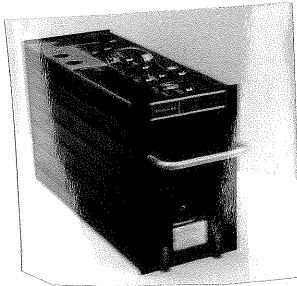


4.0 Drawings and Photographs

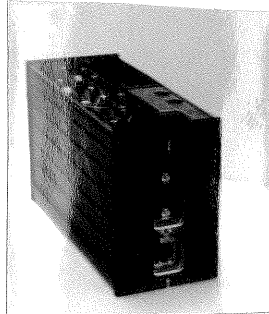
4.1 The drawings listed in section 2.3 of this document are furnished as separate items with this application.

4.2 Photographs of the Mode S Transponder illustrating the assembly drawings are presented on the next page. Photographs showing the overall appearance including placement of the nameplates, views showing the details of the nameplates and a view of the control panel, which provides the only available user controls, are shown in 8 x 10 prints in the attachments.

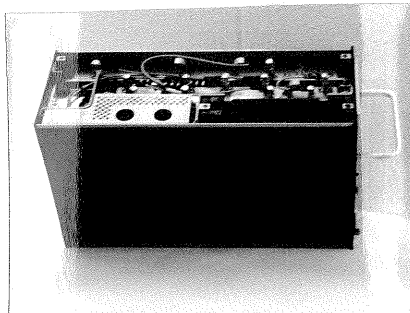
4.2 Photographs of the Mode S Transponder



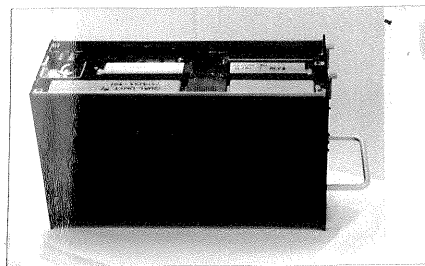
Oblique front view
Top cover removed



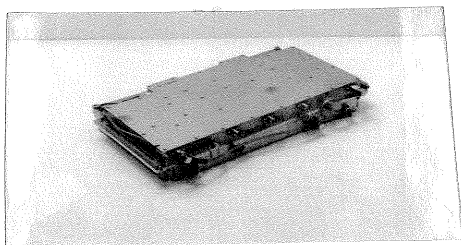
Oblique rear view
Shows ARINC 600 connector



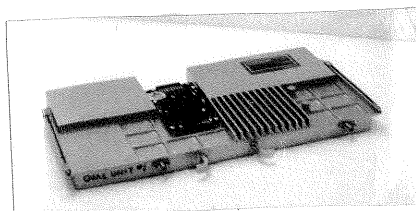
Inside top view



Inside bottom view



Receiver I/O Assembly



Transmitter Assembly

Note: All original photographs are available for inspection.

5.0 Test Data

Data from the required tests is appended to this report per the following list. Paragraphs referenced are from FCC Rules and Regulations, Part 2, Subpart J.

5.1 RF Power Output, para. 2.985

MOPS Test data sheet for test 2.4.2.2, page 3 of 16.

5.2 Modulation Characteristics, para 2.987

MOPS test data sheets showing ATCRBS and Mode S reply pulse characteristic measurements, test 2.4.2.3, pages 4 and 5 of 16. Oscilloscope photographs of transponder replies showing typical patterns and rise and fall times. (Note: The data was taken using a negative polarity crystal detector.)

5.3 Occupied Bandwidth, para 2.989

Data sheet from spectrum analyzer showing spectral data close in (2 MHz per division) and in the extended range (10 MHz per division). All spectra were taken while the transponder was replying to Mode S interrogations at a rate of 45 per second with a typical reply. Because of the nature of the Mode S reply patterns, spectra of any of the reply formats are identical.

The measured occupied bandwidth as shown on the 2 MHz per division spectrum is from 1082 to 1095 MHz.

5.4 Spurious Emissions, para. 2.991, 2.993

Data sheets from EMI testing, radiated emissions from 150 kHz to 10 GHz. The data from 1.2 to 10 GHz was taken using a computer program for a Douglas Aircraft Company specification since the D0-160 program ended at 1.215 GHz. Therefore the limit line on those data sheets has no meaning, only the received signals are important. Additionally, spectra were taken directly from the antenna terminals through 10.9 GHz, the 10th harmonic of the fundamental frequency.

5.5 Frequency Stability with Temperature, para 2.995b

Data sheet taken during the D0-160 temperature performance testing of the environmental tests on the transponder.

5.6 Frequency Stability under Voltage Fluctuations, para 2.995d

Data taken during the D0-160 power variations testing on the transponder. The last three entries on the data sheet were specifically added for this FCC requirement.

APPENDIX
DATA SHEETS AND OTHER MATERIAL

All items are separated by identifying cover sheets.

1. RF Power Output, para. 2.985
2. Modulation Characteristics, para 2.987
3. Occupied Bandwidth, para 2.989
4. Spurious Emissions, para. 2.991, 2.993
5. Frequency Stability with Temperature, para 2.995b
Frequency Stability under Voltage Fluctuations, para 2.995d

RF POWER OUTPUT



SPERRY COMMERCIAL FLIGHT SYSTEMS DIVISION

TEST DATA SHEET CONTINUATION

TEST NAME 110P5
UUT NAME MODE 5 TRANSPONDER
P/N 4061400-901 SERIAL 88110102

Mode S Transponder - Transmitter Characteristics
Test 2.4.2.2

2.4.2.2.1 Reply Transmission Frequency

Transmission Type Frequency

Mode A 1089.9Mode S 1089.95Reply frequency shall be 1090 $\pm$ 1 Mhz PASS PASS/FAIL2.4.2.2.2 RF Peak Power Output See note, next column
Transmission(ips) 100 200 400 800 1200Mode A 240 239 239 239 239 240Mode S at 95 ips 220Power measured at the LRU shall be 160W to 630W 239 WPASS PASS/FAIL2.4.2.2.3 Unwanted Power Output
(Disable Squitters)Power Output at 1090 $\pm$ 3 Mhz ≤ -70 dBm

2.4.2.2.4 Reply Rate Capability

Step 1 - Continuous ATCRBS/Mode S

Condition Output Power Freq
500 ATCRBS, 50 Mode S 54 dBm 1089.97 MHzPASS PASS/FAIL

Step 2 - 100 ms ATCRBS/Mode S

Condition Output Power Freq
120 ATCRBS, 18 Mode S 54 dBm 1089.96 MHzPASS PASS/FAILStep 3 - 25 ms ATCRBS/Mode S
Condition Output Power Freq
30 ATCRBS, 8 Mode S 54 dBm 1089.97 MHz
PASS PASS/FAILStep 4 - 1.6 ms ATCRBS/Mode S
Condition Output Power Freq
2 ATCRBS, 4 Mode S 54 dBm 1089.97 MHz
PASS PASS/FAIL

2.4.2.2.5 ATCRBS Reply Rate Limiting

Step 1 - Reply Rate Limit

Start with 500 interrogations/second and gradually increase to 2000 interrogations/second
Verify does not exceed 2000 replies/sec PASS PASS/FAIL
665 REPLIES MAX

Step 2 - Sensitivity Reduction

Reply Rate

Mode A 7.6%Mode C 99.0%90% replies Mode C and 10% replies Mode A PASS PASS/FAIL

NOTE: Power output limits are based on 125 to 500 watts at the antenna with 3dB loss in connections and cables to the antenna. Therefore, LRU output is 250 to 1000 watts. Loss in cables and connectors from LRU to test set is $\approx$ 2 dB, therefore allowing 160 to 630 watts measured.

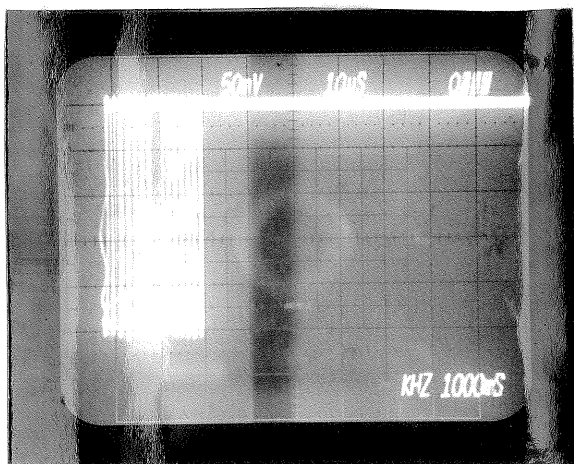
QC

TESTER

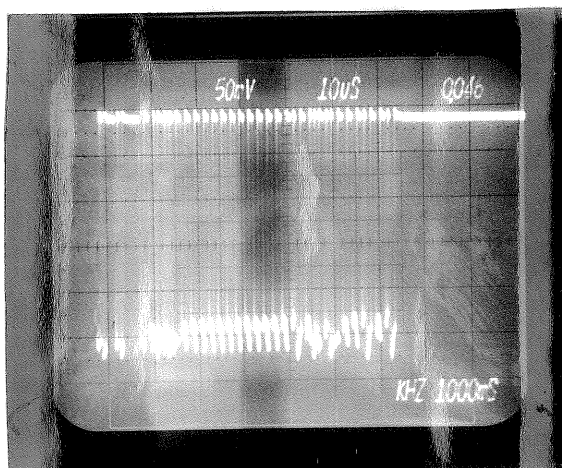
DATE 1/13/89E. R. Beckett
John Elliott1/14/89PAGE 3 OF 16

MODULATION CHARACTERISTICS

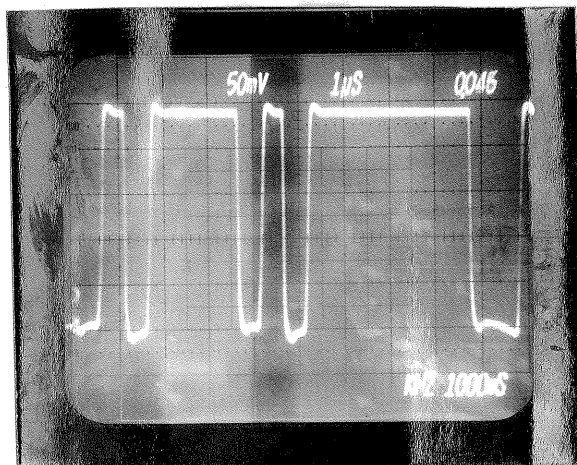
Oscilloscope photographs of typical modulation patterns. Note that a negative polarity crystal detector was used in taking these data. Thus the zero reference for the waveforms is at the top of the figures.



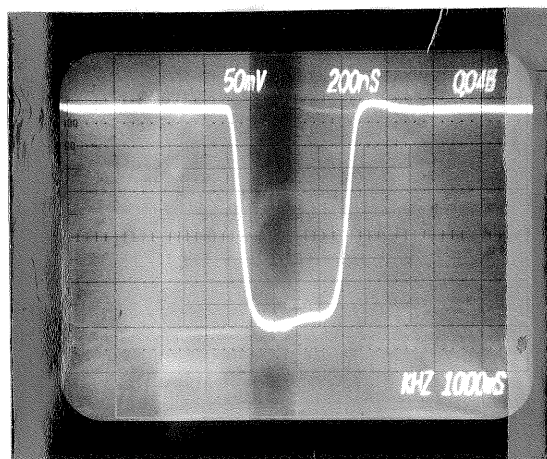
ATCRBS Mode A Reply
with a 7777 identification code



Mode S Reply, DF=11 Format
per RTCA D0-181



Close up of Mode S Reply
Preamble and First Message Pulse



Typical ATCRBS or Mode S Reply Pulse
Showing Rise and Fall Times

TEST DATA SHEET CONTINUATION

TEST NAME MOPS
 UUT NAME MODE 5 TRANSPONDER
 P/N 4061400-901 SERIAL 88110102

Mode S Transponder - Reply Pulse Characteristics
 Test 2.4.2.3

2.4.2.3.1 ATRCBS Reply Pulse Characteristics

Step 1 - Spacing		Spacing Tolerance +0.10 usec		Pulse Position		Spacing Tolerance +0.10 usec	
F1/C1	<u>1.5</u>	<u>0.05</u>		F1/B1	<u>11.7</u>	<u>0.1</u>	
F1/A1	<u>2.95</u>	<u>0.05</u>		F1/D1	<u>13.1</u>	<u>0.05</u>	
F1/C2	<u>4.40</u>	<u>0.05</u>		F1/B2	<u>14.6</u>	<u>0.1</u>	
F1/A2	<u>5.90</u>	<u>0.10</u>		F1/D2	<u>16.0</u>	<u>0.05</u>	
F1/C4	<u>7.30</u>	<u>0.05</u>		F1/B4	<u>17.4</u>	<u>0</u>	
F1/A4	<u>8.80</u>	<u>0.1</u>		F1/D4	<u>18.90</u>	<u>0.05</u>	
				F1/F4	<u>20.4</u>		

Pulse Position PASS PASS/FAIL; Spacing PASS PASS/FAIL

Step 2 Shape

Characteristics Measured

Duration 0.5 us

Rise Time 0.05 us

Ampl Variation 0.66 dBmax

All Reply Pulses will have the following:

Pulse Dur. 0.45 usec +0.10

Pulse Rise Time 0.05 to 0.10 usec

Pulse Ampl. Var. not to exceed 1 Db

PASS PASS/FAIL

PASS PASS/FAIL

PASS PASS/FAIL

Step 3 SPI Pulse

Characteristic Measured

4.35 usec after F4 4.4 us

Time On 18 +2.0 usec 18.1 s

Pulse Position PASS PASS/FAIL

Time ON PASS PASS/FAIL

2.4.2.3.2 ATRCBS Reply Delay and Jitter

Step 1 Reply Delay

Time From P3 to F1, Delay (3.0 +0.5 usec)

Inpt Pwr -73 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -21

Time, us 3.175 3.23 3.175 3.183 3.175 3.175 3.173 3.173 3.173 3.173 3.173 3.173

Average Delay 3.178 us PASS PASS/FAIL

Step 2 Reply Jitter

Time from P3 to F1, Jitter (+0.1 usec)

Inpt Pwr -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -21

Time, us, 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25

Average Jitter 0.228 us PASS PASS/FAIL

Step 3 Reply Delay Variation

Time from P3 to F1, (Mode A to Mode C ≤0.2 usec)

Inpt Pwr -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -21

Mode A, us 1.75 1.7 1.8 1.6 1.8 1.6 1.75 1.8 1.6 1.6 1.7

Mode C, us 1.5 1.8 1.7 1.7 1.7 1.7 1.65 1.8 1.6 1.5 1.6

Diff, us 0.25 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0 0 0.1

Variation PASS PASS/FAIL

QC

TESTER

DATE 11/3/89

E. R. Buehler
John Allen

114189

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TEST DATA SHEET CONTINUATION

TEST NAME MUPSUUT NAME MODE 3 TRANSPONDERPIN 4061400-901 SERIAL 88110102

2.4.2.3.3 Mode S Replies

Step 1 Preamble

Pulse	1	2	3	4
Duration	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>
Spacing	<u>NA</u>	<u>1.0</u>	<u>3.55</u>	<u>4.5</u>
Pulse Duration	<u>0.5 ± 0.05 usec</u> <u>PASS</u> PASS/FAIL			
Pulse Spacing Tol.	<u>0.05 usec</u> <u>PASS</u> PASS/FAIL			

Step 2 Reply Data Pulses

Pulse Duration	Position	Beginning	Middle	End
Short		<u>0.55</u> us	<u>0.5</u> us	<u>0.5</u> us
Long		<u>0.5</u> us	<u>0.5</u> us	<u>0.5</u> us
Pulse Duration	<u>0.5 ± 0.05 usec</u> <u>PASS</u> PASS/FAIL			

5th Reply Pulse to 1st Reply Pulse 8.0 usPASS PASS/FAIL

Step 3 Amplitude Variation

Maximum Variation In Pulse Height	Not to exceed
<u>2</u> V <u>1.3</u> dB	<u>Not to exceed 2 Db one pulse to another</u> <u>PASS</u> PASS/FAIL

Step 4 Pulse Rise Time

0.1 us; Not to exceed 0.1 us PASS PASS/FAIL

Step 5 Pulse Decay Time

0.1 us; Not to exceed 0.2 us PASS PASS/FAIL

Step 6 Pulse Spacing Tolerance

Maximum Deviation From Nominal	Not to exceed
<u>0.04</u> us	<u>Not to exceed 0.05 us</u> <u>PASS</u> PASS/FAIL

Step 7 Delay and Jitter (Dly 128 ± 0.25 us; Jtr ≤ 0.08 us)
 Pwr in (dBm) MTL+3 -60 -50 -40 -30 -21

Delay (us) 127.85 127.875 127.88 127.9 127.9Jitter (us) 0.5 0.4 0.5 0.5 0.5Average Delay 127.89 us PASS PASS/FAILAverage Jitter 0.48 us PASS PASS/FAIL

Step 8 All-call Delay and Jitter

Pwr in (dBm) MTL+3 -60 -50 -40 -30 -21

Delay (us) 127.95 127.95 127.95 127.9 127.9Jitter (us) 0.5 0.5 0.5 0.5 0.5Average Delay 127.9 us PASS PASS/FAILAverage Jitter 0.5 us PASS PASS/FAIL

2.4.2.3.4 Frequency Spectrum of Mode S Replies

Relative Response Spec (dB) Spec (Mhz)

1090 Mhz Carrier

Relative Response	Spec (dB)	Spec (Mhz)
-4 dB	3dB	≥ 1.3 and < 7
-25 dB	20dB	≥ 7 and < 23
-50 dB	40dB	≥ 23 and < 78
-73 dB	60dB	≥ 78

QC

TESTER

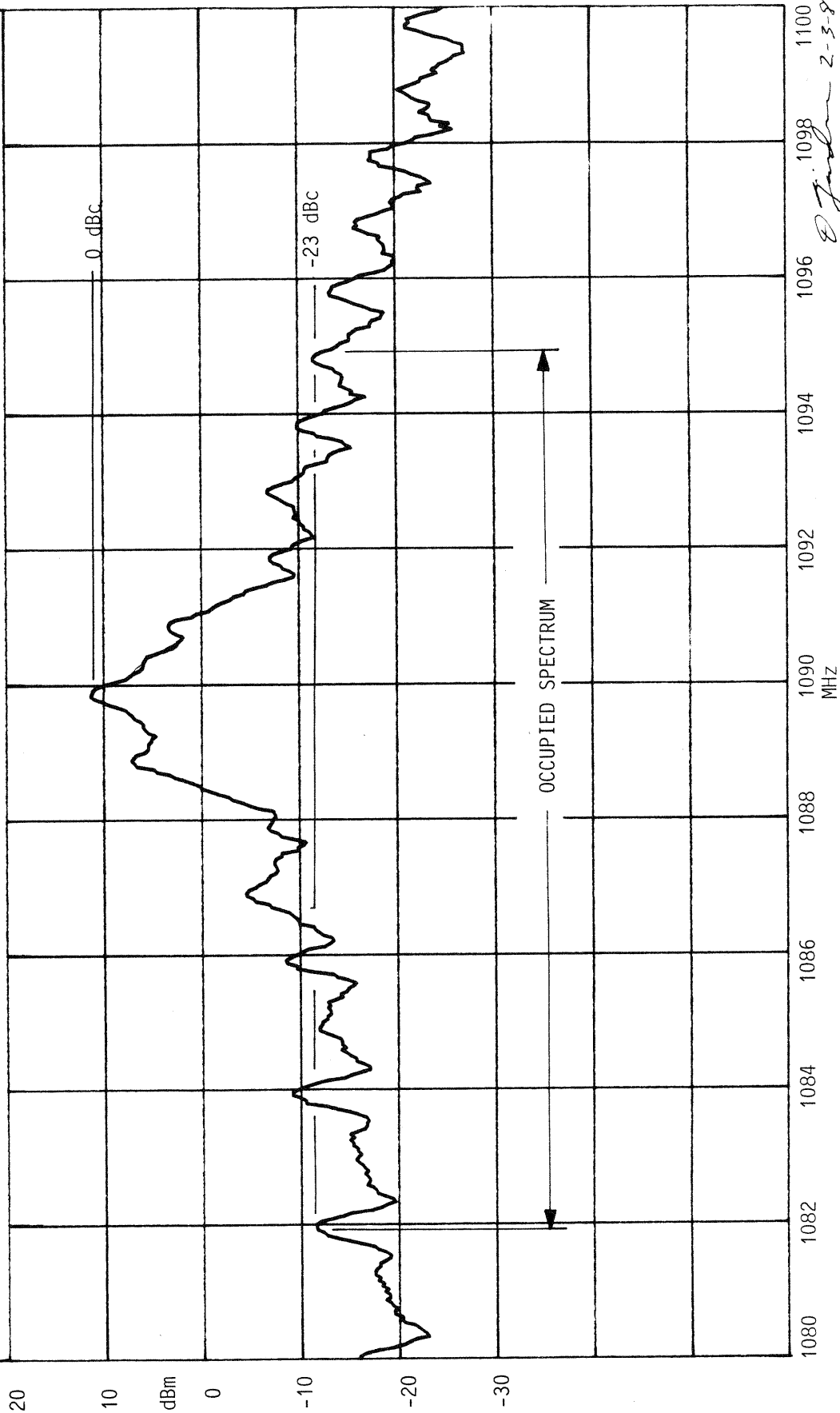
DATE 1/13/891/14/89PAGE 5 OF 16

OCCUPIED BANDWIDTH

TRANSPONDER OUTPUT

CTR 1.0900 GHZ SPAN 2 MHZ/ RES BW 300 KHZ VF OFF
REF 20 dBm 10 dB/ ATTN 50 dB SWP AUTO

SPECTRUM OF MODE S REPLIES AT 45/SECOND



1098 1100
2-3-89