

PD2-TX-100-S Report of Measurements

RF Power Output

Modulation Characteristics-Deviation Frequency Response

Modulation Characteristics-Modulation Sensitivity

Occupied Bandwidth/Spurious Emissions

Frequency Stability-Temperature Stability

Frequency Stability-Power Supply Stability

PD2-TX-100-S RF Power Output

Relevant FCC Chapter:

(a) 2.1046 Measurements required: RF power output.
 For transmitters other than single side-band, independent side-band and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

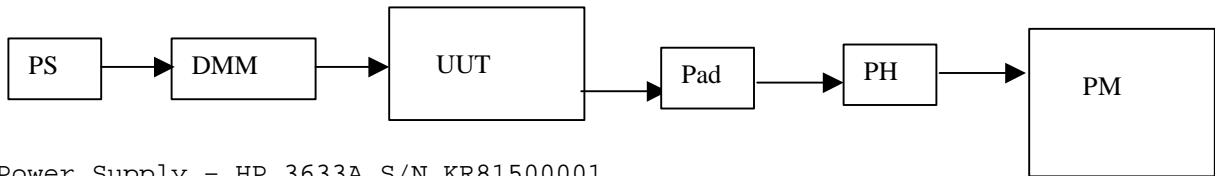
2.1033 Application for certification.

(c) Applications for equipment other than that operating under parts 15 and 18 of the rules shall be accompanied by a technical report containing the following information:

(8) The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

Test Setup:

The setup for this test is shown below.

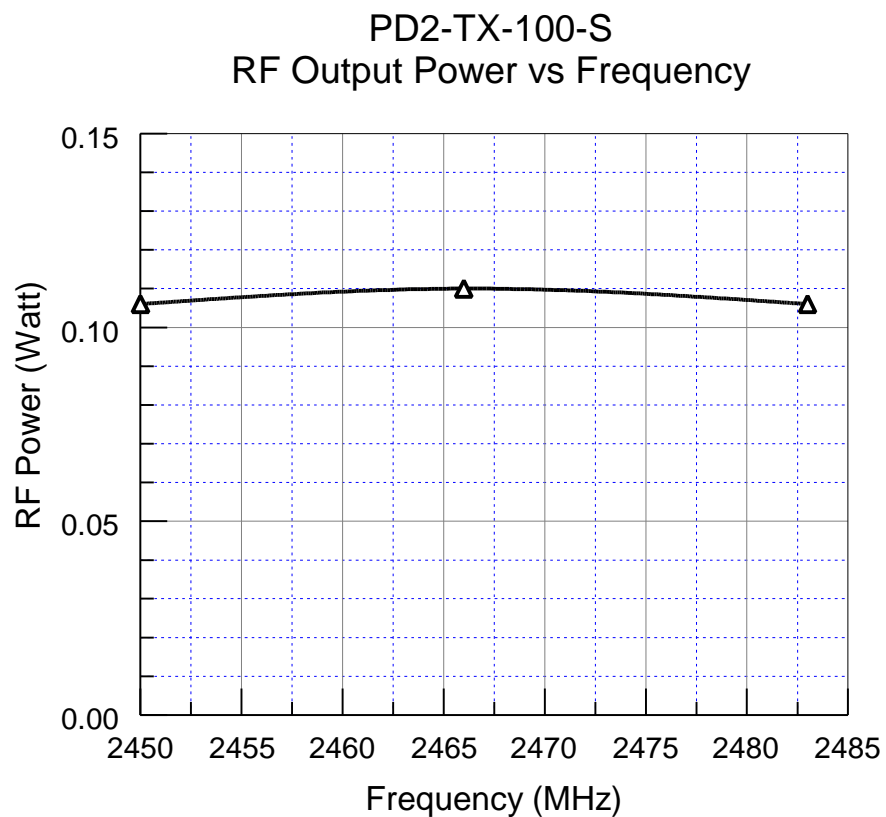


- PS - Power Supply - HP 3633A S/N KR81500001
- DMM - Digital Multi-Meter
- UUT - PD2-TX-100-S
- Pad - 30 dB Pad - Mini Circuits CAT30
- PH - Power Head - HP 8481A - SN 2702A53289
- PM - Power Meter - HP 437B - SN 2912A01689

**Figure 1 - RF Power Output vs Voltage and Frequency
 (Pursuant to FCC Requirement 2.1046) - Raw Data**

Vsupply	Pout Vs Voltage		Pout Vs Voltage		Pout Vs Voltage	
	F = 2450 MHz		F = 2466 MHz		F = 2483 MHz	
	Po Watt	Idc Amp	Po Watt	Idc Amp	Po Watt	Idc Amp
9.0	0.109	0.67	0.109	0.68	0.108	0.68
9.5	0.109	0.64	0.109	0.64	0.108	0.64
10.0	0.109	0.61	0.109	0.61	0.108	0.61
11.0	0.109	0.56	0.109	0.56	0.108	0.57
12.0	0.109	0.52	0.109	0.52	0.108	0.52
13.0	0.109	0.49	0.109	0.49	0.108	0.49
14.0	0.109	0.46	0.109	0.46	0.108	0.46
15.0	0.109	0.44	0.109	0.44	0.108	0.44

Figure 2 - RF Power Output vs Frequency
(Pursuant to FCC Requirement 2.1046)



PD2-TX-100-S Modulation Characteristics - Deviation Frequency Response

Relevant FCC Chapter:

2.1047 Measurements required: Modulation characteristics.

(d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Test Method: See below

Test Results:

Whereas this is a pure Digital COFDM Video System with no audio sub-carriers, no test is relevant and none was performed.

PD2-TX-100-S Modulation Characteristics

Modulation Sensitivity

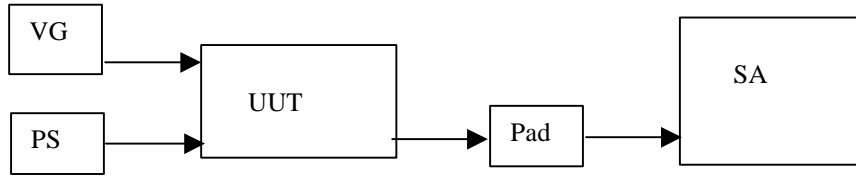
Relevant FCC Chapter:

2.1047 Measurements required: Modulation characteristics.

(d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Test Setup:

The setup for this test is shown below.



VG - Video Generator - Tektronix TSG195 - SN B032558

Power Supply -Hewlett Packard E3633A- S/N KR81500001

UUT - HVT-250-S

Pad - 30 dB Pad - Mini Circuits- CAT 30

SA - Spectrum Analyzer - Advantest R3162 - SN 120401992

Test Results:

Since the nature of a digital COFDM modulation system is such that the video input signal has no effect on the modulated carriers, no test is relevant and none was performed.

PD2-TX-100-S Occupied Bandwidth / Spurious Emissions**Relevant FCC Chapters:****2.1049 Measurements required: Occupied bandwidth.**

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

90.210 Emission masks.

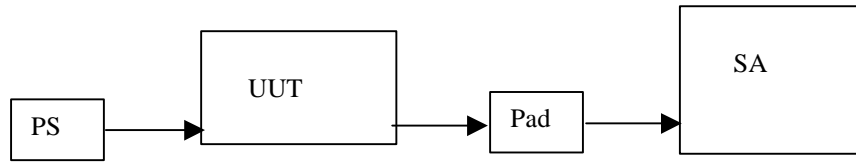
(Under Part 90 section 210, the masks for equipment designated to operate in the 2.38 to 2.48 MHz band are not specified in the Applicable Emission Masks Chart. Therefore, while the HVT-250-S has no provision to inject an audio sub carrier into the transmitted RF signal, we have applied Mask B as noted for "All other bands". Although Mask B generally pertains to equipment with an audio low pass filter, Mask C is completely inappropriate in that it does not allow for spread spectrum carriers within the designated bandwidth.)

(b) *Emission Mask B* - For transmitters that are equipped with an audio low pass filter pursuant to 90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

Test Setup:

The setup for this test is shown below.



Power Supply HP 3633A- S/N KR81500001

UUT - PD2-TX-100-S

Pad - 30 dB Pad - Mini Circuits- CAT 30

SA- Spectrum Analyzer- HP 8565A S/N 1811A00402 - Conducted Emissions

Test Method:

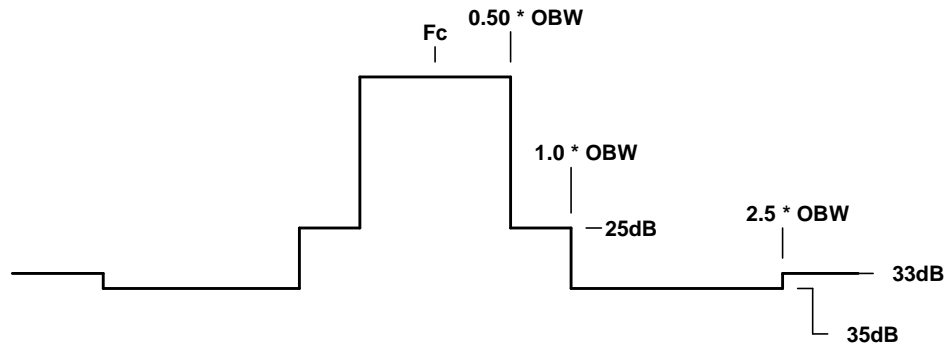
For the purpose of calculating mask segments, the power of the un-modulated carrier was 0.10 Watts, therefore the value calculated per 90.210 (b) (3):

For the frequency region removed from the carrier by more than 250 percent of the authorized bandwidth, the emissions shall be less than:

$$P_{max} = 43 + 10\log(0.10) = 33.0 \text{ dB}$$

Figure 1

Mask Parameters for the 5 TX modes:



TX Mode	0.5*OBW (MHz)	1.0*OBW (MHz)	2.5*OBW (MHz)
DOMO-N	0.61	1.22	3.05
DOMO-W	1.22	2.44	6.10
DVB-T - 6	2.88	5.76	14.4
DVB-T - 7	3.36	6.72	16.8
DVB-T - 8	3.84	7.68	19.2

PD2-TX-100-S Spectrum Data

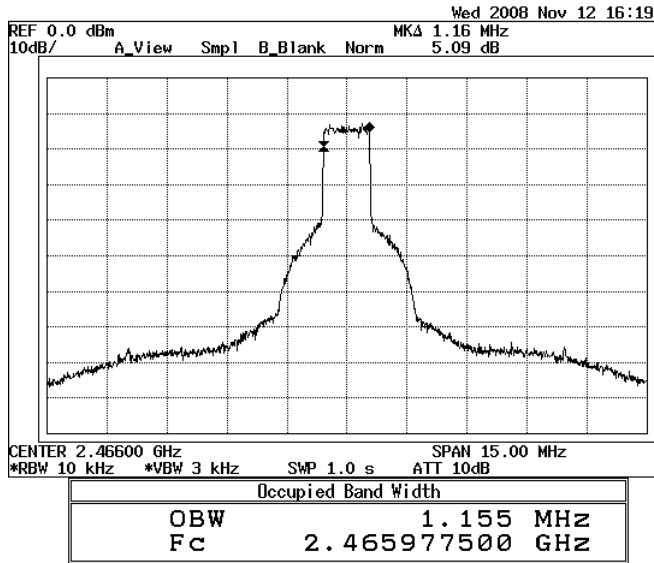


Fig. 2
 Spectral Mask Compliance
 TX Mode = DOMO-N
 Emission: 1M2W7D

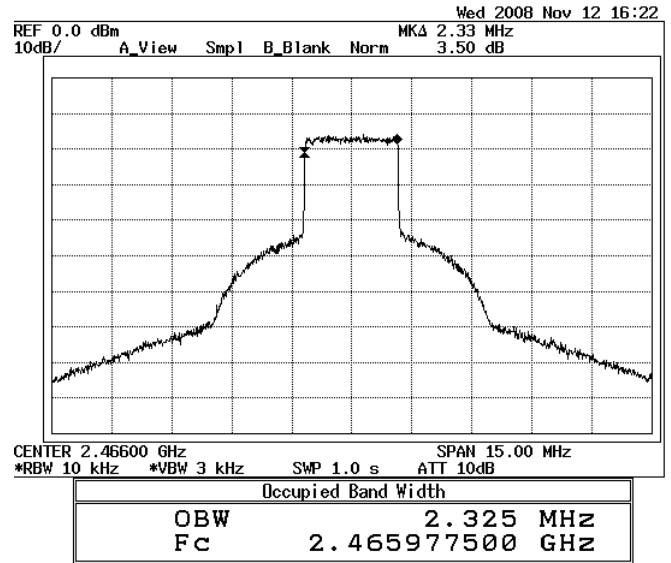


Fig. 3
 Spectral Mask Compliance
 TX Mode = DOMO-W
 Emission: 2M4W7D

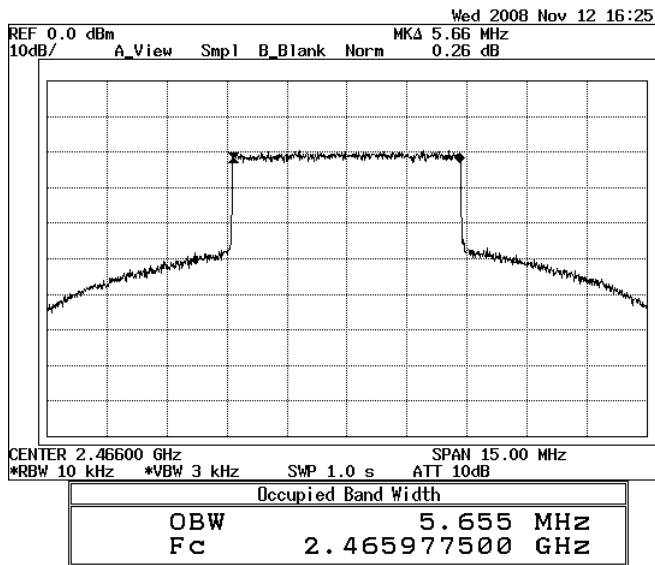


Fig. 4
 Spectral Mask Compliance
 TX Mode = DVB-T 6 MHz
 Emission: 5M8W7D

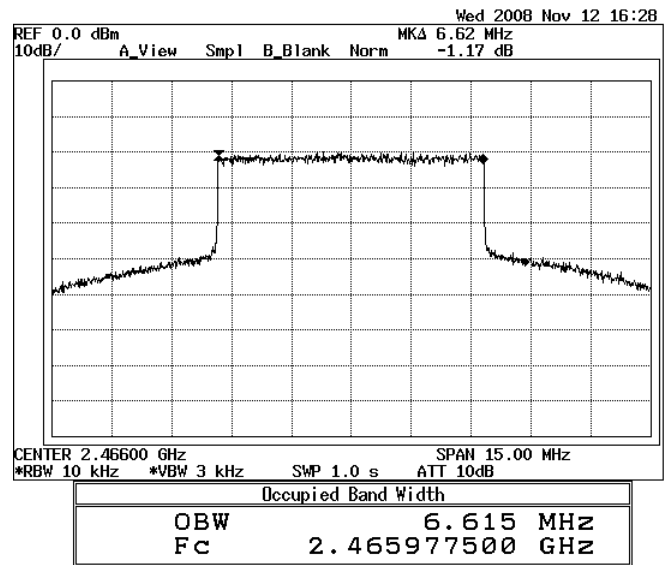


Fig. 5
 Spectral Mask Compliance
 TX Mode = DVB-T 7 MHz
 Emission: 6M7W7D

PD2-TX-100-S Spectrum Data, Continued

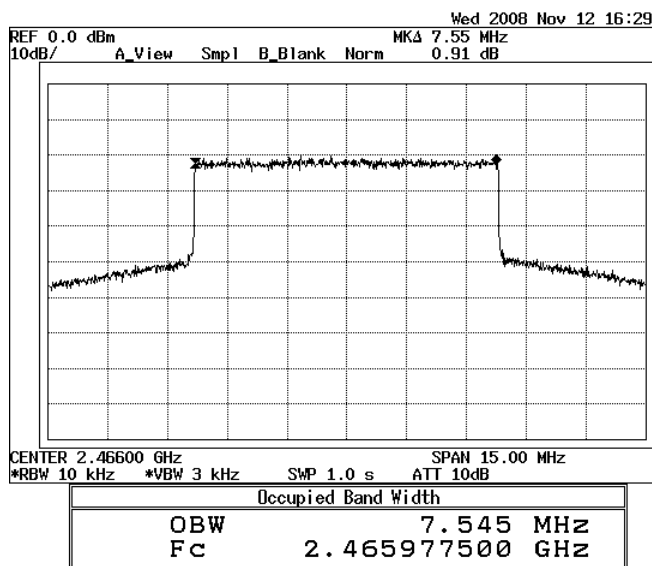


Fig. 6
Spectral Mask Compliance
TX Mode = DVB-T 8 MHz
Emission: 7M7W7D

PD2-TX-100-S Spurious Emissions at Antenna Terminals

Test Results:

Frequency Range Investigated: 7 MHz to 26 GHz

UUT: PD2-TX-100-S

Measurement: Conducted Spurious

Frequency Range: 7 MHz to 26 GHz

Device: SN# ENG-FCC

FCC Limit(dBc) = 43 + 10*LOG(P)dBc = 43 +10*LOG(0.1) = -33dBc

Pcarrier = 100mW = +20 dBm

Fcc Limit(dBm) = +20dB(pad) -33dB(carrier) = **-13dBm**

Vsupply = 15VDC

Isupply = 0.42ADC

Spectrum Analyzer Setup:

RBW = 3 MHz

VBW = 10 kHz

Fig. 10

Conducted Spurious TEST DATA

Fc (GHz)	Range 7 MHz- Fc	Harmonic (Fc x2)	Harmonic (Fc x3)	Harmonic (Fc x4)	Harmonic (Fc x5)
2.450	XXXXXXX	4.900	7.350	9.800	12.250
Level	<-40dBm	<-40dBm	<-40dBm	<-40dBm	<-40dBm
2.466	XXXXXXX	4.932	7.398	9.864	12.330
Level	<-40dBm	<-40dBm	<-40dBm	<-40dBm	<-40dBm
2.483	XXXXXXX	4.966	7.449	9.932	12.415
Level	<-40dBm	<-40dBm	<-40dBm	<-40dBm	<-40dBm

Fc (GHz)	Harmonic (Fc x6)	Harmonic (Fc x7)	Harmonic (Fc x8)	Harmonic (Fc x9)	Harmonic (Fc x10)
2.450	14.700	17.150	19.600	22.050	24.500
Level	<-40dBm	<-40dBm	<-40dBm	<-40dBm	<-40dBm
2.466	14.796	17.262	19.728	22.194	24.660
Level	<-40dBm	<-40dBm	<-40dBm	<-40dBm	<-40dBm
2.483	14.898	17.381	19.864	22.347	24.830
Level	<-40dBm	<-40dBm	<-40dBm	<-40dBm	<-40dBm

Note that all conducted spurious emissions were observed to be less than the FCC limit by at least 27dB.

PD2-TX-100-S Frequency Stability**Relevant FCC Chapter:**

2.1055 Measurements required: Frequency Stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

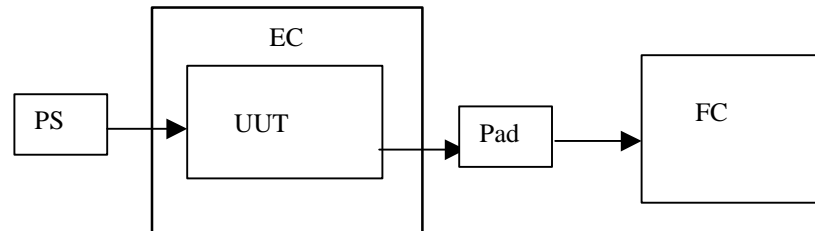
(1) From -30° to $+50^{\circ}$ centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

[The PD2-TX-100-S does not qualify under part 90, chapter 2.1055 (a) (2) or (a) (3)]

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

Test Setup:

The setup for this test is shown below.



PS - Power Supply - Agilent E3633A - S/N KR81500001

EC - Environmental Chamber - Applied Systems BK-1101 - SN 8665

UUT - PD2-TX-100-S

Pad - 30 dB Pad - Mini Circuits- CAT 30

FC - Frequency Counter - Systron Donner 6420- S/N 61003-8

Test Method:

The unit under test was powered at 15.0 VDC and set to a carrier frequency of 2.466 GHz. The digital modulation was disabled in order to allow the unit to transmit a single CW center frequency carrier. The Environmental Chamber was set to -30° C and swept to $+50^{\circ}$ C in 10° steps. Due to the small size of the chamber and the UUT, the unit was left at each temperature for 1 hour before the measurement was made. Since there is no method of keying the transmitter or any form of heating element in the UUT, those results are not required.

Test Results:

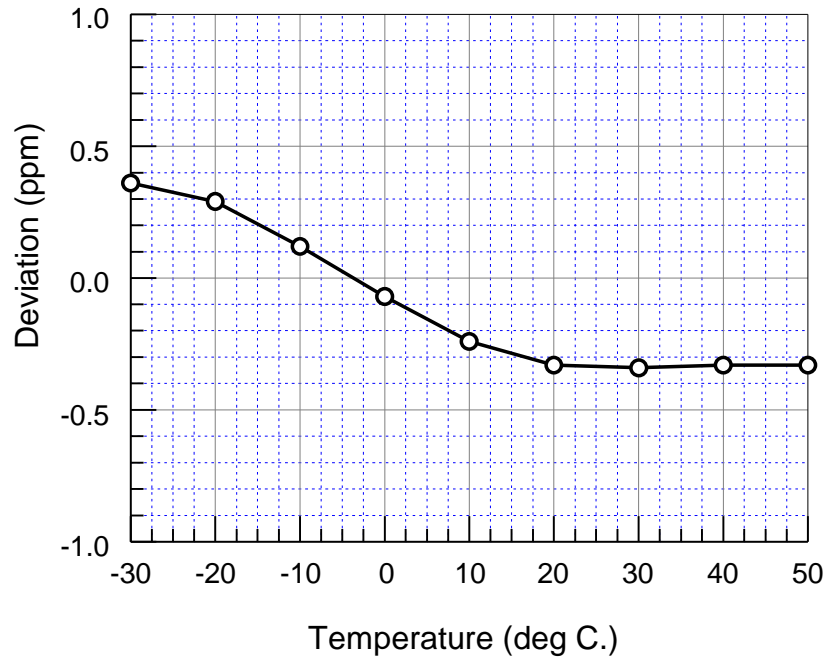
The results of the test are shown in Figures 11 and 12.

**Figure 11 - Frequency Stability as a Function of Temperature
(Pursuant to FCC Requirement 2.1055a) - Raw Data**

PD2-TX-100-S
SN# ENG-FCC

Temp (deg C.)	Frequency (Hz)	Deviation (ppm)
-30	2,466,000,639	+0.36
-20	2,466,000,703	+0.29
-10	2,466,000,285	+0.12
0.0	2,465,999,832	-0.07
+10	2,465,999,275	-0.24
+20	2,465,999,189	-0.33
+30	2,465,999,158	-0.34
+40	2,465,999,176	-0.33
+50	2,465,999,193	-0.33

**Figure 12 - Frequency Deviation (PPM) as a Function of Temperature
(Pursuant to FCC Requirement 2.1055a)**



PD2-TX-100-S Frequency Stability - Power Supply Stability

Relevant FCC Chapter:

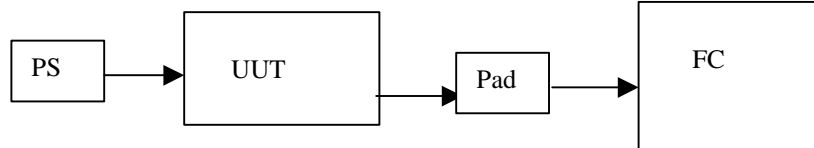
2.1055 Measurements required: Frequency Stability.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

Test Setup:

The setup for this test is shown below.



PS - Power Supply - Hewlett-Packard E3633A - S/N KR81500001

UUT - PD2-TX-100-S

Pad - 30 dB Pad - Mini Circuits- CA

FC - Frequency Counter - Systron Donner 6420- S/N 61003-8

Test Method:

The Frequency output of the unit under test was measured at supply voltages in 5 increments from 80% to 120% of the nominal 12 VDC.

Test Results: The results of the test are shown in Figures 13 and 14.

Frequency Deviation (PPM) as a function of supply voltage

Figure 13 - Frequency Stability as a Function of Supply Voltage (Pursuant to FCC Requirement 2.1055d) - Raw Data

Vsupply VDC	Frequency Vs Supply Voltage Fc = 2,466,000,000 Hz	
	Frequency (Hz)	Deviation (PPM)
9.0	2,465,997,568	-0.99
9.5	2,465,997,564	-0.99
10.0	2,465,997,556	-0.99
11.0	2,465,997,540	-1.00
12.0	2,465,997,524	-1.00
13.0	2,465,997,506	-1.01
14.0	2,465,997,487	-1.02
15.0	2,465,997,514	-1.01

Figure 14 - Frequency Deviation (PPM) as a Function of Supply Voltage (Pursuant to FCC Requirement 2.1055d)

