



## ***Mobile Communications***

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LOW POWER



MEDIUM/HIGH POWER



**DELTA™ - SX**  
136 - 174 MHz  
**RADIO COMBINATIONS**  
**(NEGATIVE GROUND ONLY)**

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## **Maintenance Manual**

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**SYSTEM SPECIFICATIONS\***

FREQUENCY RANGE	136-174 MHz
FREQUENCY CAPACITY	1, 8, 16 or 32 channels
CHANNEL GUARD	33 EIA Tones, 83 Digital Codes
FREQUENCY STABILITY	±0.0005% or optional ±0.0002%
TEMPERATURE RANGE	-30C (-22F) to +60C (140E)
DUTY CYCLE	100% Receive, 20% Transmit (EIA)
BATTERY VOLTAGE	
Transmit	13.4 VDC +20%
Receive	13.8 VDC +20%
BATTERY DRAIN (Maximum)	
Receive	
Squelched	0.7 Amperes
Unsquelled	2.2 Amperes
Transmit	
40 Watts	12.0 Amperes at 13.6 Volts
60 Watts	17.0 Amperes at 13.6 Volts
110 Watts	27.0 Amperes at 13.4 Volts

**WARNING**

Although the highest DC voltage in Mobile Two-Way Radio equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

## SYSTEM SPECIFICATIONS\* - Cont.

### DIMENSION, LESS ACCESSORIES (H X W X D)

40-60 Watts	65 mm X 260 mm X 325 mm (2.5 X 10.2 X 12.7 inches)
110 Watts	65 mm X 290 mm X 325 mm (2.5 X 11.4 X 12.7 inches)

### WEIGHT, LESS ACCESSORIES

40 and 60 Watts	5.9 kg (13.0 pounds)
110 Watts	6.5 kg (14.5 pounds)

TRANSMITTER	RECEIVER
CONDUCTED SPURIOUS - 85 dB	AUDIO OUTPUT 12 Watts with less than (to 4.0 ohm speaker) 3% distortion
MODULATION $\pm 5.0$ KHz	SENSITIVITY <u>Standard</u> <u>UHS Preamp</u>
AUDIO SENSITIVITY 60 to 120 Millivolts	12 dB SINAD (EIA) Method 0.35 uV 0.175 uV
AUDIO FREQUENCY CHARACTERISTICS Within +1 dB to -4.5 dB of a 6 dB/octave pre-emphasis from 300 to 3000 Hz per EIA standards. Post limiter filter per FCC and EIA	20 dB Quieting Method 0.50 uV 0.25 uV
	Squelch <6 dB SINAD 0.25 uV 0.125 uV
	Channel Guard 8 dB SINAD
DISTORTION Less than 2% (1000 Hz) Less than 5% (300 to 3000 Hz)	ADJACENT CHANNEL SELECTIVITY
	EIA Two-Signal Method
	( @ 25 kHz channels) - 85 dB - 85 dB
	( @ 30 kHz channels) - 95 dB - 95 dB
DEVIATION SYMMETRY 0.5 kHz maximum	SPURIOUS RESPONSE - 90 dB - 90 dB
MAXIMUM FREQUENCY SEPARATION	INTERMODULATION @ 25/30 kHz - 85 dB - 80 dB
136-153 MHz 17 MHz	MODULATION ACCEPTANCE $\pm 7.0$ kHz
150.8-174 MHz 23.2 MHz	MAXIMUM FREQUENCY SEPARATION
MICROPHONE LOAD IMPEDANCE 600 ohms	136 - 153 MHz 17 MHz
POWER ADJUST RANGE 2:1 of rated power	150.8 - 174 MHz 23.2 MHz
RF OUTPUT IMPEDANCE 50 ohms	FREQUENCY RESPONSE Within +2 and -8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
FM NOISE - 65 dB	RF INPUT IMPEDANCE 50 ohms
CARRIER ATTACK TIME 25 milliseconds	HUM/NOISE RATIO
AUDIO ATTACK TIME 25 milliseconds	UNSQELCHED - 55 dB
CHANNEL GUARD TX TONE DISTORTION <5%	SQELCHED - 70 dB
	RECEIVER RECOVERY TIME 200 milliseconds
	RECEIVER ATTACK TIME 150 milliseconds
	CHANNEL SPACING 25/30 kHz
	CHANNEL GUARD (Optional)
	Tone 67 - 210.7 Hz ( $\pm 0.5\%$ ) **
	Digital 023 - 526 (H) code (Standard Codes)

\* These specifications are intended primarily for use of the serviceman. Refer to the appropriate Specifications Sheet for the complete specifications.

\*\* Any tone (67-210 Hz)  $\pm 0.5\%$

FCC FILING NUMBER

RECEIVER	TRANSMITTER	POWER OUTPUT	FREQUENCY
ER-151-A	KT-242-A,B* KT-244-A,B*	40 - WATTS 110 - WATTS	136 - 174 MHz 136 - 174 MHz

\* A - Oscillator Stability of 5 PPM  
B - Oscillator Stability of 2 PPM

COMBINATION NOMENCLATURE

Digits 1 & 2	Digit 3	Digit 4	Digit 5	Digit 6	Digits 7-9	Digit 10	Digit 11
Product Code	Transmit Frequency Range	Receive Frequency Range	Channel Spacing	Type	RF Power Output	Mode/Channel Capacity	Oscillator Stability
<b>N3</b> DELTA-SX	<b>G</b> 136 - 153 MHz	<b>G</b> 136 - 153 MHz	<b>1</b> 30 kHz	<b>W</b> (Wide Band)	<b>040</b> 40 Watts	<b>T</b> A Mode 16 Channel	<b>A</b> ±2 PPM
	<b>H</b> 150 - 174 MHz	<b>H</b> 150 - 174 MHz	<b>2</b> 25 kHz		<b>110</b> 110 Watts	<b>Z</b> A/B Mode 32 Channel	<b>B</b> ±5 PPM

STRUCTURED OPTIONS

Digit A	Digit D	Digit M	Digit N	Digit R	Digit V
Program- ming	Channel Guard	Mounting	Antenna	Receiver Type	Voice Guard
<b>0</b> Test Program	<b>0</b> None	<b>0</b> Std. Frame & Mtg. Hdwe.	<b>0</b> None	<b>0</b> Standard	<b>0</b> None
<b>1</b> Custom Program	<b>B</b> Tone/ Digital	<b>N</b> None	<b>A</b> Whip	<b>A</b> UHS Pre Ampl	<b>G</b> Voice Guard
<b>3</b> S-950 Download					

## DESCRIPTION

General Electric DELTA-SX mobile radio combinations are completely solid state utilizing microcomputer technology and integrated circuits to provide high quality - high reliability radios. The DELTA-SX radio is designed for use in vehicles having a negative ground battery system. In vehicles having a positive ground battery system a polarity converter must be used. Standard combinations may be equipped with:

- Microcomputer Control led Frequency Synthesizer
- Up to 32 channels
- .0002% or .0005% frequency stability
- UHS Preamplifier (Ultra High Sensitivity), optional
- Tone and/or Digital Channel Guard, optional

The radio set is housed in a weather resistant case only 2 1/2 inches high. The radio is secured to the vehicle by a bottom mounting plate, and is tamperproof when locked into the plate. When unlocked, the handle can be pulled down and the radio pulled out of the mounting plate or the top cover removed for servicing. When pulled down, the handle can be used to carry the radio.

The PA board is inserted into the radio from the top of the frame, while the TRS board is inserted from the bottom. There are no wires used in the basic radio. Interconnections are provided by pins on the TRS board that mate with connectors on the PA assembly. A power bus connects A+ and A- from the front connector to the PA assembly. The PA board is isolated from ground (floating). power is supplied directly from the battery to the PA power output stage.

The radio is of single-layer construction with all major modules and tuning adjustments easily accessible from the top of the radio.

Centralized metering jacks for the transmitter, receiver and system functions are provided for simplified alignment and troubleshooting.

Excluding option boards, the basic radio consists of two printed wiring boards mounted in a cast aluminum frame. The two boards are the transmitter-receiver-system (TRS) board 19D901650G1 and the power amplifier board (See Figure 1). The TRS board is connected to chassis ground allowing it to be used in vehicles with a negative ground battery system only. Option boards include the Channel Guard board and VG Interface board. The VG Interface board is used in radios equipped with VOICE GUARD.

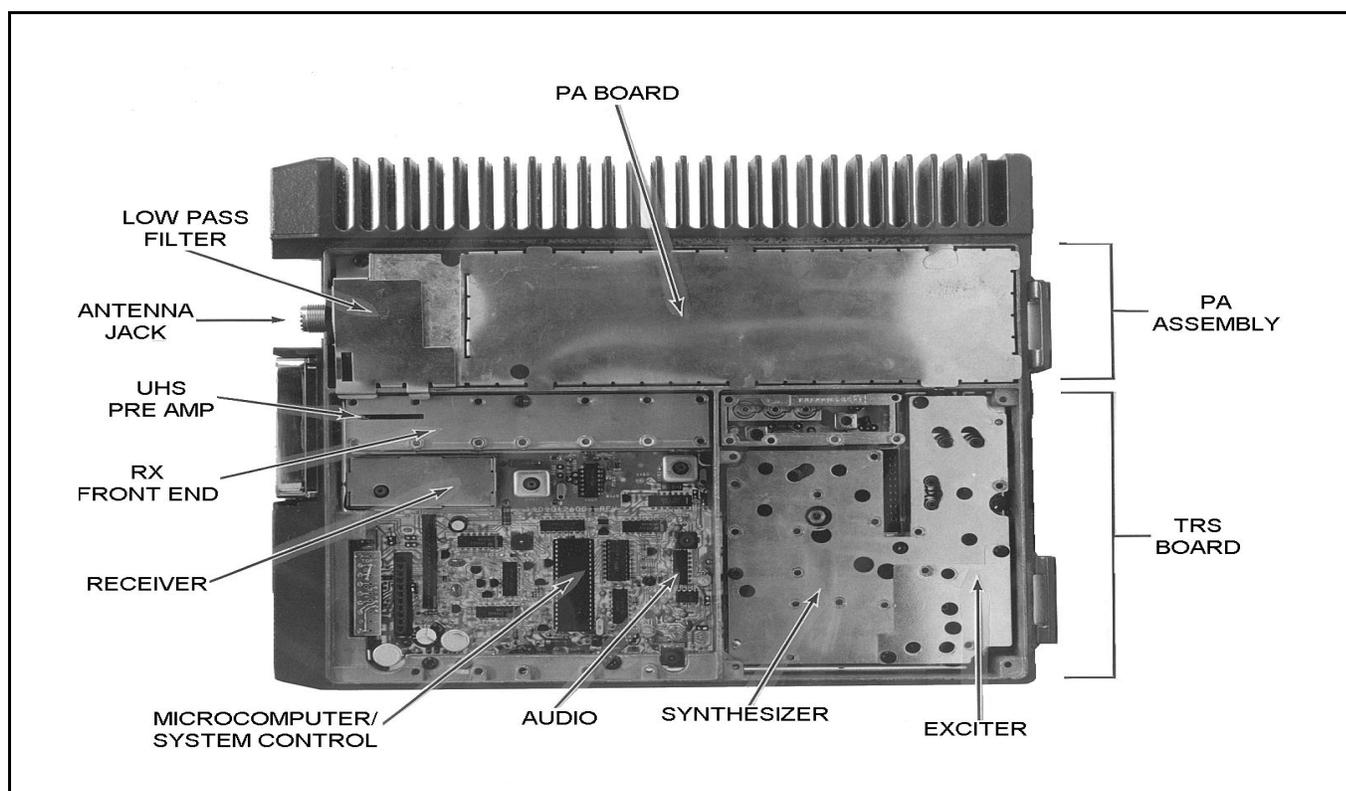


Figure 1 - Typical Module Layout

## **FREQUENCY SYNTHESIZER**

The frequency synthesizer consists of a microcomputer, electrically erasable PROM(S) (EEPROM), a frequency synthesizer IC, transmit and receive VCO's, and associated circuitry. The frequency synthesizer under control of the microcomputer generates all transmit and receive RF frequencies.

## **EEPROM**

The EEPROM stores binary data for all RF frequencies, Channel Guard tones/ digital codes, and the timing function of the carrier control timer (CCT). The microcomputer accesses the EEPROMS and provides the correct WALSH bits to the Channel Guard board to generate the correct Channel Guard tone or digital code on a per channel basis.

## **PROGRAMMING**

The EEPROM allows the radio to be reprogrammed as needed to adapt to changing system requirements. RF frequencies, Channel Guard tones and digital codes, and the CCT function can be reprogrammed.

Depending on the configuration of the radio, one or two EEPROMS may be provided. Radios not equipped with a MODE A/B switch will have one EEPROM. Radios with more than 16 channels and those with the MODE switch will have two EEPROMS.

### **NOTE**

When programming, remember that all RF frequencies must be divisible by 5 or 6.25 kHz but not both.

The EEPROMS can be reprogrammed through the radio front connector using the General Electric Universal PROM Programmer Model TQ23IO. This programmer allows all information to be loaded simultaneously.

Alternatively, a single channel Programmer Model 4EX22A10 allows the user to reprogram the radio on a per channel basis. This programmer requires the removal of the radio top cover and any option boards present. A special programming jack, J711, is provided in the radio for interconnections.

Programming instructions are provided in the respective Programmer Maintenance Manuals.

## **TRANSMITTER**

The transmitter consists of the exciter, frequency synthesizer, TX VCO, and a power amplifier assembly. The PA assembly consists of a PA board mounted along the side of the radio next to the heat sink assembly. The PA board also contains a hermetically sealed antenna relay and a low pass filter.

## **RECEIVER**

The receiver consists of the frequency synthesizer, RX VCO, injection amplifiers, front end, IF and limiter detector. In UHS receivers, a preamplifier board is added in the receiver front end. Audio and squelch circuitry for the receiver is located in the system section of the TRS board. Jacks for the Channel Guard and other structured options are also located in the system area.

## **CONTROL UNITS**

Several "S" series control units are available for use with the DELTA-SX, radio combinations.

The S-500 control unit contains an on-off volume control switch, a rotary channel selector switch for 1, 8, or 16 channels, a MODE A/B switch (optional) to expand the channel select capability to 32, seven segment channel indicators(s), a red transmit indicator, channel busy indicator (optional), and an external tone option jack. Options that may be used with this control unit include Type 90 and 99 tone, squelch operated relay SOR, GE-STAR encoder, and public address.

The S-600 control unit contains an on-off volume control switch, squelch disable switch, red transmit indicator, and a 7 segment channel indicator. A rotary channel select switch permits selection of up to eight- channels. A white power on indicator is used for back lighting the front panel. Space is provided for two optional. pushbutton switches and two optional indicators.

The S-900 series control units designed specifically for the DELTA class radios are highly versatile, software controlled units providing numerous functions and options including:

- Dual priority Scan
- Digital Volume Control
- Digital Squelch Control
- Type 90 or 99 Encode Tones
- GE-STAR Identification

- 128 Channels in -  
8 Modes of 16 Channels each  
or  
4 Modes of 32 Channels each
- Carrier Control Timer (per mode basis)\*
- Channel Guard - Tone or Digital\*
- Channel Frequencies\*
- Home Channel Revert
- Auxiliary Relay Control

## CHANNEL SELECTION

Depending on the control unit used a single rotary or pushbutton selector switch will select up to 16 channels. In radios equipped with more than 16 channels, the control unit contains a MODE A/B switch. The MODE switch allows the user to select a second set of 16 channels (17-32).

The MODE A/B switch may be used to provide mobile-to-mobile communications through an intermediate repeater (repeated path) or direct mobile-to-mobile communications. For example: channel 1 Mode A may be programmed for the repeater frequency (repeated path) while channel 1 Mode B would be programmed for the mobile receive frequency (direct path). Judicious programming will allow selection of repeated or direct communications paths on selected channels.

## MICROPHONE AND HANDSET

A hand held microphone with a built-in transistorized microphone preamplifier is available for use with the radio. The microphone is housed in a sturdy twopiece case, and the extendable coiled cord plugs into the microphone jack at the k of the control unit. The plug is secured to the jack by a retaining screw.

An optional telephone-type hand set is available for use with the radio. The handset uses a dynamic microphone with a built-in microphone preamplifier. The extendable coiled cord plugs into the microphone jack on the back of the control unit, and is secured to the jack by a retaining screw.

- \* These functions are actually performed in the radio. If you down-load, the data is stored in the control unit.

## HOOKSWITCHES

In Channel Guard or other tone applications, a microphone or handset hookswitch is supplied with the radio. The hookswitches are equipped with a Channel Guard disable switch.

Placing the switch in the "up" position (towards the small speaker symbol) disables the Channel Guard decoder. With the switch in the "down" position, the Channel Guard is disabled when the microphone or handset is removed from the hookswitch.

## SPEAKER

A three by five-inch speaker contained in a molded plastic housing provides an audio output of 12 watts with a speaker impedance of four ohms. The speaker leads are terminated in Vehicle Systems Plug P3 which connects to J1-A on the rear of the control unit.

## INITIAL ADJUSTMENT

After the radio has been installed (as described in the Installation Manual), the following adjustments should be made by a certified electronics technician.

## TRANSMITTER ADJUSTMENT

The transmitter adjustments include measuring the forward and reflected power and optimizing the antenna length, then setting the transmitter to rated power output. Next, measuring the frequency and modulation and recording these measurements for future reference. For the complete transmitter adjustment, refer to the Alignment Procedure in the service section of this manual.

## RECEIVER ADJUSTMENT

The initial adjustment for the receiver includes tuning the input circuit to match the antenna. Refer to the Front End Alignment Procedures in the service section of this manual.

## OPERATION

Complete operating instructions for the Two-Way Radio are provided in the Operator's Manual. The basic procedures for receiving and transmitting messages in mobile combinations are as follows:

## **TO RECEIVE A MESSAGE**

1. Turn the radio on by turning the OFF-VOLUME control halfway to the right.
2. Turn the SQUELCH control clock-wise (to the right) as far as possible. A noise will be heard from the speaker.
3. Adjust the VOLUME control for the desired listening level.
4. Turn the SQUELCH control counterclockwise to the left until the noise just cuts off.
5. In multi-frequency radios, select the desired channel.

The radio is now operational.

## **TO TRANSMIT A MESSAGE**

1. Turn the radio on and select the proper channel.
2. If a lengthy message (or several messages) are to be sent, the vehicle engine should be running to maintain the battery charge.
3. Pick up the microphone and listen briefly to the speaker to make sure that no one else is using the channel.

4. Press the push-to-Talk (PTT) switch on the microphone and send the message. The red transmit light on the control unit will glow each time the PTT switch is pressed.

## **MAINTENANCE**

The use of microcomputer technology allows self diagnostic maintenance routines to be incorporated in the microcomputer software. These routines are easy to run and provide a quick analysis of microcomputer and frequency synthesizer operation.

The service section of this manual contains the diagnostic routines, and other maintenance information to service this radio. The service section includes:

- System interconnections
- Mechanical layout
- Disassembly procedures
- Replacement of IC's chip capacitors and resistors
- Microcomputer self diagnostics
- Alignment procedures for the transmitter and receiver
- Troubleshooting flowcharts and waveforms



**Ericsson GE Mobile Communications Inc.**  
Mountain View Road • Lynchburg, Virginia 24502