AUX button to exit and save the setting. Turning the illumination off will increase battery life in battery powered applications.

TX power setting: The RF power out can be disabled. Pressing the down (▼) button for approximately two seconds will toggle the RF power amp setting. If the RF PA has been disabled, a right arrow icon (▶) will be displayed in the LCD. This setting is stored immediately after pressing the button. Pressing AUX again will return to repeater mode. Please note, if the RF PA is disabled, the cooling fan will be disabled as well.

LTR Decoder: For those who are using the CS-540 with an LTR controller, the CS-540 supports an internal LTR decoder for diagnostic purposes. This feature is enabled/disabled by simply pressing the BASE button while in AUX mode. The LTR Decoder is active when the LCD displays 'd-----'. The LTR Decoder will display the home channel and ID of the call being repeated. For Example: 'd-05-001' indicates the CS-540 is repeating user ID 001 whose home channel is 05. To deactivate the LTR Decoder, simply press the BASE button and 'AUX' will be re-displayed.

Composite Input Enable/Disable: Certain external controllers may mix the data and voice. In the event the CS-540 is required to transmit a composite data/voice input, it will need to be set up to support the composite signal. The composite output from the external controller is to be connected to **PIN 21** of the ACCESSORY connector. While in AUX mode, press and hold the BASE button for approximately two seconds. The left arrow icon (◀) will be displayed indicating the CS-540 is processing a composite input. Once this input is enabled, make sure your controller is aligned for the proper TX data and voice deviations. To disable the composite input, simply press-and-hold the BASE button for approximately two seconds. The left arrow icon (◀) will disappear.

External Controllers

When in AUX mode the CS-540's internal tone panel is disabled and total control of the repeater is surrendered to an external peripheral such as an LTR controller or another tone panel. Please refer to Appendix A: for the pin-out description of the CS-540 to help you make your custom cable. **When AUX mode is entered, the circuit path is set up to where the DATA or Composite output of the external controller has DC access to the transmitter. The CS-540 requires the DC input of the DATA or Composite output be centered at 2.5 V DC otherwise the external peripheral could cause a DC shift to make the CS-540 transmit off frequency. To help achieve this 2.5 V DC input requirement, the CS-540 incorporates a DC level shifting Trim Pot (P1) on the internal accessory board. Open the unit to access the accessory board. This is the board the accessory connector is on. With your external controller connected, use a DC voltmeter to measure the DC input voltage on TP1. (Located in center of board) Preferably while the controller is sending data, Adjust P1 until 2.5 Volts DC is achieved.**

CHAPTER 8: REMOTE PROGRAMMING

Overview

Many settings of the CS-540 can be remotely programmed using DTMF tone sequences. You can add and delete users, as well as modify all individual user settings, such as TX/RX squelch options and courtesy tones. In addition, many channel settings can be modified remotely as well, such as the broadcast ID interval and the TX Timeout timer.

Before You Begin

Before you begin using the remote programming features, please go through the following checklist to make sure that you meet all the requirements for remote programming.

- ✓ Some basic channel settings, such as the channel ID, remote access PIN, RX/TX frequencies must be set up by your dealer or by using the PGM-540 programmer.
- ✓ A four-digit remote access PIN must be entered in order to access the remote program mode. Make sure that you know the PIN for the channel that you wish to modify before you begin.
- ✓ You must have a handheld or mobile radio that can generate CTCSS tones / DCS codes and DTMF tones simultaneously. The handheld or mobile must generate each DTMF tone for at least 40ms and the duration between DTMF tones must be at least 40 ms.
- ✓ Every user belongs to a particular "slot". There are 64 slots, numbered from 0 to 64. Whenever you modify an individual user's settings, you must enter their slot number, so make sure that you know their slot number. Moreover, if you want to add users remotely, you must know which slots are free. Try to keep an updated list of all the slots and their corresponding users. A blank template is provided in Appendix D of this manual for this purpose. You can also export a list of users and their settings for printing using the PGM-540 programmer.
- ✓ The user in Slot 0 is the designated System Operator. Only the System Operator may remotely program the CS-540, so make sure that you have a user in Slot 0. The Slot 0 user settings must be set up by your dealer or by using the PGM-540 programmer.
- ✓ You'll want to try to keep remote programming sessions as short as possible. While in remote programming mode, all other users are locked out of the system, so you'll want to minimize the repeater's downtime. Another consideration to keep in mind is that the repeater will automatically exit remote programming mode without saving the changes if it doesn't receive a DTMF tone for 60 seconds. For these reasons, we highly suggest that you write down all the command sequences that you would like to enter before you begin.

Accessing remote program mode

To access remote program mode, the System Operator must key the remote access PIN, followed by the pound (#) symbol. Not just any user can enter the PIN – the repeater must also detect the presence of the System Operator’s CTCSS tone / DCS code. If the System Operator’s tone/code is detected, then the repeater will not repeat the call, so don’t worry about the PIN being transmitted to other users.

Once you enter the PIN and press the # key, the repeater will transmit 3 –1500 Hz tones to indicate that remote mode was entered. The LCD will also display REMOTE.

Commands

Each commands is composed of a sequence of DTMF tones containing a two-digit command prefix, followed by a series of command parameters, followed by the # key. The commands are executed once the # key is received and the calling party de-keys their radio.

De-keying after each command is necessary so that the repeater can respond to each command with a series if either success or failure tones. A response of four 1500 Hz tones indicates the operation was a success. A response of four 500 Hz tones indicates the operation failed.

The table below is a list of the available tasks followed by their 2-digit command prefix:

Command	Prefix
ENTER REMOTE MODE	N/A
ADD USER	01
DELETE USER	02
ACTIVATE USER	03
DEACTIVATE USER	04
MODIFY USER TX SQUELCH OPTION	05
MODIFY USER RX SQUELCH OPTION	06
MODIFY USER TX DCS POLARITY	07
MODIFY USER RX DCS POLARITY	08
MODIFY USER TX HOLD TIME	09
MODIFY USER TONE IN TAIL	10
MODIFY USER COURTESY TONE	11
MODIFY CHANNEL ID INTERVAL	12
MODIFY CHANNEL MORSE RATE	13
MODIFY CHANNEL TX TIMEOUT	14
MODIFY RX MODULE OUTPUT 1	15
MODIFY RX MODULE OUTPUT 2	16
EXIT WITHOUT SAVE	98
SAVE AND EXIT	99
REBOOT	5555

The following pages contain a description of all the available commands. Throughout the descriptions, [0] through [9] denotes a particular digit that must entered. [N] denotes a single digit that must be entered, the value of which depends on your choice of settings. A [#] key must be entered after each command sequence for the system to process the command.

Please note that for all multi-digit settings, you must enter the required number of digits, using zeroes as placeholders where necessary. For example, if [N][N][N] is required and you want to enter 12, you must enter 012.

ENTER REMOTE MODE:

Field	Digits
1) Remote access PIN	[N] [N] [N] [N]

- The remote access PIN is preprogrammed on a per channel basis. You must know it before you begin.
- Only the System Operator may access remote programming mode.
- The four-digit code "5555" is reserved for the REBOOT command.
- If you have successfully entered remote programming mode, you'll hear three 1500 Hz tones. If you weren't successful, you won't hear any response.

ADD USER:

Field	Digits	Remarks
1) Command	[0] [1]	
2) User Slot	[N] [N]	00 < NN < 63
3) Tone/Code	[N] [N] [N]	001 < NNN < 162

- See "Appendix C" for a table of available tones/codes and their corresponding index.
- If you attempt to add a user to a slot that is already occupied by an existing user (active or not), then this command will fail. You must first delete the existing user and then add a new one if you wish to add a new user in that slot.
- By default, the same tone/code will be used for both the TX and RX squelch options. After adding the user, you can modify the TX and RX squelch options individually by using the MODIFY TX SQUELCH OPTION or MODIFY RX SQUELCH OPTION commands.

DELETE USER:

Field	Digits	Remarks
1) Command	[0] [2]	
2) User Slot	[N] [N]	00 < NN < 63

- This command will delete the user's profile entirely and the slot will be considered empty. If you want to temporarily disable a user while preserving their profile, try using the DEACTIVATE USER command instead.
- You can not delete the user in Slot 0 (System Operator) or Slot 1. These users can only be deleted by using the PGM-540 programmer.

ACTIVATE USER:

Field	Digits	Remarks
1) Command	[0] [3]	
2) User Slot	[N] [N]	00 < NN < 63

- All users are active by default. This command is used only to reactivate a user that has been previously deactivated.

DEACTIVATE USER: Deactivate an active user.

Field	Digits	Remarks
1) Command	[0] [4]	
2) User Slot	[N] [N]	00 < NN < 63

- DEACTIVATE USER is a good alternative to DELETE USER when you want to temporarily prevent a user from accessing the repeater without deleting their profile.

MODIFY USER TX SQUELCH OPTION:

Field	Digits	Remarks
1) Command	[0] [5]	
2) User Slot	[N] [N]	00 < NN < 63
3) Tone/Code	[N] [N] [N]	001 < NN < 162

- CTCSS tones are numbered from 1-50 and DCS codes are numbered from 51-162. See "Appendix C:" for a complete table of available tones/codes and their corresponding index.

MODIFY USER RX SQUELCH OPTION:

Field	Digits	Remarks
1) Command	[0] [6]	
2) User Slot	[N] [N]	00 < NN < 63
3) Tone/Code	[N] [N] [N]	001 < NN < 162

- CTCSS tones are numbered from 1-50 and DCS codes are numbered from 51-162. See "Appendix C" for a complete table of available tones/codes and their corresponding index.

MODIFY USER TX DCS SIGNAL POLARITY:

Field	Digits	Remarks
1) Command	[0] [7]	
2) User Slot	[N] [N]	00 < NN < 63
3) Polarity	[N]	0 = inverted 1 = non-inverted

- This command will fail if the user is not using a DCS Code as the squelch option.

MODIFY USER RX DCS SIGNAL POLARITY:

Field	Digits	Remarks
1) Command	[0] [8]	
2) User Slot	[N] [N]	00 < NN < 63
3) Polarity	[N]	0 = inverted 1 = non-inverted

- This command will fail if the user is not using a DCS Code as the squelch option.

MODIFY USER TX HOLD TIME:

Field	Digits	Remarks
1) Command	[0] [9]	
2) User Slot	[N] [N]	00 < NN < 63
3) Hold Time (ms)	[N]	0000 < NNNN < 9999

- TX Hold Time, measured in milliseconds, determines how long the repeater will continue transmitting after the user has de-keyed.

MODIFY USER TONE IN TAIL:

Field	Digits	Remarks
1) Command	[1] [0]	
2) User Slot	[N] [N]	00 < NN < 63
3) Tone in Tail	[N]	0 = No 1 = Yes

- The Tone in Tail setting determines whether or not the user's CTCSS tone or DCS code is transmitted during the hold time.
- Tone in Tail only has meaning if the TX Hold Time is greater than zero. Although the command won't fail, Tone in Tail has no meaning if the TX Hold Time is set to zero.

MODIFY USER COURTESY TONE:

Field	Digits	Remarks
1) Command	[1] [1]	
2) User Slot	[N] [N]	00 < NN < 63
3) Courtesy Tone	[N]	0 = None 1 = 500 Hz 2 = 1000 Hz 3 = 1500 Hz

- The courtesy tone sounds for 75 milliseconds, after the user de-keys but before the hold time begins.

MODIFY CHANNEL ID INTERVAL:

Field	Digits	Remarks
1) Command	[1] [2]	
2) Interval (minutes)	[N] [N] [N]	000 < NNN < 999

- If you set the broadcast interval to zero, this feature will be disabled.
- The ID will be broadcast if and only if the repeater was in use during the most recent interval.

MODIFY CHANNEL MORSE RATE:

Field	Digits	Remarks
1) Command	[1] [3]	
2) Rate	[N]	0 = 11 WPM 1 = 22 WPM

MODIFY CHANNEL TX TIMEOUT:

Field	Digits	Remarks
1) Command	[1] [4]	
2) Timer (seconds)	[N] [N] [N]	000 < NNN < 999

- If you set the TX Timeout to zero, this feature will be disabled.
- The TX Timeout timer controls the maximum amount of timer that the transmitter will remain keyed.
- This feature is useful to prevent a radio with a "stuck mic" from keeping the repeater transmitted keyed.

MODIFY RX MODULE OUTPUT 1:

Field	Digits	Remarks
1) Command	[1] [5]	
2) Pin Setting	[N]	0-Low 1-High

- This command sets or clears the state of the Output pin 16 on the accessory connector.

MODIFY RX MODULE OUTPUT 2:

Field	Digits	Remarks
1) Command	[1] [6]	
2) Pin Setting	[N]	0-Low 1-High

- This command sets or clears the state of the Output pin 17 on the accessory connector.

EXIT WITHOUT SAVE:

Field	Digits
1) Command	[9] [8]

- Upon exit, the repeater will transmit the exit remote mode alert, which is three consecutive 600 Hz tones.

SAVE AND EXIT:

Field	Digits
1) Command	[9] [9]

- After this command is received, the repeater will begin transmitting a series of tones as it updates its internal memory.
- Upon exit, the repeater will transmit the exit remote mode alert, which is three consecutive 600 Hz tones.

REBOOT:

Field	Digits
1) Command	[5] [5] [5] [5]

- This command remotely reboots the CS-540 as if someone had manually toggled the power switch. Although the CS-540 has been designed to be as robust as possible, this command can save a trip to the site in the rare case that the CS-540 fails to repeat calls or otherwise becomes unresponsive.
- You don't need to be in remote programming mode to issue the reboot command. It can be used at any time. Also, valid signaling is not required to issue a remote reboot command.
- It is not necessary to reboot the CS-540 after making changes using remote programming commands. If you ever do need to remotely reboot, it should only be to relieve an immediate problem.
- This command will not be followed by any type of success or failure alert. After using this command, wait 20-30 seconds for the CS-540 to reset and then try using it again.

Example 1: Add a new user and modify the user's profile

Before you begin these examples, make sure that you have a two-way radio capable of transmitting DTMF tones, and that this radio is set up to transmit the CTCSS tone / DCS code assigned to the user in Slot 0, the System Operator. Because the System Operator's calls are not repeated, the easiest way to confirm that the System Operator can access the repeater is to have the System Operator press the PTT (push-to-talk) button on their radio. Visually confirm that the repeater's LCD displays the System Operator's ID, which is by default "SYS-OP".

In this example, we will add a user to slot #30 with a DCS code of 223 and then modify its profile's hang time and courtesy tone. If Slot #30 is already occupied on your system, go through this examples using another slot that is empty.

1) Enter remote programming mode

With the repeater turned on and in an idle state, the System Operator should push-to-talk, enter the remote access PIN, press the '#' key, and then release the PTT button. The repeater should respond with the "remote mode entered" alert, which is a series of three 1500 Hz tones.

2) Add a user to slot #30 with DCS code 223

To add a user, we need to enter the ADD USER command prefix, the slot number, and the tone/code index. The ADD USER command has a prefix of 01. We want to add the user to slot #30. From the table in Appendix C, "CTCSS Tone / DCS Code tables", we can see that that DCS code 223 corresponds has an index of 094.

In order to add a user, we need to enter the following sequence (without the dashes):

```
[0][1]-[3][0]-[0][9][4]-[#]
```

Upon dekey, the repeater should respond with a success alert, which is a series of four 1500Hz tones. If it failed, you'll hear a failure alert, which is a series of four 500Hz tones. If this process fails, then possible causes for this failure include: Slot #30 is already occupied, DCS code 223 is already being used by another user, or the command was entered incorrectly.

3) Turn on tone-in-tail in the user's newly created profile

To turn on a user's tone-in-tail, we need to enter the MODIFY USER TONE IN TAIL command prefix, the user's slot number, and the tone-in-tail preference. The MODIFY USER TONE IN TAIL prefix is 10. We are modifying the user in Slot #30. Because we want tone-in-tail to be on, we need to set the tone-in-tail preference to 1.

In order to turn on tone-in-tail, enter the following sequence (without the dashes):

```
[1][0]-[3][0]-[1]-[#]
```

Once you dekey, you should hear the success alert (four 1500 Hz tones.)

4) Set the user's TX hold time to three seconds

To modify the TX hold time, we need to enter the MODIFY USER TX HOLD TIME command prefix, the user's slot number, and the number of milliseconds of the TX hold time. The MODIFY USER TX HOLD TIME prefix is 09. We are modifying the user in Slot #30. We want to set the TX hold time to 3 seconds, which is 3,000 milliseconds.

In order to set the TX hold time to three seconds, enter the following sequence (without the dashes):

```
[0][9]-[3][0]-[3][0][0][0]-[#]
```

Once you dekey, you should hear the success alert (four 1500 Hz tones.)

5) Add a courtesy tone of 1000 Hz to the new user's profile

To modify the courtesy tone preference, we need to enter the MODIFY USER COURTESY TONE command prefix, the user's slot number, and the index of courtesy tone that we would like to select. The MODIFY USER COURTESY TONE prefix is 11, the user's slot number is 30, the index of the 1000 Hz courtesy tone is 2.

In order to add a courtesy tone of 1000 Hz, enter the following sequence (without the dashes):

```
[1][1]-[3][0]-[2]-[#]
```

Once you dekey, you should hear the success alert (four 1500 Hz tones.)

6) Save and exit

When you finish making all the above changes, you need to save and exit remote programming mode. To store the settings of the new user, all you need to do is enter the SAVE AND EXIT command prefix. The SAVE AND EXIT prefix is 99.

In order to save and exit, enter the following sequence (without the dashes):

```
[9][9]-[#]
```

The repeater will respond with a series of tones as it updates followed by a remote mode exited alert, which is a series of three 600Hz tones.

Example 2: Deactivate an existing user

In this example, we will deactivate an existing user.

1) Enter remote programming mode

With the repeater turned on and in an idle state, the System Operator should push-to-talk, enter the remote access PIN, press the '#' key, and then release the PTT button. The repeater should respond with the "remote mode entered" alert, which is a series of three 1500 Hz tones.

2) Deactivate the user in slot #30

To deactivate a user, we need to enter the DEACTIVATE USER command prefix and the user's slot number. The DEACTIVATE USER prefix is 04 and the user's slot number is 30.

In order to deactivate the user in slot #30, enter the following sequence (without the dashes):

```
[0][4]-[3][0]-[#]
```

Once you dekey, you should hear the success alert (four 1500 Hz tones.)

Upon de-key, the repeater will respond with an OPERATION SUCCESS ALERT.

3) Save and exit

When you finish deactivating the user, you need to save and exit remote programming mode. To store the changes, you need to enter the SAVE AND EXIT command prefix. The SAVE AND EXIT prefix is 99.

In order to save and exit, enter the following sequence (without the dashes):

```
[9][9]-[#]
```

The repeater will respond with a series of tones as it updates followed by a remote mode exited alert, which is a series of three 600Hz tones.

At this point, the user in slot 30 will be deactivated. Attempts to access the repeater with code/tones in slot 30 will be ignored by the repeater. To reactivate the user, go through same exact procedure above, except that you need to use the ACTIVATE USER command prefix of 03 rather than the DEACTIVATE USER prefix.

CHAPTER 9: ALIGNMENT

Overview

The CS-540 is designed to operate in a wide range of the RF spectrum and the repeater is factory aligned to work at any frequency within that spectrum. However, because the repeater operates on a single transmit frequency at a time, you will likely want to optimize performance for that frequency. The CS-540 is equipped with the ability to fine-tune the repeater's operation at a specific transmit frequency.

If you ordered the CS-540 with custom programming, then it should already be aligned to operate at its programmed frequency. If you ordered the CS-540 without custom programming, then it is advised that you follow the alignment procedures in this section. In addition, anytime you change the transmit frequency for any channel, it is necessary to fine-tune the alignment for that channel.

NOTE: Since the CS-540 is a multi-channel repeater with the capability to operate at a different frequency on each channel, you will need to align each channel individually.

Parameters

During the alignment process, you will have the opportunity to fine-tune all of the listed parameters below. The heading of each bullet (all caps in bold) is the abbreviated name of the parameter that you will see in the CS-540's display during the alignment process.

- **DEFAULT:** Allows for restoring factory defaults for all parameters listed below.
- **AL-GAIN:** This parameter controls the received audio gain. You need to adjust this parameter to attain optimum audio deviation for the given channel spacing (12.5 kHz or 25 kHz). AL-GAIN ranges from -4.0dB to 3.5dB in 0.5 dB steps, for a total of sixteen possible settings.
- **AL-AMP:** This parameter controls the gain before limiter. It used in conjunction with AL-GAIN to attain optimum audio deviation for the given channel spacing (12.5 kHz or 25 kHz). AL-AMP ranges from 0.0 dB to 35 dB, with roughly 3.3-3.4 dB steps above 15 dB. There are eight possible settings, including 0.0 dB, 15.0 dB, 18.3 dB, 21.7 dB, 25.0 dB, 28.3 dB, 31.7 dB, and 35.0 dB.
- **SUB DEV:** This parameter controls the deviation level of the transmitted sub audible tone/code.
- **TX-DEV:** This parameter controls the overall TX deviation. It is highly recommended that prior to adjusting this setting, AL-GAIN, AL-AMP, and SUB DEV have already been tuned. When adjusting this setting, be mindful of the FCC regulations for the selected channel spacing so as not to over deviate.
- **TX FREQ:** This parameter controls the temperature-controlled crystal oscillator (TCXO) voltage. The TCXO is adjusted at the factory to work across the repeater's RF operating range. You can adjust the TX FREQ parameter to fine-tune the TCXO voltage for the selected frequency.
- **TX PWR:** This parameter controls the power level. It is used in conjunction with the factory aligned settings for low and high power to achieve the desired power level at the selected transmit frequency.

Restoring Factory Default Alignment

To restore the factory default alignment settings, perform the following procedure:

- 1) In repeater mode on the selected channel you wish to restore, press and hold the AUX button for approximately two seconds. The word DEFAULT is displayed and the TX LED is illuminated. Note: No RF power is emitted.
- 2) Press and release the UP or DOWN button. This restores the factory defaults. The CS-540 responds by displaying DONE.
- 3) To exit, press and release the AUX button again. The selected channel's name is displayed for approximately two seconds and then a series of dashes is displayed.

It should be noted the receiver is already factory aligned to open squelch at 12dB SINAD and close at 8dB SINAD.

Fine-tuning Transmitter Alignment

In order to fine-tune the transmitter alignment, you'll need to find the optimal value of each of the six parameters listed on the previous page. For this process, you'll need a VHF/UHF service monitor capable of duplex operation. Follow the steps below:

1) Start the alignment procedure

Once the repeater has powered up and it is on the selected channel that you wish to fine tune, press and hold the AUX button for approximately two seconds. The LCD will display DEFAULT and the TX LED will be illuminated. Press and release the BASE button. AL-GAIN will be displayed. To cycle through the available alignment parameters, press the BASE button repeatedly.

2) Set up the service monitor

Set the service monitor to duplex mode. For 25 kHz channel spacing (wide band), generate a 1 kHz tone at 3 kHz deviation on the receive frequency. For 12.5 kHz channel spacing (narrow band) generate a 1 kHz tone at 2 kHz deviation on the receive frequency. The signal strength of the tone should be a reasonable level for the receiver to pick-up. With sufficient carrier, the yellow RX LED will illuminate.

3) Adjust the TX-FREQ parameter

Select TX FREQ in the alignment menu. With the receiver quiet, place the service monitor on the transmit frequency. Adjust the TCXO voltage by pressing the up and down buttons to the point where the transmitter is on frequency as close as possible.

4) Adjust the AL-GAIN and AL-AMP parameters

Select the AL-GAIN and AL-AMP parameters by cycling through the available alignment parameters as described in Step 1 above. Adjust the AL-GAIN and AL-AMP parameters by pressing the up (▲) and down (▼) buttons on the keypad. Adjust these parameters for the best sounding level. The effect of stepping through these settings is to be observed on the service monitor.

The CS-540's built-in limiter will keep the transmitter from overdeviating by more than 5 kHz for 25 kHz channel spacing (wide band) and by more than 2.5 kHz for 12.5 kHz channel spacing (narrow band).

5) Adjust the SUB DEV parameter

Select the SUB DEV parameter in the alignment menu. Using the service monitor in duplex mode, send to the receiver a full-quieting signal with a tone or code the repeater is programmed to decode. Once the repeater has decoded the sub audible signal, the transmitter will begin sending the programmed tone or code. Using the service monitor's deviation meter, adjust the sub-audible deviation by pressing-and-releasing the UP (▲) and DOWN (▼) buttons to achieve the desired level.

6) Adjust the TX-DEV parameter

Select the TX-DEV parameter. Inject a 1 kHz tone at 3 kHz deviation along with the programmed sub-audible tone or code. Once the repeater has decoded the sub-audible and the transmitter is engaged, use the service monitor's deviation meter to adjust the over-all transmit deviation level. Once the desired level is achieved, it is recommended you test the settings by using a hand portable or mobile to communicate through the repeater. If necessary, repeat the above steps to achieve the best performance.

7) Adjust the TX-PWR parameter

Select TX PWR in the alignment menu. With the receiver quiet, press-and-release either the up or down button to engage the RF power amp. Using the service monitor, observe the output power level. The transmit power level is factory set for a low power of 5W and a high power of 40W. Depending on whether the CS-540 was programmed for low power or high power, this setting should be around 5W or 40W respectfully. Adjust the power to the level required by simply pressing-and-releasing the up or down buttons until the desired output power level is achieved. The RF Power Amp is disengaged when the AUX button is pressed.

8) Exit

Pressing the AUX button will exit the alignment mode and restore the CS-540 to repeater mode. The new settings should be tested to the satisfaction of the system operator.

CHAPTER 10: Keypad Lock

Overview

Many of the operations such as alignment and channel change are carried out using the front panel's keypad, therefore the CS-540 incorporates a simple keypad lock to prevent unwanted manipulation of the CS-540's settings during operation at the site. The keypad can be locked and unlocked in any one of the three operating modes. While not a sophisticated lock, it can prevent someone who is not aware of the CS-540's operation from tampering with the unit's settings.

Procedure

To lock the keypad, simply turn the volume control knob all the way counter clockwise and press-and-release the MON button. The LOCK icon will be displayed on the LCD. The keypad is now locked and the UP, DOWN, BASE, and AUX buttons are disabled. If not already on, the monitor feature may now be enabled by pressing-and-releasing the MON button again. To unlock the keypad, turn the volume control knob all the way clockwise and press-and-release the MON button. The LOCK icon will disappear and the keypad is now unlocked. The monitor feature now works as normal. The locking and unlocking of the keypad can only be done when the MON button is pressed when the volume control knob is at one its two extremes.

Chapter 11: Duplexer Installation

Overview

The CS-540 is designed to allow the installation of an optional internal duplexer. Because of the sensitive nature of the internal components of the CS-540, we highly recommended that a skilled technician performs this procedure.

Procedure

Follow the steps below to install an internal duplexer:

- 1) Disconnect the detachable AC cord from the CS-540. Power must not be applied during duplexer installation.
- 2) Using a Philips screwdriver, remove the nine screws affixing the chassis top to the bottom chassis. Using a 7/64" Allen wrench, remove the one socket head screw affixing the top of the chassis to the front panel.
- 3) Carefully pull the chassis top off the chassis bottom and set the chassis top aside.
- 4) Looking inside the chassis bottom and to the rear, remove the screws connecting each panel mount N connector from the rear of the chassis.
- 5) Using the screws from the RX/TX module's N connectors, connect the panel mount N connector of the antenna cable provided in the duplexer installation kit (BridgeCom Part #:08-01-001) to the duplexer out port on the rear of the chassis.
- 6) Pick up the chassis top. Using the four screws and nuts provided in the duplexer installation kit, attach the duplexer to the chassis top as shown in *Figure 11-1* on the next page. Make sure the nuts are located on the duplexer side of the chassis and the screw heads are located on the topside of the chassis top.
- 7) Attach an N-type male to BNC Male adapter to the receiver and transmitter ports of the duplexer.
- 8) Referencing *Figure 11-1*, connect the RX Module cable to the Receiver input and TX module cable to the transmitter input of the duplexer.
- 9) Connect the BNC-male end of the recently installed cable to the antenna port of the duplexer.
- 10) Replace the chassis top carefully back on the chassis bottom with the duplexer being enclosed inside the chassis.
- 11) Line up the holes of the chassis top with the chassis bottom. Connect the one socket-head screw from the front panel to the chassis top and place one screw in the middle of the chassis rear.
- 12) Screw-in the remaining screws. Duplexer installation is now complete.

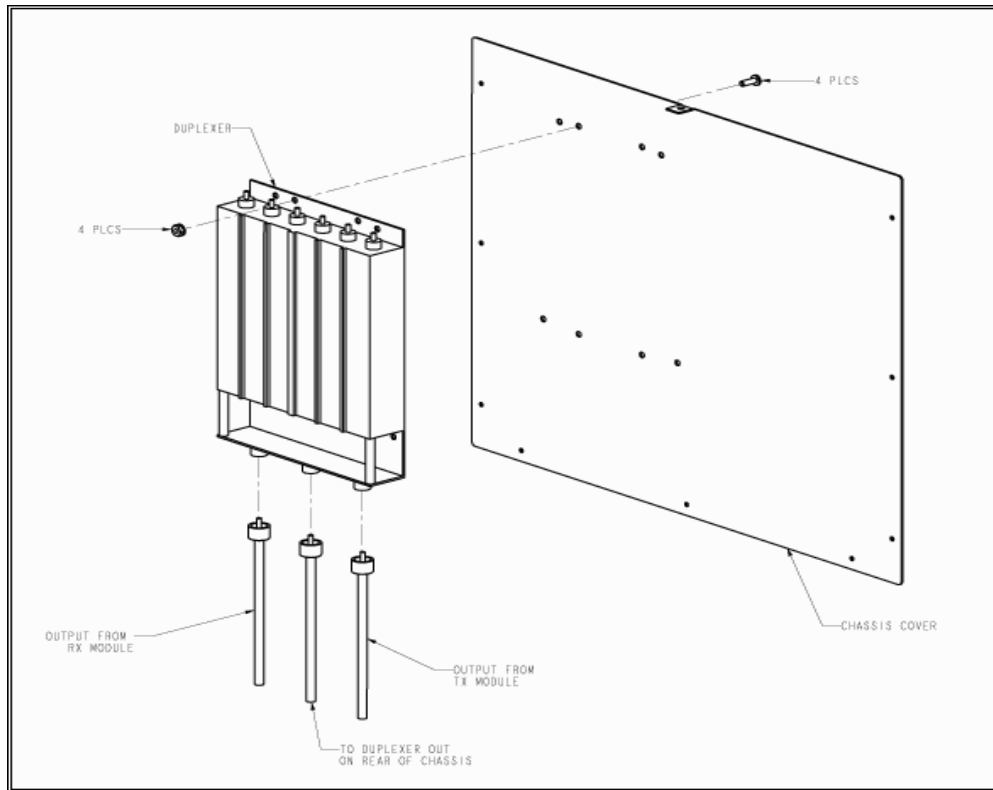


Figure 11-1: Duplexer Installation – UHF Version Shown

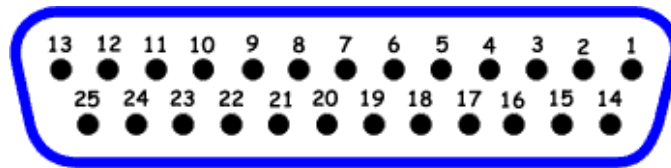
Chapter 12: Battery Backup/External DC In

OVERVIEW

The CS-540 can be battery backed-up by connecting a 12 Volt deep cycle battery to the battery backup/Ext DC In terminals. If the AC Line fails, the internal relay will switch to where the battery can power the unit. When AC power is restored, the internal relay takes the battery out of the circuit and switches to the internal power supply. For convenience, the CS-540 provides a maintenance charge to keep the battery at its optimum level. The internal charging circuit can comfortably provide a charge current up to 1.3 Amps to the battery. As the battery reaches full charge, the charging circuit provides a maintenance charge of around 200 mA. For virtually maintenance free operation, it is recommended that a GEL CELL type deep cycle battery be used.

If it is desired for the CS-540 to be powered from a vehicle or an external 12-13.8V supply, this can be done by connecting the external source to the CS-540's Battery/Ext DC terminals. When the CS-540 is being powered by an external source other than a battery, **DO NOT** turn on the internal power supply. If an external power supply other than a battery is connected and the internal supply is turned on, the internal supply will attempt to 'charge' the external supply, which could damage the external supply. The internal blocking diode protects the internal power supply from receiving any unwanted voltages or currents from the external supply or battery.

APPENDIX A: ACCESSORY CONNECTOR DESCRIPTION



DB-25 Female

PIN #	Description
1	13.8 Volts out (1A max)
2	Communications Bus – BUSY
3	Communications Bus – DATA
4	
5	
6	
7	
8	Discriminator Out – Demodulated received audio
9	
10	RSSI – Received Signal Strength Indicator
11	CrossBand Discriminator Out – X-Band Repeater
12	
13	
14	Rx Module – General Purpose Input 1
15	Rx Module – General Purpose Input 2
16	Rx Module – General Purpose I/O 1 – Fan2/Fan3 Control
17	Rx Module – General Purpose I/O 2 – COS Output
18	
19	TX Audio Input
20	External PTT Input
21	TX Subaudible Data or BROADBAND/Composite Input
22	TX Module – General Purpose Input 1
23	Tx Module – Fan2/Fan1 Control
24	Tx Module – General Purpose I/O 2
25	GND

APPENDIX B: REMOTE PROGRAMMING QUICK REFERENCE

Each command below must be followed the '#' symbol to execute. After you press '#' and dekey, you'll hear either a success alert (four 1500 Hz tones) or a failure alert (four 500 Hz tones.) When you save and exit, you'll hear a series of tones then three 600 Hz tones to let you know it exited remote programming.

ENTER REMOTE MODE:			EXIT WITHOUT SAVE:		
1) Remote access PIN	[N] [N] [N] [N]		1) Command Prefix	[9] [8]	
ADD USER:			SAVE AND EXIT:		
1) Command Prefix	[0] [1]		1) Command Prefix	[9] [9]	
2) User Slot	[N] [N]	00 < NN < 63	REBOOT:		
3) Tone/Code	[N] [N] [N]	001 < NNN < 162	1) Command Prefix	[5] [5] [5] [5]	
DELETE USER:					
1) Command Prefix	[0] [2]				
2) User Slot	[N] [N]	00 < NN < 63			
ACTIVATE USER:					
1) Command Prefix	[0] [3]				
2) User Slot	[N] [N]	00 < NN < 63			
DEACTIVATE USER:					
1) Command Prefix	[0] [4]				
2) User Slot	[N] [N]	00 < NN < 63			
MODIFY USER TX SQUELCH OPTION:					
1) Command Prefix	[0] [5]				
2) User Slot	[N] [N]	00 < NN < 63			
3) Tone/Code	[N] [N] [N]	001 < NN < 162			
MODIFY USER RX SQUELCH OPTION:					
1) Command Prefix	[0] [6]				
2) User Slot	[N] [N]	00 < NN < 63			
3) Tone/Code	[N] [N] [N]	001 < NN < 162			
MODIFY USER TX DCS SIGNAL POLARITY:					
1) Command Prefix	[0] [7]				
2) User Slot	[N] [N]	00 < NN < 63			
3) Polarity	[N]	0 = inv; 1 = non			
MODIFY USER RX DCS SIGNAL POLARITY:					
1) Command Prefix	[0] [8]				
2) User Slot	[N] [N]	00 < NN < 63			
3) Polarity	[N]	0 = inv; 1 = non			
MODIFY USER TX HOLD TIME:					
1) Command Prefix	[0] [9]				
2) User Slot	[N] [N]	00 < NN < 63			
3) Hold Time (ms)	[N] [N] [N] [N]	0000 < NNNN < 9999			
MODIFY USER TONE IN TAIL:					
1) Command Prefix	[1] [0]				
2) User Slot	[N] [N]	00 < NN < 63			
3) Tone in Tail	[N]	0 = No / 1 = Yes			
MODIFY USER COURTESY TONE:					
1) Command Prefix	[1] [1]				
2) User Slot	[N] [N]	00 < NN < 63			
3) Courtesy Tone (Hz)	[N]	0 = None, 1 = 500, 2 = 1000, 3 = 1500			
MODIFY CHANNEL ID INTERVAL:					
1) Command Prefix	[1] [2]				
2) Interval (minutes)	[N] [N] [N]	000 < NNN < 999			
MODIFY CHANNEL MORSE RATE:					
1) Command Prefix	[1] [3]				
2) Rate	[N]	0 = 11 WPM, 1 = 22 WPM			
MODIFY CHANNEL TX TIMEOUT:					
1) Command Prefix	[1] [4]				
2) Timer (seconds)	[N] [N] [N]	000 < NNN < 999			
MODIFY RX MODULE OUTPUT 1:					
1) Command Prefix	[1] [5]				
2) Position	[N]	0-Low 1-High			
MODIFY RX MODULE OUTPUT 2:					
1) Command Prefix	[1] [6]				
2) Position	[N]	0-Low 1-High			

APPENDIX C: TONE/CODE TABLES

CTCSS Tones

Index	Tone	Index	Tone	Index	Tone	Index	Tone	Index	Tone
001	254.1	011	199.5	021	167.9	031	127.3	041	91.5
002	250.3	012	196.6	022	165.5	032	123.0	042	88.5
003	241.8	013	192.8	023	162.2	033	118.8	043	85.4
004	233.6	014	189.9	024	159.8	034	114.8	044	82.5
005	229.1	015	186.2	025	156.7	035	110.9	045	79.7
006	225.7	016	183.5	026	151.4	036	107.2	046	77.0
007	218.1	017	179.9	027	146.2	037	103.5	047	74.4
008	210.7	018	177.3	028	141.3	038	100.0	048	71.9
009	206.5	019	173.8	029	136.5	039	97.4	049	69.4
010	203.5	020	171.3	030	131.8	040	94.8	050	67.0

DCS Codes

Index	Code	Index	Code	Index	Code	Index	Code	Index	Code
051	006	074	115	097	243	120	364	143	532
052	007	075	116	098	244	121	365	144	546
053	015	076	122	099	245	122	371	145	565
054	017	077	125	100	246	123	411	146	606
055	021	078	131	101	251	124	412	147	612
056	023	079	132	102	252	125	413	148	624
057	025	080	134	103	255	126	423	149	627
058	026	081	141	104	261	127	431	150	631
059	031	082	143	105	263	128	432	151	632
060	032	083	145	106	265	129	445	152	654
061	036	084	152	107	266	130	446	153	662
062	043	085	155	108	271	131	452	154	664
063	047	086	156	109	274	132	454	155	703
064	050	087	162	110	306	133	455	156	712
065	051	088	165	111	311	134	462	157	723
066	053	089	172	112	315	135	464	158	731
067	054	090	174	113	325	136	465	159	732
068	065	091	205	114	331	137	466	160	734
069	071	092	212	115	332	138	503	161	743
070	072	093	214	116	343	139	506	162	754
071	073	094	223	117	346	140	516		
072	074	095	225	118	351	141	523		
073	114	096	226	119	356	142	526		

APPENDIX D: REPEATER SYSTEM RECORD SHEET

NAME:			
RX Freq:	TX Freq:	Spacing:	Power:
Broadcast ID:	Interval (mins):	Rate (WPM):	
Remote PIN:		Stuck Mic Timeout (secs):	

Slot	User ID	RX Option	TX Option	Courtesy	Hold Time	Tone In Tail
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

Slot	User ID	RX Option	TX Option	Courtesy	Hold Time	Tone In Tail
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
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52						
53						
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61						
62						
63						

Appendix E: 120V AC ~ 240V AC Conversion

It is recommended the following service be performed by a qualified service technician.

To convert the CS-540 to 240V AC, follow these steps:

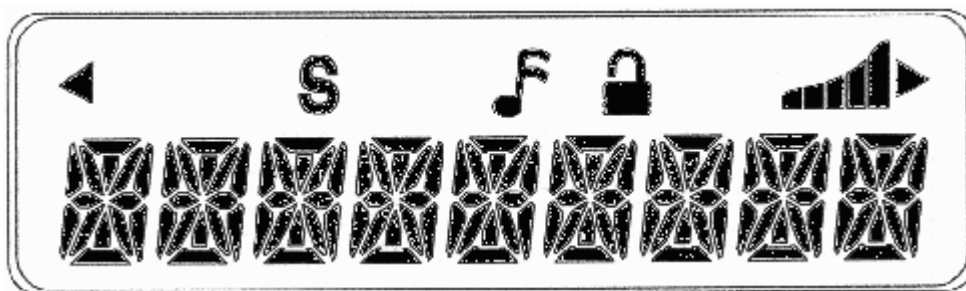
1. **Make sure the unit is unplugged from the AC outlet.**
2. Remove the top chassis piece by unscrewing the nine screws and one socket head screw from the front panel.
3. Locate the power supply in the upper left corner of chassis.
4. Remove the jumper cable connecting D and E located on the circuit board. To remove the jumper, unplug both ends of the cable.
5. Replace chassis top.

APPENDIX F: Frequently Asked Questions

1. **Q: I've programmed the repeater for 40 Watts, why is it only transmitting 5 Watts?**
A: Restore factory defaults for that channel. See restoring factory defaults section in the Alignment Chapter 9.
2. **Q: The repeater indicates it's transmitting, yet I'm not getting any power out and the fan is not turning on. What's wrong?**
A: You may have the RF PA turned off. If this is the case there should be an arrow icon illuminated in the upper right corner of the display. To turn the RF PA back on, go to AUX mode and press-and-release the DOWN button. This will toggle the RF PA setting.
3. **Q: I've programmed the repeater's channel information, and it's not repeating the audio. What's wrong?**
A: Restore factory defaults for the channel. See restoring factory defaults section in the Alignment Chapter 9. Also, did you place the user information in question in Slot 0? If so, this slot is reserved for the system operator to manage the repeater and calls on this slot will not be repeated. Therefore place all users of the system in slots other than 0.
4. **Q: How do I reduce/increase the Transmit tone/code deviation and reduce/increase the overall transmit Deviation?**
A: While repeating a call, press and hold the AUX button to go to the alignment menu. Select the Sub Dev option. Using your service monitor, adjust the sub deviation to your liking by pressing the up/down buttons. You may now want to adjust your TX Deviation. This is done by selecting the TX Dev menu option. Press-and-release the up/down buttons to adjust the TX Deviation level to your liking. It may be the repeater will stop transmitting during this procedure. This is due to the TX Timeout Timer expiring. See Alignment Chapter 9 for more information.
5. **Q: The repeater is transmitting off frequency slightly. How do I fine tune?**
A: Go to the alignment menu and select TX Freq. Adjust the TCXO voltage by pressing the up/down buttons to get the repeater dead-on frequency. See Alignment Chapter 9 for exact procedure.
For all other questions, email BridgeCom Systems: TechSupport@BrideComSystems.com.

APPENDIX G: LCD Quick Reference Sheet

The following is a quick description of what all the icons on the display mean and how to change their settings.



Left Arrow – This arrow indicates the composite input to the transmitter is enabled. The composite input allows for DC coupled broadband audio to be transmitted. To toggle this setting, from AUX mode press and hold the base button for approximately two seconds.



S - Icon indicates the external audio PA is enabled. To toggle this setting, press the MON button.



The Note Icon indicates the front panel speaker is enabled. To toggle this setting, press the MON button.



The lock icon indicates the keypad lock is enabled. To disable the keypad lock, rotate the volume control all the way clockwise and then press the MON button. To enable the keypad lock, rotate the volume control all the way counter clockwise and press the MON button.



Volume control – these bars indicate the volume level. Rotate the volume control knob to change the volume settings.



Right Arrow – This arrow indicates the RF PA is disabled. To toggle this setting you must be in AUX mode. Press and hold the DOWN button for approximately two seconds.

WARRANTY AND SERVICE

Limited Warranty

This product is warranted by BridgeCom Systems, Inc. to be free of defects in materials and workmanship for a period of **two years** from the date of purchase. If a defective part causes this product to operate improperly during the two-year warranty period, we will service it to the original owner free of charge if shipped to BridgeCom Systems at the owner's expense. This warranty does not apply to any parts damaged due to improper use or violation of instructions. It does not extend to damage incurred by misuse or abuse, unauthorized modifications, natural causes such as lightning, fire, floods, and other such catastrophes; nor to damage caused by environmental extremes, such as power surges and/or transients, theft, or accidents.

All warranties must be performed at BridgeCom Systems, Inc. No credit will be given for unauthorized repair work attempted by the customer.

BridgeCom Systems, Inc. will repair or replace the equipment and return to the customer freight pre-paid, within the continental United States. Equipment found not to be defective will be returned at the customer's expense, and it will include the cost to ship, test, and return the equipment.

Equipment returned for repair must have a return merchandise authorization (RMA) number. To obtain an RMA contact our Technical Support Department at (816)-532-8451 or email techsupport@BridgeComSystems.com. All returned equipment must have the RMA number listed on the outside of the shipping container.

Ship all returns to BridgeCom Systems, Inc. 617 Liberty Rd. Smithville, MO 64089 Attn:Repair

Out of warranty repairs and service charges are billed at the current hourly rate plus parts.

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FCC Statements

Warning and Compliance Statement:

Note: The ComLink CS-540V and CS-540U has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: --Reorient or relocate the receiving antenna. --Increase the separation between the equipment and receiver. --Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. --Consult the dealer or an experienced radio/TV technician for help.

Caution:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.