

ENGINEERING SPECIFICATION		SECURITY NOTATION		SPEC NO. EB7519386		— REV LTR
				CAGE CODE 55939		
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DOCUMENT TYPE ENGINEERING BULLETIN				CLASS A		INITIAL RELEASE DATE
DIVISION BCAS	DEPARTMENT NO. 450472	PRODUCT LINE NO. 5111	CONTRACT NO.			
TITLE FCC CERTIFICATION REPORT FOR THE HONEYWELL, INTL MINI-M SATCOM SYSTEM SCS-1000						
PREPARED BY: J. Reyes`		DATE 10 Sept 01	APPROVED BY TECHNICAL MANAGER C. Shore		DATE 10 Sept 01	APPROVED BY ENGINEERING DEPARTMENT MANAGER
APPROVED FOR SCM		DATE	APPROVED FOR SQA		DATE	APPROVED BY: DATE
REF AWAEB/PSAEB NO. XXXXXXXX	CHECKER	PRODUCT DESIGN CHECKER (FOR REF, SPCL CONT PER EPM 1-A-40)			COGNIZANCE OF QE SUPVR (FOR REF, SPCL CONT PER EPM 1-A-40)	
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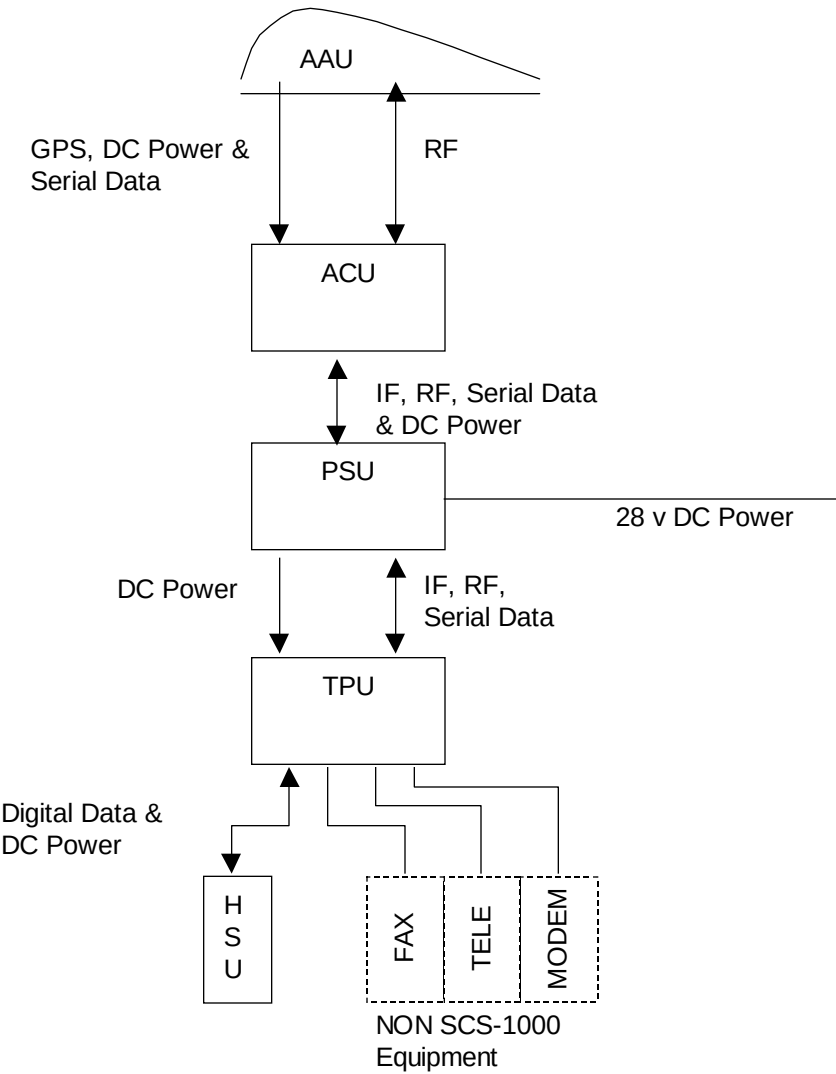
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REV LTR	TITLE: FCC CERTIFICATION REPORT FOR THE HONEYWELL MINI-M SATCOM SYSTEM SCS-1000 1. INTRODUCTION This report consists of technical and other related information to support FCC certification of the Honeywell SCS-1000 system. This document has been prepared in accordance with 47 CFR 2.1033(c). 1.1 System Description The SCS-1000 system described herein is an avionics communication system that provides single channel voice, fax, and PC data communication services to and from the aircraft as defined in the INMARSAT Mini-M Aero System Description Manual. The SCS-1000 system interfaces with the aircraft 28 VDC power bus and communicates with the INMARSAT satellite constellation via L-band RF signals which emanate from the SCS-1000 antenna unit. These satellites convey the information to and from ground stations that interface with the terrestrial public-switched telephone network (PSTN). The SCS-1000 system consists of 5 sub-components: the Aero Antenna Unit (AAU), the Antenna Control Unit (ACU), the Power Supply Unit (PSU), the Telephone Unit (TPU), and the Handset Unit (HSU). The functions of encoding/decoding, modulation/demodulation, position determination, power distribution, antenna position computations, communications protocol, and user interface are distributed among the ACU, PSU, TPU, and HSU. See section 4.1 for the part numbers of the above listed units. The AAU contains a 2 axis mechanically steered antenna for tracking a geo-stationary satellite from a moving base. The gimballed antenna transmits and receives signals in the 1.6 GHz band. In addition to the mechanically steered antenna, the AAU also contains a GPS antenna, angular sensors and electronics for processing the inputs from the ACU for antenna positioning. The AAU also contains a micro-controller which is used to read the sensors, communicate this sensor data serially to the ACU, process the serial inputs from the ACU, and translate the serial input data into motor commands to drive the antenna to the correct orientation. The ACU serves as an interface module between the AAU and the TPU. It is comprised of an RF Board, an Antenna Tracking Board, a BPS Engine, and a Diplexer/LNA. The function of the RF Board is to amplify the received and transmitted signals, mix down the received signal, set the transmitted power and perform serial communications with the TPU. The Antenna Tracking Board performs serial communications with the TPU, the GPS Engine, and with the AAU. Additionally, it performs 5 VDC voltage regulation, superimposes DC voltage onto the GPS line, executes the tracking algorithm, and stores aircraft calibration data. The GPS Engine takes in the GPS data from the Antenna Tracking board and computes aircraft position and velocity. The Diplexer/LNA amplifies the Received L-band signal and combines the received and transmitted signal. The voltage source for the PSU is the 28 VDC supply from the aircraft. From this DC source the PSU supplies regulated 16 VDC to the TPU and 27.5 VDC to the ACU. In addition to providing a regulated voltage source, the PSU acts as a conduit for the RF signal between the TPU and the ACU. The PSU monitors the DC voltage from the TPU which is superimposed onto the RF signal. This DC component is removed and replaced with 27.5 VDC which serves as the voltage			
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REV LTR	source for the ACU. When the DC voltage from the TPU drops below 7 VDC the 27.5 VDC to the ACU is turned off. The TPU serves as the interface between the various user devices (i.e. handset, PC and FAX machine) and the network. The TPU is responsible for handling the communication protocol, frequency adjustment resulting from doppler shift and channel changes, the encoding and decoding of voice, fax, and PC data, and generating the RF signal for transmission. The interface with the PC is through a standard RS232 port, while the phone and fax use a standard RJ11 jack. The HSU interface is via a RJ45 jack. The HSU interfaces with the TPU providing not only a telephone handset but also a display screen. The display screen allows the system to request information from the user such as PINs, display the state of the system, and generally allows the user to capitalize on the complete suite of functions the system supports. The HSU also has a keypad which allows the user to enter PINs and dial phone numbers, select functions, turn off and on the speaker phone function, and an OFF/ON key which switches the system off and on. Figure 1 shows a block diagram for the SCS-1000.					
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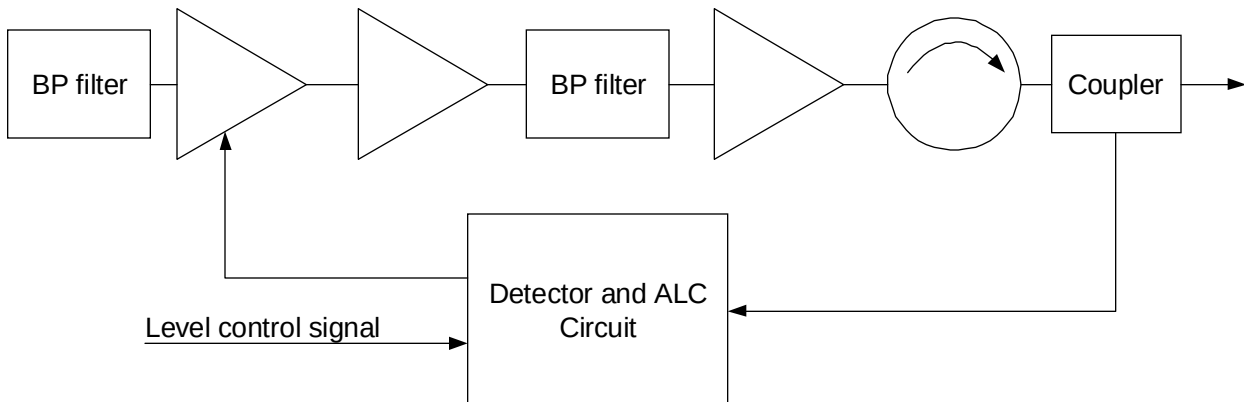
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REV LTR	Figure 1: SCS-1000 Block Diagram					
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	LIST OF ACRONYMS AND ABBREVIATIONS A/D AGC BW CCA CCS CF CFM D/A DTMF FL GES IF LO LNA LRU TCXO PLO VHF Analog to Digital Converter Automatic Gain Control Bandwidth Circuit Card Assembly Cabin Communication System Center Frequency Channel Filter Module Digital to Analog Converter Dual Tone Multi-Frequency Filter Ground Earth Station Intermediate Frequency Local Oscillator Low Noise Amplifier Line Replacement Unit Temperature Compensated Crystal Oscillator Phase Locked Oscillator Very High Frequency					
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2. REFERENCES AND ATTACHMENTS 2.1 <u>References</u> Code of Federal Regulations, Title 47 Part 2, Subpart J Part 87, Subpart D 2.2 <u>Attachments</u> 2.2.1 SCS-1000 Testing Results Verification of Transmitter Model: Mini-M SATCOM SYSTEM SCS-1000 to FCC Part 2 dated 20 December 1999. 2.2.2 System Description and Installation Manual A15-5111-002 2.2.3 SCS-1000 Components Assembly Drawings 7519371-901 Antenna Assembly, Mini-M Aero – AU-100/Parts List 7519373-901 Antenna Control Unit Assembly, Mini-M Aero – AC-100/Parts List 7519375-901 Power Supply Unit Assembly – Mini-M Aero – PS-100/Parts List 7519377-901 Telephone Unit Assembly, Mini-M Aero – TP-100/Parts List 7519379-901 Handset Unit Assembly, Mini-M Aero – HS-100/Parts List 2.2.4 Equipment Identification Plate Drawing 7500050, Rev AD Plate, Identification 7519382, Rev B Plate, Identification – PMA-FAA-PMA							
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	3. TEST CERTIFICATION I do hereby certify that to the best of my knowledge the technical test data contained in this report are true and correct and that the SCS-1000 has been shown to have completely met the cited requirements. SIGNED: _____ J. Reyes Test Engineer Certification J. Reyes MSEE Arizona State University, 1999 10 Years Experience in Commercial Avionics					
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<table><tr><td>Unit</td><td>Unit Nomenclature</td><td>Unit Part Number</td></tr><tr><td>Aero Antenna Unit</td><td>AU-100</td><td>7519371-901</td></tr><tr><td>Antenna Control Unit</td><td>AC-100</td><td>7519373-901</td></tr><tr><td>Power Supply Unit</td><td>PS-100</td><td>7519375-901</td></tr><tr><td>Telephone Unit</td><td>TP-100</td><td>7519377-901</td></tr><tr><td>Handset Unit</td><td>HS-100</td><td>7519379-901</td></tr></table>							Unit	Unit Nomenclature	Unit Part Number	Aero Antenna Unit	AU-100	7519371-901	Antenna Control Unit	AC-100	7519373-901	Power Supply Unit	PS-100	7519375-901	Telephone Unit	TP-100	7519377-901	Handset Unit	HS-100	7519379-901
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Handset Unit	HS-100	7519379-901																						
4.2 <u>Mailing Address</u>																								
The mailing address for Honeywell, Intl the applicant, is as follows: Honeywell, Intl. 5353 W. Bell Road Glendale, AZ 85308																								
4.3 <u>FCC Identifier</u>																								
In accordance with 47 CFR 2.926(c)(1), Honeywell recommends the FCC Identifier for the SCS-1000 be GB8SCS-1000.																								
4.4 <u>Service and Rule for Intended Operation</u>																								
Aeronautical Mobile Satellite Service Part 87, Subpart A.																								
4.5 <u>Description of Equipment</u>																								
4.5.1 Type of Emission																								
The SCS-1000 uses two types of modulation types O-QPSK and BPSK. The emission designators for these modulation types are as follows: O-QPSK: 7K68G1W BPSK: 20K0G1W																								
4.5.2 Frequency Range [MHz]																								
1626.5 to 1660.5																								
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4.5.3 Power Rating 4.1 Watts Maximum 4.5.4 DC Voltages The dc voltage which is applied to the Antenna Control Unit which represents the final amplifying device is 27.5 Vdc with a maximum current draw of 1.1 Amp. 4.5.5 Range of Operating Power The maximum output from the Power Amplifier is 6.1dBW. The output power level can be stepped down by 6dB in 2dB steps. 4.5.6 Tune-Up Procedures Each RF power amplifier will be tested and tuned-up according to the test instruction. A part of the test procedure is to trim and verify the correct output level at mid channel at the highest output level, then verify the correct levels over the frequency band, by testing output power at lowest and highest channel. The final test is to verify that the output power is correct at the different back off levels. The power amplifier is designed with an output power control loop to ensure the correct output power over the frequency range, temperature changes and input voltage changes.  Figure 2: Power Control Block Diagram					
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REV LTR	4.5.7 Transmission Frequency Circuit Diagram and Description 4.5.7.1 Circuit Diagrams The circuitry which determines and stabilizes the transmission frequency is contained in the TPU and the ACU. In the circuitry inside the ACU which assists in this function is the RF Board (RFB). The schematic diagrams for this circuitry will be provided by OmniPless due to their containing proprietary information. The electronic files which contain these schematic diagrams are listed below: TPU Schematic File Name: 1911_QROF2199232_E_P2-3.pdf RFB Schematic File Name: 1911_QROF2199188_H_P6-7.pdf 4.5.7.2 Circuit Diagram Descriptions The output frequency is generated by a phase locked loop with a TCXO (Temperature Compensated Crystal Oscillator) reference. The TX frequency stability and tolerance will be determined by the quality of the TCXO. The chosen TCXO has +/- 2.5 ppm tolerance over temperature range -25 to +70 °C. Low aging specification is selected for the TCXO. During a call the terminal will be synchronized to the LES (Land Earth Station) frequency reference by means of fine adjustment of the output frequency from the synthesizer. Due to the nature of the fractional synthesizer realized with sigma / delta high order modulator, sub hertz frequency raster is obtained together with the possibility to do direct modulation to gain high quality offset QPSK modulation. The very high phase comparator frequency in this system (MHz range), low reference spurious is obtained together with very rapid frequency change in agile systems. Randomization of the fractional part in the divide by N in the PLL has the effect of spreading the noise far beyond the loop filter cut off frequency thus effectively attenuating the spurious to very low values. Out of band noise and spurious radiation is suppressed by several band pass filters in the transmitter chain. Output power is limited and controlled as described under Section 4.5.6		
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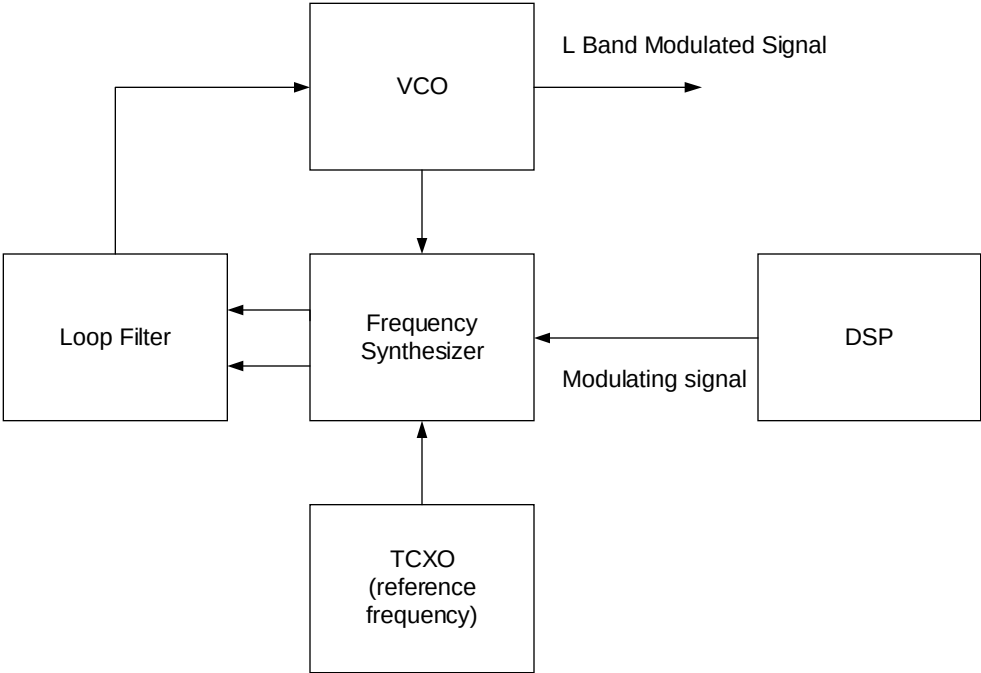


Figure 3: Modulating Block Diagram

4.5.8 Modulation Method and Description

The satellite terminal use O-QPSK modulation under maximum rated condition. The impulse response of the pulse shaping filter is shown in Figure 4. Transmitted power due to modulation is shown in Figure 5. The DSP (Digital Signal Processor) programs the frequency synthesizer directly with the modulating signal.

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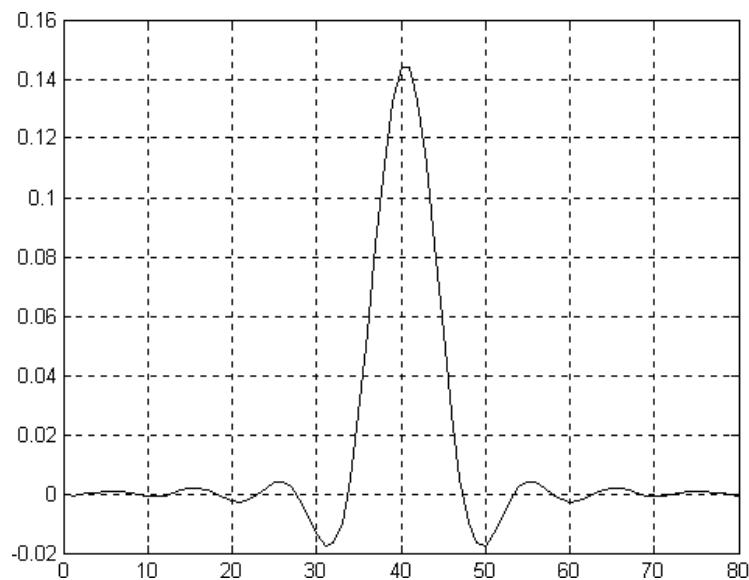
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Figure 4: Impulse response of the 2.8ks/s O-QPSK pulse shaping filter, over sampling = 8, Filter-length 10 = symbols')

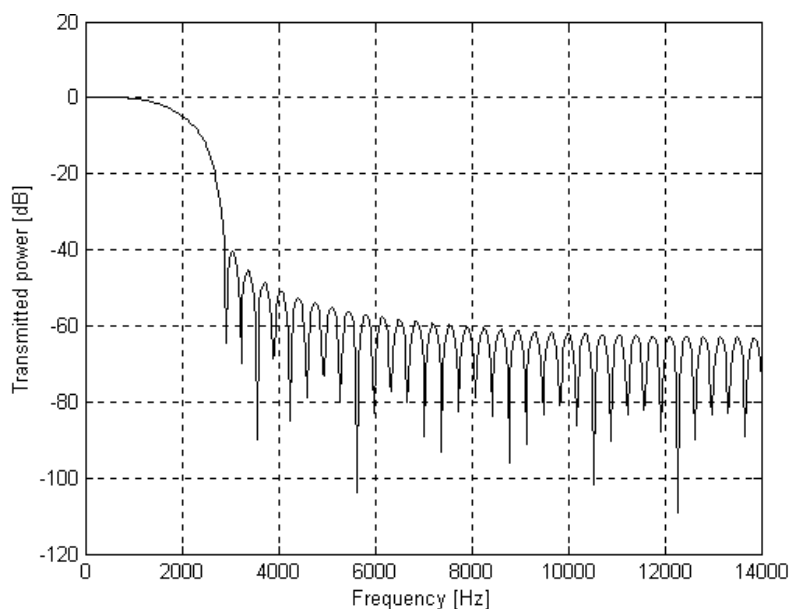


Figure 5: Transmitted power as a function of frequency for the O-QPSK channel.

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The transmit frequency spectrum on air with O-QPSK modulation, is within the frequency mask defined by: <table><tr><td>Frequency [kHz]</td><td>Relative Spectral Density [dB]</td></tr><tr><td>1.7</td><td>+1</td></tr><tr><td>2.3</td><td>-12</td></tr><tr><td>3.5</td><td>-22</td></tr><tr><td>4.7</td><td>-22</td></tr><tr><td>8.2</td><td>-40</td></tr><tr><td>11.7</td><td>-50</td></tr><tr><td>100</td><td>-60</td></tr></table> The Mini-M satellite terminal is designed and tested to fulfil the EN301444 v1.1.1 (TBR 44) according to in- and out-off band emission with transmitter on and off. 5. IDENTIFICATION PLATE DRAWING The identification plates which will be used on the SCS-1000 are contained in the attached drawing, 7500050 and 7519382. The part numbers of the identification plates used are shown in the table below. <table><tr><td>Unit</td><td>Part Number</td><td>Identification Plate Dash Number</td></tr><tr><td>AU-100</td><td>7519371-901</td><td>7500050-14</td></tr><tr><td>AC-100</td><td>7519373-901</td><td>7500050-15</td></tr><tr><td>PS-100</td><td>7519375-901</td><td>7500050-16</td></tr><tr><td>TP-100</td><td>7519377-901</td><td>7500050-17</td></tr><tr><td>HS-100</td><td>7519379-901</td><td>7519382</td></tr></table> The location of these labels on the SCS-1000 units are shown in the assembly drawings called out in section 2.2.3.					Frequency [kHz]	Relative Spectral Density [dB]	1.7	+1	2.3	-12	3.5	-22	4.7	-22	8.2	-40	11.7	-50	100	-60	Unit	Part Number	Identification Plate Dash Number	AU-100	7519371-901	7500050-14	AC-100	7519373-901	7500050-15	PS-100	7519375-901	7500050-16	TP-100	7519377-901	7500050-17	HS-100	7519379-901	7519382
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6. PHOTOGRAPHS

6.1 Telephone Unit (TPU) Photographs



Figure 6: TPU Assembly

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Figure 7: Bottom View of TPU Circuitry.



Figure 8: Top View of TPU Circuitry

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6.2 Antenna Control Unit (ACU) Photographs



Figure 9: ACU Assembly



Figure 10: ACU Assembly with DLNA

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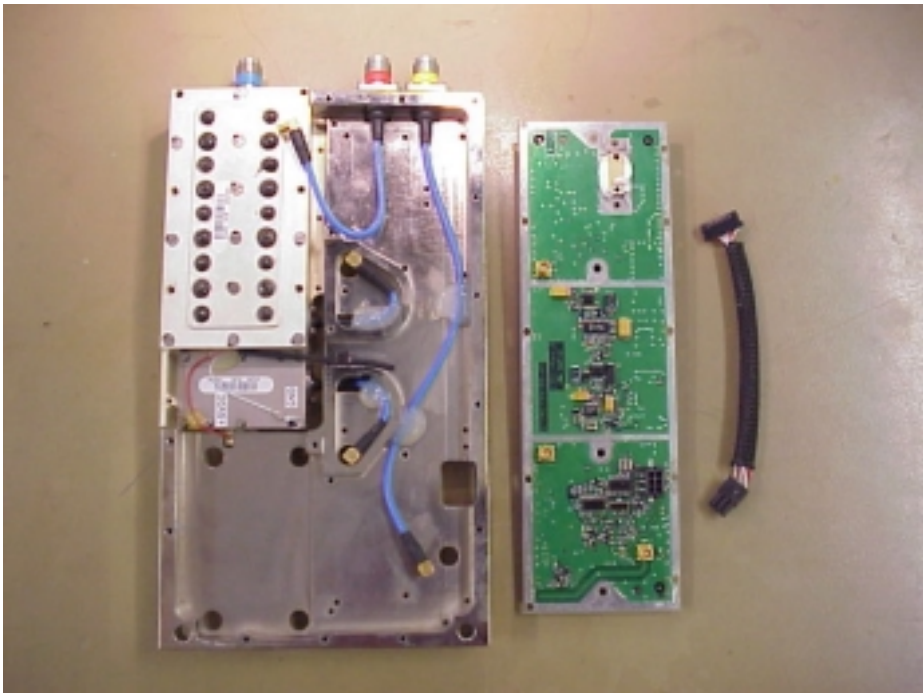


Figure 11: Underside of ACU

7. CERTIFICATION TEST RESULTS

The testing required for certification was performed by M. Flom Associates, Inc. – Global Compliance Center located in Chandler, AZ. The report provided is attached.

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