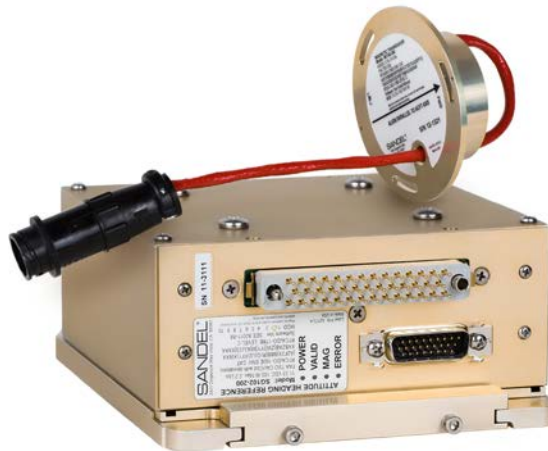


# SANDEL<sup>®</sup>

## Installation Manual

### **SG102 Attitude Heading Reference System**

*Including:*  
**SG102/D (Digital)**  
&  
**SG102 MOD 2 with High Speed ARINC 429 and Reduced Initialization Time**  
&  
**MT102  
Magnetic Transducer Accessory**



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## Revision History

Rev	Date	Section(s)	Comments
J	29-SEP-2014	7.2	LED Error Code table updated.
H1	17 APR-2014	2.5.2	Summary Environmental table updated.
H	25-MAR-2014	ALL 1.2 1.4 2.2 2.3 2.3.3 2.5.1 2.5.2 2.5.3 2.5.5 2.5.7 3.2.3 3.2.4 3.3.2 3.3.6 3.3.7 3.7 4.1 4.2 6.1.2 6.1.4 7.2 12 14	SG102 MOD 0 not covered in this IM. Added IM applicability statements. Updated for high speed ARINC 429.Heading data output formats updated. MOD levels updated. Additional part numbers added. Substitution note updated to include SG102-x5x P/Ns. SG102 Install Kit Bill of Materials updated. MOD 1 & MOD 2 Length spec corrected (+.05" / excluding mating connectors). Dimensions for SG102/D added. Summary environmental data updated for SG102/D. Summary Environmental data for MOD 1 & MOD 2 listed. Updated for SG102/D. Updated for SG102/D. Mounting base alignment note clarified. Updated for applicability. Section 2 references added. Updated for applicability. Updated for applicability. Images updated to include SG102/D. Updated for SG102/D. Updated for effectivity. Updated for SG102/D. Typo corrected. LED Error Code table updated. Updated for SG102/D. List of effective drawings updated.
G2	6-FEB-2014	REV History 2.2	G1 section 2.4.2 reference changed to 2.5.2 Section 2.2: Mod Levels corrected.
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G	30-JAN-2014	1.2 2.4.1 2.4.3 2.4.4 2.4.5 3.2.4 3.3.1 3.7 4.1 6.1.2 6.1.3 7.1 12 14	Limitations updated for MOD-2. Added note for recommended maximum North and South latitude operation. Updated for Mod 2 Updated for Mod 2 Initialization time and Arinc 429 info updated Updated for Hi Speed Arinc 429. Rep rates updated Added note for use as KG102 replacement when used with SN3500/SN4500. Updated for Mod 2 Mod 2 drawing added. Updated for Hi speed Arinc 429 Updated for Hi speed Arinc 429 Mounting orientation drawings updated with MOD 2 SG102 SG102 LED Display image updated. MOD-2 Initialization time added. Mod 2 added to Sample AFMS. List of Effective Drawings updated. Drawing 1071-05 Updated for MOD 2

## Revision History

F	17-FEB-2011	1.3 2.2.1 2.2.2 2.4 2.4.3 2.4.4  3.3.8 4.2 5.4 6.1.6 Appendix B Appendix D	Added note about 4-quadrant compass calibration. Updated Ground Test references to Installation Software. Updated installation program description. Changed Install Kit text. Updated mechanical specifications. Added AHRS specs Added new Arinc labels and selection info. Added 429 low speed notes. Added note on 10k pullup. Added gnd/open to pin table Added installation tolerance to MT102 longitudinal alignment. Added reference to software loading. Added DO-160E Environmental Qualification Forms. Removed aerobatic limitation mod1.
E	11-FEB-2009	1.212	Update limitation note. Limitation, modified for reversionary or backup display.
D	06-NOV-2008	7.1 12	Changed initialization time. Changed sample AFMS section IV
C	30-OCT-2008	Cover Rev History 2.2 2.2.3 2.4.1 3.3.1 3.7 7.1 12 13.1.4 14	Updated. Format. Added model number substitution notes. Removed the -A from part numbers 84051 and 61251 on B.O.M. Corrected dimensions and included MOD 1. Changed installation drawing for MOD 1. Modified Fig. 3-3 to cover SG102 with MOD 1. Updated initialization time to include MOD 1 units. Added MOD 1 initialization time to sample AFMS. Added MOD 1 initialization time to ground test. Updated drawing table, added note column.
B	07-FEB-2008	App. F	A/R 972 drawing 82011-10 sheets 4 & 5.
A	19-DEC-2007	All	Initial release.

## 1 General Information

### 1.1 Disclaimer

Sandel Avionics does not assume any risk for nor accept any responsibility for the interface descriptions contained within this Installation Manual. It is the responsibility of the installer to ensure that such equipment is compatible with the SG102 as described, and to ensure that the installation of the SG102 is accomplished with such equipment using the specific equipment manufacturer's installation and technical instructions. No other representations are expressed herein.

### 1.2 Introduction

The Sandel model SG102 is a solid-state sensor that combines angular rate, linear acceleration and magnetic field measurements to create an electronically stabilized strap-down Attitude and Heading Reference System (AHRS).

The information contained within this manual describes the features, functions, technical characteristics, components, approval procedures, installation considerations, setup procedures, checkout procedures, and instructions for continued airworthiness for the SG102.

This revision of the SG102 Installation Manual is applicable to the following SG102 models: SG102 MOD 1, SG102 MOD2. SG102/D.

For information pertaining to the SG102 MOD 0, please refer to 82011-IM revision G.

The SG102 requires the use of the Sandel MT102 magnetic transducer accessory. No additional flux gate is used or required.

#### **Limitation Notes:**

- (1) The SG102 is not certified to provide primary attitude information to the flight crew. The SG102 is certified to provide reversionary attitude in the primary field of view. The SG102 may also be used to stabilize other aircraft equipment for example, RADAR and/or FLIR systems.**

**NOTE: The SG102 may not provide satisfactory heading performance above 70° north latitude or below 70° south latitude.**

The SG102 AHRS meets the pertinent requirements of

TSO-C4c "Bank and Pitch Instruments";  
TSO-C6d "Direction Instrument, Magnetic (Gyroscopically Stabilized)"  
RTCA DO-160E  
RTCA DO-178B, Level C Software

## 1.3 General Information on Strapdown AHRS

When used as a DG replacement, the SG102 differs in certain key characteristics from the electro-mechanical gyro it replaces which affect the installation. It must be remembered that the SG102 is a strapdown AHRS and this means it is installed like an AHRS - even if it is used or thought of as a directional gyro.

A strapdown AHRS is composed of three sensors in a Roll-Pitch-Heading orientation. When the aircraft is level it is easy to visualize its operation as each of the three sensors senses the movement in its own axis. However, the operation of the AHRS gets complicated as the aircraft maneuvers. For instance in a 90 degree bank what was the Pitch sensor is now the Heading sensor; the Heading sensor is now the Pitch sensor. This sensor translation occurs at every intermediate attitude. In order for this process to work properly, the SG102 itself must be precisely aligned with the aircraft axis; otherwise changes in roll may induce like small changes in pitch, and vice-versa. Very small misalignments will wash out during operation, but large misalignments will cause improper operation.

A mechanical DG has no such requirement as it is gimballed and will level itself to gravity on startup and stay level during most flight maneuvers. This means that a mechanical DG installed non-level will work properly; however installing with the SG102 without checking the mechanical alignment will *not* work. Make sure the SG102 is mechanically aligned! Once correctly installed the SG102 mounting base is designed to allow removal and replacement of the SG102 without realignment.

The 4-quadrant compass calibration (part of the ground test procedure) is important for correct system operation. Do this carefully! The benefit of doing this calibration correctly is the SG102 will be more accurate in heading, especially during maneuvers, than a mechanical DG.

## 1.4 SG102 Features

The SG102 is intended for use in airplanes or helicopters to provide stabilized primary magnetic heading to compass indicators, flight control and director systems, or other aircraft systems requiring stabilized heading information.

The SG102 provides output heading data in the following formats:

Heading Format	SG102		SG102/D
	MOD1	MOD2	
ARINC 407 (XYZ)	X	X	-
ARINC 429 (LOW SPEED)	X	X	X
ARINC 429 (HIGH SPEED)	-	X	X
RS-232 Stormscope™	X	X	X
Quadrature Stepper	X	X	-

The SG102 incorporates a single 26 pin “D” connector with a Positronics latch. Additionally, the SG102 MOD 1 and MOD 2 (P/Ns SG102-000, -100, -200) is signal and plug compatible with the Bendix/King KG102 electromechanical directional gyro used in the KCS55 compass system.

Contact the factory with any questions about interfacing to specific equipment not covered in the installation drawings.

## 2 Technical Information

### 2.1 General

The following section describes the technical characteristics that include the appliance approval basis, physical and electrical properties, electrical connector pin allocation which details function and gradient or equipment protocol, and ARINC label support. Also included is the description of the SG102 and MT102 installation components, other equipment and installation requirements. A review of the installation approval procedures is provided for filing with authorities.

### 2.2 MOD Levels

The SG102 models covered in this Installation Manual have been produced in several variations over time: (As indicated on TSO label)

SG102 MOD 1 Shock Mount Base, Increased Roll Rate

SG102 MOD 2 Rigid Base. Provides High Speed ARINC 429, initialization time is reduced.

SG102/D Rigid Base. All digital.

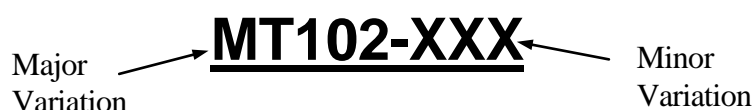
MOD 1 and MOD 2 units are, except for the specifications, interchangeable.

### 2.3 Part Numbers

The part number (SPN) for the Sandel SG102 is:

Major Variation → **SG102-XXX** ← Minor Variation

Description	SPN - SG102 (MOD 1, MOD 2)	SPN - SG102/D
Fixed Wing, Piston Aircraft	SG102-000	SG102-050
Fixed Wing, Turbine Aircraft	SG102-100	SG102-150
Helicopter	SG102-200	SG102-250



Description	SPN
Fixed Wing, Piston Aircraft	MT102-000
Fixed Wing, Turbine Aircraft	MT102-100
Helicopter	MT102-200
All Variants	MT102-300

The dash numbers differ in the environmental category certifications.

Note: The turbine models (-100, and -150) of the SG102 and the turbine model (-100) of the MT102 can be substituted for the piston fixed wing models (-000, and -050) of the SG102 and the piston model (-000) MT102. The helicopter models (-200, and -250) of the SG102 and the helicopter model (-200) MT102 can be substituted for either the turbine models (-100, and -150) or the piston models (-000, and -050) of the SG102 and the MT102.

### 2.3.1 Software Version

The version number of software for the SG102 and MT102 is accessed by the Installation-Calibration Software. See section 6.

### 2.3.2 Install Kit

Description	SPN
SG102 Installation Kit	90171-IK

### 2.3.3 Bill of Materials – SG102 Install Kit

Description	SPN	QTY
Installation Software CD (includes Installation Manual)	82011-INCD	1
HD-26 Connector	32101	1
Plug, Circular Plastic, 9 Pin, Sealed	32097	1
Contact, Female – Size 16 Removable, 24-20 AWG	32099	9
Cable Clamp, Shell size 13 CPC	32100	1
Mounting Base Assembly	84051	1
Pan Head Machine Screw, 10-32 x .875	60220	4
Flat Washer #10	60221	4
Pan Head Machine Screw, 6-32 x .75 Brass	60222	3
Flat Washer #6 Brass	60223	6
Nut, Self-Locking 6-32 Brass	60224	3
Shim, Mounting Base	61251	6

## 2.4 Approval Summary

### 2.4.1 License Requirements

None.

### 2.4.2 Approval Data

Technical Standard Order:	C4c, Bank and Pitch Instruments C6d, Direction Instrument, Magnetic (Gyroscopically Stabilized)
Software Certification:	RTCA/DO-178, Level C
Environmental Categories:	RTCA/DO-160E (Reference Appendix B)

### 2.4.3 Technical Standard Order Stipulation

The following stipulation as presented is required by the Federal Aviation Administration for articles approved under Technical Standard Order. This statement does not preclude multiple installation and operational approvals in regard to specific aircraft make, model, or type:

*“The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standard. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.”*

### 2.4.4 Installation and Operational Approval Procedures

For the purpose of seeking installation approval, declarations should be made in the “Description of Work Accomplished” section of a Federal Aviation Administration (FAA) Form 337 or other field approval, or other limited supplemented type certification form. A sample Form 337 is included in the Appendix. The basis of approval is for use as a gyroscopically stabilized magnetic direction instrument. Applicable Federal Aviation Regulations (FAR) must be adhered to.

The Environmental Qualification Forms for the SG102 and the MT102 is included in the Appendix, and should be referenced to the categories appropriate to the aircraft type and environment into which the system is to be installed. The environmental category for the AHRS should be stipulated on the FAA Form 337, or other approval form.

A “Functional Ground Test Procedures/Report” and an “Operational Flight Check Procedures/Report” is also included in the appendix, and should be used as a basis for validating the SG102 equipment configuration and for verifying proper installation and functional performance. A copy of this form should be submitted along with the FAA Form 337, or other approval or certification form. A permanent copy must be filed and maintained by the installing

agency. Another copy must be presented to the aircraft owner for entry into the aircraft maintenance records, as well as a copy forwarded to Sandel Avionics along with the Warranty Registration Form, Part Number 82011-0137, to be filed after completion and installation acceptance. If any difficulty is experienced with the functionality or operational performance of the SG102, contact Sandel Avionics for assistance.

## 2.5 Characteristics

### 2.5.1 Dimensions

#### SG102/D

Item	Dimension
Width:	5.0 in. (12.7 cm.)
Height:	2.53 in. (6.4 cm.)
Length:	6.3 in. (16.0 cm.) excluding mating connector
Weight:	1.65 lbs. (.75 kg.) including connector
CG:	2.54" from forward face, 1.1" from bottom of mounting surface

#### SG102, MOD 2

Item	Dimension
Width:	5.0 in. (12.7 cm.)
Height:	2.53 in. (6.4 cm.)
Length:	6.3 in. (16.0 cm.) excluding mating connectors
Weight:	2.4 lbs. (1.08 kg.) including connectors
CG:	2.54" from forward face, 1.1" from bottom of mounting surface

#### SG102, MOD 1

Item	Dimension
Width:	5.0 in. (12.7 cm.)
Height:	2.7 in. (6.9 cm.)
Length:	6.3 in. (16.0 cm.) excluding mating connectors
Weight:	2.8 lbs. (1.27 kg.) including connectors
CG:	2.54" from forward face, 1.22" from bottom of mounting surface

#### MT102

Parameter	Value
Width:	3.37 in. (8.55 cm) - Diameter
Height:	0.95 in. (2.41 cm.)
Weight:	0.4 lbs. (.18 kg.)
CG:	@ Centerline, .25" below mounting face (excluding cable/connector)

## 2.5.2 Summary Environmental

Parameter	SG102 (Mod 1)	SG102 (Mod 2)	SG102/D
Power Inputs (Nominal)	15 watts	11 watts	8 watts
Startup Current (11-33 vdc)	140 watts, 1 minute	20 watts, 1 minute	18 watts, 1 minute
Temperature	-55° C to +70° C		
Altitude	Up to 55,000 feet		

## 2.5.3 Operational Specifications SG102 (MOD 2), SG102/D

Item	Spec
Body Rate Limits	+/- 250 °/sec
Initialization Time	Approximately 1 Minute, Standard day
ARINC 429	Low or High Speed

## 2.5.4 Operational Specifications

Item	Spec
Static Pitch and Roll Accuracy	.35° typical initial; .2 ° typical after 10 minutes
Dynamic Pitch and Roll Accuracy	±1° typical
Static Heading Accuracy	±1° typical after calibration
Dynamic Heading Accuracy	±4° during maneuvers
Body Rate Limits	+/- 150 °/sec*
Body Acceleration Limits	+/- 5g rms typ (see env. qual. category)
Aerobatics	Permitted, software version 1.25 and later. Aerobic maneuvers must be approx wings level 50% of the time over any 5 minute period.
Turn Time Limits	Unlimited turn time (i.e. turns around a point), software version 1.25 and later.
Initialization Time	Approximately 3 Minutes*
ARINC 429	Low Speed Only*

\* SG102 MOD 1 Only. See section 2.5.3 above for SG102 MOD 2 and SG102/D specs.

### 2.5.5 Arinc 429 Labels – SG102 MOD 1

Label	Definition	Repetition Rate
155	Maintenance *	1 Hz
270	Discrete	30 Hz min
300	Compass Heading (averaged)	30 Hz min
320	Magnetic Heading	30 Hz min
324	Pitch Attitude	30 Hz min
325	Roll Attitude	30 Hz min
332	Body Lateral Acceleration	30 Hz min
350	Maintenance *	1 Hz
351	Maintenance *	1 Hz
352	Maintenance *	1 Hz
353	Maintenance *	1 Hz
354	Maintenance *	1 Hz

### 2.5.6 Arinc 429 Labels – SG102 MOD 2, SG102/D

Label	Definition	Repetition Rate	
		Low Speed	High Speed
155	Maintenance *	1 Hz	1 Hz
270	Discrete	25 Hz min	50 Hz min
300	Compass Heading (averaged)	25 Hz min	50 Hz min
320	Magnetic Heading	25 Hz min	50 Hz min
324	Pitch Attitude	25 Hz min	50 Hz min
325	Roll Attitude	25 Hz min	50 Hz min
332	Body Lateral Acceleration	25 Hz min	50 Hz min
350	Maintenance *	1 Hz	1 Hz
351	Maintenance *	1 Hz	1 Hz
352	Maintenance *	1 Hz	1 Hz
353	Maintenance *	1 Hz	1 Hz
354	Maintenance *	1 Hz	1 Hz

\*

Items with an asterisk are enabled or disabled during installation configuration. These items are Sandel-specific binary labels intended for data recording and remote diagnostic purposes when used with Sandel SN3500 and SN4500 series PNDs.

## 3 Installation

This section provides information need to install the SG102 including interconnect diagrams, mounting dimensions and information pertaining to installation.

### 3.1 Unpacking and Inspecting Equipment

Exercise care when unpacking the equipment. Make a visual inspection of the unit for evidence of damage incurred during shipment. If a claim for damage is to be made, save the shipping container to substantiate the claim. The claim should be promptly filed with the carrier. It would be advisable to retain the container and packaging material after all equipment has been removed in the event that equipment storage or reshipment should become necessary.

### 3.2 Installation Planning

#### 3.2.1 General Considerations

The SG102 should be installed in accordance with standards established by the installing agency, and existing conditions as to unit location and type of installation. However, the following considerations should be considered before installing the SG102. The installing agency will supply and fabricate all external cables when required. The required connectors and associated installation hardware are supplied by Sandel in the Installation Kit.

#### 3.2.2 Mounting Orientation

The SG102 supports various mounting orientations. See section 3.4 below. These orientations provide flexibility in locating the position of the output connectors in relation to existing harnesses.

Ensure that the 4 LED's on the front of the unit are visible after installation.

#### 3.2.3 Mounting Base Alignment

The SG102 is designed so that all aircraft alignments are made at the mounting base. After the initial mounting base alignment the SG102 may be removed from the mounting base and replaced *without* realignment.

#### 3.2.4 Bendix/King KG102 Replacement Applications (SG102 P/Ns -000, -100, -200)

When used as a directional gyro replacement for a Bendix King KG102 used in KCS55 compass systems, with minor wiring modification the SG102 can be used to directly replace the KG102 DG and will drive a KI525 indicator with stepper-motor drive directly. The SG102 is designed with the same legacy rectangular connector as the KG102 allowing easy retrofits.

In these applications the KMT112 fluxgate is removed and replaced with the Sandel MT102 magnetic transducer. The SG102 has an output which drives the KI525 in place of the original KMT112 fluxgate. All other connections to the KI525 are retained and the SG102 drives all the

original signals, including the flags and stepper motor pulses.

The KA51 slaving accessory is not required. However, it may be retained for the use of the Slaving Switches and Slaving Meter, which will continue to operate. The slaving adjustments are non operational and should be centered.

The SG102 is capable of operation during higher heading rates (up to 150 deg/s) than the KI525 indicator. If the actual heading rate exceeds 33 deg/sec, the SG102 limits the stepper pulses issued to the KI525 to a maximum rate of 33deg/sec and keeps track of the dropped pulses. When the aircraft rate slows down below 33deg/sec the missing pulses are re-inserted and the KI525 is allowed to catch up to the correct heading. If at any time the KI525 compass card lags the true heading in this fashion the KI525 HDG flag is asserted momentarily.

**Note: When upgrading an existing installation from a KG102 to an SG102 interfaced to either a Sandel SN3500 or SN4500, you must remove connections between the c, j, and n pins.**

### 3.3 Installation Considerations

#### 3.3.1 General

The SG102 installation should conform to customer requirements and airworthiness standards affecting the location and type of installation.

For installation refer to Drawing No. 90171-05 titled, "Installation, SG102", for specific assembly and mounting instructions.

#### 3.3.2 Power

Note that primary power is supplied on *either* P1 (26 Pin D) or the KG102 compatibility connector (for P/Ns -000, -100, -200), but not both.

Please see sections 2.5.2 and 2.5.3 for Summary Environmental information.

The SG102 should be powered by the main bus or emergency bus (as appropriate). The SG102 is immune to transients and other anomalies which may be present on the main bus.

The SG102 requires 14vdc or 28vdc power

14vdc: 5.0A circuit breaker

28vdc: 5.0A circuit breaker.

Existing KG102 installations utilizing a 5amp circuit breaker may retain the 5amp circuit breaker providing that the specific circuit breaker type can tolerate 5.0 amps for as much as 5 minutes during startup.

### 3.3.3 Cooling

No external cooling is required. The SG102 under normal operation will be warm to the touch.

### 3.3.4 Slaving Control Switches

In an existing Bendix/King replacement installation the KA51 slaving accessory may be used to control the 'slaving off' mode. In new installations three switches may be installed if manual slaving control is desired:

Slaving Off	GND to operate; maintained
CW	GND to operate; momentary
CCW	GND to operate; momentary

**NOTE: The SG102 may be installed with one set of slaving switches only; either a KA51 connected to the 44 pin rectangular connector, or new switches connected to the 26 Pin D connector.**

### 3.3.5 Operation without MT102

The SG102 will not operate without the MT102 connected. Any application which requires operation without a magnetic reference will not work with the SG102.

**Note: The SG102 will not initialize unless it has communication with the MT102. The SG102 will flag if communication is removed from the MT102**

### 3.3.6 Inverter Outputs

The SG102 contains an internal sine wave inverter. The inverter load is limited to 5VA, which is sufficient to drive two synchro transmitters.

### 3.3.7 Synchro Outputs

The SG102 contains an XYZ heading output. The XYZ output is limited to 50ma and is sufficient to drive two synchro CT's.

Note: The XYZ output operates at a nominal 10.5v RMS. This output is compatible with any Arinc 407 CT specified for 11.8V.

### 3.3.8 Discretes

The SG102 has Valid GND/OPEN and Invalid GND/OPEN discretes.

**NOTE:** Since these outputs are both GND/OPEN, if the receiving device does not pull up to ACFT PWR, a 10K 1/2W resistor may be used between the discrete output and ACFT PWR as a pullup source.

### 3.4 Mounting Orientation

The SG102 may be mounted in different orientations to facilitate the installation. See section 6.1.3.

### 3.5 Attachment to the Airframe

The SG102 is designed to be rigidly attached to the airframe, the stiffer the better. Do not use any shock mounts or other external parts.

### 3.6 General Installation Instructions for the Hardware

- A. The installing agency will supply and fabricate all wiring harnesses when required. The length and routing of wires must be carefully measured and planned before the actual installation is attempted. Avoid sharp bends in the harness or locating the harness near aircraft controls. Observe all recommended wire sizes and types and subscribe to appropriate FAR Parts 23, 25, 27, and 29, as well as AC 43.13-1( ) and -2( ).
- B. The use of MIL-C-27500 shielded wire and MIL-W-22759 single conductor wire is recommended. The use of ferrules or grounding blocks for signal ground and digital ground returns is satisfactory; however, each ground return must be electrically separated.
- C. In order to ensure correct performance the SG102 and associated wiring must be kept at least a minimum of three feet from high noise sources and not routed with cables from high power sources.
- D. The pinout descriptions will assist you in determining installation requirements. Adhere to all notes within these descriptions and on installation wiring diagrams.
- E. Ground Bonding. In order to assure installation characteristics match the DO-160 RF and Lightning test conditions, ensure that ground wires of at least the recommended size are installed in accordance with the installation drawings and these wires are connected to a bonded aircraft ground.
- F. Power Wiring. To assure that the SG102 will operate properly down to its rated minimum input voltage of 11Vdc, ensure that power wires of at least the recommended size are connected from the AHRS/DG circuit breaker to the SG102 in accordance with the installation drawings.

### 3.7 Alignment

The alignment process is performed as follows:

Step 1: Determine the aircraft leveling means. This information is noted either in the maintenance manuals or may be found on the aircraft's Type Certificate Data Sheet which can be found easily on the FAA website. It is not necessary to actually level the aircraft – just know how to measure the tilt as it sits.

Step 2: Where the SG102 is going to be mounted, make a sharp pencil line along the longitudinal axis of the airframe. This can be accomplished by the use of a straightedge aligned square to a bulkhead or

other transverse member. This line must be accurate – to within  $\frac{1}{4}$  degree, which is easily obtainable with hand tools.

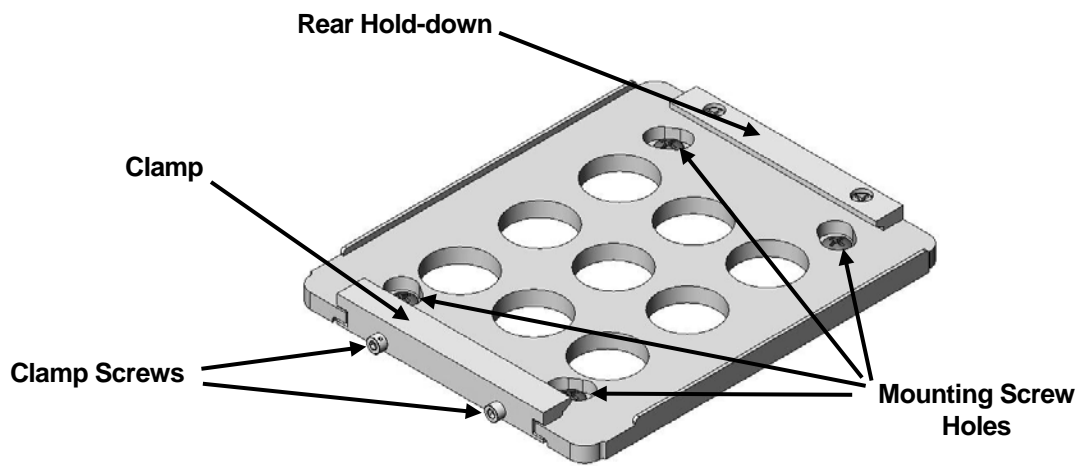
Step 3: Take a small digital level and note the current lateral (roll) and longitudinal (pitch) tilt of the aircraft as it sits, using the criteria determined in step 1. Make sure getting in and out of the aircraft doesn't change its position.

Step 4: Now shim the SG102 mounting base to reproduce the same pitch and roll tilt angle as the airframe. Tighten the base mounting screws friction tight.

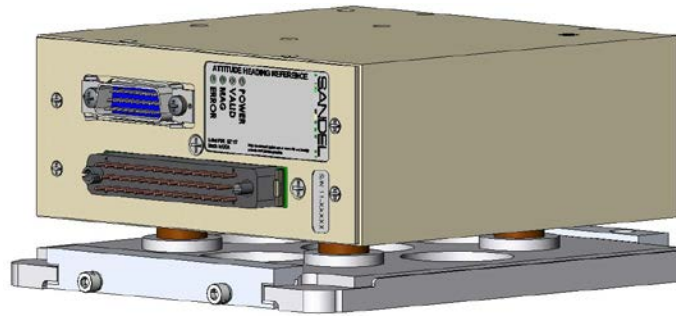
Step 5: Adjust the longitudinal axis of the mounting base so that it is parallel with the longitudinal axis pencil line. Align Visually.

Step 6: Tighten the mounting screws. Make sure these are going into self-locking nutplates. The base should be extremely stiff and shouldn't slip.

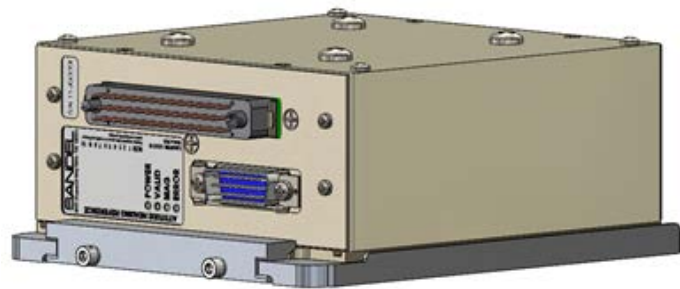
Step 7: Install the SG102 into the base by sliding it into the rear hold-down, tighten the clamp, and safety wire the clamp screws.



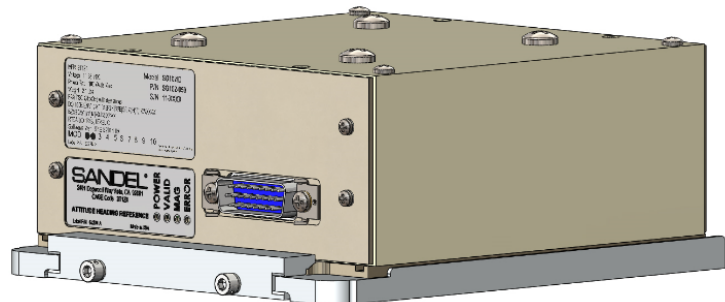
**Figure 3-1: Mounting base assembly features**



**Figure 3-2: SG102-0xx w/MOD 1, -1xx, -2xx, -3xx installed in Mounting Base Assembly**



**Figure 3-3 SG102-XXX w/MOD 2 installed in Mounting Base Assembly**



**Figure 3-4 SG102-X5X (SG102/D) installed in Mounting Base Assembly**

### 3.8 Post Installation Summary

Prior to installing the SG102, a point-to-point continuity check of the wiring harness should be accomplished to verify proper wiring. See FUNCTIONAL GROUND TEST PROCEDURES / REPORT in the appendix for verification of this step and other checks. Apply power to the SG102 and check that the status lights indicate correctly. (See section 7.1 for details).

Perform Ground Test procedures.

## 4 Connector Pinouts

### 4.1 P-1 Connector

Pin		Name		Signal Type
	10	6.6 Volts	Out	MT102 Power Out
1		Gnd	In	Shield/Signal Gnd
	19	MT102 Rx+	In	RS422
	11	MT102 Rx-	In	RS422
2		MT102 Tx	Out	RS232 +/-5v
	20	429-1 A Out	Out	Arinc 429 Hi/Low Speed Out
	12	429-1 B Out	Out	Arinc 429 Hi/Low Speed Out
3		RS232 Maint Rx	In	RS232
	21	RS232 Maint/Hdg	Out	RS232 +/-5v
	13	n/c		Do Not Connect
4		n/c		Do Not Connect
	22*	26VAC Inverter Out	Out	26VAC out
	14*	Hdg X Out	Out	Arinc 407 Out (Z GND)
5*		Hdg Y out	Out	Arinc 407 Out (Z GND)
	23	Gnd	Out	Shield/Signal Gnd
	15	Valid Gnd	Out	Open Collector
6		Invalid Gnd	Out	Open Collector
	24	Slaving Meter	Out	+/-5vdc; 1k ohms
	16	Manual CW Sw In	In	Ground to operate
7		Manual CCW Sw In	In	Ground to operate
	25	Slaving Off	In	Ground to operate
	17	Signal Ground	In	Shield/Signal Gnd
8		Maint Mode		GND/OPEN
	26	Factory Use		Do Not Connect
	18	Aircraft Power Gnd	In	Power Ground
9		Aircraft Power In	In	Primary Power

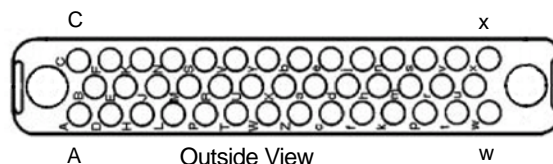
\*Not used in SG102/D.



Outside View  
(Mating Connector)  
Sandel P/N 32101  
P-1 Connector

## 4.2 P-2 Connector (SG102 only)

Pin	Name	Pin	Name
A	Fluxgate Y out	a	Gyro Valid Out
B	Unused	b	Aircraft Power Gnd
C	Fluxgate X out	c	Slaving Off Sw In
D	Signal Gnd	d	AP Disconnect Out
E	Unused	e	Aircraft Power In
F	+15 VDC	f	Unused
H	+15 VDC	h	Unused
J	Unused	j	CW Sw In
K	-15 VDC	k	Slaving Meter Out
L	Stepper C (GND/OPEN)	-	-
M	Unused	m	Unused
N	Stepper D (GND/OPEN)	n	CCW Sw In
P	Stepper A (GND/OPEN)	p	26 VAC Out
R	Unused	r	Unused
S	Stepper B (GND/OPEN)	s	Unused
T	+5.0 VDC	t	Signal Gnd
U	Unused	u	Unused
V	Signal Gnd	v	Slaving Ct In
W	Signal Gnd	w	Unused
X	Unused	x	Unused
Y	Signal Gnd	-	-
Z	Unused	-	-



Outside View  
(Mating Connector)  
P/N GMCT41FON000VL  
(P-2 Connector)

## 5 MT102 Information

### 5.1 Differences between the MT102 and a Fluxgate

The MT102 differs from a Fluxgate (such as a King KMT112) in significant ways. It is solid state and there is not an internal moving pendulum. The MT102 is strapdown and detects the earth's field separately in the Pitch-Roll-Heading body axis of the aircraft. Because it is a strapdown sensor, the axis' orientations change when the aircraft attitude changes. The magnetic axis is then mathematically leveled to produce the 'level magnetic field'. This has a distinct advantage over a Fluxgate since the MT102 does not have turning or acceleration errors due to the pendulum motion, so the system will often remain more accurate during maneuvers.

### 5.2 Environmental

The MT102 is designed to be mounted in the physical environment of the wing or tail of the aircraft. It has a unique upside-down mechanical design which provides a drip loop from the cable entry point. For this reason it is essentially moisture proof.

### 5.3 Wiring

The MT102 is designed to be installed using the existing wires that originally ran to a fluxgate. The original triplex-shielded cable is used for data and the original duplex excitation line is used for DC power. This simplifies installation in retrofit applications.

It is often the case that the original fluxgate wiring is routed to an existing HSI and not to the existing Gyro. In this case the MT102 wiring must be extended to reach the SG102 AHRS. See the installation drawings for details.

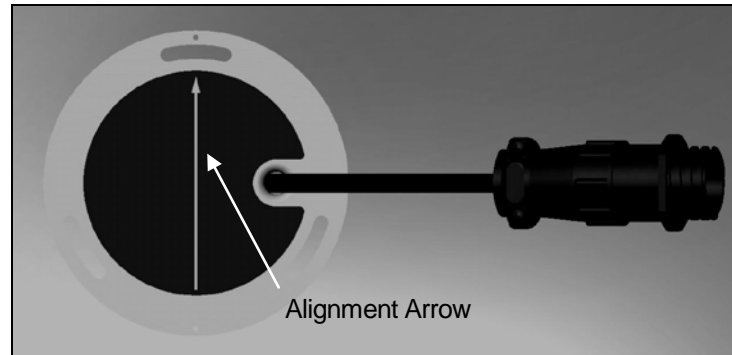
### 5.4 Installation

The MT102 must be installed in alignment to the axis of the aircraft. In the event that the mounting pad for the MT102 is not level with the aircraft, the MT102 should be shimmed using the same measuring technique as is used to align the AHRS. If shimming is required, the washers or shim stock must be brass, plastic or other nonmagnetic material. Non-magnetic stainless-steel may be used.

The MT102 alignment is important as it affects the accuracy of the heading in flight during maneuvering. The MT102 has an alignment arrow that must be oriented parallel to the longitudinal axis of the aircraft and pointed to the nose. For AHRS software 1.31 or later, this alignment is not critical up to  $\pm 10^\circ$  but it is recommended it be as closely aligned as possible for good practice. Alignment tooling holes are present and can be used to assist in installation (see figure 5-1).

**Note: If the SG102 system is installed in an airplane that has a second standard DG and Fluxgate, after maneuvers the pilot may see a small heading split between the two systems of a few degrees. It is likely that this split is due to turning errors in the DG/Fluxgate compass system. This will be visible in**

the DG slaving meter. After straight and level flight this split should be reduced to the static accuracy of the DG system.



**Figure 5-1 MT102 showing alignment arrow**

## 5.5 Connector

The MT102 uses an environmentally sealed CPC connector which adds to the water-proofness of the installation. Use care when crimping and sealing the mating connector as if this is done incorrectly it will be the weak point in the installation.

### 5.5.1 Pinouts

Pin #	Name	Signal Type
1	PWR +	6.6 VDC unregulated (Power input)
2	GND	Power Ground
3	Shield	Shield Ground
4	GND	Shield Ground
5		Unused
6	Shield	Shield Ground
7	Data Rx	RS-232 Rx (Input)
8	Data Tx+	RS-422 + (Output)
9	Data Tx-	RS-422 - (Output)



Outside View  
(Mating Connector)

## 6 Setup Procedures

### 6.1 Software Configuration

#### 6.1.1 SG102 Maintenance Adapter (USB) p/n 81032

The Sandel 81032 SG102 Maintenance Adapter is available to allow USB communication between the setup PC and the SG102 in order to operate the Installation-Calibration software.

See the Maintenance Adapter User Guide for instructions for use.

#### 6.1.2 SG102 Installation-Calibration Utility Software

Sandel 82011-ICU Installation-Calibration Utility software is used in conjunction with the 81032 SG102 Maintenance Adapter to support the following functions:

- View the serial number and software version of the SG102 and MT102.
- Selecting the default SG102 mount orientation.
- Compass calibration.
- Selecting Arinc 429 enhanced maintenance labels.
- Selecting Arinc 429 Hi/Low Speed. For SG102 (MOD 2) and SG102/D

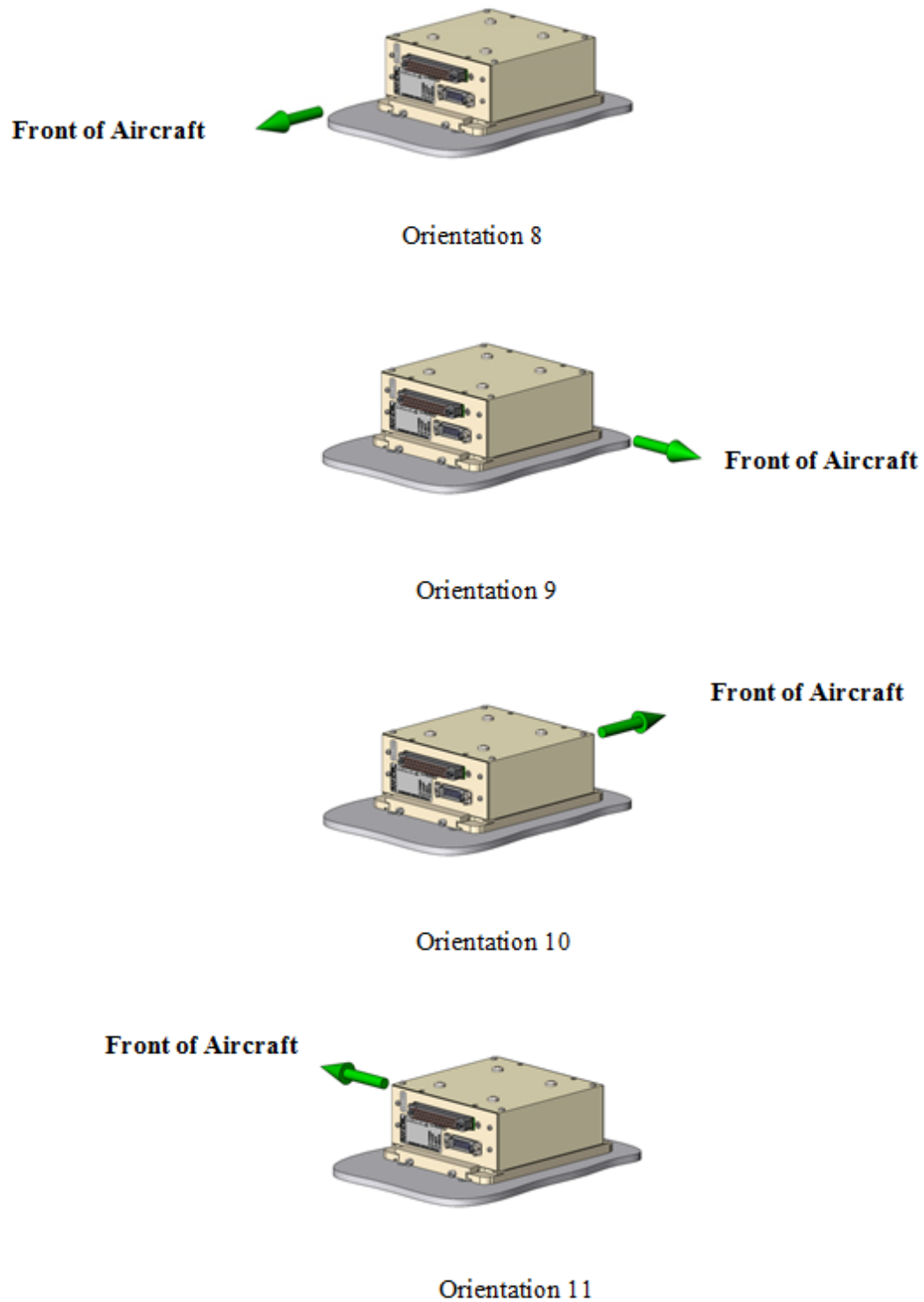
See 82011-ICUG (SG102 Installation Calibration Utility User Guide) for use of this software.

Any time changes are made to the SG102 setup or calibration, an entry must be made in the aircraft maintenance logs by an appropriately rated person stating the action taken.

#### 6.1.3 Mounting Orientation Select

The 82011-ICU Installation-Calibration Utility software is used to select the mounting orientation. Follow the instructions in the User Guide.

NOTE: If the correct software orientation selection is not made the SG102 will appear to operate properly on the ground but will malfunction during flight.



**Figure 6-1 SG102 mounting orientations**

#### **6.1.4 Compass Calibration**

Compass Calibration is a two-pass calibration done at the four cardinal points N-S-E-W. Follow the instructions in 82011-ICUG (SG102 Installation-Calibration Utility Users Guide).

#### **6.1.5 Arinc Maintenance Labels**

The SG102 can output labels 155, 350, 351, 352, 353 and 354. These are Sandel specific maintenance labels. When used in conjunction with the Sandel SN3500 EHSI the labels are recorded by the SN3500 Data Recording function, and the resulting data files can be used by the Factory to diagnose intermittent or installation related problems.

The Installation-Calibration Utility Software provides a means to enable/disable these maintenance labels. Enable only when interconnected to Sandel SN3500 or SN4500 products.

#### **6.1.6 Software Updating**

The 81032 SG102 Maintenance Adapter also supports a software loader capability which may be required in response to service letters or service bulletins. In that event specific instructions for use will be supplied with that documentation.

## 7 Operational Details

### 7.1 Front Panel LED's



SG102



SG102/D

**Figure 7-1 SG102 LED display**

At initial power application, a 2 second LED test is performed with all LEDs on.

After the 2 second test, the functions of the LEDs are as follows (See Figure 5-1):

LED	STATE	DESCRIPTION
POWER	ON	Presence of primary power
	OFF	Absence of primary power
VALID	ON	Initialized and ready for operation (outputs unflagged)
	Flash	Operating in Slaving Off mode, or fast slaving
	OFF	Not initialized (outputs flagged)
MAG	ON	MT102 Communicating and operating
	Fast Flash	MT102 Non Volatile Memory Failure
	OFF	MT102 not communicating or operating
ERROR	FLASH	Power up initialization in progress shown by continuous flashing. After initialization any detectable internal error flashes a numeric code.
	Fast Flash	SG102 Non Volatile Memory failure
	OFF	Normal operation

Under normal conditions, SG102's with MOD 1 under normal conditions will initialize in less than 3 minutes. SG102's without MOD 1 take approximately 5 minutes. While the SG102 is initializing (prior to validity) the aircraft should not be moved.

SG102's with MOD 2 will initialize in approximately 1 minute.

## 7.2 LED Error Codes

The ERROR LED normally is used only as a health monitor during startup when it flashes continuously. If an internal failure does occur the ERROR led will flash with a number of consecutive flashes followed by a pause. The flashes will continue to repeat as long as power is applied to the SG102 and the error condition continues to exist. The ERROR flash codes are as follows.

No. of Flashes	Cause
1	-15v Power Supply
2	-5v Power Supply
3	+15v Power Supply
4	+5v Power Supply
5	+1.9v Power Supply
6	+1.5v Reference
7	+2.5v Gyro Reference
8	+5v Gyro Reference – SG102 (MOD 1). Altitude Error - an internal error is detected (outputs flagged) SG102 (MOD 2) and SG102/D.
9	Attitude Error - an internal error is detected (outputs flagged) SG102

## 8 Instructions for Continued Airworthiness

The following is a summary of the Instructions for Continued Airworthiness prepared under the guidelines of FAA Advisory Circulars 23.1309-1(C) and 25.1309-1(A) which identifies potential failure modes of the Sandel Avionics Model SG102 AHRS. The assumption made is that the function of the SG102 will be used as a gyroscopically stabilized magnetic direction instrument (DG).

No scheduled maintenance required.

After all wiring has been verified and the SG102 has been installed into the mounting base, the included software must be used to set the SG102 mounting orientation and to calibrate the MT102.

## 10 Appendix B: Environmental Qualification

## RTCA/DO-160E Environmental Qualification – SG102 Fixed-Wing Piston Engine Aircraft

NAMEPLATE NOMENCLATURE: [A2F2X]BBB[S(LM)H(R)]XWXXXBZAB[ZW][YY]M[A3J33]XXAX	
MODEL/PART NO: SG102 AHRS	TSO NUMBERS: C4c, C6d
MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:	
TSO C4c deviation: Change starting time from 3 min. to 5 min. @ > 59F, 7.5 min. @ < 59F.	
MANUFACTURER: Sandel Avionics, Inc.	
ADDRESS: 2401 Dogwood Way	
Vista, CA 92081	
REVISION & CHANGE NOS. OF DO-160: Revision E	DATE TESTED: From: 7/05/07 To: 12/11/07

ENVIRONMENTAL TESTS	RTCA DO-160E SECTION	Equipment Test Category	Notes
Temperature & Altitude	4.0	A2F2	PASS
In-Flight Loss of Cooling	4.5.5	X	Not Applicable
Altitude	4.6.1	F2	PASS
-Decompression	4.6.2	A2	PASS
-Overpressure	4.6.3	A2	PASS
Temperature Variation	5.0	B	PASS:
Humidity	6.3.1	B	PASS
Operational Shock and Crash Safety	7.0	B	PASS
Vibration	8.0	[S(LM)H(R)]	PASS: 160E Section 8.5.1: Standard Vib. Cat. S Curves L and M 160E Section 8.6: HLSD, Curve R SAE AS396B: Zone 1 (Fuselage), Max. Accel=5g, 5-500Hz RESONANT FREQUENCIES: 160E Section 8.5.1: Curve L Pre-Scan: X: >150Hz, Y: >150Hz, Z: >150Hz Post-Scan: X: >150Hz, Y: >150Hz, Z: >150Hz 160E Section 8.5.1: Curve M Pre-Scan: X: 250Hz, Y: 225Hz, Z: 250Hz Post-Scan: X: 250Hz, Y: 225Hz, Z: 250Hz SAE AS396B: Pre-Scan: X: 250Hz, Y: 225Hz, Z: 250Hz Post-Scan: X: 250Hz, Y: 300Hz, Z: 250Hz
Explosion	9.0	X	n/a
Water-proofness	10.0	W	PASS: Drip proof. Cat. Y, condensation, applicable.
Fluids Susceptibility	11.0	X	n/a
Sand and Dust	12.0	X	n/a
Fungus	13.0	X	n/a
Salt Spray	14.0	X	n/a
Magnetic Effect	15.0	B	PASS
Power Input	16.0	Z	PASS
Voltage Spike	17.0	A	PASS
Audio Frequency Susceptibility	18.0	B	PASS
Induced Signal Susceptibility	19.0	ZW	PASS
Radio Frequency Susceptibility	20.0	[YY]	PASS
Radio Frequency Emission	21.0	M	PASS
Lightning Induced Transient Susceptibility	22.0	[A3J33]	PASS
Lightning Direct Effects	23.0	X	n/a
Icing	24.0	X	n/a
Electrostatic Discharge	25.0	A	PASS
Fire, Flammability	26.0	X	n/a

**RTCA/DO-160E Environmental Qualification – SG102 Fixed-Wing Turbine Engine Aircraft**

<b>NAMEPLATE NOMENCLATURE:</b> [A2F2X]BBB[H(R)R(BB1CC1)]XWXXXBZAB[ZW][YY]M[A3J33]XXAX	
<b>MODEL/PART NO:</b> SG102 AHRs	<b>TSO NUMBERS:</b> C4c, C6d
<b>MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:</b>	
TSO C4c deviation: Change starting time from 3 min. to 5 min. @ > 59F, 7.5 min. @ < 59F.	
<b>MANUFACTURER:</b> Sandel Avionics, Inc.	
<b>ADDRESS:</b> 2401 Dogwood Way	
Vista, CA 92081	
<b>REVISION &amp; CHANGE NOS. OF DO-160:</b> Revision E	<b>DATE TESTED:</b> From: 7/05/07 To: 1/15/08

ENVIRONMENTAL TESTS	RTCA DO-160E SECTION	Equipment Test Category	Notes
Temperature & Altitude	4.0	A2F2	PASS
In-Flight Loss of Cooling	4.5.5	X	Not Applicable
Altitude	4.6.1	F2	PASS
-Decompression	4.6.2	A2	PASS
-Overpressure	4.6.3	A2	PASS
Temperature Variation	5.0	B	PASS:
Humidity	6.3.1	B	PASS
Operational Shock and Crash Safety	7.0	B	PASS
Vibration	8.0	[H(R)R(BB1C C1)]	PASS: 160E Section 8.6: HLSD, Curve R 160E Section 8.7.2: Robust, Curves B B1 C C1 SAE AS396B: Zone 1 (Fuselage), Max. Accel=5g, 5-500Hz RESONANT FREQUENCIES: Curve B, Section 8.7.2, Step a. and d.: Pre-Scan: X: 400Hz, Y: 125Hz, Z: 110Hz Post-Scan: X: 395Hz, Y: 125Hz, Z: 100Hz Curve C, Section 8.7.2, Step a. and d.: Pre-Scan: X: 395Hz, Y: 130Hz, Z: 105Hz Post-Scan: X: 410Hz, Y: 130Hz, Z: 100Hz SAE AS396B: Pre-Scan: X: >500Hz, Y: 82Hz, Z: 120Hz Post-Scan: X: >500Hz, Y: 82Hz, Z: 140Hz
Explosion	9.0	X	n/a
Water-proofness	10.0	W	PASS: Drip proof. Cat. Y, condensation, applicable.
Fluids Susceptibility	11.0	X	n/a
Sand and Dust	12.0	X	n/a
Fungus	13.0	X	n/a
Salt Spray	14.0	X	n/a
Magnetic Effect	15.0	B	PASS
Power Input	16.0	Z	PASS
Voltage Spike	17.0	A	PASS
Audio Frequency Susceptibility	18.0	B	PASS
Induced Signal Susceptibility	19.0	ZW	PASS
Radio Frequency Susceptibility	20.0	[YY]	PASS
Radio Frequency Emission	21.0	M	PASS
Lightning Induced Transient Susceptibility	22.0	[A3J33]	PASS
Lightning Direct Effects	23.0	X	n/a
Icing	24.0	X	n/a
Electrostatic Discharge	25.0	A	PASS
Fire, Flammability	26.0	X	n/a

**RTCA/DO-160E Environmental Qualification – SG102 Helicopters**

<b>NAMEPLATE NOMENCLATURE:</b> [A2F2X]BBB[R(G)U2(FF1)]XWXXXXBZAB[ZW][YY]M[A3J33]XXAX	
<b>MODEL/PART NO:</b> SG102 AHRS	<b>TSO NUMBERS:</b> C4c, C6d
<b>MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:</b>	
TSO C4c deviation: Change starting time from 3 min. to 5 min. @ > 59F, 7.5 min. @ < 59F.	
<b>MANUFACTURER:</b> Sandel Avionics, Inc.	
<b>ADDRESS:</b> 2401 Dogwood Way Vista, CA 92081	
<b>REVISION &amp; CHANGE NOS. OF DO-160:</b> Revision E	<b>DATE TESTED:</b> From: 7/05/07 To: 1/15/08

ENVIRONMENTAL TESTS	RTCA DO-160E SECTION	Equipment Test Category	Notes
Temperature & Altitude	4.0	A2F2	PASS
In-Flight Loss of Cooling	4.5.5	X	Not Applicable
Altitude	4.6.1	F2	PASS
-Decompression	4.6.2	A2	PASS
-Overpressure	4.6.3	A2	PASS
Temperature Variation	5.0	B	PASS:
Humidity	6.3.1	B	PASS
Operational Shock and Crash Safety	7.0	B	PASS
Vibration	8.0	[R(G)U2(F F1)]	PASS: 160E Section 8.8.1: SoR, Curve G 160E Section 8.8.3: Rondon (unknown freq.), Curves F F1 SAE AS396B: Zone 1 (Fuselage), Max. Accel=5g, 5-500Hz RESONANT FREQUENCIES: Curve G, Section 8.8.1.3, Step a. and e.: Pre-Scan: X: 190Hz, Y: 140Hz, Z: 115Hz Post-Scan: X: 390Hz, Y: 90Hz, Z: 95Hz Curve F, Section 8.8.1.3, Step a. and e.: Pre-Scan: X: 180Hz, Y: 125Hz, Z: 180Hz Post-Scan: X: 240Hz, Y: 95Hz, Z: 140Hz Curve F, Section 8.8.1.3, Step b. and d.: Pre-Scan: X: 35Hz, Y: 58Hz, Z: 120Hz Post-Scan: X: 28Hz, Y: 85Hz, Z: 95Hz SAE AS396B: Pre-Scan: X: >500Hz, Y: 82Hz, Z: 120Hz Post-Scan: X: >500Hz, Y: 82Hz, Z: 140Hz
Explosion	9.0	X	n/a
Water-proofness	10.0	W	PASS: Drip proof. Cat. Y, condensation, applicable.
Fluids Susceptibility	11.0	X	n/a
Sand and Dust	12.0	X	n/a
Fungus	13.0	X	n/a
Salt Spray	14.0	X	n/a
Magnetic Effect	15.0	B	PASS
Power Input	16.0	Z	PASS
Voltage Spike	17.0	A	PASS
Audio Frequency Susceptibility	18.0	B	PASS
Induced Signal Susceptibility	19.0	ZW	PASS
Radio Frequency Susceptibility	20.0	[YY]	PASS
Radio Frequency Emission	21.0	M	PASS
Lightning Induced Transient Susceptibility	22.0	[A3J33]	PASS
Lightning Direct Effects	23.0	X	n/a
Icing	24.0	X	n/a
Electrostatic Discharge	25.0	A	PASS
Fire, Flammability	26.0	X	n/a

**RTCA/DO-160E Environmental Qualification – MT102 All Variants**

NAMEPLATE NOMENCLATURE: [A2F2X]BBB[H(RP)R(BB1CC1EE1GJ)U2(FF1)]XWXXXXBXXX[ZW][YY]M[A3J33]XXAX	
MODEL/PART NO: MT102 Magnetic Transducer	TSO NUMBERS: C6d
MANUFACTURER'S SPECIFICATION AND/OR OTHER APPLICABLE SPECIFICATION:	
MANUFACTURER: Sandel Avionics, Inc.	
ADDRESS: 2401 Dogwood Way Vista, CA 92081	
REVISION & CHANGE NOS. OF DO-160: Revision E	DATE TESTED: From: 7/05/07 To: 1/15/08

ENVIRONMENTAL TESTS	RTCA DO-160E SECTION	Equipment Test Category	Notes
Temperature & Altitude	4.0	A2F2	PASS
In-Flight Loss of Cooling	4.5.5	X	Not Applicable
Altitude	4.6.1	F2	PASS
-Decompression	4.6.2	A2	PASS
-Overpressure	4.6.3	A2	PASS
Temperature Variation	5.0	B	PASS:
Humidity	6.3.1	B	PASS
Operational Shock and Crash Safety	7.0	B	PASS
Vibration	8.0	[H(RP)R(BB1CC1EE1GJ)U2(FF1)]	PASS: 160E Section 8.6: HLSD, Curves R and P 160E Section 8.7.2: Robust, Curves B B1 C C1 E E1 160E Section 8.8.1: SoR, Curves G J 160E Section 8.8.3: Rndom (unknown freq.), Curves F F1 SAE AS396B: Zone 1 (Fuselage), Max. Accel=5g, 5-500Hz
Explosion	9.0	X	n/a
Water-proofness	10.0	W	PASS: Drip proof. Cat. Y, condensation, applicable.
Fluids Susceptibility	11.0	X	n/a
Sand and Dust	12.0	X	n/a
Fungus	13.0	X	n/a
Salt Spray	14.0	X	n/a
Magnetic Effect	15.0	B	PASS
Power Input	16.0	X	n/a
Voltage Spike	17.0	X	n/a
Audio Frequency Susceptibility	18.0	X	n/a
Induced Signal Susceptibility	19.0	ZW	PASS
Radio Frequency Susceptibility	20.0	[YY]	PASS
Radio Frequency Emission	21.0	M	PASS
Lightning Induced Transient Susceptibility	22.0	[A3J33]	PASS
Lightning Direct Effects	23.0	X	n/a
Icing	24.0	X	n/a
Electrostatic Discharge	25.0	A	PASS
Fire, Flammability	26.0	X	n/a

## 11 Appendix C: Sample FAA Form 337

**NOTICE**

*Weight and balance or operating limitation changes shall be entered in the appropriate aircraft record. An alteration must be compatible with all previous alterations to assure continued conformity with the applicable airworthiness requirements.*

## 8. Description of Work Accomplished

*(If more space is required, attach additional sheets. Identify with aircraft nationality and registration mark and date work completed.)*

## A. Installed the following equipment and components:

1. Sandel Avionics, Inc., SG102 AHRS *(or as appropriate)*.

## B. The Sandel Avionics SG102 is interfaced to the following equipment:

1. SN4500 Primary Navigation Display

*(By example state the following functional interface properties)...*

C. Interference and functional tests and inspections were accomplished with reference to Advisory Circular 23.1311. *(or as appropriate)*.

D. A system design and analysis was conducted with reference to Advisory Circular 23.1309-1(C). *(Or as appropriate)*.

E. Federal Aviation Regulations, 23.1301, 23.1309(a)(b) and (d), 23.1351, 23.1357(a)(b)(c)(d), 23.1365, 23.1529, and 23.1581 *(or as appropriate)*, were the basis of compliance.

F. The aircraft equipment list, and weight and balance were revised and recorded within the aircraft maintenance records.

G. All pertinent records of this alteration are on file at *(State your repair station name and number)*.

----- End -----

## 12 Appendix D: Sample Airplane Flight Manual Supplement

The following is being provided for installations in which the local FSDO requires an Airplane Flight Manual Supplement. This sample is simply being provided for the convenience of the installer. Note that the cover page, table of contents and log of revisions has not been included here, and will be specific to your installation. The text is specific to the installed equipment. This text must be modified by the installation facility to be compatible with the installed equipment.

### SECTION I - GENERAL

The Sandel Avionics SG102 Attitude Heading Reference System is a compact solid state device that performs the functions of a Directional Gyro (DG) and as a source of Reversionary Attitude.

### SECTION II LIMITATIONS

[SG102 (Mod 1) software prior to 1.25: Not approved for primary attitude information except for reversionary or backup attitude display in the primary field of view. Not approved for aerobatic flight]

Otherwise:

[SG102 (software 1.25 and later) and SG102/D: Not approved for primary attitude information except for reversionary or backup attitude display in the primary field of view.]

### SECTION III EMERGENCY PROCEDURES

None

## SECTION IV NORMAL PROCEDURES

The circuit breaker for the SG102 is located on the (right/left) circuit breaker panel labeled AHRS.

While the SG102 is initializing the aircraft should not be moved. When the Flag is removed from the heading display, the SG102 initialization is complete.

The SG102 is normally be operated in the slaved mode. If it is desired to operate in the unslaved mode, select the Slaving Off position on the mode selector switch. Adjust the heading clockwise or counter clockwise as needed using the manual slew switches. All heading outputs will track the new heading. Selecting Slaving On will return all heading outputs to the current magnetic heading and restore slaving operation.

If the SG102 fails to operate or the display indicates that the heading is invalid, use the aircraft compass and/or other available heading source for heading information.

## SECTION V PERFORMANCE DATA

No Change to AFM.

**13 Appendix E: Checkout Procedures****13.1 Functional Ground Test Procedures/Report**

The “Functional Ground Test Procedures/Report” below is for the purpose of simplifying ground tests of the SG102 and Mt102. A copy of this report must be retained by the installing agency and a copy must be installed in the aircraft maintenance records. A copy must also be forwarded to Sandel Avionics, Inc. along with the Warranty Registration Form, Part Number 82011-0137, which should be mailed after operational acceptance.

Repair Station Name: _____
Number: _____
Address or Location: _____
City _____ ST _____ ZIP _____
A/C Make: _____ A/C Model: _____ A/C Serial No: _____
Work Order No.: _____ Technician: _____ Date Performed: _____

COMPANY NAME  
COMPANY ADDRESS  
TELEPHONE/FAX

**Ground Test Procedures/Report  
for  
Sandel Avionics  
SG102 and MT102**

**Installed in  
{Aircraft make and model}**

**Registration No.** \_\_\_\_\_ **Serial No.** \_\_\_\_\_

**Document No.** \_\_\_\_\_ **Rev.** \_\_\_\_\_ **Date** \_\_\_\_\_

### 13.1.1 Introduction

The following ground test procedures are to be performed after the SG102 and MT102 have been properly installed and configured in the “Post-Installation Procedures. Successful completion of the Ground Test procedures is necessary to support the claim that the SG102 and MT102, as installed, perform their intended functions and are compatible with all aircraft systems. The ground test procedures contained herein will include testing of interfaces to other systems. Therefore, this ground test must be conducted in conjunction with, or subsequent to ground testing of other systems.

### 13.1.2 Physical Installation

Verify that the SG102 mounting base has been properly installed in accordance with the manufacturer’s instructions, that any external switches affecting SG102 operation have been clearly labeled, and that a trip-free re-settable circuit breaker labeled “AHRS” is clearly visible.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Install the SG102 into the mounting base and verify that the unit installs solidly and without obstruction.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

### 13.1.3 Wiring Verification and Initial Power-Up

Perform a 100% continuity check of all aircraft wiring to verify in accordance with installation wiring diagrams.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Power check all wiring to ensure that primary power is applied to the proper pins and nowhere else.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Pull AHRS circuit breaker. Verify that power is removed from wires supplying primary power to the SG102. Reset circuit breaker when complete.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Connect P1 and/or P2 as the installation requires to the SG102 and verify the mating MT102 connector is connected. Verify that the connectors mate and latch correctly.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

### 13.1.4 System Functions

Activate the aircraft master switch. Verify that the SG102 LED self-test is performed (all LEDs shall illuminate upon initial power application).

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Verify that during the initialization period the “POWER” LED is illuminated.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Verify that during the initialization period the “VALID” LED is not illuminated.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Verify that during the initialization period the “MAG” LED is illuminated.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Verify that during the initialization period the “ERROR” LED is flashing.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Verify that following the initialization period the “VALID” LED illuminates steadily.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Verify that following the initialization period, the “ERROR” light is extinguished.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

If installed, verify that the slaving control functions properly when in the Slaving Off mode. Return to Slaving On mode when complete.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

**13.1.5 Installation Software: Mount Orientation Select**

Verify that the SG102 Installation-Calibration Utility Software has been used to select the correct mount position.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

**13.1.6 Installation Software: Heading Calibration**

Perform the Compass Calibration instructions in the SG102 Installation-Calibration Utility Software Users Guide and verify that the heading shown on the Primary Navigation Display interfaced to the SG102 is within +/- 2 degree for the four cardinal headings (**90°, 180°, 270°, and 360°**).

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

**13.1.7 Additional Testing**

Perform other tests deemed necessary.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

**13.2 EM/RFI Test Procedures****13.2.1 NAV/COM Testing**

Apply power to the avionics bus and ensure that all electrical equipment, including the SG102 and MT102, are operating normally. Open the squelch on the primary communications radio and tune the radio to each whole megahertz frequency sequentially. Attempt to discern any interference caused by the SG102 or MT102. Pull the AHRS breaker if interference is noted, to verify that the SG102 or MT102 is the source.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Repeat for the secondary communications radio.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Tune the primary navigation radio to 112 MHz and enable the audio output. Attempt to discern any audible interference cause by the SG102 or MT102.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Repeat for the secondary navigation radio.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Transmit on the frequencies 118.000 MHz, 126.975 MHz, and 135.975 MHz on the primary communications radio and attempt to discern any changes in the SG102 operation.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

Repeat for the secondary communications radio.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

### 13.2.2 General Testing

Observe any unusual interaction between the transponder, DME, ADF or Marker Beacon receivers, and the SG102 when switching power to any equipment.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

### 13.2.3 Other Appliances

Observe any unusual interaction other installed appliances such as Air Conditioner, Strobes, Beacons, etc.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

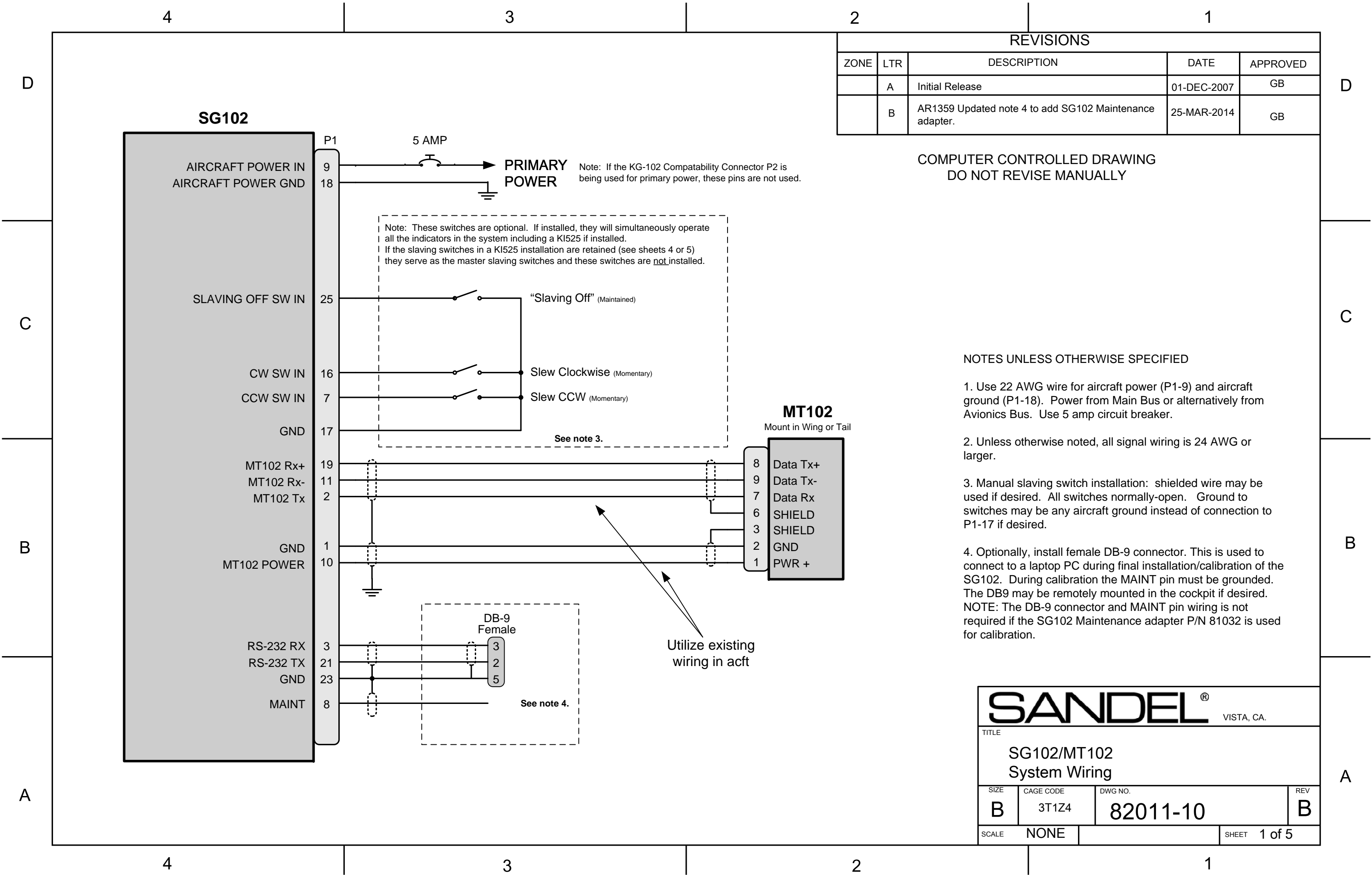
### 13.2.4 Additional Testing

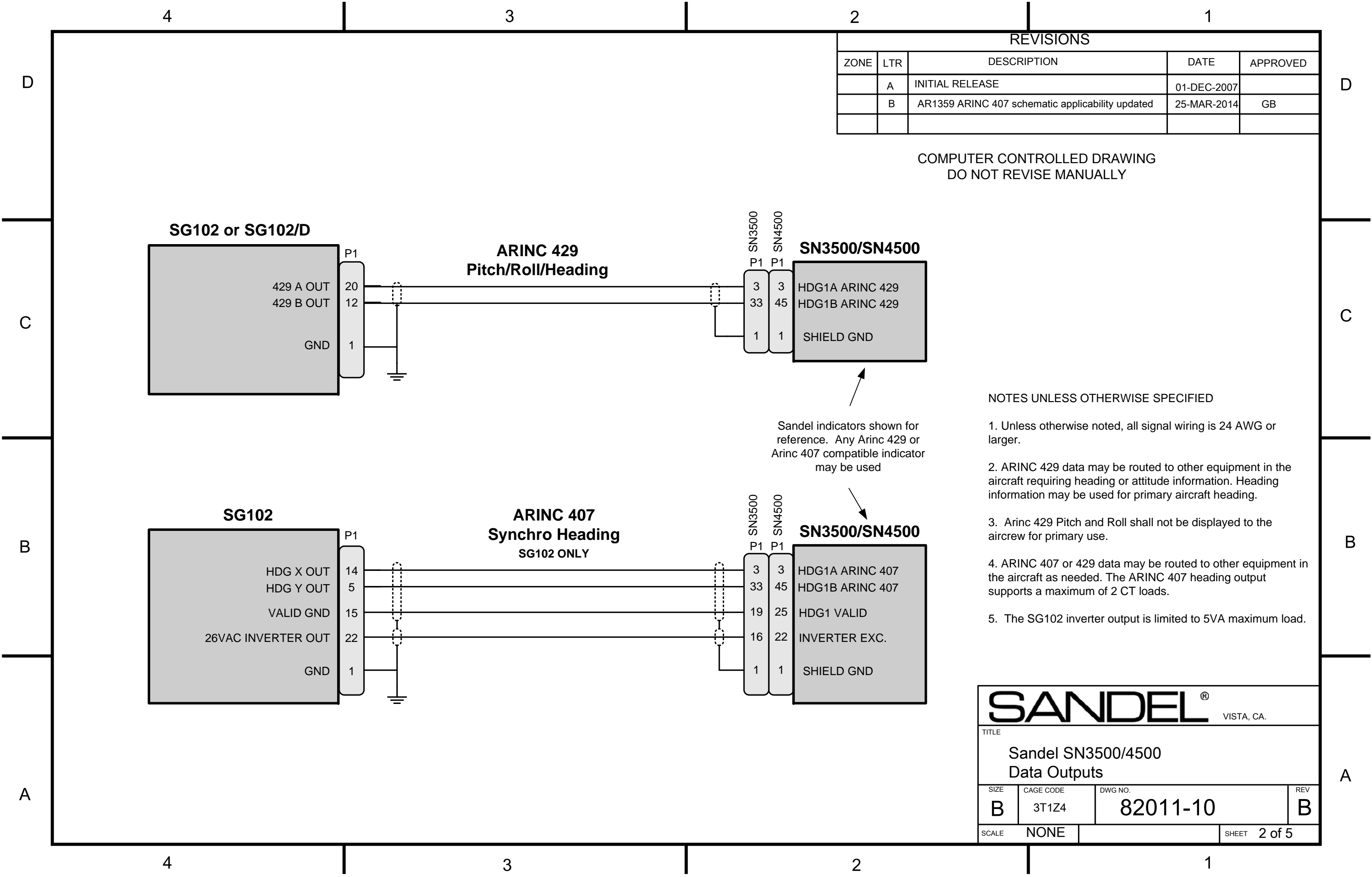
Perform any additional EMI/RFI-related tests deemed necessary.

**Completed** \_\_\_\_\_ **Comment** \_\_\_\_\_

## 14 Appendix F: List of Effective Drawings and Attachments

Page 14-1





D

D

C

C

B

B

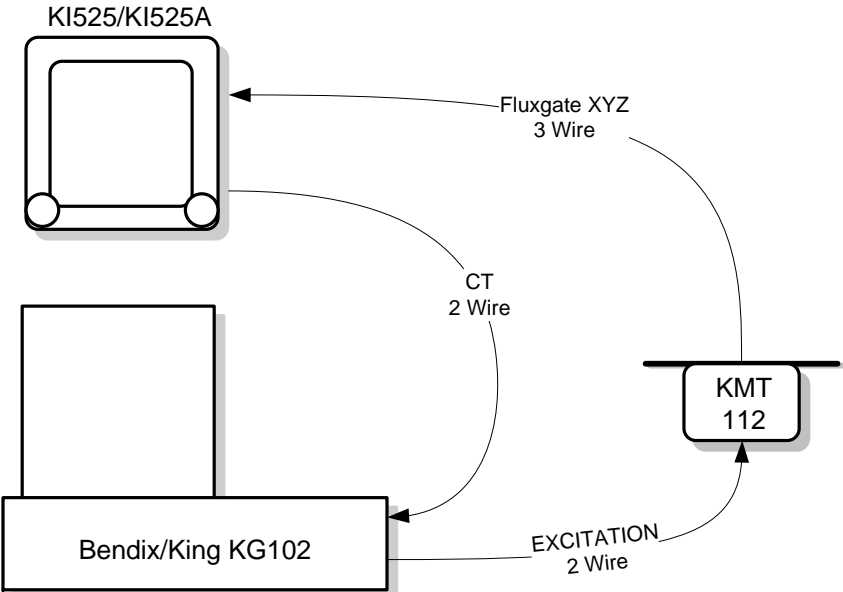
A

A

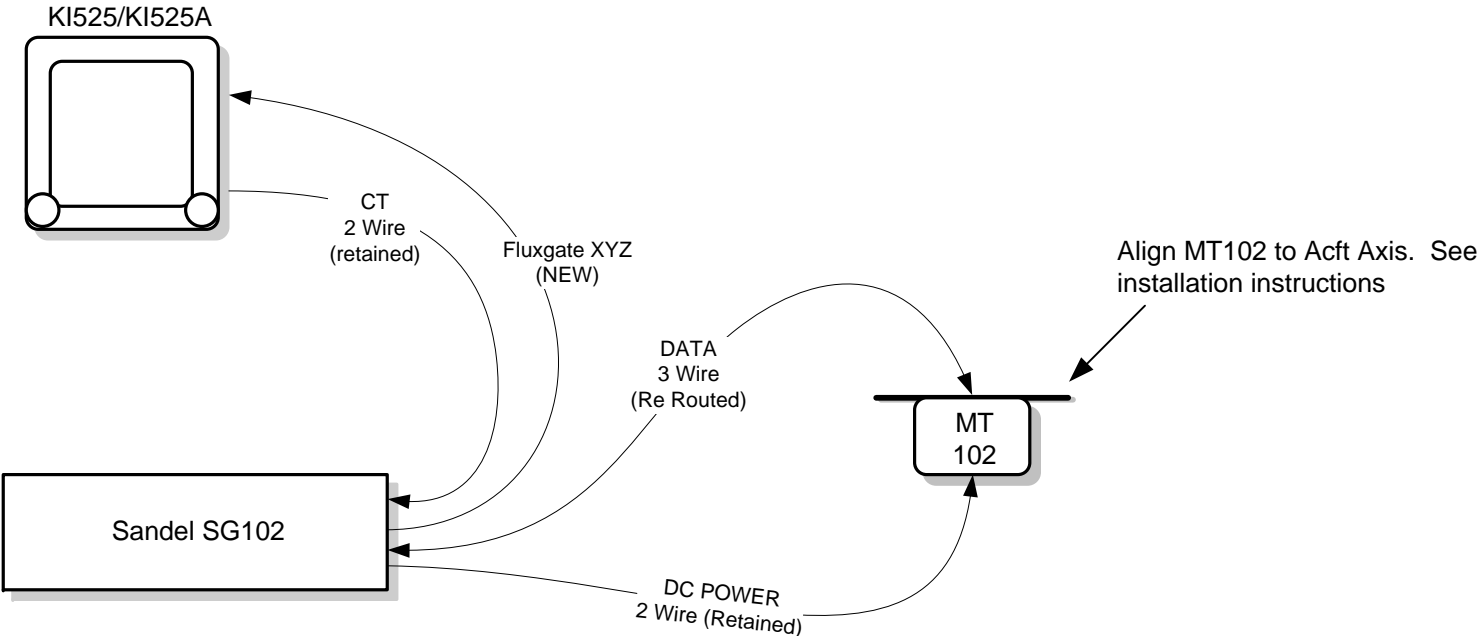
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
All	A	Initial Release	01-DEC-2007	
	B	AR 1359 – Note 3 added for applicability.	25-MAR-2014	GB

COMPUTER CONTROLLED DRAWING  
DO NOT REVISE MANUALLY

BEFORE



AFTER



- Note:
- 1. For detail MT102 connection see sheet 1.
  - 2. Other wiring from KG102 system to drive the KI525 indicator is retained but not shown on this diagram. See sheets 4/5 for detail information
  - 3. This drawing is applicable only to SG102 MOD1 and SG102 MOD 2 units.

SANDEL® VISTA, CA.			
TITLE Bendix/King KG102 Replacement MT102 Installation Block Diagram			
SIZE B	CAGE CODE 3T1Z4	DWG NO. 82011-10	REV B
SCALE NONE			SHEET 3 of 5

4

3

2

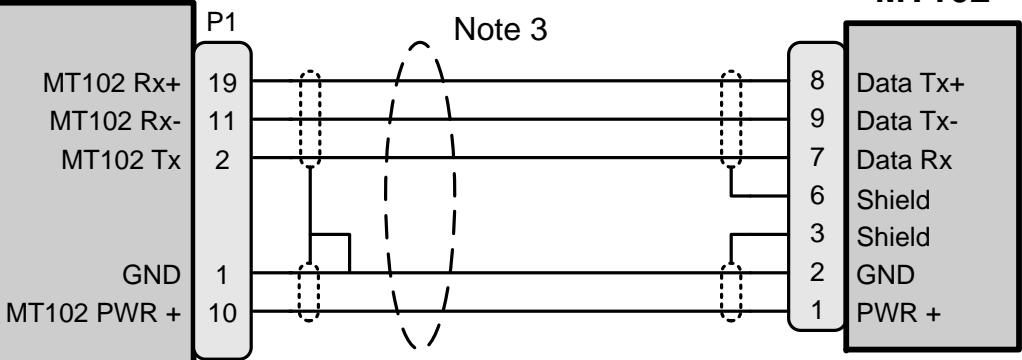
1

D

D

SG102

MT102



REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
All	A	Initial Release	01-DEC-2007	
	B	AR #972 - SG102 P2-A & P2-C swapped	06-MAR-2008	

COMPUTER CONTROLLED DRAWING  
DO NOT REVISE MANUALLY

NOTES UNLESS OTHERWISE SPECIFIED

1. This drawing is for reference to existing KCS 55 wiring when replacing a KG102 with an SG102. For additional KCS 55/55A information consult original manufactures installation manual.

2. If a KI525 indicator is not installed this wiring is not required. See sheet 1

3. The KMT112 fluxgate is removed. The circled items are re-routed wires.

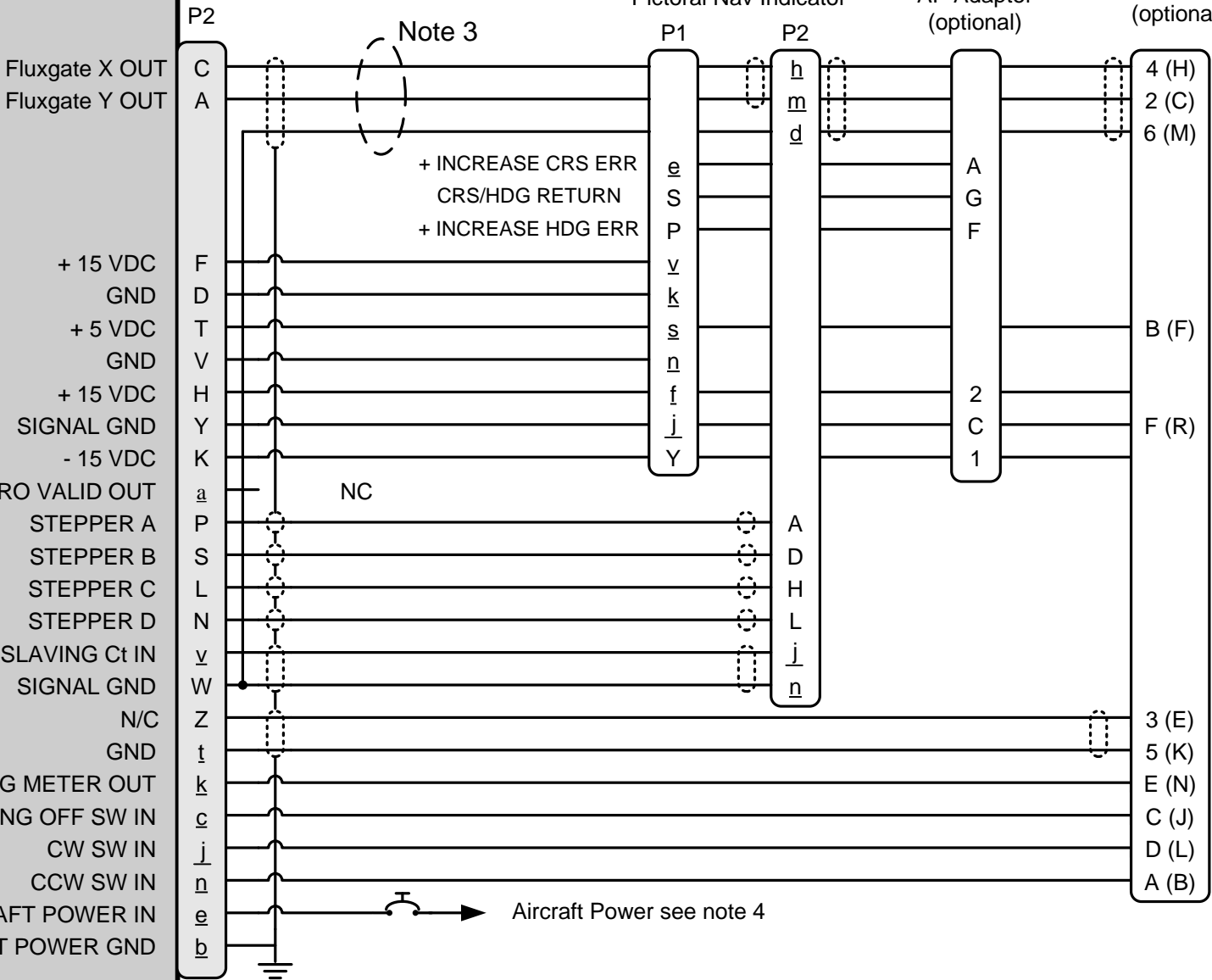
4. A 5 amp circuit breaker is required. If installing in a 28 volt system, check existing circuit breaker and replace if necessary. Reference sheet 1 of this drawing set. Use 22 AWG wire. If power is applied to SG102 P1 then power does not need to be applied to P2, see sheet 1 of this drawing set.

5. The KA51/KA51A is not required except if it is desired to retain the original manual slaving switches. If these manual slaving switches are retained they will slave the entire SG102 system (including the Arinc 429 data) and the optional slaving switches shown on sheet 1 are not required.

6. If J2 pins A/C are missing in the original Bendix/King connector, insert new pins (supplied)

C

C



B

B

A

A

SANDTEL® VISTA, CA.			
TITLE			
REFERENCE ONLY: KI525 (NON-A) WITH SG102 SYSTEM			
SIZE	CAGE CODE	DWG NO.	REV
B	3T1Z4	82011-10	B
SCALE	NONE		SHEET 4 of 5

4

3

2

1

4

3

2

1

SG102

MT102

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
All	A	Initial Release	01-DEC-2007	
	B	AR #972 - SG102 P2-A & P2-C swapped	06-MAR-2008	

COMPUTER CONTROLLED DRAWING  
DO NOT REVISE MANUALLY

NOTES UNLESS OTHERWISE SPECIFIED

1. This drawing is for reference to existing KCS55-A wiring when replacing a KG102 with an SG102. For additional KCS 55/55A information consult original manufactures installation manual.
2. If a KI525 indicator is not installed this wiring is not required. See sheet 1
3. The KMT112 fluxgate is removed. The circled items are re-routed wires.
4. A 5 amp circuit breaker is required. If installing in a 28 volt system, check existing circuit breaker and replace if necessary. Reference sheet 1 of this drawing set. Use 22 AWG wire. If power is applied to SG102 P1 then power does not need to be applied to P2, see sheet 1 of this drawing set.
5. The KA51/KA51A is not required except if it is desired to retain the original manual slaving switches. If these manual slaving switches are retained they will slave the entire SG102 system (including the Arinc 429 data) and the optional slaving switches shown on sheet 1 are not required.
6. If J2 pins A/C are missing in the original Bendix/King connector, insert new pins (supplied)

SANDTEL® VISTA, CA.				
TITLE REFERENCE ONLY: KI525-A WITH SG102 SYSTEM				
SIZE B	CAGE CODE 3T1Z4	DWG NO. 82011-10	REV B	
SCALE	NONE	SHEET 5 of 5		

4

3

2

1

D

D

C

C

B

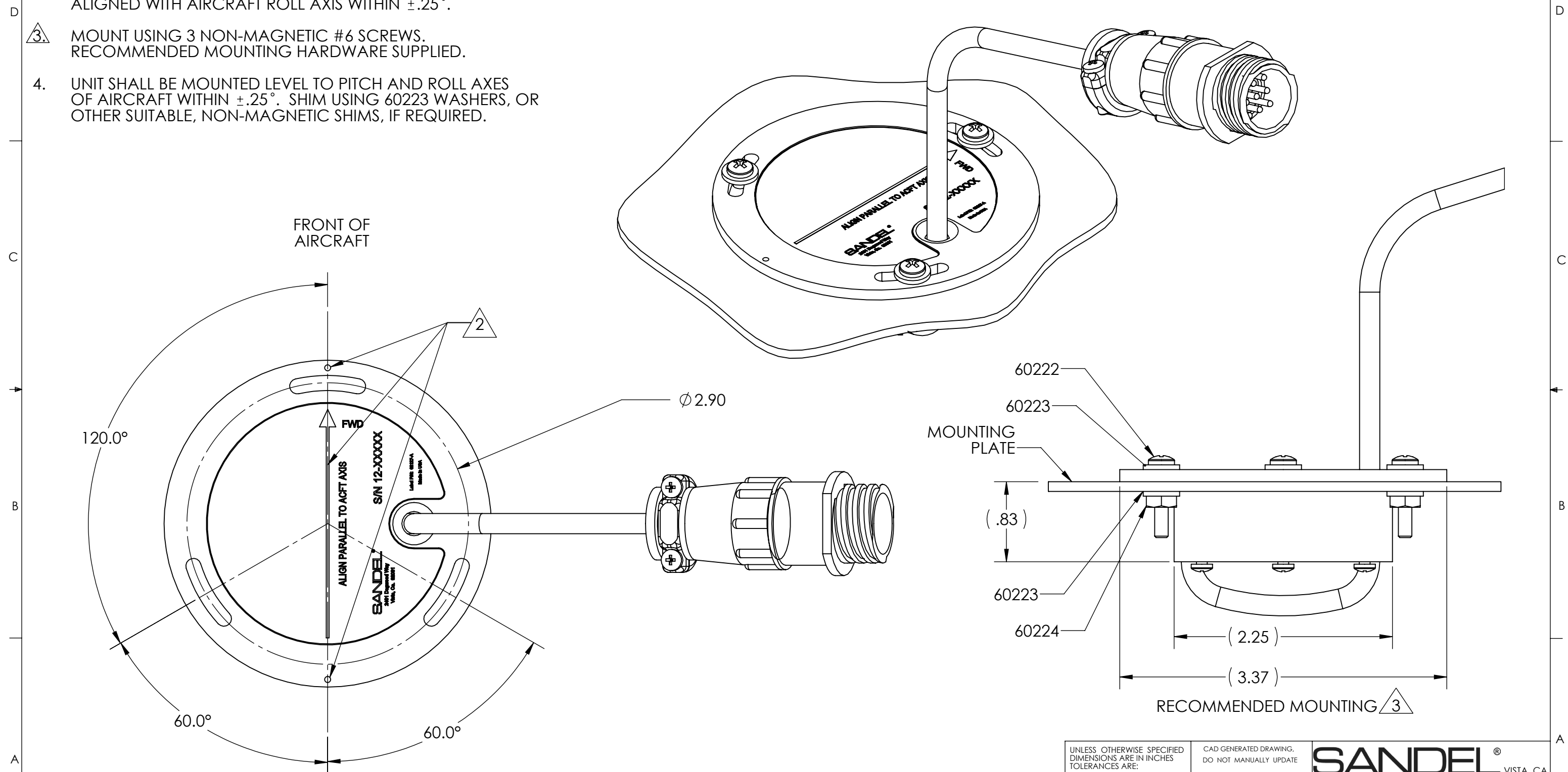
B

A

A

4. UNIT SHALL BE MOUNTED LEVEL TO PITCH AND ROLL AXES OF AIRCRAFT WITHIN  $\pm .25^\circ$ . SHIM USING 60223 WASHERS, OR OTHER SUITABLE, NON-MAGNETIC SHIMS, IF REQUIRED.

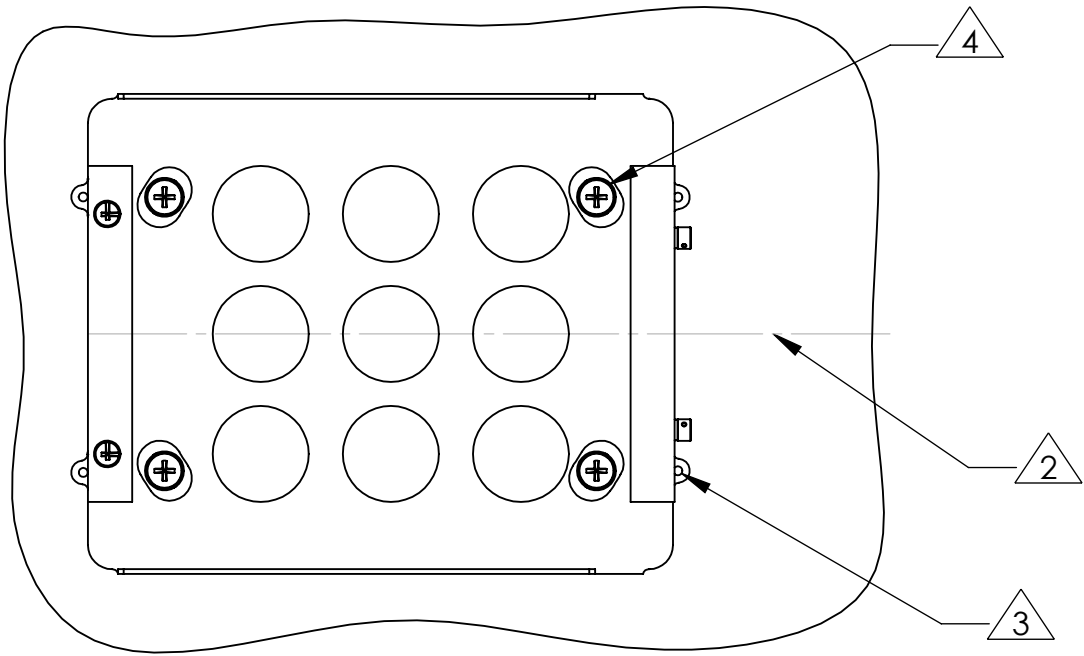
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A		INITIAL RELEASE	844	01/02/08	



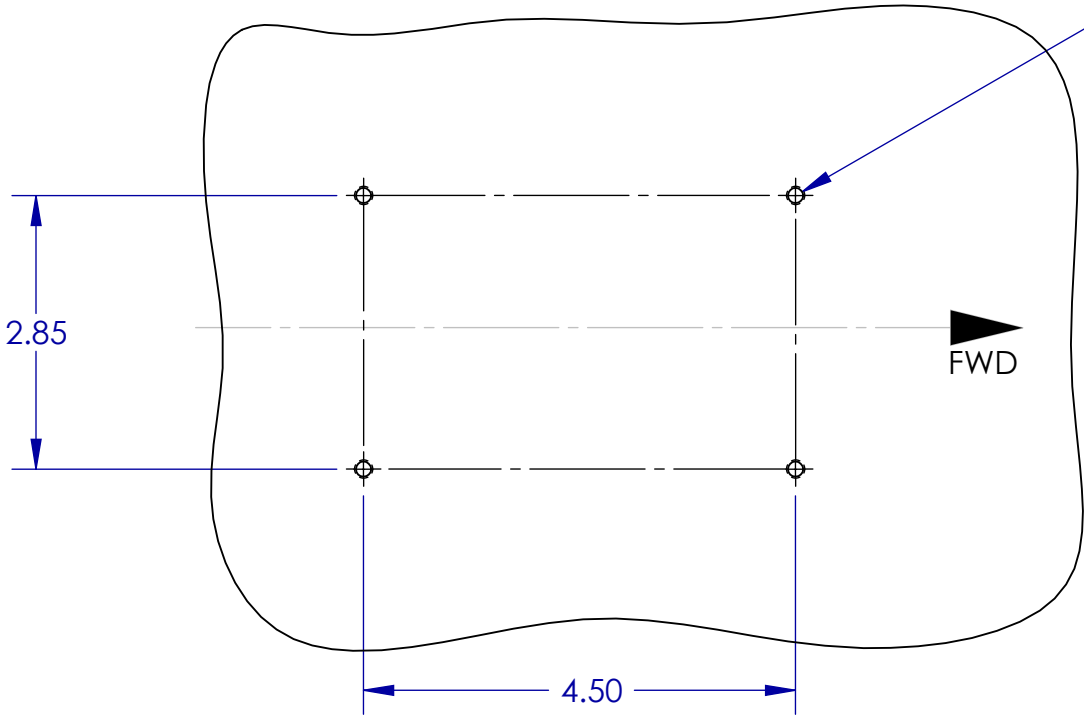
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		DECIMALS .XX ± .01 .XXX ± .005		ANGLES ±.5°		APPROVALS		DATE		TITLE					
		MATERIAL  -  FINISH  -		-  -  -		DRAWN M. Wiley		12/11/07		INSTALLATION INSTRUCTIONS, MT102					
						CHECKED T. MORRISON		12/11/07							
						RESP ENG T. MORRISON		12/11/07							
NEXT ASSY	USED ON					MFG ENG				SIZE	CAGE CODE	DWG. NO.	CATEGORY	REV.	
										B	3T174	82012	05	A	
APPLICATION		DO NOT SCALE DRAWING		APPROVAL				SCALE 1:1 & NOTED			CAD FILE 82012, INSTALLATION, MT-102			SHEET 1 OF 1	

NOTES:

1.
- ASME Y14.5M-1994 APPLIES.
2.
- INSTALL 84051 MOUNTING PLATE IN DESIRED ORIENTATION PER 82011-IM (CURRENT REV), SECTION 6. 84051 SHALL BE ALIGNED TO AIRCRAFT AXES WITHIN  $\pm .25^{\circ}$ .
3.
- 84051 MOUNTING BASE SHALL BE LEVELED TO PITCH AND ROLL AXES OF AIRCRAFT WITHIN  $\pm .25^{\circ}$ . SHIM USING 61251 SHIMS, UNDER MOUNTING SCREWS, IF REQUIRED.
4.
- INSTALL 84051 MOUNTING BASE USING 4 X 60220 PHMS, 10-32 X .875 (MS51958-66, OR EQ.) WITH 60221 WASHER, FLAT, #10 (NAS1149C0363R OR EQ.). LOCKING HARDWARE REQUIRED FOR SUPPORTING STRUCTURE. EQUIVALENT FASTENERS OF DIFFERENT LENGTHS MAY BE SUBSTITUTED, IF REQUIRED.
5.
- ENSURE SUFFICIENT CLEARANCE FOR CONNECTORS AND CABLING.
6.
- TORQUE FORWARD RETAINER SCREWS TO SECURE SG102. INSTALL SAFETY WIRE WHEN COMPLETE.
7.
- WEIGHT OF SG102, MOD 1: 2.2 LBS.  
WEIGHT OF SG102, MOD 2: 1.8 LBS.  
WEIGHT OF SG102/D: 1.65 LBS  
WEIGHT OF MOUNTING PLATE: .61 LBS.  
C.G. SHOWN IS COMPOSITE.



84051 MOUNTING PLATE INSTALLATION 2 3 4



MOUNTING HOLE PATTERN 2

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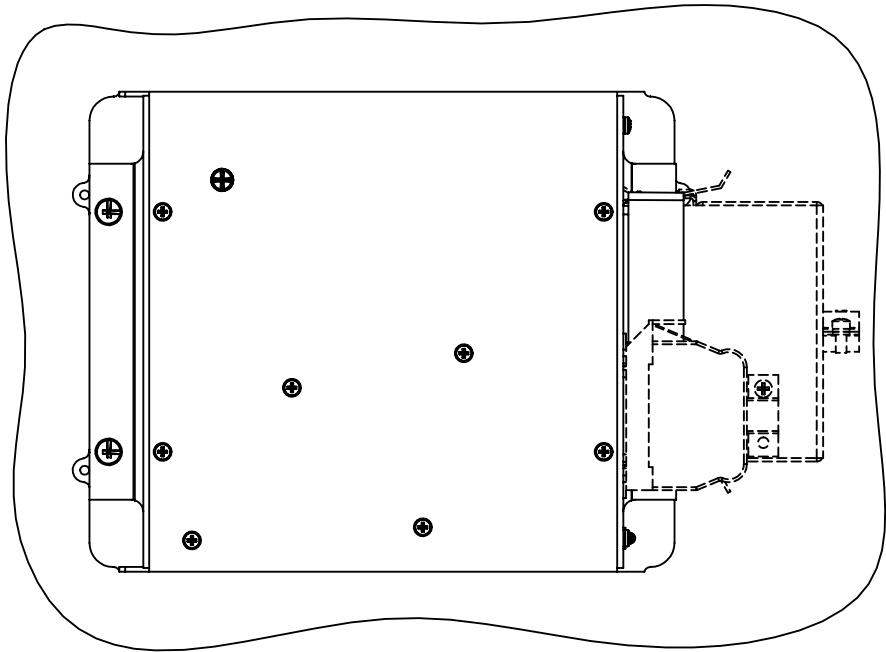
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REV.	ZONE	DESCRIPTION	A/R	DATE
A		INITIAL RELEASE	844	12/21/07
B		ADDED SHEET 3, MOD 2 MOUNTING DETAILS	1441	01/30/14
C		REVISED AND REDRAWN, WITH CHANGES, INCORPORATING MOUNTING DETAILS FOR ALL SG102 VARIANTS	1359	03/13/14

APPROVED
JS. FOR GB
G. BLOCK

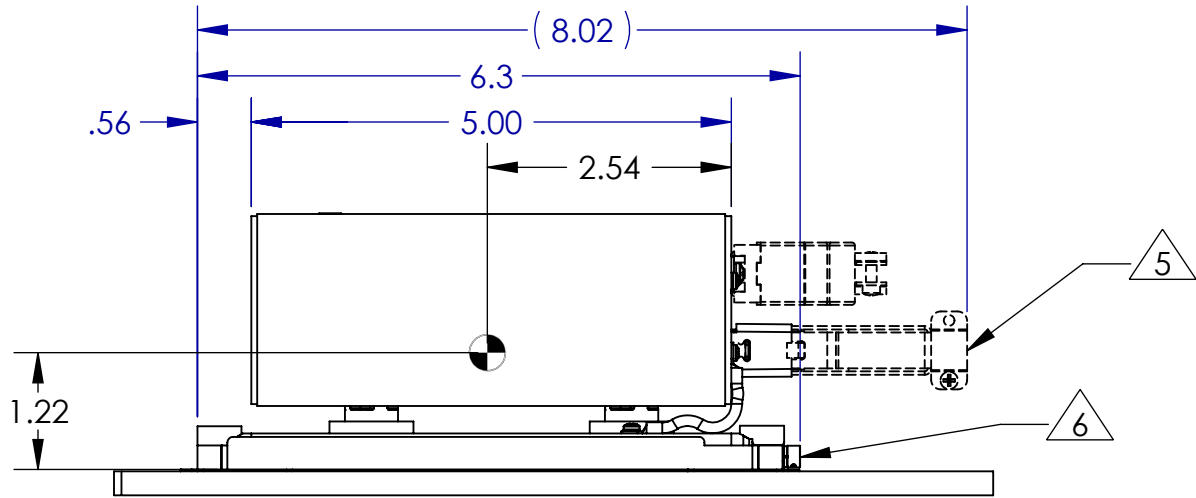
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.XXX $\pm$ .005		CHECKED	J. SLATTERY		
		RESP ENG	12/21/07		
		T. MORRISON			
		MFG ENG			
NEXT ASSY	USED ON	FINISH		APPROVAL	
		DO NOT SCALE DRAWING			
APPLICATION					

SIZE	CAGE CODE	DWG. NO.	CATEGORY	REV.
B	3T1Z4	90171	05	C

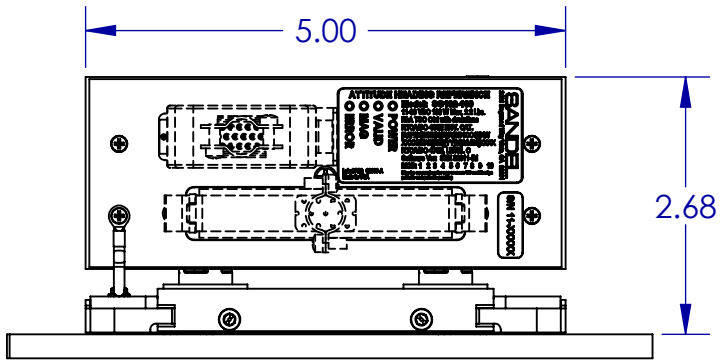
SCALE 1:2 CAD FILE & NOTED 90171-05 INSTALLATION, SG102 SHEET 1 OF 4



TOP VIEW

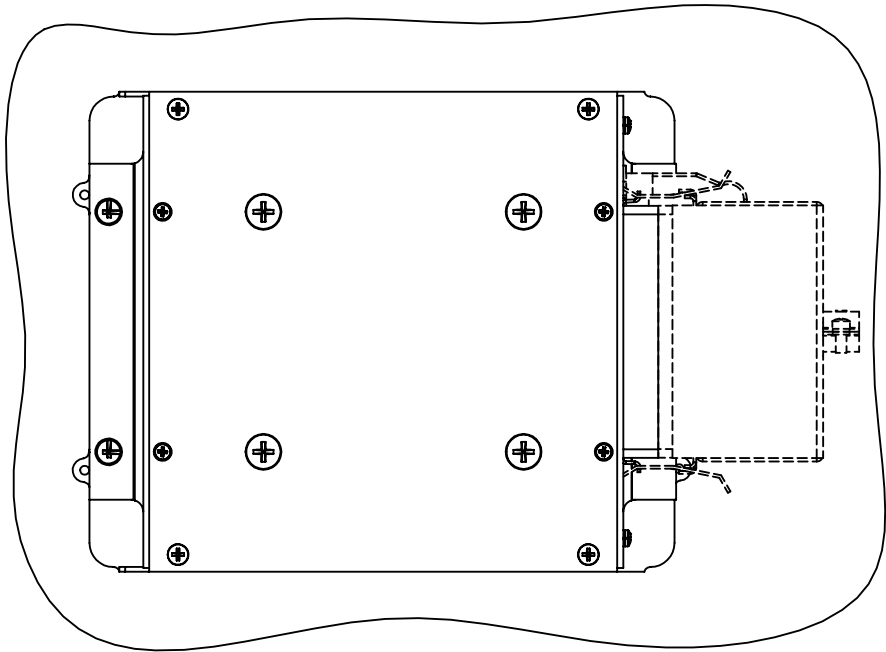


SIDE VIEW

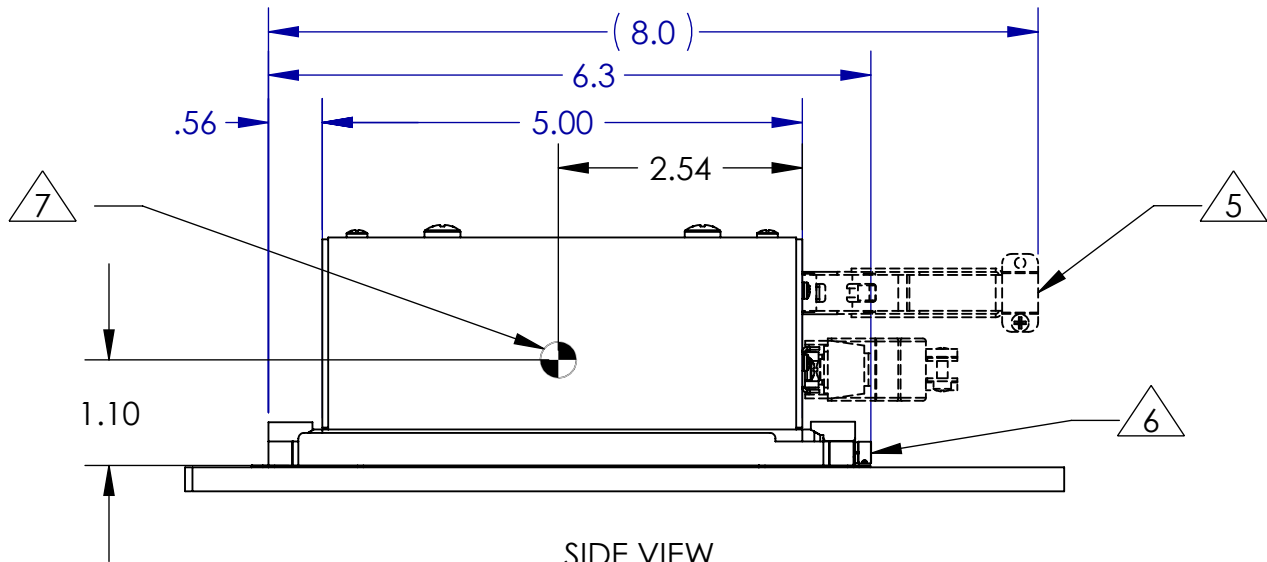


FRONT VIEW

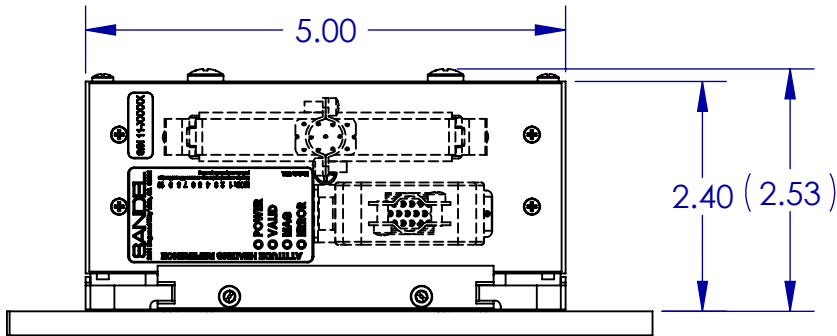
SG102-XXX MOD 1



TOP VIEW

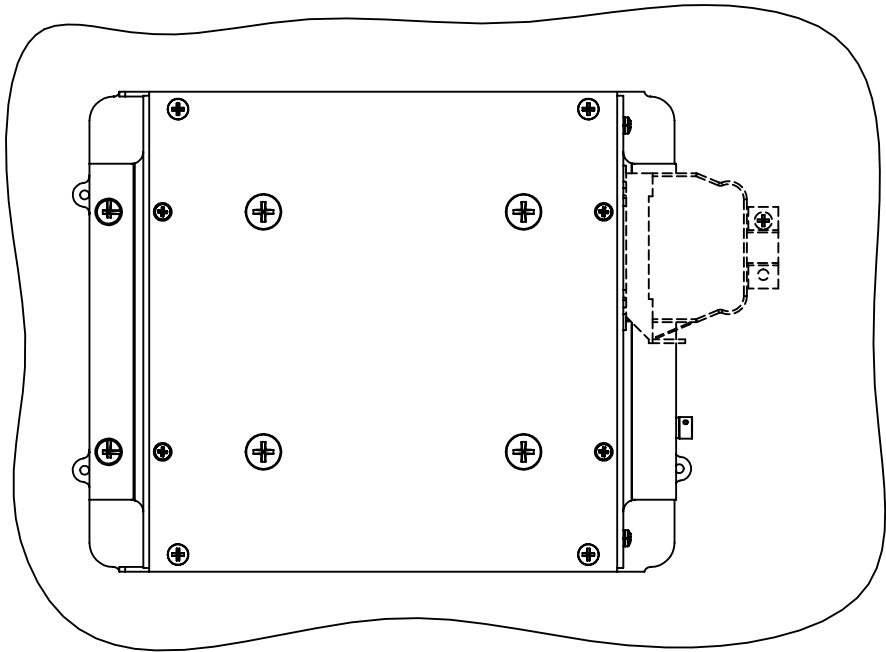


SIDE VIEW

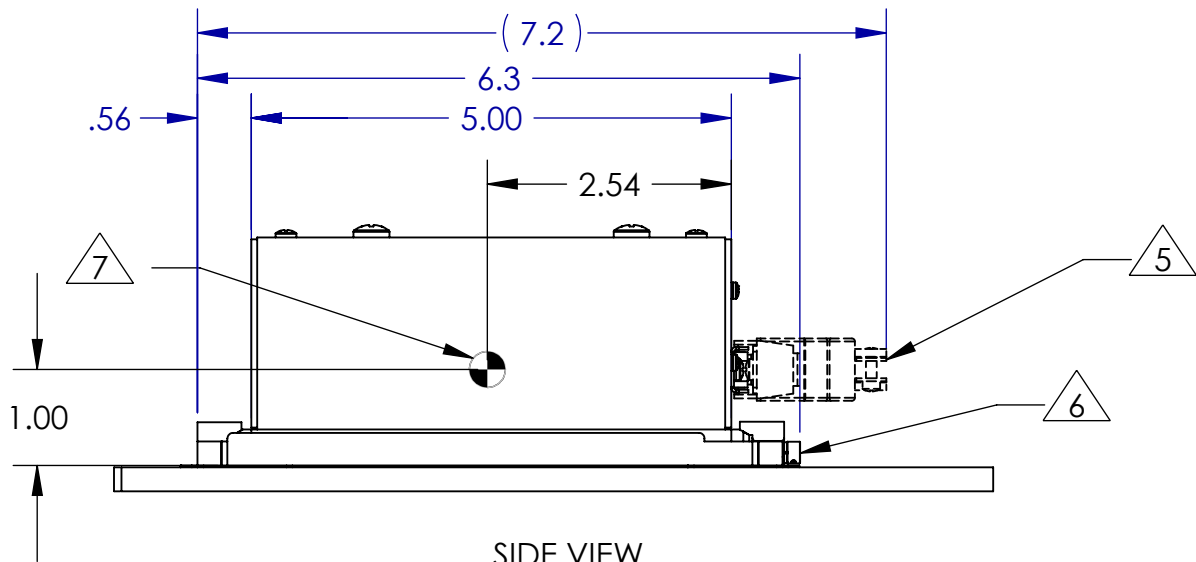


FRONT VIEW

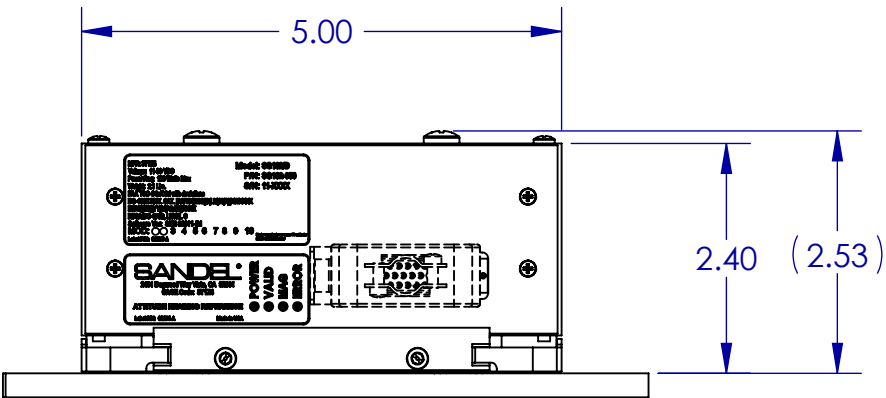
# SG102-XXX MOD 2



TOP VIEW



SIDE VIEW



FRONT VIEW

SG102/D-XXX