

# ACRONYMS & ABBREVIATIONS

A	ampere
AC	alternating current
AGC	automatic gain control
AGL	above ground level
ANT	antenna
ATU	antenna tuning unit
AUTO	automatic
AWG	American wire gauge
AWOS	automated weather observing system
BATCHG +/-	battery charger +/-
BITE	built in test equipment
BTRY +/-	battery +/-
BNC	Bayonet Neill-Concelman
BOM	bill of materials
CARR	carrier
CD	compact disc
COM	communication
CONT	continuous
CPU	central processing unit
dBm	decibel referenced to 1 milliwatt

DMM	digital multi meter
DC	direct current
DCAD	DC automatic disconnect
DDS	direct digital synthesis
ESD	electrostatic discharge
FWD	forward
GND	ground
HV	high voltage
HZ	Hertz
ID	identifier
IDENT	identifier
I/O	input/output
LCD	liquid crystal display
LINE 1/ LINE 2	ac input voltage
LOTO	lock out/tag out
LVPS	low voltage power supply
MOD	modulation
MSEC	millisecond
MSK	minimum shift keyed
N/A	“not applicable, not available”
NDB	non-directional beacon
NVRAM	non-volatile random access memory
PA	power amplifier
PAI	power amplifier current

PAV	power amplifier voltage
PC	personal computer
PCB	printed circuit board
PE GND	protective earth ground
PPM	parts per million
PWM	pulse width modulation
RAM	random access memory
REFL	reflected
RF	radio frequency
RG	radio grade
ROM	read only memory
RS	recommended standard
SAC	Southern Avionics Company
SE	current digital series transmitter
sd	shutdown
TCXO	temperature controlled oscillator
TX	transmitter
V	“volts, voltage”
V <sub>AC</sub>	alternating current voltage
V <sub>DC</sub>	direct current voltage
V <sub>MAX</sub>	maximum voltage
V <sub>MIN</sub>	minimum voltage
V <sub>PP</sub>	volts peak-to-peak
VSWR	voltage standing wave ratio

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# 1 INTRODUCTION:

## 1.1 SE Series Introduction

The SE Series beacon 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 Controller/Monitor is performed by a separate personal computer (PC) or laptop connected either locally or remotely via one of the hard wire protocols mentioned above, or remotely using phone lines or any other carrier which can handle a standard modem. The PC or laptop uses custom software to generate a graphical user interface that allows monitoring of system parameters and provides setup and control of the following:

- Direct Digital Synthesis (DDS) of RF frequency and Audio Tone Frequency
- Identifier Morse code dot, dash, and space intervals
- Customer IDENT sequence
- Standard alarms
- Additional fault handling based on multipoint voltage, current, and temperature monitoring
- Transfer criteria (dual transmitter only)
- Power limits
- Modulation limits

Additionally, an intergraded operator front panel that offers the common user controls normally found on an analog transmitter. With the remote application, a separation distance between the operator panel and the transmitter of up to 4000 feet is allowed by the RS485 protocol employed.

## 1.2 SPECIFICATIONS: SE Series Transmitter

- **Frequency range** - continuously variable from 190 -1800 kHz, in 190 - 650 kHz, 500 - 1250 kHz, and 1500 - 1800 kHz bands.
- **Frequency tolerance** - 5PPm TCXO Oscillator standard. Optional 1PPm TCXO.
- **RF power output** - 10 - 125 Watts RF Output Amplitude Modulated 0-95%. Power and modulation level adjustable from front keypad.
- **Central Processor** - Renesas M16C 16 bit processor operating at 20 Mhz. Optional dual 50 Ohm unbalanced outputs selectable from front panel.
- **Noise and hum levels** - more than 50 dB below the carrier level
- **Spurious emission** - using the matching antenna coupler, radiated harmonics are more than 70 dB 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 or user programmable tone from 30-3000 Hz. Morse code operation at a speed of 5-15 WPM. All these parameters are user programmable.
- **Power Amplification** - Class D using power MOSFETS.
- **Audio line input** - Balanced, 600 Ohms, -25 to 0 dBm level
- **Audio Distortion** - Less than 1% @ 95% modulation
- **Antenna** - Type - N female output standard.
- **Monitoring** - Built in firmware monitoring shuts transmitter down under the following conditions:
  - Loss of tone
  - Continuous tone
  - Reduced modulation level
  - Reduced power output below a 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 of critical parameters within transmitter modules covers all stages of operation. Also, built in frequency counter maintains proper frequency operation.
- **Display** - 40 character by 4 line LCD with white characters on a blue background.
- **User interface** - Power control keypad
- **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.
- **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 - 30 degree C to +70 degree C relative humidity 0-95% non-condensing. High Salinity environments as encountered in offshore conditions when housed in optional IP66 enclosure.

## 1.2.1 Model SE125 General Description

The SE series non-directional beacon is a microprocessor controlled amplitude modulated (AM) transmitter with calibrated 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, and high voltage (HV) and low voltage (LV) regulator modules resulting in an efficient system.

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

The Controller/Monitor section of the system has at it's heart the Renesas M16C/29 microprocessor, which was designed specifically for efficient embedded systems. The Controller/ Monitor 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 the furnished user friendly operational software interfaces through the RS232/RS485 port connector to communicate with, configure, and optionally monitor the system.

All of the standard fault conditions like Low Power, No-Tone, VSWR, and Continuous Tone are monitored. The user can set the parameters under which these faults are triggered and how they are acted upon. 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 and logged to allow long term trends to be analyzed. 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 measurement.

System configuration includes discreet control of all of the Morse code timing parameters as well as virtually unlimited ID sequences. Dual system operation is available in a totally redundant system including two independent Controller/Monitors that communicate with each other ensuring system control integrity.

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. Bandpass filtering limits the audio output to satisfy Federal Communications Commission (FCC) bandwidth requirements.



The Single and the Dual transmitter beacons are available with an enclosure or a 19 inch rack mountable version. The enclosure version consists of a cabinet designed for outside operation and meets IP66 specifications.

Qualifications: Enclosure version meets 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).

## 1.2.2 SE Series Transmitter Specifications

	<p><b>Danger: Shock Hazard. Serious injury or death</b> 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.</p>
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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.

### SE SERIES SINGLE TRANSMITTER



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

### 1.2.2.1 Maximum Input current Requirements

**MAXIMUM INPUT CURRENT REQUIREMENTS (AMPS)**

SYSTEM	115 VAC	230 VAC	BATTERY (48VDC)
SE125	2.24	1.12	4.55

**Table 1-1. Transmitter Power Requirements**

### SE SERIES DUAL TRANSMITTER



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

MAXIMUM INPUT CURRENT REQUIREMENTS (AMPS)

SYSTEM	115 VAC	230 VAC	BATTERY (48VDC)
SE125	4.48	2.24	4.55

Table 1-2. Dual Transmitter Power Requirements

### 1.2.2.2 RF Specifications

- **Type of emission** - NON, A2A, A3E (optional) or any combination; GID (with optional GPS beacon modulator)
- **Frequency range** - continuously variable from 190 -1800 kHz, in 190 - 650 kHz, 650 - 1250 kHz, and 1500 - 1800 kHz bands for SE125
- **Frequency stability** - better than 5PPM from -20°C to +70°C
- **RF power output** - continuously variable from 10 - 125 Watts
- **PA efficiency** - better than 90% from 5 - 50 and 10 - 100 Watts, carrier only
- **Tone modulation frequency** - user definable from 0 - 3000 Hz (typically 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 (10 character maximum length) with any user set values pertaining to the length of dots and dashes, the time between them and the number of repetitions of the identification code per minute (character length dependent)
- **Spurious emission** - harmonics are more than 65 dB below the 25, 50, and 125 Watt carrier (measured at a dummy antenna)
- **Noise and hum levels** - more than 40 dB below the carrier level

### 1.2.2.3 Transmitter Environment Tolerance

Continuous unattended operation in the following environments:

- Ambient temperature, -30°C to +55°C
- Relative humidity, 0-95% non-condensing
- High salinity (as encountered in offshore conditions)
- Enclosure meets IP66 standard

#### **1.2.2.4 Circuit Protection (hardware)**

- Input AC fusing
- Input DC fusing
- Low voltage/High voltage Power Supply
- 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

#### **1.2.2.5 Software (user definable)**

- No tone % mod
- Low/high power
- Calculated VSWR fold-back timeout retries
- DC automatic disconnect (DCAD) of batteries

#### **1.2.2.6 Dual Operation (Optional)**

#### **1.2.2.7 Total Redundancy**

- Two Independent Transmitter Sections with independent Transmitter Controller sections with separate LV/HV power supplies
- Controller/Monitor cross communication VIA I2C bus
- Automatic transferring

### **1.2.2.8 Active Monitoring and Control**

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

- Loss of modulation (carrier only, duration >30 sec)
- Low modulation (user defined value, duration >30 sec)
- Continuous modulation (no keying, duration >30 sec)
- Low power (user defined value, duration >30 sec)
- High power (user defined value, duration >30 sec)
- VSWR (immediate action)
- Over-temperature (duration >30 sec)
- ID sequence error\_(change in the code, immediate action)
- Frequency out of tolerance (+/- 100Hz)

### **1.2.2.9 Passive Monitoring**

- Battery charge/discharge rates
- Antenna current

### **1.2.2.10 Local PC Control**

A standard PC running an internet browser connected to the ethernet port located on the front panel of the SE Transmitter

### **1.2.2.11 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)

#### **1.2.2.12 Remote Operation (Optional)**

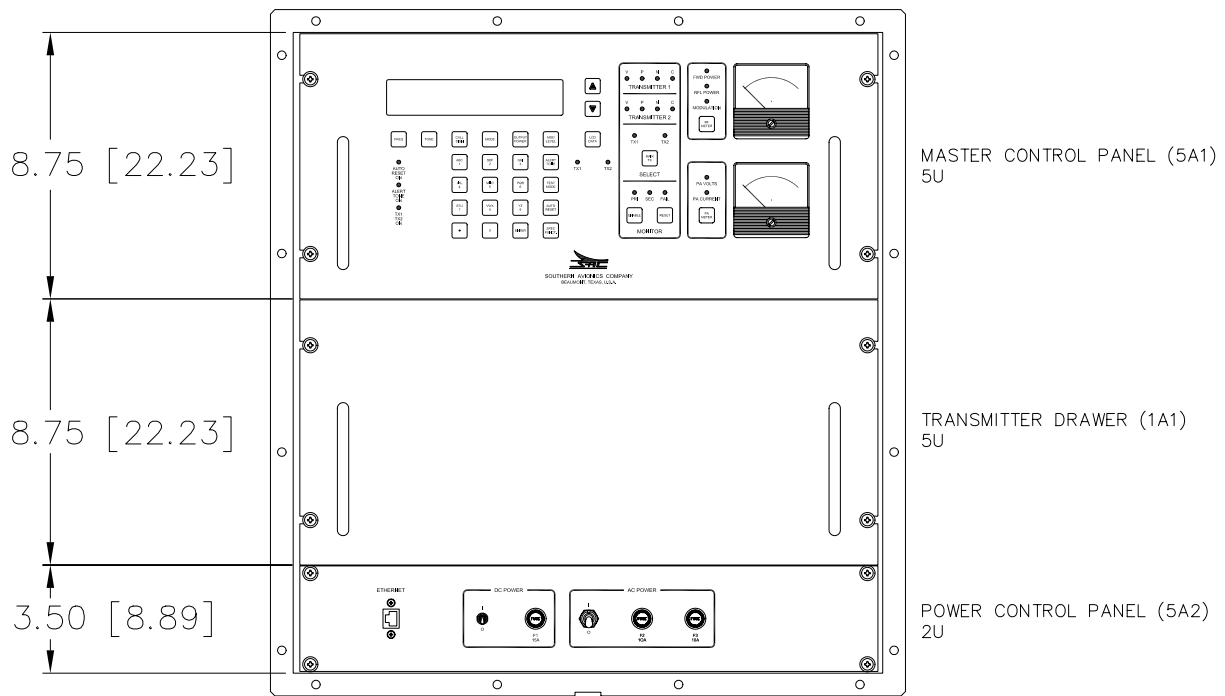
- Multiple remote computers
- Ethernet Communication via embedded server

#### **1.2.2.13 AWOS Operation (optional A3E mode)**

Plug in PCB enabling external voice modulation and featuring:

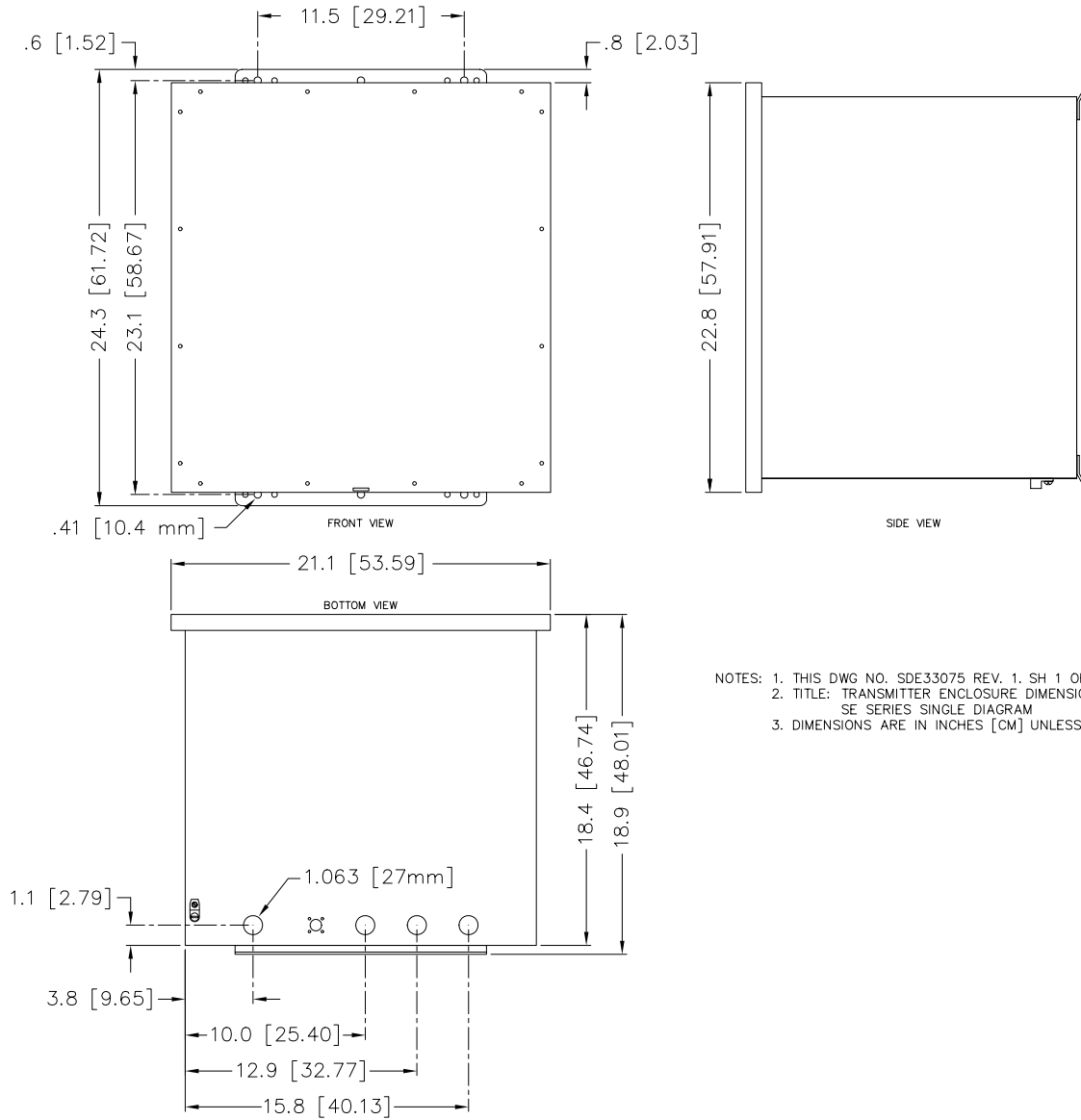
- Automatic gain control (prevents over-modulation) capture, -30dBm to +5dBm
- Automatic keyer tone modulation level reduction
- Bandpass filtering, 300 - 3000 Hz
- Nominal user input of -17dbm @ 600 ohms for 95% modulation

### 1.2.3 SE Series Single Transmitter



NOTES: 1. THIS DWG NO. SDE33075 REV. 1. SH 2 OF 2  
 2. TITLE: TRANSMITTER PORTRAIT SE SERIES SINGLE DIAGRAM

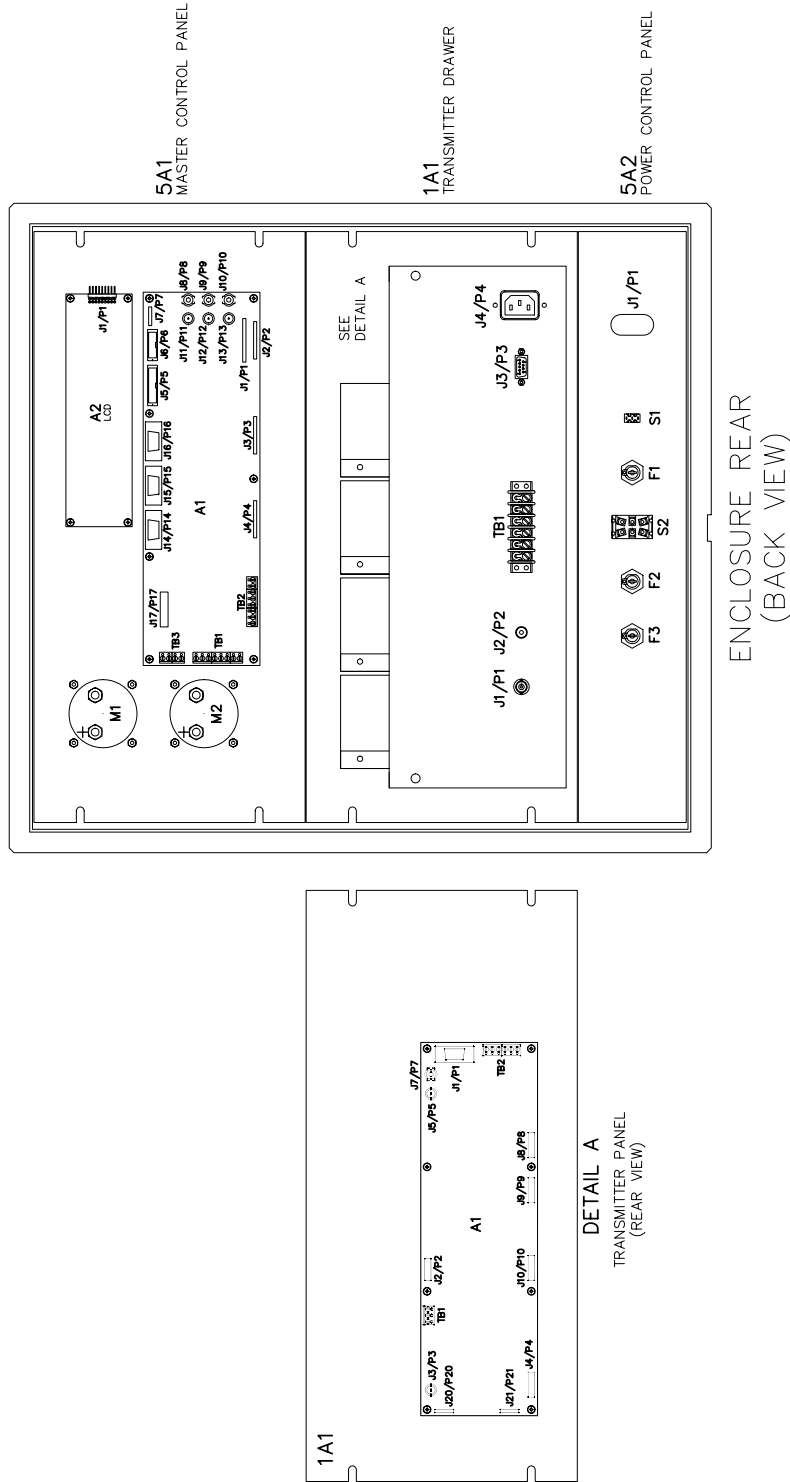
Figure 1-1. SDE33075 - SE Single Transmitter portrait



- NOTES: 1. THIS DWG NO. SDE33075 REV. 1, SH 1 OF 2  
 2. TITLE: TRANSMITTER ENCLOSURE DIMENSIONS  
 SE SERIES SINGLE DIAGRAM  
 3. DIMENSIONS ARE IN INCHES [CM] UNLESS NOTED.

Figure 1-2. SDE33075 - SE Single Transmitter dimensions





NOTES: 1. THIS DWG NO. SDE33082 REV. 1. SH 1 OF 3  
 2. TITLE: SE SERIES SINGLE CONNECTION DIAGRAM.

Figure 1-3. SDE33082 - SE Single unit connection diagram (1 of 3)

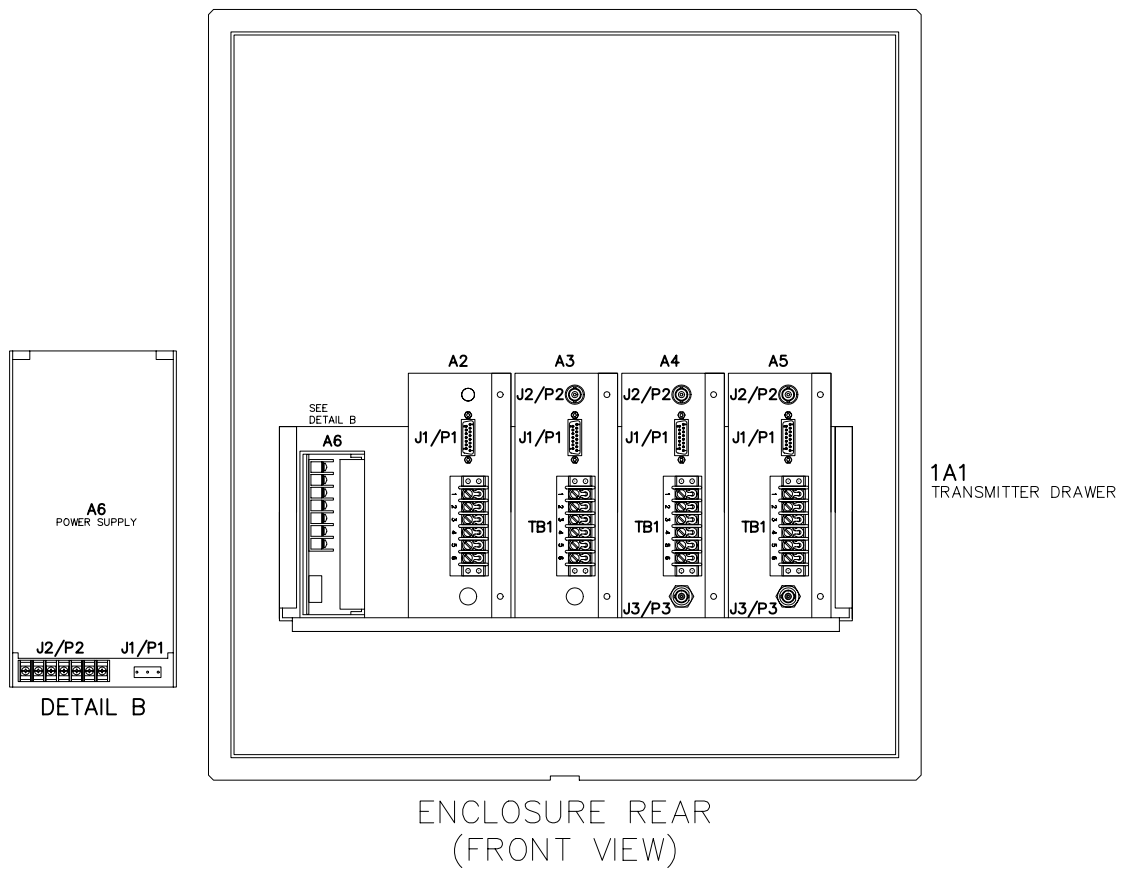
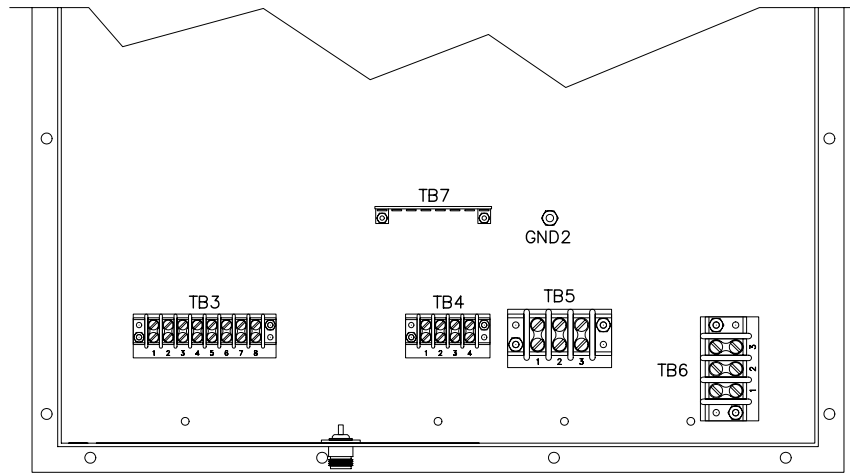
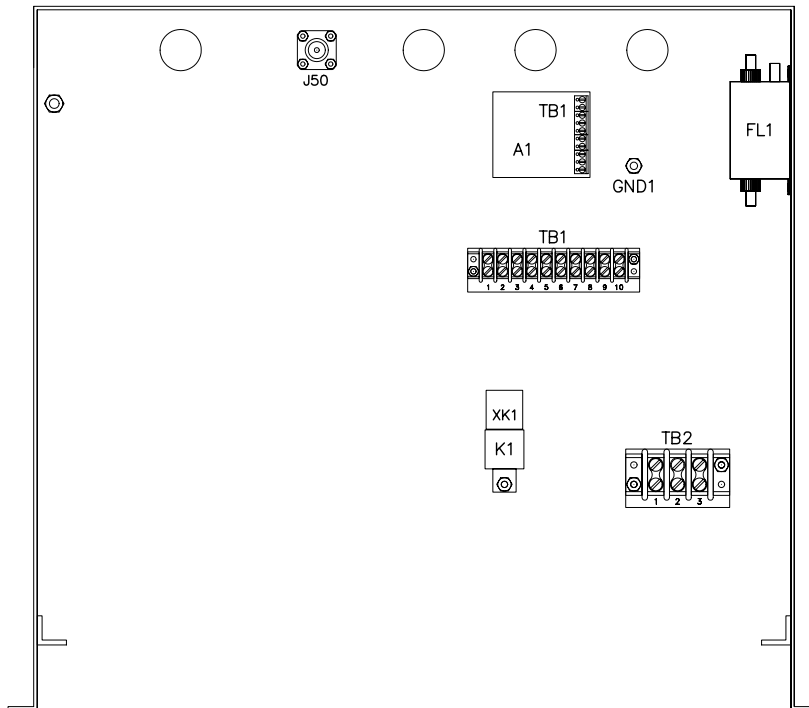


Figure 1-4. SDE33082 - SE Single unit connection diagram (2 of 3)



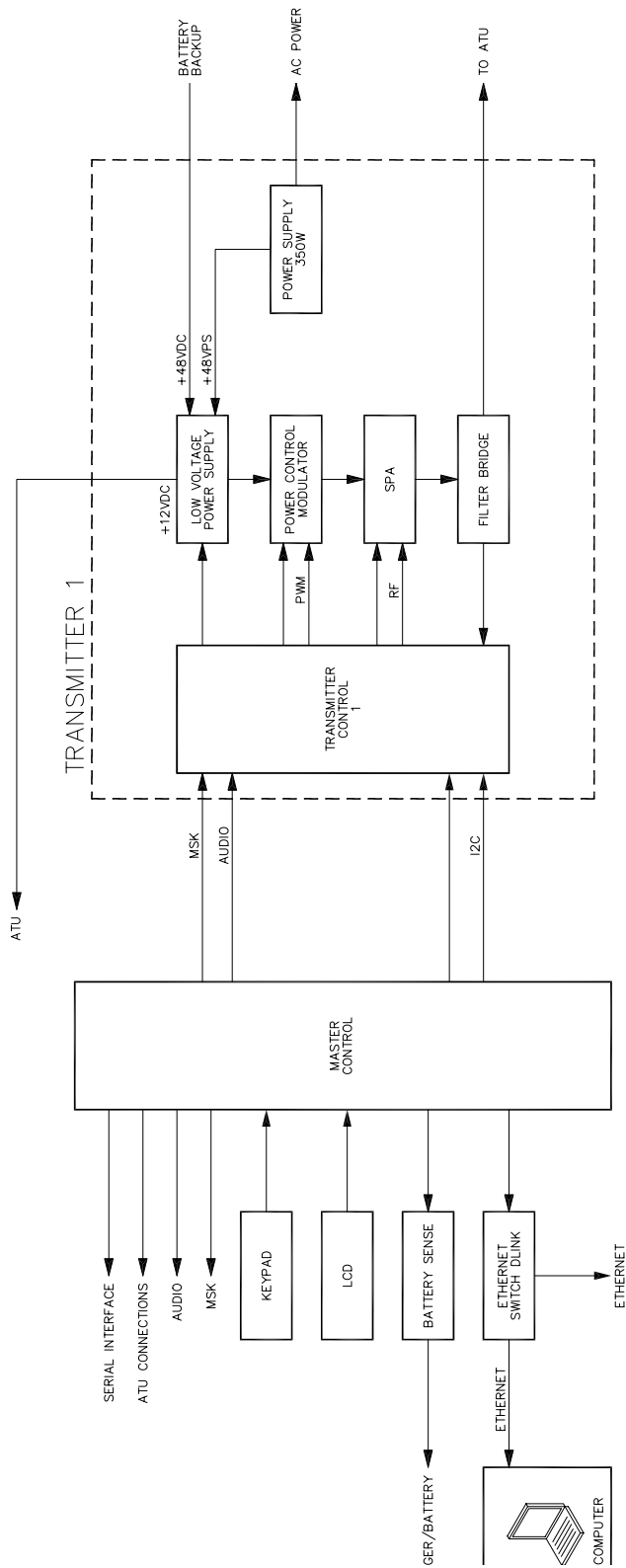
ENCLOSURE REAR  
(FRONT VIEW)



ENCLOSURE BOTTOM  
(TOP VIEW)

- NOTES: 1. THIS DWG NO. SDE33082 REV. 1. SH 3 OF 3  
2. TITLE: SE SERIES SINGLE CONNECTION DIAGRAM.

**Figure 1-5. SDE33082 - SE Single unit connection diagram 3 of 3)**



NOTES: 1. THIS DWG NO. SDB33001 REV. 1.  
 2. TITLE: SE SERIES SINGLE TRANSMITTER BLOCK DIAGRAM.

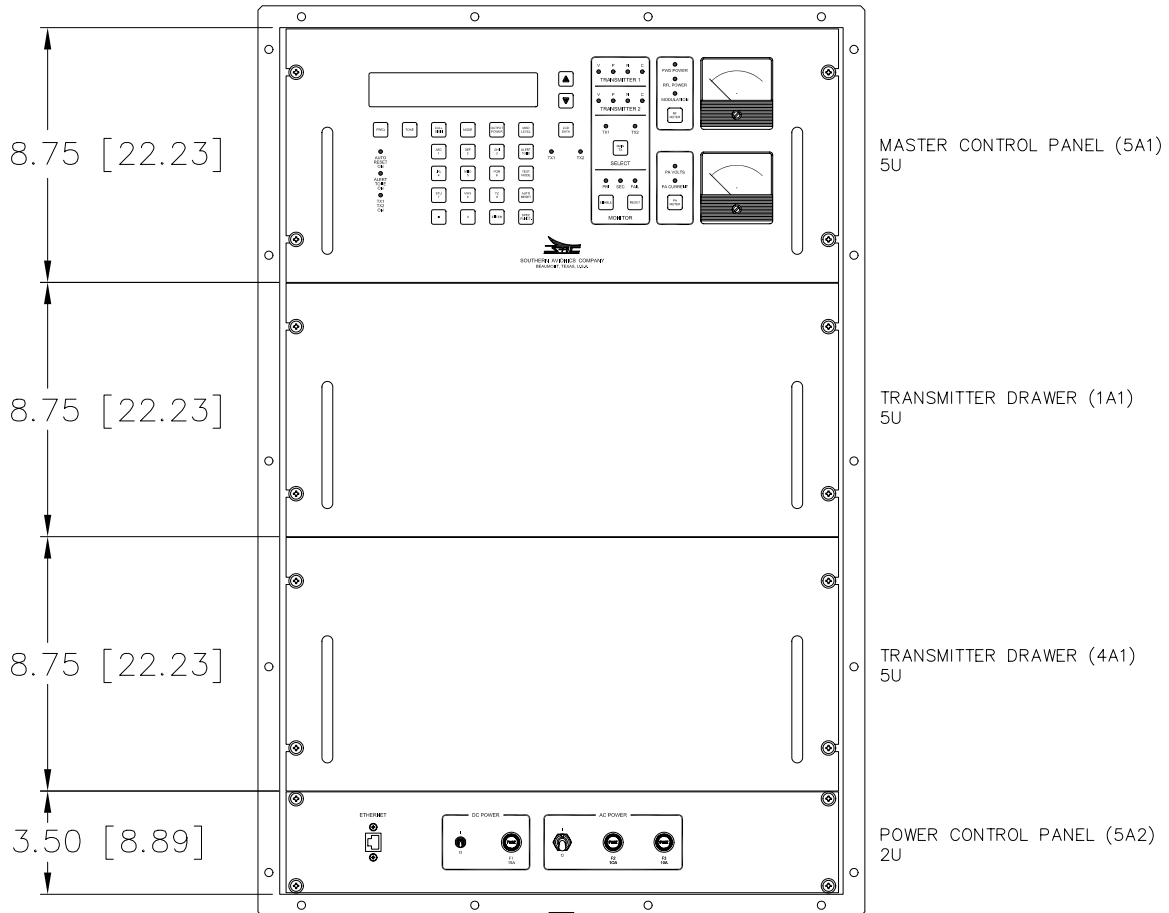
Figure 1-6. SDB33001 - SE Series Single Transmitter block diagram

**Figure 1-7. SEM33001 - SE Series Single overall schematic**

**1.2.3.1 SLF33001 - Assembly, Transmitter, SE Series Single**

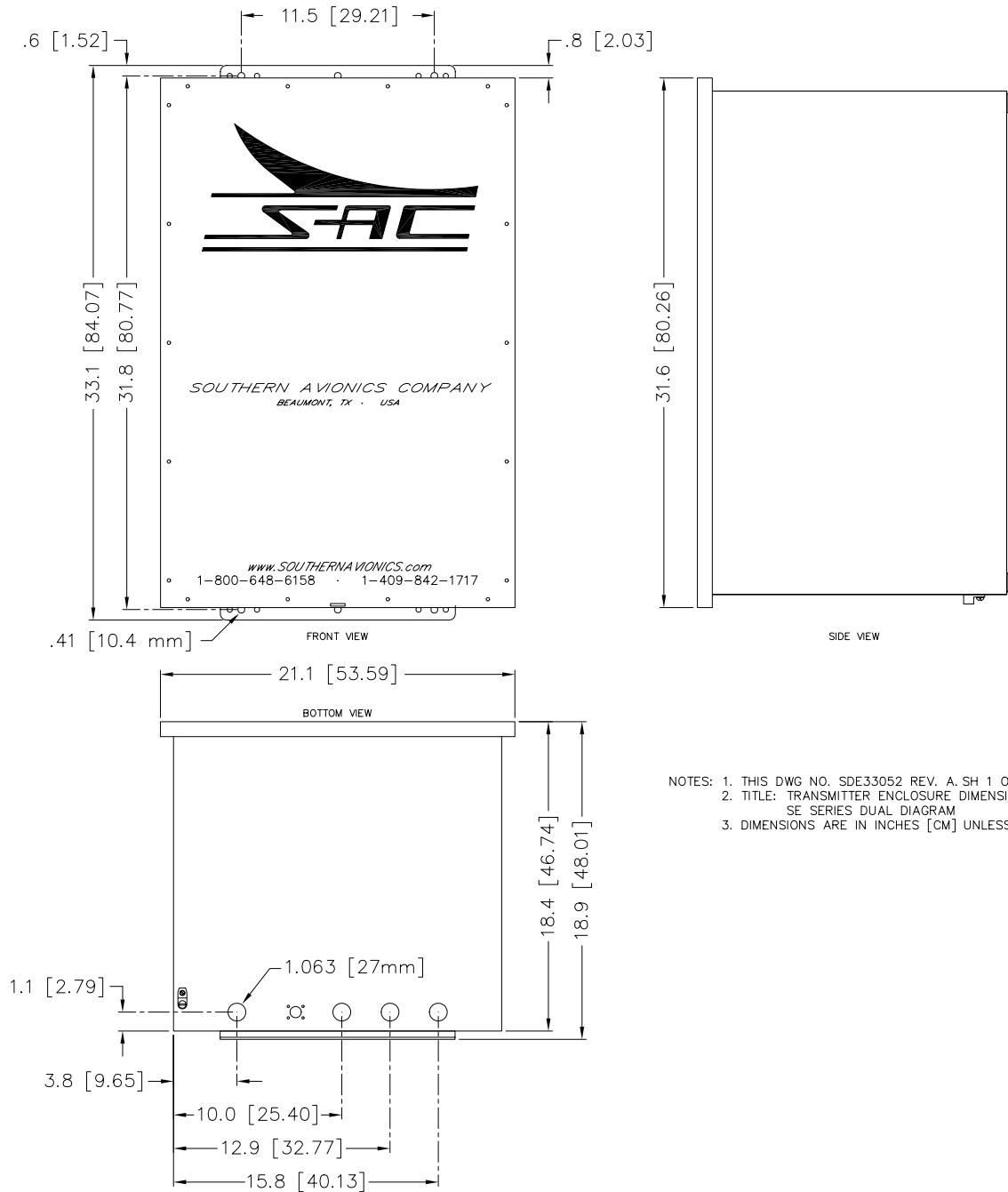
REFERENCE DESIGNATOR	COMPONENT	DESCRIPTION
1A1	SLE33031	ASSY, TRANSMITTER DRAWER
1A1A1	SLP43500	ASSY, TRANSMITTER CONTROLLER
A2	SLE43200	ASSY, FILTER/BRIDGE STANDARD BAND MODULE
A3	SLE43000	ASSY, SPA MODULE
A4	SLE43100	ASSY, POWR CONTROL MODULATOR MODULE
A5	SLE43400	ASSY, LOW VOLTAGE POWER SUPPLY MODULE
2A1		ASSY, COUPLER
3A1		ASSY, ANTENNA
4A1	SLE33031	ASSY, TRANSMITTER DRAWER
5A1	SLM33000	ASSY, MASTER CONTROL PANEL
A2	9L100000	LIQUID CRYSTAL DISPLAY MODULE
M1	9M190009	METER 2025/22, 0-1 MADC RF POWER
M2	9M190028	METER, 72T .25 0-1MA, PA SC200
A1	SLP43300	PRINTED CIRCUIT BOARD, MASTER CONTROL
S1	9S900005	SWITCH, DPST
S2	9S901004	SWITCH, SPDT PC
5A2	SLM33003	ASSY, POWER CONTROL PANEL

## 1.2.4 SE Series Dual Transmitter



NOTES: 1. THIS DWG NO. SDE33052 REV. A. SH 2 OF 2  
2. TITLE: TRANSMITTER PORTRAIT SE SERIES DUAL DIAGRAM

Figure 1-8. SDE33052 - SE Dual Transmitter portrait



- NOTES: 1. THIS DWG NO. SDE33052 REV. A. SH 1 OF 2  
 2. TITLE: TRANSMITTER ENCLOSURE DIMENSIONS  
 SE SERIES DUAL DIAGRAM  
 3. DIMENSIONS ARE IN INCHES [CM] UNLESS NOTED.

Figure 1-9. SDE33052 - SE Dual Transmitter dimensions



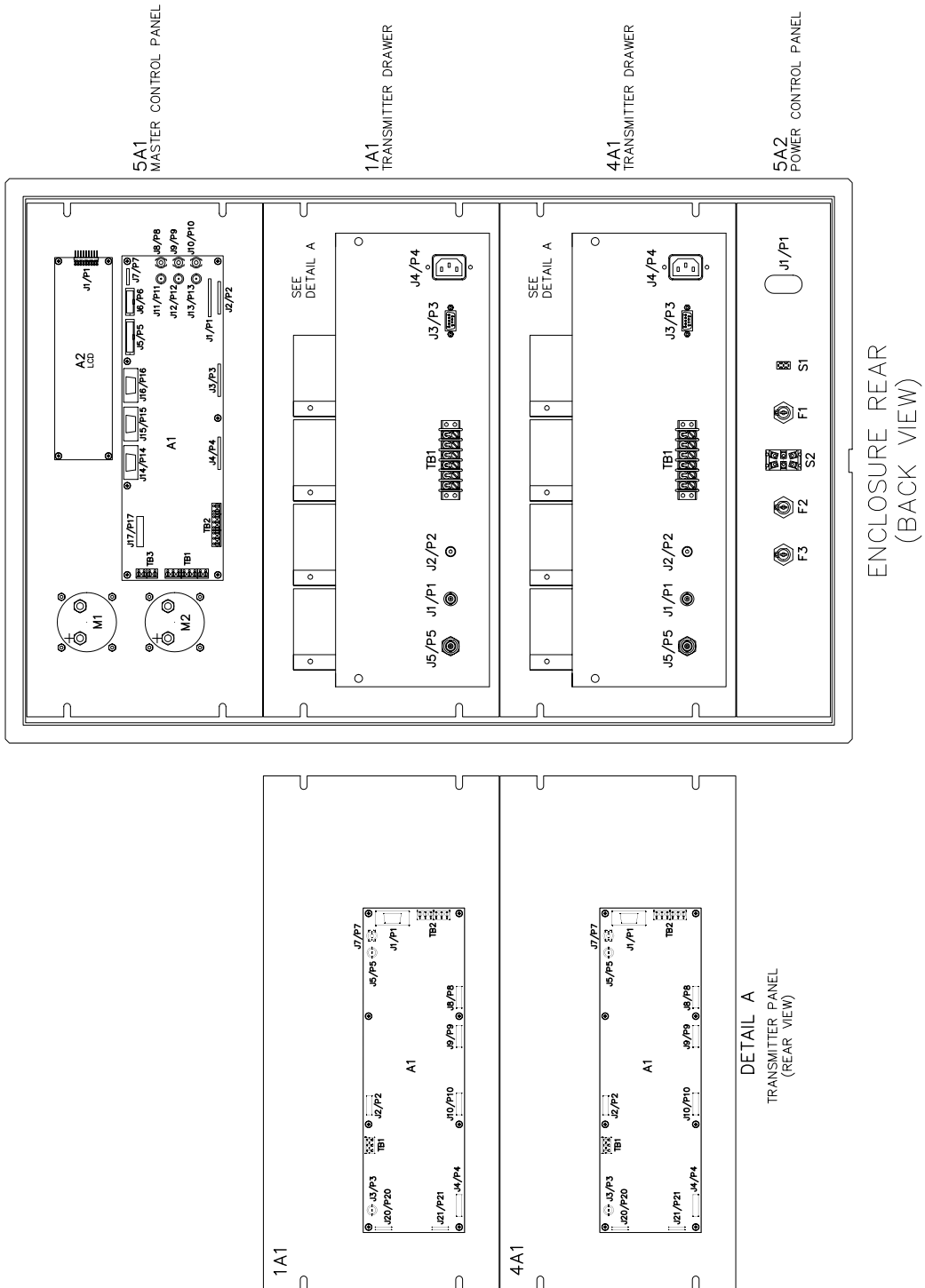
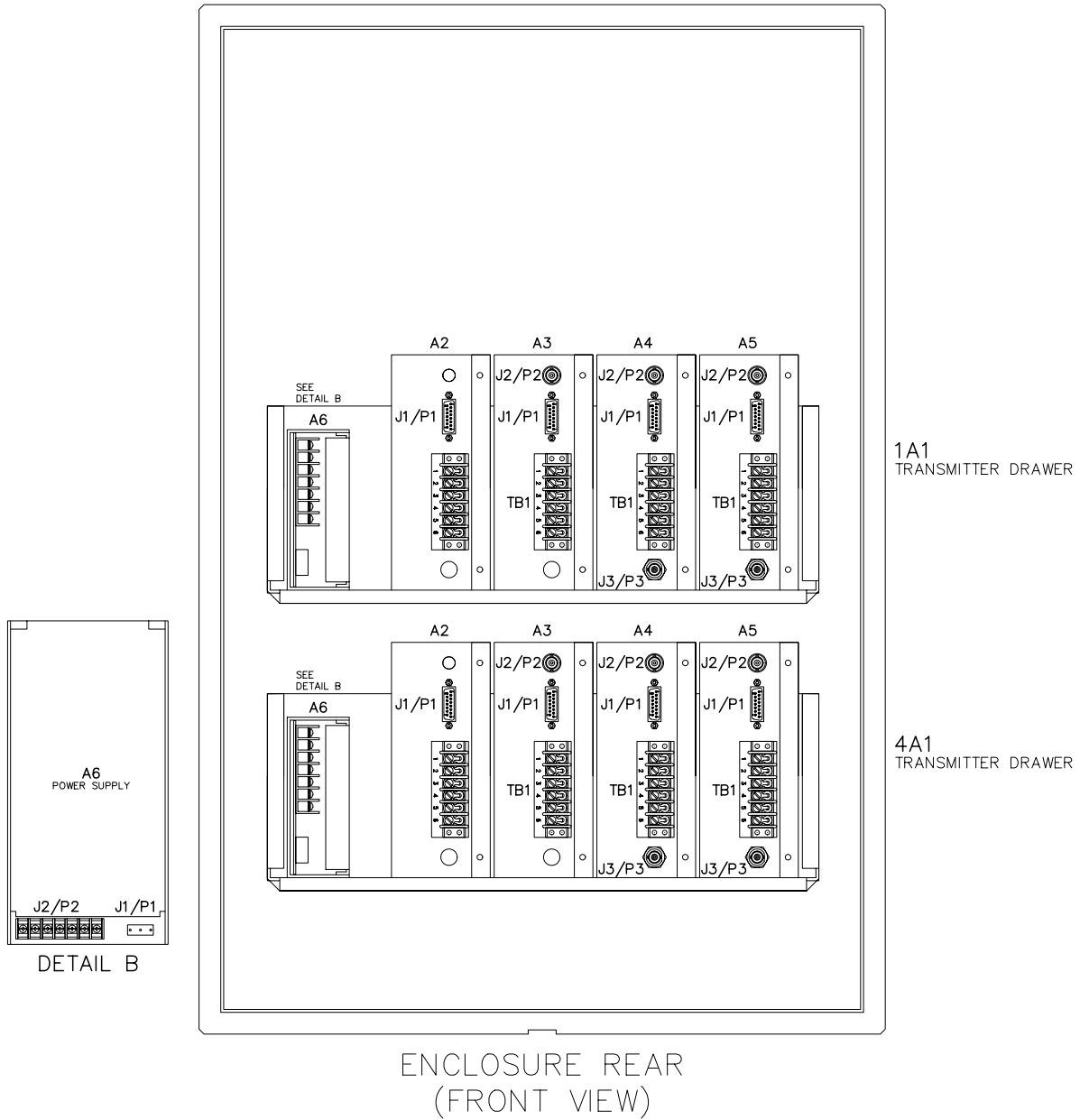
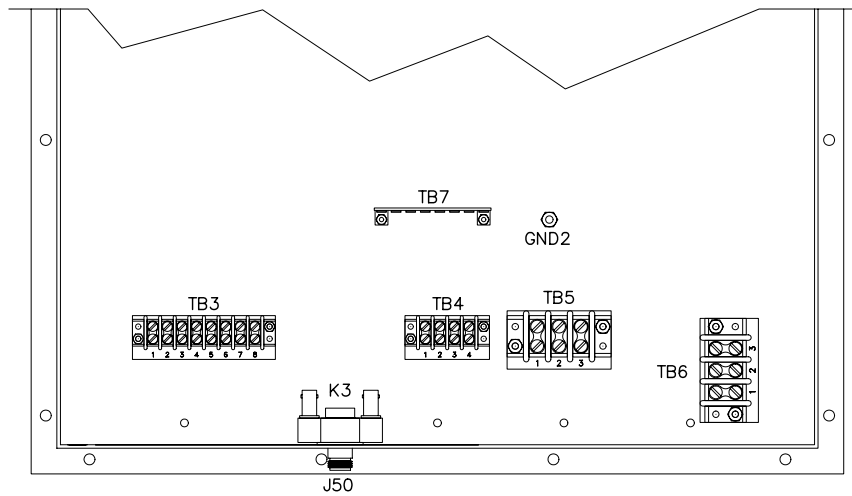


Figure 1-10. SDE33054 - SE Dual unit connection diagram (1 of 3)

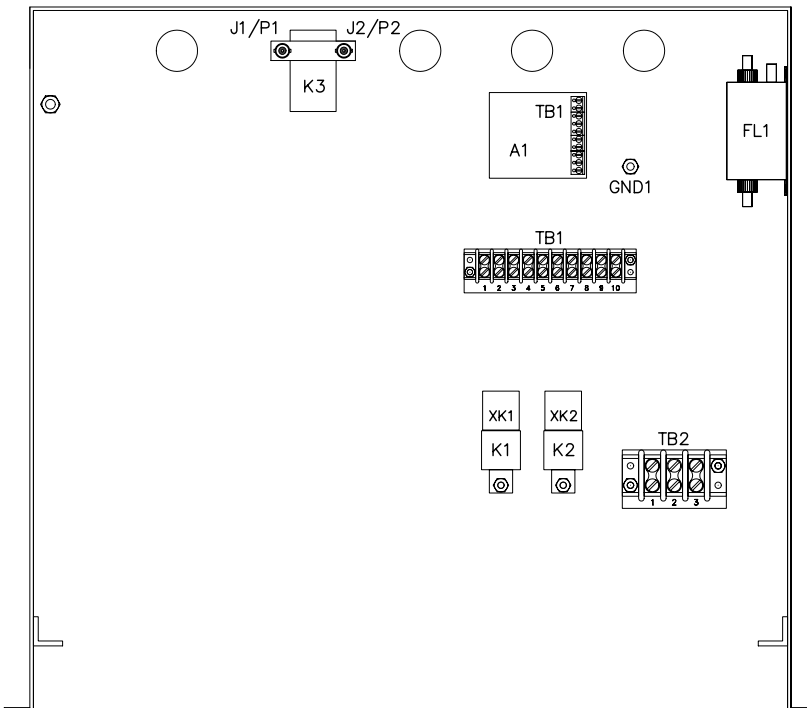


NOTES: 1. THIS DWG NO. SDE33054 REV. A. SH 2 OF 3  
 2. TITLE: SE SERIES DUAL CONNECTION DIAGRAM.

Figure 1-11. SDE33054 - SE Dual unit connection diagram (2 of 3)



ENCLOSURE REAR  
(FRONT VIEW)



ENCLOSURE BOTTOM  
(TOP VIEW)

- NOTES: 1. THIS DWG NO. SDE33054 REV. A. SH 3 OF 3  
2. TITLE: SE SERIES DUAL CONNECTION DIAGRAM.

**Figure 1-12. SDE33054 - SE Dual unit connection diagram (3 of 3)**

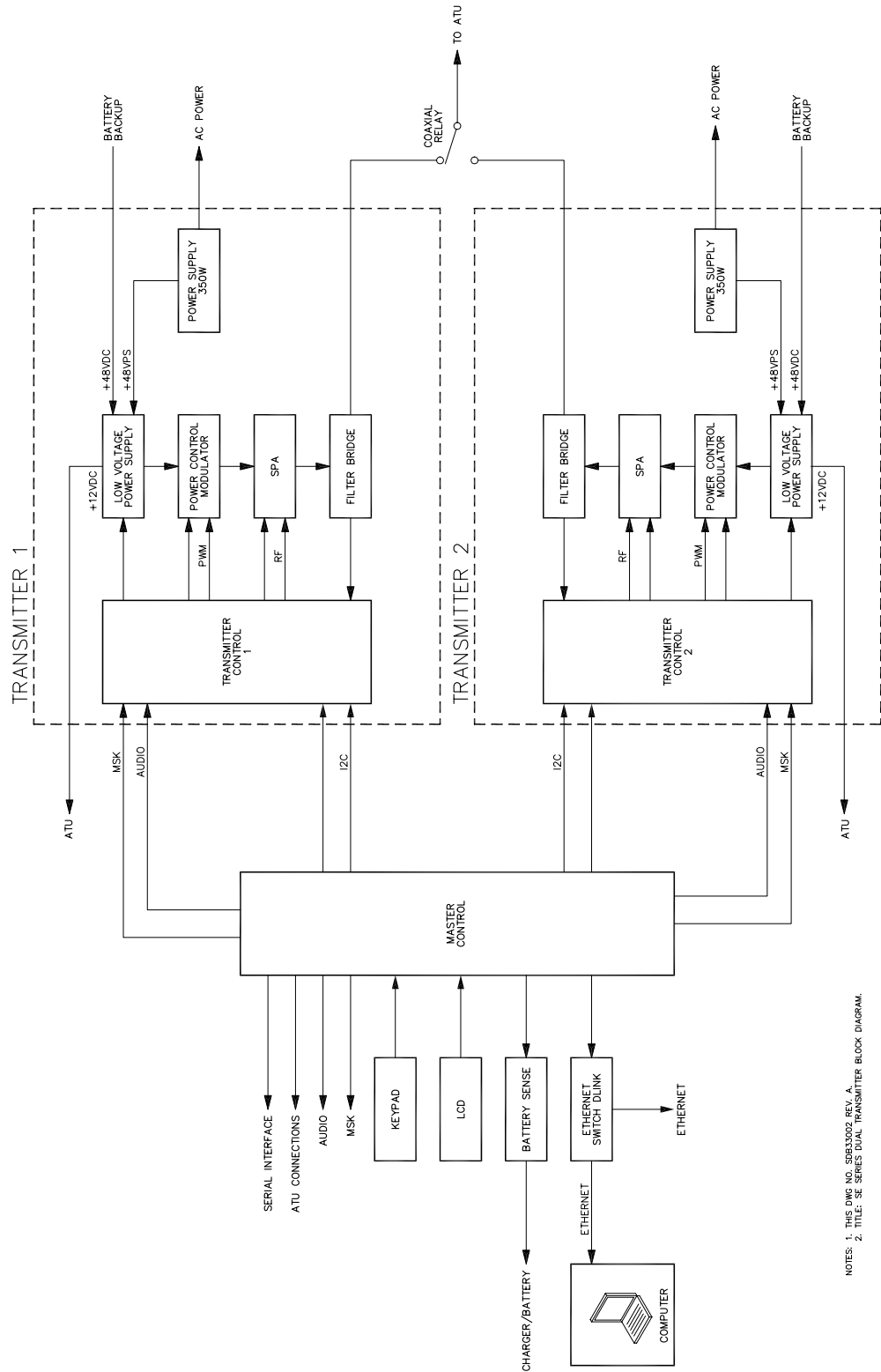


Figure 1-13. SDB33002 - SE Series Dual Transmitter block diagram

**Figure 1-14. SEM33002 - SE Series Dual overall schematic**

**1.2.4.1 SLF33002 - Assembly, Transmitter, SE Series Dual**

REFERENCE DESIGNATOR	COMPONENT	DESCRIPTION
1A1	SLE33031	ASSY, TRANSMITTER DRAWER
1A1A1	SLP43500	ASSY, TRANSMITTER CONTROLLER
A2	SLE43200	ASSY, FILTER/BRIDGE STANDARD BAND MODULE
A3	SLE43000	ASSY, SPA MODULE
A4	SLE43100	ASSY, POWR CONTROL MODULATOR MODULE
A5	SLE43400	ASSY, LOW VOLTAGE POWER SUPPLY MODULE
2A1		ASSY, COUPLER
3A1		ASSY, ANTENNA
4A1	SLE33031	ASSY, TRANSMITTER DRAWER
4A1A1	SLP43500	PRINTED CIRCUIT BOARD TRANSMITTER CONTROLLER
A2	SLE43200	ASSY, FILTER/BRIDGE STANDARD BAND MODULE
A3	SLE43000	ASSY, SPA MODULE
A4	SLE43100	ASSY, POWR CONTROL MODULATOR MODULE
A5	SLE43400	ASSY, LOW VOLTAGE POWER SUPPLY MODULE
5A1	SLM33000	ASSY, MASTER CONTROL PANEL
A2	9L100000	LIQUID CRYSTAL DISPLAY MODULE
M1	9M190009	METER 2025/22, 0-1 MADC RF POWER
M2	9M190028	METER, 72T .25 0-1MA, PA SC200
A1	SLP43300	PRINTED CIRCUIT BOARD, MASTER CONTROL
S1	9S900005	SWITCH, DPST
S2	9S901004	SWITCH, SPDT PC
5A2	SLM33003	ASSY, POWER CONTROL PANEL