SANDIA aerospace

SI-11X
Installation Manual

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Rev B

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Section 1 - General Description

1.1 Introduction

This manual describes the installation of the SANDIA aerospace SI-11X Electronic Course Deviation Indicator. It is intended for use by experimental aircraft builders in experimental aircraft. This product is not approved for installation in type certificated aircraft.

The installer must ensure that all functions are operating properly according to their intended purpose in their particular installation.

1.2 SI-11X Product Description

The SI-11X Electronic Course Deviation Indicator is a panel mounted device to display lateral and vertical needles from a typical navigation receiver or GPS navigator.

All information is displayed on a color 3.5" diagonal LCD display in traditional aerospace symbology.

1.2.1 System Functions

The SI-11X performs the following functions:

- Display of Lateral Deviation (Either VOR, ILS or GPS)
- Display of Vertical Deviation (Either ILS or GPS)
- Display of VOR OBS Degrees
- Display of VOR TO/FROM indication
- Display of 4 Annunciations.
  - NAV or VLOC
  - GPS
  - BC (Back Course)
- Backlight Control (%)

Various parameters can be configured by the installer (not pilot accessible):

- Configuration of Analog Gain and Offsets
- OBS Resolver interface Ratio and Swap Rotor D/F

1.2.2 System Interfaces

The SI-11X provides a typical analog electrical interface to typical navigation receiver and GPS navigators. Bipolar +-150mVdc Left/Right, Up/Down and To/From. Unipolar 0-150mV Left/Right, Up/Down Flags and 6 wire, resolver.

1.2.3 Unit Outer Dimensions

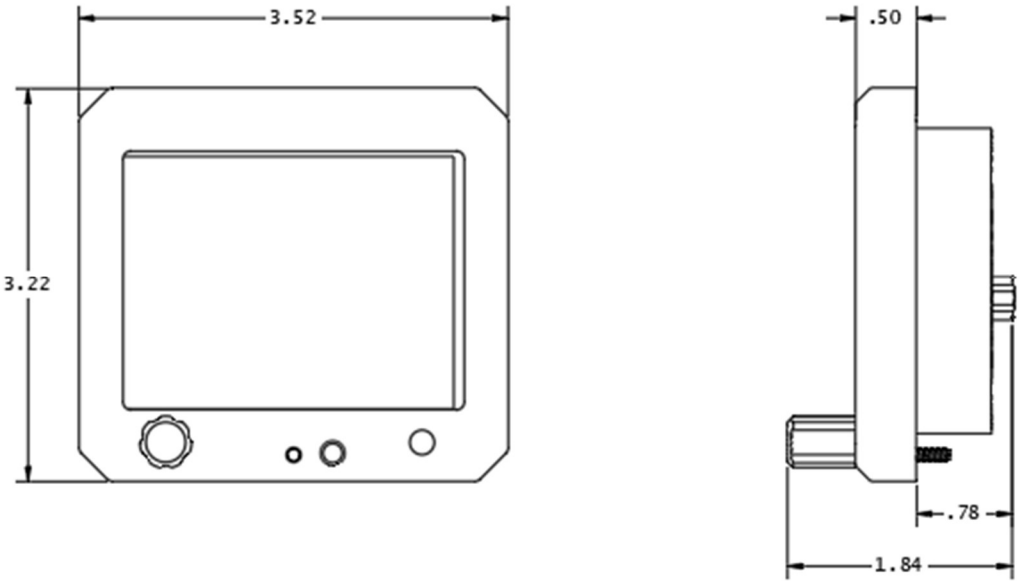

Figure 1 – Unit Outer Dimensions

1.3 Specifications

1.3.1 Physical Characteristics

Mounting.....Standard 3-1/8" Round Hole
Overall Dimensions.....3.52 x 3.22 x 1.84 in
Bezel Dimensions.....3.52 x 3.22 x 0.50 in
Weight.....0.56 lbs (Including Bracket and Connector)
Viewing Angle.....60° Left/Right, 45° Up/Down
Operating Temp.....-20°C to +55°C
Power Input.....10-32 VDC
Current.....1 Amp Max
Power.....5 Watts at Max Display Brightness

1.3.2 Electrical Characteristics

Needle Range.....+-150mV Full Scale Deflection
Needle Accuracy.....2% of Full Scale Deflection
Needle Max Deflection.....+-175mV Max Deflection
Needle Common Mode Voltage.....+-3Vdc
Needle Differential Load.....1 kOhm
To/From Threshold.....+-40mV (To Positive)
To/From Threshold Accuracy.....+-2mV
To/From Common Mode Voltage.....+-3Vdc
To/From Differential Load.....1 kOhm
Flags Threshold.....+125mV
Flags Common Mode Voltage.....+3Vdc
Flags Load.....1 kOhm
Max Rotor Input Voltage.....up to 8 Vp-p - Vcm
Rotor Input Frequency.....30 to 500Hz
Rotor Common Mode.....+- 2.5Vdc
Stator D/F Accuracy.....<1 degree
Stator D/F Resolver Ratio.....0.2 to 1.0
Stator Common Mode Voltage.....+-3Vdc

1.4 Environmental Characteristics

Temperature .....-20 to 55 Degrees C
Humidity .....DO-160G Standard Humidity, TBD
Power .....DO-160G Section 16, TBD
EMI .....TBD
RFI .....TBD

Section 2 - Installation Considerations

2.1 General

The SI-11X interfaces to typical navigation receiver or GPS navigators via the standard analog that typically drove mechanical needle movements and flags. The resolver circuit in the SI-11X can also emulate electrically the mechanical resolver found in traditional mechanical CDI's.

2.2 Cooling Considerations

The SI-11X does not require any special cooling considerations.

Section 3 – Installation Procedures

3.1 General

Installation consists of securely fastening the mounting bracket to the instrument panel, constructing & connecting the power cable assembly and mounting the unit to the bracket. Power-On is then performed, followed by unit configuration and finally unit checkout procedures.

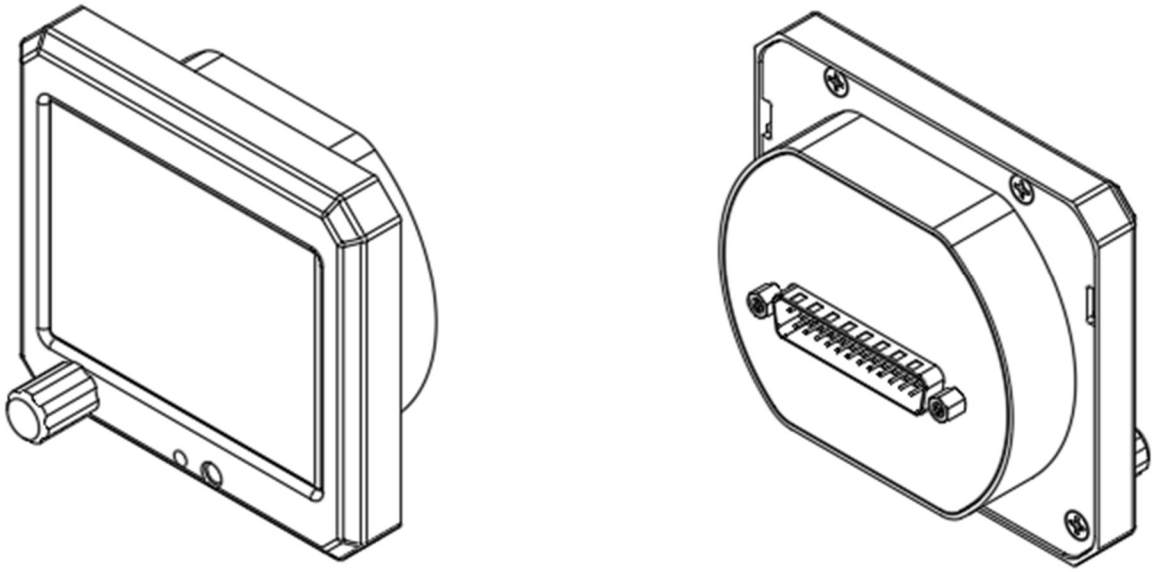

Figure 2 – Unit Front and Rear Views

3.2 Equipment Required

3.2.1 Supplied

SI-11X (Unit) ..... P/N 905020-00
Kit, Install Electrical SI-11X..... P/N 305663
Conn, "D" 25 Pos, Rcpt, w/crimp pins..... P/N 305720
Clamp, D Conn 45/180 Deg..... P/N 305437
Kit, Install Mechanical SI-11X ..... P/N 905035-00
Bracket, Mounting Front..... P/N 306179
Bracket, Mounting Rear ..... P/N 306185
Hex Wrench, 3/32" L-WR Short..... P/N 306333

3.2.2 Operational Software

SI-11X Operation Software..... P/N 905321-00-OC-VX.Y

3.2.3 Required, But Not Supplied

Wire (24 AWG, Stranded unless otherwise noted)
24 AWG Shielded Twisted Pair.

3.3 Mounting Hole

The SI-11X is designed to mount in a standard 3” round mounting hole. The supplied front mounting bracket (P/N 306179) and rear mounting bracket (P/N 306185) must be utilized to mount the instrument. The panel cutout should be as follows:

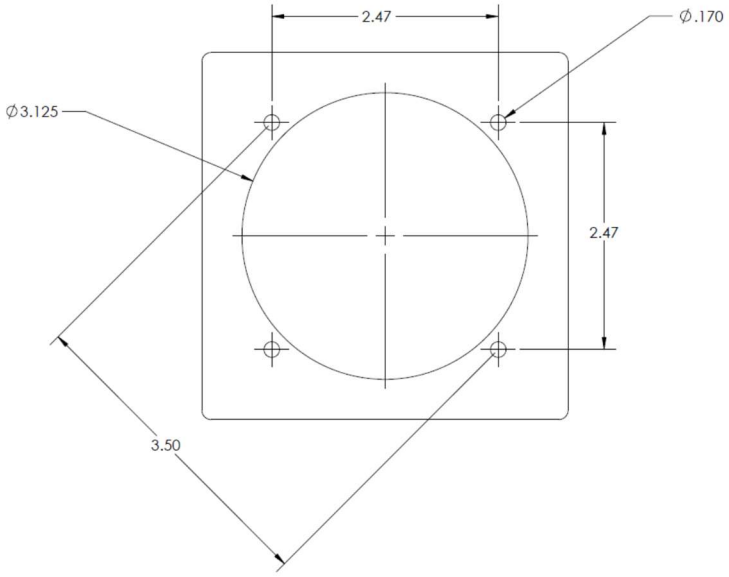

Figure 3 - Instrument Cutout

Front and rear mounting brackets adapt the unit connection points to the 3” round instrument hole cutout. The rear bracket is utilized to fasten the unit to the panel. The supplied screws and nuts must be used to retain the brackets.

3.4 Mounting Bracket Installation

1. Install the bracket per Figure 4 and tighten the four screws & nuts.

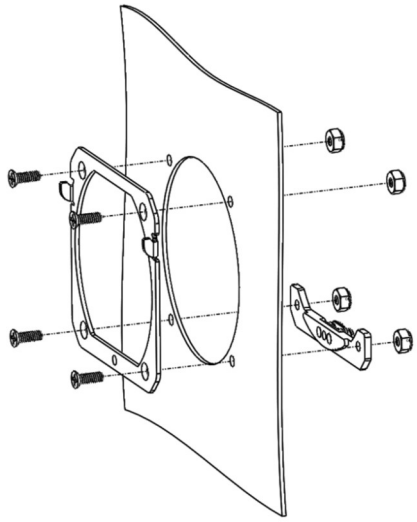

Figure 4 – Front & Rear Mounting Bracket

3.5 Wiring Installation

1. The power line must be protected by a 1 AMP circuit breaker.
2. Keep power and ground lines less than 1 meter in length.

The SI-11X is supplied with one 25 pin Sub-D female mating connector and back-shell. The Sub-D connector uses screw lock assemblies to secure the connector to the unit. The screw lock assemblies can be replaced with slide lock posts if desired by the installer.

NUM	NAME	I/O	DESCRIPTION
P1-1	Rotor H	Input	Rotor Reference
P1-2	Rotor C	Input	Rotor Reference
P1-3	Stator D	Output	Cosine of Rotor Reference
P1-4	Stator F	Output	Sine of Rotor Reference
P1-5	Stator E	Output	Return for Stator D
P1-6	Stator G	Output	Return for Stator F
P1-7	VLOC+ Flag	Input	Flag +- differential. Positive for needle active at 125mV
P1-8	VLOC- Flag	Input	Flag +- differential return

NUM	NAME	I/O	DESCRIPTION
P1-9	VOR TO	Input	VOR TO/FROM differential input. TO positive for TO indication at 40mV
P1-10	VOR FROM	Input	VOR TO/FROM differential input. FROM positive for FROM indication at -40mV
P1-11	VLOC LEFT	Input	VLOC LEFT/RIGHT differential. LEFT positive for left needle movement. 150mV for Full Scale (5 dots)
P1-12	VLOC RIGHT	Input	VLOC LEFT/RIGHT differential. RIGHT positive for right needle movement. -150mV for Full Scale(5 dots)
P1-13	GS UP	Input	Glideslope UP/DOWN differential. UP positive for up needle movement. 150mV for full scale(5 dots)
P1-14	GS DOWN	Input	Glideslope UP/DOWN differential. DOWN positive for down needle movement. -150mV for full scale(5dots)
P1-15	GS +FLAG	Input	Glideslope Flag differential. Positive for needle active at 125mV
P1-16	GS -FLAG	Input	Glideslope Flag differential return.
P1-17	GPS ANN	Input	Active Low for GPS annunciation
P1-18	VLOC Ann	Input	Active low for VLOC annunciation
P1-24	NAV ANN	Input	Active low for NAV annunciation
P1-25	BC ANN	Input	Active low for BC (back course) annunciation
P1-19	A/C PWR	Input	10-32Vdc. Diode OR'd with P1-20
P1-20	A/C PWR	Input	Alternate Power input Diode OR'd with P1-19
P1-21	GND PWR	Input	Power Return
P1-22	RS232 RX	Input	DNC
P1-23	RS232 TX	Output	DNC

Table 1- Electrical Pin-Out

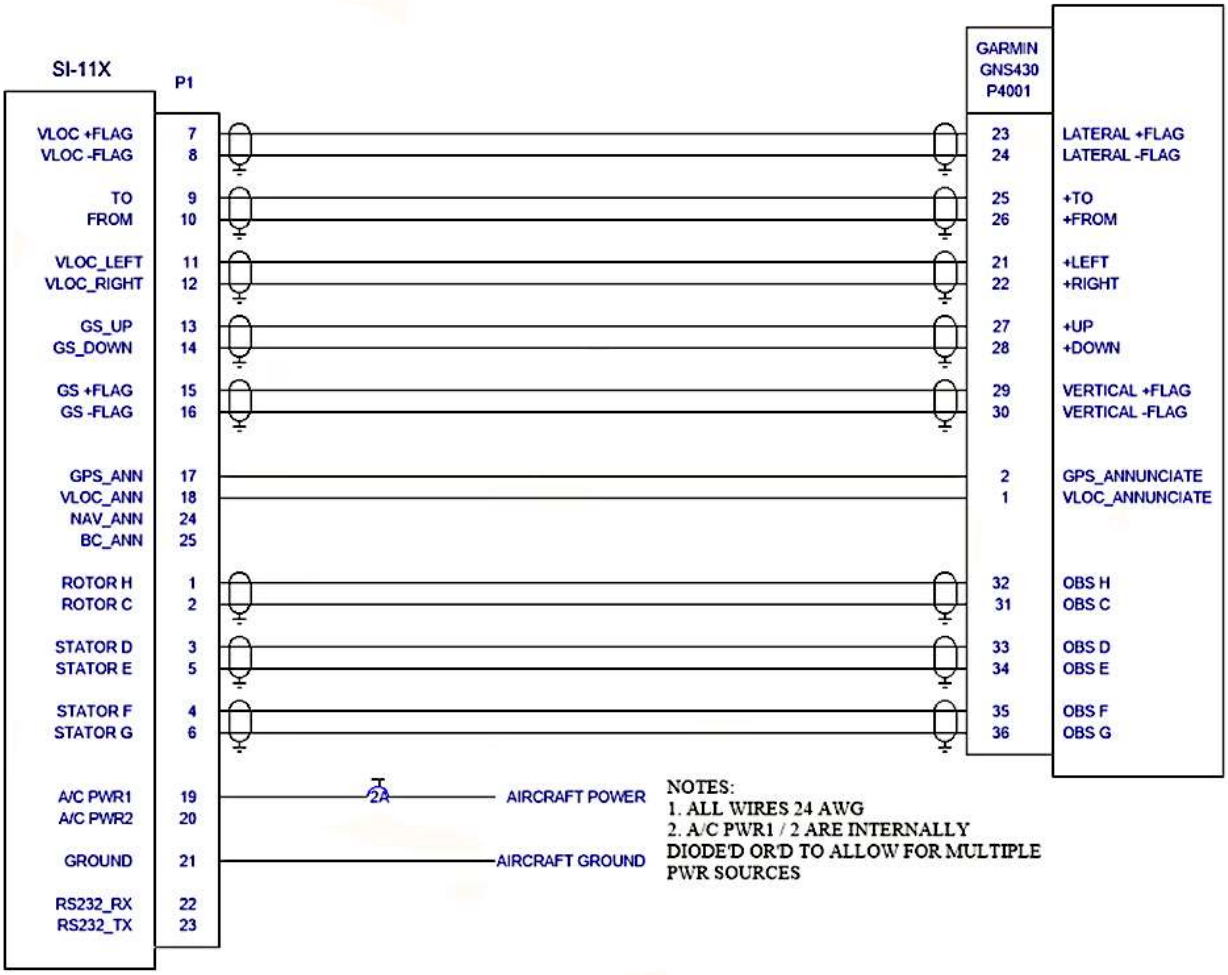

Figure 5 - Wiring Diagram

3.6 Unit Mounting

1. The unit connects to the mounting bracket utilizing two upper tabs and a lower fastener.
2. Place gasket on unit before installing unit onto bracket.
3. The unit is installed by engaging the two upper tabs first, then securing the bottom screw.
4. Hold the unit at a slight angle off of the instrument panel (as shown below) and align the upper tabs with the slots on the rear of the unit.

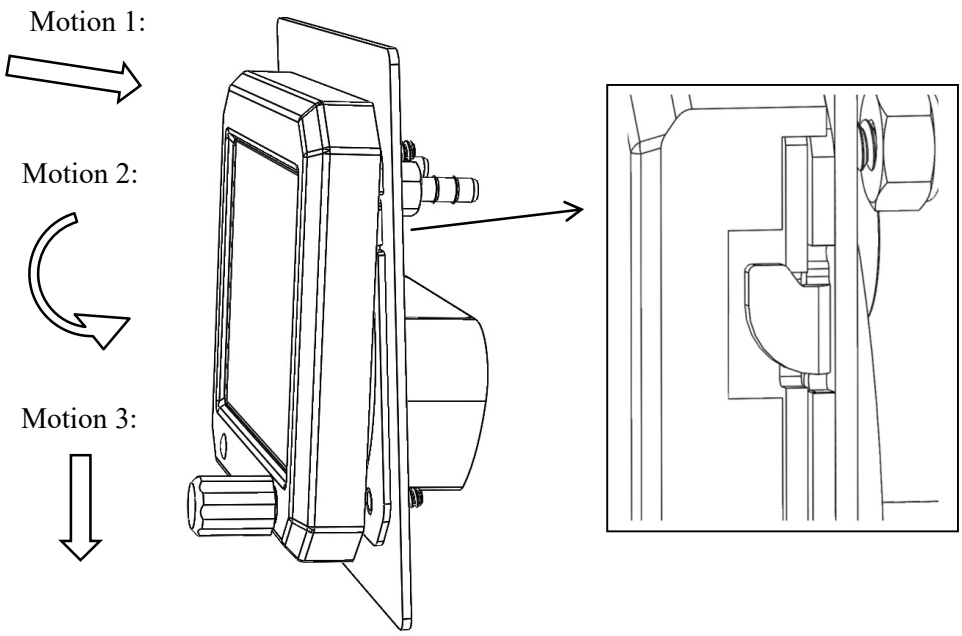

Figure 6 - Unit Mounting With Tab/Slot Cutaway

5. Push the unit toward the instrument panel until it stops against the bracket.
6. While maintaining inward pressure, rotate the bottom such that the unit is now parallel to the panel.
7. Once parallel to the panel, apply downward pressure to ensure the upper tabs remain fully engaged.
8. While holding in-ward and down-ward pressure on the unit, tighten the lower screw with the 3/32 hex drive. Torque to 5 inch-lbs. Do not over-tighten.

9. Verify that the unit is firmly attached to the instrument panel. (The bezel of the unit will stand-off slightly from the instrument panel, which is normal.)

3.7 System Configuration

The following section provides instructions for initial setup configuration of the SI-11X

Upon normal power-on, the unit will display the company logo, model number, part number and software version as follows:

Figure 7 - Power On Screen

After displaying the splash screen for approximately 7 seconds, the unit will enter the main operating mode.

3.7.1 Entry & Exit Configuration Mode

Setup mode is enabled when the unit is powered-on while the rotary knob is being held in the pressed state. The unit will display a "Caution: Enter Config Mode? NO YES". To enter configuration mode, rotate the encoder until YES is yellow and press the knob.

Figure 8 – Setup Mode Entry

Exiting the configuration mode is accomplished by long press and hold of the knob or cycling power to the unit. **CAUTION: When setting have changed, the SI-11X needs to write to non-**

volatile memory. The Configuration Page display a yellow box in the upper left hand corner of the display. *DO NOT CYCLE POWER WHILE THIS BOX IS DISPLAYED*. Otherwise, a corruption of the non-volatile memory may occur and the unit will default it's configuration.

3.7.2 Configuration Page

Upon entry of configuration mode, the unit displays the following page:

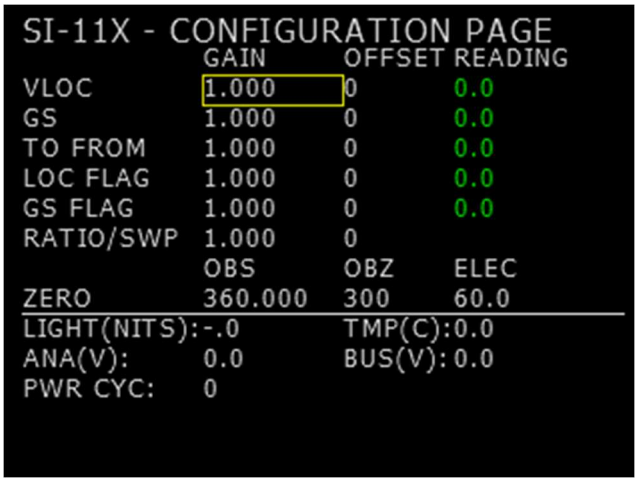

Figure 9-Configuration Screen

Setup Page	Purpose	Min Value	Max Value	Increment
VLOC GAIN	Lateral needle gain adjustment	.8	1.2	.001
VLOC OFFSET	Lateral needle zero offset adjustment (10ths of mV)	-2000	2000	1
GS GAIN	Vertical needle gain adjustment	.8	1.2	.001
GS OFFSET	Vertical needle zero offset adjustment (10ths of mV)	-2000	2000	1
TO/FROM GAIN	TO/FROM input gain	.8	1.2	.001
TO/FROM OFFSET	TO/FROM zero offset (10ths of mV)	-2000	2000	1
LOC FLAG GAIN	LOC Flag gain adjustment	.8	1.2	.001
LOC FLAG OFFSET	LOC Flag zero offset (10ths of mV)	-2000	2000	1
GS FLAG GAIN	GS Flag gain adjustment	.2	1.0	0.01
SWAP	GS Flag zero offset (10ths of mV)	-2000	2000	1
RATIO	Rotor to Stator Transfer Ratio	0.2	1.0	.01
SWAP	Can swap SIN/COS on Stator D/F either 0 or 1.	0	1	1
OBS	Current displayed OBS	1	360	1
OBZ	Electrically Zero OBS	1	360	1

Table 2 - Configuration Parameters

The reading column shows the mV reading on that input. The ELEC column on the ZERO row gives the electrically output angle on Stator D/F.

To edit an adjustment, rotate the knob until the desired item is selected with a yellow box. Press the knob and that element will be highlighted in blue. Rotate the knob to the desired value and resulting reading. Press the knob to store the value and allow selection of another item.

3.7.3 Installation Adjustment

The SI-11X needs to be adjusted to the navigation receiver or GPS navigator that it's interfaced to. Many modern receivers have configuration pages that help in adjustment of the CDI. Garmin GNS4XX/5XX for example have a configuration page to drive the needles to Full Left, Right, Up and Down that can assist in the adjustment. A calibrated DMM is also useful in determining the voltages that are being applied by the navigation system.

For a typical navigation receiver, the following steps should be performed with the receiver and a NAV Test Set.

1. Starting with the lateral VLOC needle, inject a strong localizer signal nav receiver.? Adjust DDM to zero and adjust the VLOC OFFSET so that VLOC READING is 0 +- 1.5 mV.
2. The LOC FLAG READING should be greater than 125mV.
3. Adjust DDM to .155 "Left" and adjust VLOC GAIN so that VLOC READING is 150mV +-1.5mV.
4. Adjust DDM to .155 "Right" and Observe the VLOC READING is 150mV +-1.5mV.
5. Remove the localizer signal and observe the VLOC FLAG READING is 0 + 1.5mV.
6. Switch to the Glideslope receiver. Inject a strong glideslope signal. Adjust DDM to zero and adjust GS OFFSET so that GS READING is 0 +- 1.5mV
7. The GS FLAG READING should be greater than 125mV
8. Adjust DDM to .175 "UP" and adjust GS GAIN so that GS READING is 150mV +-1.5mV.
9. Adjust DDM to .175 "DOWN" and observe that GS READING is -150mV +-1.5mV
10. Remove the glideslope signal and observe the GS FLAG READING is 0 + 1.5mV

The VLOC and GS needles should now be calibrated.

3.7.3.1 OBS Resolver Adjustment

Various navigation equipment has different methods for checking the operation of the OBS resolver. Typically, the OBZ is set to 300, the RATIO is 1.0 and SWAP is 0. If the navigation equipment is reading incorrectly, adjust the OBZ. If when incrementing the OBS and the navigation equipment readout is decreasing, change the SWAP to 1. This will swap SIN/COS signals on STATOR D/F resulting in the proper rotation direction.

Verify OBS operation by checking that the navigator is reading within 2 degrees. Do this at 30 degree intervals.

3.7.3.2 VOR TO/FROM Check

After the needles and flags have been adjusted and the OBS Resolver is accurate, the system VOR operation should be verified. Typically, the TO/FROM indications do not need adjustment.

3.7.3.3 Annunciator Checks

Operate the navigation equipment through its various modes and ensure that the connected ANNUNCIATOR inputs are operating normally.

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