SE250 Transmitter

1 Introduction

The Southern Avionics SE250 is a dual configuration Non-Directional Beacon (NDB) comprised of two fully redundant 20 to 250 watt carrier power Digital NDB transmitters with auto-transfer unit housed in a 19 inch rack cabinet for indoor installation.

The SE250 includes BITE, Direct Digital Synthesis (DDS), LCD display, membrane keypad and Remote Monitoring & Maintenance (RMM) using the optional Ethernet interface.

All user controls normally found on an analog transmitter are located on the front panel with two analog meters. A 40 character by 4 line LCD and power control keypad with numeric and functional membrane switches is provided for ease of data entry and control without the need of a computer.

Setup and control of the SE250 can also be performed using a personal computer (PC) or laptop connected locally or remotely using the optional Ethernet feature.

The Ethernet interface allows customers to control their Beacon from various points on their Local Area Network (LAN) or the World Wide Web.

Operators can access the transmitter homepage simply by connecting a standard PC or laptop to the RJ45 jack on the SE transmitter. At the homepage the operator can monitor system parameters; setup and control is provided for the following:

From the homepage, system parameters can be monitored. Setup and control is provided for the following:

- (DDS)-generated RF carrier and Audio Tone frequencies
- Morse Code Identifier
- Standard alarms
- Fault handling
- Transfer criteria
- Power limits
- Modulation limits

An optional Remote Control Unit (RCU) is available which uses phone lines or other carriers that can handle leased line or dial-up modems. The RCU allows full monitoring and basic control of the transmitter.

1.1 General Specifications

- **Frequency Range** - continuously variable bands: 190 - 650, 650 to 1250, and 1500 to 1800 kHz
- **Frequency Tolerance** - 5ppm standard (1ppm optional) Temperature Controlled Crystal Oscillator (TCXO)
- **RF Power Output** - 20 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 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 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 2dB

  VSWR rise above a preset 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; built in frequency monitor maintains proper frequency 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.
- **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 SE250 General Description

The SE series non-directional beacon is a microprocessor controlled Amplitude Modulated (AM) transmitter with output power adjustable from 20 - 250 Watts. The radio frequency (RF) section uses field effect transistor (FET) switching technology in the power amplifier (PA), power control modulator (PCM), high voltage (HV) and low voltage (LV) regulator modules resulting in an extremely 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 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 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 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 250 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	110-264 VAC	BATTERY (38-52 VDC)
SE250	6.6A	11.4A

1.3.1.2 Dual Transmitter

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

SYSTEM	100-264 VAC	BATTERY (38-52VDC) DC BACKUP NOT INTENDED FOR TEST MODE OPERATION
SE250	12.9A	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 20 - 250 Watts
- **PA Efficiency** - better than 90%
- **Tone Modulation Frequency** - user definable 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 65dB below the 250 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°C to +55°C
- 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
- Power Control 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_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 LV/HV power supplies
- Monitor Control communicates and controls both Transmitters via I^2C bus
- automatic transferring

1.3.6 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)

1.3.7 Passive Monitoring

- battery charge/discharge rates
- antenna current

1.3.8 Local PC Control

A 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 front 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 be 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