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TITLE

FCC CERTIFICATION REPORT FOR THE HONEYWELL, INTL MINI-M SATCOM SYSTEM SCS-1000

PREPARED BY:	DATE	APPROVED BY TECHNICAL MANAGER	DATE	APPROVED BY ENGINEERING DEPARTMENT MANAGER	DATE
J. Reyes`	10 Sept 01	C. Shore	10 Sept 01		
APPROVED FOR SCM	DATE	APPROVED FOR SQA	DATE	APPROVED BY:	DATE

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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 Anetnna 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 gimbaled 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 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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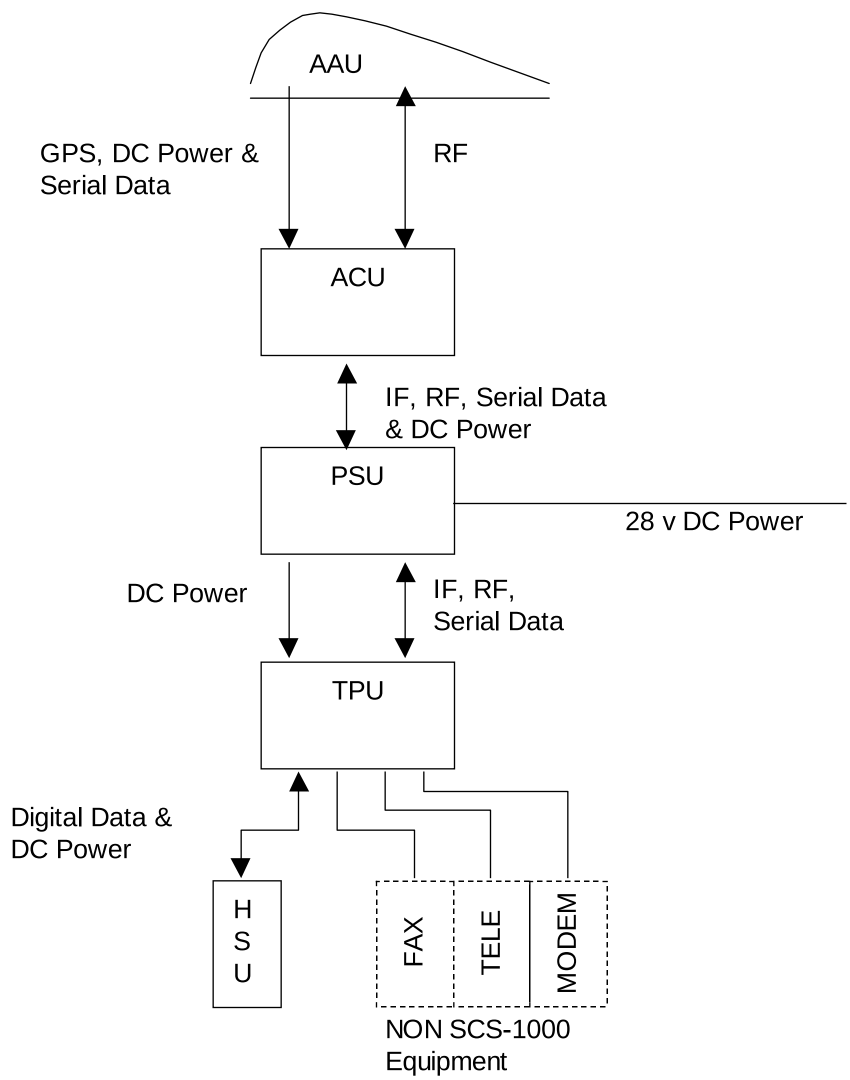

AAU
GPS, DC Power &
Serial Data
RF
ACU
IF, RF, Serial Data
& DC Power
PSU
28 v DC Power
DC Power
IF, RF,
Serial Data
TPU
Digital Data &
DC Power
H S U
FAX
TELE
MODEM
NON SCS-1000
Equipment

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Figure 1: SCS-1000 Block Diagram

LIST OF ACRONYMS AND ABBREVIATIONS

A/D	Analog to Digital Converter
AGC	Automatic Gain Control
BW	Bandwidth
CCA	Circuit Card Assembly
CCS	Cabin Communication System
CF	Center Frequency
CFM	Channel Filter Module
D/A	Digital to Analog Converter
DTMF	Dual Tone Multi-Frequency
FL	Filter
GES	Ground Earth Station
IF	Intermediate Frequency
LO	Local Oscillator
LNA	Low Noise Amplifier
LRU	Line Replacement Unit
TCXO	Temperature Compensated Crystal Oscillator
PLO	Phase Locked Oscillator
VHF	Very High Frequency

2. REFERENCES AND ATTACHMENTS

2.1 References

Code of Federal Regulations, Title 47

Part 2, Subpart J

Part 87, Subpart D

2.2 Attachments

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

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

4. GENERAL INFORMATION

4.1 System Part Numbers

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

4.2 Mailing Address

The mailing address for Honeywell, Intl the applicant, is as follows:

Honeywell, Intl.

5353 W. Bell Road

Glendale, AZ 85308

4.3 FCC Identifier

In accordance with 47 CFR 2.926(c)(1), Honeywell recommends the FCC Identifier for the SCS-1000 be GB8SCS-1000.

4.4 Service and Rule for Intended Operation

Aeronautical Mobile Satellite Service

Part 87, Subpart A.

4.5 Description of Equipment

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

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.

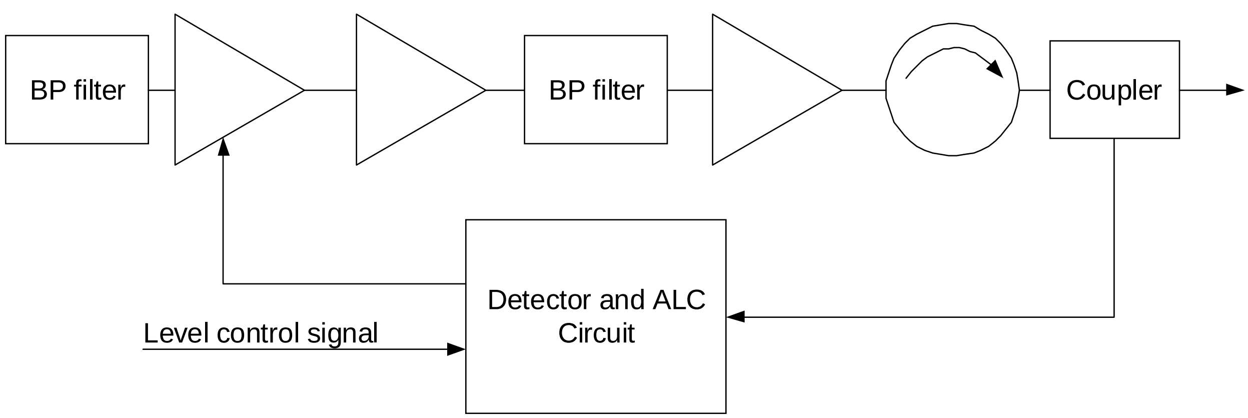

Figure 2: Power Control Block Diagram

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

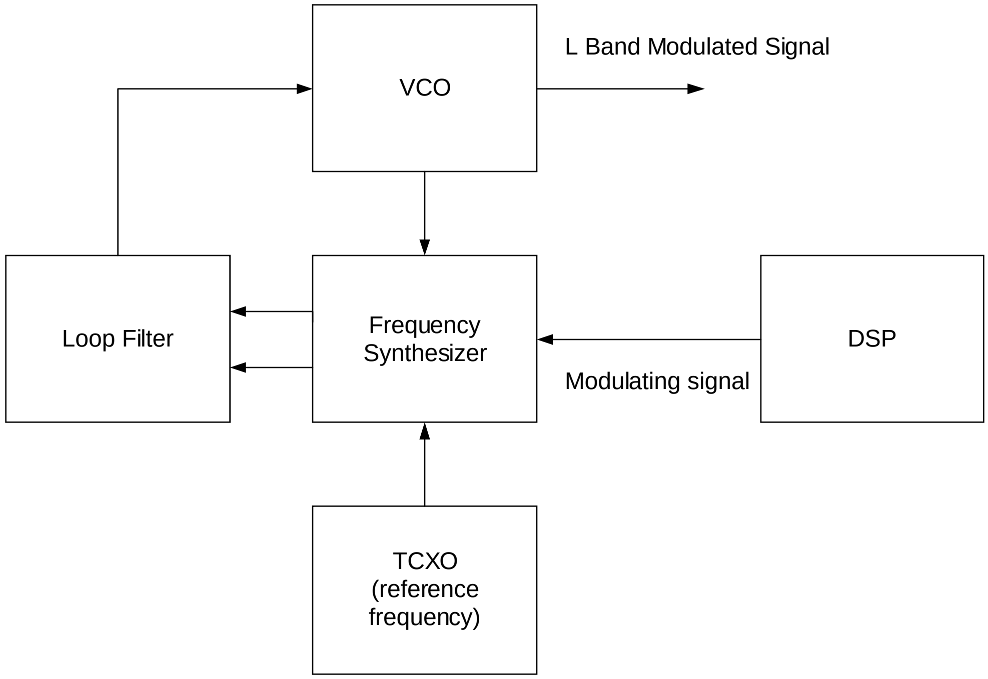

Figure 3: Modulating Block Diagram

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.

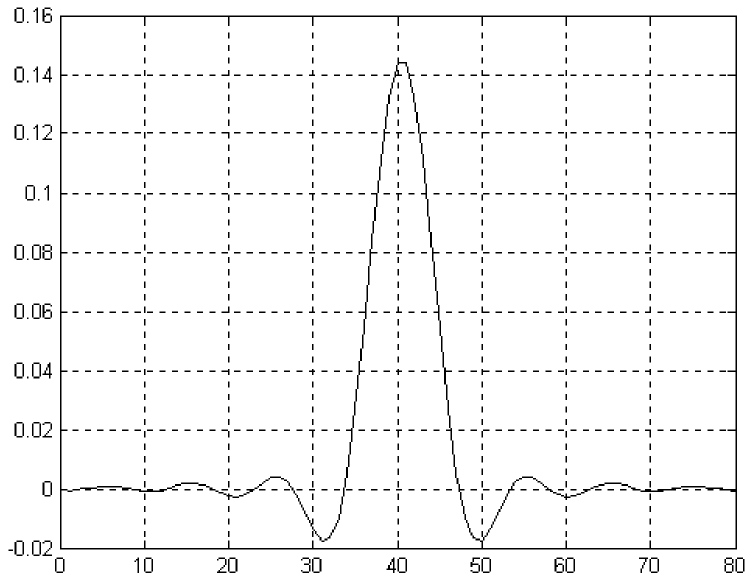

Figure 4: Impulse response of the 2.8ks/s O-QPSK pulse shaping filter, over sampling = 8, Filter-length 10 = symbols')

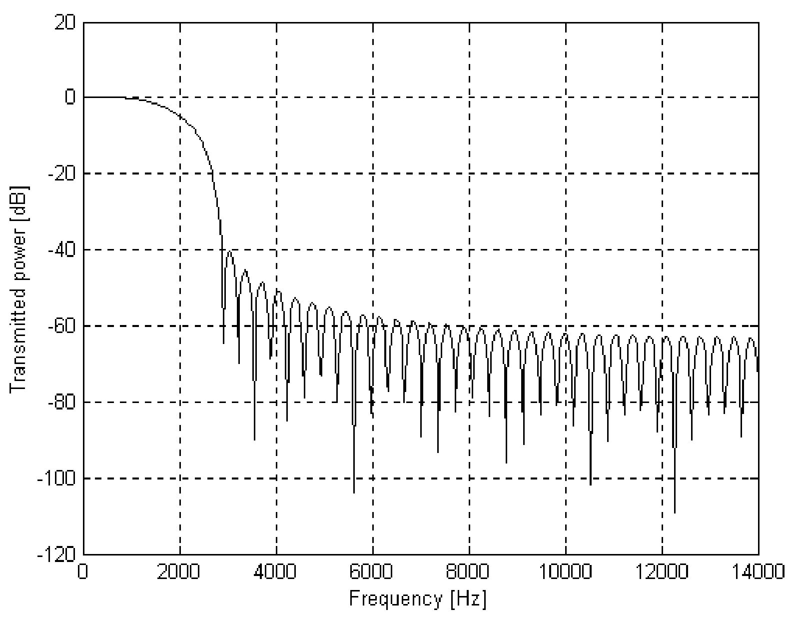

Figure 5: Transmitted power as a function of frequency for the O-QPSK channel.

The transmit frequency spectrum on air with O-QPSK modulation, is within the frequency mask defined by:

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

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.

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

The location of these labels on the SCS-1000 units are shown in the assembly drawings called out in section 2.2.3.

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

6.2 Antenna Control Unit (ACU) Photographs

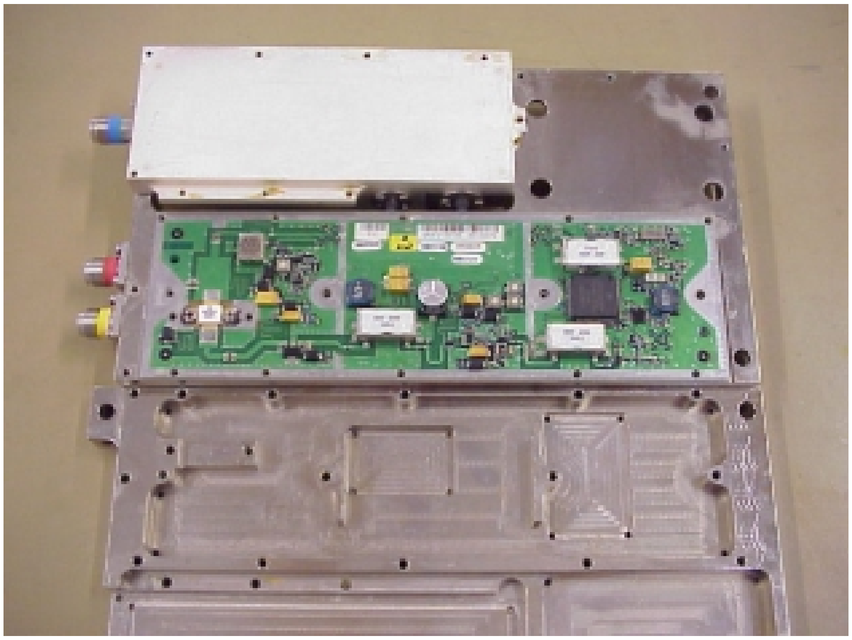

Figure 9: ACU Assembly

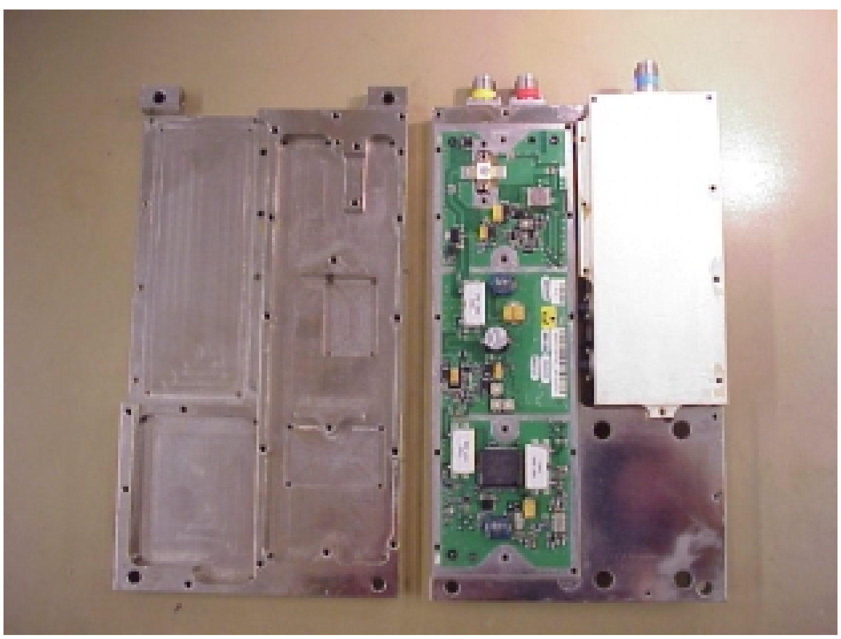

Figure 10: ACU Assembly with DLNA

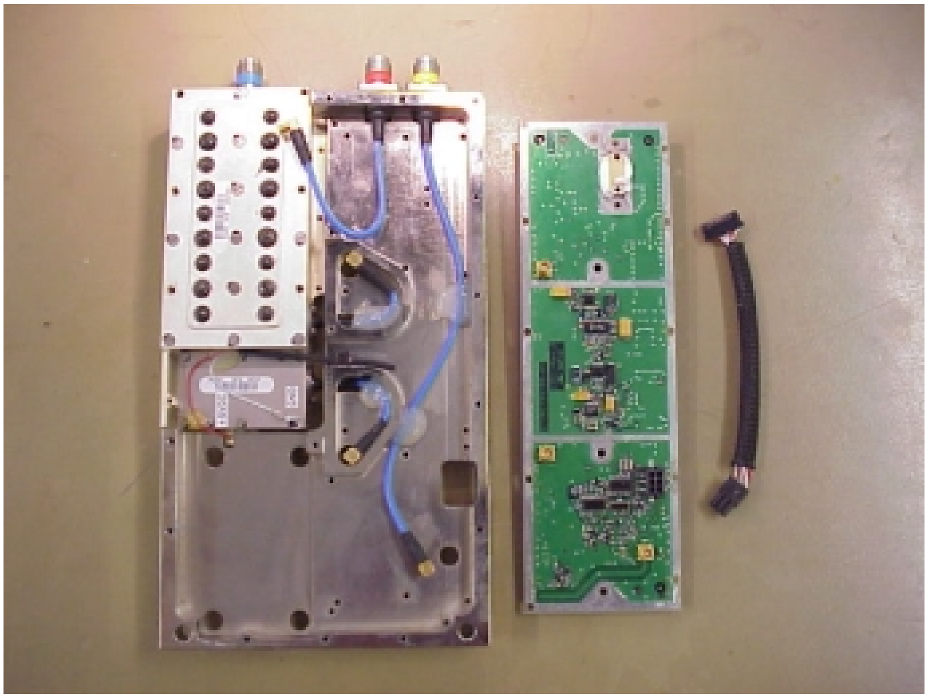

Figure 11: Underside of ACU

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.