



Mobile Communications



**65-110 WATT
MOBILE RADIO**

DELTA-S
NARROW BAND, SYNTHESIZED
403-430-450-512 MHz
Mobile Communications
(*NEGATIVE GROUND ONLY*)

TABLE OF CONTENTS

MILITARY SPECIFICATIONS	3
SYSTEM SPECIFICATIONS	3
COMBINATION NOMENCLATURE	6
STRUCTURED OPTIONS	6
DESCRIPTION	7
FREQUENCY SYNTHESIZER	8
EEPROM	8
PROGRAMMING	8
TRANSMITTER	8
RECEIVER	8
CONTROL UNITS	8
CHANNEL SELECTION	9
MICROPHONE AND HANDSET	9
HOOKSWITCHES	9
SPEAKER	9
INITIAL ADJUSTMENT	9
TRANSMITTER ADJUSTMENT	9
RECEIVER ADJUSTMENT	10
OPERATION	10
TO RECEIVE A MESSAGE	10
TO TRANSMIT A MESSAGE	10
MAINTENANCE	10
ILLUSTRATIONS	
FIGURE 1 - TYPICAL MODULE LAYOUT	7

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 burns upon contact. Keep away from these circuits when the transmitter is energized!

MILITARY SPECIFICATIONS

STANDARD	METHODS/PROCEDURES	
	MIL-STD-810-C	MIL-STD-810-D
Low Pressure	500.1/Procedure 1	500.2/Procedure 1
High Temperature	501.1/Procedure 1,2	501.2/Procedure 1,2
Low Temperature	502.1/Procedure 1	502.2/Procedure 1,2
Temperature Shock	503.1/Procedure 1	503.2/Procedure 1
Solar Radiation	505.1/Procedure 1	505.2/Procedure 1
Humidity	507.1/Procedure 2	507.2/Procedure 2
Vibration	514.2/Procedure 8, 10	514.3/Procedure 1
Shock	516.2/Procedure 1,2,3,5	516.3/Procedure 1, 3, 4, 5, 6

SYSTEM SPECIFICATIONS*

FREQUENCY RANGE	403-430 MHz** & 450-512 MHz
BATTERY VOLTAGE	13.8 volts \pm 20% RX 13.6 or 13.4 volts \pm 20% TX
BATTERY DRAIN (Maximum)	
Receive	
Squelched	0.7 amperes
Unsquelled	2.2 amperes
Transmit	
35/40 watts	10.0 amperes at 13.6 volts
30 watts (DOC***)	10.0 amperes at 13.6 volts
50 watts	12.0 amperes at 13.6 volts
80 watts	21.0 amperes at 13.4 volts
90 watts	22.0 amperes at 13.4 volts
100 watts	23.0 amperes at 13.4 volts
FREQUENCY STABILITY	0.0005% or optional 0.0002%
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	100% Receive, 20% Transmit (EIA)
DIMENSION, LESS ACCESSORIES (H x W x D)	
35-50 watts	65 mm x 260 mm x 325 mm (2.5 x 10.2 x 12.7 inches)
80-100 watts	65 mm x 290 mm x 325 mm (2.5 x 11.4 x 12.7 inches)
WEIGHT, LESS ACCESSORIES	
35-50 watts	5.9 kg (12.9 pounds)
80-100 watts	6.5 kg (14 pounds)

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

** 403-430 MHz combinations are for International use (50 Watt Transmitters). 421-430 MHz combinations may be used for domestic applications.

*** Canadian Department of Transportation.

GENERAL

FCC FILING NUMBER (see table below):

RECEIVER	TRANSMITTER	OSCILLATOR STABILITY	POWER OUTPUT	FREQUENCY
ER-140-B	KT-218-B	±5 PPM	40 WATTS	450-470 MHz
ER-140-C	KT-220-B	±5 PPM	100 WATTS	450-470 MHz
	KT-221-B	±5 PPM	35 WATTS	470-494 MHz
ER-140-D	KT-223-B	±5 PPM	90 WATTS	470-494 MHz
	KT-221-C	±5 PPM	35 WATTS	494-512 MHz
	KT-223-C	±5 PPM	80 WATTS	494-512 MHz
ER-140-B	KT-218-B2	±2 PPM	40 WATTS	450-470 MHz
ER-140-C	KT-220-B2	±2 PPM	100 WATTS	450-470 MHz
	KT-221-B2	±2 PPM	35 WATTS	470-494 MHz
ER-140-D	KT-223-B2	±2 PPM	90 WATTS	470-494 MHz
	KT-221-C2	±2 PPM	35 WATTS	494-512 MHz
	KT-223-C2	±2 PPM	80 WATTS	494-512 MHz

DOC FILING NUMBER: RSS-119

TRANSMITTER

CONDUCTED SPURIOUS -85 dB

MODULATION ±4.5 kHz

AUDIO SENSITIVITY 70 to 120 millivolts

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 standards per FCC and EIA.

DISTORTION Less than 2% (1000 Hz)
Less than 5% (300 to 3000 Hz)

DEVIATION SYMMETRY 0.5 kHz maximum

MAXIMUM FREQUENCY

	No Center Tuning	Center Tuning
450-512 MHz	6 MHz	12 MHz
403-430 MHz	5 MHz	10 MHz

RF OUTPUT IMPEDANCE 50 ohms

POWER OUTPUT Rated Power ±0.5 dB

RECEIVER

AUDIO OUTPUT (to 4.0 ohm speaker)	12 Watts with less than 3% distortion.		
SENSITIVITY 12 dB SINAD (EIA Method)	<u>Standard</u>	<u>UHS Preamp</u>	
	0.35 mV	0.20 mV	
20 dB Quieting Method	0.50 mV	0.25 mV	
SELECTIVITY EIA Two-signal Method	-90 dB	-90 dB	
SPURIOUS RESPONSE	-100 dB	-90 dB	
INTERMODULATION	-85 dB	-80 dB	
MODULATION ACCEPTANCE	±7.0 kHz		
SQUELCH SENSITIVITY	8 dB SINAD		
MAXIMUM FREQUENCY SPREAD	No Center <u>Tuning</u> 1 MHz	Center <u>Tuning</u> 2 MHz	1 dB degradation with Center <u>Tuning</u> 2.5 MHz
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).		
RF INPUT IMPEDANCE	50 ohms		

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	Frequency Capacity	Oscillator Stability
N3 DELTA S	R 403-430 MHz	R 403-430 MHz	2 25 kHz	N Narrow Band	035 35 Watts	T 16 Channel	A ±2 PPM
	U 450-470 MHz	U 450-470 MHz			040 40 Watts	Z 32 Channel	A ±5 PPM
	V 470-494 MHz	V 470-494 MHz			050 50 Watts		
	W 494-512 MHz	W 494-512 MHz			090 90 Watts		
					100 100 Watts		

STRUCTURED OPTIONS

Digit A	Digit C	Digit D	Digit F	Digit M	Digit N	Digit R	Digit V
Program- ming	Option	Channel Guard	Fuse	Mounting	Antenna	Receiver Type	Voice Guard
O Test Program	O None	O None	O Standard	O Std Frame & Mtg Hdwe	O None	O None	O None
1 Customer Program	N MII Interface	B Tone/ Digital	N None	N None	A Whip	A UHS Pre Ampl	G Voice Guard
2 S950 Download							

DESCRIPTION

General Electric DELTA-S mobile radio combinations are completely solid state utilizing microcomputer technology and integrated circuits to provide high quality - high reliability radios. The DELTA-S 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 Controlled Frequency Synthesizer
- Up to 32 channels
- 0.0002% or 0.0005% 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 tamper proof when locked

into the plate. When unlocked, the handle can be 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.

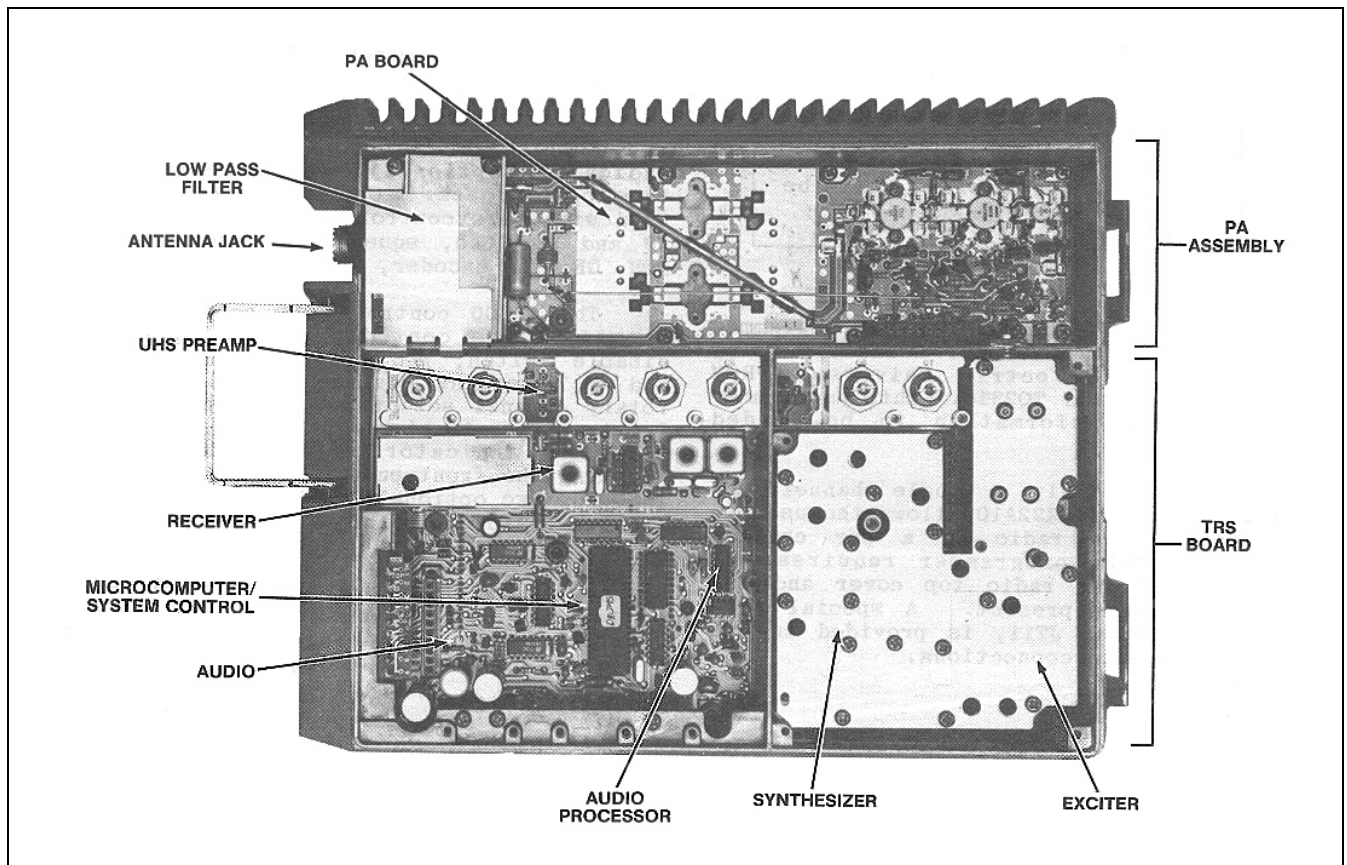


Figure 1 - Typical Module Layout

Excluding option boards, the basic radio mounted in a cast aluminum frame. The two boards are the transmitter-receiver-system (TRS) board 19D9901620G1 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.

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 12.5 kHz.

The EEPROMs can be reprogrammed through the radio front connector using the General Electric Universal PROM Programmer Model TQ2310. 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 pre-amplifier 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-S 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 indicator(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 seven 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 push-button 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

* These features are actually performed in the radio. If you have downloaded, the data is stored in the control unit.

CHANNEL SELECTION

Depending on the control unit used, a single rotary or push-button 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 pre-amplifier is available for use with the radio. The microphone is housed in a sturdy two-piece case, and the extendable coiled cord plugs into the microphone jack at the back of the control unit. The plug is secured to the jack by a retaining screw.

An optional telephone-type handset is available for use with the radio. The handset uses a dynamic microphone with a built in microphone pre-amplifier. 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.

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 clockwise (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 counter-clockwise 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 interconnection
- Mechanical layout
- Disassembly procedures
- Replacement of IC's, chip capacitors, and resistors
- Microcomputer self-diagnostics
- Alignment procedures for the transmitter and receiver
- Troubleshooting flow charts and waveforms



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