NCS-C250E
INSTRUCTION MANUAL

Rev L

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co‖comm inc

Revision History			
Rev	**Description**	**Date**	**Approved**
A		9/8/04	CIF
B		01/21/05	CIF
C	Add TOC. General Cleanup	06/06/05	CIF
D	ECO-C250MANUAL-001	08/08/05	CIF
E	Combine Option Manual	10/15/05	CIF
F	Add S/N, VOX/COR ID, MIC INFO	10/14/06	CIF
G	Change Default Shunts	06/22/07	CIF
H	Change to B model, impedance jumper clarification.	10/23/08	CIF
I	Change to C model.	08/01/09	CIF
J	Corrected Missing Tables	09/14/10	CIF
K	Updated for Rev D units	02/27/13	CIF
L	Update for Rev E units	10/29/13	JFP

FACTORY INSTALLED OPTION IDENTIFICATION TABLE

The Serial Number Label located on the bottom of the unit indicates which Options are installed according to the following chart:

Option	Multicast	Sidetone
M0		
M1	X	
M2		X
M3	X	X

UNIT CONFIGURATION

Model Number:

NCS-C250EM0   **NCS-C250EM1**   **NCS-C250EM2**   **NCS-C250EM3**

☐   ☐   ☐   ☐

Serial Number: _____

Microphone Configuration

If a microphone was ordered with this unit, it has been factory setup for the supplied microphone identified below.
(To change microphone setup, see page 8; otherwise it is configured for DEFAULT.)

NCS-E217   **NCS-E219**   **NCS-E302**   **NCS-E303**

☐   ☐   ☐   ☐

NCS-E305   **NCS-E326**   **NCS-E411**   **Other: _____**

☐   ☐   ☐   ☐

Audio Busy Detection Mode

Unless specified, the unit comes from the factory with each RAD Port (RAD1 – RAD4) configured for COR. The following ports checked below have been set for VOX:

RAD1   **RAD2**   **RAD3**   **RAD4**

☐   ☐   ☐   ☐

Table of Contents

1.0 Introduction

The C250E provides a method of switching one microphone or headset and two speakers to multiple radios.

Nearly any dynamic or electret microphone can be used with the C250E. Pin assignments, impedance, level, and electret mic element voltage (phantom voltage) are jumper selectable.

Separate speaker outputs are provided for Selected and Unselected audio with individual volume controls and mute functions.

A high power PA speaker output and a voice-operated cross-band repeater/range extender support out-of-vehicle operation.
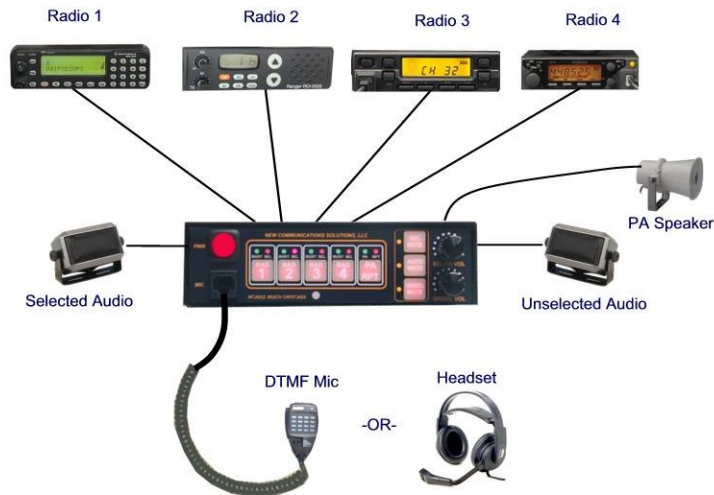
TYPICAL APPLICATION

2.0 Safety Information

The C250E is an electrical device requiring appropriate safety measures during installation and operation. The following safety precautions should be observed:

- When connecting the unit to a DC power source, a minimum wire size of 18 AWG should be used. When using in a mobile environment, automotive grade wire should be used.

- Do not route cables or wires through areas that may cause the insulation to be worn resulting in shorting of the wires to ground or to each other.

- Do not place your ears in close proximity to the local speakers or PA speaker at high volume settings. Your hearing could be impaired as a result.

- Do not attempt to operate this equipment while driving a vehicle. For safety, pull over to the side of the road when making adjustments.

- **NEVER** connect this device to an AC voltage source. Death or injury could occur and/or the unit can be badly damaged. Connect this device only to a DC power source with a voltage output of 12-15 volts and a current capability of at least 2A.

3.0 Accessory Kit & Mounting Bracket

An Accessory Kit and a Mounting Bracket are packed with the C250E. The following items are included in the Kit:

Item	Qty	Description
Power Cable, DC	1	10 foot cable for connecting C250E to DC power source.
Kit, Speaker Connector	1	Consists of 1 Plug Housing and 10 each contacts for 18-22 AWG and 22-26 AWG speaker wire.
Shunts, Black	10	Used to program the microphone pins.
Mounting Feet	4	Used for table-top installation.
Clamp, Power Connector	1	Used to clamp the C250E power pigtail connector to the DC Power Cable.
Knobs, Mounting Bracket	2	Used to attach Mounting Bracket to NCS-C250E

The Mounting Bracket can be used to mount the NCS-C250E to a flat surface. The Bracket may be mounted such that it is oriented on the topside or bottom-side of the NCS-C250E.

4.0 Front Panel Controls
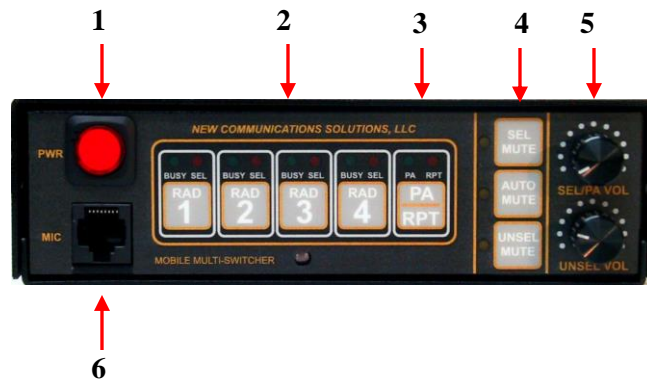
Item	Description
1	Power Switch with Red LED Indicator- Latching
2	Radio Select Switches with Red Selected and Green Busy Indicators, Momentary
3	PA/Repeater selection switch with Red RPT and Green PA Indicators, Momentary
4	Mute Function Switches with Yellow Indicators, Momentary
5	Volume Controls for Selected Audio and PA (SEL/PA) and Unselected Audio (UNSEL)
6	Front Panel Microphone Jack , RJ45 Modular

5.0 Radio, Speaker and Microphone Requirements

5.1 Radio

5.1.1 Receive Audio
Receive Audio input levels from the radio should be from 200mVp-p to 500mVp-p. The Busy lights activate at approximately 150mV. Receive audio input levels are normally adjusted using the Volume Controls on the radios.

CAUTION: When using radios with bridged audio speaker outputs, connect only one of the speaker output lines to the C250E. Leave the other speaker output line disconnected and preferably insulated with shrink tubing. The receive audio return path is via the ground connection between the radio and the C250E.

5.1.2 Transmit Audio
Transmit audio levels are separately adjustable for each radio and sufficient gain is available to drive nearly any radio.

5.1.3 <u>PTT</u>

PTT is via an Open-Drain output. This signal pulls the PTT line of the radio low and will key any radio with a low-true PTT requirement. Maximum switching capacity of the PTT output is 100V, 1.5A DC.

Some radios use a single line to combine PTT and other control functions. These radios may not be compatible with the PTT circuitry of the C250E. Contact NCS for information on use of these radios.

5.2 Speaker

The C250E was designed to drive speakers of 4-8 Ohms nominal impedance. Maximum power output is achieved with 4 Ohm speakers. Speaker power ratings should be chosen according to the speaker impedance as shown in this chart:

Speaker	Impedance (Ohms)	Minimum Power Rating (Watts-rms)
Selected	4 Ω	4
	8 Ω	2
Unselected	4 Ω	4
	8 Ω	2
PA	4 Ω	16
	8 Ω	8

CAUTION: NEVER ground either side of the PA speaker output terminals. Doing so may damage the audio amplifier in the C250E.

5.3 Microphone

The adjustable amplifier in the C250E allows most any dynamic or electret microphone to be used. Typical input level from the microphone should be in the range 50mV-250mV.

6.0 Power Supply

6.1 Power Requirements

The NCS-C250D will operate with any 9-16 VDC power supply capable of providing at least 2A continuous.

6.2 Power Connection

Power is supplied to the pigtail on the rear of the unit. The connector is an Anderson Powerpole PP-15. As part of the accessory kit, a 10 foot power cable is supplied with a mating connector attached. Connect the power cable to a 9-16 VDC source capable of supplying at least 2A. Additional connectors are available from Powerwerx (web site: http://www.powerwerx.com, telephone: 714-570-3303)

6.3 Polarity

Power cable polarity is: Red = +, Black = - (or chassis).

6.4 Fusing

The power supply line is internally protected against overload with a PTC Resettable Fuse. If an overload occurs, the fuse will open. It will automatically re-close when the power is removed from the unit. This is not a replaceable or serviceable item.
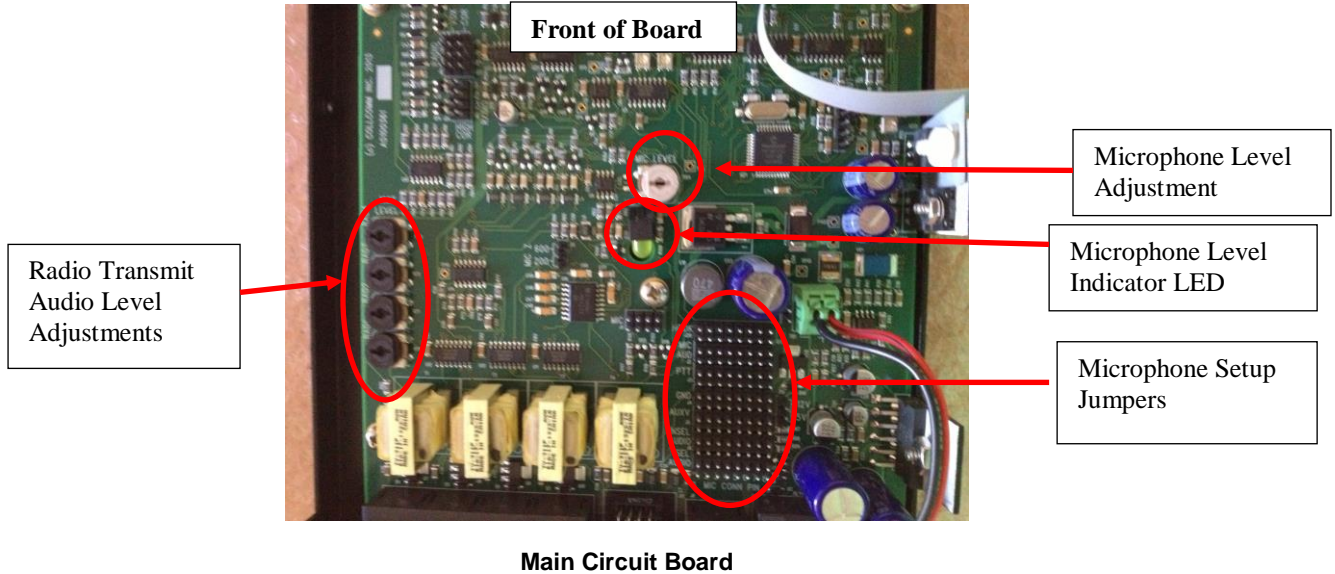
6.5 Using an AC Power Supply

The C250E can be operated from any well-regulated 9-16 VDC power supply capable of delivering a minimum of 2 Amperes. Voltages higher than 16V may result in damage to the circuitry.

6.6 Power Cable Clamp

The Power Cable Clamp is used to keep the Power Cable from separating from the Power Pigtail in Mobile use.

7.0 Microphone Setup

The main circuit board inside the C250E has provisions for setting up the microphone functions. To setup these functions, remove the cover of the C250E and refer to the picture below for the locations of settings and adjustments.

Front of Board

Microphone Level Adjustment

Microphone Level Indicator LED

Radio Transmit Audio Level Adjustments

Microphone Setup Jumpers

Main Circuit Board

7.1 Front and Rear Panel Microphone Connections

The microphone connectors on the front and rear panels accept standard 8-pin RJ-45 modular plugs. Either connector can be used. The front and rear connectors are connected in parallel and both use the same pin programming. The function of each pin is programmable using the jumper blocks on the main circuit board.

7.1.1 Microphone Pin-outs
The RJ45 modular plug pin numbering used on this unit is shown below:

8 7 6 5 4 3 2 1   1 2 3 4 5 6 7 8

Figure 1:
End view of RJ45 Plug

Figure 2:
Looking into an RJ45 Jack
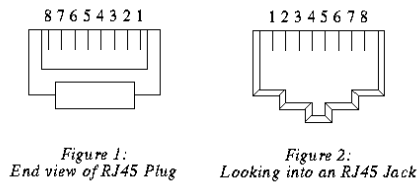
7.1.2 Programming the Microphone Connectors
Programming the microphone connectors is accomplished by setting the microphone connector pin functions, selecting the impedance level and connecting a voltage supply pin if using an electret microphone element.

The diagram below shows the Microphone Setup Area of the main circuit board. Refer to it for the following steps.

Mic Impedance and Attenuation Jumper

Electret Voltage Jumper

Microphone Setup Area
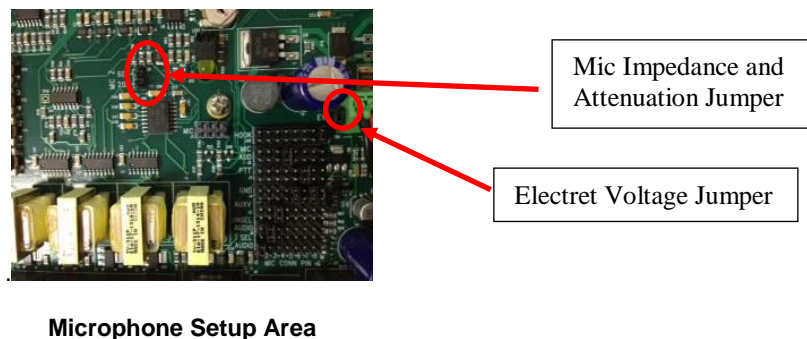
To program the functions of the pins on the microphone connectors, use the shunts supplied in the Accessory Kit to jumper the appropriate microphone pin numbers to the corresponding signals on the MIC CONN PIN jumper blocks.

For example, to program the microphone shown in the following chart, install the PIN SELECT shunts as shown. NOTE: These shunts are shown in the factory default positions.

Default Microphone Pin-out

MIC Pin	Shunt Row	Signal Name
Pin 1	J7	SEL AUDIO
Pin 2	J6	UNSEL AUDIO
Pin 3	J5	AUXV
Pin 4	J2	MIC AUD
Pin 5	J4	GND
Pin 6	J3	PTT
Pin 7	J4	GND
Pin 8	J20	HOOK

7.1.2.1 Microphone Impedance
Select the microphone impedance using shunts on the Impedance jumper block (J10) as shown in this image:

Hi-Z: do not install shunt

600 Ohms: install shunt in corresponding position

200 Ohms install shunt in corresponding position

7.1.2.2 Electret Supply Voltage
If the microphone is an Electret type that needs a voltage supply, install a shunt on J9

7.1.2.3 Auxiliary Supply Voltage
If the microphone requires a separate voltage supply to operate a preamp, DTMF keyboard or similar circuitry, install a shunt on the AUXV block (J5) at the corresponding microphone pin number. Also, select the desired supply voltage, 5V or 12V using a shunt on the AUXV jumper block (J15).

7.1.2.4 Speaker Connections
For microphones with built-in speakers or for headsets, install shunts at the corresponding pin numbers for Selected and/or Unselected Audio on the SEL AUD block (J7) and/or UNSEL AUD block (J6).

8.0 COR/VOX Setup

The NCS-C250E is available with a COR feature. This feature causes the Busy Lights and the Repeater function to be controlled by digital Busy signals from the radios. The sense of the busy signals from the radios is selectable either "High = Busy" or "Low = Busy". Unless identified on Page 2 of this manual, all Radio Ports (R1, R2, R3, R4) are set for COR.

8.1 COR Logic Level

The COR feature uses a logic level input from the radios to illuminate the Busy lights and to operate the Repeater function.   The Busy signals from the radios are on Pin 8 of the modular Radio connectors. Signal levels from the radios are:

    Low: < 1.0 VDC
    High: > 1.5 VDC

NOTE: When utilizing the COR feature, receive input levels should be set using audio voltage measurements to 200mVp-p - 300mVp-p for each radio.
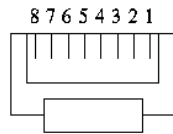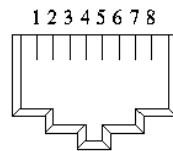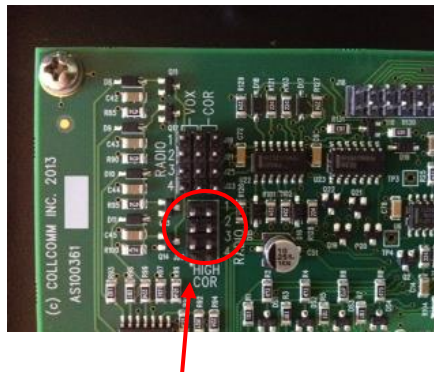

RAD1-RAD4 Modular Radio Connector. Pin 8 is the COR Signal Line.

8.2 COR Polarity

The sense of the Radios' Busy signals can be individually selected using the jumper block shown below. Absence of a jumper means that a "Low" signal indicates "Busy". The presence of a shunt on the jumper block means that a "High" signal indicates "Busy".

Add Jumper for "High" Busy signal. Do Not Add Jumper for "Low" Busy signal.

8.3 VOX Enable

To enable VOX on one or more Radio Ports (R1, R2, R3, R4), install a shunt on the respective VOX pins on the front of the main PC Board.
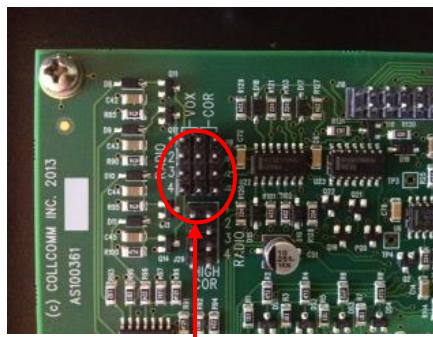
Move Jumper from COR side to VOX side for corresponding radio.

9.0 Hookswitch Setup

The NCS-C250E is available with a Hookswitch feature. This feature allows a Hookswitch or microphone "hang-up" signal to be sent from the microphone through the C250E to the radios. In operation, the Hookswitch line of all Unselected radios is pulled "low". When a radio is selected, that radio's Hookswitch line is released unless the microphone connected to the C250E is hung up on a grounded hook. In this case the Hookswitch line for the Selected Radio is pulled "low".

One example of use of this feature is to activate radios' scan functions. In this application, all radios scan continuously. When the mic is lifted off its grounded hook, the Selected radio stops scanning. Scanning on the Selected radio resumes when the mic is placed back on its grounded hook.

The Hookswitch feature uses an input line from the Mic connectors to activate the Hookswitch function.   The Hookswitch signal from the microphone can be programmed to be on any of the 8 Mic connector pins. The state of the signal is determined by the resistance between the Hookswitch line and ground as follows:

On-Hook: < 1000 Ohms   Off-Hook: > 5000 Ohms

The Hookswitch signals to the radios are on Pin 7 of the modular Radio connectors. These signal levels are:
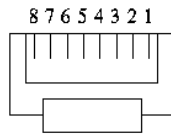
On Resistance: < 10 Ohms   Off Resistance: > 1 Megohm
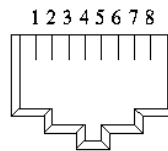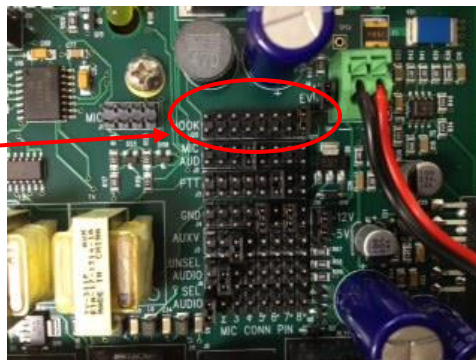

Figure 1:
End view of RJ45 Plug

Figure 2:
Looking into an RJ45 Jack

RAD1-RAD4 Modular Radio Connector. Pin 7 is the Hookswitch Signal Line.

Maximum Load Imposed by the Radio:
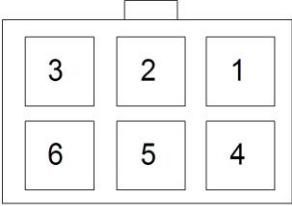
Off Voltage: < 60 V   On Current: < 200mA

Add Jumper to appropriate Microphone Pin Used for Hookswitch.(J20)

10.0 Rear Panel Connections

NAME	PINOUT	NOTES
MIC RJ45 Connectors on Front and Rear Panel	8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 *Figure 1:* *End view of RJ45 Plug* *Figure 2:* *Looking into an RJ45 Jack*	Pin functions set by internal programming shunts.
RAD1-RAD4 RJ45 Connectors on Rear Panel	8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 *Figure 1:* *End view of RJ45 Plug* *Figure 2:* *Looking into an RJ45 Jack* See table below.	Refer to Section 9.0 for cable information.

RAD1-RAD4 Pinout

Pin	Signal	Note
1	Transmit Audio	To Radio Mic Input
2	Transmit Audio Common	To Radio Mic Input Common or Gnd
3	PTT	To Radio PTT Input
4	GND	Signal Ground
5	Receive Audio	From Radio Audio (Speaker) Output
6	GND	Signal Ground
7	Hookswitch	Out to Radio
8	COR	In from Radio

EXPANSION — 13 Pin DIN Connector on Rear Panel

Pin	Signal	Note
1	MIC_MIX	Microphone Mixer
2	GND	Signal Ground
3	PTT	Low = True (In/Out)
4	SLAVE_MIXER	Input Low=True
5	UNSEL_MIX	Unselected Radios Mixer
6	SEL_MIX	Selected Radio Mixer
7	EXT_MUTE	Output; External Mute Logic Level
8	PAD	Spare/Factory Use
9	GND	Signal Ground
10	RX_RS232	Serial Data In
11	TX_RS232	Serial Data Out
12	SLAVE	Input; Low = True
13	GND	Signal Ground

EXPANSION NOTES: Used for special functions. Must be enabled by firmware or special cables. **CAUTION:** Pin functions vary; Consult factory before connecting anything to this connector.

NAME	PINOUT	NOTES
EXT MUTE RCA Phono Jack on Rear Panel	Center Pin - Signal Shell - Ground This is an open drain output that goes low when PTT is keyed, and, optionally, when any Busy Light comes on (See Section 11.2.5.3) Maximum Switching Capacity: 100V, 1.5A	This output can be used to mute external equipment such as automobile radios or can be used to turn on external equipment such as "On-the-Air" lights.
SPEAKERS Mating Connector: • AMP/Tyco 172168-1 Plug Housing • AMP 770988-1 Socket Contacts (18-22 AWG) • AMP 770986-1 Socket Contacts (22-28 AWG)	REAR PANEL JACK <table><tr><td>Pin</td><td>Signal</td><td>Description</td></tr><tr><td>1</td><td>GND</td><td>Signal Ground</td></tr><tr><td>2</td><td>SP_BR_2</td><td>Bridged Speaker Output (PA)</td></tr><tr><td>3</td><td>SP_U</td><td>Unselected Speaker</td></tr><tr><td>4</td><td>GND</td><td>Signal Ground</td></tr><tr><td>5</td><td>SP_BR_1</td><td>Bridged Speaker Output (PA)</td></tr><tr><td>6</td><td>SP_S</td><td>Selected Speaker</td></tr></table>	**Selected Audio Speaker:** Pins 6 and GND. **Unselected Audio Speaker:** Pins 3 and GND. **PA Speaker:** Pins 2 and 5. **All speakers may be connected at the same time.**

11.0 Radio Interface Cables

A Radio Interface Cable is required for each radio interfaced to the C250E. This cable contains mic audio, receive audio and PTT signals. It can be fabricated from the documentation supplied in the instruction manual or obtained from NCS. The cable consists of an RJ-45, 8 pin modular connector on one end for mating to the C250E and a radio interface connector on the other end. Un-terminated cables are also available that require the customer to attach the radio interface connector.

There are two general cable configurations. The first is for radios that have the receive audio available on the microphone connector or accessory connector and the second is for radios with a separate mic connector and speaker jack. The two configurations are shown below.
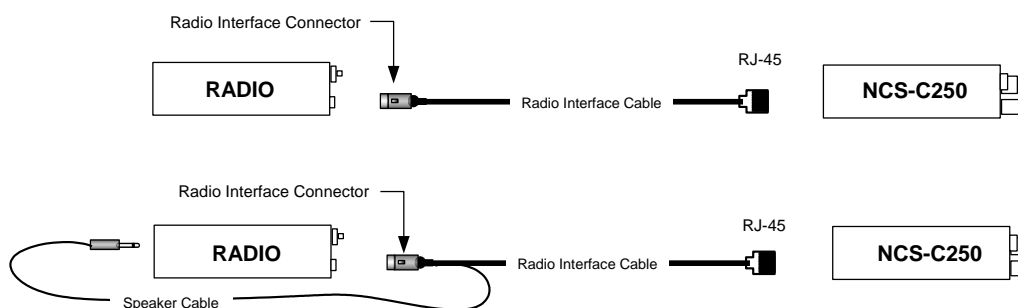
Most commercial radios have an accessory connector that usually has mic audio, receive audio and PTT connections available and usually is the preferred interface to the NCS-C250E.
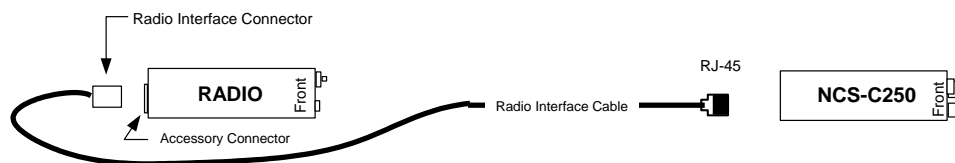
11.1 Specifying Radio Interface Cables

NCS can supply Radio Cables for most any radios. Standard cable length is six feet, however, custom lengths are available. Since there are numerous connector types for interfacing to various commercial and amateur radio transceivers, the radio model and connector type should be specified at the time of purchase. A document describing Cable Specification and Ordering is available on our website at

http://www.ncsradio.com/documents/NCS-C250cables.pdf

12.0 Adjustments

12.1 Transmit Audio
Transmit Adjustments can be made from inside or on the bottom of the C250E. The images below show the adjustment locations.

FRONT
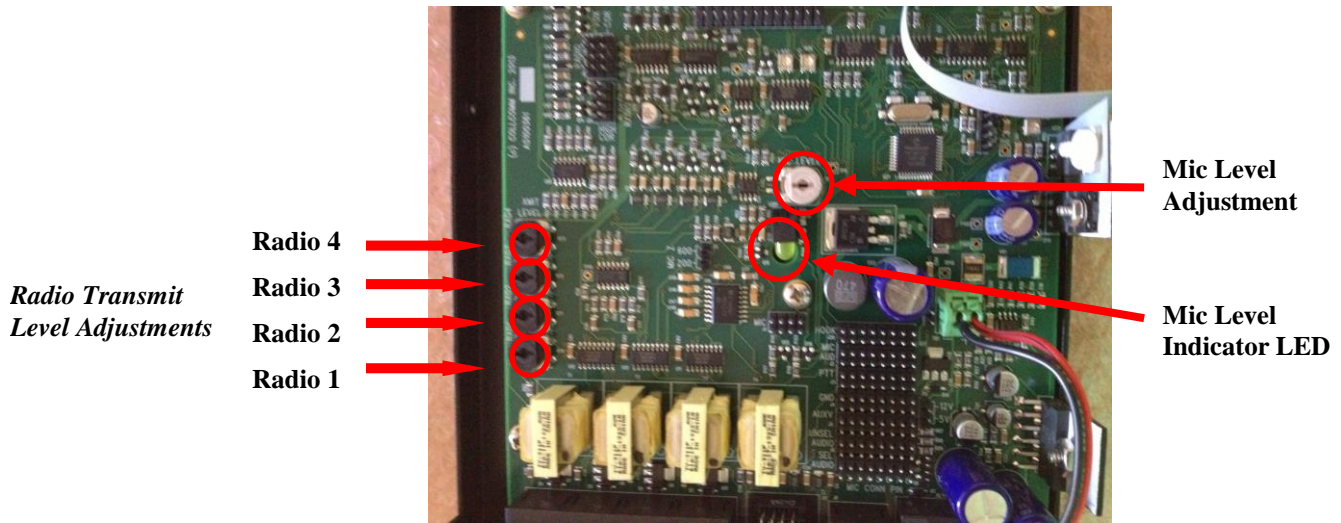
Adjustments Inside the C250E
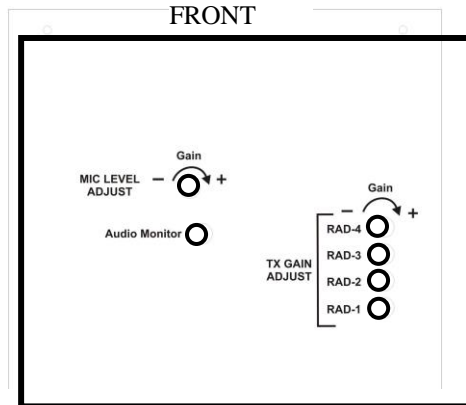
Transmit Adjustments on Bottom of C250E

Transmit Audio Adjustment Procedure

i. Adjust each radio for proper operation using its standard microphone.

ii. Connect NCS Radio Cables between the C250E and each radio.

iii. Preset the Mic Level control to minimum (clockwise from inside, counterclockwise from the bottom, of the C250E).

iv. Preset all Radio level controls to midrange (clockwise from inside, counterclockwise from the bottom, of the C250E).

v. Adjust the Mic input level as follows:
Connect the microphone to the connector on the front or rear panel. Turn the C250E on. While speaking into the microphone adjust the Mic Level control until the Mic Level LED lights on voice peaks. If the mic level will not adjust low enough, add an Impedance Jumper in the 600 or 200 Ohm location.

vi. Select each radio in turn, press the Mic PTT, and adjust the respective output level control for proper transmitter operation.

12.2 Receive Audio

12.2.1 When using Radio Fixed Level Audio Output
When using fixed level audio output make sure the audio level is a minimum of 1.4 V.

12.2.2 When using Radio Speaker Audio Output
If C250E is setup for VOX, adjust the volume control on each radio so that the Busy light on the C250E associated with that radio lights with the lowest level normal received audio.

12.3 User Programmable Functions
The NCS-C250E has three user programmable functions. To turn functions on or off, perform the following:

1. Deselect all radios.
2. Press and hold the Mic PTT Button and the UNSEL MUTE button until both the PA (green) and RPT (red) indicators above the PA/RPT button are illuminated. The unit is now in User Programming Mode.
3. The SEL (red) indicators above RAD1-RAD4 buttons show the current status of the functions. Red Indicator ON = Function On.
4. Momentarily press the desired Function button to toggle the function on or off.
5. Momentarily press the UNSEL MUTE button to exit the User Programming Mode.

To reset the unit to the factory settings, press and hold the SEL MUTE button while in User Programming Mode. When the PA (green) and RPT (red) indicators turn off, the unit has been reset.

Function 1 - Sidetone
This function is a Factory Installed Option. If the Sidetone Option is installed in the unit at the factory, this button turns Sidetone On and Off. The Sidetone function allows mic (transmitted) audio to be heard in the SELECTED Audio channel (speaker or headset). The factory default for this function is OFF.

Function 2 - MultiCast
This function is a Factory Installed Option. The Multicast Option allows the operator to select two or more radios at the same time so as to be able to transmit as well as receive on multiple radios. Receive audio from all radios selected using the Multicast mode will be heard from the Selected speaker channel. Keying the mic and transmitting will cause all selected radios to be keyed and audio from the mic will be transmitted over all selected radios. The factory default for this function is ON if the Multicast Option was installed at the factory.

Function 3 – Supplemental Thump Filter
In RPT Mode, a variable delay is normally in effect when the transmitting radio goes from transmit to receive. This delay is necessary for many radios that create a Busy indication when returning to receive when using VOX repeater control. The Busy indication appears to be a valid received signal and it causes the receiving radio to enter transmit. If both radios produce a Busy indication when going from transmit to receive, both radios would alternate between transmit and receive with no valid audio signal present. The built in Thump Filter alleviates this problem. The factory default setting for this function is OFF.

When entering transmit, a very few radios produce another thump. The Supplemental Thump Filter function may be helpful in eliminating problems due to this thump.

Function	Function Name	Button
1	Sidetone On/Off	RAD2
2	MultiCast On/Off	RAD3
3	Supplemental Thump Filter On/Off	RAD4

This completes setup and adjustment of the C250E.

13.0 Operating the C250E

13.1 Mode and Selected Radio Memory
The current Mode and the Radio Selections for all modes are automatically saved in memory so the C250E will stay in the same Mode and Radio Selection when powered off and back on. Power failures will not affect the saved state of the C250E.

13.2 Normal Mode

13.2.1 Mode Description
In this mode, only one radio at a time can be selected unless the MultiCast Option is installed (see 12.3). Received Audio from the Selected radio is connected to the Selected Audio Speaker Output and microphone audio is connected to the Selected radio. Received Audio from all Unselected Radios is mixed together and sent to the Unselected Speaker Output. Keying the mic will transmit on the Selected radio. The Selected radio will be heard on the Selected speaker and all other radios will be heard on the Unselected speaker.

13.2.2 Selecting Normal Mode
In Normal mode, neither the PA nor RPT indicators are lit. If either light is on, momentarily press the PA/RPT button to select Normal Mode.

13.2.3 Selecting a Radio
To select or deselect a radio, momentarily press the desired radio button (RAD1-RAD4) button. The associated SEL (red) indicator will light when the radio is Selected. The BUSY (green) indicator will light when audio is received.

13.2.4 SELECT/UNSELECT Audio Control
Received audio from the Selected radio will be heard on the Selected Speaker and received audio from all Unselected radios will be heard on the Unselected Speaker.

The SEL/PA Volume Control controls volume of the Selected radio. Note that the SEL/PA Volume Control doesn't completely shut off all audio when turned all the way down. This is normal. To completely shut off all audio from the Selected radio, press the SEL MUTE button.

The UNSEL Volume Control controls the volume of the Unselected radios. Note that the UNSEL Volume Control doesn't completely shut off all audio when turned all the way down. This is normal. To completely shut off all audio from the Unselected radios, press the UNSEL MUTE button.

13.2.5 Mute Functions

13.2.5.1 SEL MUTE
To mute the Selected radio, momentarily press the SEL MUTE button. The associated yellow indicator will light and the Selected audio will be silenced.

13.2.5.2 UNSEL MUTE
To mute the Unselected radios, momentarily press the UNSEL MUTE button. The associated yellow indicator will light and the Unselected audio will be silenced.

13.2.5.3 AUTOMUTE and the EXT MUTE Connector
This function automatically mutes the UNSEL audio and external equipment connected to the EXT MUTE jack when PTT is keyed. Also, to mute external equipment connected to the EXT MUTE jack on the rear panel when a received signal lights a green Busy indicator, press and hold the AUTO MUTE button until the AUTO MUTE indicator blinks once. A short blink means the function has been enabled. A long blink means the function has been disabled.

13.3 PA Mode

13.3.1 Mode Description
In this mode, received audio from selected radios will be output through the PA Speaker Output. Keying the PTT will send Mic audio to the PA Speaker.

13.3.2 Selecting PA Mode
In PA mode, the PA (green) indicator is lit. If it's not lit, momentarily press the PA/RPT button.

13.3.3 Using PA Mode

Select any radio(s) to be sent to the PA Speaker by momentarily pressing any of the RAD1-RAD4 button(s). To make a PA announcement, key the PTT and speak into the microphone.

The SEL/PA Volume Control controls the PA volume.

13.4 RPT Mode

13.4.1 RPT Mode Description

In this mode, received audio from one radio is retransmitted through another radio. Retransmitting is controlled by activation of the Busy indicators which operate by detecting received audio (VOX). If received audio is too low in volume, these indicators won't light and the RPT function won't work.

13.4.2 Selecting RPT Mode

Press and hold the PA/RPT button until the RPT (red) indicator turns on.

13.4.3 Using RPT Mode

Any number of radios can be selected at the same time in RPT Mode. To select a radio, momentarily press the button for the desired radio(s).

Unless the COR Option is installed, RPT operation is VOX-based. When RPT Mode is on, an audio level that is sufficient to light a radio's Busy indicator will key the PTT for the other Selected radio(s) and retransmit received audio.

When in RPT Mode, keying the Mic's PTT causes all selected radios to transmit microphone audio. This can be used for transmitting on multiple radios simultaneously where legal and appropriate.

13.5 Additional Functions

13.5.1 Watchdog Timers

Each Radio's PTT incorporates a Watchdog Timer that disables a Radio's PTT after 3 minutes of continuous transmission. To reset the Watchdog Timer and resume transmission, PTT must be released briefly. In RPT Mode, the received signal being retransmitted must stop briefly. The Watchdog Timer also resets automatically after 30 seconds even if PTT is still keyed or the received signal has not stopped. This is helpful in the event of a radio problem or other malfunction.

14.0 Block Diagram

Mobile Multi-Switcher Block Diagram
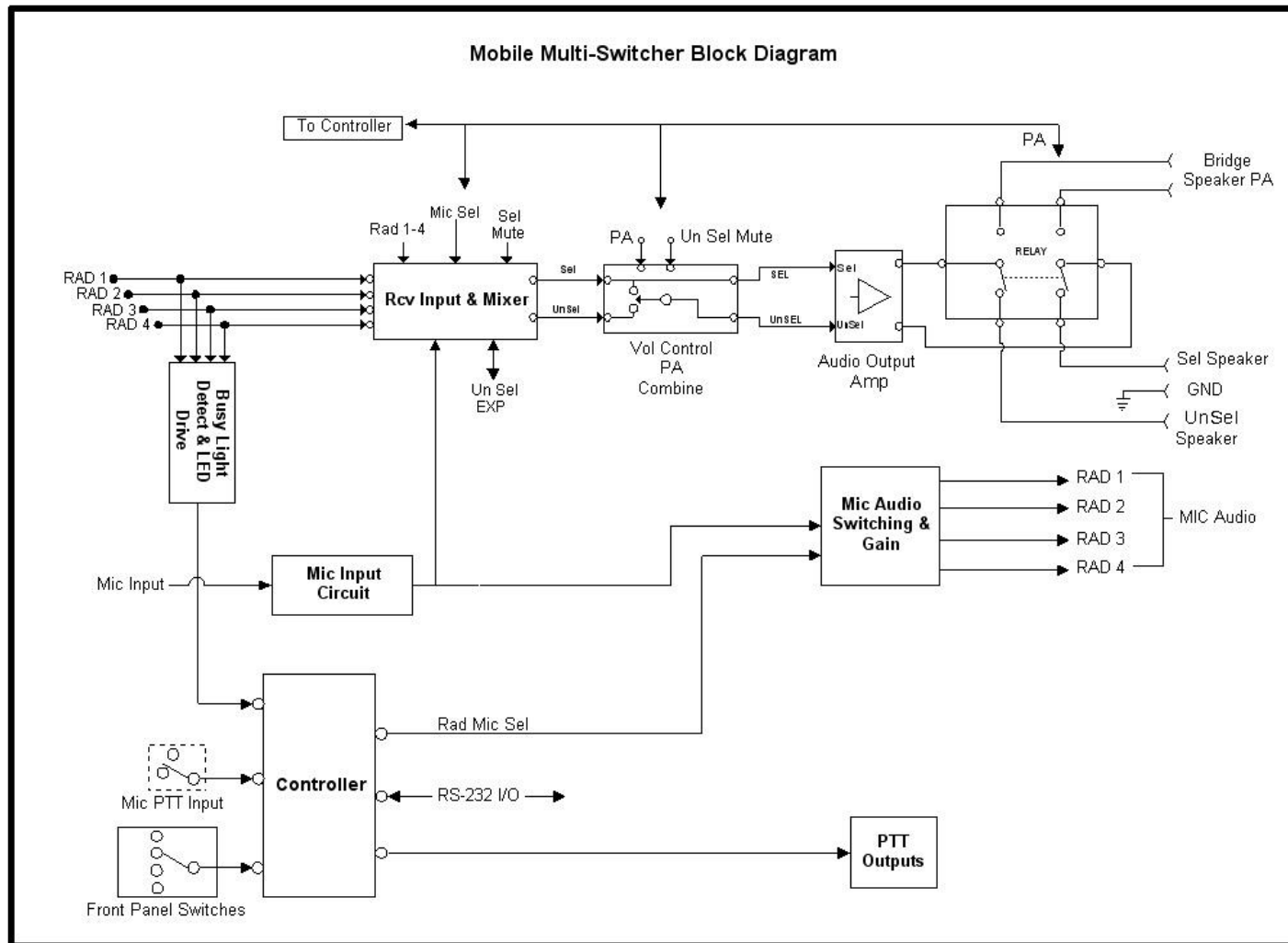
15.0 Troubleshooting

The C250E was designed with care and uses high quality components and construction. You should not experience any operating difficulties when you follow the setup and use instructions in this manual. If you do experience problems, here is some information that may help you resolve any difficulties.

15.1 Hum
Magnetically induced hum can be caused to any modern piece of audio equipment by too close proximity to unshielded power transformers or other equipment that radiates strong AC magnetic fields. You can tell if you have this type of hum by rotating the C250E left/right, up/down and moving its position. If the hum increases and decreases, then you are experiencing magnetic coupling from an unshielded power transformer or other equipment. The C250E should be several inches away from equipment that radiates AC magnetic fields.

Another source of hum can be a ground loop. This is a situation when pieces of audio equipment that are connected together do not have their grounds well connected.   This results in a voltage difference between the equipment grounds and can be a safety hazard as well as introducing electrical problems. The solution to this problem is to tie all your equipment grounds (usually case or chassis) together with a low impedance RF connection. The best choice for connecting material is a wide braid or copper strap.

15.2 Noise
Excessive noise can be caused by many factors. The C250E uses state-of-the-art low noise amplifier ICs. Nevertheless, even these components can add a bit of noise or "hiss" to an audio signal if not adjusted properly. If you seem to have excessive "hiss" type noise, review the setup and level adjustments you've made to the C250E. In some cases, increasing the radio's own mic gain and decreasing the levels from the C250E may improve the noise level.

Excessive noise can also be caused by ground loops. See the previous "hum" discussion for information on eliminating ground loops.

15.3 Distortion
Distorted audio can be caused by one of two situations. The first and most common is improper adjustment of audio levels. Be sure you've adjusted the Radio and C250E level controls as recommended in this manual and that your radio's mic gain control is properly adjusted. Setting the Volume Controls at too high a level can also cause distortion.

RF at the operating position can also cause distorted audio. To determine whether this is the problem, connect your transmitter to a dummy load. If the distortion disappears, then you have RF entering the interface cables. To eliminate RF problems, first make sure you have set up the jumpers and radio cables correctly. Then check that you have a good ground between all pieces of equipment and that your RF ground is low impedance.

16.0 Contacting NCS

NCS wants you to experience trouble free operation of our equipment. If you have any questions, comments or need technical help, please use the following resources:

1. Go to the web site, www.ncsradio.com. Here you will find the latest instruction manuals, any factory developed modifications and Frequently Asked Questions. Schematics for all NCS products may be found at www.ncsradio.com/schematics.

2. Email us at support@ncsradio.com. Be sure to include all pertinent information, e.g. make and model of radios, how they're connected to the C250E, detailed description of any problems, antenna and grounding configurations, etc.

3. Telephone us toll-free at 888-883-5788. Be near your equipment and have the manuals for your radios available. We will do our best to help you using our technical expertise.

17.0 C250E Specifications

General Specifications

Dimensions	1.8"H x 6.4"W x 7.1"D 4.6cm x 16.3cm x 18.0cm
Weight	2.0 lb (0.91kg)
Temp Range	0° to +50° C
Memory Protection	Radio Selection Switches preserved in non-volatile memory
Power Requirements	9 to 16 VDC @ 2A typical
Audio Output Power	**Selected & Unselected:** 2W @ 8 Ω 4W @ 4Ω **PA:** 8W @ 8Ω 16W @ 4Ω
Speaker Impedance	4-8 Ω
Automatic Mute Function	Mutes external equipment when Mic is keyed or when received signal is present (User selectable)

Front Panel

Power On/Off	Pushbutton Switch with Red LED Indicator
Radio Select (RAD1-RAD4)	Momentary Pushbutton Switch with Green LED "Busy" Indicator and Red LED "Selected" Indicator
PA/RPT Select	Momentary Pushbutton Switch with Green LED "PA" Indicator and Red LED "RPT" Indicator
Selected Audio Mute	Momentary Pushbutton Switch with Yellow LED Indicator
Automatic Mute	Momentary Pushbutton Switch with Yellow LED Indicator
Unselected Audio Mute	Momentary Pushbutton Switch with Yellow LED Indicator
Selected Audio Volume	Volume Control - also controls PA Volume when in PA Mode
Unselected Audio Volume	Volume Control

COR

Radio Connector Pin #	8
Signal Levels	**COR Logic Input from Radio:** Low: < 1.0 VDC High: > 1.5 VDC
COS Sense	Selectable Low or High

Rear Panel Connections

Radio Interface Connectors (1-4)	RJ-45 Modular Jack
Expansion	13 pin DIN Jack
Microphone	RJ-45 Modular Jack
External Mute	RCA Phono Jack
Speakers	AMP/Tyco MATE-N-LOK 6 pin receptacle
DC Power	Six inch pigtail terminated in an Anderson PowerPole PP-15 connector.

Accessory Kit

Mounting Bracket	NCS-MTG501
Mounting Bracket Hardware	Qty 2 knobs with 10-32 Threaded Studs
Speaker Mating Connector	AMP/Tyco MATE-N-LOK 6 pin plug housing
Speaker Mating Connector Pins	Qty 10 pins for 18-22 AWG wire. Qty 10 pins for 24-26 AWG wire.
Shunts	Qty 10
Power Cable	10 foot, 18 AWG wire terminated with mating connector
Rubber Feet	Qty 4 Self Adhesive
Power Cable Clamp	Used to keep Power Cable from separating from Power Pigtail in Mobile use.

Hookswitch

Radio Connector Pin #	7
Signal Levels	**Hookswitch Input Resistance to Ground:** On-Hook: < 1K Ohms Off-Hook: > 5K Ohms **Output Switching Resistance to Ground:** On: < 10 Ohms Off: > 1 Mohm **Max Load Imposed by Radio:** Off Voltage: < 60 V On Current: < 200mA
Microphone Pin #	Selectable 1-8

18.0 Warranty

<div align="center">

Collcomm Inc. d.b.a. NCS
Limited Product Warranty

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All products manufactured by Collcomm Inc. (hereafter referred to as NCS) and purchased from an authorized dealer or purchased directly from NCS will be warranted to be free from defects in material and workmanship for a period of one (1) year from the date of purchase.

NCS' liability under this warranty and the Customer's exclusive remedy is limited to repairing, servicing or adjusting, and/or replacing the defective product returned to NCS within the warranty period. Whether the defective product is repaired or replaced will be at the sole discretion of NCS. The warranty will be voided for products that have been abused, misused, or subjected to abnormal operating conditions as determined by NCS. Further, products damaged by lightning, power surges or force majeure events are not covered under this warranty.

If, in the Customer's estimation the product appears to be defective and is within the warranty period NCS should be notified as to the nature of the defect. If the product appears to be covered by the terms of the warranty, NCS will promptly communicate a return authorization number and shipping instructions to the Customer. When returning a product for repair/replacement under warranty the proof of purchase or a copy thereof must be returned with the defective product. NCS at its discretion may deny warranty in the absence of proof of purchase. Acceptable proof of purchase includes bill of sale, cancelled check or credit card receipt. Evidence of alteration of the proof of purchase document shall be reason to immediately void the terms of the warranty.

For those products returned that prove to be defective and covered under the warranty, the Customer will bear the cost of shipment for the return of the product to NCS. Collect shipments will not be accepted. NCS will bear the cost of shipment for return of the product to the Customer after repair/replacement. Mode of shipment for return to the Customer will be determined by NCS. Should examination reveal that the product is not defective, NCS will notify the Customer and request return shipping instructions and NCS will be due all shipping expenses. In the event that the examination reveals that the product is defective, but for any reason is excluded from this warranty, NCS will prepare a quotation of the cost to repair, and will communicate same to the Customer. In the latter event, NCS will be due all shipping charges incurred for return of the product to the Customer.

The Customer may attempt to repair a defective product under warranty provided authorization to do so is received from NCS Technical Support. NCS will supply replacement parts free of charge for authorized Customer repairs provided that the defective part along with the proof of purchase is submitted to NCS. NCS will pay postage and handling for replacement parts provided the above terms are met. The product warranty under these circumstances will remain in force for the life of the warranty.

EXCEPT FOR THE EXPRESS WARRANTIES STATED IN THIS WARRANTY, WHICH ARE EXCLUSIVE, NCS DISCLAIMS ALL WARRANTIES ON PRODUCTS SOLD HEREUNDER, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. UNDER NO CIRCUMSTANCE IS NCS LIABLE FOR CONSEQUENTIAL DAMAGES TO PERSON OR PROPERTY AS A RESULT OF THE USE OF ANY NCS PRODUCTS.

The Customer may have additional rights beyond those specifically outlined in this document based on individual state laws.