

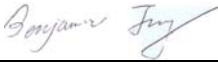
FCC PART 90 TYPE APPROVAL EMI MEASUREMENT AND TEST REPORT

For

PACIFIC CREST CORPORATION

990 Richard Avenue, Suite 110
Santa Clara, CA 95050

FCC ID: KEAPDLUH35

This Report Concerns: ☒ Original Report	Equipment Type: Wireless Positioning Data Link
Test Engineer: Ming Jing 	
Report No.: R0411292(PDL4535)	
Report Date: 2004-12-15	
Reviewed By: Daniel Deng 	
Prepared By: Bay Area Compliance Laboratory Corporation 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164	

Note: The test report is specially limited to the above company and the product model only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the US Government.

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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *Pacific Crest Corporation's* product, *FCC ID:KEAPDLUH35* (Model: *PDL4535*) or the "EUT" as referred in this report is Positioning Data Link, which measures approximately 16.7cmL x 15.8cmW x 7.0cmH.

The EUT operates at 450-470 MHz with maximum power of 45.67dBm (35.898W), frequency tolerance 1.0 ppm for 6.25 kHz channel bandwidth, 2.5 ppm for 12.5 kHz channel bandwidth, and 5.0 ppm for 25 kHz channel bandwidth, emission designator 4K9F1D, 9K8F1D, and 19K6F1D.

**The test data gathered are from production sample, serial number 04480869, provided by the manufacturer.*

Objective

This type approval report is prepared on behalf of *Pacific Crest Corporation* in accordance with Part 2 and Part 90 of the Federal Communication Commissions rules.

The objective of the manufacturer is to determine compliance with FCC rules for output power, modulation characteristic, occupied bandwidth, spurious emission at antenna terminal, frequency stability, and radiated margin.

Related Submittal(s)/Grant(s)

No Related Submittals

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA EIA 137-A, TIA EIA 98-C, TIA/EIA-603, ANSI 63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, IEC/CISPR 22: 1998, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167.

SYSTEM TEST CONFIGURATION

Justification

The host system was configured for testing according to TIA 603A.

The EUT was tested in the normal (native) operating mode to represent *worst-case* results during the final qualification test.

Block Diagram

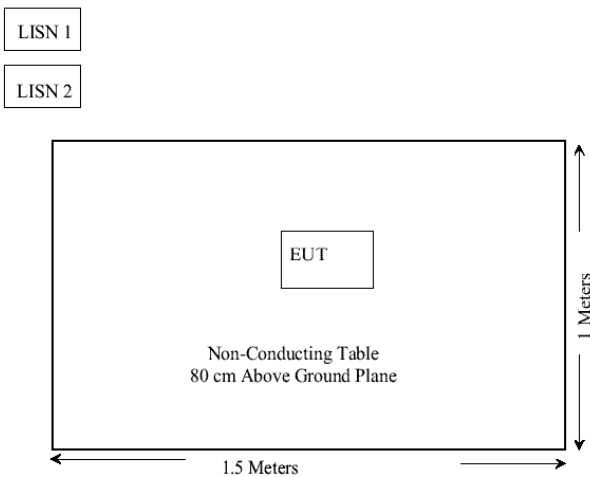
Please refer to Exhibit D.

Equipment Modifications

No modifications were made by BACL to the EUT. The copper tape at RF board will be implemented by the manufacturer.

Test Setup Block Diagram

The EUT is a standalone device.



SUMMARY OF TEST RESULTS

FCC RULE	DESCRIPTION OF TEST	RESULT
§ 2.1046	Conducted Output Power	Compliant
§ 2.1046, § 90.205	RF Output Power	Compliant
§ 2.1047 § 90.207	Modulation Characteristics	Compliant
§ 2.1049 § 90.209	Emission, Occupied Bandwidth	Compliant
§ 2.1051 § 90.210	Spurious emissions at antenna terminals	Compliant
§ 2.1053 § 90.210	Field strength of spurious radiation	Compliant
§ 2.1055 § 90.213	Frequency stability vs. temperature Frequency stability vs. voltage	Compliant
§ 90.214	Transient Frequency Behavior	Compliant

§2.1046 - CONDUCTED OUTPUT POWER

Provision Applicable

Per FCC §2.1046 and §90.205: maximum ERP is dependent upon the station's antenna HAAT and required service area.

Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuator.

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Hewlett Packard	Spectrum Analyzer	HP8565C	06042	2004-05-03
Hewlett Packard	Plotter	HP7470A	N/A	N/A
Narda	Attenuator	DC-11	203350	N/A

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

Environmental Conditions

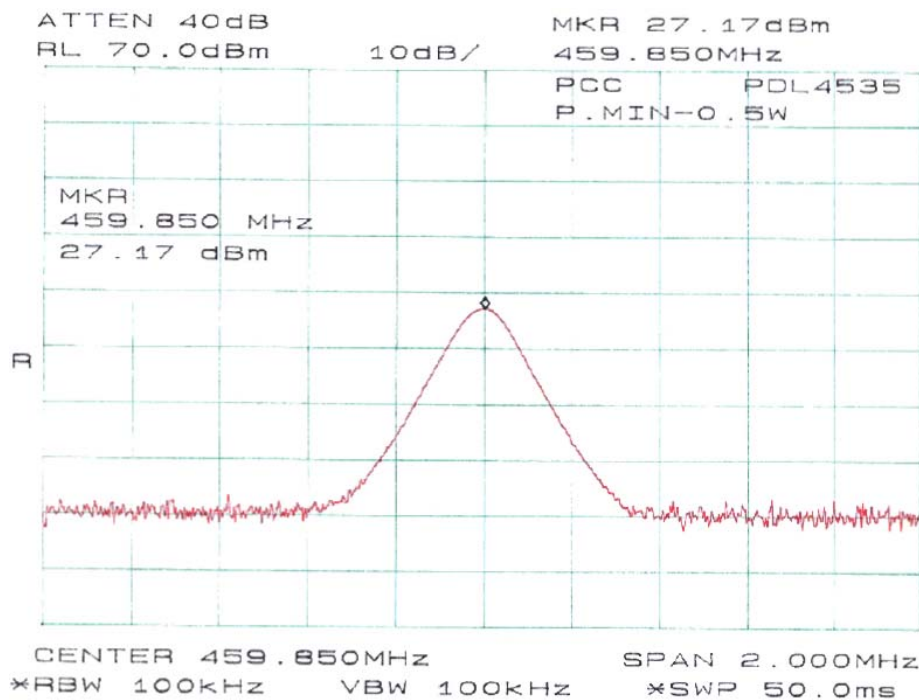
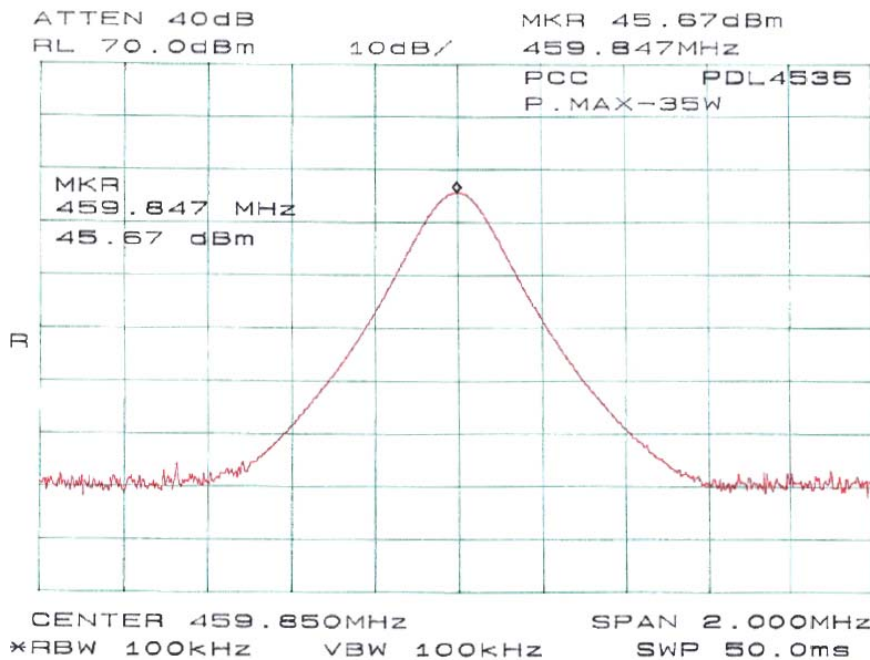
Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jing on 2004-12-09.

Test Results

	Frequency	Output Power in dBm	Output Power in W
Maximum Power	459.847	45.67	36.898
Minimum Power	459.850	27.17	0.521

Note: The power output may depend on the intended use of the EUT. For all tests, the EUT was set to maximum conditions. Please refer to the plots in following pages.



§2.1047, §90.207 - MODULATION CHARACTERISTIC

Applicable Standard

§2.1047 & §90.205:

A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rule.

Test Procedure

Test Method: TIA/EIA-603 2.2.3

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Spectrum Analyzer	8565EC	3946A00131	2004-06-30
Hewlett Packard	Modulation Analyzer	8901A	2026A00847	2004-08-19
Narda	Attenuator	DC-11	203350	N/A

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

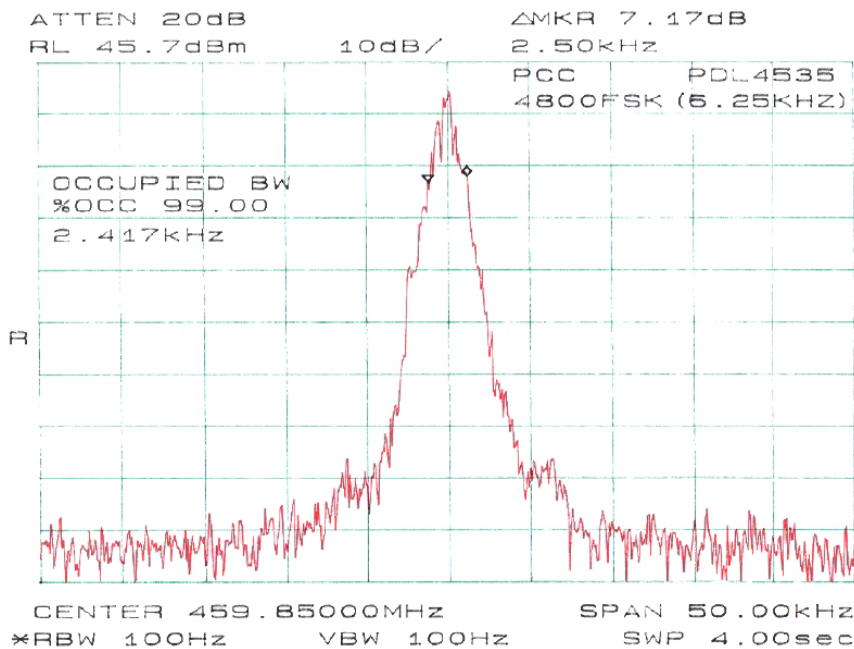
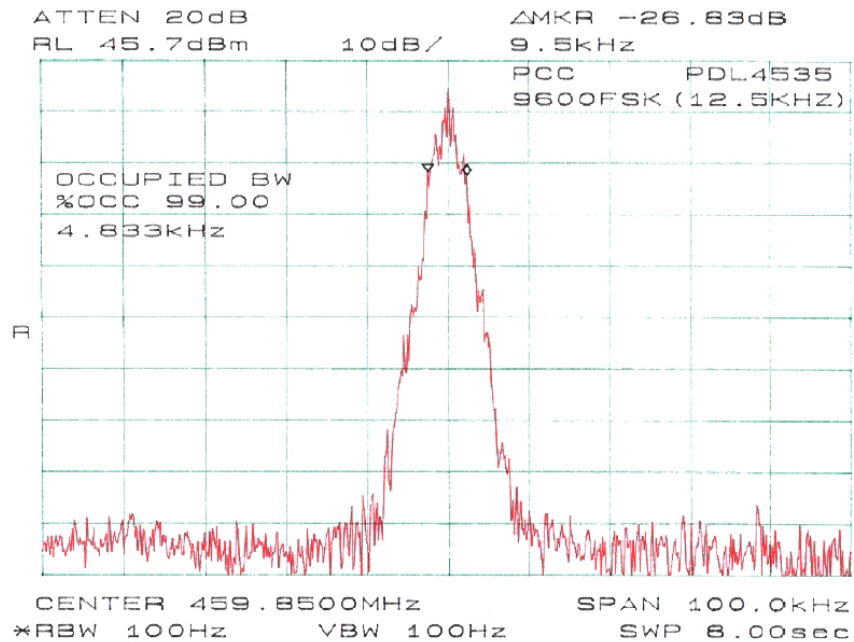
Environmental Conditions

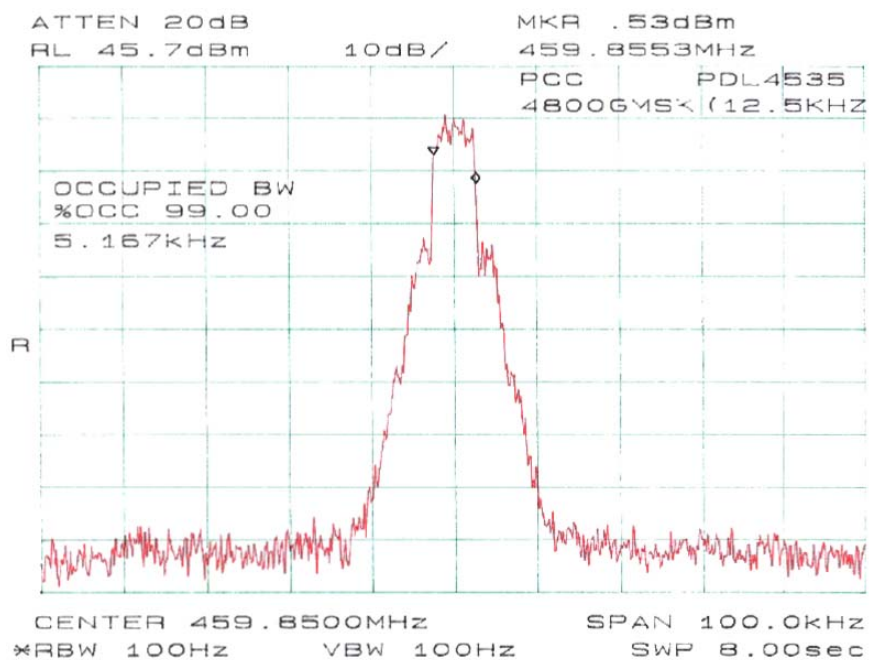
Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jing on 2004-12-09.

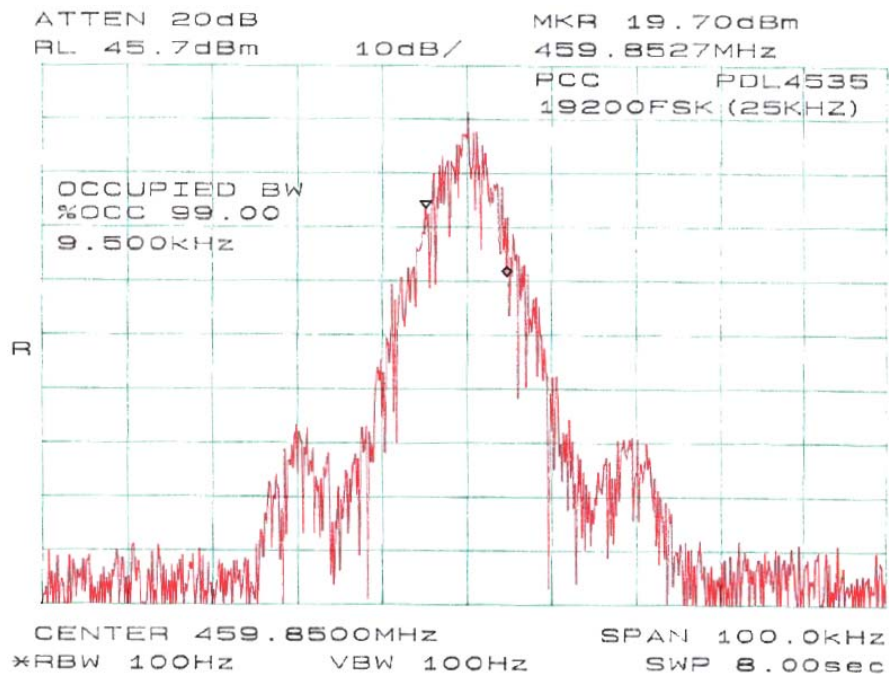
Test Results

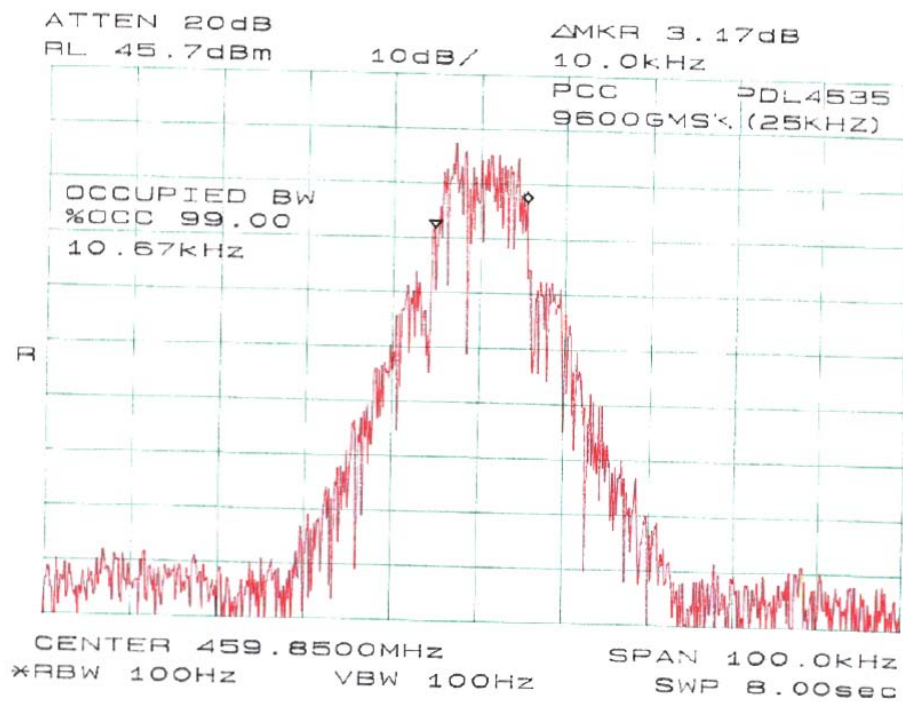
The plot(s) of modulation characteristic is presented hereinafter as reference.

For 6.25 kHz Channel Spacing:*For 12.5 kHz Channel Spacing:*



For 25kHz Channel Spacing:





§2.1049, and § 90.209 – OCCUPIED BANDWIDTH

Applicable Standard

§2.1049, §90.209 and §90.210

6.25kHz bandwidth:

For any frequency removed from the center of the authorized bandwidth f_0 to 3.0kHz removed from f_0 , 0dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 3kHz but no more than 4.6kHz, at least $30 + 16.67 (f_d - 3\text{kHz})$ dB or $55 + 10 \text{ Log } (P)$ or 65 dB.

On any frequency removed from the center of the authorized bandwidth by more than 4.6kHz at least: $55 + 10 \text{ Log } (P)$ or 65 dB.

12.5kHz bandwidth:

For any frequency removed from the center of the authorized bandwidth f_0 to 5.625kHz removed from f_0 , 0dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.626kHz but no more than 12.5kHz, at least $7.27 (f_d - 2.88\text{kHz})$ dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5kHz at least:

$50 + 10 \log P$ or 70 dB.

25kHz bandwidth:

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5kHz but not more than 10kHz, at least $83 \text{ Log } (f_d / 5)$ dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10kHz but not more than 250% of the authorized bandwidth, at least $29 \text{ Log } (f_d^2 / 11)$ dB or 50 dB.

On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: least $43 + 10 \text{ Log } (P)$.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the frequency band $\pm 50 \text{ KHz}$ or $\pm 25\text{kHz}$ from the carrier frequency.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	8565EC	3946A00131	2004-06-30
Hewlett Packard	Plotter	HP7470A	N/A	N/A
Narda	Attenuator	DC-11	203350	N/A

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jing on 2004-12-09.

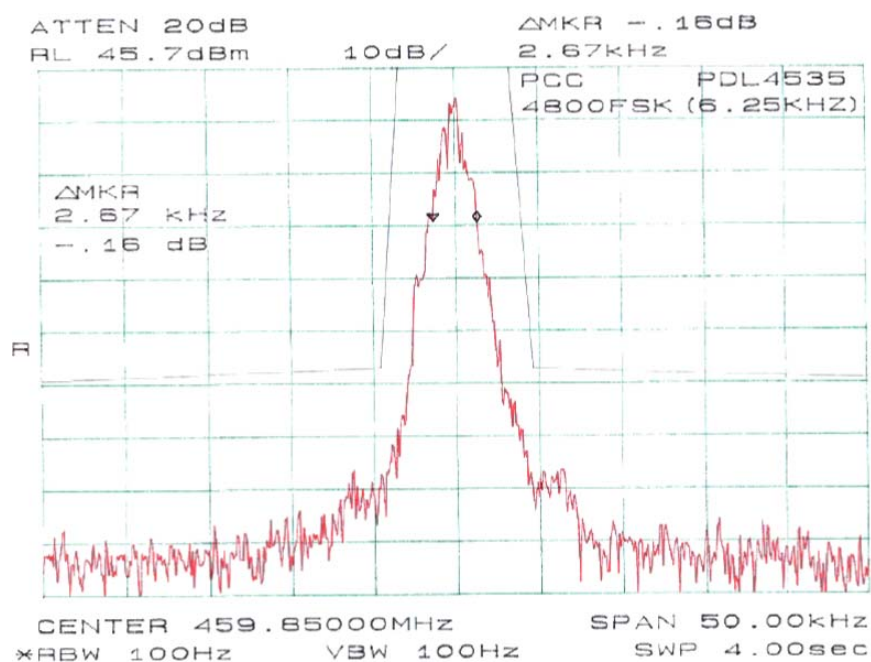
Test Results

Please refer to the hereinafter plots.

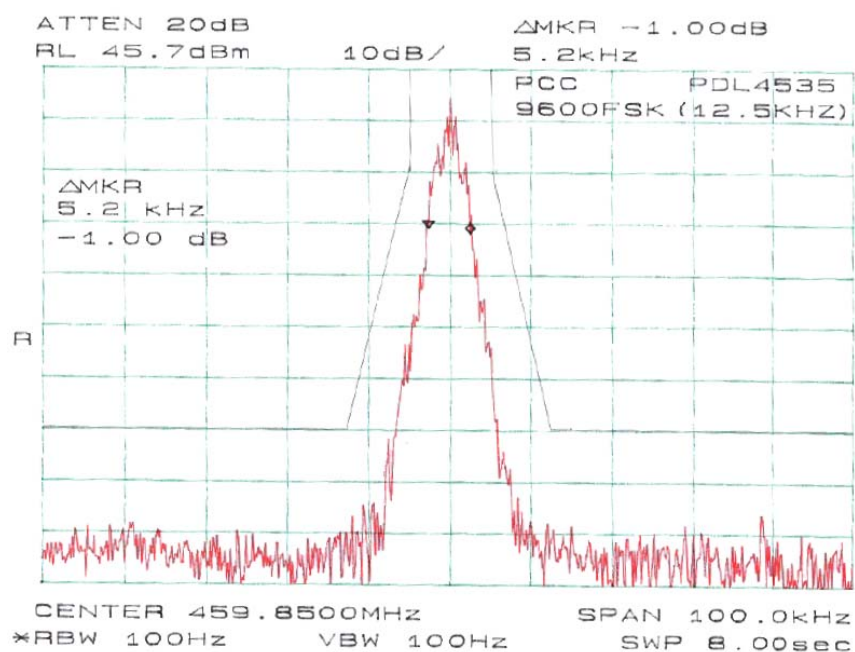
Emission Designator:

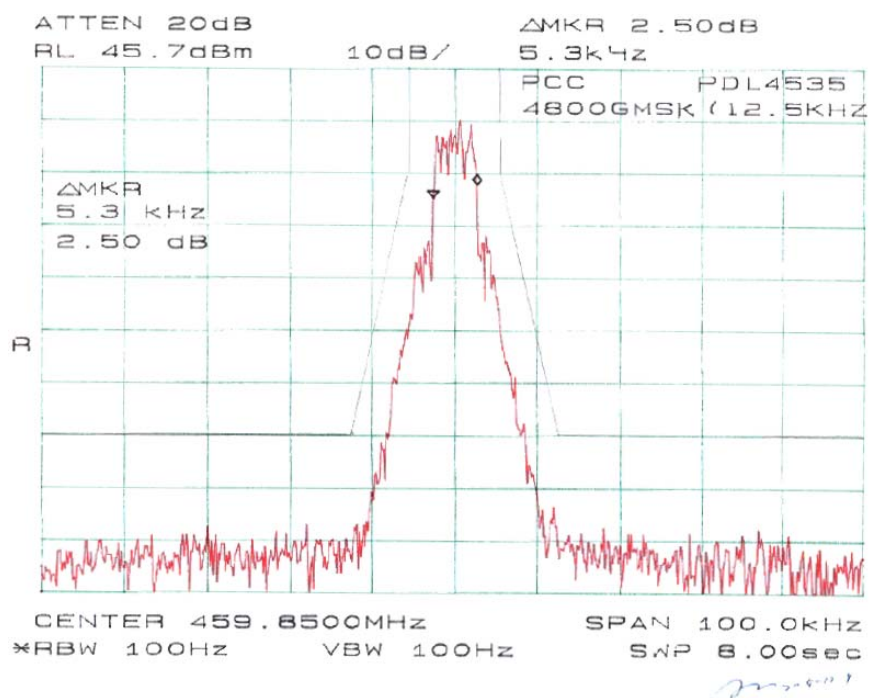
For 6.25KHz Channel bandwidth: 4K9F1D
For 12.5KHz Channel bandwidth: 9K8F1D
For 25 KHz Channel bandwidth: 19K6F1D

For 6.25 kHz Channel Spacing:

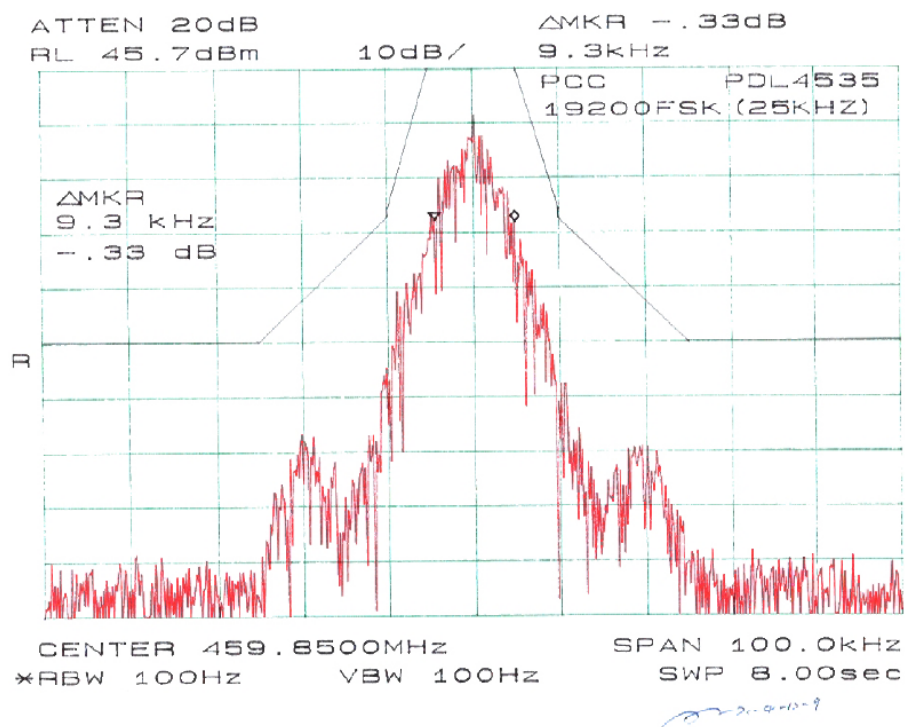


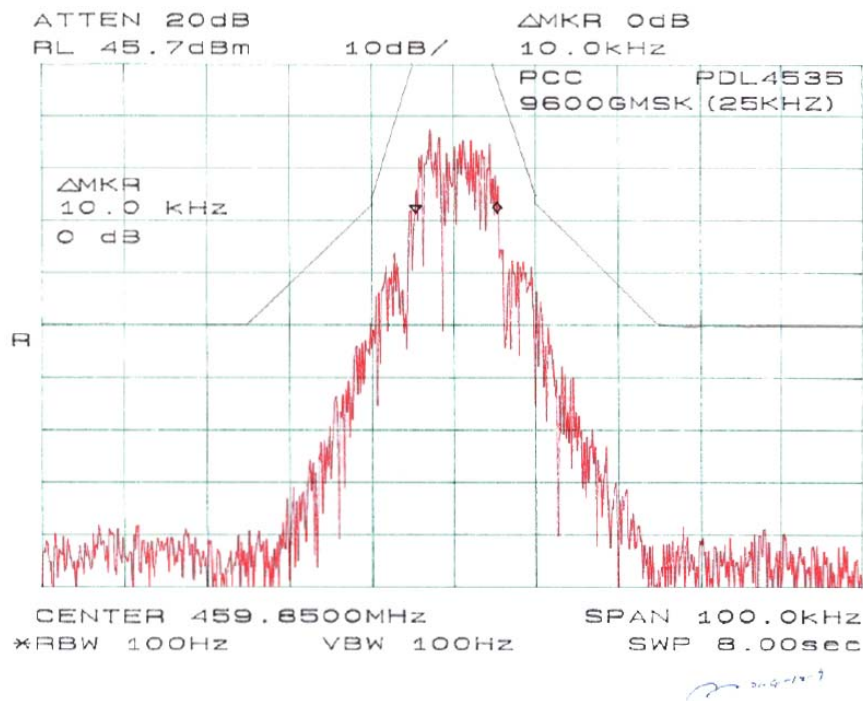
For 12.5 KHz Channel Spacing:





For 25 KHz Channel Spacing:





§2.1051 and §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

§2.1051 and §90.210 (25kHz bandwidth only)

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

$$43+10\log(P)$$

Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	8565EC	3946A00131	2004-06-30
Narda	Attenuator	DC-11	203350	N/A

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

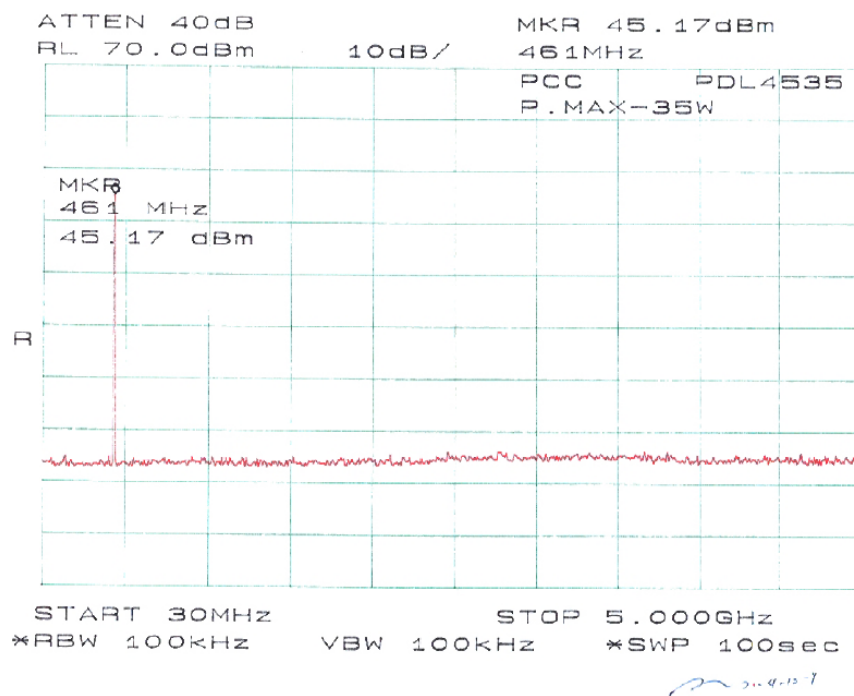
Environmental Conditions

Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jing on 2004-12-09.

Test Results

Please refer to the hereinafter plots.



§2.1053 and §90.210 - RADIATED SPURIOUS EMISSION

Applicable Standard

§2.1053 and §90.210

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = $10 \lg (\text{TXpwr in Watts}/0.001)$ – the absolute level

Spurious attenuation limit in dB = $43 + 10 \log_{10} (\text{power out in Watts})$ for EUT with a 25KHz channel bandwidth.

Spurious attenuation limit in dB = $50 + 10 \log_{10} (\text{power out in Watts})$ for EUT with a 12.5KHz channel bandwidth.

Spurious attenuation limit in dB = $55 + 10 \log (\text{power out in Watts})$, for EUT with a 6.25 kHz channel bandwidth.

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Spectrum Analyzer	8568B	2601A02165	2004-07-03
HP	Amplifier	8447E	2944A10187	2004-09-23
HP	Quasi-Peak Adapter	85650A	3019A05393	2004-06-13
HP	Signal Generator	8657A	2026A00847	2004-08-20
EMCO	Biconical Antenna	3110B	9309-1165	2004-10-11
EMCO	Log Periodic Antenna	3146	2101	2004-10-11
Narda	Attenuator	DC-11	203350	N/A
AH System	Horn Antenna	SAS-200/511	261	2004-08-02

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jing on 2004-12-09.

Test Result

-15.5 dB at 459.85 MHz, for 25 kHz channel bandwidth
 -9.2 dB at 459.85 MHz, for 12.5 kHz channel bandwidth
 -3.1 dB at 1379.55 MHz, for 6.25 kHz channel bandwidth

EUT					Generator						Standard	
Indicated		Table	Test Antenna		Substitution			Antenna	Cable	Absolute	FCC	FCC
Frequency MHz	Ampl. dBuV	Angle Degree	Height Meter	Polar H/V	Frequency MHz	Level dBm	Polar H/V	Gain Corrected	Loss DB	Level dBm	Limit dBm	Margin DB
25 kHz Channel Spacing (Mask C), Low Frequency 459.85 MHz (Mid. Ch.)												
1379.55	39.5	30	1.5	V	1379.55	-35.1	V	7.1	0.5	-28.5	-13	-15.5
1379.55	36.1	90	1.5	H	1379.55	-37.2	H	7.1	0.5	-30.6	-13	-17.6
1839.4	33.5	120	1.5	V	1839.4	-43.3	V	6.8	0.7	-37.2	-13	-24.2
1839.4	29.7	180	1.6	H	1839.4	-46.2	H	6.8	0.7	-40.1	-13	-27.1
919.7	29.7	60	1.5	V	919.7	-47.9	V	6.3	0.3	-41.9	-13	-28.9
919.7	26.8	270	1.6	H	919.7	-51.3	H	6.3	0.3	-45.3	-13	-32.3
12.5 kHz Channel Spacing (Mask C), Low Frequency 459.85 MHz (Mid. Ch.)												
1379.55	39.3	180	1.5	V	1379.55	-35.8	V	7.1	0.5	-29.2	-20	-9.2
1379.55	35.4	45	1.2	H	1379.55	-39.1	H	7.1	0.5	-32.5	-20	-12.5
1839.4	33.1	120	1.5	V	1839.4	-42.2	V	6.8	0.7	-36.1	-20	-16.1
1839.4	28.8	30	1.2	H	1839.4	-47.3	H	6.8	0.7	-41.2	-20	-21.2
919.7	27.1	60	1.5	V	919.7	-49.5	V	6.3	0.3	-43.5	-20	-23.5
919.7	26.5	270	1.6	H	919.7	-49.7	H	6.3	0.3	-43.7	-20	-23.7
6.25 kHz Channel Spacing (Mask E), Low Frequency 459.85 MHz (Mid. Ch.)												
1379.55	39.2	180	1.8	V	1379.55	-34.7	V	7.1	0.5	-28.1	-25	-3.1
1379.55	36.1	180	1.5	H	1379.55	-38.3	H	7.1	0.5	-31.7	-25	-6.7
1839.4	33.1	120	1.5	V	1839.4	-42.1	V	6.8	0.7	-36	-25	-11
1839.4	29.1	180	1.6	H	1839.4	-45.5	H	6.8	0.7	-39.4	-25	-14.4
919.7	28.5	0	1.5	V	919.7	-48.5	V	6.3	0.3	-42.5	-25	-17.5
919.7	27.7	270	1.6	H	919.7	-49.3	H	6.3	0.3	-43.3	-25	-18.3

Note:

- 1) No preamplifier used.
- 2) Test in three orthogonal plane.
- 3) Normal condition

§2.1055 (d) and §90.213- FREQUENCY STABILITY

Applicable Standard

§2.1055 (d)

§90.213

For output power > 2 watts, the limit is 1.0 ppm for 6.25 kHz channel bandwidth.

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

Frequency Stability vs. Voltage: An external variable DC power supply was connected to the equipment under test. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the end point. The output frequency was recorded for each voltage.

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Tenney	Temperature Chamber -50 ⁰ to +100 ⁰ C	Versa	12.222-193	2004-04-23
Agilent	Spectrum Analyzer	8565EC	3946A00131	2004-06-30
Narda	Attenuator	DC-11	203350	N/A

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jing on 2004-12-09.

Test Results

Reference Frequency: 459.85 MHz, Limit: 1.0 ppm			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	13	459.84982	-0.39
40	13	459.84991	-0.19
30	13	459.84995	-0.11
20	13	459.85006	0.13
10	13	459.85009	0.19
0	13	459.85012	0.26
-10	13	459.85015	0.33
-20	13	459.85017	0.37
-30	13	459.85017	0.37

Frequency Stability Versus Input Voltage

Reference Frequency: 459.85 MHz, Limit: 1.0 ppm		
Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
	Frequency (MHz)	Error (ppm)
9	459.85006	0.13
16	459.85006	0.13

Note: 1) Limit 1.0 ppm is for EUT operating with 6.25 KHz channel bandwidth.

§90.214 - TRANSIENT FREQUENCY BEHAVIOR

Standard Applicable

§90.214

Test Method

TIA/EIA-603 2.2.19

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Tektronix	Oscilloscope	TDS7104	B020557	2004-10-09
Narda	Attenuator	DC-11	203350	N/A
HP	Modulation Analyzer	8901A	2026A00847	2004-08-09

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

Environmental Conditions

Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

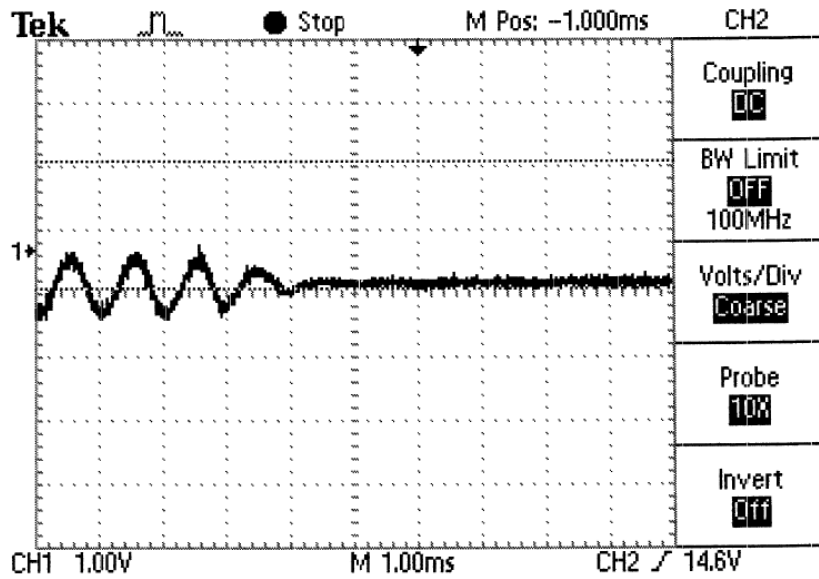
The testing was performed by Ming Jing on 2004-12-09.

Test Result

PDL4535 Transient Frequency Behaviour

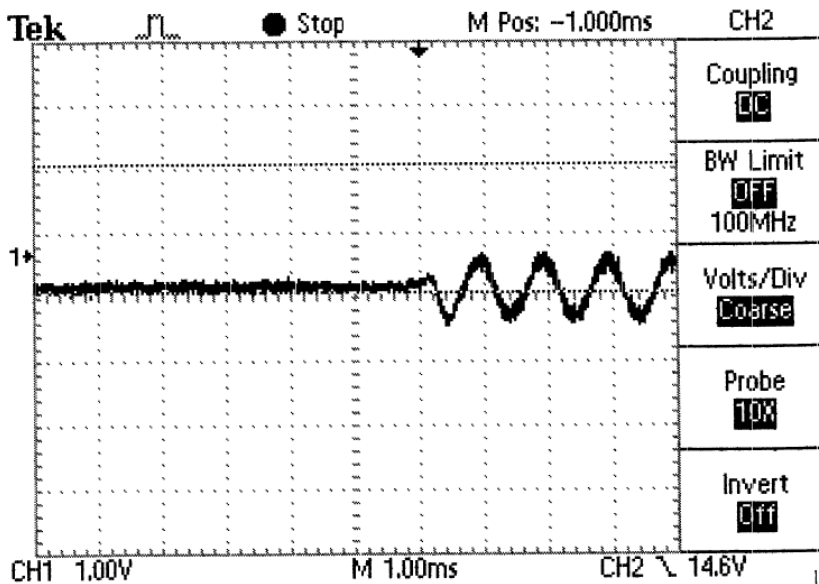
RF Frequency	Channel Bandwidth	Transient Period	Transient Behaviour	Result
459.85MHz	6.25KHz	t1 = 10 ms	< +/- 6.25KHz	Pass
		t2 = 25 ms	< +/- 3.15KHz	
		t3 = 10 ms	< +/- 6.25KHz	
	12.5KHz	t1 = 10 ms	< +/- 12.5KHz	Pass
		t2 = 25 ms	< +/- 6.25KHz	
		t3 = 10 ms	< +/- 12.5KHz	
	25KHz	t1 = 10 ms	< +/- 25KHz	Pass
		t2 = 25 ms	< +/- 12.5KHz	
		t3 = 10 ms	< +/- 25KHz	

Please refer to the plot hereinafter.



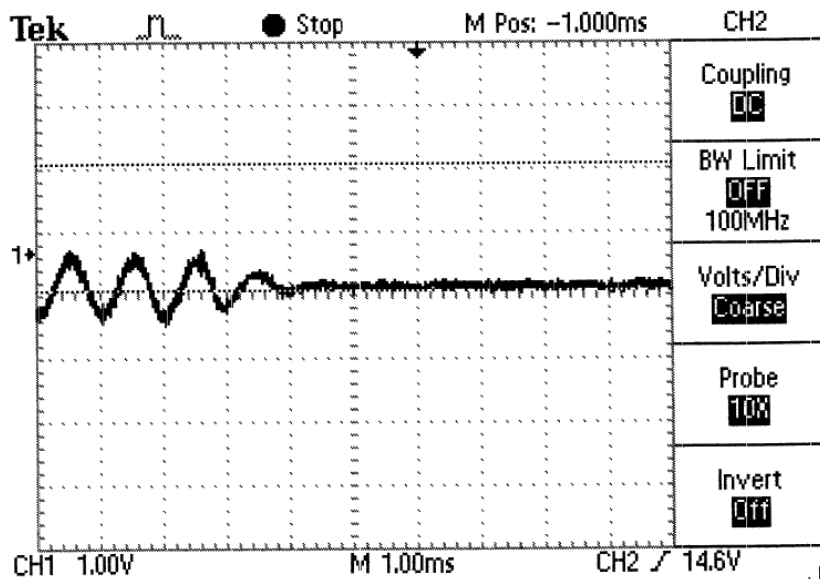
6.25 KHz
4800 4LFSK

T_{ON}

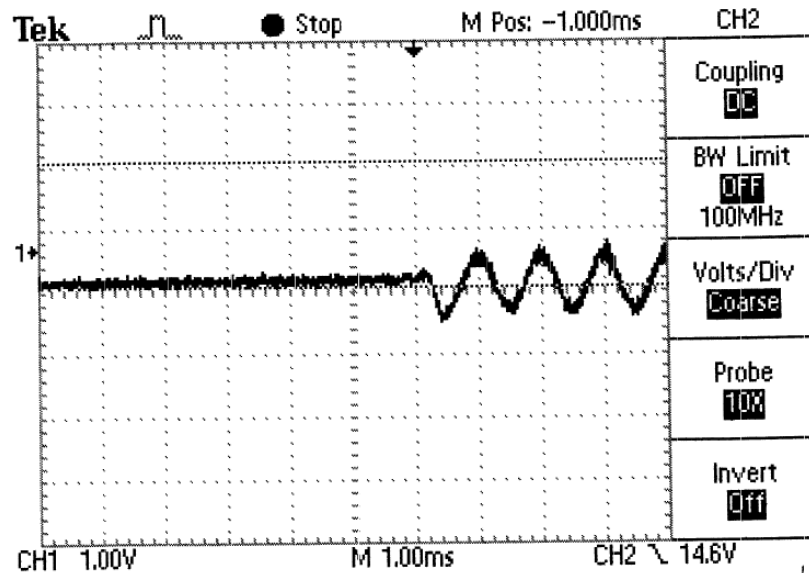


6.25 KHz
4800 4LFSK

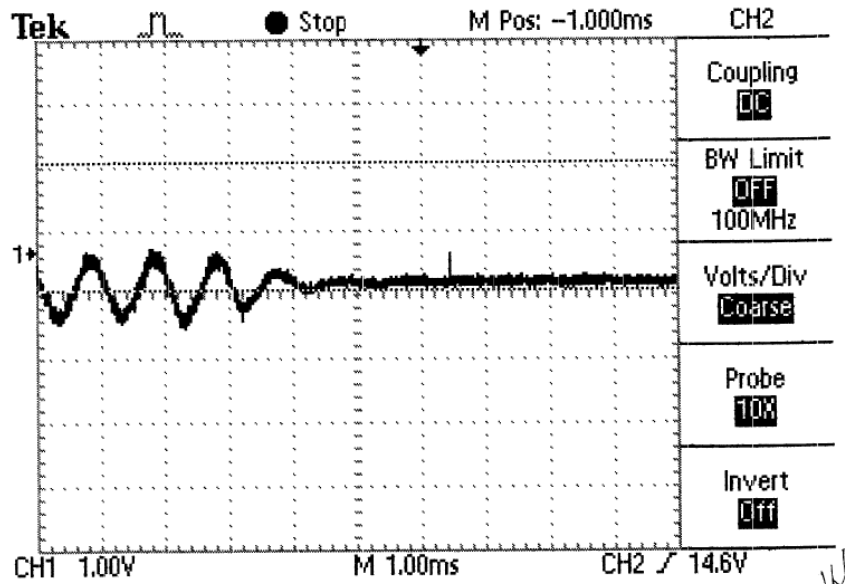
T_{OFF}



12.5KHz
96n 4LF9K Ton



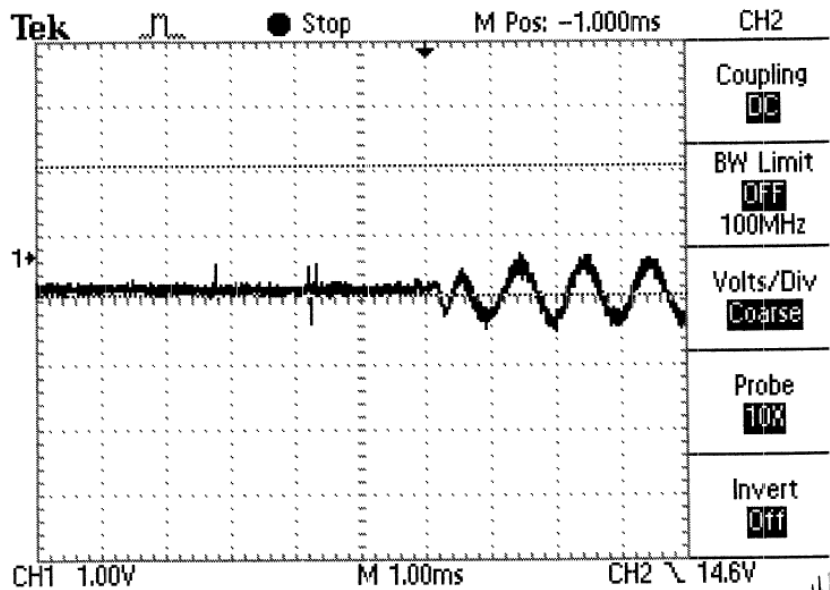
12.5 KHz
96n 4LF8K Toff



25 KHz ; 9600 GMSK

Turn-on Transient

12/07/04



25 KHz ; 9600 GMSK

Turn-off Transient

12/07/04