

## SE250 Operational Description



# 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. 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 a standard Internet browser 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
- Power value
- Modulation value

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 (1220m) 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** - 25 to 250 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 95% modulation
- **Spurious Emission** - using the matching antenna coupler, radiated harmonics are more than 70dB below the carrier
- **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 at 400 Hz or 1020 Hz.
- **Power Amplification** - Class D using power MOSFETS
- **Audio Line Input** - balanced, 600 Ohms, -25 to 0dBm
- **Audio Distortion** - less than 1% @ 95% modulation
- **Antenna Connection** - Type N female output standard
- **Monitoring** - monitoring firmware will shutdown the primary transmitter and initiate a transfer to secondary under the following conditions:
  - loss of tone
  - continuous tone
  - reduced modulation level
  - reduced power output below 3dB
  - increased power output above 120%
  - VSWR rise above a reset level
  - loss of heartbeat pulse from Renesas processor
  - incorrect Morse code identification
- **Built-in Test Equipment (BITE)** - Front panel or remote monitoring (via Web Watch) of critical parameters within transmitter modules covers all stages of operation
- **Digital Display** - A LCD screen 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 connections for AC/DC Voltage, Antenna tuning unit and Remote Control Unit (RCU). User can select RS-232 or RS485 for RCU communications.
- **RJ45 Ethernet Connection** - Ethernet can be configured either static 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 Battery backup
- **Environmental** - ambient temperature -30°C to +55°C, relative humidity 100% non-condensing.

## 1.2 Model SE250 General Description

The SE series non-directional beacon is a microprocessor controlled Amplitude Modulated (AM) transmitter with output power adjustable from 25 - 250 Watts. The radio frequency (RF) section uses field effect transistor (FET) switching technology in the power amplifier (PA) and power control modulator (PCM) modules resulting in a highly efficient system.

The front control panel utilizes membrane switches and an easy to view 40 line by 4 character Liquid Crystal Display (LCD) with white characters on a blue background. Front panel controls include 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.

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 as 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 which is correctable to near test equipment 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 battery voltage and discharge current being monitored. The DC automatic disconnect (DCAD) feature, which protects the battery stack from excessive discharge, is user-selectable on or off.

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 a 19 inch rack mountable configuration.

Qualifications: Transmitter is designed to meet applicable requirements of the 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.. 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 Transmitter current

The maximum current is based on both transmitters running simultaneously (AC only) at 250 Watts and 100% continuous modulation. Fault protection circuitry will shutdown the system if these are exceeded.

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

SYSTEM	100-264 VAC	BATTERY (38-52 VDC) DC BACKUP NOT INTENDED FOR TEST MODE OPERATION
SE250	12.9A	14.8A

### 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 -20°C to +70°C
- **RF Power Output** - continuously variable from 25 - 250 Watts
- **PA Efficiency** - better than 90%
- **Tone Modulation Frequency** - user-selectable 400 or 1020Hz

- **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 70dB below the 250 Watt carrier (measured at a dummy antenna)
- **Residual Noise and Hum Levels** - more than 40dB below 95% modulation

### 1.3.3 Transmitter Environment Tolerance

Continuous unattended operation in the following environments:

- ambient temperature, -30 °C to +55 °C
- relative humidity, 0-100% non-condensing
- operation up to 10,000ft (3050m)

### 1.3.4 Circuit Protection (hardware)

- input AC circuit breaker
- input DC fuse
- ATU 12VDC fuse
- Power Control Modulator automatic over-current shutdown
- RF PA automatic over-current shutdown
- hardware triggered fault interrupts for

PAI_FAULT	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 Total Redundancy**

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

### **1.3.6 Active Monitoring and Control**

Transmitter transfer shutdown 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 = 30 sec)
- high power (120%, duration = 30 sec)
- VSWR (>2.62:1, duration = 2 sec)
- under-temperature (<-30 °C, duration = 120 sec)
- over-temperature (>70 °C, duration = 120 sec)
- ID sequence error (immediate action)
- over/under-frequency (>100Hz, duration = 120 sec)

### **1.3.7 Passive Monitoring**

- battery discharge rate
- antenna current

### **1.3.8 Local PC Control**

Local PC control is established using a Desktop or Laptop personal computer (PC) running Vista, XP or Windows 7 running an Internet browser connected to the Ethernet port located on the back panel of the SE Transmitter.

### **1.3.9 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:

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

### **1.3.10 Remote Operation (optional)**

- Allows full monitoring and basic control over the existing transmitter
- All readings at the transmitter are available at the RCU via RS-485 at a distance of up to 4,000ft (1,220m)
- Selection of Primary Transmitter can be made and the system Powered Up or Down. All Built-In Test Equipment data is displayed on the LCD screen

- Indications for Primary, Secondary and Fail are provided, as well as those for ICAO Annex 10 Chapter 3.4 shutdown requirements
- Power provided by external 12VDC wall-mounted power supply or customer's 12VDC source

### **1.3.11 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

## **1.4 Equipment Weights**

SE250 Dual Transmitter	(SLF33030)	173 lbs. (78KG)
PC3000 Antenna Coupler	(SLF20020)	39 lbs. (18KG)