SE125 Transmitter

1 Introduction

The SE Series transmitters are computer controlled systems designed around an embedded microprocessor. These systems are capable of remote monitoring and maintenance via Ethernet (optional). All aspects of transmitter setup and operation, with the exception of main power application, come under the direct control of the Controller/Monitor. Setup and control of the Transmitter is performed at the local control panel or by a separate personal computer (PC)/ laptop connected locally or remotely via Ethernet. Options are available for control remotely using phone lines or other carrier, which can handle leased line or dial up modems. The PC or laptop uses custom software to generate a graphical user interface (Web Watch) which allows monitoring of system parameters and provides setup and control of the following:

- Direct Digital Synthesis (DDS) generated RF carrier frequency and Audio Tone Frequencies
- Identifier Morse Code (up to eight (8) characters or numbers)
- Standard alarms
- Additional fault handling based on multipoint voltage, current, and temperature monitoring
- Transfer criteria (dual transmitter only)
- Power limits
- Modulation limits

The integrated operator front panel offers the user controls normally found on an analog transmitter. With the remote application, a separation distance between the Remote Control Unit and the Transmitter of up to 4000 feet is allowed, when using RS485 protocol.

1.1 General Specifications

- **Frequency Range** - continuously variable from 190 - 1800 kHz
- **Frequency Tolerance** - 5ppm standard (1ppm optional) Temperature Controlled Crystal Oscillator (TCXO)
- **RF Power Output** - 10 to 125 Watts RF Output Amplitude Modulated 0-95%; power and modulation level adjustable from local keypad
- **Central Processor** - Renesas M16C 16 bit processor operating at 20 MHz
- **Residual Noise and Hum Levels** - more than 40dB below the carrier level at 95% modulation
- **Spurious Emission** - using the matching antenna coupler, radiated harmonics are more than 70dB below the carrier
- **Type of Emission** - NON, A2A, A3E (optional) or any combination; GID (with optional GPS beacon modulator)
- **Modulation** - NON produces blank carrier with no modulation; A3E Amplitude Modulated voice carrier from audio input line; A2A continuous or keyed tone modulation available with internal 400 Hz or 1020 Hz tone ; Morse Code operation at a speed of 5-15 WPM. Modulation frequency is user-programmable.
- **Power Amplification** - Class D using power MOSFETS
- **Audio Line Input** - balanced, 600 Ohms, -25 to 0dBm
- **Audio Distortion** - less then 1% @ 95% modulation
- **Antenna Connection** - Type N female output standard
- **Monitoring -** monitoring firmware will shutdown the transmitter under the following conditions:

  loss of tone

  continuous tone

  reduced modulation level

  reduced power output below 3dB

  increased power output above 2dB

  VSWR rise above a preset level

  loss of heartbeat pulse from Renesas processor

  incorrect Morse code identification

With a dual transmitter, the front panel processor initiates a transmitter transfer, when a fault condition occurs.

- **Built-in Test Equipment (BITE)** - Front panel or remote monitoring (via Web Watch) of critical parameters within transmitter modules covers all stages of operation; built in frequency monitor maintains proper frequency operation
- **Display** - 40 character by 4 line LCD with white characters on a blue background
- **User Interface** - power control keypad with numeric and functional membrane switches for ease of data entry and control without the need of a computer
- **Metering** - dual front panel analog meters for forward and reflected power, modulation percentage, final PA voltage and current
- **Interface** - barrier block connector for user selectable RS232/RS485 standard for Remote Control Unit interface.
- **Optional RJ45 Ethernet Connection** - Ethernet can be configured either hard wired IP address or server set using DHCP (TCP/IP or UDP). Full control and monitoring available through IP connection. Internal firmware supports Ethernet interface. No additional user software required.
- **Power Input** - 100-264VAC, 47-63Hz, or 48VDC
- **Environmental** - ambient temperature -50ºC to +55ºC, relative humidity 100% non-condensing.

1.2 Model SE125 General Description

The SE series non-directional beacon is a microprocessor controlled Amplitude Modulated (AM) transmitter with output power adjustable from 10 - 125 Watts. The radio frequency (RF) section uses field effect transistor (FET) switching technology in the power amplifier (PA), modulator, high voltage (HV) and low voltage (LV) regulator modules resulting in an efficient system.

The front control panel utilizes membrane switches and an easy to view 40 line by 4 character LCD with white characters on a blue background. Front panel controls include Desired Carrier Frequency, Tone Frequency, Call Sign/Identifier, Output Power, Modulation Level, Main Transmitter select, Mode of Operation, Monitor Enable, and controls for monitoring critical transmitter parameters and test modes.

The Master Control and Transmitter Control sections utilize the Renesas M16C/29 microprocessor, which was designed specifically for efficient embedded systems. The Transmitter Control utilizes modern direct digital synthesis (DDS) technology to create the precision audio and radio frequencies needed by the RF section. Beacon operation is program controlled and monitored. Most of the operational parameters are user-definable thus facilitating customized equipment configurations. Using an Ethernet connection, the user has complete control of the SE transmitter. In addition, a personal computer (PC) running an Internet Browser and connected to the Transmitter's IP address can communicate with, configure, and monitor the system.

All standard fault conditions such a Low Power, No-Tone, VSWR, and Continuous Tone are monitored. Additional fault conditions designed to protect the equipment are reported via an interrupt request (IRQ) to trigger an immediate response from the controller.

Other important system parameters such as PA current, PA voltage, AC and DC current and voltage, high voltage, and RF current are also monitored.

RF frequency is monitored with an independent counter and is correctable beyond the stated base frequency accuracy. RF Power and Modulation percentage readings are also corrected to yield near test equipment quality measurements.

System configuration includes discreet control Morse Code entry as well a maximum of eight (8) character ID sequences. Dual system operation is available in a totally redundant system including two independent Transmitter Controllers, RF sections and Power Supplies.

Optional emergency battery power is supported with both charge and discharge voltage and current being monitored. The DC automatic disconnect (DCAD) feature, which protects the battery stack from excessive discharge, is user-definable, and allows the system to be optimized for whatever battery type the user chooses.

Optional automated weather observing system (AWOS) voice operation is supported with automatic gain control (AGC) ensuring proper operation over a wide range of user inputs. Band pass filtering limits the audio output to satisfy Federal Communications Commission (FCC) bandwidth requirements.

The transmitter is provided in an IP66 rated enclosure or a 19 inch rack mountable configuration.

Qualifications: Transmitter is designed to meet applicable requirements of International Civil Aviation Organization (ICAO), Federal Communications Commission (FCC), Federal Aviation Authority (FAA), Transport Canada, United Kingdom's Civil Aviation Authority (CAA), and the European Commission (CE).

1.3 SE Series Transmitter Specifications

Danger: Shock Hazard. Serious injury or death from electrical shock is possible when handling electrical power input wiring. Ensure AC and DC main breakers are open. Observe any applicable standards regarding Logout/Tagout (LOTO) procedures.

1.3.1 Maximum Input Current Requirements

The maximum continuous AC and DC current requirements are tabulated in Table 1-1 and Table 1-2. The main AC and DC power breakers selected should be rated accordingly and, in the case of the AC breaker, incorporate appropriate delay.

1.3.1.1 Single Transmitter

The maximum current is based on a single transmitter running at 125 Watts power and 100% continuous modulation. Fault protection circuitry will shutdown the system if these are exceeded.

Table 1-1. Single Transmitter MAX Input Current Requirements (Amps)

SYSTEM	100-264 VAC	BATTERY (38-52 VDC)
SE125	3.2A	7.6A

1.3.1.2 Dual Transmitter

The maximum current is based on both transmitters running simultaneously (AC only) at 125 Watts and 100% continuous modulation. Fault protection circuitry will shutdown the system if these are exceeded.

Table 1-2. Dual Transmitter MAX Input Current Requirements (Amps)

SYSTEM	100-264 VAC	BATTERY (38-52VDC) DC BACKUP NOT INTENDED FOR TEST MODE OPERATION
SE125	6.0A	14.8

1.3.2 RF Specifications

- **Type of Emission** - NON, A2A, A3E (optional) or any combination; GID (with optional GPS beacon modulator)
- **Frequency Range** - continuously variable from 190 - 650 kHz or optionally 650-1250kHz and 1500-1800kHz
- **Frequency Stability** - better than 5ppm from -20ºC to +70ºC
- **RF Power Output** - continuously variable from 10 - 125 Watts
- **PA Efficiency** - better than 90%
- **Tone Modulation Frequency** - user definable 400 or 1020 Hz
- **Tone Modulation Depth** - user definable from 0 - 95%; modulation tracks carrier power changes
- **Identification Keying** - any combination of Morse code letters or numerals (8 character maximum length)
- **Spurious Emission** - harmonics are more than 65dB below the 125 Watt carrier (measured at a dummy antenna)
- **Residual Noise and Hum Levels** - more than 40dB below the carrier level at 95% modulation

1.3.3 Transmitter Environment Tolerance

Continuous unattended operation in the following environments:

- ambient temperature, -50℃ to +55℃
- relative humidity, 0-100% non-condensing
- high salinity (as encountered in offshore conditions)

1.3.4 Circuit Protection (hardware)

- input AC fusing

- input DC fusing
- Low voltage/High voltage Power Supply over - current shutdown
- modulator automatic over-current shutdown
- RF PA automatic over-current shutdown
- hardware triggered fault interrupts for:

HVPS_HIGH/LOW SIDE	High voltage power supply high/low side current (overload)
PAI(F)	Power amplifier over current
PWR_CTRL_I_OVLD	Power control current (overload)
MOD_SHTDN	Modulator shutdown
MOD_I_OVLD	Modulator current overload

1.3.5 Dual Operation (Optional)

1.3.6 Total Redundancy

- two independent transmitter sections with independent transmitter controller sections with separate LV/HV power supplies
- Monitor Control communicates and controls both Transmitters via I^2C bus
- automatic transferring

1.3.7 Active Monitoring and Control

Transmitter shutdown (single) or transfer (dual) conditions:

- loss of modulation (carrier only, duration = 30 sec)
- low modulation (70%, duration = 30 sec)
- continuous modulation (no keying, duration = 30 sec)
- low power (50%, duration = 40 sec)
- high power (120%, duration = 40 sec)

- VSWR (>2.62:1, duration = 2 sec)
- under-temperature (<-40°C, duration = 120 sec)
- over-temperature (>70°C, duration = 120 sec)
- ID sequence error (immediate action)
- over/under-frequency (>100Hz, duration = 120 sec)

1.3.8 Passive Monitoring

- battery charge/discharge rates
- antenna current

1.3.9 Local PC Control

A local PC control is established using a standard PC running an Internet browser connected to the Ethernet port located on the front panel of the SE Transmitter.

1.3.10 Master Control Panel

Displays the following without the need of a PC:

- selected transmitter
- RF forward power
- RF reflected power
- modulation percent
- PA voltage
- PA current
- RF frequency
- AF frequency
- power select status (transmitter activated)
- primary transmitter selected
- operational mode (Carrier/Ident/Continuous)
- shutdown alarms
- monitor disabled

Controls the following without the need of a PC:

- displayed transmitter selection
- RF forward power, RF reflected power, or modulation % display
- PA voltage, PA temperature, or PA current display
- RF frequency or AF frequency display
- primary transmitter selection
- operational mode (Carrier/Ident/Continuous) selection
- monitor functions (alarms) disable
- simultaneous test mode operation for both transmitters (dual only)

1.3.11 Remote Operation (optional)

- multiple remote computers
- Ethernet communication via embedded server
- multiple Remote Control Units daisy chained utilizing RS485 up to 4000 ft (1220m)

1.3.12 AWOS Operation (optional A3E mode)

Optional PCB enabling external voice modulation and featuring:

- automatic gain control (prevents over-modulation) capture, -30dBm to +5dBm
- automatic keyer tone modulation level reduction
- band pass filtering, 300 - 3000 Hz
- nominal user input of -17dBm @ 600 Ohms for 95% modulation