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KTS 150  
AUTOPILOT TEST SET

## SECTION I GENERAL INFORMATION

### 1.1 INTRODUCTION

This manual covers the physical, mechanical and electrical characteristics of the KTS 150 Autopilot Test Set. Installation, operation and maintenance of the test set is also included.

### 1.2 DESCRIPTION OF EQUIPMENT

The KTS 150 Autopilot Test Set has been designed to troubleshoot problems in the KFC 200 Flight Control System. Isolation of the problem to a system component is easily accomplished using the troubleshooting chart and test procedure found in the KFC 200 System Manual. The test set is housed in an aluminum case. The electronics are installed in the removable lid of the case. The cables and gyro test kit are stored in the bottom portion of the case.

Both the KC 295 Autopilot Computer and the KC 296 Yaw Damp Computer can be tested with the KTS 150 either individually or simultaneously.

The test set is placed in series with the autopilot and yaw damp computers and the aircraft harness.

The KI 255/KI 256/KG 258 Attitude Gyro is placed on the gyro test stand for gyro/computer calibration.

### 1.3 TECHNICAL CHARACTERISTICS

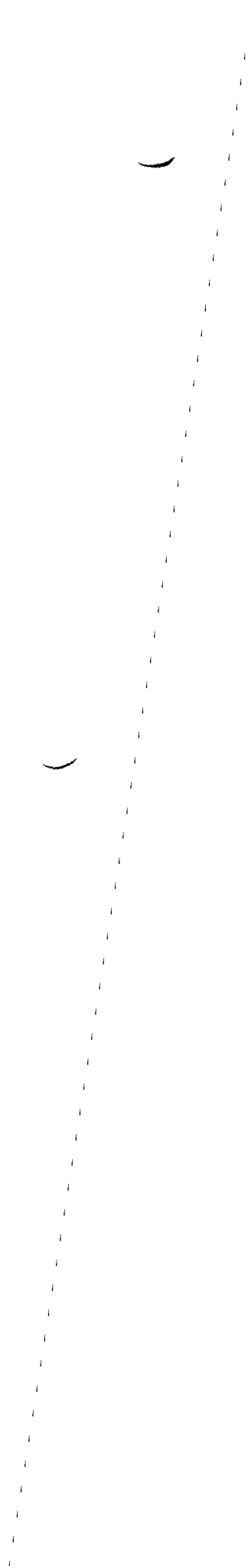
The Technical Characteristics of the KTS 150 Autopilot Test Set are herein presented:

| SPECIFICATION      | CHARACTERISTIC  |
|--------------------|---|
| SIZE:              | 9" x 16" x 15 1/2" nominal<br>22.8 x 40.6 x 39.3 centimeters    |
| WEIGHT:            | 33.5 lbs. (15.2Kg)<br><br>Servo Slip Clutch tools not included. |
| POWER REQUIREMENT: | 14VDC @ 1A<br>28VDC @ 1.5A                                      |

### 1.4 ACCESSORIES SUPPLIED WITH TESTER

The following accessories are supplied with the KTS 150 Autopilot Test Set:

- a) Cables
- b) Card Puller (KPN 047-1277-00)
- c) Extra Light Bulbs
- d) Gyro Test Kit (KPN 071-5024-00)
- e) Turn Slip Gyro Extender Cable
- f) Test Set printed circuit board extenders (stored in lid of case behind test set panel)
- g) KM 275 Bench Test Kit (KPN 050-1453-00)
- h) KM 276 Bench Test Kit (KPN 050-1451-00)
- i) Board Provision Kit (050-1543-00)





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## SECTION II INSTALLATION

### 2.1 GENERAL

The KTS 150 Autopilot Test Set is hand carried to the aircraft and connected into the harnesses of the KC 295 and KC 296 computers. Figure 2-1 describes this interface. Figure 2-2 illustrates the KI 255/KI 256/KG 258 Flight Command Indicator installed on the Gyro Test Stand.

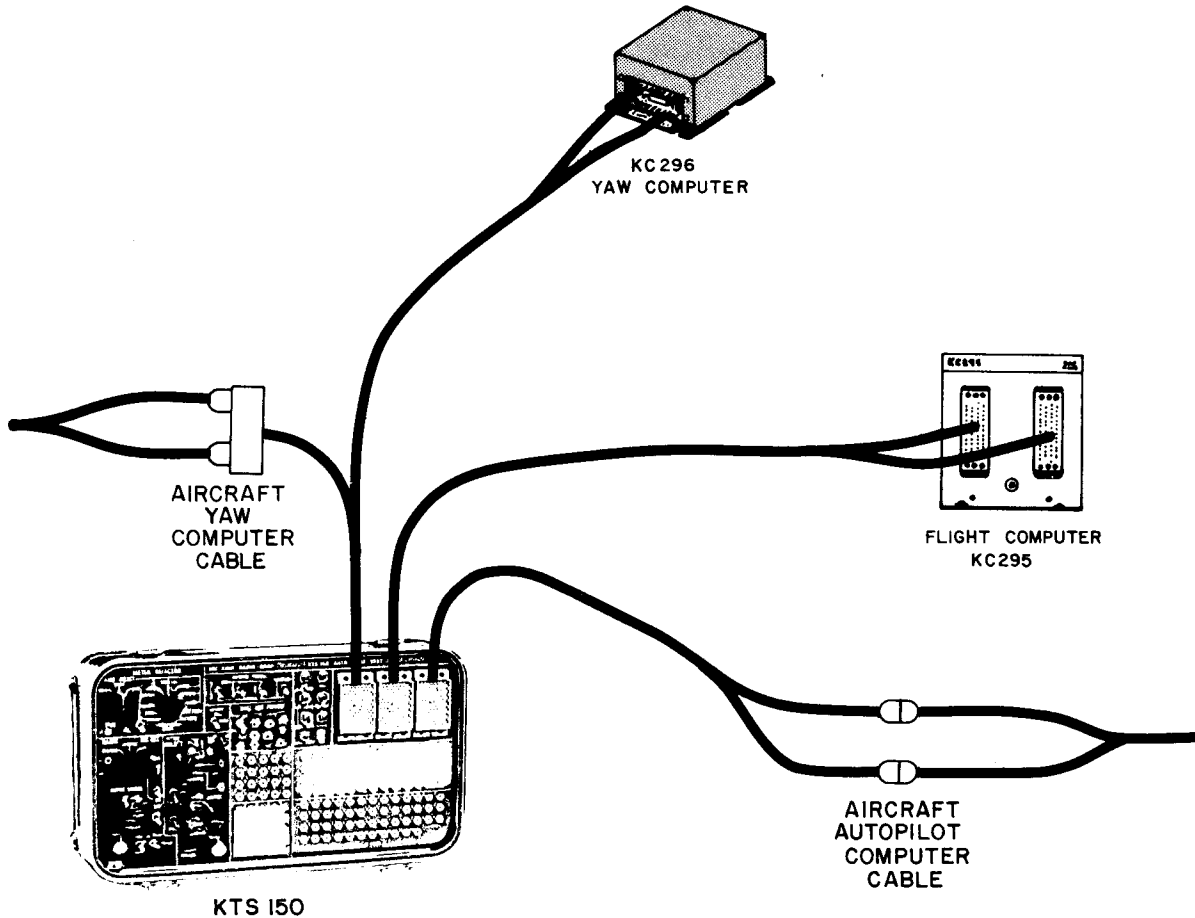


FIGURE 2-1 KTS 150 INTERFACE WITH KC 295 AND KC 296

### 2.2 UNPACKING AND INSPECTING EQUIPMENT

Exercise extreme care when unpacking each unit. Make a visual inspection of each 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. When all equipment is removed, place in the shipping container all packing materials for use in unit storage or reshipment. The KTS 150 will conform to standards designated by the customer, installing agency and existing conditions as to unit location and type of installation.

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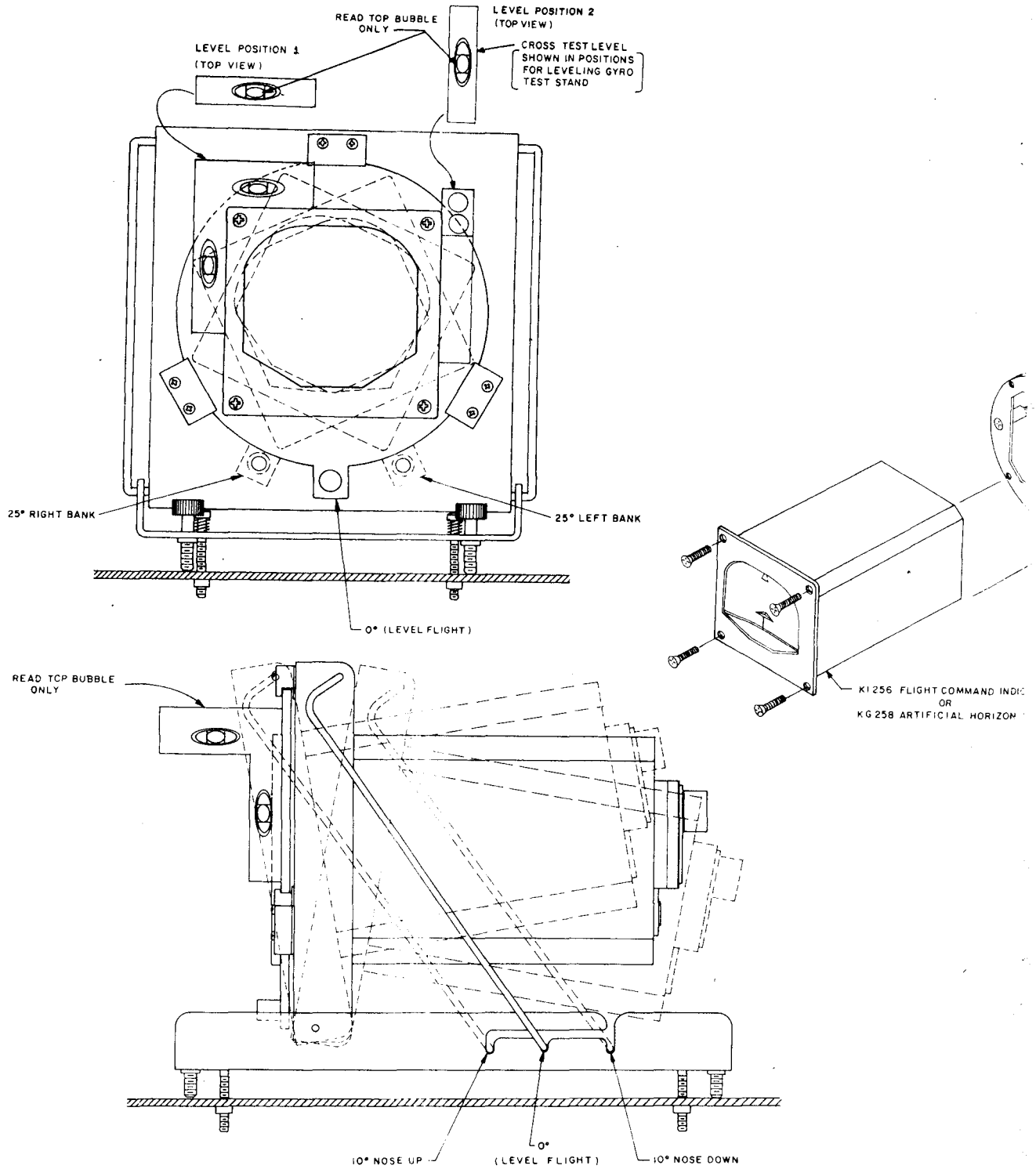
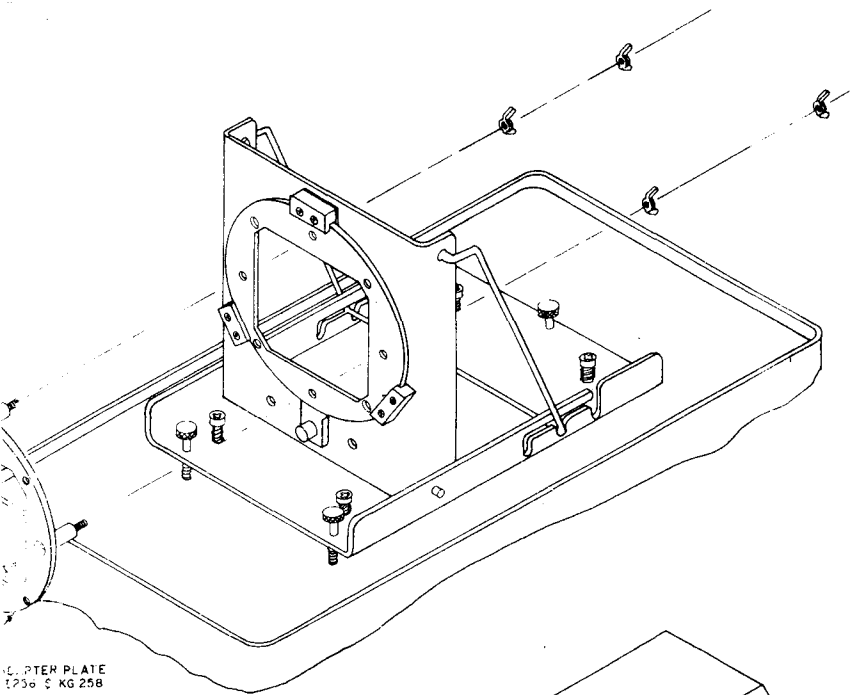
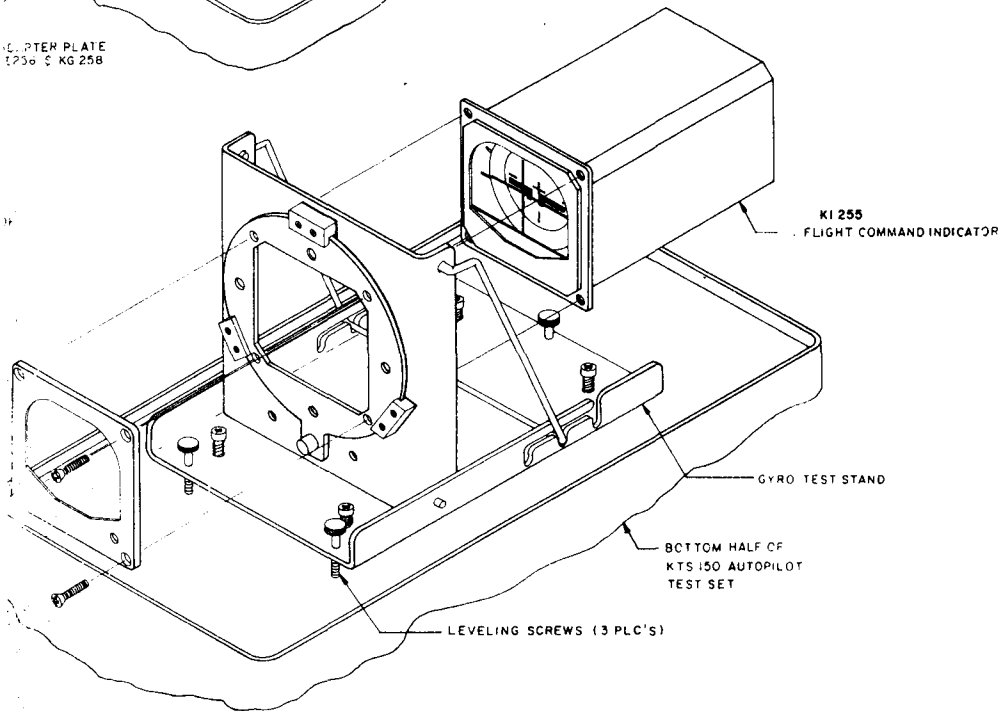


FIGURE 2-2 GYRO TEST STAND  
(Dwg. No. 696-5302-00, R-1)





COVER PLATE  
KTS 150 & KG 258



KI 255  
FLIGHT COMMAND INDICATOR

GYRO TEST STAND

BOTTOM HALF OF  
KTS 150 AUTOPILOT  
TEST SET

LEVELING SCREWS (3 PLC'S)







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## SECTION III OPERATION

### 3.1 GENERAL

The controls of the KTS 150 are described in this section. Procedures for use with the KFC 200 System are found in the Maintenance Section of the KFC 200 Flight Line Maintenance Manual.

### 3.2 CONTROLS

The controls of the KTS 150 Autopilot Test Set are described as follows (Figure 3-1):

#### METER

- |                     |   |
|---------------------|---|
| 1. Meter Selector   | Determines DC voltages to be measured with external meter at meter test jacks.  |
|                     | <u>+10V</u> AP or YD +10V supplies<br><u>-15V</u> AP or YD -15V supplies<br><u>+15V</u> AP or YD +15V supplies<br><u>A+</u> AP or YD ACFT A+ supply<br><u>Autotrim Drive</u> selects KC 295 autotrim drive output to trim servo.<br><u>Yaw Rate</u> - Selects DC yaw rate to KC 296.<br><u>Alt Hold</u> - Selects Alt Hold error test point KC 295.<br><u>ACCEL</u> - Selects roll or pitch acceleration test point KC 295 and roll and yaw rate summation test point KC 296.<br><u>Servo</u> - Selects roll, pitch or yaw servo drive test point.<br><u>Fader</u> - Selects roll or pitch fader test point KC 295.<br><u>Gyro</u> - Selects roll, pitch or yaw gyro buffered test point.<br><u>Tach FB</u> - Selects roll, pitch or yaw servo tach motor feedback voltage. |
| 2. Meter LO/HI      | Connect external voltmeter Hi to Lo to measure voltages selected by Meter Selector Switch.  |
| 3. YD/AP            | Selects YD or AP +10, +15, A+ supplies to meter selector switch.  |
| 4. Roll, Pitch, Yaw | Selects roll, pitch, yaw gyro, fader, servo, tach FB and acceleration test points to meter selector.  |

#### TEST SET POWER

- |               |             |   |
|---------------|-------------|---|
| 5. A+ Status  | <u>+14</u>  | Displays test set +14V A+ supply automatically selected. Should agree with ACFT A+. |
|               | <u>+28</u>  | Displays test set +28V A+ supply automatically selected.                            |
| 6. PWR        |             | Turns test set power On/Off.  |
| 7. Test Jacks | <u>+12V</u> | 12V preregulation test set power.   |
|               | <u>+15V</u> | +15V test set DC supply.  |
|               | <u>-15V</u> | -15V test set DC supply.  |
|               | GND         | Power ground reference for measuring test set power supply voltages.                |



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GYRO SELECTOR

8. Gyro Selector  
 Selects simulated gyro inputs to KC 295 and KC 296.  
CAL - Grounds GA bias  
Normal - Basic position, no simulation, on ACFT  
Pitch - Selects pitch vertical gyro input for simulation  
Roll - Selects roll vertical gyro input for simulation  
Yaw - Selects yaw rate gyro input to KC 296 for simulation  
Roll Crossfeed - Selects roll crossfeed input to KC 296 for simulation.
9. Test Jacks  
 Duplicates breakout test jacks for convenience.  
Pitch/Ref - Measure pitch gyro input port of KC 295.  
Roll/Ref - Measure roll gyro input port of KC 295.  
Yaw Hi-Lo - Measure yaw rate gyro input port of KC 296.  
Roll Crossfeed Hi-Lo - Measure roll crossfeed input port of KC 296.
10. Step  
 Apply simulation to selector switch.  
Short - Input port shorted  
In - Input simulation applied
11. Hi/Lo  
 Selects Hi/Lo level simulation input.  
 Pitch Hi Preset  $5^{\circ}$  .25VAC  
 Pitch Lo Preset  $1^{\circ}$  .05VAC  
 Pitch Hi Ramp  $4^{\circ}/s$  .2V/sec  
 Pitch Lo Ramp  $.8^{\circ}/s$  .04V/sec  
 Roll Hi Preset  $5^{\circ}$  .25VAC  
 Roll Lo Preset  $1^{\circ}$  .05VAC  
 Roll Hi Ramp  $4^{\circ}/s$  .2V/s  
 Roll Lo Ramp  $.8^{\circ}/s$  .04V/s  
 Yaw Rate Hi Preset  $3.125^{\circ}/s$  1.25VDC  
 Yaw Rate Lo Preset  $.625^{\circ}/s$  .25VDC  
 Yaw Hi Ramp  $2.5^{\circ}/s/s$  1.0V/s  
 Yaw Lo Ramp  $.5^{\circ}/s/s$  .2V/s  
 Roll Crossfeed Hi Preset  $6.25^{\circ}/s$  1.25V  
 Roll Crossfeed Lo Preset  $1.25^{\circ}/s$  .25V  
 Roll Crossfeed Hi Ramp  $5^{\circ}/s/s$  .2V/s  
 Roll Crossfeed Lo Ramp  $.2^{\circ}/s/s$  .04V/s
12. Input Select  
 Selects Simulation Mode  
Preset + - Selects Hi/Lo +/- preset AC or DC input per above  
Ramp + - Selects Hi/Lo +/- AC or DC ramp rate per above  
Adjust - Selects adjustable AC or DC input.
13. Gyro Adjust  
 Provides continuously adjustable AC or DC simulation inputs.

RADIO SELECTOR

14. Radio Selector  
 Selects simulated radio inputs to KC 295.  
Normal - Basic position, No simulation, on ACFT.  
Nav/Loc - Selects Nav/Loc (lateral) input for simulation  
GS - Selects glideslope (vertical) input for simulation



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15. Test Jacks Duplicates breakout test jacks for convenience.  
Nav Hi/Lo - Measure Nav/Loc input signals.  
GS Hi/Lo - Measure Glideslope input signals.
16. Step Apply simulation to selector switch.  
Short - Input port shorted  
In - Input simulation applied.
17. Hi/Lo Selects Hi/Lo level input simulation.  
Nav/Loc Hi Preset  $1^0/.25^0$  15mVDC  
Nav/Loc Lo Preset  $.5^0/.125^0$  7.5mVDC  
Nav/Loc Hi Ramp  $.1465^0/s$  (Loc) 8.75mV/s  
Nav/Loc Lo Ramp  $.1125^0/s$  (Vor) 1.7mV/s  
GS Hi Preset  $.07^0$  15mV  
GS Lo Preset  $.037^0$  7.5mV  
GS Hi Ramp  $.040^0/s$  8.75mV/s  
GS Lo Ramp  $.0079^0/s$  1.7mV/s
18. Input Select Selects simulation mode.  
Preset + - Selects Hi/Lo +/- preset DC input per above  
Ramp + - Selects Hi/Lo +/- DC ramp rate per above  
Adjust - Selects adjustable DC input.
19. Radio Adjust Provides continuously adjustable DC simulation inputs.
20. GS Valid ACFT - GS valid input connected to ACFT radio.  
Invalid - GS Valid input open (invalid).  
Valid - GS Valid input 400mVDC (valid) +7 volt common mode level
21. MM (Middle Marker) ACFT - Middle Marker input connected to ACFT radio  
MM - 2Hz, 2V, 7 volt common mode square wave (Middle Marker)
- RAMP
22. Set/Hold/Run Controls ramp generators  
Set - Sets ramp generator to predetermined initial condition.  
Hold - Holds ramp at any desired position such as a capture point  
Run - Starts ramp generators.
23. Lamp Test Depress to illuminate all indicators for test.
24. Alt Hold Indicates that Alt Hold is engaged. Internal output. Not the same signal as goes to annunciator panel.
25. LBT Indicates that lateral beam track has been sensed.
26. MM Gain Cmd Indicates that middle marker has been sensed and is commanding a gain change.
27. Vert Trim Indicates that a vertical trim command has been received.
28. AP Clutch Eng Indicates that the autopilot clutches are being commanded to engage.
29. YD Clutch Eng Indicates that the yaw damp clutch is being commanded to engage.
30. YD Eng Indicates that the yaw damp mode switch is being engaged.

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- 31. KC 296 Connector      Connection of the test set with the KC 296 and aircraft is made via this connector and the cable provided.
- 32. KC 295 Unit          Connection of the test set to the KC 295 unit is made via this connector and the 4 foot cable provided.
- 33. KC 295 ACFT          Connection of the test set to the aircraft KC 296 connector is made via this connector and the 12 foot cable provided, and to the KC 296 via the 4 foot cable.

TEST JACKS

- 34. Test Jacks            All connections of the KC 295 and KC 296 are brought out for testing and troubleshooting purposes.
- 35. Gyro Test Stand      Level provides for test stand leveling. Pitch attitude angles of 0°, +10° and -10° are available. Roll attitude angles of 0°, +25°, and -25° are available.

SERVO DRIVE

- 36. Pitch                    Normal - Servo drive connected from KC 295 to KS 270 Pitch servo  
Open - Servo drive disconnected from Pitch servo.
- 37. Roll                     Normal - Servo drive connected from KC 295 to KS 271 Roll Servo  
Open - Servo drive disconnected from Roll servo.
- 38. Yaw                     Normal - Servo drive connected from KC 296 to KS 271 Yaw Servo.  
Open - Servo drive disconnected from Yaw servo
- 39. Trim                    Normal - Servo drive connected from KC 295 to KS 272 Trim Servo  
Simulate - Servo drive disconnected from trim servo and connected to trim servo load resistor simulation.

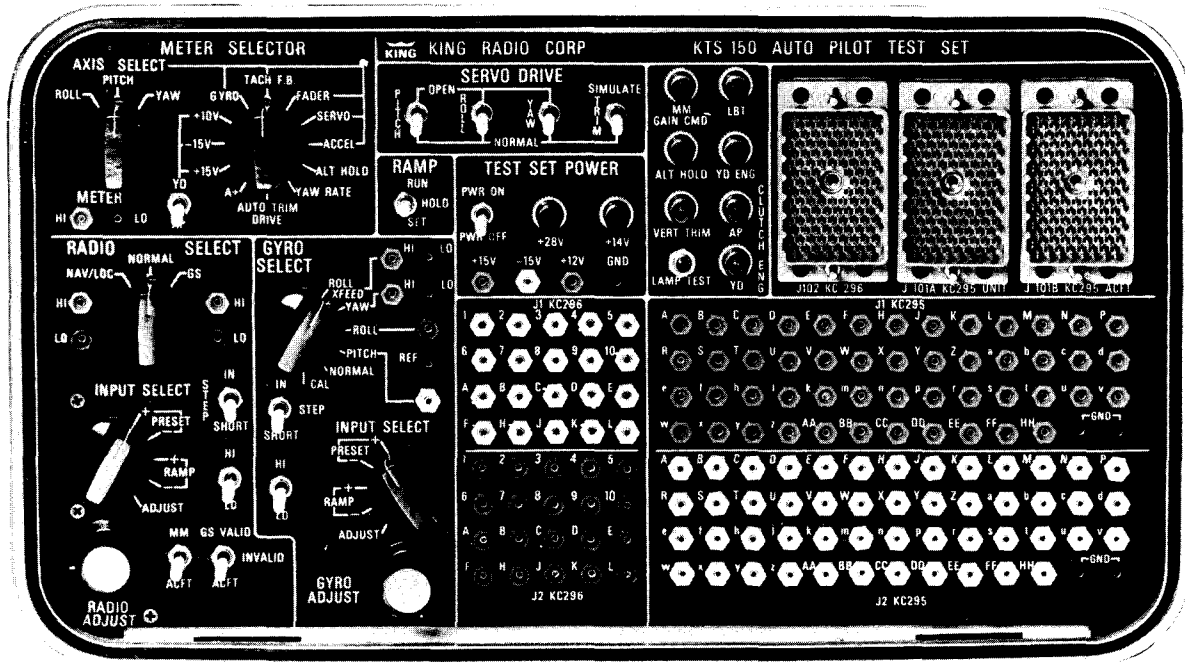


FIGURE 3-1 KTS 150 TEST SET

## **SECTION IV THEORY OF OPERATION**

### **4.1 GENERAL**

The KTS 150 Autopilot Test Set has been designed to facilitate troubleshooting of the KFC 200 Flight Control SYstem. The KTS 150 is placed in series with the harnesses of the KC 295 and KC 296. Provisions have been made to isolate the KTS 150 from each harness when required but yet maintain a breakout test jack for each wire entering or leaving the KC 295 or KC 296. When a signal from units other than the KC 295 or KC 296 are suspect of being incorrect, the particular signal is interrupted and a simulated signal led into the computers. Thus, the problem can be isolated to an incoming signal to the computers or the internal processing of the signal in the KC 295 or KC 296. In this way, KFC 200 System problems can be troubleshot to component levels.

### **4.2 CIRCUIT DESCRIPTION**

A description of the circuitry included in the KTS 150 can be found in shcematics located in Section VI. Basic OP Amp circuitry makes up most of the electronics in the KTS 150.

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