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Tests commissioned by Entel UK Limited for FCC approval.

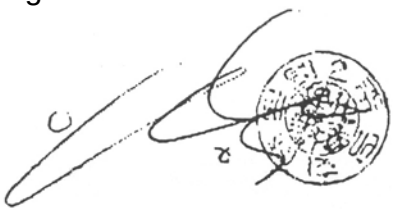
Unit tested: HT640 Serial number 95E200046

Some of the data used in this report has been taken from ETSI test report number HT640/1.3 prepared by Naun Telecom, Seoul, Korea.

Tests carried out according to 47CFR part 80
Stations in the Maritime Services

Tests completed 26th January 2004
Report amended 24th May 2004

Signed:-



SahngBok Yi
Quality Manager

The HT640 is a handheld, 5-watt, VHF, frequency modulated transceiver intended for applications in the 156-163MHz marine band.

General information. (Paragraph 2.1033 of the rules)

1. Applicant: Entel UK Limited

2. Identification of equipment: FCC ID: RV6HT640

   a. The equipment identification label is submitted separately.
   b. Photographs of the equipment are submitted separately.

3. Quantity production is being carried out for the European marked.

4. Technical description:

   a. 16K0G3E emission
      Frequency range 156.000 – 163.275MHz.
   b. Operating power of the transmitter is fixed at the factory at 5 Watts with a 1 Watt low power setting.
   d. Maximum power permitted under part 80 of the FCC Rules is 25 Watts, with capability to reduce, readily, to one Watt maximum. The HT640 meets both of these requirements.
   e. The DC voltage and DC current at the final amplifier:
      Drain voltage: 7.4Vdc
      Drain current: 1.6A
   f. Function of each active semiconductor device:
      See Appendix 1.
   g. Complete circuit diagram:
      See service manual - separate exhibit.
   h. Instruction book is submitted separately.
   i. Transmitter set up procedure:
      See service manual separate exhibit.
   j. A description of circuits for stabilising the frequency is included in appendix 2.
   k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in appendix 3.

5. Data for 2.1047 to 2.1057 follows in this section.

6. The equipment identification label is submitted separately.

7. Photographs of the equipment are submitted separately.

8. RF output power (paragraph 2.1046 (a) of the rules)
The RF power output was measured with an Agilent 8929A radio communications test set. A power output of 5.0 Watts (high power) and 0.95 Watts (low power) was measured on channel 16 at an ambient temperature of 25°C with a supply voltage of 7.4 Volts.

The power is automatically reduced to the low setting on channels 15 and 17, channel 70 being receive only.

C. Modulation characteristics

1. A curve showing frequency response of the transmitter is shown in figure 1. The reference was 1KHz audio generated by an Agilent 8929A radio communications test set. Audio output was measured using the audio analyser of a second Agilent 8929A radio communications test set.
2. Modulation limiting curves are shown in figure 2. these were plotted using results obtained from the modulation analyser in an Agilent 8929A radio communications test set. The curves show compliance with paragraphs 2.1047 (b)
3. Figure 3 is a graph of the post-limiter low pass filter which meets the requirements of 80.211(e) in providing a roll-off of 60Logf/3 dB where f is the audio frequency in KHz. The measurements were made using an Agilent 8929A radio communications test set.
4. Occupied Bandwidth
(Paragraphs 2.1049 (c), and 80.211 (f) of the rules)
Figure 4 shows the displayed sideband envelope of the transmitter taken from the display of an Agilent Spectrum analyser model 8594E
Modulation corresponds to conditions of 2.1049 and consisted of 2500Hz to at an input level 16dB greater than that necessary to produce 50% modulation at 3KHz. The frequency of maximum response. Measured modulation under these conditions was 4.2KHz

   The plots are within the limits imposed by part 80 for frequency modulation.

Modulation frequency response.

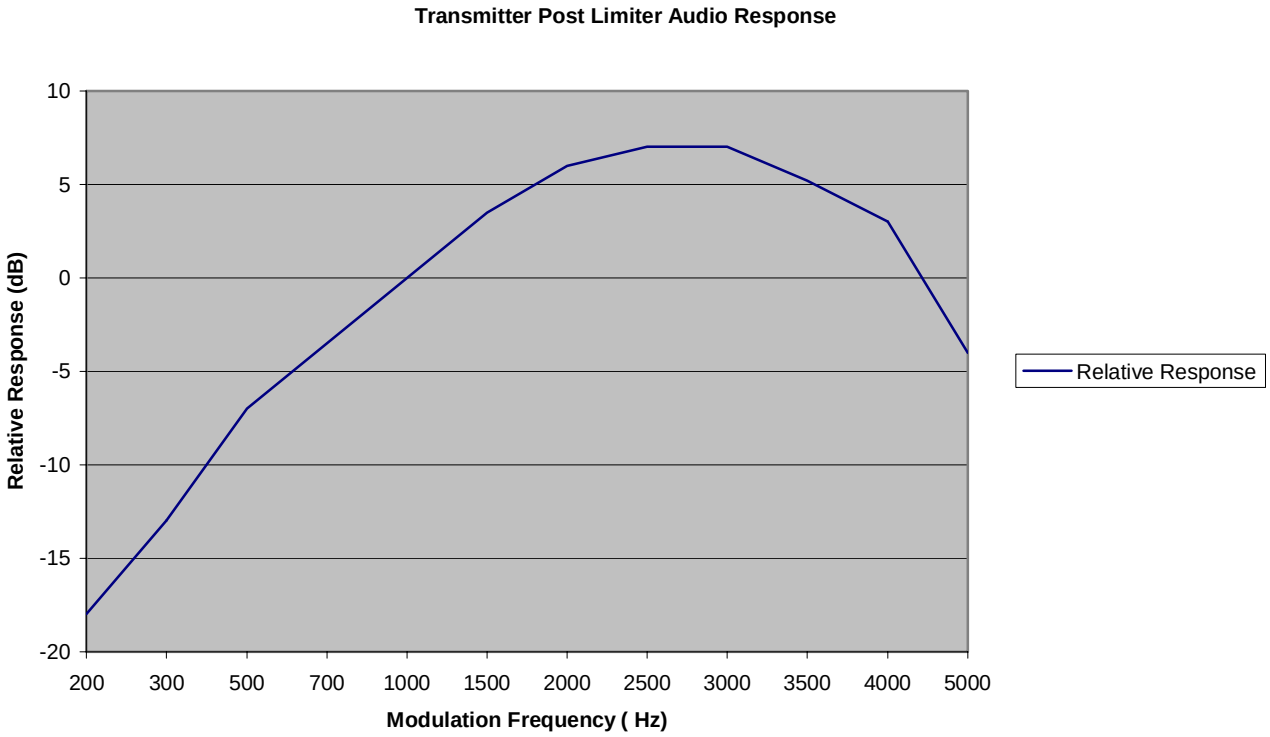
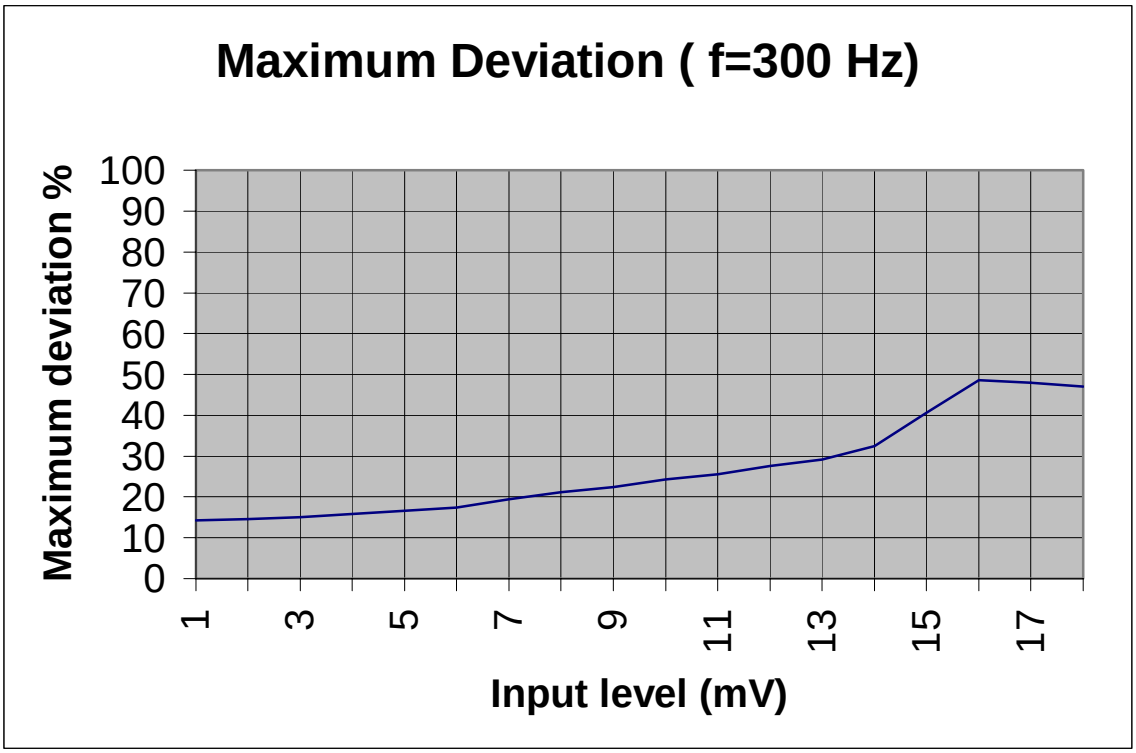


Figure 1

Audio limiter characteristic (300Hz)

Modulation Limiting 300Hz
Test carried out under normal conditions

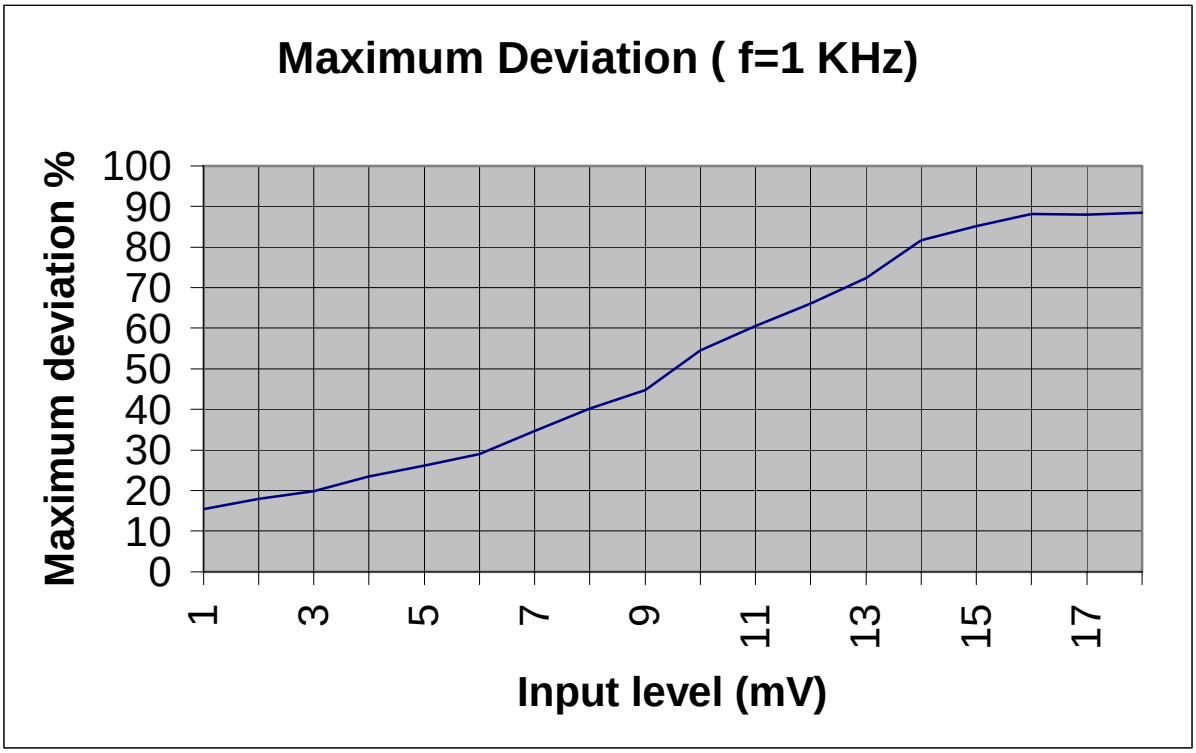


Tests carried out in accordance with 47CFR part 80.213

Figure 2a

Audio limiter characteristic (1000Hz)

Modulation Limiting 1KHz
Test carried out under normal conditions

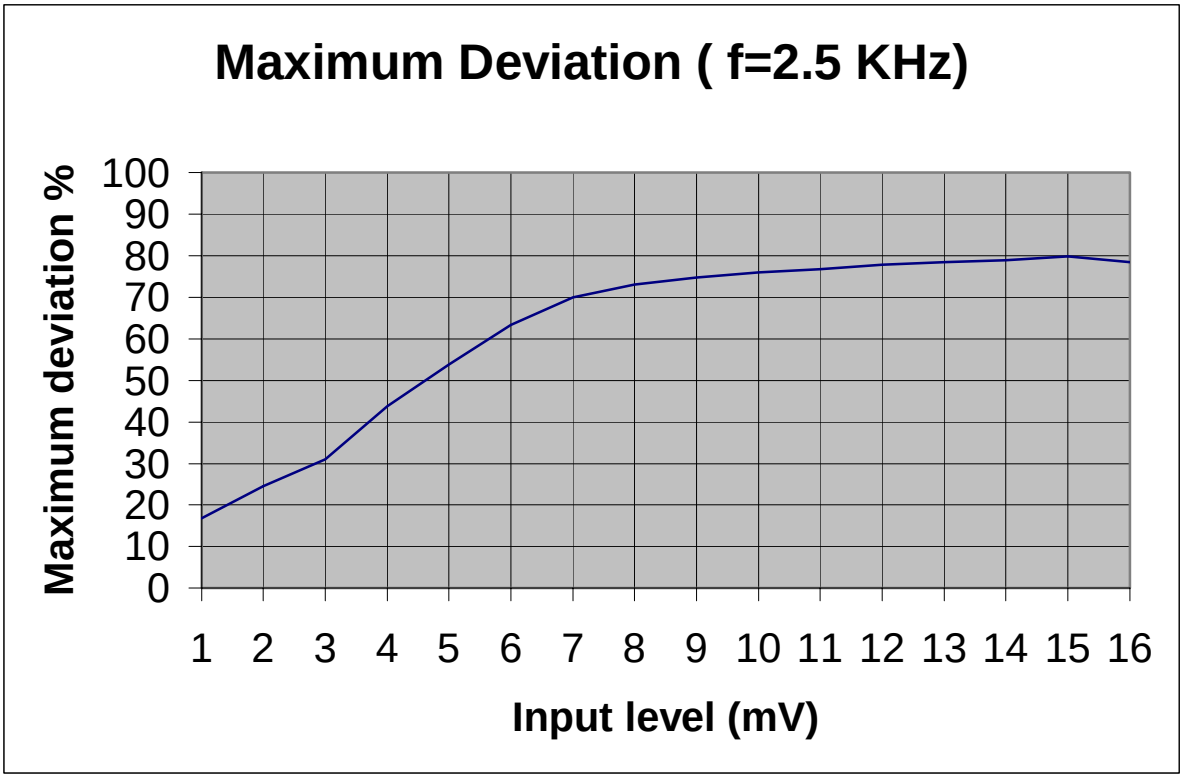


Tests carried out in accordance with 47CFR part 80.213

Figure 2b

Audio limiter characteristic (2500Hz)

Modulation Limiting 2.5KHz
Test carried out under normal conditions

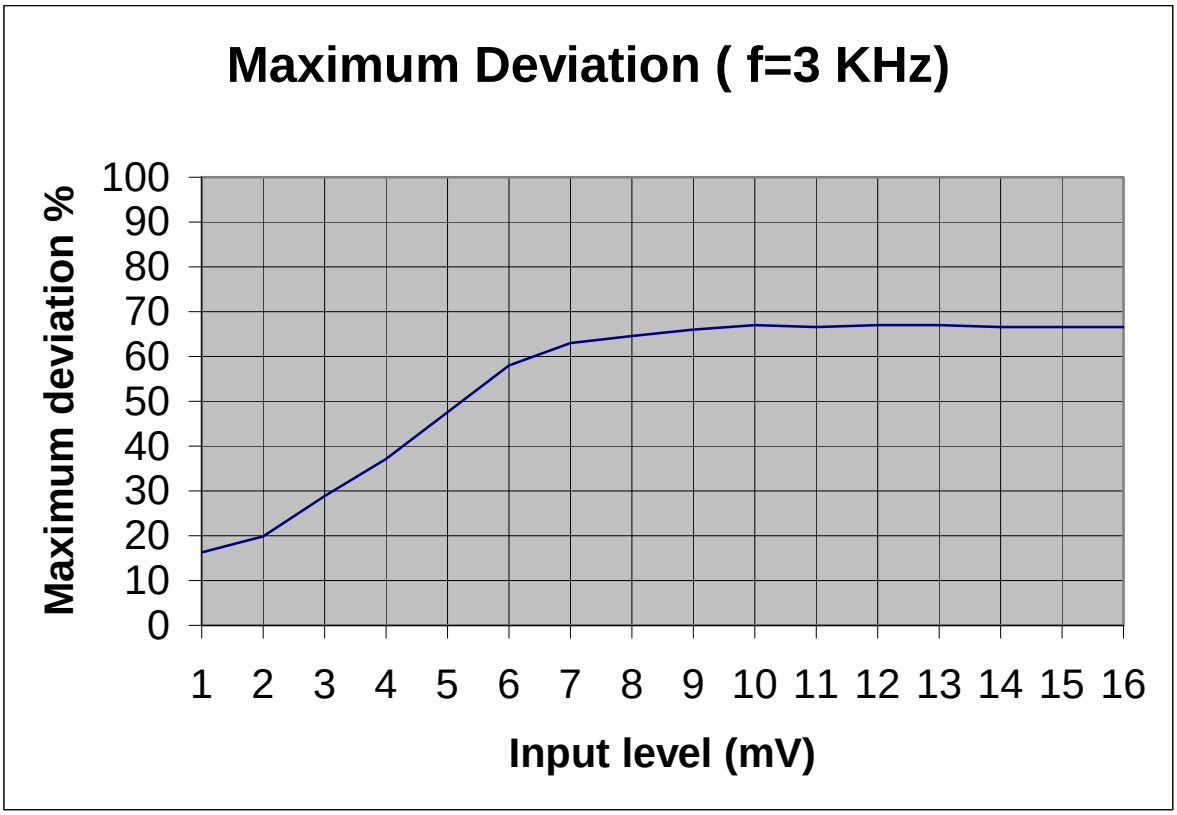


Tests carried out in accordance with 47CFR part 80.213

Figure 2c

Audio limiter characteristic (3000Hz)

Modulation Limiting 3KHz
Test carried out under normal conditions



Tests carried out in accordance with 47CFR part 80.213

Figure 2d

Audio low pass filter response

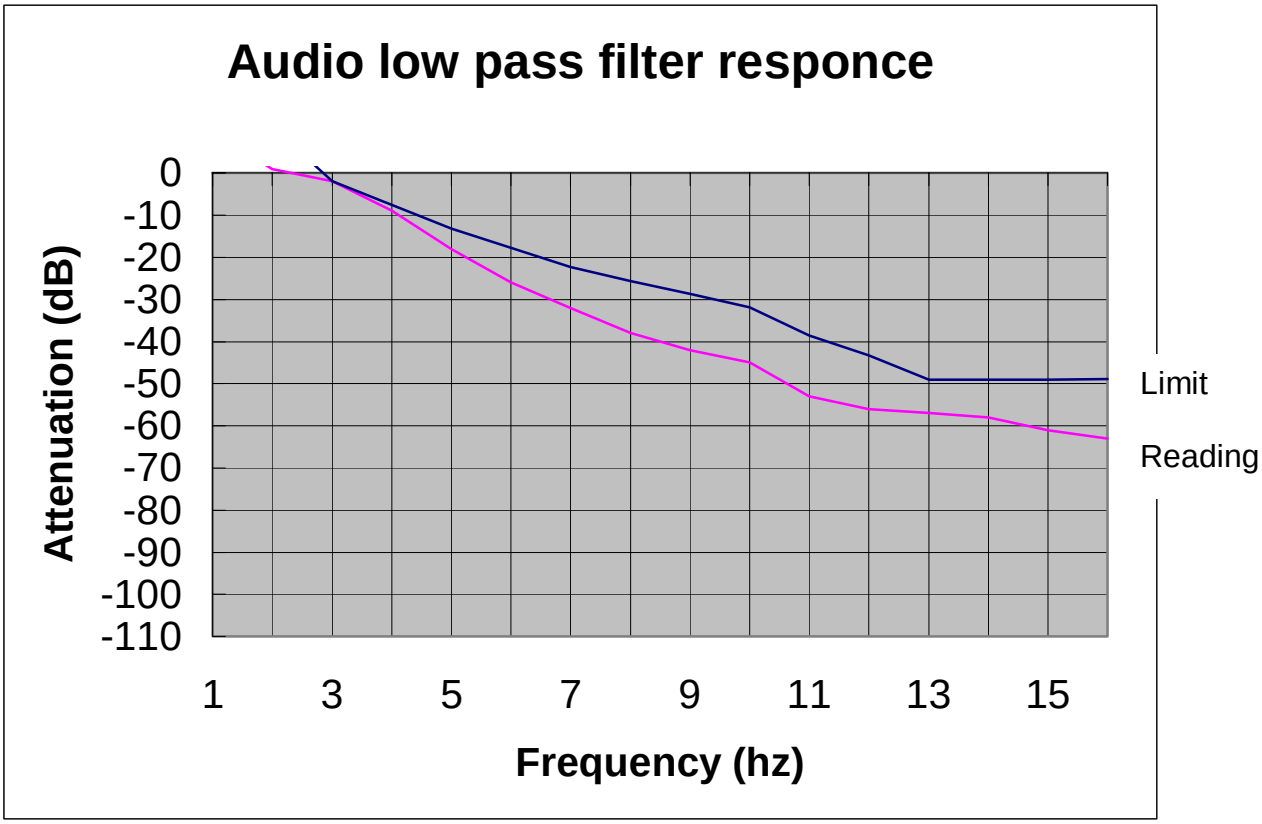
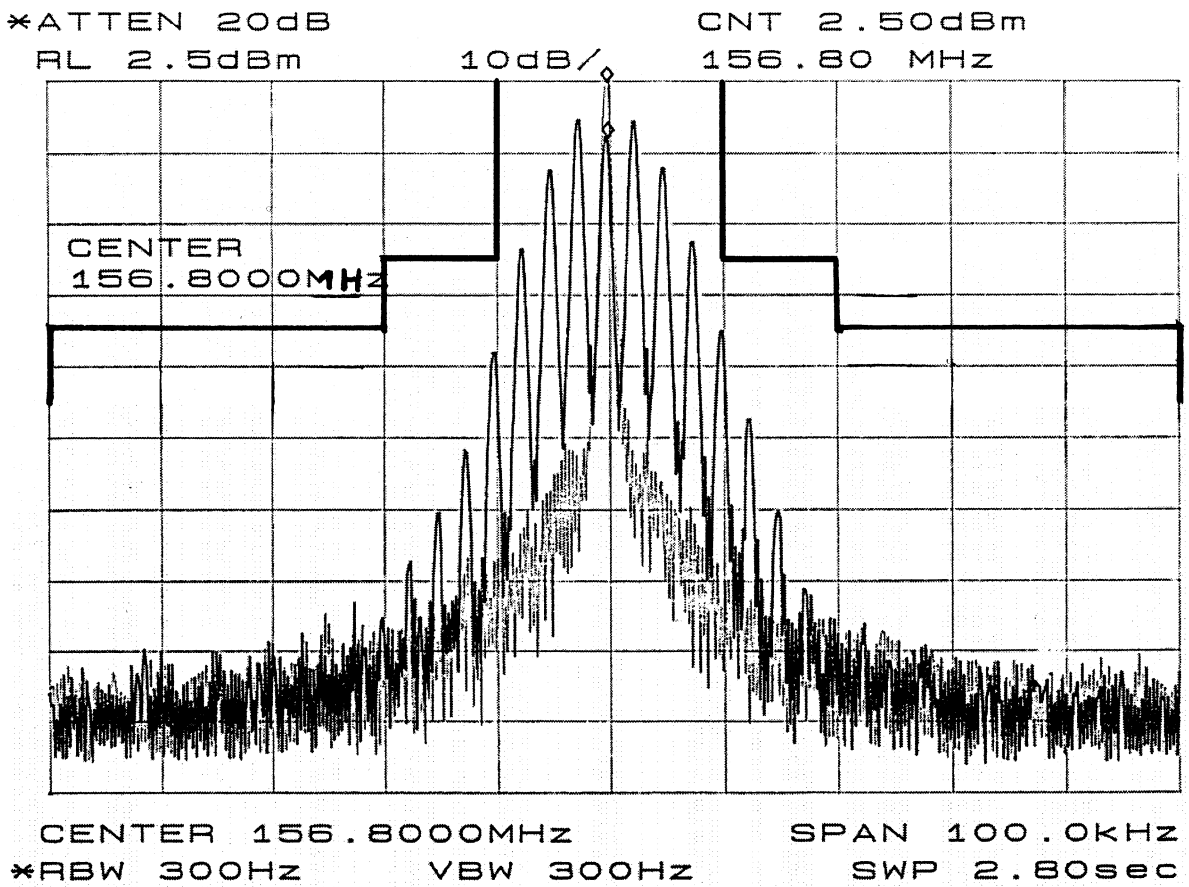


Figure 3

Occupied bandwidth



Carrier with 2500Hz audio modulation only, 16K0G3E

Tests carried out in accordance with 47CFR part 2.1049

Figure 4

Spurious Emissions at the Antenna Terminals
(paragraph 2.1051 of the rules)

The HT640 transmitter was tested for spurious emissions at the antenna terminals while the equipment was modulated with a 2500Hz signal, 16dB above minimum input signal for 50% (2.5KHz deviation) modulation at 3KHz.

Measurements were made with an Agilent spectrum analyser model 8594E through power attenuator. A notch filter was used to attenuate the carrier.

Throughout the tests the power was monitored and a DC power supply was used to maintain 7.4Volts.

Spurious emissions were measured between 3.5MHz (The lowest frequency generated inside the HT640 is 3.6864MHz) and 1600MHz

All emissions that were between the and the noise floor (88dB) were recorded

Conducted spurious emissions (1 Watt output)

Frequency MHz	**Measured level (dB below carrier)**	**Limit (dB)**
313.600	56	43
470.400	79	43
784.000	71	43
1097.600	83	43
Frequency	156.800MHz	
Measurement uncertainty (dB)	3	

Tests carried out in accordance with 47CFR part 80.211

Conducted spurious emissions (5 Watts output)

Frequency MHz	**Measured level (dB below carrier)**	**Limit (dB)**
313.600	60	50
470.400	69	50
784.000	75	50
1097.600	83	50
Frequency	156.800MHz	
Measurement uncertainty (dB)	3	

Tests carried out in accordance with 47CFR part 80.211

E. Field Strength Measurements of Spurious Radiation. (Transmit) (Paragraph 2.1053(a) (b) (2) of the rules)

Field strength measurements of radiated spurious emissions were made in an open air test site used for measurements to the ETSI standards.

Figures show the worst case in either the vertical or horizontal plane

Measurements were made from 3.5 to 1600MHz (The lowest frequency generated inside the HT640 is 3.6864MHz).

Frequency (MHz)	**Measured level (dB below carrier)**
21.250	110
270.200	102
675.500	104
945.700	106
Test frequency	156.800MHz
Measurement uncertainty (dB)	3

Limit 43+10log (5.1) = 50dBc

Frequency Stability 2.1055, 80.209(a) as a function of temperature

Measurement of frequency stability versus temperature was made at temperatures from -20°C to +50°C at each temperature the unit under test was allowed to stabilize for 60 minutes.

The tests were carried out in a temperature chamber made by All Three Engineering Co Ltd (see separate submission)

Temperature (°C)	Frequency (MHz)	Error (KHz)
-20	156.79932	-0.68
-10	156.79961	-0.39
0	156.79977	-0.23
10	156.79982	-0.18
20	156.79985	-0.15
30	156.80030	+0.30
40	156.80042	+0.42
50	156.80055	+0.55

Test voltage 7.4VDC Temperature ±0.5°C Limit ±1.568KHz

F. **Frequency Stability 2.1055, 80.209(a) as a function of voltage.**

Supply Voltage	Frequency (MHz)	Error (KHz)
7.4	156.79960	-0.40
7.3	156.79960	-0.40
7.1	156.79933	-0.67
6.9	156.79919	-0.81
6.7	156.79910	-0.90
6.5	156.79896	-1.04

End Voltage 6.5V Temperature 25°C Limit ±1.568KHz

Appendix 1

Description of Semiconductor Devices

Reference	Component	Part number	Description
D105	Diode	KDS122	Protection
D802,808	Diode	KDS226	Protection
D108,202	PIN Diode	KDS114	RF Switching
D402	Diode	KDS160	Isolation
D401	Vari-cap Diode	KDV154	Local Osc compensation
D500	Zener Diode	KDZ5.1V	Voltage reference APC
D303	Vari-cap Diode	1SV217	Frequency control
D304	Vari-cap Diode	1SV324	Modulation
D100, 101,201, D203	PIN Diode	HVC131	Antenna switching
D813-D820	LED Green	KP-2012SRC	Backlight
D901	Diode	DL4004	Reverse protection
D807	Bi-colour LED	YGUR302TM	TX/RX indicator
Q301,302	Transistor	2SC4901	VCO
Q101	Transistor	2SC4901	1st Amplifier
Q203	Transistor	2SC4226	Buffer
Q802	Transistor	KRA302	PTT control
Q106,305,500,801	Transistor	KRA305	Switching
Q502,803~806	Transistor	KRC404	Switching
Q602,	Transistor	KTC3875Y	VOX amplifier
Q105	Transistor	KTC3880Y	IF amplifier
Q103	FET	3SK240	Mixer
Q202	FET	2SK3475	RF driver
Q201,	FET	2SK3476	RF output
IC801	IC	Upd789418AGK	Microprocessor
IC101	IC	TA31136FN	IF and demodulator
IC401	IC	U2781B	PLL
IC901	IC	TDA7233D	Audio output
IC802	IC	TK71750SCL	5 Volt regulator
IC501	IC	TA75W01FU	Comparator APC
IC803	IC	AT24C08M SMD	EEPROM
IC601	IC	AK2342B	Audio processor

Appendix 2

Circuits and devices to determine and stabilise frequency.

The frequency is generated by a by a voltage controlled oscillator, The control being provided by PLL technology and referenced to a quarts crystal (X401 21.250MHz)

Appendix 3

Circuits to suppress spurious emissions, control modulation and power.

A. Circuits to suppress spurious emissions:
The spurious filter comprises L201, 202, 203, C201, 202, 203, 209, 215, and C220.

B. Modulation limiter:
The limiter and low pass filter circuit is part of IC601 (AK2342B)