IFF-701
IFF Transponder Test Set

IFF-701 provides pre-mission verification of next generation MK12/Mode S IFF transponders

- Accurate measurement of transponder transmitting frequency, power and receiver sensitivity
- AUTO TEST minimizes test time
- Configuration control provides user selectable predetermined test limits
- GO/NOGO or Diagnostic operation
- Mode 4 Stored Code operation
- Built-in self test
- LCD display with automatic backlight
- Hand held directional antenna
- 2 hour battery operation
- Compliant with test requirements of FAR Part 43 Appendix 'F'
- Two-year limited warranty

IFF-701

The IFF-701 is an organizational level/1ST Line, portable battery operated test set for testing IFF transponders installed in airborne, naval or land based platforms. The IFF-701 may also be used at intermediate level/2ND Line.

The IFF-701 provides a comprehensive 'AUTO TEST' function which allows the operator to verify and certify the operation of MK10A, MK12, MK12/Mode S IFF transponders with minimal intervention once the test has been commanded.

Testing may be conducted 'over the air' or by direct connection to the transponder.

Tests may be individually run for diagnostic fault finding purposes during routine maintenance.

The IFF-701 is environmentally packaged to operate in all weather conditions.

OPERATION

Set up Menu

Three set up menus are used to program parameters for power and sensitivity measurements, test set operational modes, test data storage and recall.

```
          ** SETUP#1 MENU **
UUT ANTENNA: RANGE HEIGHT  PWR UP=1ST/L
       TOP:    20     15
    BOTTOM:    20      3
  SELECTED: BOTTOM
GAIN_1030=11.5 GAIN_1090=12.0 LOSS=1.0
```

```
          ** SETUP#2 MENU **
STORED CODE:LOADED      ERP UNITS= WATTS
STORE= 0 RECALL= 1      DIVERSITY= ON
CONFIG= MK12/M_S  XPDR MODES:C,S,1,2,3,4
CODE SOURCE= STORED A(VB)  INTERR= BURST
Change store/recall field then press RUN
```

1ST Line Auto Test

The 'PWR UP' field in set up #1 menu is used to determine which autotest mode is available after power up. If '1st/L is selected, the 1ST LINE AUTO TEST screen is displayed when the 'AUTO TEST' key is pressed.

The 1ST Line mode is used to provide simple 'point and press' testing using a hand held directional antenna. A ratiometric test is used to confirm that ERP (Effective Radiated Power) and MTL (Minimum Trigger Level) are within pass limits. This test is independent of distance from the transponder antenna, over a 6 ft to 250 ft range.

When initiated with the 'RUN/STOP' key, this test runs through 31 discrete tests. The 'RUN/STOP' button mounted on the directional antenna handle may also be used for 'single handed' operation.

The modes tested, specific tests and PASS/FAIL limits are determined by the configuration selected in the 'CONFIG' field.

During the Mode 4 reply tests the operator is prompted to change transponder control panel settings to verify the crypto A/B code select and verify bit 1 functions. The test may be configured to only use the A code without operator prompt.

Upon completion the 1ST LINE AUTO TEST screen displays the modes tested, the modes passed, the modes failed, ERP/MTL pass or fail, and lobing Ant pass or fail (if enabled in the selected configuration). The 'LOBING ANT' field is used to display correct operation of a lobing antenna RF switch, typically used with MK10A transponders. The 'DIST' field is used by the operator to confirm the approximate distance from the antenna under test.

The detailed results of individual tests conducted during AUTO TEST are stored in memory and may be reviewed by using the 'SELECT' keys. Once selected the test may be initiated by the 'RUN/STOP' key and will continue to run until the 'RUN/STOP' key is pressed again.

```
    ** 1ST LINE AUTO TEST - PASSED **
MODE TESTED-C,S,1,2,3,4   FRQ:1090.00 MHz
MODE PASSED-C,S,1,2,3,4   ERP/MTL: PASS
MODE FAILED-              DIST: 16-32 ft
CONFIG: MK10A             LOBING ANT: PASS
          Press RUN TO start
```

IFF-701

Access to a direct connect POWER TEST is provided in 1ST Line mode and is used for testing feeder and lobing switch losses. Access to the set up menus is prevented in 1ST Line mode.

The 2ND Line mode may be entered when the IFF-701 is in 1st Line mode, by a twin key press on power up.

2nd Line Auto Test

If '2ND/L' is selected in set up menu #1, the IFF-701 will power up in 2ND line mode. The 2ND LINE AUTO TEST screen is displayed when the 'AUTO TEST' key is pressed. Pressing the 'SET UP' key provides access to the set up menus.

The 2ND Line mode provides precise 'over the air' ERP and MTL testing using the directional antenna. Range and height parameters are entered in set up #1 menu.

This mode may be used periodically to confirm specific installation performance and monitor feeder/antenna deterioration. Direct connection via the RF I/O port is also selectable for bench operation.

The 2ND LINE AUTO TEST operation is identical to the 1ST LINE AUTO TEST mode except ERP and MTL measurements are displayed. LOBING ANT and DIST are not displayed. LOBING Configuration files are selected in set up #2 menu.

Two sets of test results may be stored in non volatile memory stores and the last set of results are held in current memory. Test results may be down loaded to a PC or printer for hardcopy.

```
    ** 2nd LINE AUTO TEST - PASSED **
MODE TESTED-C,S,1,2,3,4   FRQ:1090.00 MHz
MODE PASSED-C,S,1,2,3,4   ERP: 55 dBm
MODE FAILED-              MTL: -74 dBm
DIVERSITY ISOLATION: NOT RUN
          Press RUN TO start
```

Reply Delay Test

```
    ** REPLY DELAY TEST - PASSED **

     MODE S: 128.00 uS
      ITM 3: 128.00 uS  C: 128.00 uS
      ATC 3:   3.02 uS  C:   3.10 uS
          Press RUN to start
```

ATCRBS Reply Test

```
    ** ATCRBS REPLY TEST - PASSED **
F1 TO F2 SPACING 3:20.30 uS  C:20.30 uS
F1 PULSE WIDTH   3: 0.45 uS  C: 0.45 uS
F2 PULSE WIDTH   3: 0.45 uS  C: 0.45 uS
CODE=EM7777      ALT= 10,700 FT [6140]
          Press RUN to start
```

ATCRBS Decoder Test

```
    ** ATCRBS DECODER TEST - PASSED **
MODE A:7.90uS: REPLY    8.10uS: REPLY
       7.20uS: NO REPLY 8.80uS: NO REPLY
MODE C:20.9uS: REPLY    21.1uS: REPLY
       20.2uS: NO REPLY 21.8uS: NO REPLY
          Press RUN to start
```

Mode 4 Reply Test

Verifies correct Mode 4 replies to Mode 4 interrogation challenges derived from one of three selectable code sources.

1. Test A/B
2. Crypto A/B or A/B with verify bit 1
3. Stored A/B or A/B with verify bit 1

```
    ** MODE 4 REPLY TEST - PASSED **
CODES TESTED:  :A  :B  :A(VB)  :B(VB)
CODE SOURCE= STORED A(VB) T1 PW: 0.45 uS
T1 TO T2 SP: 1.800 uS     T2 PW: 0.45 uS
T1 TO T3 SP: 1.750 uS     T3 PW: 0.45 uS
          Press RUN to start
```

Mode 1, 2, 4 Reply Delay Test

```
** 1,2,4 REPLY DELAY TEST - PASSED **
  MODE  1: 3.02 uS
  MODE  2: 3.02 uS
  MODE  4: TDV:268.20 uS
  CODE SOURCE: STORED A
        Press RUN to start
```

Mode 1, 2, 4 SLS Level Test

```
  ** 1,2,4 SLS LEVEL TEST - PASSED **
MODE 1: -9 dB: REPLY  0 dB: NO REPLY
MODE 2: -9 dB: REPLY  0 dB: NO REPLY
MODE 4: -9 dB: REPLY  0 dB: NO REPLY

          Press RUN to start
```

Mode 1, 2, Reply Test

```
   ** MODE 1,2 REPLY TEST - PASSED **
F1 TO F2 SPACING 3: 20.30 uS C: 20.30 uS
F1 PULSE WIDTH   3:  0.45 uS C:  0.45 uS
F2 PULSE WIDTH   3:  0.45 uS C:  0.45 uS
M1_CODE=EM7777   M2_CODE=EM7120
          Press RUN to start
```

MTL Difference Test

```
   ** MTL DIFFERENCE TEST - PASSED **
A-C = 1.0 dB  A-4 = 2.0 dB  A-4 = 2.0 dB
A-S = 1.0 dB  C-S = 1.0 dB  1-2 = 1.0 dB
A-1 = 1.0 dB  C-2 = 1.0 dB  1-4 = 2.0 dB
A-2 = 1.0 dB  C-2 = 1.0 dB  2-4 = 2.0 dB
          Press RUN to start
```

Power Test

```
      ** POWER TEST - PASSED **
                    ERP    MTL
  TOP AVG (dBm) = 53.0  -73.4 PASSED
 •BOT AVG (dBm) = 52.0  -74.3 PASSED
  INSTANTANEOUS = 47.0  -73.4
        Press RUN to start
```

Mode S Tests (General)

The discrete address reported in each individual DF reply content is verified against the address reported in the All-Call DF11 replies. Where altitude is displayed, the Mode S reported altitude is verified against Mode C reported altitude.

Downlink data is displayed in RTCA DO-181A format.

Squitter Test

This test displays the squitter address (aircraft's discrete address) in Hexadecimal and Octal numeric formats. The Squitter period is also displayed.

```
    ** SQUITTER TEST - PASSED **
PERIOD = 1.00 SECONDS
TAIL NUMBER = N12345
SQUITTER ADDRESS = 3AC421 [1654201]

        Press RUN to start
```

Mode S UF0 Test

This test displays the DF0 (Short Special Surveillance) reply content.

```
    ** MODE S UF0 TEST - PASSED **

DF 0  VS=1    RI=C    AC= 10,700 FT
ADDRESS=3AC421

        Press RUN to start
```

Mode S UF4 Test

Displays the DF4 (Surveillance Altitude) reply content.

```
    ** MODE S UF4 TEST - PASSED **

DF 4 FS=1  DR=00 UM=00 AC= 10,700 FT
ADDRESS=3AC421

        Press RUN to start
```

Mode S UF5 Test

Displays the DF5 (Surveillance Identity) reply content.

```
    ** MODE S UF5 TEST - PASSED **

DF 5 FS=1  DR=00 UM=00  ID= 3247
ADDRESS=3AC421

        Press RUN to start
```

Mode S UF11 Test

Displays the DF11 (All-Call Reply) content.

```
    ** MODE S UF11 TEST - PASSED **

DF11   CA=0  AA=3AC421 PI=000000


        Press RUN to start
```

Mode S UF16 Test

Displays the DF16 (Long Special Surveillance) reply content.

```
    ** MODE S UF16 TEST - PASSED **

DF16 VS=0  SL=0 RI=0 AC= 10,700 FT
MV=00000000000000 ADDRESS=3AC421

        Press RUN to start
```

Mode S DF20 Test

Displays the DF20 (Comm-B Altitude) & AIS reply content.

```
    ** MODE S DF20 TEST - PASSED **

DF20 FS=0  DR=00 UM=00 AC= 10,700 FT
MB=00000000000000 ADDRESS=3AC421

        Press RUN to start
```

Mode S DF21 Test

Displays the DF21 (Comm-B Identity) and AIS reply content.

```
** MODE S DF21 TEST - PASSED **

DF21 FS=0   DR=00 UM=00 ID= 3247
MB=00000000000000 ADDRESS=3AC421

        Press RUN to start
```

Flight ID Test

Displays the Flight Identity information encoded in the AIS subfield contained in the MB message field within DF20.

```
** FLIGHT ID TEST - PASSED **

DF20   BDS1=02   BDS2=00
AIS=20420CCB9C1041   FLIGHT ID=BA349
ADDRESS=3AC421
        Press RUN to start
```

Individual Tests

1. REPLY DELAY
2. REPLY JITTER
3. ATCRBS REPLY
4. SLS LEVEL
5. ATCRBS ONLY ALL-CALL
6. MODE S ALL-CALL
7. INVALID MODE S ADDRESS
8. SPR ON/OFF
9. MODE S UF0
10. MODE S UF4
11. MODE S UF5
12. MODE S UF11
13. MODE S UF16
14. MODE S UF20
15. MODE S UF21
16. SQUITTER
17. FREQUENCY
18. FLIGHT ID
19. MODE S UELM
20. MODE S DELM
21. DIVERSITY
22. MTL DIFFERENCE
23. MODE 1, 2, 4 REPLY DELAY
24. MODE 1, 2, 4 REPLY JITTER
25. MODE 1, 2, REPLY
26. MODE 1, 2, 4 SLS LEVEL
27. ATCRBS DECODER
28. MODE 1, 2 DECODER
29. MODE 4 DECODER
30. MODE 4 REPLY
31. POWER

Specification

Signal Generator

Frequency
1030 MHz DCXO controlled ±10 kHz

Level
-57 to -7 dBm typically, into 50 Ω (Automatically controlled to determine receiver sensitivity [MTL] for the selected range and 4 dB typically, higher than MTL for test interrogations)

Test Antenna
VSWR <1.5:1
Gain 10 dB typical, specified on the antenna
Range 6 feet (1.83 meters) to 250 feet (76.20 meters)

Interrogation Test Signals

Rate
Modes 1, 2, 3/A, C 235 Hz PRF (±5 Hz)
Mode S 47 Hz PRF (±5 Hz)

Interlace Ratio
MTL Interrogations to Test interrogations
Mode 1, 2, 3/A, 4, C 2:1
Mode S 8:1
Mode 1, 2, 3/A, 4, C, S, Intermode

NOTE:
The IFF-701 Interrogates with the mode(s) necessary to run selected test.

Pulse Spacing (Nominal)
Mode 1
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 3.00 µs (± 50 ns)

Mode 2
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 5.00 µs (± 50 ns)

Mode 3/A
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 8.00 µs (± 50 ns)

Mode 4
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 4.00 µs (± 50 ns)
P_1 to P_4 6.00 µs (± 50 ns)
P_1 to P_5 8.00 µs (± 50 ns)
P_1 to P_6 10.00 µs (± 50 ns) (Test Code A & B)

Mode C
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_3 21.00 µs (± 50 ns)

Mode S
P_1 to P_2 2.00 µs (± 50 ns)
P_1 to P_6 3.50 µs (± 50 ns)
P_1 to SPR 4.75.µs (± 50 ns)

Intermode Pulse Spacing
Mode 3/A
P_1 to P_3 8.00 µs (± 50 ns)
P_1 to P_4 10.00 µs (± 50 ns)

Mode C
P_1 to P_3 21.00 µs (± 50 ns)
P_1 to P_4 23.00 µs (± 50 ns)

Pulse Spacing Deviation
Decoder Tests 1, 2, 3/A, 4, C
Range 1 to 23.00 µs
Accuracy ±50 ns

Pulse Widths
Mode 1, 2, 3/A, C, S, Intermode
P_1, P_2, P_3 0.80 µs

Mode 4
P_1, P_2, P_3, P_4 0.50 µs
ISLS P_5 0.50 µs
P_6 to P_{37} 0.50 µs

Mode S
P_6 (Short) 16.25 µs
P_6 (Long) 30.25 µs

Intermode
P_4 (Short) 0.80 µs
P_4 (Long) 1.60 µs

All Modes
Accuracy ±50 ns
Rise Time 30 to 100 ns
Fall Time 30 to 100 ns

Mode 4 Code Sources
Test Codes A/B selectable
Live Crypto A/B selectable
Stored Code
32 A Codes
32 B Codes
32 A (Verify Bit 1) Codes
32 B (Verify Bit 1) Codes

Phase Modulation
Transition time ≤80 ns
Phase Shift 180° (±10°)

Amplitude Levels
SLS Level (P_2/ P_5) -9 dB (±1 dB) and 0 dB relative to P_1 level
NOTE : SLS Level is automatically controlled in the SLS LEVEL Test.

UUT Measurements (Replies)

XMTR Power (at 1090 MHz)

Effective Radiated Power (ERP)
Range +48.5 to + 57 dBm (71 to 500 W)
Accuracy ±2 dBm

Direct Connection - Peak Pulse Power
Range +46.5 to +60 dBm (45 to 1000 W)
Accuracy ±1 dB
Resolution 0.1 dB

XMTR Frequency
Range 1087 to 1093 MHz
Accuracy ±50 kHz
Resolution 10 kHz

Receiver Sensitivity
Direct Connection - Minimum Triggering Level (MTL)
Range -67 to -79 dBm
Accuracy ±2 dB

Radiated Field Strength (MTL)
Range -69 to -77 dBm into 0 dBi antenna
(-77 dB W/m² to -85 dB W/m²)

Squitter Period
Range 0.10 to 4.88 seconds
Accuracy ±10 ms

Reply Delay
Mode A, C, 1, 2
Range 1.80 to 7.00 µs
Accuracy ±100 ns

Mode 4 Triplet
Range 195.00 to 265.00 µs
Accuracy ±250 ns

Mode 4 TDV
Range 194.00 to 819.00 µs
Accuracy ±250 ns

Reply Jitter
Mode 1, 2, 3/A, C
Range 0.00 to 2.30 µs
Accuracy ±90 ns

Mode 4 TDV
Range 0.00 to 10.50 µs
Accuracy ±90 ns

Mode S and ATCRBS/Mode S All Call
Range 0.00 to 6.00 µs
Accuracy ±90 ns

Pulse Spacing
F_1 to F_2
Range 19.70 to 21.60 µs
Accuracy ±50 ns

Mode 4 Triplet
Range
T_1 to T_2 1.30 to 2.00 µs
T_1 to T_3 3.05 to 3.75 µs
Accuracy ±50 ns

Pulse Widths
F_1 to F_2
Range 0.20 to 1.00 µs
Accuracy ±50 ns

Mode 4 Triplet
Range 0.350 to 0.600 µs
Accuracy ±50 ns

Diversity Isolation
Range 0 to >20 dB (depending on Antenna range)
Antenna Range 1.83 meters (6 feet) to 28.96 meters (95 feet)
Accuracy ±3 dB

General

Calibration Interval
1 year

Temperature
-20 to +50°C (functional)

Battery Operation
Duration 2 hours before recharge at 25°C
Automatic Shutoff after 15 minutes of non-use

AC Supply
103.5 to 129 VAC, 207 to 253 VAC, 47.5 to 420 Hz, 30 watts (used to recharge battery)

Dimensions
284 mm (11.2 in) W; 361 mm (14.2 in) D;

IFF-701

279 mm (11 in) H

Weight
13.7 kg (30 lb)

Supplied Accessories

RF Coax Cable
Connects Directional Antenna to IFF-701

Directional Antenna
Used for all 'over the air' tests

TNC-BNC Adapter
For direct connection to antenna feeders, lobing switches and transponder

Crypto Umbilical Cable Length 3 ft
Connects IFF-701 to KIR-1C-TSEC Crypto, for stored code loading. Provided with 4 ft power leads for +28 VDC aircraft battery connection

Versions and Accessories

When ordering please quote full ordering number information

Order Number	*Versions*
701-110	IFF-701 Transponder Mode 4 Test Equipment, 110 VAC operation
701-110-C	IFF-701 Transponder Mode 4 Test Equipment, 110 VAC with Certificate of Calibration
701-220	IFF-701, 220 VAC operation
701-220-C	IFF-701, 220 VAC operation with Certificate of Calibration
	Accessories (supplied)
	Line Cord
	RF Coax Cable
	Operators Manual
	Directional Antenna
	TNC-BNC Adapter x 2
	Crypto Umbilical Cable

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