



TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Dynex Semiconductor Ltd
DA5823-C33 Mass Movement Sensor

To: FCC Part 15 Subpart C
(Intentional Radiators)
Section 15.245

Test Report Serial No:
RFI/MPTB1/RP44233JD08A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: pp 
Tested By: 	Release Version No: PDF01
Issue Date: 28 April 2003	Test Dates: 14 April 2003 to 15 April 2003

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The results in this report apply only to the sample(s) tested.

RADIO FREQUENCY INVESTIGATION LTD.

Operations Group

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1. Client Information

Company Name:	Dynex Semiconductor Ltd
Address:	Lincoln Industrial Park Doddington Road Lincoln Lincolnshire LN6 3LF
Contact Name:	Mr J Ashburner

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2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification Of Equipment Under Test (EUT)

Brand Name:	Dynex Semiconductor
Model Name or Number:	DA5823-C33
Unique Type Identification:	Not applicable
Serial Number:	DA5823-033-031404-00488
Country of Manufacture:	UK
FCC ID Number:	MAYDA58233
Date of Receipt:	07 April 2003

2.2. Description Of EUT

The Dynex Semiconductor Mass Movement Sensor, DA5823-C33 is a volumetric microwave Doppler radar sensor that operates at 2.45 GHz in the ISM band, and is intended for automotive applications.

2.3. Modifications Incorporated In EUT

The EUT has not been modified from the Model Name or Unique Type Identification number stated above.

2.4. Additional Information Related To Testing

Power Supply Requirement:	DC supply of 12 Volts
Intended Operating Environment:	Vehicle Interior
Weight:	0.06 kg
Dimensions:	71.8 x 76.2 x 18.6 mm
Interface Ports:	DC Connector (JAE) ILAG5-5PK-S3L2-LB

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2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Programming Box
Brand Name:	Dynex Manufacture
Model Name or Number:	None stated by client
Serial Number:	None stated by client
FCC ID Number:	None stated by client
Cable Length And Type:	250 mm multicore
Connected to Port:	(Interface Unit)

Description:	Interface Unit
Brand Name:	Dynex Manufacture
Model Name or Number:	None stated by client
Serial Number:	None stated by client
FCC ID Number:	None stated by client
Cable Length And Type:	400 mm multicore
Connected to Port:	Power, Control and Output

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3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	FCC Part 15: 2001 Subpart C (Intentional Radiators) Section 15.245
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices: Intentional radiators.
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complies with the requirements of the specification for the purpose of certification.

3.2. Methods And Procedures

The methods and procedures used were as detailed in:

ANSI C63.2 (1996)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2001)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1998)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1 (1999)

Title: Specification for radio disturbance and immunity measuring apparatus and methods. Part 1. Radio disturbance and immunity measuring apparatus.

3.3. Definition Of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the Methods & Procedures section above. Appendix 1 contains a list of the test equipment used.

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4. Deviations From The Test Specification

None

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5. Operation Of The EUT During Testing

5.1. Operating Conditions

The EUT was tested in normal operating conditions.

5.2. Operating Modes

The EUT was operated in its normal operation (sensing movement).

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

Set for normal operation (sensing movement).

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6. Summary Of Test Results

6.1. Radiated Emissions

Range Of Measurements	Specification Reference	Compliance Status
Electric Field Strength, Fundamental Emission	Section 15.245 of C.F.R. 47	Complied
Electric Field Strength of Spurious Emissions, 1000 MHz to 26500 MHz	Section 15.245 of C.F.R. 47	Complied
Electric Field Strength, Band Edges	Section 15.245 of C.F.R. 47	Complied

6.2. Location Of Tests

All the measurements described in this report were performed at the premises of Radio Frequency Investigation Ltd., Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ.

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7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only. Details of the test methods and procedures can be found in Appendix 2 of this report.

7.1.2. Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 8 for details of measurement uncertainties.

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7.2. Radiated Emissions

7.2.1. Electric Field Strength Measurements: Fundamental Emission

7.2.1.1. The following tables list the frequency at which the fundamental emission was measured using a peak detector function. Average figures were calculated using a duty cycle correction factor of 25.7 dB.

7.2.1.2. Plots of the initial scans can be found in Appendix 4.

Average Levels

Frequency (MHz)	Antenna Polarity (H/V)	Av. Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Av Level (dB μ V/m)	Av. Limit (dB μ V/m)	Margin (dB)	Result
2449.30	Horiz.	42.25	20.6	1.3	64.15	114	49.85	Complied

Peak Levels

Frequency (MHz)	Antenna Polarity (H/V)	Peak. Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
2449.30	Horiz.	69.95	20.6	1.3	89.87	134	44.15	Complied

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7.2.2. Electric Field Strength Measurements (30 to 26500 MHz)

7.2.2.1. The client has stated that the highest clock frequency for the EUT was 2452 MHz. Therefore tests were required up to 10 times this frequency and, for convenience, performed up to 26500 MHz.

7.2.2.2. Radiated spurious emission limits shown in section 15.245 (b) (3) state that spurious emissions, except for harmonics, shall not exceed a level of 50 dB below the fundamental carrier, or the limit specified in section 15.209, whichever is the higher limit.

7.2.2.3. Due to dynamic range limitations of the measuring receiver, scans at frequencies between 4 GHz and 12.5 GHz were performed at a 1 m measurement distance, whilst scans above 12.5 GHz were performed at a 0.3 m measurement distance. The measured value was then corrected by 9.5 dB or 20 dB using the formula $20\log(D1/D2)$ Where D1 was 3 m and D2 was 1 m or 0.3 m

7.2.2.4. The following tables list frequencies at which emissions were measured using a peak detector function. Average figures were calculated using a duty cycle correction factor of 25.7 dB.

7.2.2.5. All the detected emissions are harmonics.

Average Levels

Frequency (MHz)	Antenna Polarity (H/V)	Average Level (dB μ V)	Antenna Factor (dB)	Cable Loss (dB)	Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
4899.105	Horiz.	17.83	12.9	1.8	32.53	54	21.47	Complied
7348.730	Horiz.	11.70	17.3	2.0	31.00	54	23.00	Complied
9798.030	Horiz.	4.80	18.8	2.2	25.80	64	38.20	Complied
12247.68	Horiz.	11.94	18.9	2.3	33.14	54	20.86	Complied
14696.95	Horiz.	13.34	11.2	2.5	27.04	64	36.96	Complied

Peak Levels

Frequency (MHz)	Antenna Polarity (H/V)	Peak Level (dB μ V)	Antenna Factor (dB)	Cable Loss (dB)	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
4899.105	Horiz.	43.53	12.9	1.8	58.23	74	15.77	Complied
7348.730	Horiz.	37.40	17.3	2.0	56.70	74	17.30	Complied
9798.030	Horiz.	30.50	18.8	2.2	51.50	84	32.50	Complied
12247.68	Horiz.	37.64	18.9	2.3	58.84	74	15.16	Complied
14696.95	Horiz.	39.04	11.2	2.5	52.74	84	31.26	Complied

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7.2.3. Electric Field Strength Measurements: (Emissions at Band Edges):

7.2.3.1. The EUT and spectrum analyser was configured as for radiated emission measurements.

7.2.3.2. The following table lists the field strength for the emissions at the band edges for the EUT.

7.2.3.3. A duty cycle correction factor of 25.7 dB has been applied to the peak measurements in order to calculate the average levels.

7.2.3.4. Plots showing the responses at the band edges can be found in Appendix 4.

Average Levels

Frequency (MHz)	Antenna Polarity (H/V)	Average Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Average Level (dB μ V/m)	Average Limit (dB μ V/m)	Average Margin (dB)	Result
2433.00	Horiz.	4.72	20.6	1.3	26.62	54	27.38	Complied
2474.00	Horiz.	1.55	20.6	1.3	23.45	54	30.55	Complied

Peak Levels

Frequency (MHz)	Antenna Polarity (H/V)	Peak Detector level (dB μ V)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB)	Result
2433.00	Horiz.	30.42	20.6	1.3	52.32	74	21.68	Complied
2474.00	Horiz.	27.25	20.6	1.3	49.15	74	24.85	Complied

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8. Measurement Uncertainty

8.1. No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

8.2. The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

8.3. The uncertainty of the result may need to be taken into account when interpreting the measurement results.

8.4. The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level	Calculated Uncertainty
Radiated Emissions at 3.0 m	30 MHz to 26.5 GHz	95%	+/- 1.78 dB

8.5. The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

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Appendix 1. Test Equipment Used

RFI No.	Instrument	Maker	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	557
A197	Site 2 Controller SC144	-	SC144	150720
A1059	WG22 to K-Type Coaxial Adapter	Flann Microwave	22094-KF20	2017
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A255	WG 16 Microwave Horn	Flann Microwave	16240-20	519
A428	WG 12 horn	Flann	12240-20	134
A430	WG 18 horn	Flann	18240-20	425
A553	Bi-log Antenna	Chase	CBL6111A	1593
C1082	Rosenberger Cable 2m	Rosenberger	FA210A1020M50 50	28463-1
C222	Cable	Rosenberger	UFA210A-1-1181- 70x70	None
C346	Coaxial Cable	Rosenberger	UFA210A-1-1181- 70x70	1932
M072	FSM Spectrum Analyser	Rohde & Schwarz	FSM	862 967/010 (RF) & 863 912/048 (Display)
M505	Analyser Display Unit	Rohde & Schwarz	ESAI-D	825316/010
M506	RF unit	Rohde & Schwarz	ESBI-RF	827060/004
S202	Site 2	RFI	2	S202-15011990
S209	Site 9	RFI	9	
S011	D.C. PSU	INSTEK	PR-3010H	9401270

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

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Appendix 2. Measurement Methods

A2.1. Radiated Emissions

A2.1.1. Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

A2.1.2. Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.1.3. The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested on the open area test site, at the appropriate distance, using a measuring receivers with a Quasi-Peak detector (below 1000 MHz), where applicable, for measurements above 1000 MHz average and peak detectors were used.

A2.1.4. For the main (final) measurements the EUT was arranged on a non-conducting table on an open area test site, as detailed in the specification.

A2.1.5. All measurements on the open area test site were performed using broadband antennas.

A2.1.6. On the open area test site, at each frequency where a signal was found, the levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m. At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

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A2.1.7. The test equipment settings for radiated emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements Below 1GHz	Final Measurements Above 1 GHz
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak/Average
Mode:	Max Hold	Not applicable	Not applicable
Bandwidth:	100 kHz	120 kHz	1 MHz
Amplitude Range:	60 dB	20 dB	20 dB (typical)
Measurement Time:	Not applicable	> 1 s	> 1 s
Observation Time:	Not applicable	> 15 s	> 15 s
Step Size:	Continuous sweep	Not applicable	Not applicable
Sweep Time:	Coupled	Not applicable	Not applicable

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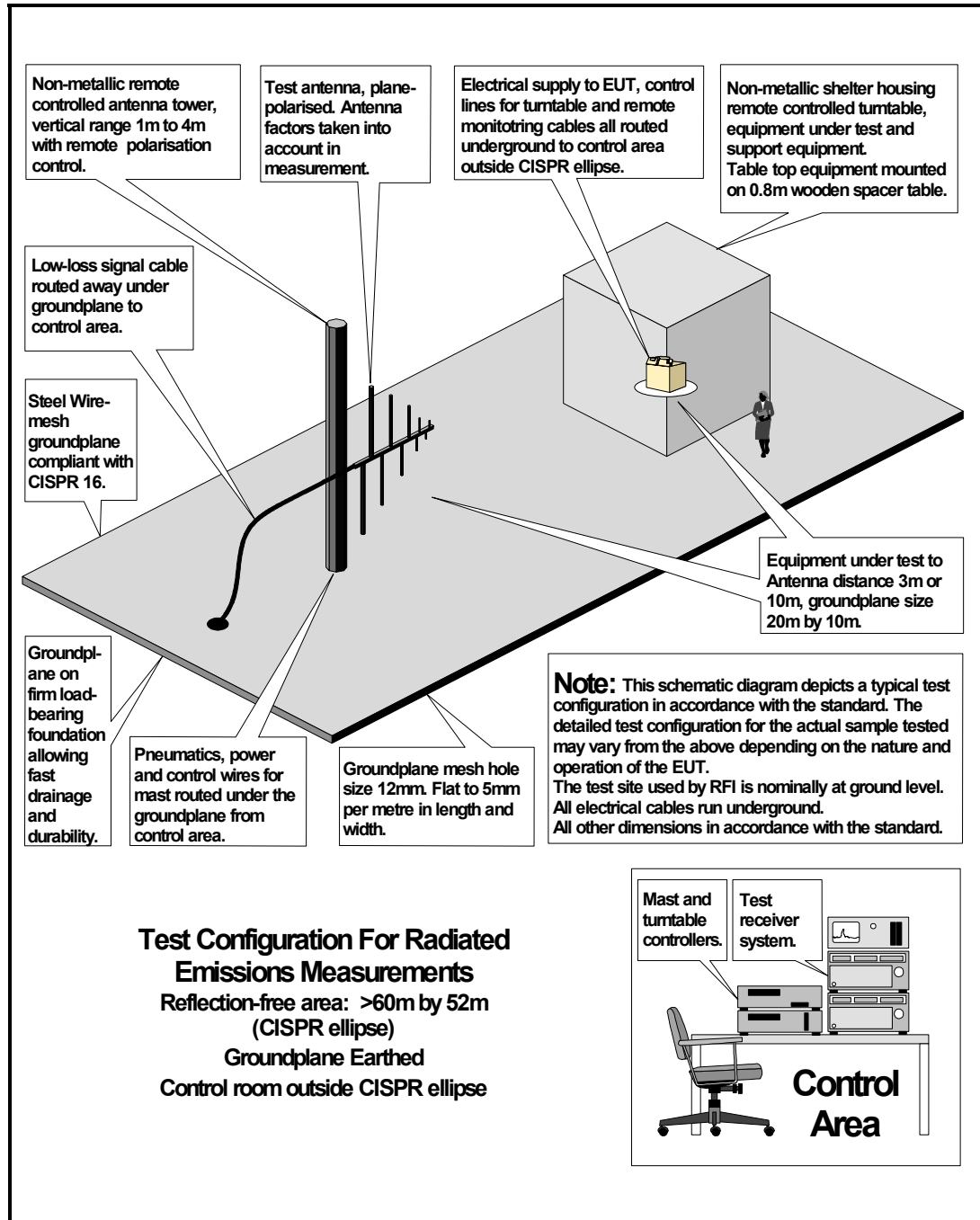
Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\44233JD08\EMIRAD	Test configuration for radiated emissions measurement
DRG\44233JD08\001	Schematic diagram of the EUT, support equipment and interconnecting cables used for the test

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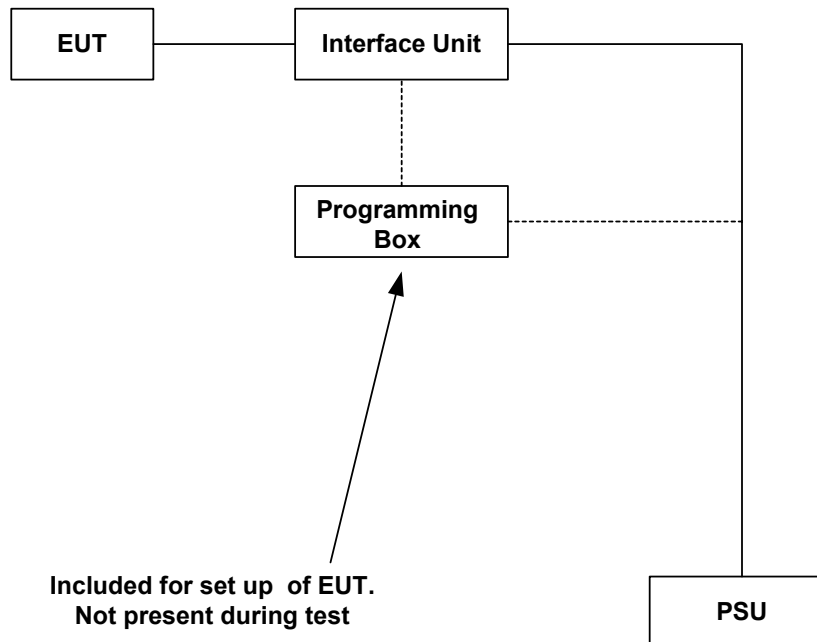
DRG\44233JD08\EMIRAD



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DRG\44233JD08\001

Configuration of EUT and Local Support Equipment



The EUT is Table Top Mounted

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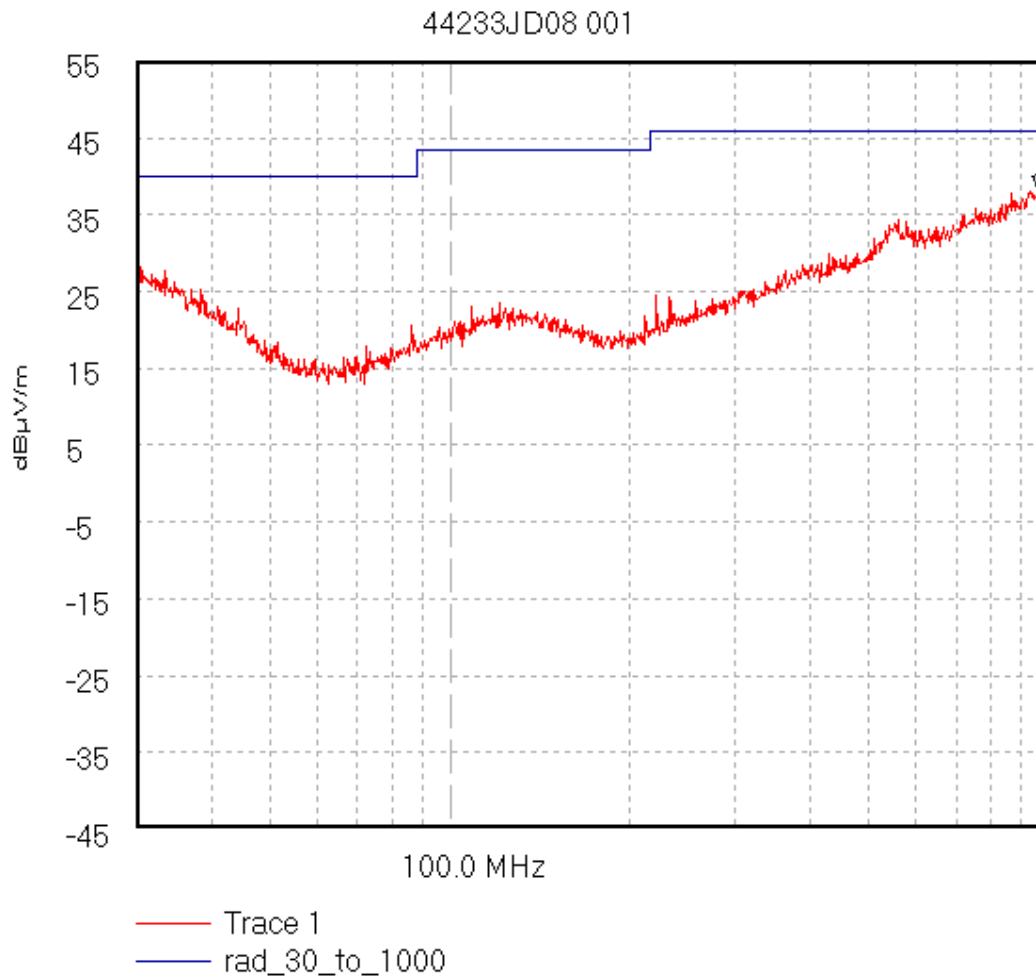
Appendix 4. Graphical Test Results

This appendix contains the following graphs:

Graph Reference Number	Title
GPH\44233JD08\001	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\002	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\003	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\004	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\005	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\006	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\007	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\008	Radiated Spurious Emissions. Operating Condition: Tx.
GPH\44233JD08\009	Radiated Spurious Emissions – Band Edge Plot. Operating Condition: Tx.
GPH\44233JD08\010	Radiated Spurious Emissions – Band Edge Plot Operating Condition: Tx.
GPH\44233JD08\011	Radiated Spurious Emissions - Duty Cycle Plot Operating Condition: Tx. - Off Time.
GPH\44233JD08\012	Radiated Spurious Emissions - Duty Cycle Plot Operating Condition: Tx. - On Time.

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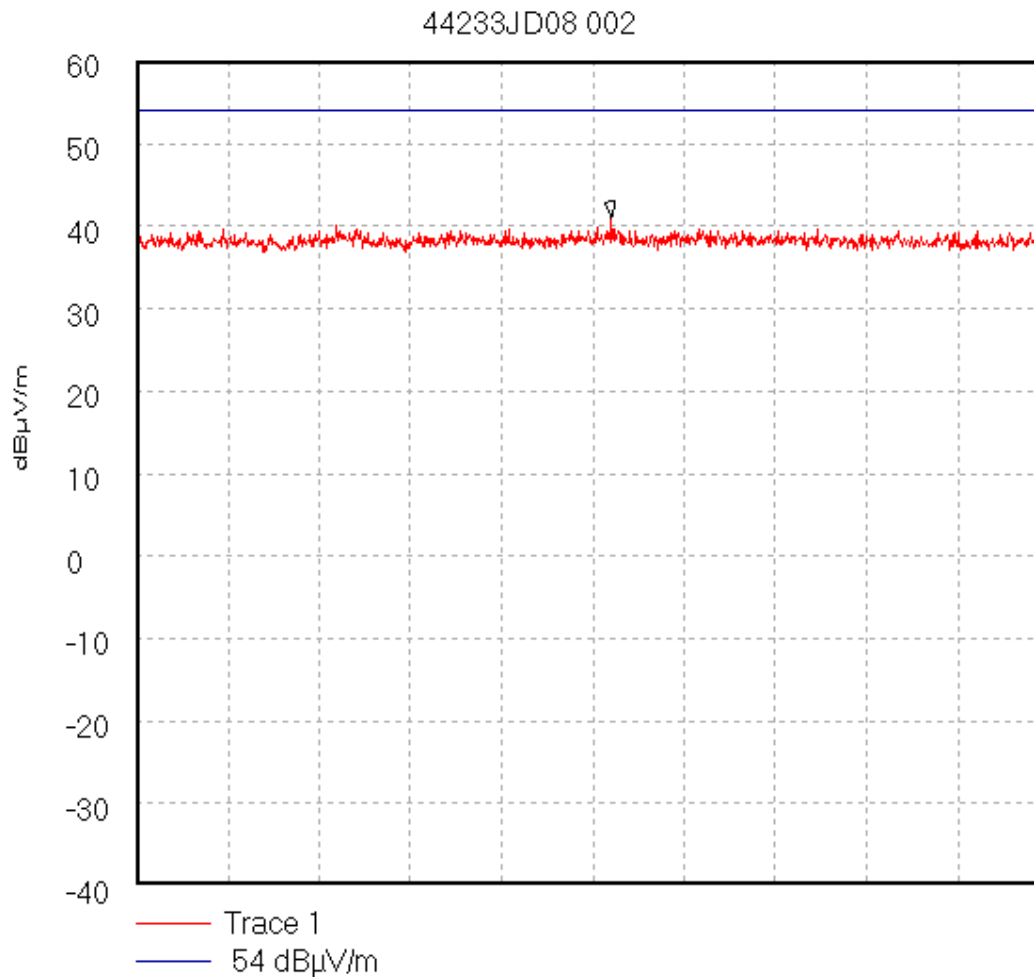
GPH\44233JD08\001
Radiated Spurious Emissions.
Operating condition : Tx.



Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 55 dBµV/m; Ref Offset 0.0 dB; 10 dB/div
RBW 122.018 kHz; VBW 100.0 kHz; Att 0 dB; Swp 220.0 mS
Peak 961.787 MHz, 38.14 dBµV/m
Limit/Mask: rad_30_to_1000;
Transducer Factors: A490
14/04/2003 10:59:01

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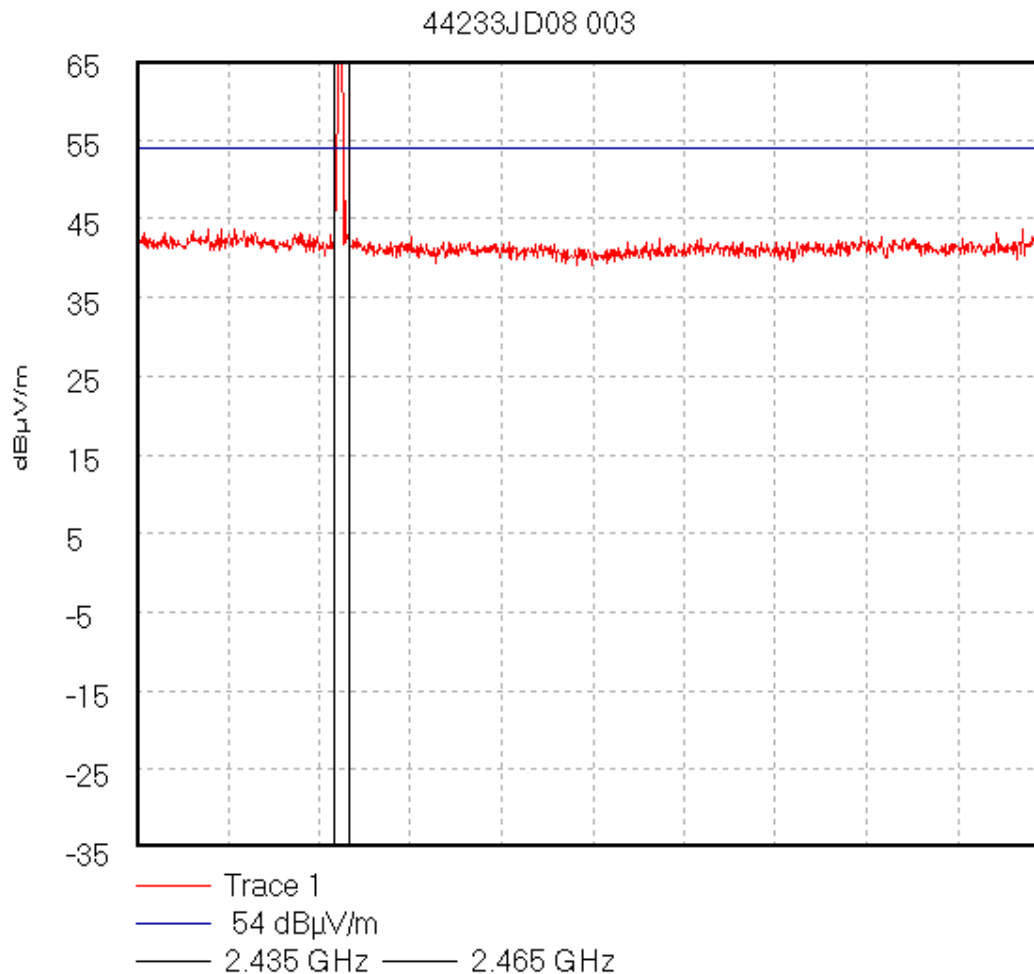
GPH\44233JD08\002
Radiated Spurious Emissions.
Operating condition : Tx.



Start 1.0 GHz; Stop 2.0 GHz
Ref 60 dBµV/m; Ref Offset 0.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 1.521 GHz, 40.96 dBµV/m
Display Line: 54 dBµV/m; ; Limit Test Passed
Transducer Factors: 1 to 2
14/04/2003 11:37:55

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GPH\44233JD08\003
Radiated Spurious Emissions.
Operating condition : Tx.



Start 2.0 GHz; Stop 4.0 GHz

Ref 65 dBµV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS

Peak 2.449 GHz, 68.98 dBµV/m

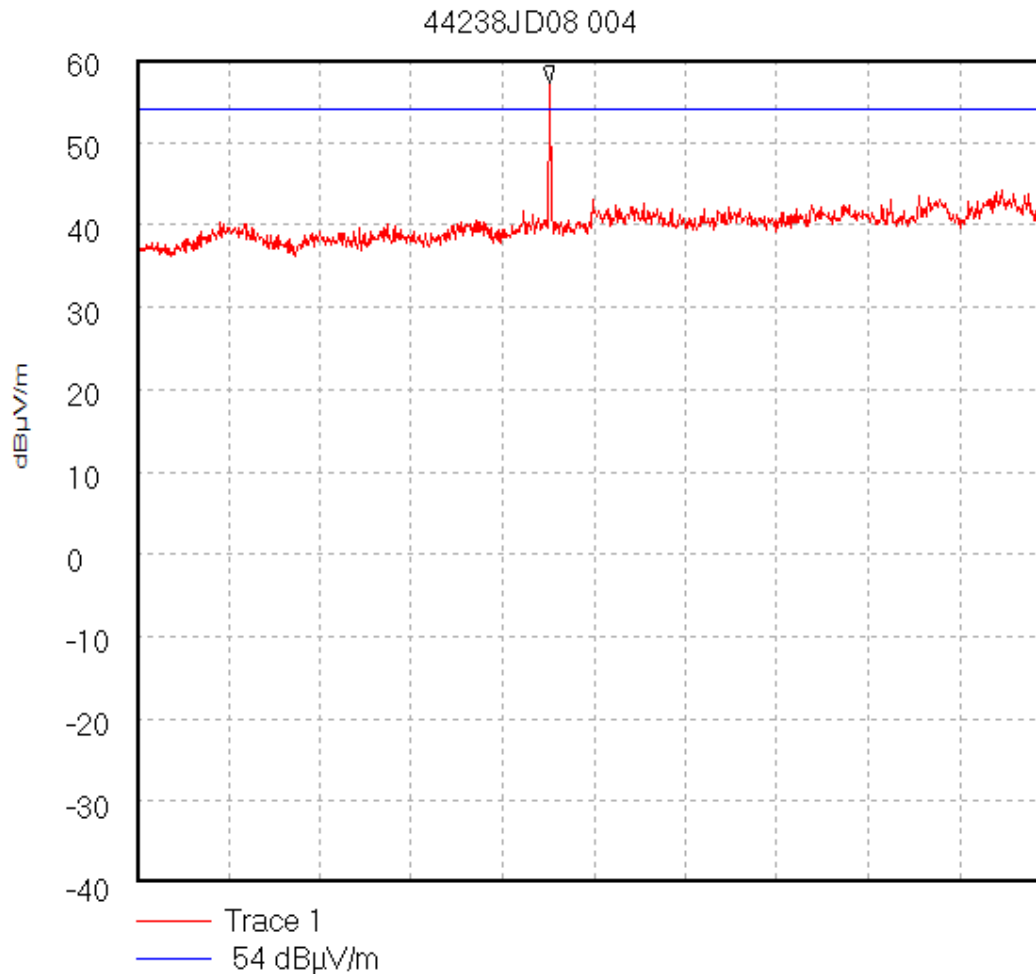
Display Line: 54 dBµV/m; ; Limit Test Failed

Transducer Factors: 2 to 4

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GPH\44238JD08\004
Radiated Spurious Emissions.
Operating condition : Tx.



Start 4.0 GHz; Stop 6.0 GHz

Ref 60 dBµV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS

Peak 4.904 GHz, 57.29 dBµV/m

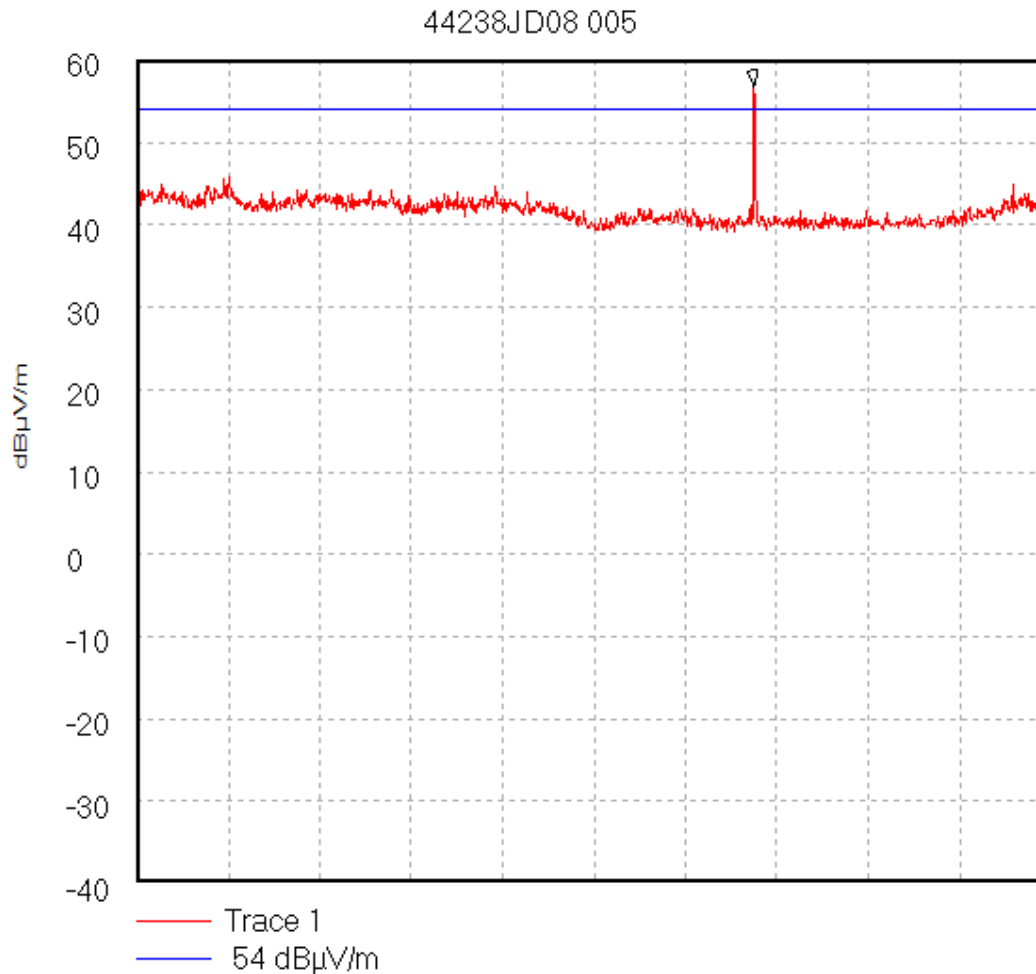
Display Line: 54 dBµV/m;

Transducer Factors: 4to6g_Horn

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GPH\44238JD08\005
Radiated Spurious Emissions.
Operating condition : Tx.



Start 6.0 GHz; Stop 8.0 GHz

Ref 60 dBµV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS

Peak 7.351 GHz, 56.75 dBµV/m

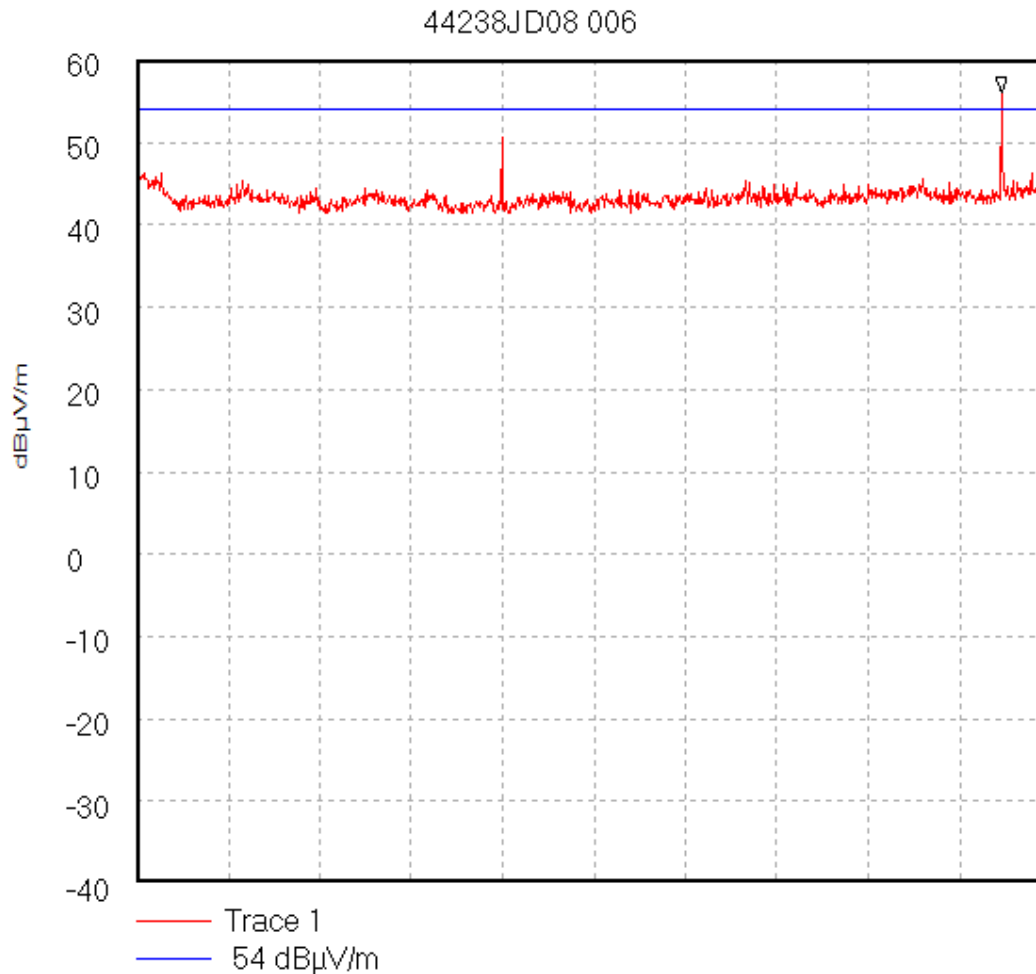
Display Line: 54 dBµV/m;

Transducer Factors: 6to8g_Horn

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GPH\44238JD08\006
Radiated Spurious Emissions.
Operating condition : Tx.



Start 8.0 GHz; Stop 12.5 GHz

Ref 60 dBµV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS

Peak 12.26 GHz, 55.99 dBµV/m

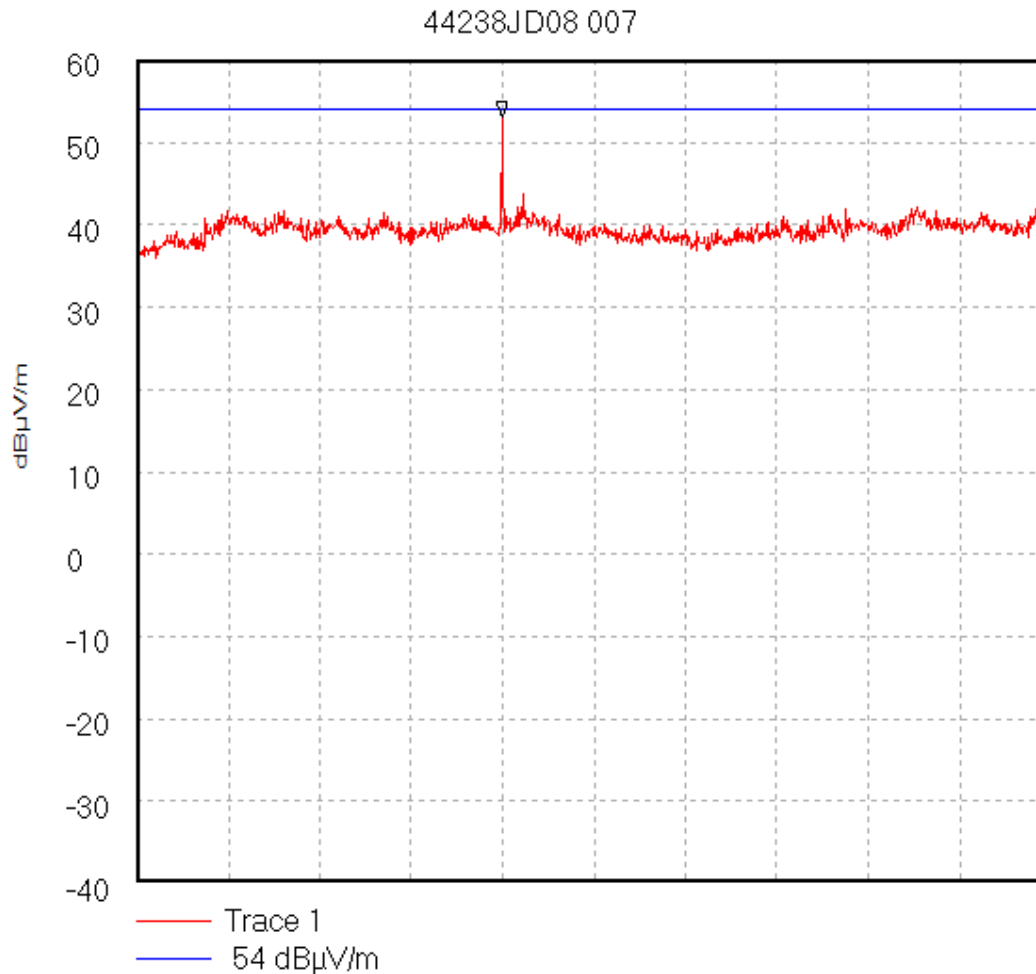
Display Line: 54 dBµV/m;

Transducer Factors: 8to12G_Horn

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Test Of: Dynex Semiconductor Ltd
DA5823-C33 Mass Movement Sensor
To: FCC Part 15 Subpart C (Intentional Radiators)
Section 15.245

GPH\44238JD08\007
Radiated Spurious Emissions.
Operating condition : Tx.



Start 12.5 GHz; Stop 18.0 GHz

Ref 60 dBµV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS

Peak 14.7 GHz, 53.0 dBµV/m

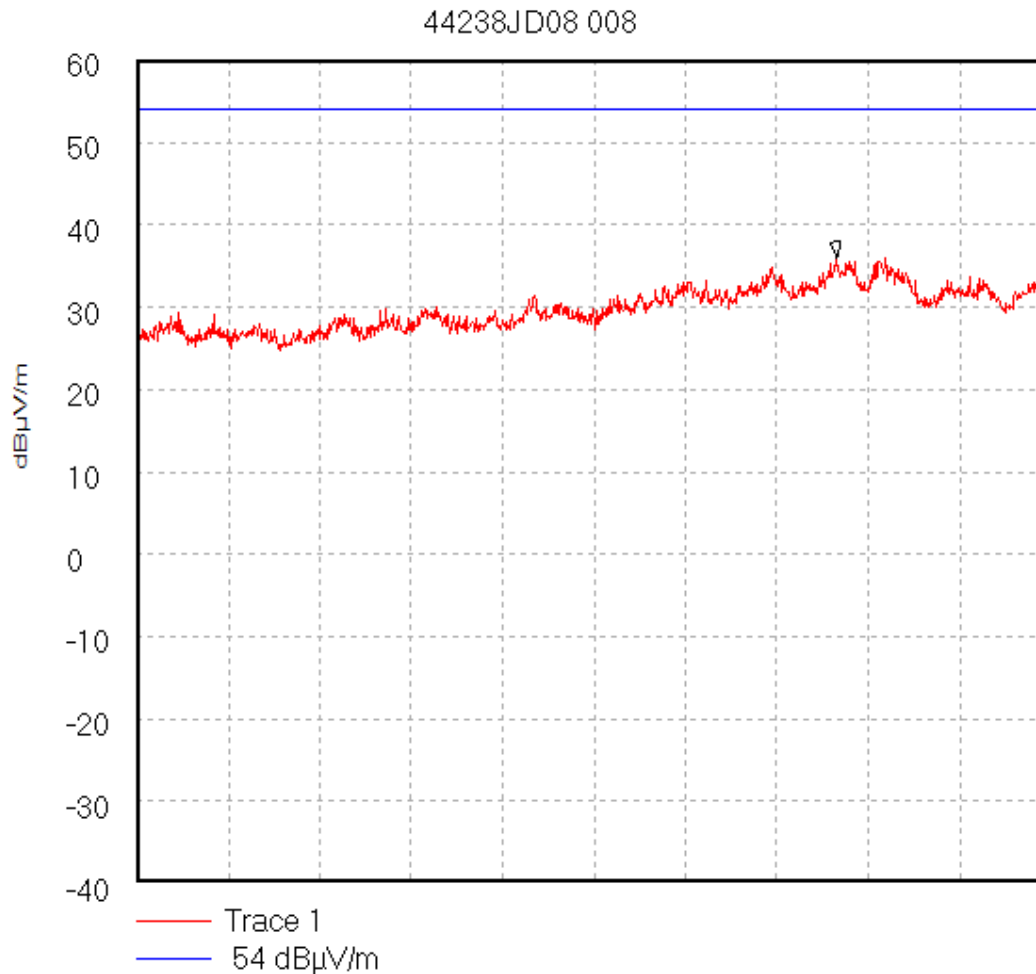
Display Line: 54 dBµV/m;

Transducer Factors: 12to18G_Horn

14/04/2003 15:47:01

Test Of: Dynex Semiconductor Ltd
DA5823-C33 Mass Movement Sensor
To: FCC Part 15 Subpart C (Intentional Radiators)
Section 15.245

GPH\44238JD08\008
Radiated Spurious Emissions.
Operating condition : Tx.



Start 18.0 GHz; Stop 26.5 GHz

Ref 60 dBµV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS

Peak 24.507 GHz, 36.01 dBµV/m

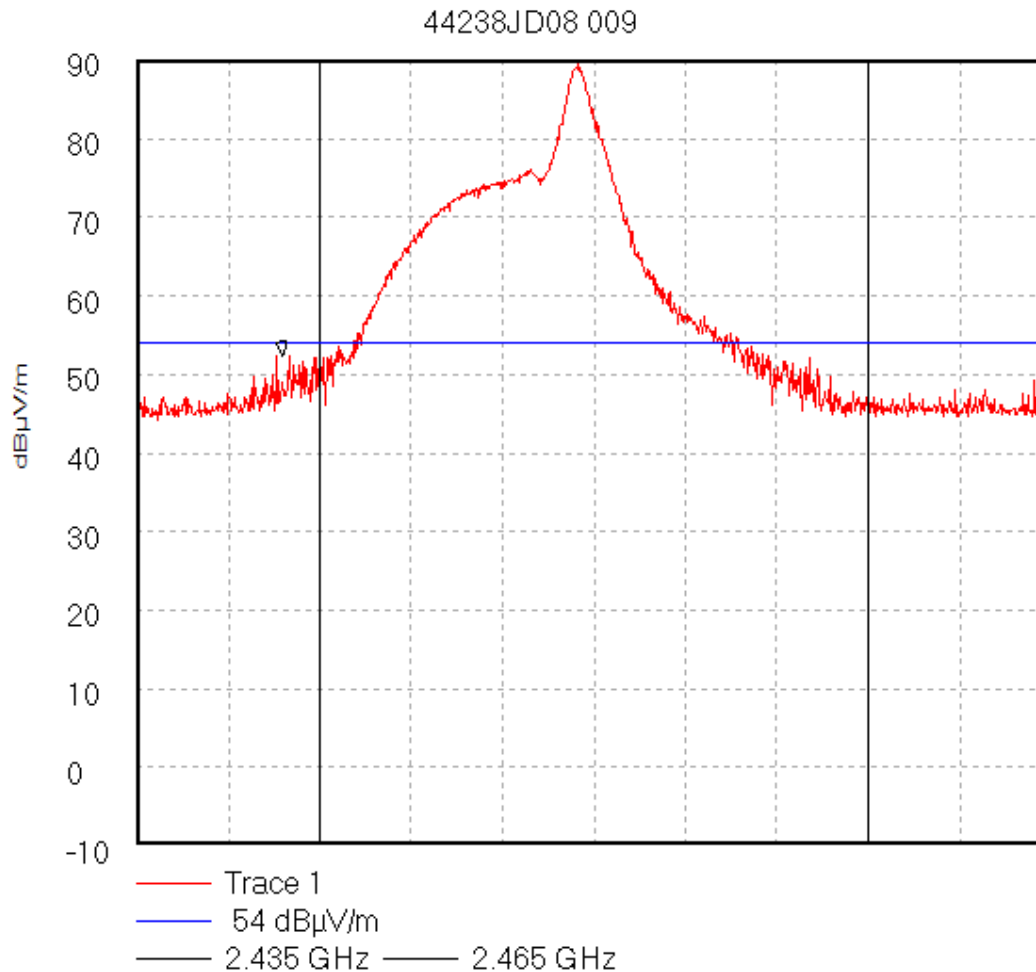
Display Line: 54 dBµV/m;

Transducer Factors: 18to26

14/04/2003 15:54:47

Test Of: Dynex Semiconductor Ltd
DA5823-C33 Mass Movement Sensor
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Section 15.245

GPH\44238JD08\009
Radiated Spurious Emissions - Band Edge Plot.
Operating condition : Tx.



Start 2.425 GHz; Stop 2.475 GHz

Ref 90 dBμV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS

Marker 2.433 GHz, 52.32 dBμV/m

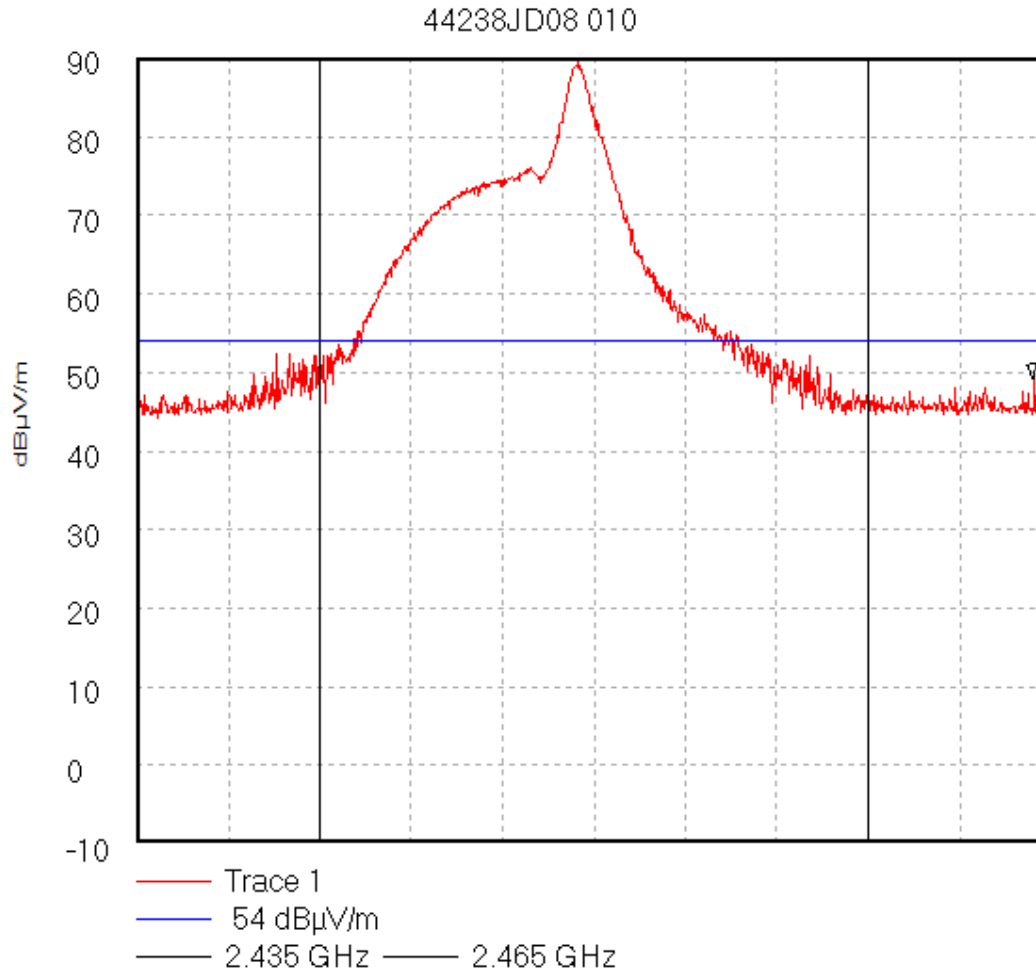
Display Line: 54 dBμV/m;

Transducer Factors: 2to4g_Horn

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Test Of: Dynex Semiconductor Ltd
DA5823-C33 Mass Movement Sensor
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Section 15.245

GPH\44238JD08\010
Radiated Spurious Emissions - Band Edge Plot.
Operating condition : Tx.



Start 2.425 GHz; Stop 2.475 GHz

Ref 90 dBµV/m; Ref Offset 0.0 dB; 10 dB/div

RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS

Marker 2.474 GHz, 49.15 dBµV/m

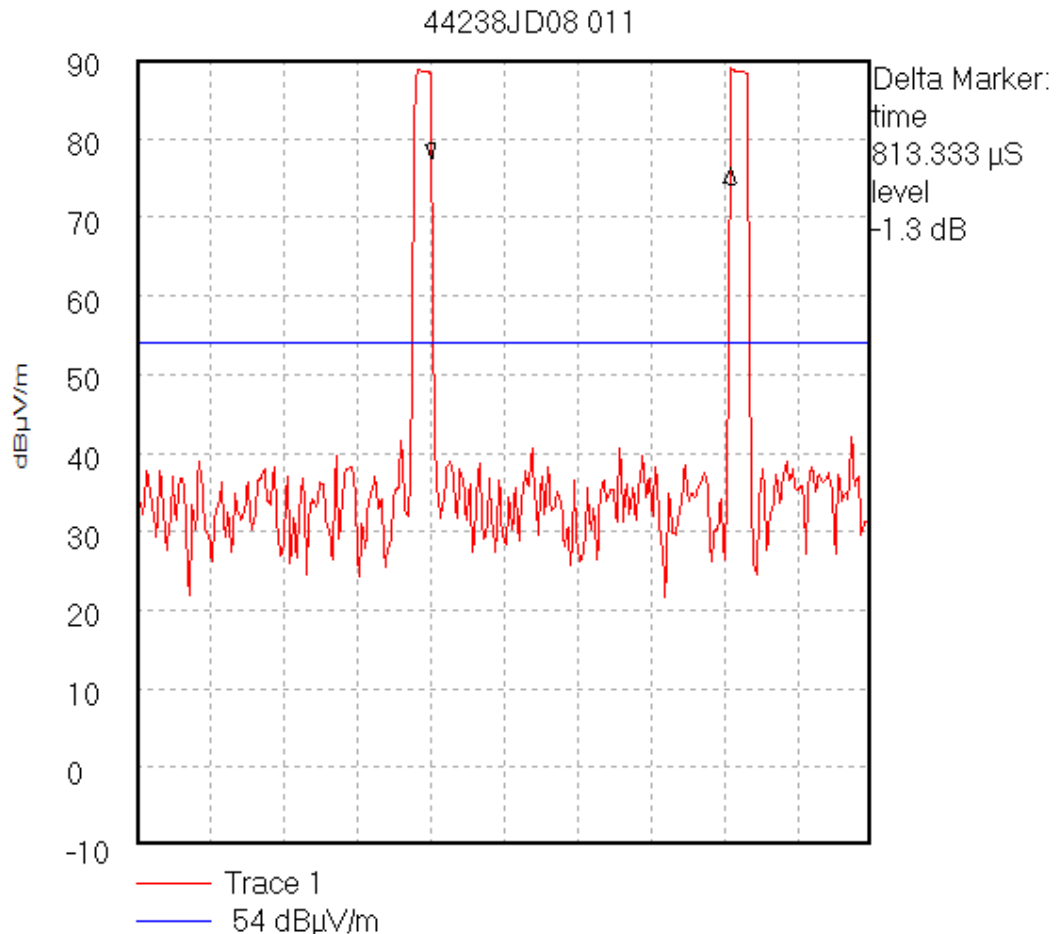
Display Line: 54 dBµV/m;

Transducer Factors: 2to4g_Horn

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Test Of: Dynex Semiconductor Ltd
DA5823-C33 Mass Movement Sensor
To: FCC Part 15 Subpart C (Intentional Radiators)
Section 15.245

GPH\44238JD08\011
Radiated Spurious Emissions - Duty Cycle Plot
Operating condition : Tx. - Off Time



Start 2.449 GHz; Stop 2.449 GHz
Ref 90 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 2.0 mS
Marker 802.222 μ S, 77.49 dB μ V/m
Delta 1.616 mS, 76.19 dB μ V/m
Display Line: 54 dB μ V/m;
Transducer Factors: 2to4g_Horn
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Test Of: Dynex Semiconductor Ltd
DA5823-C33 Mass Movement Sensor
To: FCC Part 15 Subpart C (Intentional Radiators)
Section 15.245

GPH\44238JD08\012
Radiated Spurious Emissions - Duty Cycle Plot
Operating condition : Tx. - On Time.



Start 2.449 GHz; Stop 2.449 GHz
Ref 90 dB μ V/m; Ref Offset 0.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 2.0 mS
Marker 1.617 mS, 88.94 dB μ V/m
Delta 1.661 mS, 88.35 dB μ V/m
Display Line: 54 dB μ V/m;
Transducer Factors: 2to4g_Horn
14/04/2003 16:57:33