

EMC Measurement/Technical Report

on

vehicle remote keyless entry transmitter
4F2T-15K601-A



TTI-P-G 178/99

Report Reference: 2_ALPS_1502_TAS_FCCa

7 Layers AG
Borsigstr. 11
40880 Ratingen
Germany

Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the testing laboratory.

Registergericht - registered in:
Ratingen, HRB 3264
Aufsichtsratsvorsitzende -
Chairman of the Supervisory Board:
Dr. Sabine Grobecker

Vorstand - Board of Directors:
Dr. Wolfgang Dahm
Dr. Hans-Jürgen Meckelburg

7 layers AG, Borsigstrasse 11
40880 Ratingen, Germany
Phone: +49 (0) 2102 749 0
Fax: +49 (0) 2102 749 350
<http://www.7Layers.com>



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0 Summary

0.1 Technical Report Summary

Type of Authorization:

Certification for an Intentional Radiator (Periodic operation in the band above 70 MHz)

Applicable FCC Rules:

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 0 to 19 (10-1-98 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification Sections

Part 15, Subpart C - Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits (not applicable for battery powered equipment)

§ 15.209 Radiated emission limits; general requirements

§ 15.231 Periodic operation in the band 40.66-40.70 MHz, above 70 MHz

Note:
none

Summary Test Results:

The EUT complied with all the applicable FCC rules as listed above.



0.2 Measurement Summary

FCC Part 15, Subpart C,231 § 15.231(b)

Spurious Radiated Emissions

The measurement was performed according to ANSI C63.4 1992

OP-Mode	Setup	Port	Final Result
op-mode 2	setup 1	enclosure	passed

FCC Part 15, Subpart C,231

Dwell Time measurement to determine the duty cycle

The measurement was performed according to FCC §15.31 10-1-1998

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 1	enclosure	

FCC Part 15, Subpart C,231 § 15.231(a)

Occupied Bandwidth

The measurement was performed according to ANSI C63.4 1992

OP-Mode	Setup	Port	Final Result
op-mode 1	setup 1	enclosure	passed

Responsible for
Accreditation
Scope: _____

Responsible
for Test Report: _____



1. Administrative Data

1.1 Testing Laboratory

Company Name: 7 Layers AG
Address: Borsigstr. 11
40880 Ratingen
Germany

This facility has been fully described in a report submitted to the FCC and accepted in a letter dated February 07, 2000 under the registration number 96716.

The test facility is also accredited by the following accreditation organisation:

- Deutscher Akkreditierungs Rat DAR-Registration no. TTI-P-G 178/99

Responsible for Accreditation Scope: Dipl.-Ing Bernhard Retka
Dipl.-Ing Arndt Stöcker

1.2 Project Data

Responsible for testing and report: Robert Machulec
Receipt of EUT: 05.09.2002
Date of Test(s): 12.09.2002-16.09.2002
Date of Report: 17.09.2002

1.3 Applicant Data

Company Name: ALPS Automotive Inc.
Address: 1500 Atlantic Boulevard

48326 Auburn, Michigan
USA
Contact Person: Mr. Don Clark

1.4 Manufacturer Data

Company Name: please see Applicant data
Address:

Contact Person:



2.0 Product Labeling

2.1 FCC ID Label:

At the time of the test report there was no FCC label available

2.2 Location of Label on the EUT:

see above

3. Testobject Data

3.1 General EUT Description

Equipment under Test:	vehicle remote keyless entry transmitter
Type Designation:	4F2T-15K601-A
Kind of Device: (optional)	315 MHz transmitter
Voltage Type:	DC
Voltage level:	3.0 V

General product description:

The vehicle remote keyless entry transmitter 4F2T-15K601-A is a wireless handheld remote control unit.

(Transmitter only, periodic operation in the band above 70 MHz)
the operating frequency is 315 MHz.

The transmitter is activated manually by a switch and is deactivated automatically within 5 seconds after release of the switch.

The vehicle remote keyless entry transmitter 3L7T-15K601-A and 3F2T-15K601-A are identical built except of the push button configuration.

The EUT provides the following ports:

Ports

enclosure

The main components of EUT are listed and described in Chapter 3.2



3.2 EUT Main components: Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A	vehicle remote keyless entry transmitter	4F2T-15K601-A	-	-	-	05.09.2002

wireless handheld remote control unit, transmitter only

NOTE: The short description is used to simplify the identification of the EUT in this test report

3.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But never the less Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial No.	FCC Id
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3.4 EUT Setups

This chapter describes the combination of EUT's and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
setup 1	EUT A	

3.5 Operating Modes

This chapter describes the operating modes of the EUT's used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	periodic operation	Transmitter is sending a pulse coded signal (periodic operation)
op-mode 2	continues operation	Transmitter is sending a CW signal. (continues operation)

4. Test Results

4.1 Spurious Radiated Emissions

Standard FCC Part 15, 10-1-98
Subpart C,231

The test was performed according to: ANSI C63.4 1992

4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4-1992.

The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The test was performed at an EUT to receiving antenna distance of 3m.

The radiated emissions measurements was made in a typical installation configuration.

The measurement procedure consists of four steps. It is implemented into EMI test software ES-K1 from R&S.

Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 μ s
- Turntable angle range: -180 to 180 °
- Turntable stepsize: 90 °
- Height variation range: 1 – 3m
- Height variation stepsize: 2m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. With this data, the test system performs (to reduce the number of final measurements) a data reduction with the following parameters:

- Offset for acceptance analysis: Limit line – 10 dB
- Maximum number of final measurements: 12

Step 2:

With the frequencies determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

Settings for step 2:

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: -180 to 180 °
- Turntable stepsize: 45 °

- Height variation range: 1 – 4m
- Height variation stepsize: 0,5m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0,5m

Step 3:

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency the turntable azimuth and antenna height, which was determined in step 3, will be adjusted.

The turntable azimuth will be slowly varied by +/- 22,5° around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by +/- 25 cm around the antenna height determined in step 3. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

Settings for step 3:

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: -22,5° to + 22,5 ° around the value determined in step 2
- Height variation range: -0,25m to + 0,25m around the value determined in step 2

Step 4:

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak(< 1GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1s

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

The measurement distance was reduced to 1m. The results were extrapolated by the extrapolation factor of 20 dB/decade (invers linear-distance for field strength measurements, invers linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 Ghz) and a horn antenna (18-25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.



Detector: Peak, Average
RBW = VBW = 1 MHz, above 7 GHz 100 kHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

4.1.2 Test Limits

FCC Part 15, Subpart C, §15.231(b)

(1) A radiated emission test applies to the fundamental frequency.

Frequency Range (MHz):	Limit (dB μ V/m)
40.66 – 40.70	67,04
70 – 130	67,04
130 – 174	67,04 – 71.48
174 – 260	71.48
260 – 470	71.48 – 81.93
above 470	81.93

(2) A radiated emission test applies to harmonic/spurs that fall in the restricted bands as listed in § 15.205(a). The maximum permitted QP (< 1GHz) and average (> 1GHz) field strength is listed in § 15.209(a).

(3) FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency Range (MHz):	Class B Limit (dB μ V/m)
30 – 88	40,0
88 – 216	43,5
216 – 960	46,0
above 960	54,0

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dB μ V/m) = 20 log (Limit (μ V/m)/1 μ V/m)

4.1.3 Test Protocol

Temperature: 27°C
 Air Pressure: 1012 hPa
 Humidity: 38%

Op. Mode **Setup** **Port** **Test Parameter**
 op-mode 2 setup 1 enclosure

Polarisation	Frequency MHz	Corrected Value dBµV/m			Limit QP/AV dBµV/m	Limit Peak dBµV/m	Delta to AV/QP Limit/dB	Delta to Peak Limit dB
		QP	Peak	AV				
Vertical	315,00			74,00	75,60		1,60	
Vertical	630,00			55,20	55,60		0,40	
Vertical	945,00			47,40	55,60		8,20	
Vertical	1260,00			49,12	55,60		6,48	
Vertical	1575,00			37,75	54,00		16,25	
Vertical	1890,00			39,69	55,60		15,91	
Vertical	2205,00			47,29	54,00		6,71	
Vertical	2520,00			34,27	55,60		21,33	
Vertical	2835,00			34,81	54,00		19,19	
Vertical	3150,00			38,37	55,60		17,23	

Remark: The test was performed in the frequency range from 30MHz to 3.2GHz.
 For this test a EUT sending a CW signal was used.
 The valuelisted above includes the correction factor of the test system and the duty cycle of 1 / 4 or -12 dB

4.1.3 Test result: Spurious Radiated Emissions

FCC Part 15, Subpart C,231	Op. Mode	Setup	Port	Result
	op-mode 2	setup 1	enclosure	passed

4.2 Dwell Time measurement to determine the duty cycle

Standard FCC Part 15, 10-1-98
Subpart C,231

The test was performed according to: FCC §15.31 10-1-1998

4.2.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room.

For analyzer settings please see measurement plots in annex.

4.2.2 Test Limits

Less than 5 seconds.

This test is also performed to determine the duty cycle of the transmitter and calculate the correction factor for pulse modulated transmitter.

This factor is used as a correction factor for the field strength measurement.

4.2.3 Test Protocol

Temperature: 25°C

Air Pressure: 1024 hPa

Humidity: 46 %

Op. Mode	Setup	Port	Test Parameter
op-mode 1	setup 1	enclosure	

Dwell time ms	Remarks
	DW-time measurement to determine the duty cycle. Please see annex for the measurement plot.

Remark: This test is performed to determine the duty cycle.
The on / off ratio within a cycle is 0.5.
The on / off ratio within a data word is 0.5.
The duty cycle is 0.25 or $20 \times \log(0.25) = -12\text{dB}$

4.2.3 Test result: Dwell Time measurement to determine the duty cycle

FCC Part 15, Subpart C,231	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	enclosure	

4.3 Occupied Bandwidth

Standard FCC Part 15, 10-1-98
Subpart C,231

The test was performed according to: ANSI C63.4 1992

4.3.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room.

For analyzer settings please see measurement plots in annex.

4.3.2 Test Limits

FCC Part 15, Subpart C, §15.231 (c)

The maximum 20 dB bandwidth of a transmitter operating at a frequency range:

70 MHz to 900 MHz is 0.25% of the center frequency

above 900 MHz : is 0.5% of the center frequency

4.3.3 Test Protocol

Temperature: 25°C

Air Pressure: 1024 hPa

Humidity: 46%

Op. Mode	Setup	Port	Test Parameter
op-mode 1	setup 1	enclosure	

20 dB Bandwidth MHz	Remarks
0,74	Please see annex for the measurement plot.

Remark: none

4.3.3 Test result: Occupied Bandwidth

FCC Part 15, Subpart C,231	Op. Mode	Setup	Port	Result
	op-mode 1	setup 1	enclosure	passed

5. Testequipment

Rohde & Schwarz TS8960

Bluetooth RF Conformance Test System

Equipment	Type	Serial No.	Manufacturer
10MHz Reference	MFS	5489/001	Efratom
Laserprinter	Laserjet 2100	FRFJ023447	HP
Monitor 19"	Flexscan T68	50565029 -ED	EIZO
Power Meter	NRVD	832025/059	Rohde & Schwarz
Power Sensor	NRV-Z1	832279/015	Rohde & Schwarz
Power Sensor	NRV-Z1	832279/013	Rohde & Schwarz
Power Supply	E3632A	MY40003776	Agilent
Power Supply	PS-2403D	-	Conrad
RF Step Attenuator	RSP	833695/001	Rohde & Schwarz
Rubidium Frequency Normal	MFS	002	Efratom
Signal Analyser	FSIQ26	832695/007	Rohde & Schwarz
Signal Analyser	FSP30	100051	Rohde & Schwarz
Signal Generator	SMIQ03B	832870/017	Rohde & Schwarz
Signal Generator	SMIQ03B	834344/002	Rohde & Schwarz
Signal Generator	SMIQ03B	101175	Rohde & Schwarz
Signal Generator	SMP 03	833680/003	Rohde & Schwarz
Signal Switching and Conditioning Unit	SSCU	338826/005	Rohde & Schwarz
Signalling Unit	PTW60 for TS8960	838312/014	Rohde & Schwarz
System Controller	PSM12	829323/008	Rohde & Schwarz

EUT Digital Signalling System

Equipment	Type	Serial No.	Manufacturer
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz
Signalling Unit for Bluetooth Spurious Emissions	PTW60	100004	Rohde & Schwarz

EMI Test System

Equipment	Type	Serial No.	Manufacturer
Comparison Noise Emitter	CNE III	99/016	York
EMI Analyzer	ESI 26	830482/004	Rohde & Schwarz
Signal Generator	SMR 20	846834/008	Rohde & Schwarz

EMI Radiated Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer
Antenna mast 4m	MA 240	240/492	HD GmbH H. Deisel
Biconical dipole	VUBA 9117	9117108	Schwarzbeck
Broadband Amplifier 45MHz-27GHz	JS4-00102600-42-5A	619368	Miteq
Cable "ESI to EMI Antenna"	RTK081+Aircell7	W18.01+W38.01a	Huber+Suhner
Cable "ESI to Horn Antenna"	RTK 081	W18.04+3599/001	Rosenberger
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
KUEP pre amplifier	Kuep 00304000	001	7layers
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz
Pyramidal Horn Antenna 26,5 GHz	Model 3160-09	9910-1184	EMCO

EMI Conducted Auxiliary Equipment

Equipment	Type	Serial No.	Manufacturer
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber+Suhner
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz

Auxiliary Test Equipment

Equipment	Type	Serial No.	Manufacturer
Broadband Resist. Power Divider N	1506A / 93459	LM390	Weinschel
Broadband Resist. Power Divider SMA	1515 / 93459	LN673	Weinschel
Digital Multimeter 01	Voltcraft M-3860M	IJ096055	Conrad
Digital Multimeter 02	Voltcraft M-3860M	IJ095955	Conrad
Digital Oscilloscope	TDS 784C	B021311	Tektronix
Fibre optic link Satellite	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver	FO RS232 Link	182-018	Pontis
I/Q Modulation Generator	AMIQ-B1	832085/018	Rohde & Schwarz
Notch Filter ultra stable	WRCA800/960-6EEK	24	Wainwright
Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz
Temperature Chamber	KWP 120/70	59226012190010	Weiss
Temperature Chamber	VT 4002	58566002150010	Vötsch
ThermoHygro_01	430202		Fischer

Anechoic Chamber

Equipment	Type	Serial No.	Manufacturer
Air Compressor (pneumatic)			Atlas Copco
Controller	HD 100	100/603	HD GmbH H. Deisel
EMC Camera	CE-CAM/1		CE-SYS
EMC Camera for observation of EUT	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter telephone systems / modem	B84312-C40-B1		Siemens&Matsushita
Filter Universal 1A	B84312-C30-H3		Siemens&Matsushita
Fully/Semi AE Chamber	10.58x6.38x6		Frankonia
Turntable	DS 420S	420/573/99	HD GmbH, H. Deisel
Valve Control Unit (pneum.)	VE 615P	615/348/99	HD GmbH, H. Deisel

6. Foto Report



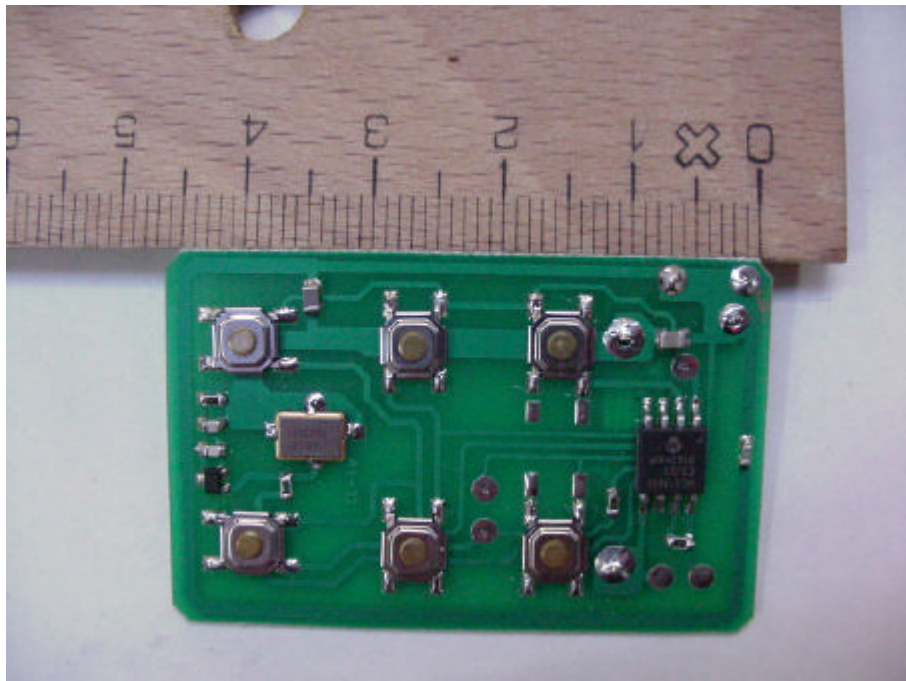
Picture 1 : vehicle remote keyless entry transmitter: 4F2T-15K601-A, front view



Picture 2 : vehicle remote keyless entry transmitter: 4F2T-15K601-A, rear view



Picture 3 : vehicle remote keyless entry transmitter: 2S4T-15K601-AA, inside view



Picture 4 : vehicle remote keyless entry transmitter: 2L3T-15K601-AA, PCB front view



7. Setup Drawings

8. Annex

measurement plots

Dwell Time measurement to determine the duty cycle

Op. Mode

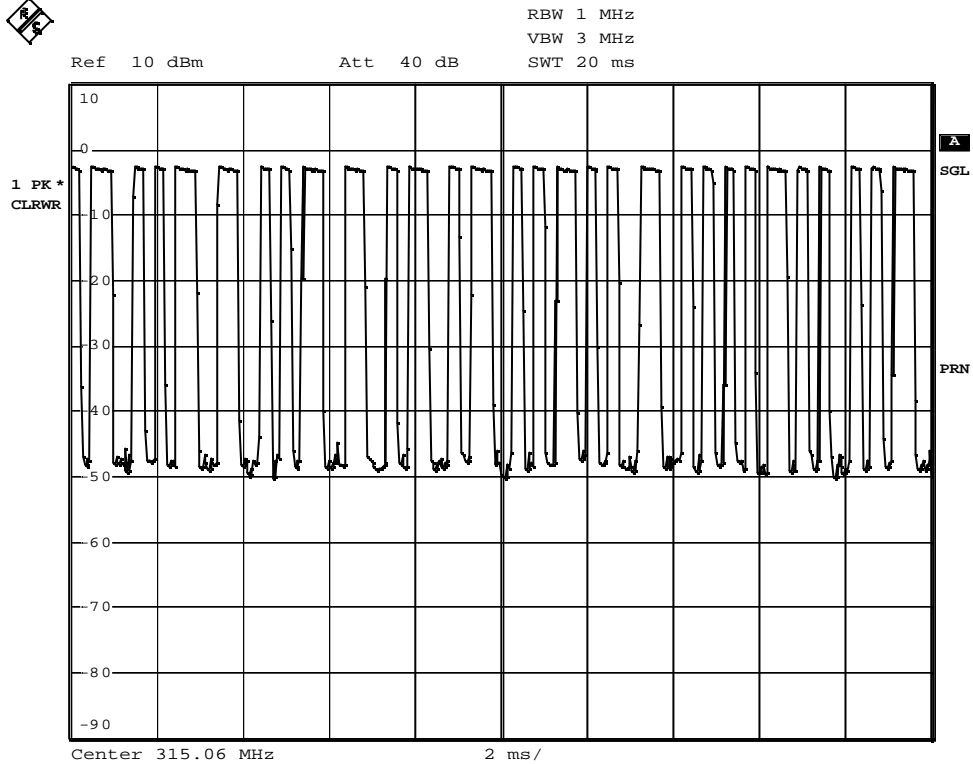
op-mode 1 periodic operation

Setup

setup 1

Port

enclosure



Date: 12.SEP.2002 13:30:45

sweep of a data word

Dwell Time measurement to determine the duty cycle

Op. Mode

op-mode 1 periodic operation

Setup

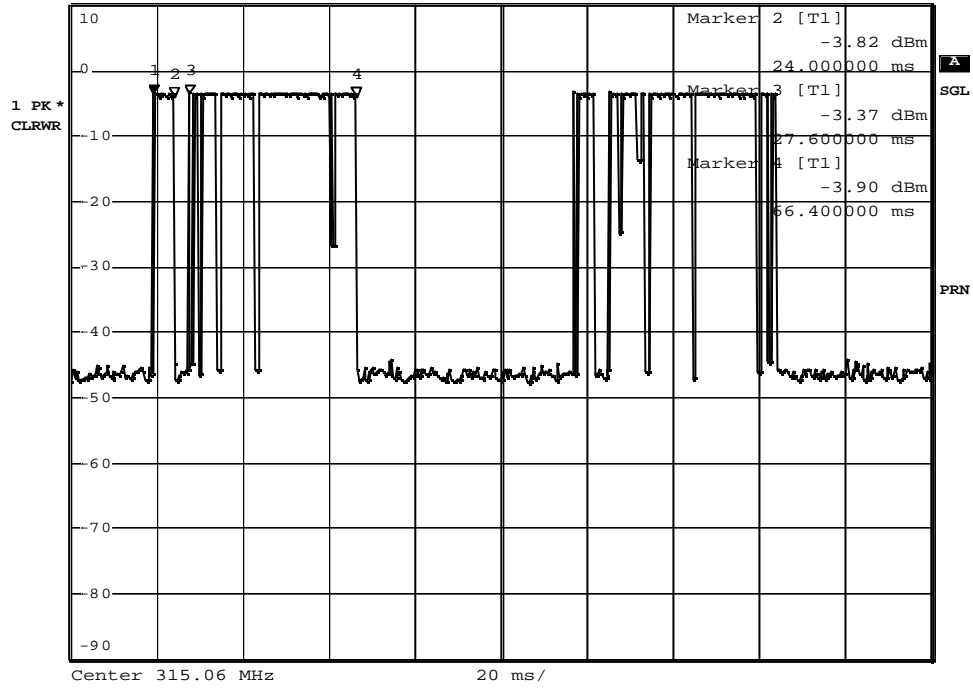
setup 1

Port

enclosure



Ref 10 dBm Att 40 dB RBW 1 MHz Marker 1 [T1] -3.31 dBm
 VBW 3 MHz SWT 200 ms 19.200000 ms



Date: 12.SEP.2002 13:27:55

200 ms sweep. Of 2 cycles to determine the on / off ration within a cycles . Ratio is 0.5

Dwell Time measurement to determine the duty cycle

Op. Mode

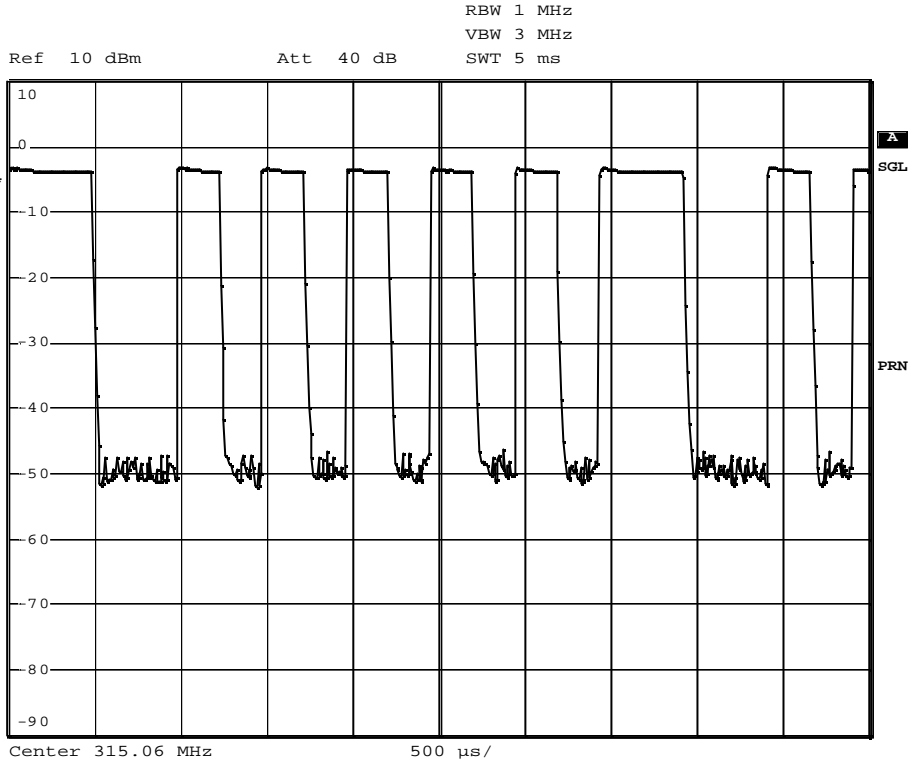
op-mode 1 periodic operation

Setup

setup 1

Port

enclosure



Date: 12.SEP.2002 13:31:52

sweep of a data word to determine the on / off ration within a data word. Ratio is 0.5

Occupied Bandwidth

Op. Mode

op-mode 1 periodic operation

Setup

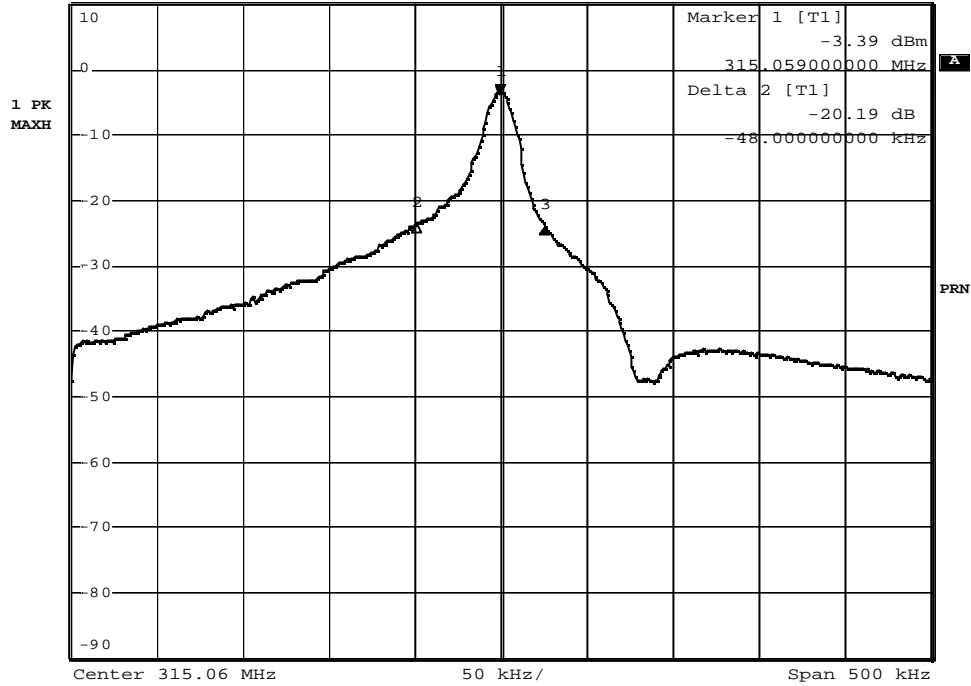
setup 1

Port

enclosure



Ref 10 dBm Att 40 dB RBW 10 kHz Delta 3 [T1] -20.23 dB
 VBW 30 kHz SWT 5 ms 26.000000000 kHz



Date: 12.SEP.2002 12:54:27

20 dB bandwidth