Spectral Efficiency per Section 90.203

CERTIFICATE:

Primayer Limited certifies that, per the requirements of 90.203(j)3, that the reference radio, FCC ID: OABST450, meets the spectrum efficiency channel of one voice channel bandwidth per 12.5 kHz of channel bandwidth. Furthermore, the reference device is capable of transmitting data and is capable of supporting a data rate of 4800 bits per second per 6.25 kHz of bandwidth. Channel bandwidth is calculated as the bandwidth containing 99% of the energy of the emission, or the 20 dB bandwidth.

FCC TYPE ACCEPTANCE INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2, Subpart J, sections 2.983 - 2.999.

2.983(a) Applicant: Primayer Limited.
2 The Spinney, Parklands Business Park
Denmead, Hampshire ENGLAND P076AR

2.983(b) FCC ID: OABST450

2.983(c) Quantity production is planned.

2.983(d) Technical Description

The ST450 is a transmitter module for incorporation in other types of devices, such as alarm panels and the like. Supply voltage is regulated, modulation input levels are limited, and the product is installed in a metal shield (can). The ST450 is comprised of two main modules:

WD1581: transmitter motherboard
WD 1592: VCO module

Refer to document named **techman.pdf** for detailed technical description.

(1) Types of Emissions

11K0F1D
11K0F2D
11K0F3D

(2) Frequency Range

Transmitter: 430-470 MHz

(3) Range of Operating Power

Operating power output can be adjusted from 1mW - 500 mW

(4) Maximum Power Rating

Maximum output power is 500 mW (27 dBm)

(5) Applied voltages and currents into the final transistor elements

Determined by TR7 and IC2a for selected power output (7 VDC for 500 mW)

(6) Function of Each Active Device

Refer to document titled **parts.pdf**.

(7) Complete Circuit Diagrams and Functional Block Diagram

Refer to documents titled **schematic.jpg** and **vco.jpg.**

(8) Instructions/Installation Manual

Refer to document titled **instruct.pdf**.

(9) Tune-up/Optimization Procedure

Refer to document titled **instruct.pdf**.

(10) Means for Frequency Stabilization

A VCTCXO with internal trimmer, manufactured by Golledge Electronics Ltd., established frequency reference for the WD1592 VCO module. Refer to **techman.pdf.**

(11) Means for Limiting Modulation

IC5 and IC6 provide audio filtering to restrict the modulation bandwidth. Refer to **techman.pdf** for more detailed description.

(11) Means for Limiting Power

Power control is provided via RV4, TR7, and IC2a. Refer to **techman.pdf.**

(11) Means for Attenuating Higher Audio Frequencies

IC5 and IC6 provide audio filtering prior to the modulator circuitry.

TX audio response curve is found in document titled **ST450AF.jpg**.

(12) Description of Modulation Techniques

FM modulation. To extend the modulation bandwidth below the loop frequency of the simple phase-locked-loop in the VCO module, modulation is applied to both the VCO and the reference TCXO (a technique known as dual point modulation). Refer to **techman.pdf.**

2.983(e) Standard Test Conditions

The transmitter was tested under the following conditions:

Room Temperature: 20 - 23 °C
Relative Humidity: 35 - 50%
DC Supply Voltage: 12 VDC

The transmitter was aligned and tuned up according to manufacturer's alignment procedure, prior to testing. All data presented represents the worst case parameter being measured.

Section 2.983(f) Equipment Identification

A drawing of the equipment identification nameplate appears in document **label.doc**

Section 2.983(g) Photographs

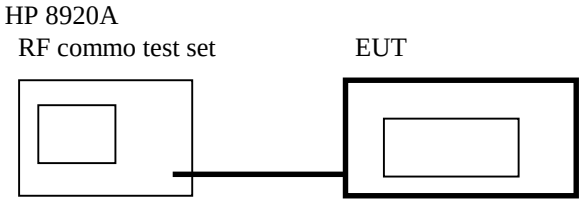
Photographs of the equipment, internal and external views, are in **jpg** format.

Section 2.983 Use of Various Power Supplies

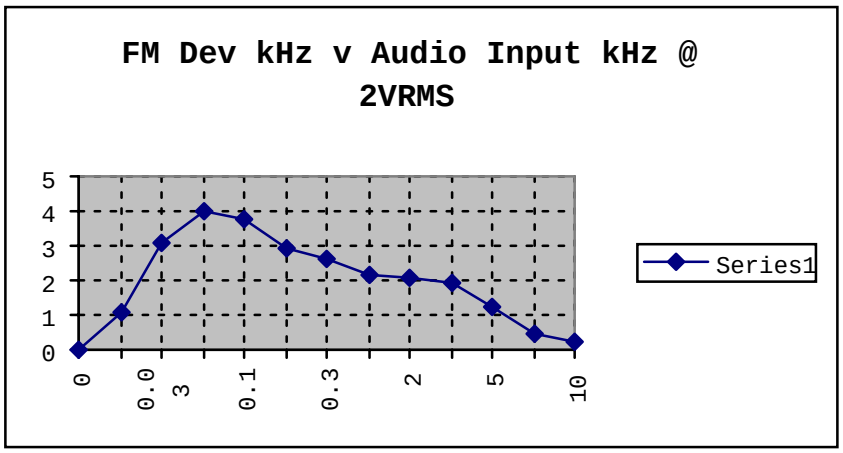
Normal operation is from 9.0 - 15 VDC sources.

Section 2.987 Measurement Required: Modulation Characteristics

Test Set-up

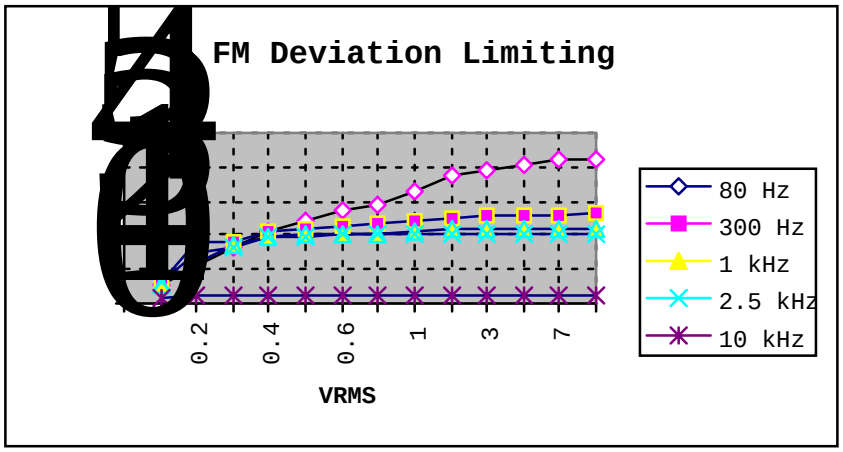


FM modulation deviation was measured at different frequencies at a constant input of 2 VRMS. Maximum deviation was measured for audio input at 80 Hz.



Modulation Limiting:

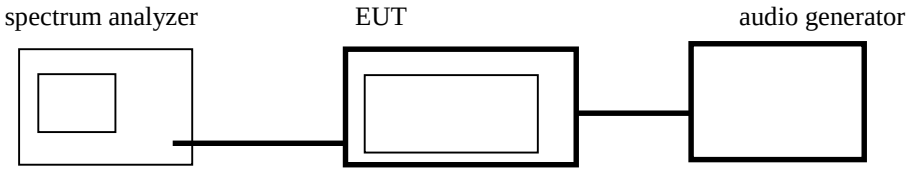
The modulation input of the radio has a design maximum input of 4 V p-p. Input voltages were varied from 0.1- 8 V p-p at five frequencies: 80 Hz, 300 Hz, 1 kHz, 2.5 kHz, and 10 kHz.



Section 2.989 Measurement Required: Occupied Bandwidth
Measurement Equipment Used:

HP 8563E Spectrum Analyzer
QIM "The Workhorse" low loss cable, 9 ft (loss: 0.85 dB/ft@ 26 GHz)
Goldstar Audio Generator

Test Set-up



Data on the bandwidth occupied by this transmitter is presented in graphical form using spectrum analyzer plots. The plots depict the carrier signal modulated with 300 Hz, 1000 Hz, 2500 Hz , and 10 kHz test signals at 6 VRMS levels, well into limiting and higher than 16 dB greater than the level required to produce a modulation level of 50% at 2500 Hz.

Level applied to modulation input: 6VRMS

90.209 Bandwidth limitations

90.209(d) Emission mask D: 12.5 kHz channel bandwidth equipment

Any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1. On any frequency from the center of the authorized bandwidth fo to 5.625 kHz removed from fo: Zero dB

2. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd-2.88 kHz) dB

3. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log(P) dB or 70 dB, whichever is the lesser attenuation.

Test Results:

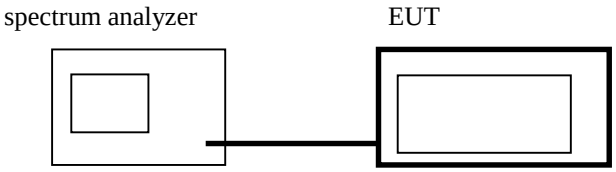
Refer to spectrum analyzer charts **occbw1.jpg** and **occbw2.jpg**.

Section 2.991 Measurements Required: Spurious and Harmonic Emissions at Antenna Terminals

Measurement Equipment Used:

HP 8563E Spectrum Analyzer
QIM "The Workhorse" low loss cable, 9 ft (loss: 0.85 dB/ft@ 26 GHz)

Test Set-up



90.210(d)

Minimum standard: The magnitude of each spurious and harmonic emission that can be detected when the equipment is operated under conditions specified in the instruction manual and/or alignment procedure, shall not be less than 50+10 log(mean output power in watts) dBc below the mean power output, which is equivalent to - 20 dBm.

Test Results

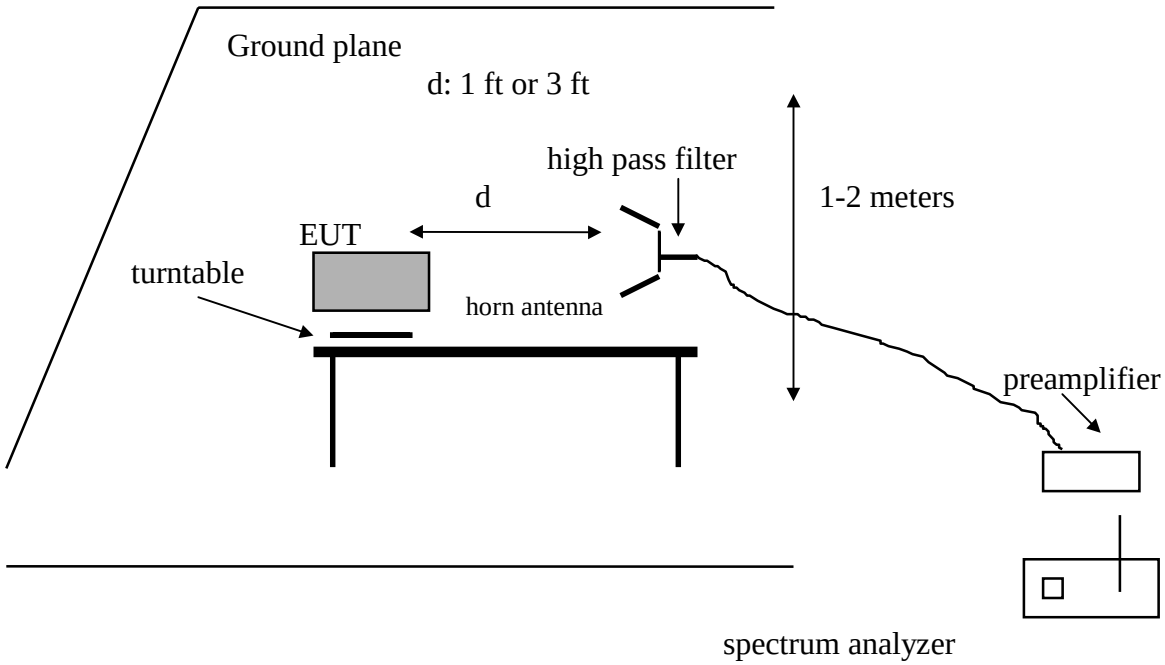
Refer to spectrum analyzer graphs **out458.jpg** and **outjpg469.jpg**. Output emissions data is presented from 1 MHz to the 10th harmonic of the carrier frequency.

Section 2.993 Measurement Required: Field Strength of Spurious and Harmonic Radiation

Measurement Equipment Used:

HP 8563E Spectrum Analyzer
EMCO 3146 Log Periodic Antenna, 200 - 1000 MHz
ARA DRG-118/A Double Ridged Horn antenna, 1 - 18 GHz

Test Set-Up



Minimum Requirement

Out of band limits per mask D limits are expressed as (50 + 10 log P) dB below carrier. This is an implied limit of -20 dBm conducted. The relationship between radiated field strength and conducted emissions into an antenna is

EV/m = (√(30*PW*G))/d meters (E in volts/m, P in watts, G numeric gain over isotropic)

Taking logarithms on both sides of the equation and assuming a distance of 3 m:

E = (95.24 + PdBm + GdBi) dBuV/m

Test Method

The antenna output port of the EUT was terminated with a 50 ohm shielded termination. With the transmitter operating at full power, the EUT was rotated 360° and the search antenna was raised and lowered in both polarities, all in an attempt to maximize the levels of the received emission for each harmonic and spurious emission up to 10 fo.

Test Results

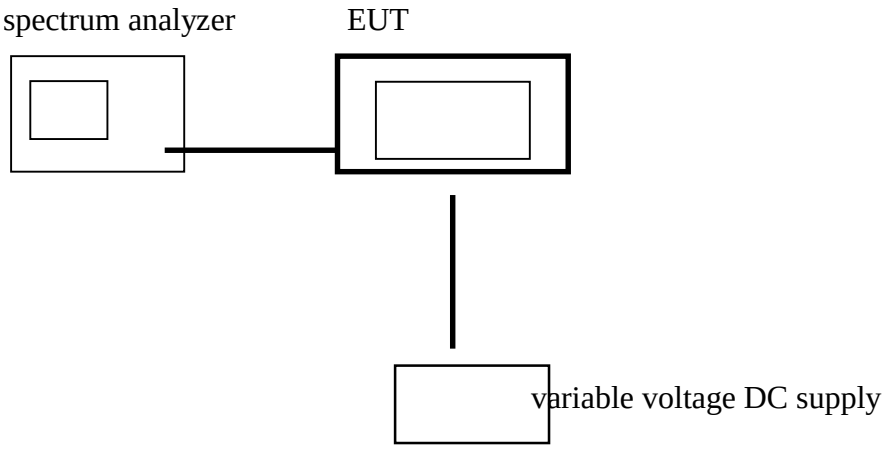
Corrected field strength readings indicated all readings were more than 20 dB below limit, or were undetectable, for emission frequencies up to 10fo.

Section 9.295 Measurement Required: Frequency Stability
Section 90.213 Minimum Frequency Stability

Measurement Equipment Used:

HP 8563E Spectrum Analyzer
QIM "The Workhorse" low loss cable, 9 ft (loss: 0.85 dB/ft@ 26 GHz)
Variable DC power supply

Test Set-up



Minimum Requirement

Fixed and base stations, 12.5 kHz bandwidth, 421 - 512 MHz: 1.5 ppm

Test Method

Temperature: Test data provided by VCTCXO manufacturer. Refer to **1vcotemp.jpg** and **2vcotemp.jpg**.

Primary Supply Voltage: Vary the supply voltage from 85% to 115% of the nominal (12V) operating voltage

Test Results

TX Output: 458.55 MHz 1.5 ppm: ± 688 Hz

Voltage	Output Frequency, MHz	Difference, Hz
15.0	458.549676	-324
12.0	458.549651	-349
10.0	458.549626	-374
7.0	458.549638	-362
5.4	RF OUTPUT UNSTABLE	
4.5	NO RF OUTPUT	

90.214 Transient frequency behavior

The Primayer ST450 is designed to operate on 12.5 kHz channels. Transient frequencies must be within the tolerances and within the time frames described below:

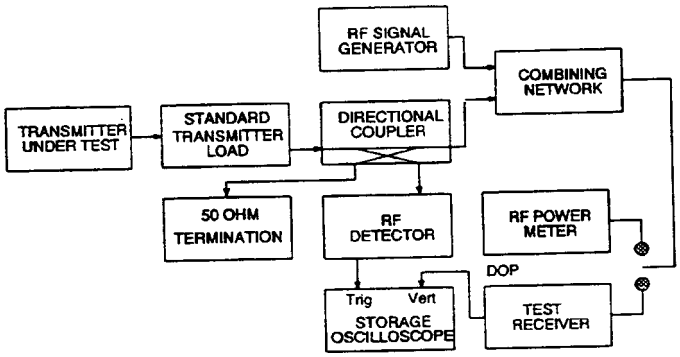
Time Intervals	Maximum freq. diff, kHz	Duration for 450-500 MHz
t1	12.5	10 msec
t2	6.25	25 msec
t3	12.5	10 msec

Transient frequency behavior was tested according to the procedures in section 2.2.19 of TIA/EIA Standard TIA/EIA - 603. The turn on /turn off limits described in the table is shown in section 5.2.19.

Measurement Equipment Used

HP 54602B Oscilloscope
HP 8920A RF Communications Test Set
Narda RF combiners, 2-2500 MHz
Narda 30 dB in-line RF attenuator, 20 watts
Directional coupler. 10 dB
HP 435 Power meter

Test Set-up



Test Results

Refer to oscilloscope charts **TurnOn.jpg** and **Turn OFF.jpg.**

The EUT meets the minimum transient frequency response limits for this type of device.