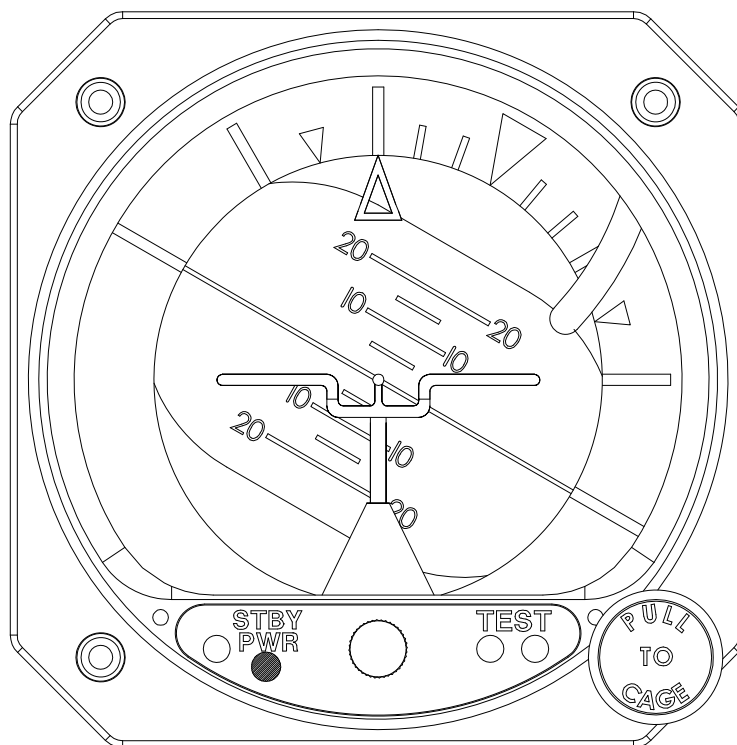




## INSTALLATION MANUAL AND OPERATING INSTRUCTIONS

### 4300-XXX Series Electric Attitude Indicator With Battery Backup



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## Section 3: Operation

### 3.1 General

This section describes the Model 4300-XXX Electric Attitude Indicator operating procedures. The indicator is required to be installed in an aircraft with the specified inputs applied. Figure 1.2 provides an illustration of a typical Model 4300 display and a table describing indicator functions.

### 3.2 Starting Procedures

The following operational procedures are recommended when preparing the indicator for use:

**\*\*\*\*CAUTION\*\*\*\***

THE INDICATOR MAY BE DAMAGED IF THE `PULL TO CAGE` KNOB IS RELEASED WITH A `SNAP`. SLOWLY RELEASE `PULL TO CAGE` KNOB AVOIDING A `SNAP` RELEASE.

NOTE: Indicator may be momentarily caged by pulling `PULL TO CAGE` knob to the fully extended position, holding knob until the display stabilizes, and then allowing the knob to return to the normal position.

- A. Apply power to the indicator. Note that the Gyro Warning flag (red) will pull out-of-view. Allow three minutes for presentation stabilization.
- B. On models with trim adjustment, rotate the symbolic airplane adjustment knob for the desired pitch attitude presentation, i.e. aligning the symbolic airplane with the horizon.
- C. If caging is required, caging should be accomplished when the aircraft is in a wings level, normal cruise attitude, as indicated by other instruments or the earth's horizon. If the gyro is caged when the aircraft is not in this attitude, the resulting attitude presentation immediately after caging will be in error by the difference between true vertical and actual aircraft attitude. Small errors in caging erection will be corrected by the indicator to true vertical in pitch and roll at 2.5° per minute minimum (5°/min. nominal).

### 3.3 In-Flight Procedures

- A. Adjust the symbolic airplane to obtain desired pitch attitude presentation after take-off.
- B. In the event of errors in excess of 10° caused by extended bank or fore-aft acceleration, the indicator should be momentarily caged after the aircraft is returned to level flight.

### 3.4 Dynamic Errors

- A. Turn Induced Errors

Pitch indication errors resulting from a standard coordinated turn (180 degrees in one minute at a true airspeed of 156 knots) will not exceed 3°. Dynamic errors developed under non-standard conditions may be greater. Errors that develop will be self corrected by the internal erection system or manually corrected by the actuation of the caging system in straight and level flight.

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### B. Acceleration & Deceleration Errors

Pitch/roll indicating errors may occur due to accelerations experienced during takeoff, climb-out, descent, and landing. Errors that develop will be self-corrected by the internal erection system or manually corrected (in straight and level flight) by the actuation of the caging system.

### C. Taxiing Errors

A pitch and roll indicator display error of approximately 1° will occur during a sudden 90° ground turn. A pitch indicator display error of approximately 2° will occur during a sudden 180° ground turn. Errors that develop will be self corrected by the internal erection system or manually corrected by the actuation of the caging system when aircraft is straight and level.

## 3.5 Standby Battery Operation

Supply aircraft power to the instrument. The internal standby battery charges automatically while the gyro is running. Lighting is on a separate circuit connected to the aircraft lighting bus.

### A. Normal Flight

At loss of external power, an amber LED will flash indicating a Power Loss Warning. With no further action from the pilot, the unit will turn off automatically (gyro flag in view) after approximately one minute. This is to prevent battery discharge at the end of a flight when the master power switch is placed in the off position.

### B. Loss of Aircraft Power

When the instrument switches to Power Loss Warning, the amber LED flashes for approximately one minute. This is intended to attract the pilot's attention and indicate that there has been a loss of primary power to the 4300 Attitude Indicator. Pushing the STBY PWR button on the face of the instrument will allow the unit to continue operating on the standby battery for nominally one (1) hour or until the battery is exhausted. See Figure 3.1 for more information on battery discharge rate. The gyro warning flag remains out of view, which indicates the gyroscope is valid and running on standby battery power. An independent standby dial lighting system also operates in this mode.

Any time aircraft power is absent, with the unit in either Power Loss Warning or shut off, pushing the STBY PWR button will put the unit in the standby power mode. The instrument will run from standby power until the standby battery is exhausted. If the unit is running on the standby battery, pushing the STBY PWR button will turn the unit off. Pushing the STBY PWR button again will restore standby power and standby lighting.

Restoring aircraft power will clear any standby operation and resume automatic battery charging.

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### C. Standby Battery Test

The control panel on the front of the instrument incorporates a manual test feature. This test feature places the standby battery pack under load for approximately one minute (the gyro is used as a load) while displaying either a red or green light under the word TEST on the front panel.

To initiate this test:

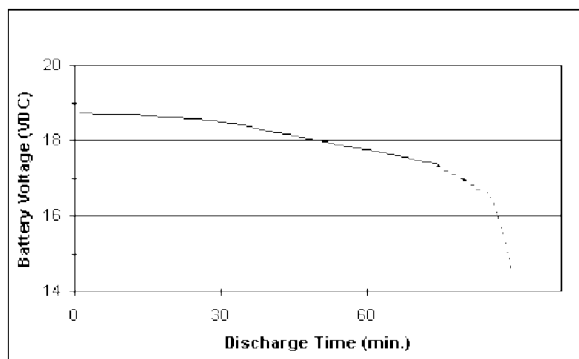
1. Turn on the indicator with aircraft power and allow the unit to spin up for 3 minutes or more
2. Press and hold the STBY PWR button. After several seconds the amber LED will start flashing, indicating unit has latched into Battery Test Mode. The test runs for approximately one minute, during which time the amber LED flashes continuously and either a red or green light is displayed under the word TEST.
3. Visually monitor the test lights until the amber LED stops flashing, signaling the end of the test.
4. A green light throughout the test indicates the standby battery pack is healthy and should be able to function normally. A red light at any time during the test means that the standby battery is at least in need of charging, and possibly of replacement.

#### Note:

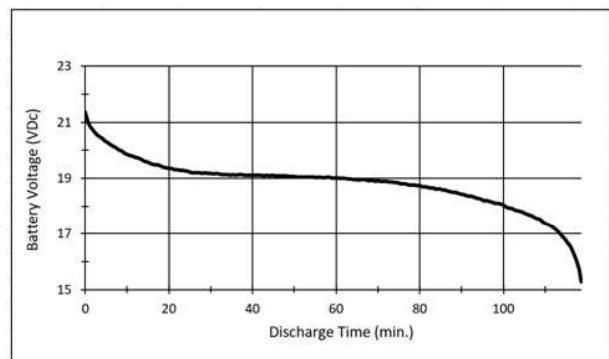
A green light throughout this short test does not guarantee that a full hour of operation time is available. Actual operation time on the battery may vary considerably depending on temperature, charge status, and battery condition. (See Section 3.6 for more details).

Complete charging may be required to bring the battery up to full charge if it has been stored for more than four months or if it has been partially discharged. If a steady red light is observed at any time during the test, charge the standby battery completely, using one of the methods described in Section 2.6 and retest the battery. If after charging, the test still fails, service may be required.

It is not recommended to test the battery when aircraft power is not available, but it is possible to put the indicator into test mode while operating on the backup battery. The test will run, but the indicator will turn off at the end of the test period. To turn the indicator back on, simply push the STBY PWR button again.



Mod 0



Mod 1

Figure 3.1: Nominal Battery Discharge Rate at 20°C

### 3.6 Equipment Limitations

The Mid-Continent 9015607 battery pack is part of a complete system. When remote mounted, the 9015607 battery pack **MUST** be installed with the Mid-Continent 4300-XXX series Electric Attitude Indicator with Battery Backup in order to be approved as a complete TSO'd system. This battery is not FAA approved if installed or used in any other way.

Actual operation time on the battery may vary considerably depending on temperature, charge status, and battery condition. Low temperatures will temporarily degrade battery capacity as shown in Figure 3.2. Internal chemistry will slowly degrade battery capacity over several years of operation as shown in Figure 3.3, even when correctly maintained. A poorly maintained battery will suffer accelerated degradation in excess of the guidelines given in this document. Extended storage in a discharged state or at high ambient temperatures, and over-charging will all permanently damage a battery. Complete charging is required to bring the battery up to full capacity if it has been stored for more than four months or if it has been partially discharged.

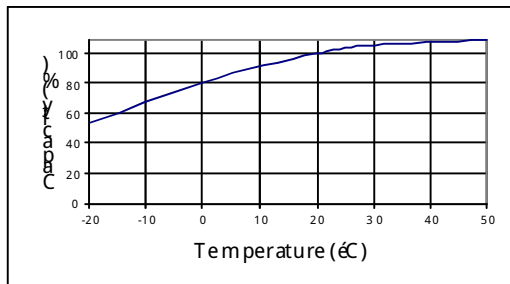


Figure 3.2: Effect of Low Temperature On Standby Battery Capacity

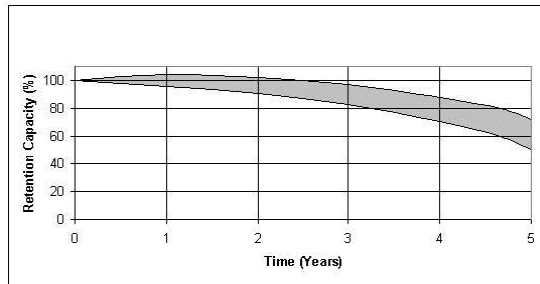


Figure 3.3: Life Characteristics In Standby Use

## Section 1: General Description

### 1.1 Purpose of Equipment

The Model 4300-XXX Electric Attitude Indicator with Battery Backup incorporates a moving display that simulates the earth's horizon and provides the pilot with a real time visual indication of the aircraft pitch and roll attitude relative to the indicator symbolic airplane.

The instrument can function as a primary or standby indicator with special configurations available to match existing systems or electronic flight displays. In the event aircraft electrical power is lost, the indicator will switch to an internal backup power source (rechargeable battery) to permit continued operation of the indicator. Panel tilt, lighting color/voltage, non-trimmable knob cover, front mount adapter plates and a slip indicator are available as options.

### 1.2 Physical Description

The 4300-XXX Electric Attitude Indicator with Battery Backup incorporates pitch and roll displays that are mechanically linked to a spinning mass gyroscope. The horizon bar moves behind the symbolic airplane. Precession error is corrected by the 4300's erection system or by pulling the 'PULL TO CAGE\_' knob. If the gyro motor is not receiving sufficient power to operate, a warning flag drops into view. This will normally occur only if the unit is turned off or after the internal standby battery is exhausted.

### 1.3 Functional Description

Model 4300-XXX Electric Attitude Indicators employ an efficient electrically driven internal vertical gyroscope assembly incorporating a special air erection mechanism. This mechanism simultaneously erects the pitch and roll axes of the gyroscope. Movement of the aircraft generates a reaction of the display that simulates the visual reference seen by the pilot when looking outside at the earth's true horizon line.

The 4300-XXX Electric Attitude Indicator with Battery Backup offers the unique feature of a self-contained standby power source. Advances in the design of this gyro system allow it to operate for about one hour after main input power is lost, depending on the battery condition at the time of power failure.

Any time aircraft power is absent, with the unit in either power loss warning mode or turned off, pushing the STBY PWR button will put the unit into the standby power mode. The instrument will run from standby power until the internal battery is exhausted. If the unit is already running on standby power (internal battery), pushing the STBY PWR button will turn the unit off completely. Pushing the STBY PWR button again will restore unit operation to standby power. Restoring aircraft power will clear any standby power mode and automatically resume standby battery charging.

The indicator will operate on an input voltage of 10 to 32 volts. An integral lighting system featuring a user replaceable light tray assembly operates from the aircraft lighting bus and is available in 5V, 14V, or 28V versions (dependent on configuration). In standby power operation, low intensity LED dial lighting is automatically turned on to provide nighttime visibility.

The internal battery is designed for emergency use only. Frequent use, extended discharging, extended lack of charging, misuse and age will require battery replacement. Replacement can be done in the field with or without removal of the attitude indicator. Do not operate this model without the specified battery intact. Battery substitution, modification, misuse and lack of

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specified maintenance will void all warranties and hold the manufacturer harmless from any and all claims or legal actions.

Refer to an FAA authorized maintenance facility for testing and maintenance of this instrument excluding battery or light tray replacement.

### 1.4 Gyro Warning Flag

A warning circuit monitors the electrical voltage used to power the gyro motor. When the Indicator is turned off, or after the internal battery is discharged, the gyro warning flag comes into view. Anytime aircraft power is lost, including normal end-of-flight power down, the unit will switch to the Power Loss Warning mode. If the STBY PWR button on the face of the instrument is not pushed before the end of the (nominal) one-minute timing period, the instrument will turn itself off and the gyro warning flag will appear. If the STBY PWR button is pushed, the gyro will run from standby power until the internal battery is exhausted before the gyro warning flag appears.

### 1.5 Options and Configurations

Options Table	
Panel Tilt Calibration	0° to 20°
Lighting Voltage	5V, 14V, or 28V (See Table 1.4)
Lighting Color	Blue/White, White, or Red (See Table 1.4)
Miscellaneous Parts:	Non-Trimable Symbolic Airplane Knob Cover (P/N 36022)
	Slip Indicator Kit (P/N 36023)
	Front Mount Kit: 3/32_ thk (P/N 36028-1) or 1/2_ thk (P/N 36027-1)
	Panel Wedges: 3° (P/N PW3R-3) or 4° (P/N PW3R-4)
	Mating Connector Kit (P/N 9015514)
	Remote Battery Mounting Kit (P/N 9015671)
	Replacement Standby Battery (P/N 9015607)
	Battery Charger (P/N 36029)

Table 1.1

### 1.6. Specifications

Physical Characteristics:	
Qualification:	FAA-TSO-C4c
Environmental Qualification:	RTCA DO-160D Environmental Category C1BAB[(SBM)(RBB1)(P)]XXXXXXZZAZZ[WF]M[A3H33]XXA
Weight:	Mod 0: 3.7 pounds (2.7 pounds without battery) Mod 1: 3.3 pounds (2.7 pounds without battery)
Dimensions:	Length behind panel (not including mating connector) 6.6 inches long max. (battery not installed) 8.6 inches long max. (battery installed) 3.28 inches high maximum. 3.28 inches wide maximum.
Mating Connector:	MS3116F8-4S or equivalent (MCIA P/N 9015514)
Cover Glass	HEA (anti-reflective) coated.
Instrument Panel Mounting:	Rear mount. Front mount with adapter plate.

Table 1.2

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Performance:	
Reliability	7500 Hour Mean Time Between Failure (MTBF).
Initial Erection:	The "PULL TO CAGE" knob will erect the gyroscope to within 2.0° of case vertical in roll and pitch from any position at any time.
Final Erection:	The vertical gyroscope should be allowed to spin up for 3 minutes after rated power is applied and after initial erection. After 5 minutes the final erection accuracy of pitch and roll will be within 1° of vertical.
Erection Rate:	Gyroscope erects to local vertical in pitch and roll at 2.5° per minute minimum.
Warning Flag:	A gyro warning circuit provides for continuous monitoring of gyro voltage. If loss of gyro motor voltage occurs, the red warning flag will appear. See section 3.5 for battery operation.
Symbolic Airplane:	The adjustment range is ± 4° minimum from the zero pitch position.
Power Consumption:	
Starting:	1.8A maximum (at 14 VDC input) 0.9A maximum (at 28 VDC input)
Running:	Nominal 0.55A ± 15% (at 14 VDC input) Nominal 0.27A ± 15% (at 28 VDC input)
Lighting:	2.5 watts maximum (for all models using 5V, 14V, or 28V lighting)

Table 1.3

Light Tray Assembly Options P/N 9015640-( )			
	5V	14V	28V
Blue/White	-1	-2	-3
White	-4	-5	-6
Red	-7	-8	-9

Table 1.4



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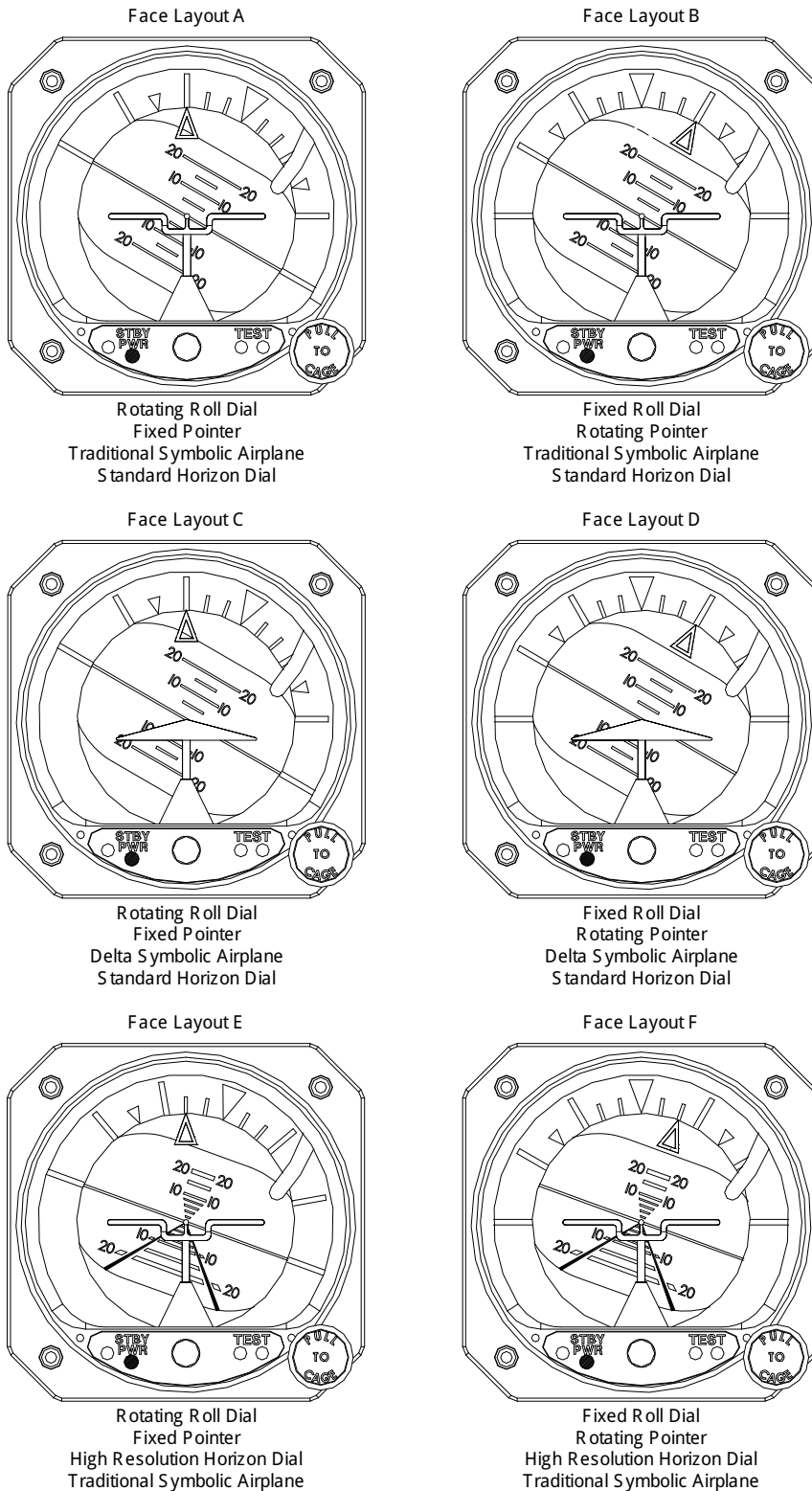
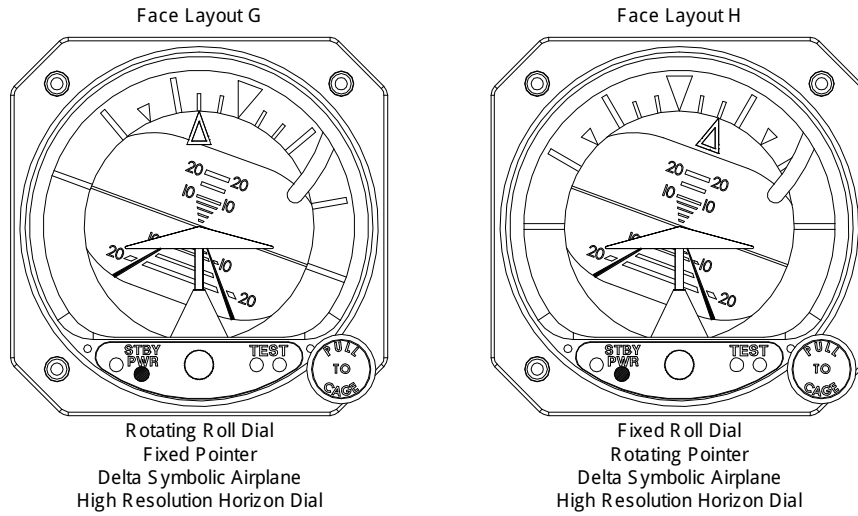


Figure 1.1  
Display Configurations

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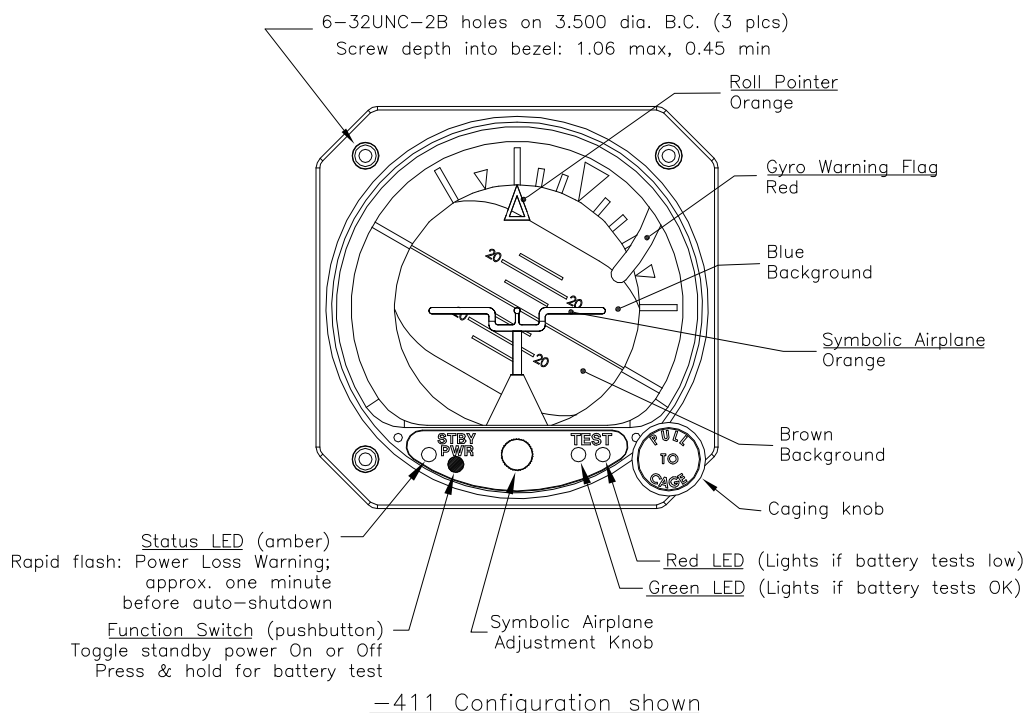


Model Number	Input Voltage	Roll Dial	Horizon Dial	Symbolic Airplane	Face Layout
4300-411	10 to 32 VDC	Rotating	Standard	Traditional	A
4300-412	10 to 32 VDC	Fixed	Standard	Traditional	B
4300-413	10 to 32 VDC	Rotating	Standard	Delta	C
4300-414	10 to 32 VDC	Fixed	Standard	Delta	D
4300-431	10 to 32 VDC	Rotating	High Resolution	Traditional	E
4300-432	10 to 32 VDC	Fixed	High Resolution	Traditional	F
4300-433	10 to 32 VDC	Rotating	High Resolution	Delta	G
4300-434	10 to 32 VDC	Fixed	High Resolution	Delta	H
4300-2XX	OEM Specific				

Figure 1.1, Continued  
Display Configurations

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- Roll Pointer:** A) Fixed roll pointer: Indicates aircraft roll displacement relative to a rotating roll dial.  
B) Rotating roll pointer: Indicates aircraft roll displacement relative to a fixed roll dial.
- Gyro Warning Flag:** If loss of operating voltage should occur, gyro warning flag will come into view.
- Display:** Lower area of display, when referenced to the symbolic airplane, indicates aircraft nose is below horizon or in a dive attitude. Upper area of display indicates aircraft nose is above horizon or in a climb attitude.
- Symbolic Airplane:** Indicates roll and pitch attitude relative to the horizon. The symbolic airplane can be moved (pitch only) using the symbolic airplane adjustment knob.
- Horizon Line:** Indicates earth horizon relative to aircraft pitch and roll attitude.
- Caging knob:  
(Manual Erection)** When pulled, manually erects the gyro vertical to the case orientation.
- Symbolic Airplane  
Adjustment Knob:** Used to adjust the symbolic airplane.



Typical Electric Attitude Indicator Display  
(Rotating Roll Dial, Fixed Roll Pointer, Traditional Wing Symbolic Airplane Shown)  
Figure 1.2