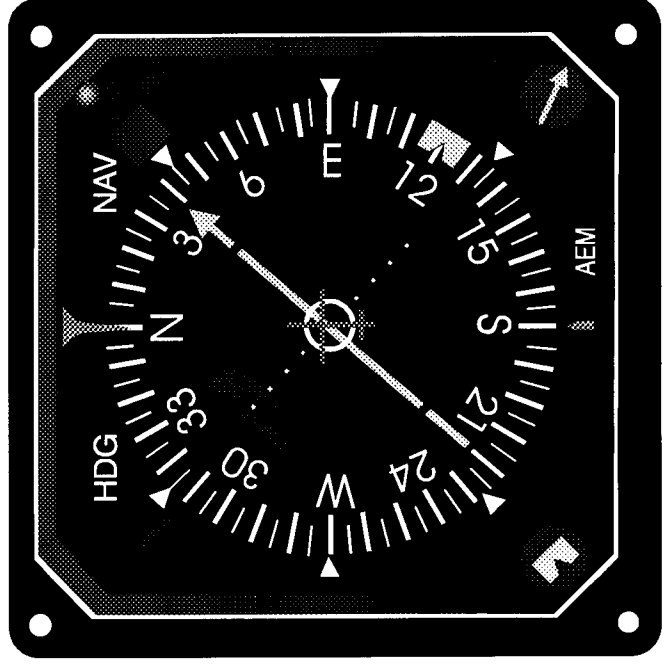




**S-TEC Corporation**

**Pilot's Operating Handbook  
for  
ST-180**

**HSI Slaved Compass System**



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**ST-180**

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# THEORY OF OPERATION

## General

The ST-180 Horizontal Situation Indicator (HSI) system combines a magnetically slaved gyroscopic compass with a VOR/Localizer and glide slope display. The resulting instrument display provides the pilot with a pictorial of the aircraft position and heading relative to the selected VOR or Localizer course.

The ST-180 system consists of the following units:

1. P/N 6443 Horizontal Situation Indicator
2. P/N 6444 Remote Electric Gyro
3. P/N 6446 Magnetic Flux Sensor
4. P/N 01171-( ) Slaving Panel

In addition to these components, the system requires inputs from a VOR/LOC receiver and converter and a glide slope receiver.

In operation, the flux sensor detects the aircraft direction relative to the earth's magnetic field and provides that information to the slaving amplifier, which provides the signal to drive the compass card to display aircraft heading. When the aircraft is in turning flight the magnetic sensor provides errors similar to those in a magnetic compass. To reduce the effects of turning error, the directional gyroscope is used to provide short term stability and its signal is mixed the flux sensor signal in a way that allows the DG to provide the headings and heading rate during turns and, in level flight, to be updated by the flux sensor signal to correct any gyroscopic drift. The result is an instrument that provides highly accurate aircraft heading in both turning and straight flight, without a requirement for the pilot to manually adjust for drift as in a standard directional gyro.

The ST-180 includes an automatic emergency mode (AEM) which will activate automatically 3 minutes after the reset button is pushed if the compass card position (HDG) does not agree with the flux detector heading during that period. When the AEM is activated, the AEM indicator LED in the HSI instrument will illuminate. In the AEM the display will continue to function as a magnetic indicator similar to the operation of a vertical card magnetic compass. In addition, the system can be operated as a Directional Gyro if the slaving portion fails, providing the pilot with maximum system safety and flexibility. (Refer to the Emergency Operations Section for additional information.)

## Horizontal Situation Indicator

The Horizontal Situation Indicator (HSI) instrument display combines continuously slaved aircraft heading information and VOR/LOC/GS displays in one unit. The instrument provides autopilot heading bug, VOR/LOC course pointer and aircraft magnetic heading outputs for use with other aircraft systems which utilize standard ARINC inputs.

## Flux Sensor

The Flux Sensor senses the direction of the earth's magnetic field and transmits this information to the slaving amplifier in the Directional Gyro unit. This slaving information is used to correct gyroscopic precession, thus providing accurate, stabilized magnetic heading information to the pilot's display unit.

## Remote Gyro

The electrically powered Directional Gyroscope is a heavy rotor unit providing high accuracy and reliability. The Directional Gyro is erected electrically in response to slaving signals.

## Slaving Panel

The Slaving Panel has a switch to select either free or slaved gyro operation, and a switch and meter with which to slave the gyro to match the output of the Flux Sensor. Figure 2 illustrates the front panel of the Slaving Panel.

# Horizontal Situation Indicator

## DISPLAY DESCRIPTION

Following is a brief description of the instrument indicators and controls. Figure 1 illustrates the HSI display.

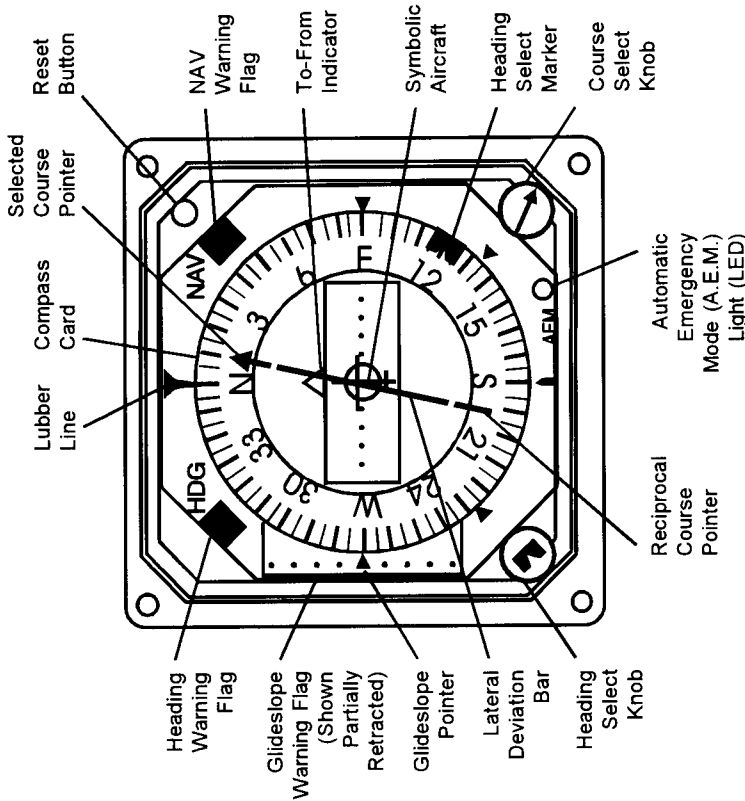


Figure 1, HSI Display

## INDICATOR AND CONTROLS

### Automatic Emergency Mode Light (LED)

Indicates that the compass card is being driven by the flux sensor information.

### Compass Card

This rotating compass card displays gyro stabilized magnetic compass information beneath the lubber line.

### Course Pointer

Indicates the selected VOR course.

### Course Select Knob

Positions the course pointer and reciprocal relative to the compass card.

### Glideslope Pointer

Represents the actual aircraft deviation from the glideslope path.

### Glideslope Warning Flag

When unusable glideslope information is present, the warning flag is in view.

### Heading Select Knob

Positions the heading select marker (Bug) relative to the compass card.

### Heading Select Marker (Bug)

The heading select marker is used as a heading reference or as a heading command to the autopilot when operating in heading mode.

### Heading Warning Flag

In view when the compass system is not operating properly.

### Lateral Deviation Bar

Displays VOR or LOC deviation. When referenced to the symbolic aircraft, the position of the bar is the aircraft deviation in relation to desired VOR or LOC course.

### Lubber Line

Aircraft magnetic heading is read under this line.

### Reciprocal Course Pointer

Indicates the reciprocal of the selected course.

### Reset Button

Returns system to initial starting conditions at turn on. (Fast slave and normal mode operation.)

### Symbolic Aircraft

Represents the relationship of the aircraft with respect to the display.

### To-From Indicator

Indicates the position to or from the VOR station.

## Slaving Panel

### SLAVING PANEL DESCRIPTION

Following is a brief description of the indicators and controls of the slaving panel. Figure 2 illustrates the slaving panel.

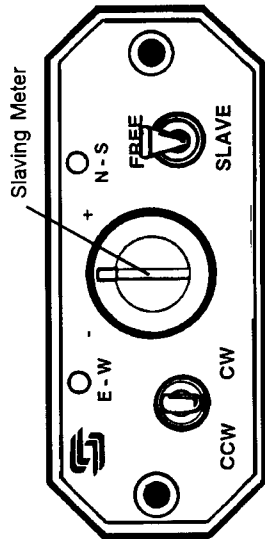


Figure 2, Slaving Panel

### INDICATOR AND CONTROLS

#### CCW/CW Switch

Sends clockwise or counter clockwise direction signals the slaving amplifier section to rotate the compass card.

#### E-W/N-S

Internal potentiometers used to calibrate the compass system to the aircraft's magnetic field and the flux detector during installation. *Do not attempt to adjust in flight—consult your avionics shop if a problem is suspected.*

#### Free/Slave Switch

Selects free or slaved gyro operation. When switching from "FREE" to "SLAVE", the system will automatically fast slave to flux sensor heading.

#### Slaving Meter

Indicates the difference between the displayed heading and the flux sensor output. Positive deflection indicates a clockwise error in the compass card.

## Operating Procedures

### Preflight

#### General

Prior to applying power to the instrument, observe that all the warning flags are in view and that VOR/LOC course deviation indicator (CDI) is centered. Flag(s) out of view and/or a CDI out of center indicates a mechanical problem that should be investigated prior to flight.

After applying power, the compass card will rotate at the fast slave rate of approximately 60 deg./min. until the card is aligned with the aircraft's magnetic heading at which time the heading flag will be pulled from view, indicating the heading is within system tolerances. Compare the HSI compass card position with the magnetic compass reading. Any significant differences between the two headings should be investigated prior to flight.

#### HDG

Rotate the heading select knob to move heading bug left and right of the lubber line. Observe that the bug movement does not cause the compass card to rotate and that the motion of the bug is smooth. If the HDG bug is connected to an autopilot, check operation for the bug in autopilot HDG mode.

#### Navigation

Tune the navigation receiver to a local VOR or VOT test signal and rotate the course pointer to the course required to center the CDI. Compare the bearing indicated to the known bearing to the station. Move the course pointer 10 deg. on each side of the course and observe the CDI needle moves smoothly to indicate full scale each direction. Observe the NAV flag is pulled from view.

## In Flight

### HDG

Rotate the heading bug to the desired heading.

### Navigation-VOR

Tune the navigation receiver and select the desired course with the course select knob. Observe the navigation flag is out of view. Fly the CDI needle as in a conventional display.

### Navigation-Localizer/Glide Slope

Tune the navigation to the localizer or ILS frequency. When the aircraft is positioned to receive the LOC and GS signals, observe the NAV and, if appropriate, GS flags retract from view.

Because an HSI superimposes the navigation display on a moving compass card, the orientation of the display relative to the ILS localizer course remains the same for both front course approaches and back course or reverse approaches. *Always set the ILS front course inbound bearing on the CDI for both front and back course approaches and always fly "to" the needle on both approaches.*

When a usable GS signal is received, the GS flag will retract uncovering the GS scale needle. Fly the GS needle as in a conventional display.

### Compass

While the compass does not require any pilot input during normal operation, it is sound operating practice to observe the slaving meter periodically in level flight to see that it is centered or oscillating and to cross check the HSI magnetic heading with the magnetic (wet) compass. In turning flight the slaving meter will always show either CW or CCW slaving, but within a minute or two of level flight, it should return to center or to oscillate gently about the center, indicating the compass card is matching the magnetic heading of the flux detector. If the HSI compass and the magnetic compass do not agree, refer to the Emergency Procedures Section.

# Emergency Operation

## Compass

The compass system includes an internal fault monitor that will cause the HDG flag to drop into view anytime a fault is detected. When the HDG flag is in view, it means the system is *not* operating properly and should *not be used for directional reference* until the fault is corrected. When the HDG flag is in view, the VOR/GS displays are unaffected.

If the system suffers a failure of the directional gyroscope, the compass card will move out of synchronization with the flux detector, which will cause the HDG flag to drop. Pushing the reset button on the instrument face will place the system in fast slave mode after a delay of approximately 8 seconds. The system will remain in fast slave mode until the compass card is again synchronized with the flux detector, or for approximately 3 minutes, if synchronized does not occur. After 3 minutes, the system will enter automatic emergency mode (AEM) without further pilot actions.

In "AEM" the system will function as a vertical card magnetic compass; that is, it will respond to northerly turning error and acceleration/deceleration as a magnetic compass. The display will be more active but will provide accurate magnetic headings when the aircraft is level. Once in AEM the system will remain in AEM until power is removed or until the reset button is pushed or the slaving switch is moved to the free gyro position.

If the system suffers a failure in the slaving subsystem, causing constant slaving, (slow 3 deg./min. or fast 60 deg./min.) the slaving switch can be set to free gyro mode and the system used as a standard Directional Gyro. In this operation, it will be necessary to periodically realign the compass card with the magnetic compass using the CW/CCW switch on the slaving panel.

If the failure involves the card drive mechanism, the compass portion will be unusable, however, the VOR/LOC CDI and course pointer and the GS displays will remain usable, unless their respective flags are in view.

## Navigation Displays

These displays (VOR/LOC/GS) receive their flag operating signals directly from the respective radio receiver/converter. If the NAV and/or GS flags appear, first check the radio receiver for proper frequency and operation. If proper operation cannot be restored, revert to other navigation equipment an notify ATC of the failure, if operating IFR.

## Procedures

### HDG Flag In View

1. Push the reset button to reset/clear the fault monitor and place the system in the fast slave mode.  
If HDG flag retracts, monitor system closely during the flight.  
If flag remains for 3 minutes without the AEM light, switch to free gyro mode, and monitor heading closely for the remainder of the flight.
2. If AEM activates (AEM light "ON") press the reset button. If the system returns to normal operation, monitor more closely during the remainder of the flight. If the system stays in AEM, continue the flight and if IFR, notify ATC of the failure.

### NAV/GS Flag In View

1. Recheck radio receiver frequency and operation. If proper operation cannot be restored, revert to the secondary source and, if IFR, notify ATC of the equipment failures.

## Notes