Honeywell

KT 73 Mode S Transponder
066-01164-0101

Alignment Procedure

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1.0 Introduction

This document describes the equipment required, the setup configuration, and the procedure necessary to align a KT73 Mode S tranponder to pass MPS requirements.

2.0 Acronyms

AA	Aircraft Address
ACL	All Call Long
ATCRBS	Air Traffic Control Radar Beacon System[1]
ATE	Automatic Test Equipment
BITE	Built In Test Equipment
dB	Decibel
dBm	Decibel Milliwatts
CCW	Counter Clockwise
CW	Continuous Wave, Clockwise
DC	Direct Current
DPSK	Differential Phase Shift Keying
EEPROM	Electrically Erasable Programmable Read-Only Memory
HW	Hardware
ICAO	International Civil Aviation Organization
IF	Intermediate Frequency
IP	Interference Pulse
LED	Light Emitting Diode
LO	Local Oscillator
MA	Milliampere
Msec	Millisecond
MTL	Minimum Trigger Level
MHz	Megahertz
ηsec	Nanosecond
nS	Nanosecond
OHL	Over High Limit
PAM	Pulse Amplitude Modulation
PPM	Pulse Position Modulation
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RLSI	Ridiculously Large Scale Integration
Rx	Receiver
SLS	Side Lobe Suppression
SPI	Special Position Identification
SPR	Sync Phase Reversal
SQTR	Squitter
SW	Software
TACAN	Tactical Air Command and Navigation
TCAS	Traffic alert Collision Avoidance System
TP	Test Point
TSS	Tangential Signal Sensitivity
Tx	Transmitter
uA	Microampere
UF	Uplink Format
ULL	Under Low Limit
UUT	Unit Under Test
μsec	Microsecond
VFR	Visual Flight Rules
XPNDR	Transponder

[1] As used herein means Non-Mode S

3.0 Reference Documents:

The following documents apply in the testing of the KT 73.

3.1 Minimum Performance Specification, KT 73 004-02148-4000.
3.2 Product Structure, KT 73 000-01007-0000.
3.3 KT 73 Software Design Document 721-00868-0000.
3.4 RTCA DO-181C Minimum Operational Performance Standards for the Air Traffic Control Radar Beacon System/Mode Select Airborne Equipment
3.5 System Requirements Document – KT 73 701-00565-0000.
3.6 Not Required: KT 73 Alignment Procedure Process Map and FMEA 001-06006-1000

4.0 Measurement Reference and Equipment List

4.1 Measurement Reference

Throughout this document, unless otherwise noted, receiver and transmitter power levels referred to are as measured at the "antenna end" of a nominal 2 dB loss coaxial cable.

4.2 Equipment List

4.2.1 Power Supply: 14-28VDC 4 AMPS Trygon Electronics Model HR40-7.5B or equivalent
4.2.2 Digital Voltmeter: Fluke 8000A or equivalent.
4.2.3 Oscilloscope: Tektronix TDS 380 or equivalent.
4.2.4 Mode S Transponder Test Set: IFR S-1403 DL/ATC-1400A or equivalent.
4.2.5 KT 73 Manual Test Panel: 071-09893-0010.
4.2.6 Test Cable KT73: 200-09895-0010
4.2.7 30 dB Directional Coupler
4.2.8 Spectrum Analyzer: HP 8591A or equivalent.

5.0 Setup

See Figure 1 KT 73 Alignment Setup.

5.1 Connect the DC Power Supply to the KT 73 Manual Test Panel: KPN 071-09893-0010 with male banana plug leads. Observe positive and negative polarity when hooking the DC Power Supply outputs to the AIRCRAFT POWER inputs on the back of the KT 73 Manual Test Panel. Set DC Power Supply output to 28 VDC +/-0.5 VDC.
5.2 Connect the KT 73 Manual Test Panel to the KT 73 UUT with the Test Cable KT73: 200-09895-0010. The P23 cable connector hooks to the back of the KT 73 Manual Test Panel at the UNIT INTERFACE. The P1 of the cable is hooked the 24 pin edge card connector on the UUT. The P6 of the cable is hooked to the 12 pin edge card connector. Be careful to observe the correct orientation of the guide key slot on both the edge card connectors to see they are properly connected without damage.
5.3 Connect the UUT RF I/O port to the IFR S1403 DL/ ATC 1400 RF I/O Port with a coaxial cable. The insertion loss of the cable must conform to the requirements listed in 4.1. The coaxial cable requires the following connectors:
5.3.1 N Type, Male.
5.3.2 BNC Male without locking sleeve.
5.4 The UUT is now ready to power up by turning on the AIRCRAFT POWER switch on the KT 73 Manual Test Panel and the Mode Select Switch on the KT73 UUT Front Panel.
5.5 The IFR S-1403 DL/ATC-1400A test set is to be used in the "LOCAL" mode throughout these procedures.

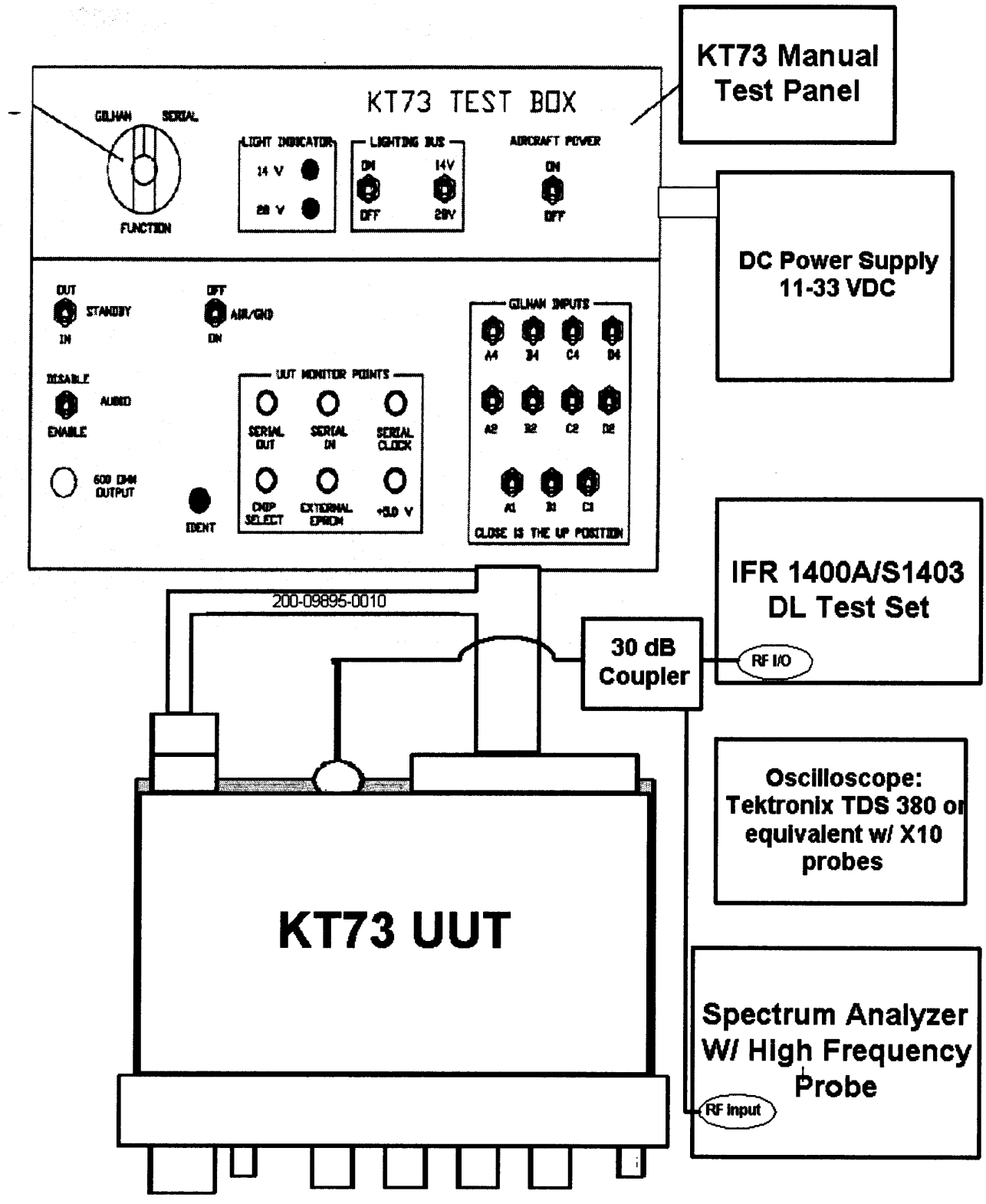


Figure 1 KT 73 Alignment Setup

6.0 Power Supply Alignment

6.1 With the UUT Mode Select switch "ON", adjust R16 for 6.0 ± 0.1 volts at TP13.

6.2 Adjust R77 for 3.3 +/- 0.1 VDC.

7.0 Programming the Internal EEPROM

The unit's build is assumed to be complete including software installation.

7.1 When the unit is turned on for the first time, it will display "AAl" in the altitude window and the four most significant OCTAL digits of the aircraft address in the Ident window which will be zeros. Then it will cycle to "AA2" and four zeros will be displayed for the 4 least significant OCTAL digits of the aircraft address. To change the aircraft address from all 0's to a valid address, the KT73 will need to be put in the programming mode.

7.1.1 The KT 73 will enter the programming mode after the following front panel control sequences:

7.1.2 Put the unit in Standby Mode.

7.1.3 Select 0000 ident code.

7.1.4 Depress the IDT button (and hold) and then the VFR button for a minimum of 3 seconds and the first menu "A/C ADDR" appears.

7.1.5 Press the IDT pushbutton and "AA1 0000" menu appears. Turn Ident code selector knobs to enter the four most significant OCTAL digits of aircraft address. "5252" is suggested.

7.2 Depress the "IDT" pushbutton and "AA2 0000" menu appears. Turn Ident code selector knobs to enter the four least significant OCTAL digits of aircraft address. "5252" is suggested.

7.3 Set Max Air Speed: Depress the "IDT" pushbutton and "MAX AIR " menu appears. Depress the IDT button. Turn the "CRSR" Ident code select knob until "75 150" appears. Depress the "IDT" button.

7.4 Set Altitude Source: Turn the Ident code select knob until "ALT SRC" appears. Depress the IDT button. Turn the Ident code select knob until "GILLHAM" appears. Depress the "IDT" button.

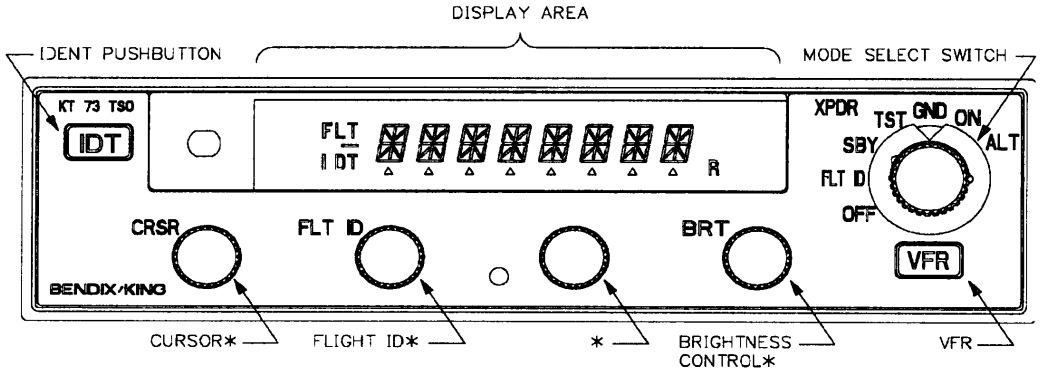
7.5 Set Auto Ground: Turn the Ident code select knob until "AUTO GND" appears. Depress the "IDT" button. Turn the "CRSR" Ident control knob until "ENABLE" appears. Depress the "IDT" button.

7.6 Set Air Volume: Turn the "CRSR" Ident code select knob until "AIR VOL" appears. Depress the "IDT" button. Turn the Ident control knob until "40" appears. Depress the "IDT" button.

7.7 Set Ground Volume: Turn the "CRSR" Ident code select knob until "AUTO GND" appears. Depress the "IDT" button. Turn the Ident control knob until "40" appears. Depress the "IDT" button.

7.8 Recycle the power of KT73 and the new address will replace previous all zero address.

Figure 2 KT73 Front Panel



LEFT SIDE OF THE DISPLAY AREA REPRESENTS THE ALTITUDE WINDOW.
RIGHT SIDE OF THE DISPLAY AREA REPRESENTS THE IDENT WINDOW.

* REPRESENTS TRANSPONDER CODE SELECTOR KNOBS. EACH SELECTS A SEPARATE DIGIT OF THE IDENTIFICATION CODE.

Note: Third knob from
the left is "Blank" knob

8.0 Receiver Tuning Procedure

NOTE: The receiver cover should be left off and the Local Oscillator should have both covers installed

8.1 Local Oscillator Alignment

8.1.1 Adjust the cores of IF transformers T2 through T6 to center position and R217 to its center position.

8.1.2 Inject a CW 1030 MHz ± 10 kHz signal to the unit under test at an RF level that can be seen at TP2 but not saturating the IF log amp. The suggested level is – 40 dBm.

8.1.3 Connect the spectrum analyzer at TP2. (limited IF).

8.1.4 Set R156 for the voltage specified in TABLE 1 at the non-ground side of C33.
NOTE:The NEC mixer transistor is graded into four IDSS categories U71, U72, U73, and U74. This category is marked on the top the transistor package.

Table 1 Q8 Mixer

IDSS CATEGORY	GATE 1 BIAS SET VIA R156
U71	-0.15VDC
U72	-0.30VDC
U73	-0.60VDC
U74	-0.80VDC

8.1.5 Set R157 for 0.0 VDC at the non-ground side of C32.

8.1.6 Adjust C4, C18, C19, and R157 for maximum signal strength to noise at TP2. Adjust C4 through its complete range while monitoring the lowest and highest frequency at TP2. Use C4 to adjust the frequency to be halfway between the highest and lowest frequency observed. This frequency should be 60 MHz ± 29.70 kHz.

8.1.7 Re-adjust R157, C18, and C19 for minimum DC voltage at TP1 using the oscilloscope.

8.2 I.F. Alignment

8.2.1 Inject a –60 dBm 1030 MHz ATCRBS interrogation into the receiver input using IFR S-1403 DL/ATC-1400A.

8.2.2 Connect an oscilloscope to TP6 to display the video magnitude of the interrogations (log video output).

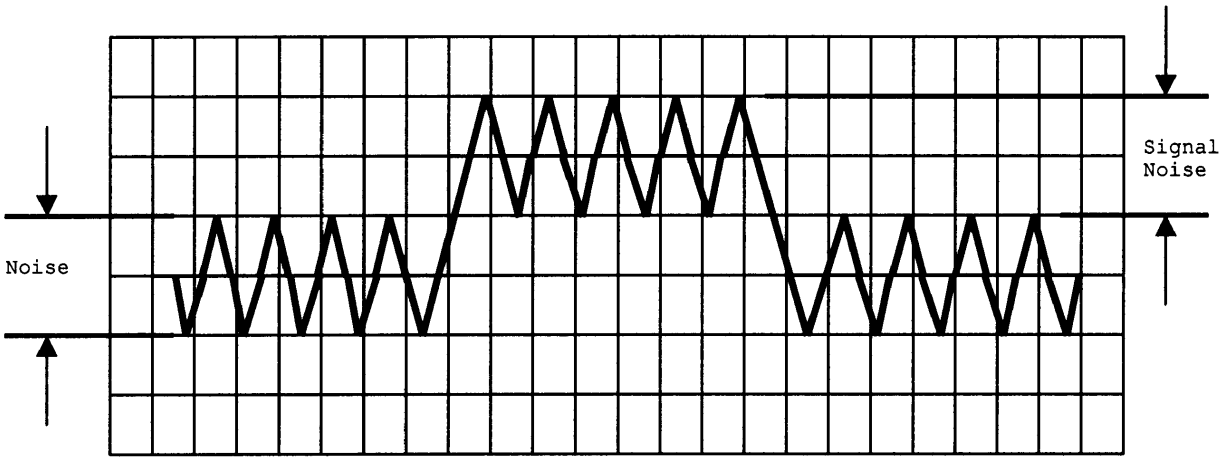
8.2.3 Adjust T2, T3, T4, T5, and T6 for a peak video output amplitude at TP6.

8.2.4 Video Gain Adjust: Connect the oscilloscope to TP6. With a standard ATCRBS interrogation of –70 dBm input power, observe peak video voltage and note it for reference in the steps to follow. Change the input power to –30 dBm and determine the difference in peak voltage. Adjust R217 to obtain 2.40 +/- 0.07 VDC difference in peak voltages as level is changed repetitively from – 70 to –30 dBm.

8.2.5 Install the receiver cover. Set ATCRBS level to –50 dBm and establish a reference line on the oscilloscope, using the horizontal cursor if available, at the pulse top seen at TP6. Set the test set delta frequency to 3.200 MHz. Switch between +Δ and - Δ repetitively while tuning T2 through T6 to obtain a response that is as high as possible for both +Δ and - Δ, while also maintaining a good pulse shape. While tuning each slug, if two peaks are possible, use the bottom position peak. With the delta off, the pulse top should not be lower than 120 mV from the original reference line. Now reset the reference line to the new pulse top position. With +Δ and - Δ, the pulse tops must be within 180 mV (3 dB) of the new reference line. Some pulse distortion is permissible at +Δ and - Δ, but not permissible with the delta off.

8.2.6 Verify that TSS at TP6 is less than or equal to -84 dBm. TSS, tangential signal sensitivity, is the pulse signal strength needed to bring the detected negative signal plus noise peaks tangent to the positive noise peaks as illustrated in Figure 3.

Figure 3 TSS Example



8.2.7 Receiver saturation should not occur below -19 dBm input RF signal level.

8.3 DPSK Detector Alignment

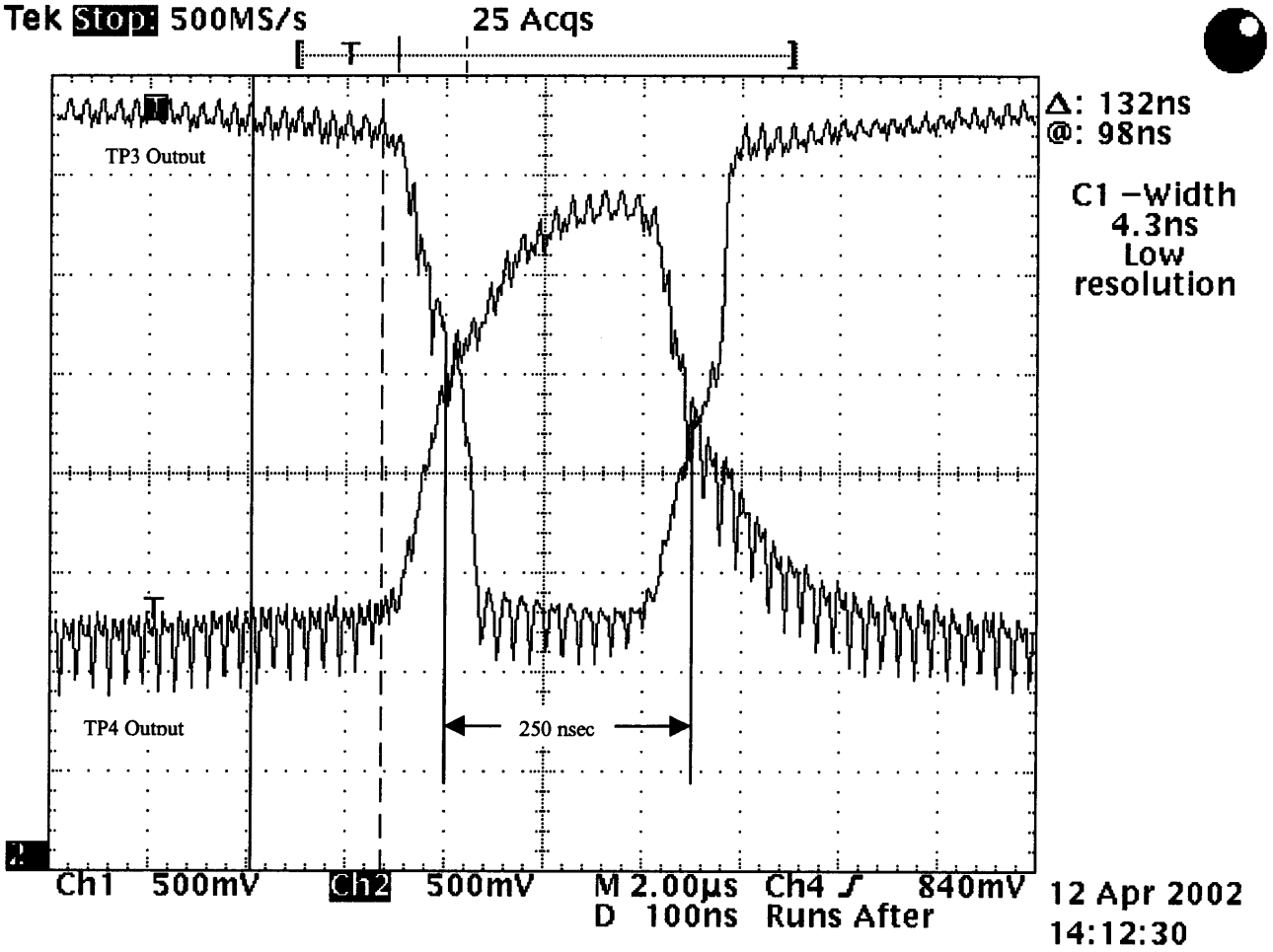
The purpose of this procedure is to align the receiver to allow it to be close to providing the required performance in Mode S operation. This is accomplished by observing the shape and noise generated (in the phase detector "eye") while following this procedure.

8.3.1 Set the ATC 1400A for a MODE-S interrogation (UF11 with 017777777 in the data field and 7's in the address field), and at a signal frequency of 1030 MHz. The MODE-S level is fixed at about -50 dBm.

8.3.2 Use an oscilloscope(s) to monitor the log video output (TP6) and the phase detector output (TP3). Using TP6, find a single data chip, ~250 ηsec wide, at approximately 16 to 18 μsec from P1.

8.3.3 Display the phase detector "eye" pattern by superimposing the signals at TP3 and TP4 on the oscilloscope. Set both channels to equal reference levels (display grid position) and vertical sensitivities. (V/display grid square) There is a spot where no signal will be present between the upper and lower traces of the "eye". See Figure 4 Sample DPSK Eye Diagram. The upper and lower traces will cross each other and the reference position twice approximately 250 ηsec apart during a phase transition in the MODE-S data field. Repetitively adjust C151, L24, and L25 for maximum signal level at TP3 and TP4.

Figure 4 Sample DPSK Eye Diagram



9.0 Main Board Alignment (partial)

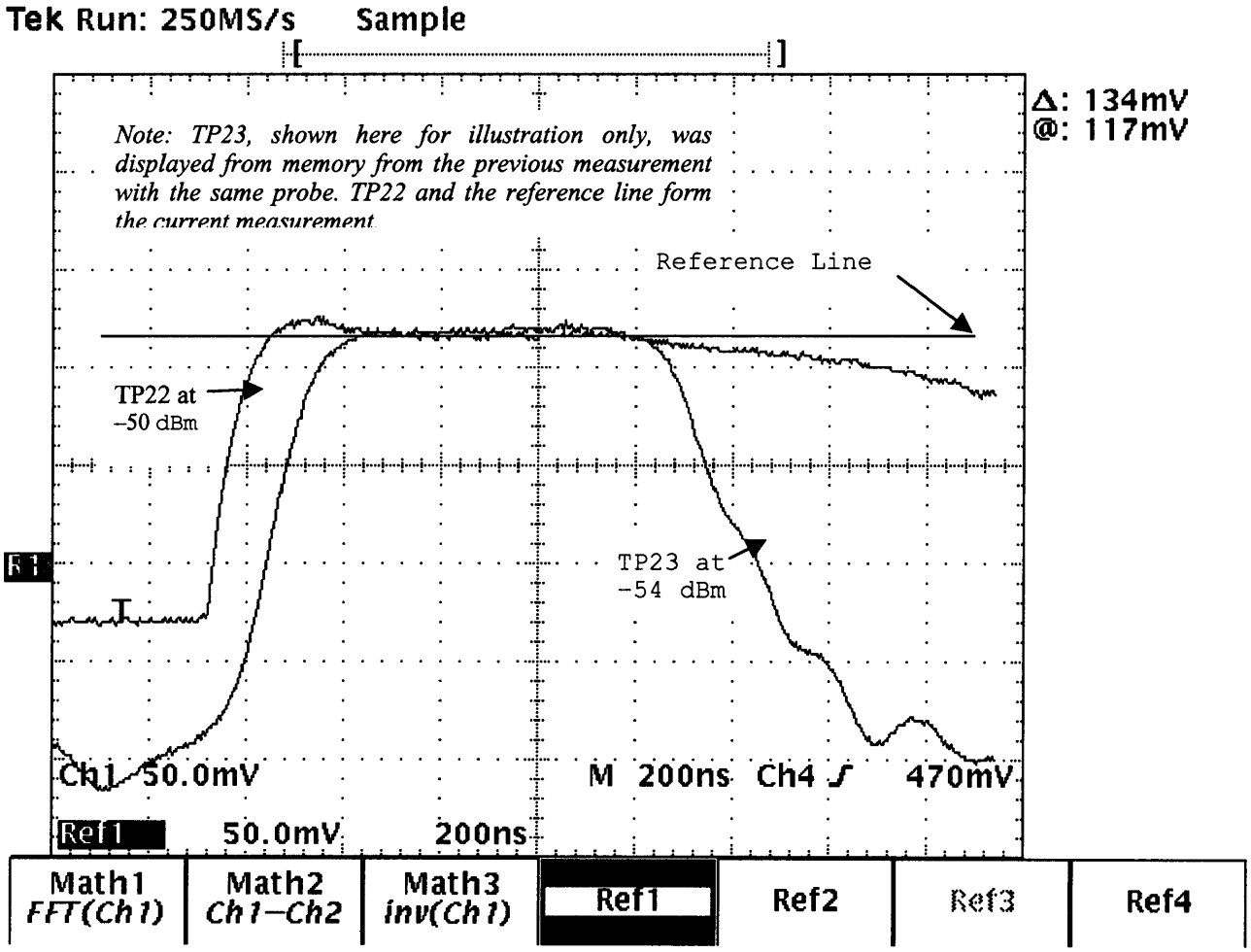
9.1 (Noise Threshold Level) Set R478 fully CCW.

9.2 Set the ATC 1400A for an ATCRBS RF output of –50 dBm.

9.3 Observe the P1 pulse top at TP23 on the oscilloscope. Reduce the signal to –54 dBm and establish a horizontal reference line at the pulse top. See Figure 5 Main Board TP22 & TP23 Outputs below.

9.4 Return the ATC 1400A to –50 dBm interrogation output and move the probe to TP22 without disturbing the DC offset or vertical sensitivity on the oscilloscope. Adjust R497 so that the flat-topped portion of the TP22 signal corresponding to the TP23 pulse top is equal to the reference line. In this way, TP22 is adjusted 4 dB below TP23.

Figure 5 Main Board TP22 & TP23 Outputs



10.0 Transmitter Alignment

10.1 On the UUT set the Mode Select Switch to "ON" and use the four other knobs to enter an IDENT Code of "7777".

10.2 Set all variable capacitors on the transmitter board to mid-range. On the modulator board, set R28 all the way clockwise and R11 to midrange.

10.3 Check that the voltage supplied to the power oscillator is 50 VDC ± 1.5 VDC at E2.

10.4 Apply a 450 PRF ATCRBS Mode A interrogation signal. Connect oscilloscope to "XMTR" on IFR S-1403 DL/ATC1400A. On the transmitter, tune C4, C7, C8 and C11 to obtain good pulse shape, maximum peak power, least delay of pulse start, and 1090 MHz frequency. Set the frequency out of the unit to 1090 ±0.1 MHz.

10.5 If difficulty is encountered refer to the "Supplemental Transmitter Alignment" section.

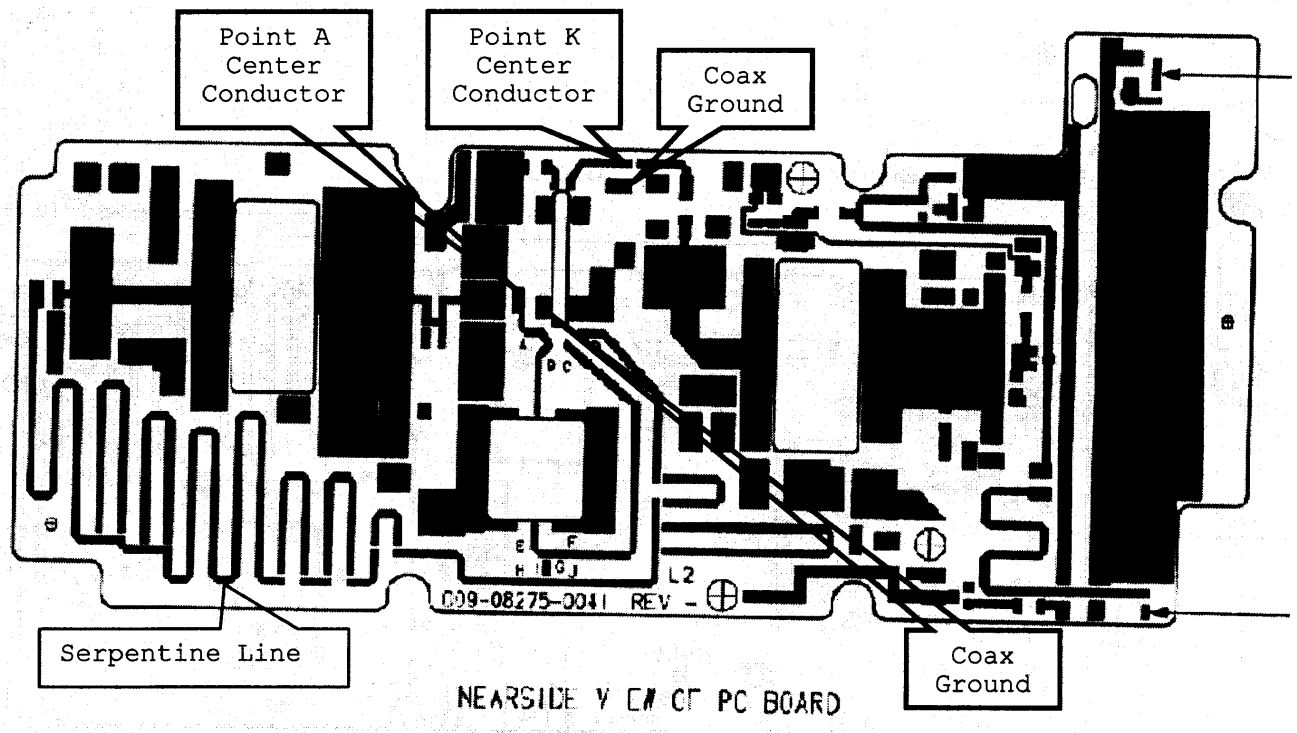
10.6 Once the adequate power is achieved, adjust R11 and R28 to set the detected RF pulse width from IFR S-1403 DL/ATC-1400A "XMTR" to 460±5 nS and the fall time to above 50 nS.

10.7 Check for pulse rise time 50 to 100 nS, fall time 50 to 200 nS, pulse width 350 to 550 nS, peak power 125 W minimum, frequency 1090 ±0.3 MHz, and spectrum per the MPS. Repeat steps 10.4, 10.6, and 10.7 as necessary.

10.8 Apply a 45 PRF long Mode S interrogation signal and repeat checks of previous step except width to be 500 ±50 nS. Repeat 10.4, 10.6, and 10.7 as necessary.

10.9 Interrogate for a long Mode S reply and check for in spec pulse width at the end of the pulse train. Repeat steps 10.4, 10.6, and 10.7 as necessary. If necessary, the width may be adjusted other than as in Step 10.6.

Figure 6 KT73 Transmitter (Top View)



11.0 Supplemental Transmitter Alignment

These procedures may be used to isolate circuit difficulties. Skip if not needed.

11.1 Ceramic Filter Check (done with UUT power off)

11.1.1 Remove C6 from the board to isolate the ceramic filter from the rest of the circuit.

11.1.2 Connect center lead of a coax to Point "A" in figure 6 and shield to Coax Ground. Connect this coax to the RF output port of a tracking generator with a spectrum analyzer. Set the tracking generator to 1090 MHz, RF level to –l0 dBm and the span to 100 MHz. Note: If a tracking generator is not available the IFR S-1403 DL/ATC-1400A in CW mode may be used for input and the regular spectrum analyzer for output to measure approximate center frequency and loss.

11.1.3 Connect center lead of another coax to point "K" and shield to Coax Ground. Connect this coax to the spectrum analyzer input.

11.1.4 Using spectrum analyzer, check for a center frequency of 1090±2 MHz. The insertion loss should not exceed 2.5 dB (for filter and coupler). Allow additional loss for estimated cable loss. Adjust the screw in the filter as necessary.

11.1.5 Remove the first coax cable completely and be sure to disconnect the second coax from the spectrum analyzer before re-installing C6. The point "K" coax may now be connected to the IFR S-1403 DL/ATC-1400A for the Power Oscillator Check. Failure to disconnect from the spectrum analyzer while turning on the power oscillator will damage the analyzer.

11.2 Power Oscillator Check

11.2.1 Unless it is already done, connect a coax from point "K" as above to the IFR S-1403 DL/ATC-1400A.

11.2.2 Apply a 450 PRF ATCRBS interrogation signal and observe the output power, detected pulse shape and spectrum.

11.2.3 Adjust the variable capacitors C4 and C8 to obtain the best pulse shape, power, frequency and least start of pulse delay. Keep in mind that both capacitors affect the center frequency, but the input capacitor should be used to control the frequency and the output capacitor should control the output power. The FL1 screw may also be used to adjust frequency. Adjust to obtain 1090±0.1 MHz and at least 70 watts. The required power reading may be reduced to allow for coax loss.

11.2.4 If the oscillator is not putting out any power, or is low on power and the Q1 transistor is known to be good, several adjustments can be performed.

11.2.5 First, try shortening the serpentine line in figure 6 by removing the smallest line from the chain. If that helps, shorten the network some more.

11.2.6 If shortening the serpentine line does not help, try lengthening it by adding the smallest line first and a longer one if it seems to help.

11.2.7 If the spectrum looks skewed to one side, try adjusting the serpentine line.

11.2.8 If the power is low, shim stock 024-05021-0005 shown in drawing 300-08275-0040 can be removed or added to try to improve the power.

11.2.9 Next remove the point "K" coax, re-connect the output of the power oscillator to the final amplifier with 0.035" shim stock, and replace the unit coax to normal.

11.3 Final Amplifier Check

11.3.1 Tune C7 and C11 to maximize peak power. Note that frequency and other parameters will have shifted some with the reconnection and may need readjustment..

11.3.2 If adequate power cannot be obtained, shim stock 024-05021-0005 shown in drawing 300-08275-0040 can be removed or added at Q2 collector to try to improve the power.

11.3.3 Return to paragraph 10.5 and complete regular alignment.

12.0 Main Board Alignment (continued)

12.1 P4 Adjust

12.1.1 Adjust the RF level of the ATCRBS/Mode S test set to -70 dBm and set for an ACL interrogation.

12.1.2 Set the P4 level on the test set to P4 = P3 - 1 dB and adjust R576 for greater than 90% Mode S reply efficiency.

12.1.3 Set the P4 level on the test set to P4 = P3 - 6dB and adjust R576 for greater than 90% ATCRBS reply efficiency.

12.1.4 Set the P4 level, on the test set, to P4 = P3 - 1 dB and verify that the Mode S reply efficiency is greater than 90%. If the Mode S reply rate is less than 90%, then adjust R576.

12.1.5 Adjust the RF level of the test set to -2ldBm and check for a Mode S reply rate of greater than 90%. Adjust R576 to achieve a reply rate greater than 90%, if needed.

12.1.6 Set the P4 level, on the test set, to P4 = P3 -6dB and check for an ATCRBS reply rate of greater than 90%. If the reply rate is less than 90%, then adjust R576 accordingly.

12.1.7 Repeat steps in 8.1 until all the conditions are satisfied.

12.2 (Setting MTL) Set the RF test set for a RF level of -75 dBm and a standard ATCRBS interrogation. Adjust R478 for approximately 50% reply rate. Check for greater than 90% reply rate at -74 dBm.

12.3 Centering SPR Position tuning by the front panel

12.3.1 The KT 73 will enter the programming mode after the following front panel control sequence:

12.3.1.1 Put the unit in Standby Mode.

12.3.1.2 Select 0000 ident code.

12.3.1.3 Depress the IDT button (and hold) and then VFR button for a minimum of 3 seconds.

12.3.2 Press the IDT until "CODE>000" menu appears.

12.3.3 Rotate three knobs, marked "FLT ID", BLANK and "BRT" until the word "SPR" appears.

12.3.4 Press IDT to enter this code. Change SPR setting from 0 by rotating BRT knob.

12.3.5 Interrogate the unit with UF11, RF level -21 dBm, and SPR position offset at 0 ηsec.

12.3.6 Vary the SPR position offset both plus time and minus time by rotating BRT knob on KT73 and observe the times where the reply rate falls below 100%.

12.3.7 Increment or decrement the delay value (-3 to +4) to obtain the best balance of plus and minus time.

12.3.8 Test the reply rate with SPR position at 0 ηsec, +50 ηsec and –50 ηsec on S-1403DL. Verify 100% replies. Set the RF level to MTL +l and verify 100% replies at SPR positions -50ηsec, 0 ηsec, and +50 ηsec. Set the SPR position on the IFR to +200 ηsec and –200 ηsec. See that the reply rate is zero at both positions.

12.3.9 Store the delay by depressing the IDT button

13.0 Unit Level Alignment for Interfering Pulses and SLS.

The purpose of this procedure is to provide the information required for aligning the unit so that it will meet the required SLS and interfering pulse performance. This is accomplished by observing the noise generated in the phase detector "eye" (by the interfering pulse) and the percent reply indicator on the ATC 1400A while following this procedure.

13.1 Refer to Appendix A of this procedure for information concerning the proper set up of the ATC A and ATC1403 DL to provide interfering pulses from a single generator. With the octal number base selected, set the IFR S-1403 DL for a MODE S interrogation (UFll with 017777777 in the data field and 7's in the add field), and signal frequency of 1030 MHz. The MODE-S level should be fixed at -50 dBm. Disable the squitter by using a shorting jumper on the two pin CJ1 of the KT73 Main Board. If Antenna B output is not –50 dBm, the power should be set on the C020 menu, Brf window of the top S1403 DL display.

13.2 Adjust the ATCRBS interfering pulse level to -60 dBm with the ATC1400 A level control.

13.3 Use an oscilloscope(s) to monitor the log video output (TP6) and the phase detector output TP3 or TP4. With the interference pulse added by setting the ATC 1400 A to DBL/INTERR/INTR PULSE to 5.0 (μsec), watch the interference pulse appear on P6 of the TP6 video signal.

13.4 Move the interference pulse to a spot with a double chip within 250 ηsec of each other near the end of P6. A good spot to observe is somewhere between 16 and 18 μsec from P1.

13.5 Use the two channels to display TP3 and TP4 using delay sweep function to place the scope CRT on the desired set of chips, while keeping the external trigger on the TAC SYNC output mentioned in 12.4.2.

13.6 Display the phase detector "eye" pattern by superimposing the signals at TP3 and TP4 on the oscilloscope. Set both channels to equal reference levels and vertical sensitivities. In the absence of interfering pulses, no signal will be present between the upper and lower traces of the "eye". See Figure 4 Sample DPSK Eye Diagram. The upper and lower traces will cross each other and the reference position during a phase transition in the MODE-S data field. As the interfering pulse magnitude is increased relative to the MODE-S interrogation, noise will become present in the "eye" at the position in the data field coinciding with the location of the interfering pulse. Adjust C151, L24, and L25 for maximum signal level at TP3 and TP4.

13.7 Near the end of the MODE-S data field will be an area where two phase changes occur 250ns apart with no phase changes occurring at least 500ns on either side. Adjust the interfering pulse position such that it will be centered on these two phase changes.

13.8 Set the level of the interfering pulse to –3 dB.

13.9 Place the interference pulse over the first chip following the SPR (1.8 us following the leading edge of P6). Using the thumbwheel switch, slowly move the interfering pulse to the end of P6 and observe the reply rate stays over 60%.

NOTE: Steps 12.10, 12.11, and 12.12 are to be performed if the unit does not achieve 60% reply rate after performing steps 1 through 9.

13.10 Adjust L24, L25, and C151 to minimize the noise and achieve the reply rate. The rate with interference must be at least 60%

13.11 While observing the eye noise and percent reply, fine adjust T5 by rotating its core no more than ± one turn from the nominal position. Fine adjust C151, L24, and L25 while adjusting T5 for minimum eye noise and maximum percent reply. It may be necessary to fine tune T4 and T6 (by no more than ± one quarter turn from nominal) while fine tuning C151, L24, and L25 for maximum percent reply.

13.12 Repeat steps 9 and 10 until the percent reply is greater than 60% with an interference level -3 dB.

13.13 Check SLS to ensure that the unit percent reply is less than 10% with P5=P6 + 3dB with the ATC 1400A RF level at -20 dBm through MTL+3dB. Also check for 100% replies with P5=P6-12dB with the RF level set from -20dBm through MTL+3dB.

NOTE: If SLS is > 10% when P5=P6+3dB, this indicates that the DPSK detector is working too efficiently in the presence of interfering pulses to allow the specified SLS performance. If this occurs the detector must be de-tuned just enough to allow passing SLS but not enough to cause failure of interfering pulse performance. First de-tune by adjusting C151 only then L24 and L25 (if required) and only as a last resort, T4, T5, and T6.

13.14 Performing step 10 may slightly off-tune the IF filter and may lower TSS. Unit TSS should be at least -84 dBm. When performing steps 9 and 10, monitor TSS to ensure it remains at this level or more. The unit is now aligned for SLS and interfering pulse performance.

Appendix A: Single IFR ATC 1400A/S1403 DL Test Set Interference Method

IFR S-1403 DL/ATC-1400A Mode S Interference Setup and Calibration

1.0 Overview:

Engineering has determined that the following procedure is the most direct method of conducting the Mode S interference measurements, using a single IFR.

*NOTE: **XXXXX's** mean a "Don't care" condition. IP means interference pulse.*

1.1 S-1403DL SETUP:

Power up the IFR by switching on the power switch on the left side of the S-1403 DL and preceed to setup tables below.

C Menu 75

AntAEnable: On	Prepulse: OFF
AntA ModSrc: Ext	
AntB ModSrc: Int	

C Menu 10

C10 f 02:	SEQ (Mode S Only)	RFLvl: +0.0
P6: CAL, Wd: CAL, Dv:CAL		P2: CAL
SPR:ON, Dv = CAL	Dly: xxxxxxxx	Sqtr: xxxx
AntA%: ATC = xxx	S = xxx, AntB = xxx	AntB: +.00

C Menu 20

	RFLvl: 50 +0.0

S Menu

S01: Fmt S		
	UF# 11	Data = 017777777
		Add = 77777777
S02: through S99: OFF		

1.2 ATC-1400A SETUP:

DISPLAY SELECT	DBL INTERR/INTRF PULSE	FREQ/FUNCTION SELECT	Δ F
XPNDR CODE	set as specified	1030	x.xx OFF

DME REPLY EFFICIENCY	PRF/SQTR	XPNR P2 / P3 DEV	DME P2 DEV	SLS/ECHO
100	200	x.xx P2 P3	P2	set as specified
		CAL CAL	CAL	OFF

XPNDR MODE	XPNDR PULSE WIDTH: x.xx	SUPPRESSOR
A	CAL	OFF

TACAN	IDENT	PRF/SQ Switch	AUTO	RANGE/VEL/ACCEL
OFF	OFF	ON	MAN	xxxxxx

F2/P2 F1/P1 Switch	FREQ STEP RATE	RF I/O
F1/P1	OFF	NORM

DISCRIMINATOR	INTRF PULSE WIDTH	TAC SYNC	CAL MARKS	CAL θ (phase)
NC	set as specified	To	1.0 μsec	OFF

1.3 Process:

1.3.1 Connect the two inputs of a 50 OHM RF combiner to the S-1403 DL Ant. B RF port and the ATC-1400A RF I/0 port. The combiner output is used for the UUT RF I/O port connection. The Ant. B Port provides a Mode S signal to sum together with an interference pulse supplied by the Port A of the ATC-1400A. Connect the power supply set between 14 to 28 VDC to the aircraft power input of the KT 73 Manual Test Panel. Connect the card edge connector from the KT 73 Manual Test Panel (Happy Box) to the UUT and power up the UUT.

1.3.2 Connect TAC SYNC output, ATC-1400A, to an oscilloscope EXT. SYNC input.

1.3.3 After following the setup in 12.2 and 12.3, the 1400-A portion of the IFR tester should not be interrogating. With the S-1403 DL: C Menu 10 in "Func; (2)", which is Mode S interrogation, Port B should be Mode S interrogating and receiving 100% replies in the "AntB" section of the C Menu 1 of the IFR test panel. Set the ATC-1400A as follows:

1.3.3.1 RF LEVEL to -50dBm.

1.3.3.2 SLS/ECHO to 0 and OFF.

1.3.3.3 DBL/INTERR/INTR PULSE to 005.0 and INTERF-.

1.3.3.4 Set the oscilloscope for a delayed sweep of 1uS/div and a main sweep of 2uS/div. Connect the vertical input of the oscilloscope to TP6 on the receiver board and set the vertical sensitivity, of the oscilloscope, to 500 mV/div using a X10 probe. Be aware that the oscilloscope probes may cause distortion of the video if their impedance and calibration is not correct.

1.3.4 The IP should be visible in front of the Mode S video signal on TP6. Adjust the ATC-1400A INTR PULSE WIDTH CONTROL such that the interference pulse (IP) is 800 ηsec in width as shown on the oscilloscope.

1.3.5 At this point the IP is just to the left of Pl, forward in time, and the calibration of the IP level with respect to P1 may begin. The IP must be placed forward in time relative to P1 because of the random amplitude shift produced by constructive and destructive interference between the Mode S and IP RF carriers introduced after detection into the TP6 video.

1.3.6 Set the oscilloscope delay time position so that the IP and P1, of the Mode S interrogation, are displayed on the oscilloscope CRT.

1.3.7 Adjust the RF LEVEL, on the ATC-1400A, and the RF level (RFLev) on the S-1403 DL (using the S-1403 DL cursor and slew control) so that the IP and P1 are of equal amplitude as shown on the oscilloscope CRT. Check the C20 menu to see Port B output is –50 dBm by seeing "RFLvl: 50 +0.0" If not, manipulate the cursor with the arrows buttons until the two digits following RFLvl are highlighted and adjust the power to indicate 50 which is actually –50 dBm output power. Fine-tuning of the amplitudes to the nearest tenth dB can be done with the second part of RFLvl "+0.0".

1.3.8 The SLS/ECHO thumb wheel switch, on the ATC-1400A, is used to control the power level of the IP, with respect to P6, instead of the ATC-1400A RF LEVEL vernier control.

1.3.9 Adjust the delay time to 2μsec/div on the oscilloscope.

1.3.10 Vary the oscilloscope delay time position so that the entire P6 part of the Mode S interrogation is visible on the oscilloscope CRT.

1.3.11 The DBL INTERR/INTERF thumb wheel switches may be used to position the IP anywhere along P6.

1.3.12 The above setup and calibration procedure MUST be repeated any time that the S-1403 DL setup is changed. This procedure should be done before ANY IP testing and measurements are conducted because the S-1403 DL may not maintain identical power levels from test-to-test. It must not be assumed that the IFR will produce identical power levels at all times. The Mode S IP alignment/testing is very sensitive to RF power levels and levels during alignment and test.

1.3.13 Setup for single IFR interference testing is complete.