

MODE S TRANSPONDER

**FCC TYPE ACCEPTANCE,
APPLICATION AND REPORT**

**HONEYWELL INC.
SPERRY COMMERCIAL
FLIGHT SYSTEMS GROUP
PHOENIX, ARIZONA**

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION

Type Acceptance

Date of Grant: April 11, 1989

Honeywell Inc
Sperry Commercial Flight Systems Div
5353 West Bell Road
Glendale, AZ 85308

File No.: 31010/EQU 17.9

Application dated: March 2, 1989

Attention: Phillip E. Hagstrom

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER

GB84DV406 1400-901

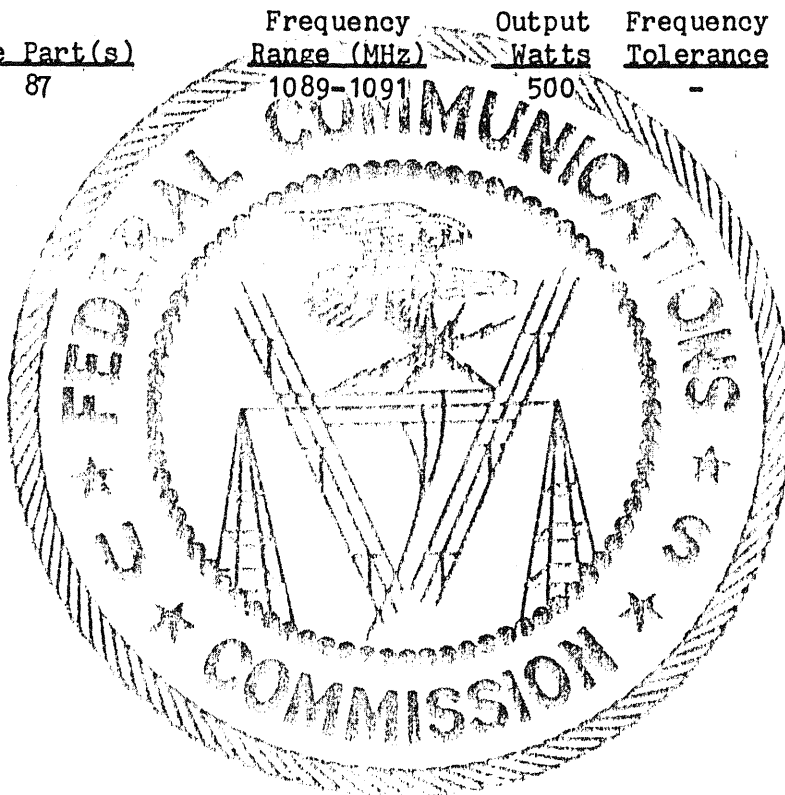
Name of Grantee

Honeywell Inc

XXXXXXXX

Equipment Class : Non-Broadcast Transmitter

Note(s)	Rule Part(s)	Frequency Range (MHz)	Output Watts	Frequency Tolerance	Emission
-	87	1089-1091	500	-	18MOP1D



APPLICATION FOR EQUIPMENT AUTHORIZATION

FCC ID: <u>G B 8 4 D V</u> <u>4 0 6 1 4 0 0 - 9 0 1</u>		FOR FCC FEE STAFF USE	
2. (a) Applicant's FULL business name <u>Honeywell Inc.</u> <u>Sperry Commercial Flight Systems Group</u>		Receipt Date	
(b) Applicant's COMPLETE address (Number, street, or P.O. Box, city, state, ZIP code) <u>P.O. Box 21111</u> <u>Phoenix, AZ 85036-1111</u>			
(c) Name and title of person at above address to receive grant (SEE INSTRUCTIONS) <u>Phillip E. Hagstrom</u>			
3. (a) Instead of applicant, FCC is authorized to mail original grant to (Firm name, number, street, city, state, ZIP code) <u>NA</u>			
(b) Name and title of person at above address to receive grant <u>NA</u>		Fee Control Number	
		Fee Type	
4. (a) FULL name of equipment manufacturer, if different from Item 2(a) above <u>NA</u>		Fee Amount	
(b) Address of equipment manufacturer, if different from Item 2(b) above (Number, street, city, state, ZIP code) <u>NA</u>		ID SEQ	
		For Bureau use only	
		Reviewer:	
		Class Code:	
5. Has a request for confidentiality been filed for any portion(s) of the data contained in this application pursuant to Section 0.459 of the Commission's rules, or has a waiver of any sections of the Commission's rules been filed?			YES NO <u>X</u>
6. Kind of equipment authorization requested (Check ONE box only) <input type="checkbox"/> Certification <input checked="" type="checkbox"/> Type Acceptance <input type="checkbox"/> Type Approval <input type="checkbox"/> Notification			
7. (a) Kind of equipment <u>Mode S Transponder</u>		(b) Equipment will be operated under FCC Rules Part(s) <u>Vol. II, Part 2, Subpart J; Vol. I, Part 87, Sub. A</u>	
8. Application is for (Check ONE box only)			
<input checked="" type="checkbox"/> 1 Original Equipment <input type="checkbox"/> 2 Change in identification of presently authorized equipment <input type="checkbox"/> 3 Change in manufacturer of presently authorized equipment <input type="checkbox"/> 4 Modification of presently authorized equipment			
List FCC ID in Item 1 and trade name, if any in Item 9.		List FCC ID in Item 1 and trade name, if any in Item 9. Complete items 10(a), (c), (d), and (e).	
List FCC ID in Item 1 and trade name, if any in Item 9. Complete items 10(b), (c), (d), and (e).		List FCC ID in Item 1 and trade name, if any in Item 9. Give date of original grant. If no FCC ID assigned, complete items 11(a)-11(d).	
9. Trade Name(s), if any (maximum of 30 characters each—see instructions) <u>NONE</u>			
10. (a) Name of present grantee, if different from Item 2(a) above <u>NA</u>		(b) Name of present manufacturer, if different from Item 4(a) above <u>NA</u>	
(c) FCC ID, if assigned/Model or Type No., and Trade name, if any <u>NA</u>		(d) FCC Type Approval No., if assigned <u>NA</u>	
(e) Date of original grant <u>NA</u>			
11. (a) Complete ONLY if no FCC ID assigned to equipment to be modified (Model or type No.) <u>NA</u>		(b) Trade Name, if any <u>NA</u>	
(c) FCC Type Approval No., if assigned <u>NA</u>		(d) Date of original grant <u>NA</u>	
12. (a) Is the equipment, or section(s) thereof, subject to more than one equipment authorization? 12(c), 12(d), or 12(e), as appropriate. <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, complete Item 12(b), and			
(b) Additional equipment authorization(s) required for equipment <u>NA</u> <input type="checkbox"/> Certification <input type="checkbox"/> Type Acceptance <input type="checkbox"/> Type Approval			
(c) FCC ID listed on simultaneously filed RCVR or RCVR section application <u>NA</u>		(d) FCC ID listed on simultaneously filed XMTR or XMTR section application <u>NA</u>	
(e) FCC ID listed on other simultaneously filed application <u>NA</u>			
FOR FCC STAFF USE ONLY		FOR FCC STAFF USE ONLY	

APPLICATION FOR
FCC TYPE ACCEPTANCE
MODE-S TRANSPONDER

5140-0645
REV. -

HONEYWELL INC.
SPERRY COMMERCIAL
FLIGHT SYSTEMS GROUP
PHOENIX, ARIZONA

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PRINTED IN U.S.A.

RELEASE DATE: 24 FEB 1989

COPY NO. _____

FCC TYPE ACCEPTANCE

MODE S TRANSPONDER

5140-0645 REV -

APPROVALS

Issue

Date

Approved By

Original

2/24/89

D. G. Evans

D. G. Evans, Department Manager

RECORD OF REVISIONS

<u>Rev Level</u>	<u>Paragraph</u>	<u>Page No.</u>	<u>Description</u>
-			Initial issue.

1.0 INTRODUCTION

1.1 SCOPE

This report consists of data establishing the conformance of the Honeywell, Inc. Mode S Transponder, Model 4061400-901, to the requirements established by the Federal Communications Commission in its rules and regulations (as referenced in Section 2 of this document).

1.2 CERTIFICATION

The Mode S Transponder as described herein has been shown to have completely met the cited requirements.



David A Zinder, PE

Test Engineer Certification

David A. Zinder

BSEE University of Arizona, 1958

11 years experience in military and commercial avionics

Holder of First Class Radiotelephone Operator License (now General Class) since 1953.

2.0 REFERENCED DOCUMENTS

2.1 Federal Communications Commission

Latest Rules and Regulations
Issue Volume II, Part 2, Subpart J
Volume V, Part 87, Subpart A

2.2 Radio Technical Commission on Aeronautics (RTCA)

D0-160 Environmental Conditions and Test Procedures for
Rev. B Airborne Equipment
July 1984

D0-181 Minimum Operational Performance Standards for
Change 2 Air Traffic Control Radar Beacon System/ Mode Select
Dec 1985 (ATCRBS/Mode S) Airborne Equipment

2.3 Honeywell, Inc. (These documents are attached to this report.)

4061400-901 TRANSPONDER SET, MODE S
REV B
21 DEC 88
C/O 13443
23 FEB 89

4061401 OUTLINE AND INSTALLATION OF
REV A TRANSPONDER, MODE S
9 NOV 88

4061948 PLATE, IDENTIFICATION - BLANK FORM (REF -3,-4)
REV B
12 SEP 88

4065516 PLATE, IDENTIFICATION - NOMENCLATURE (REF -314,-315)
REV E
4 FEB 89

7514150 RECEIVER I/O ASSY
REV A (A4)
13 SEP 88

7514153 TRANSMITTER ASSY
REV A (A5)
23 SEP 88

7514172 SCHEMATIC DIAGRAM
REV - MODE "S" RECEIVER
19 JUL 88

7514173 SCHEMATIC DIAGRAM
REV - MODE "S" TRANSMITTER
19 JUL 88

5141-0647 Operation Manual and Equipment Limitations
REV - for the Mode S Transponder
2 FEB 84

34-44-00 Mode S System Description and Installation Manual
REV 0
15 JAN 89

3.0 GENERAL REQUIREMENTS

3.1 Type Designation. The equipment has been designated by Honeywell, Inc., Sperry Commercial Flight Systems Group as Mode S Transponder, 4061400-901.

3.2 Service and Rule for Intended Operation. Air Traffic Control, Part 87, Subpart A.

3.3 Description of Equipment.

3.3.1 Type of Emission: 18MOP1D

3.3.2 Frequency Range: 1090 \pm 1 MHz

3.3.3 Power Rating: 125 to 500 watts peak pulse power at the antenna

3.3.4 Final Power Amplifier: Solid State Balanced Amplifier (Class C) using two MSC 81600M silicon bipolar transistors.

3.3.5 Active Device Functions:

<u>Function</u>	<u>Device Type</u>	<u>Manufacturer</u>
Oscillator		
SAW Resonator	RP-1063	RF Monolithics
Low Noise Transistor	HXTR-3615	Hewlett Packard
Linear Power Amplifier	HXTR-3102	Hewlett Packard
PNP Transistor	2N2907	Generic
Transmitter		
Microwave Pulse Power Transistor--Amplifier, 1 watt	MRF1000MB (2 ea)	Motorola
Microwave Pulse Power Transistor--Amplifier, 4 watt	MRF1004MB	Motorola
Microwave Pulse Power Transistor--Amplifier, 35 watt	MRF1035MB	Motorola
Microwave Pulse Power Transistor--Amplifier, 220 watt	0912-200	Microwave Semiconductor

Microwave Pulse Power Transistor--Amplifier, 81600M (2 ea) 800 watt		Microwave Semiconductor
Modulator N Channel FET Modulator	IRFF110	Generic
NPN Transistor Modulator Driver	2N3019	Generic
PNP Transistor Modulator Driver	2N2907	Generic
Transmit Enable NPN Transistor Bracket Modulator	2N2222	Generic
PNP Transistor Bracket Modulator	2N2907	Generic

3.3.6 Circuit Diagram. See attached drawings.

3.3.7 Instruction Book. The total instruction package is contained in two documents attached to this report. The document names are self explanatory:

Honeywell Document Number	Title
5141-0647	Operation Manual and Equipment Limitations for the Mode S Transponder
34-44-00	Mode S System Description and Installation Manual

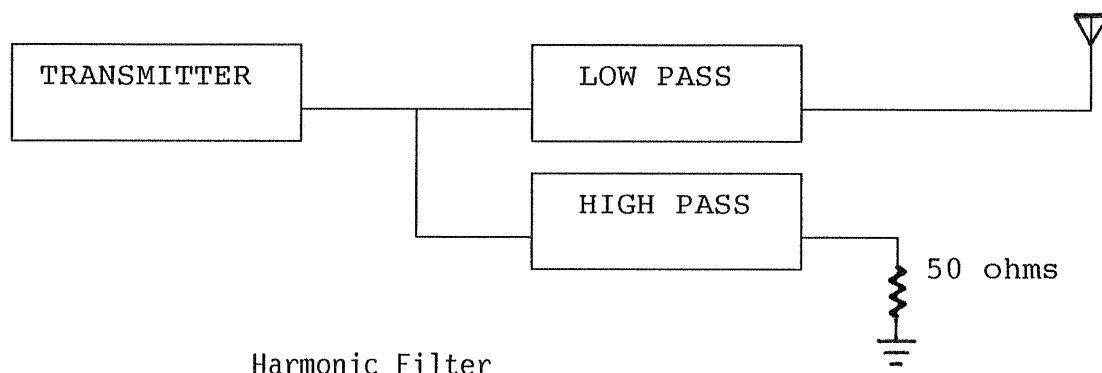
3.3.8 Tune-up Procedure. No field tuning is required. The transmit frequency can be varied ± 500 kHz in a laboratory environment by adjusting C3 or moving the attachment point of C2 in the receiver module. See drawing 7514172, sheet 7.

3.3.9 Oscillator Circuit. The oscillator consists of a bipolar transistor with collector to base feedback stabilized by a SAW resonator. Bias is supplied by an active bias network. Isolation and load stabilization is provided by a 10dB attenuator on the output followed by a buffer amplifier.

3.3.10 Frequency Stabilization. SAW resonator controlled.

3.3.11 Modulation Limiting. Not Applicable.

3.3.12 Radiated Interference Suppression. Low pass/ high pass filter consisting of microstrip printed circuit elements (see drawing below).



The filter provides essentially zero attenuation at the transmitted frequency (1090 MHz) and maximum attenuation of the second and third harmonics. The lowpass section is a five pole combline filter with a cutoff at approximately 1800 MHz. The high pass element is also a five pole combline filter with the same cutoff frequency.

The high pass section provides a termination for the higher order harmonics which will be reflected back and forth from the transmitter output to the low pass filter. To prevent the high pass filter from loading the transmitter output, the filter impedance at 1090 MHz is matched by a microstrip transformer to appear as an open circuit at that frequency.

3.3.13 Modulation Details.

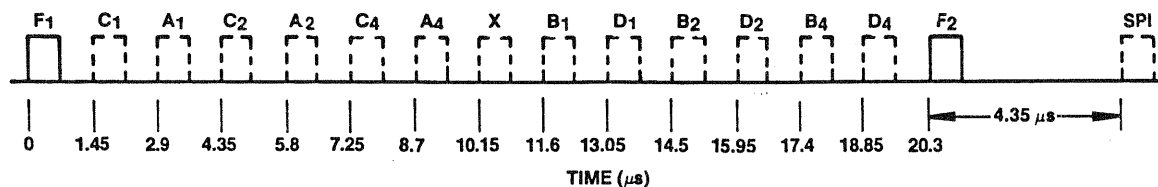
3.3.13.1 ATCRBS Replies. The details of the replies to ATCRBS interrogations are shown in the figure below. The F1 and F2 pulses will appear in all transmissions. Any or all of the data pulses may be contained in a reply transmission.

Pulse Widths: 0.45 ± 0.1 usec.

Rise Times (10% to 90%): ≤ 0.1 usec.

Fall Times (90% to 10%): ≤ 0.2 usec.

Spacing: 1.45 usec., tolerance ± 0.1 usec relative to F1.



3.3.13.2 Mode S Replies. Details of the replies to Mode S interrogations are shown in the figure below. The preamble will appear the same in all replies. The data block will be either 56 or 112 microseconds long depending upon the type of reply requested. As can be seen from the diagram, successive bits of like types will result in pulses of 0.5 usec.; alternating bits will result in pulses of 1.0 usec.

Pulse Widths: 0.5 ± 0.05 usec. or 1.0 ± 0.05 usec.

Rise Times (10% to 90%): ≤ 0.1 usec.

Fall Times (90% to 10%): ≤ 0.2 usec.

