# A TEST REPORT

# FOR

# TEAM SIMOCO Ltd

# ON

# SDB670 TU Band DMR BASE STATION

# Private Land Mobile Radio

# DOCUMENT NO. TRA-014137-W-US-1

TEST REPORT NO: TRA-014137-W-US-1

COPY NO: 1

ISSUE NO: 1

FCC ID: U89SDB670TU01

**REPORT ON THE CERTIFICATION TESTING OF A**
**TEAM SIMOCO**
**SDB670 TU Band DMR BASE STATION**
**WITH RESPECT TO**
**THE FCC RULES CFR 47,**
**PART 90**

**PRIVATE LAND MOBILE RADIO.**

TEST DATE: 3rd – 24th June 2013

APPROVED BY: _____ J CHARTERS
RADIO
PRODUCT
MANAGER

DATE: 9th July 2013

Distribution:

Copy Nos: 1. Team Simoco

2. TRaC Global

THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE

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**Notes:**

1. Component failure during test

| | |
|---|---|
| YES | [ ] |
| NO | [X] |

2. If Yes, details of failure:

3. The facilities used for the testing of the product contain in this report are FCC Listed.

## *CERTIFICATE OF CONFORMITY & COMPLIANCE*

| | |
|---|---|
| FCC IDENTITY: | U89SDB670TU01 |
| MODEL NUMBER: | SDB670TU01 |
| PURPOSE OF TEST: | Certification |
| TEST SPECIFICATION: | FCC RULES CFR 47, Part 90 |
| TEST RESULT: | Compliant to Specification |
| EQUIPMENT UNDER TEST: | SDB670 TU Band DMR Base Station |
| EQUIPMENT TYPE: | Private Land Mobile Radio |
| FREQUENCY OF OPERATION: | 400.00MHz –480.00MHz |
| MAXIMUM OUTPUT CONDUCTED: | 44.7dBm 29.51W |
| MODULATION TYPE: | F3E, F1E |
| POWER SOURCE(s): | +13.8Vdc |
| TEST DATE(s): | 3rd – 24th June 2013 |
| APPLICANT: | Team Simoco |
| ADDRESS: | Team Simoco Ltd<br>Field House<br>Uttoxeter Old Road<br>Derby<br>DE1 1NH |

APPROVED BY: ----------

RADIO
PRODUCT
MANAGER

## APPLICANT'S SUMMARY

| | |
|---|---|
| EQUIPMENT UNDER TEST (EUT): | SDB670 TU Band DMR Base Station |
| EQUIPMENT TYPE: | Private Land Mobile Radio |
| PURPOSE OF TEST: | Certification |
| TEST SPECIFICATION(s): | FCC RULES CFR 47, Part 90 |
| TEST RESULT: | COMPLIANT Yes [X]<br>No [ ] |
| APPLICANT'S CATEGORY: | MANUFACTURER [X]<br>IMPORTER [ ]<br>DISTRIBUTOR [ ]<br>TEST HOUSE [ ]<br>AGENT [ ] |
| APPLICANT'S CONTACT PERSON(s): | Mr Richard Stimson |
| EMAIL ADDRESS | Richard.stimson@teamsimoco.com |
| APPLICANT: | Team Simoco Ltd |
| ADDRESS: | Team Simoco Ltd<br>Field House<br>Uttoxeter Old Road<br>Derby<br>DE1 1NH |
| TEL: | 01332 375414 |
| MANUFACTURER: | Team Simoco Ltd |
| EUT(s) COUNTRY OF ORIGIN: | United Kingdom |
| TEST LABORATORY: | TRaC Global |
| TEST DATE(s): | 3rd – 24th June 2013 |
| TEST REPORT No: | TRA-014137-W-US-1 |

## EQUIPMENT TEST / EXAMINATIONS REQUIRED

1.

| TEST/EXAMINATION | RULE PART | APPLICABILITY | RESULT |
|---|---|---|---|
| RF Power Output | 90.205 | Yes | Complies |
| Audio Frequency Response (a) | 2.1047 | Yes | Complies |
| Modulation Limiting | 2.1047 | No | N/a |
| Occupied Bandwidth | 90.210 | Yes | Complies |
| Spurious Emissions at Antenna Terminals | 90.210 | Yes | Complies |
| Field Strength of Spurious Emissions | 90.210 | Yes | Complies |
| Field Strength of Un- Intentional Spurious Emissions | 15.109 | Yes | Complies |
| Frequency Stability | 90.213 | Yes | Complies |
| Transient behaviour | 90.214 | No | Complies |
| Emission Mask | 90.210(d) | Yes | Complies |

2. Product class: Class A [X] Class B [ ]

3. Product Use: Private Land Mobile Radio

4. Emission Designator: F3E, F1E

5. Temperatures: Ambient (Tnom) 21$^{o}$C

6. Supply Voltages: Vnom +13.8Vdc

Note: Vnom voltages are as stated above unless otherwise shown on the test report page

7. Equipment Category:
   - Single channel [ ]
   - Two channel [ ]
   - Multi-channel [X]

8. Channel spacing:
   - Narrowband [X]
   - Wideband [ ]

9. Test Location TRaC Global
   - Skelmersdale [X]

10. Modifications made during test program No modifications were performed.

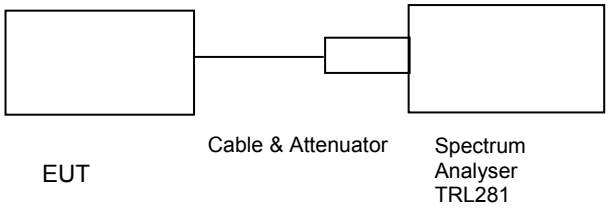
**System description:**

The SDB670 is a fully integrated Digital Mobile Radio (DMR) base station repeater. Conforming to ETSI open standards, SDB670 combines Simoco's DSP technology with advanced digital radio modules. The platform supports DMR Tier II and Tier III operation as standard with features being enabled via software licensing. Use of Ethernet networks enables the deployment of multi-site radio systems and synchronous 1PPS timing allows for simultaneous wide area coverage.

**COMPLIANCE TESTS**

**RF OUTPUT POWER – CONDUCTED – PART 2.1046**

| | | | |
|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory |
| Relative humidity | = | 39% | |
| Supply voltage | = | +13.8Vdc | |
| Channel number | = | See test results | |



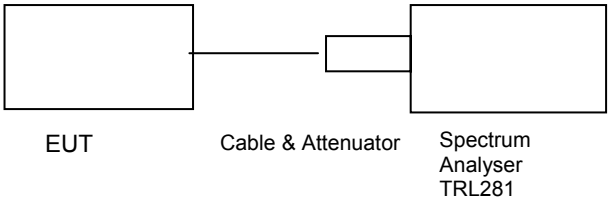

| Frequency MHz | Level at Analyser (dBm) | Output Cable & Attenuator loss (dB) | Conducted Output Power (dBm) | Conducted Output Power (W) | Rated output Power (dBm) | Rated output Power (W) |
|---|---|---|---|---|---|---|
| 400.0125 | 13.7 | 30.81 | 44.51 | 28.24 | 44.0 | 25 |
| 411.0000 | 13.8 | 30.79 | 44.59 | 28.77 | 44.0 | 25 |
| 440.0125 | 13.5 | 30.75 | 44.25 | 26.60 | 44.0 | 25 |
| 460.0000 | 13.5 | 30.73 | 44.20 | 26.30 | 44.0 | 25 |
| 479.9875 | 13.5 | 30.78 | 44.30 | 26.91 | 44.0 | 25 |

| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| SPECTRUM ANALYSER | R&S | FSU46 | 200034 | TRL281 | **X** |
| CABLE | TRAC | N/A | N/A | UH271 | **X** |
| CABLE | TRAC | N/A | N/A | UH272 | **X** |
| ATTENUATOR | SPINNER | 745357 | N/A | TRLUH225 | **X** |
| ATTENUATOR | - | - | - | 20dB | **X** |
| ATTENUATOR | BIRD | 8304-100-N | N/A | 222 | |

**TRANSMITTER TESTS**

**99% Bandwidth – CONDUCTED – Part 90.209**

| | | | |
|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory |
| Relative humidity | = | 39% | |
| Supply voltage | = | +13.8Vdc | |
| Channel number | = | See test results | |



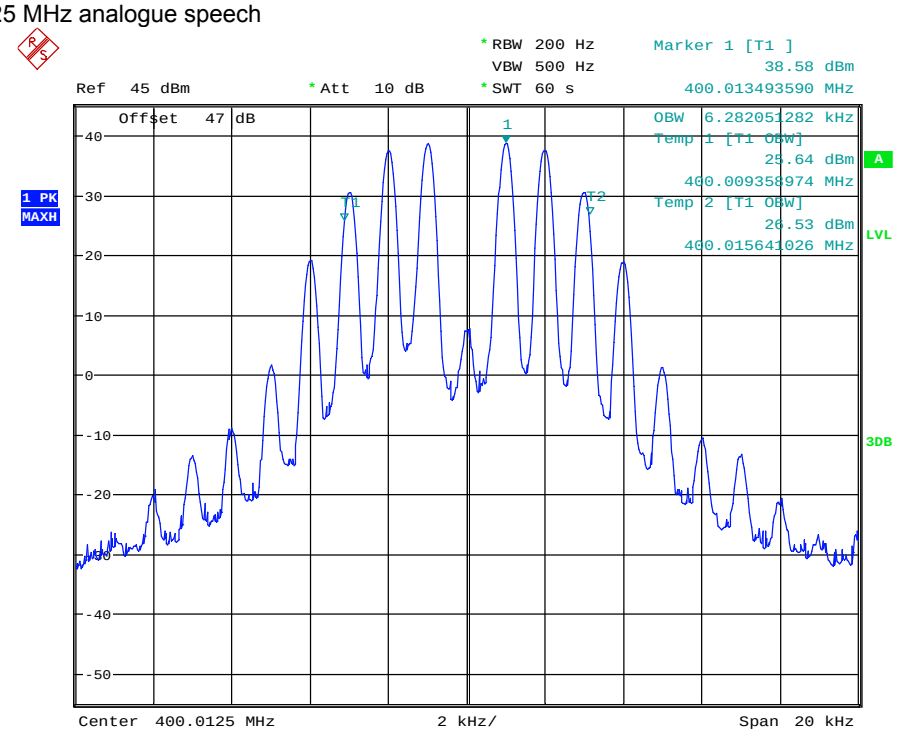

Note:

1. Cable and attenuator between EUT and spectrum analyser 47dB
2. See Table below for 99% Power Occupied Bandwidth
3. Test tone for analogue speech via T/T signal generator fed into receiver and talk thro selected
4. DMR Internally generated test tone 4FSK

| Frequency Of Operation Channel | Modulation Type |
|---|---|
| FM 12.5kHz Channel spacing | |
| 400.0125 | 99% Bandwidth =6.28kHz |
| 411.0000 | 99% Bandwidth =6.31kHz |
| 440.0125 | 99% Bandwidth =6.31kHz |
| 460.0000 | 99% Bandwidth =6.31kHz |
| 479.9875 | 99% Bandwidth =6.28kHz |
| DMR Modulation | |
| 400.0125 | 99% Bandwidth =8.17kHz |
| 411.0000 | 99% Bandwidth =8.09kHz |
| 440.0125 | 99% Bandwidth =8.17kHz |
| 460.0000 | 99% Bandwidth =8.17kHz |
| 479.9875 | 99% Bandwidth =8.17kHz |

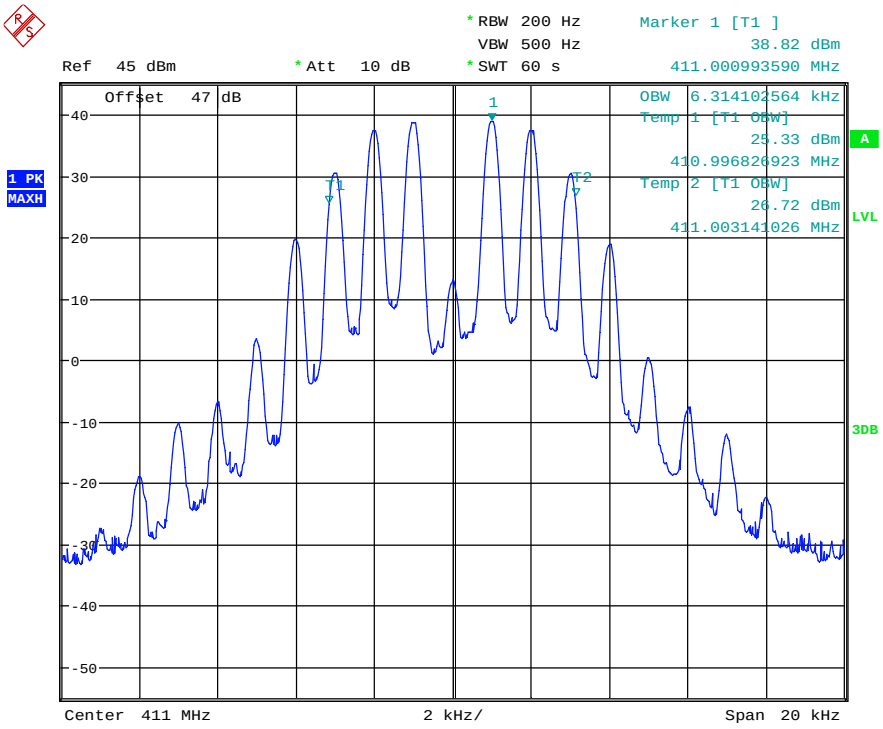
| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | TRAC No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| SPECTRUM ANALYSER | RHODE & SCHWARZ | FSU46 | 200034 | UH281 | **X** |
| CABLE | TRAC | N/A | N/A | UH271 | **X** |
| CABLE | TRAC | N/A | N/A | UH272 | **X** |
| ATTENUATOR | SPINNER | 745357 | N/A | TRLUH225 | **X** |
| ATTENUATOR | - | - | - | 20dB | **X** |
| ATTENUATOR | BIRD | 8304-100-N | N/A | 222 | **X** |

400.0125 MHz analogue speech




Date: 6.JUN.2013 14:47:52

411.00MHz analogue speech

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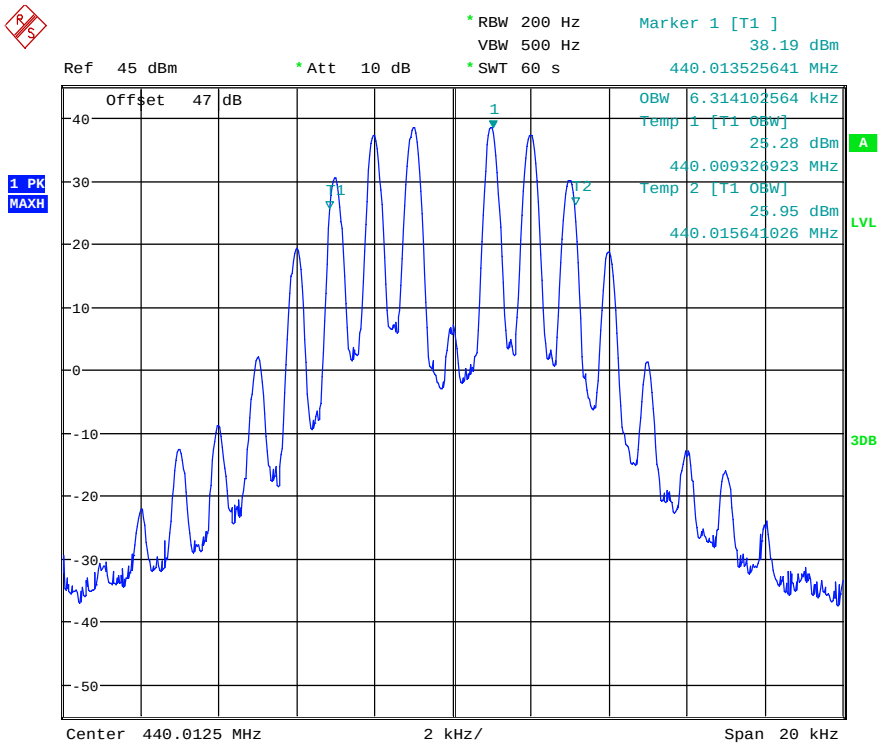
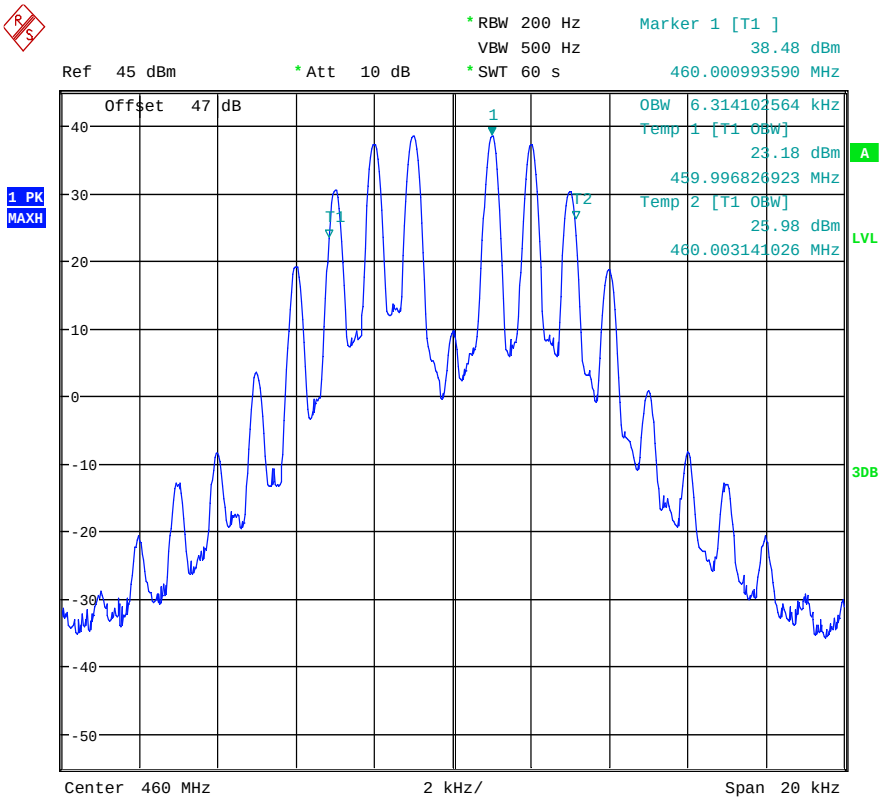
440.0125MHz analogue speech




Date: 6.JUN.2013 14:57:32

460.00MHz analogue speech

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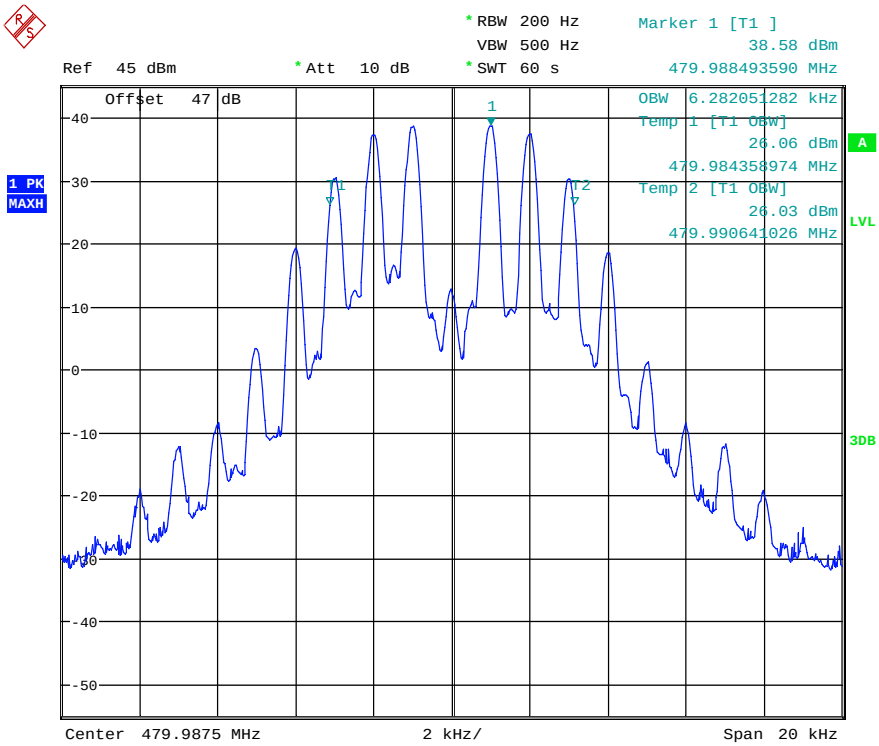
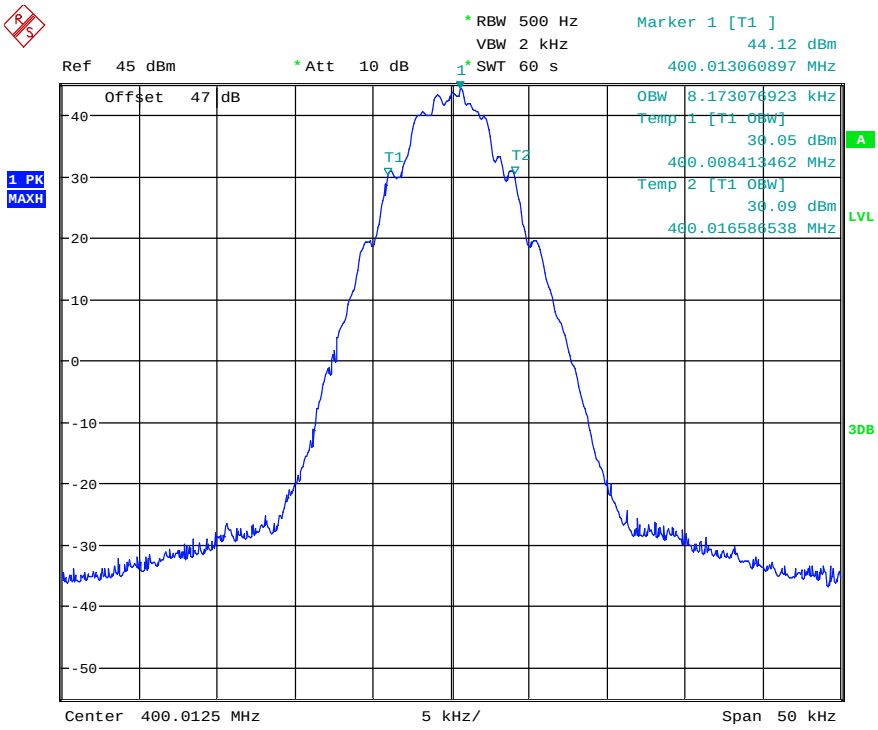
479.9875MHz analogue speech



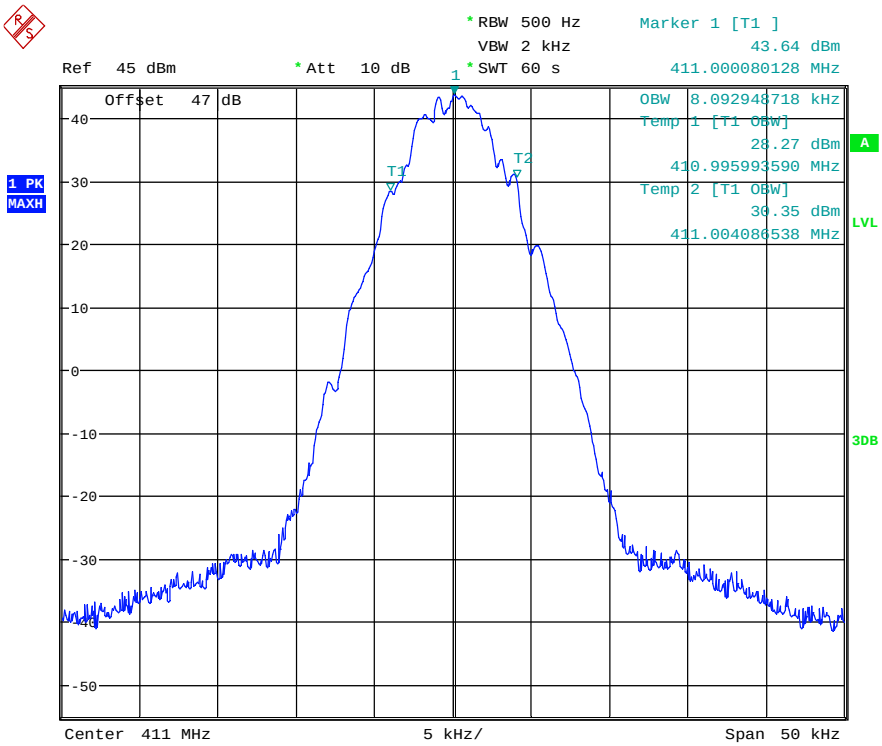

Date: 6.JUN.2013 15:08:35

400.0125 DMR Modulation



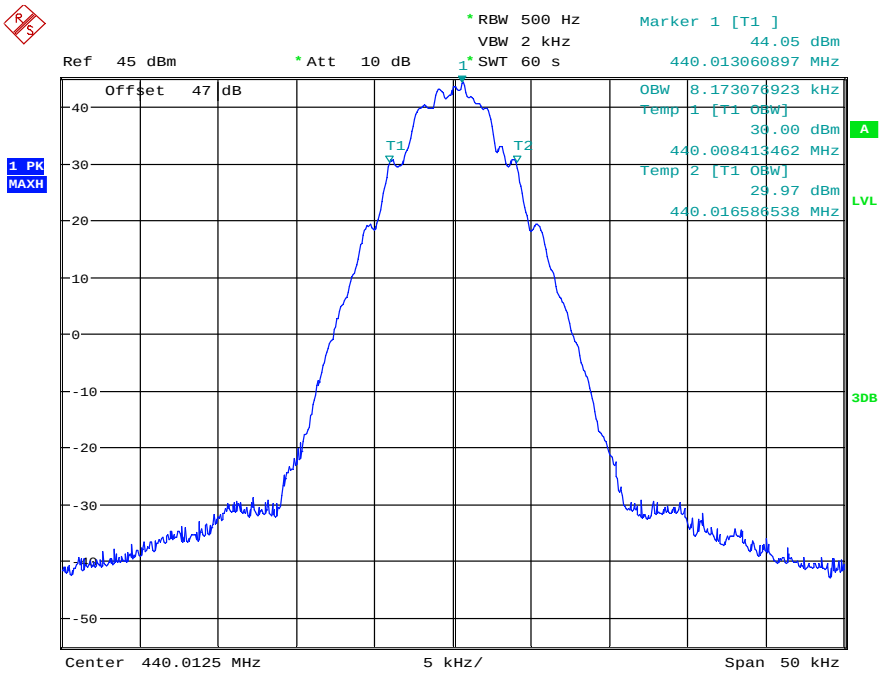

Date: 6.JUN.2013 15:21:48

411.00MHz DMR Modulation




Date: 6.JUN.2013 15:24:27

440.0125MHz DMR Modulation

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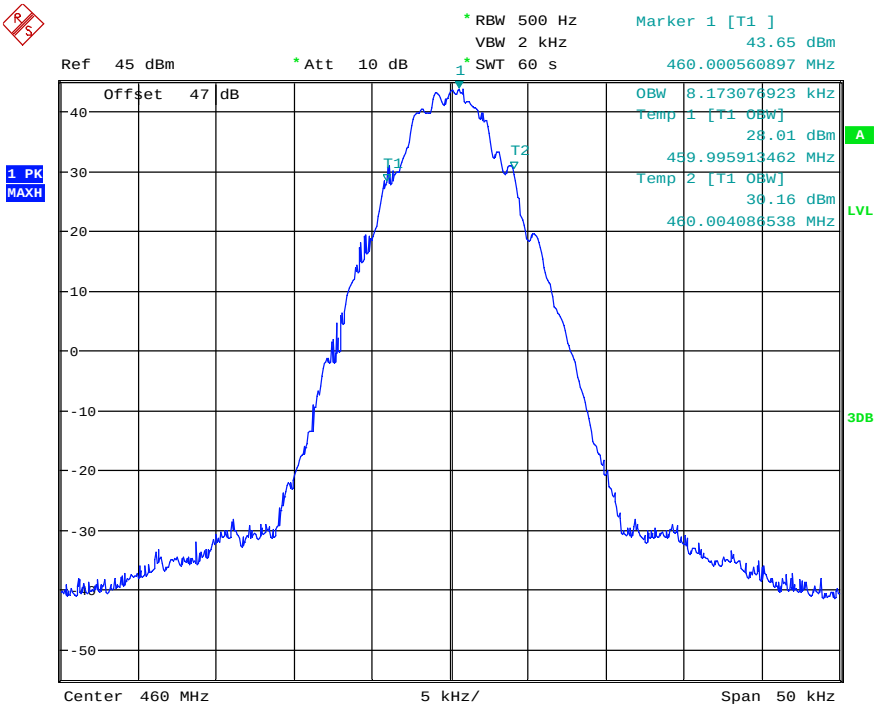
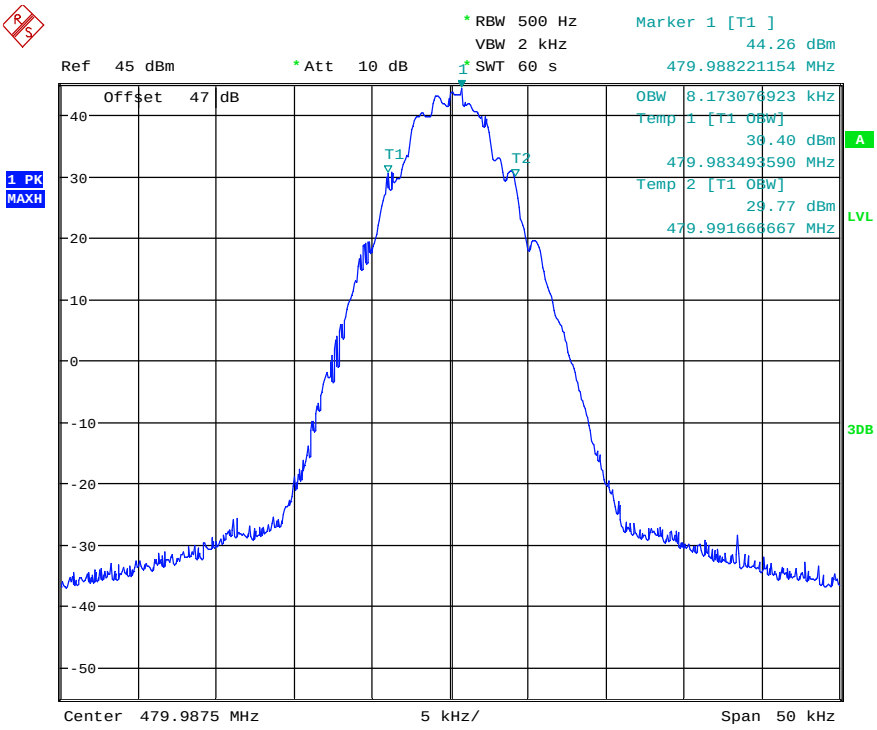
460.00MHz DMR Modulation




Date: 6.JUN.2013 15:37:32

479.9875 MHz DMR Modulation

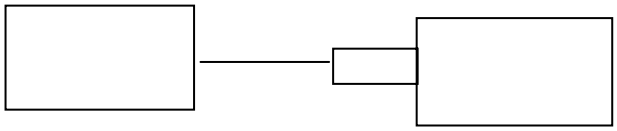



Date: 6.JUN.2013 15:44:49

**TRANSMITTER TESTS**

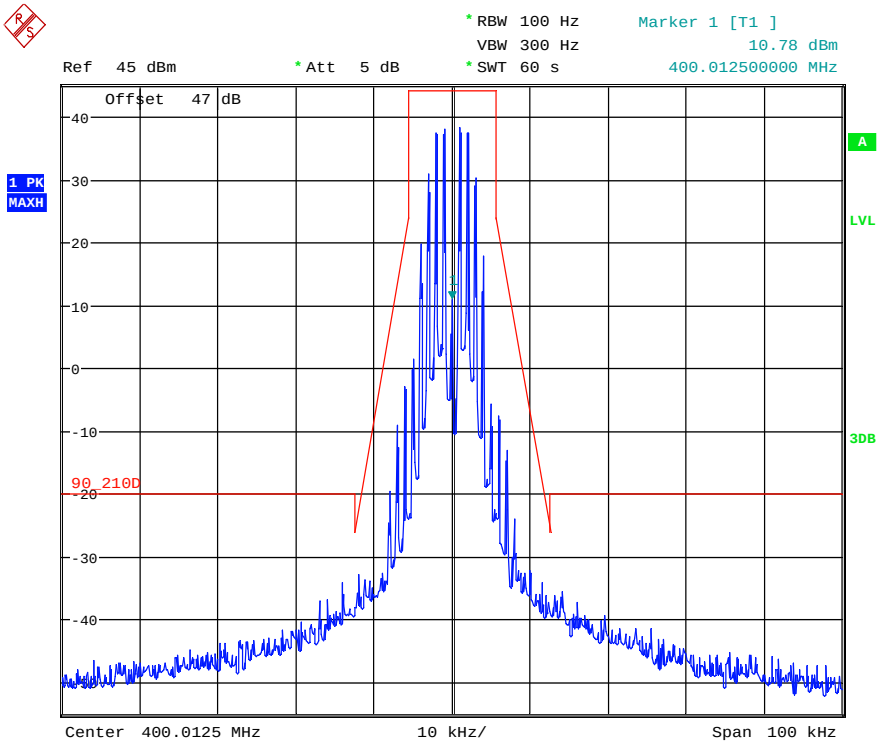
**Occupied Bandwidth**
**Emission Masks. Part 90.210(d)**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |



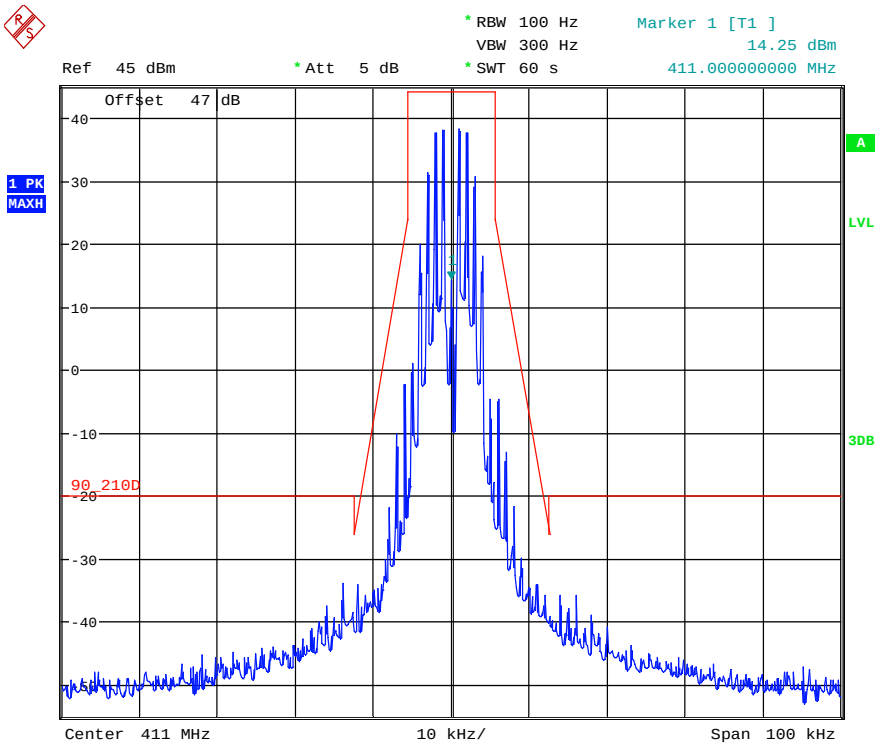
EUT Cable & Attenuator Spectrum Analyser TRL281

400.0125MHz: 12.5kHz channel spacing Emission Mask D (FM speech)



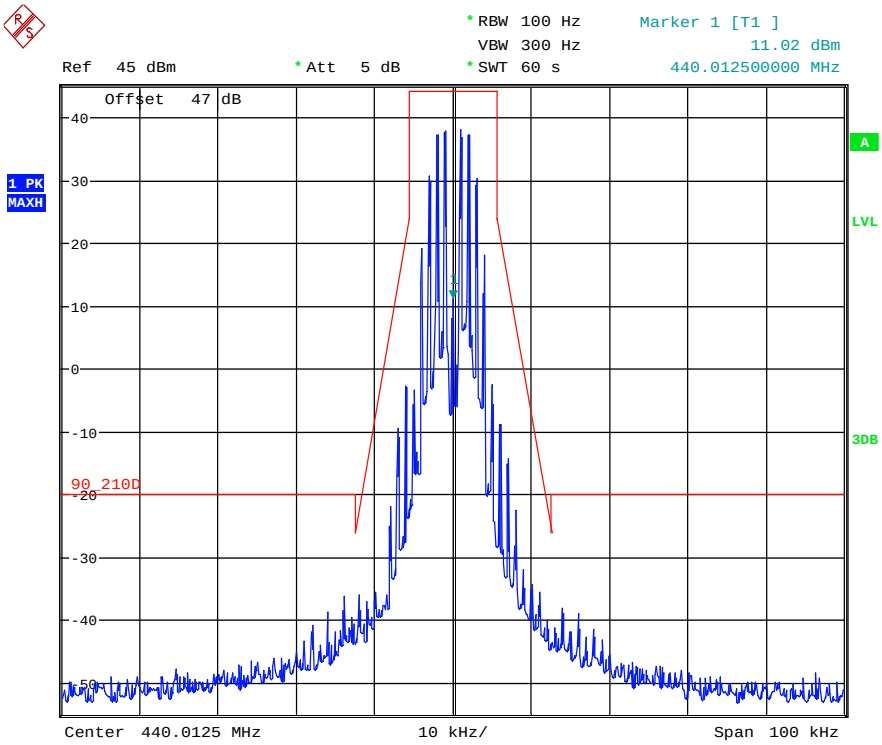

Date: 6.JUN.2013 12:11:10

## 411.00MHz:12.5kHz channel spacing Emission Mask D (FM speech)



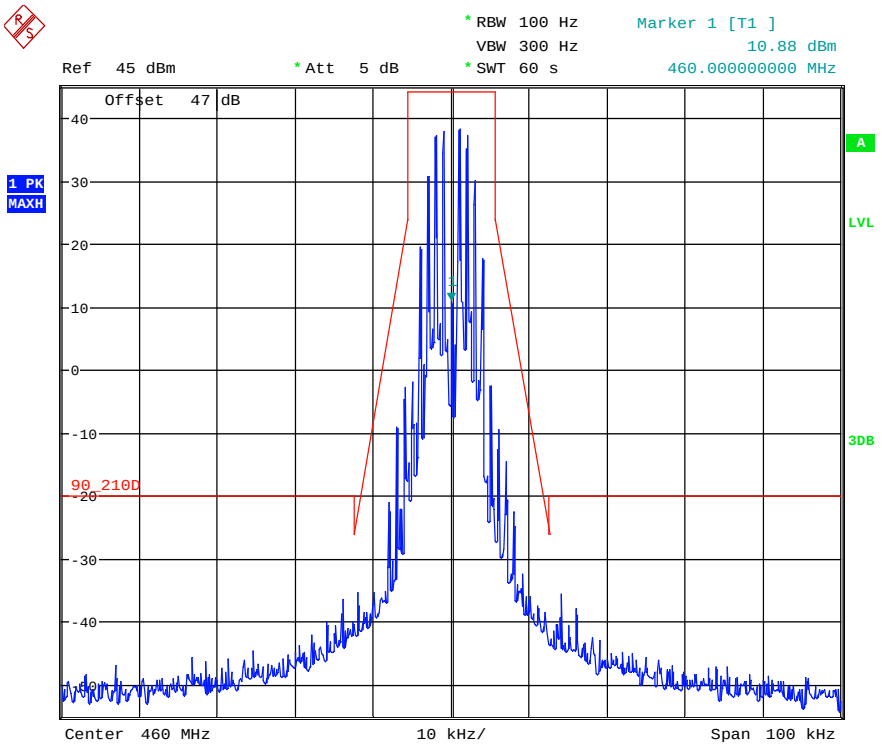

Date: 6.JUN.2013 12:16:45

## 440.0125MHz:12.5kHz channel spacing Emission Mask D (FM speech)



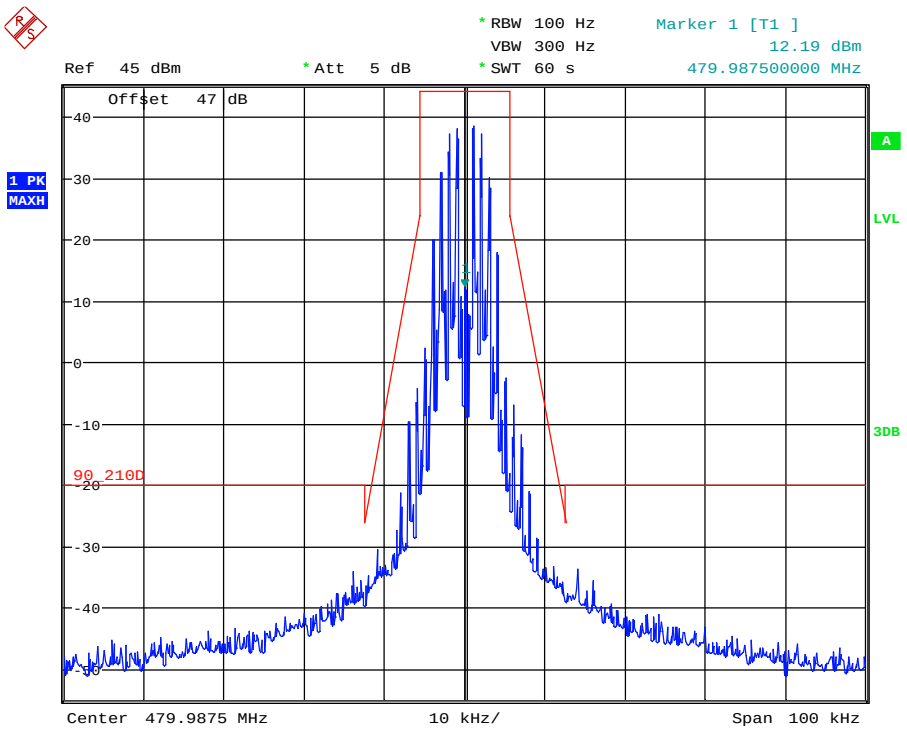

Date: 6.JUN.2013 12:23:24

460.00MHz:12.5kHz channel spacing Emission Mask D (FM speech)



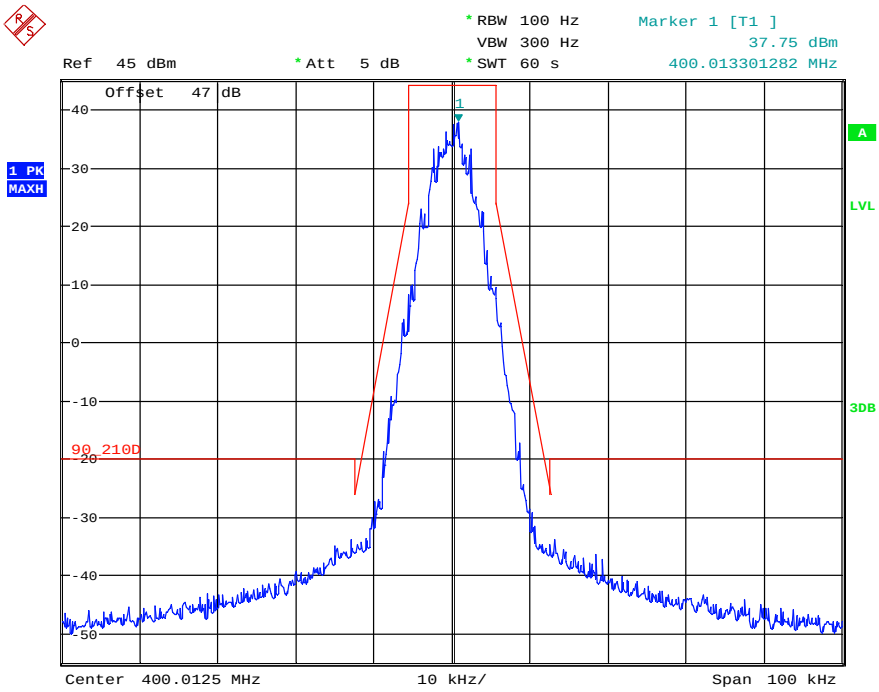

Date: 6.JUN.2013 12:32:07

479.9875MHz:12.5kHz channel spacing Emission Mask D (FM speech)



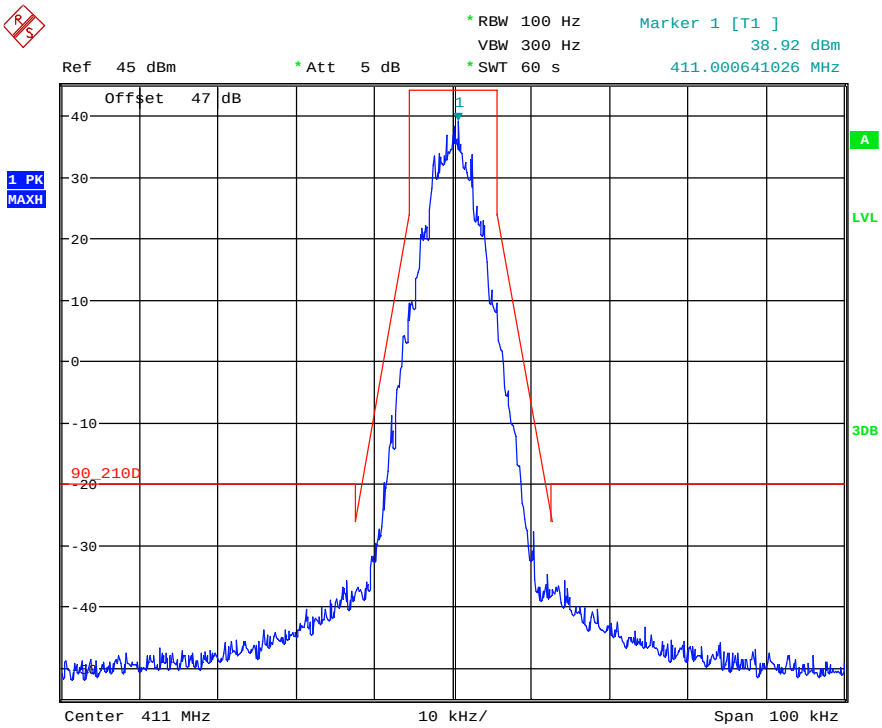

Date: 6.JUN.2013 12:37:12

## 400.0125MHz: 12.5kHz channel spacing Emission Mask D (DMR)



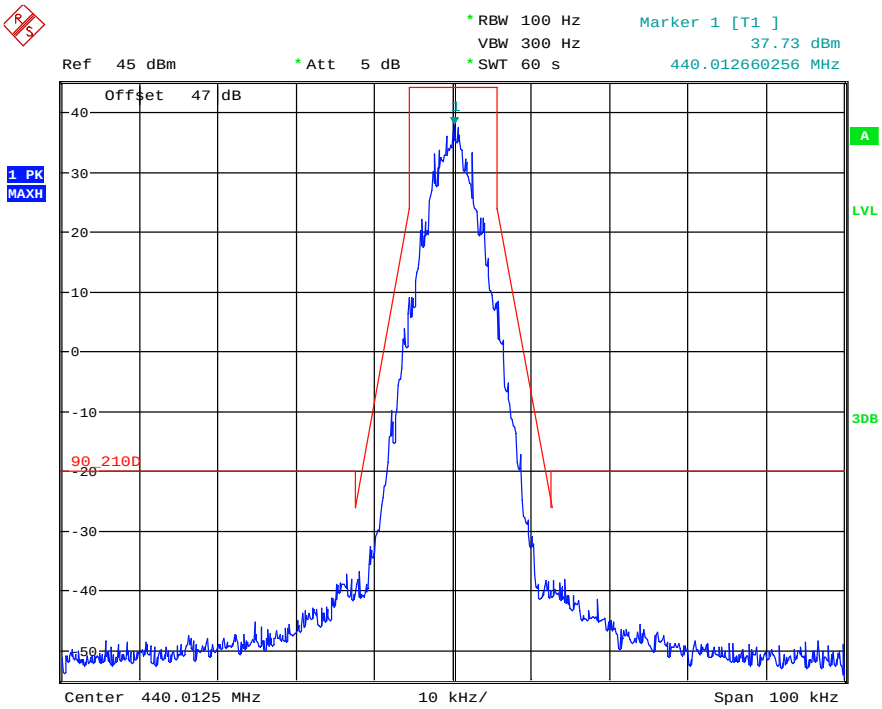

Date: 6.JUN.2013 10:49:32

## 411.00MHz: 12.5kHz channel spacing Emission Mask D (DMR)




Date: 6.JUN.2013 10:58:51

## 440.0125MHz: 12.5kHz channel spacing Emission Mask D (DMR)

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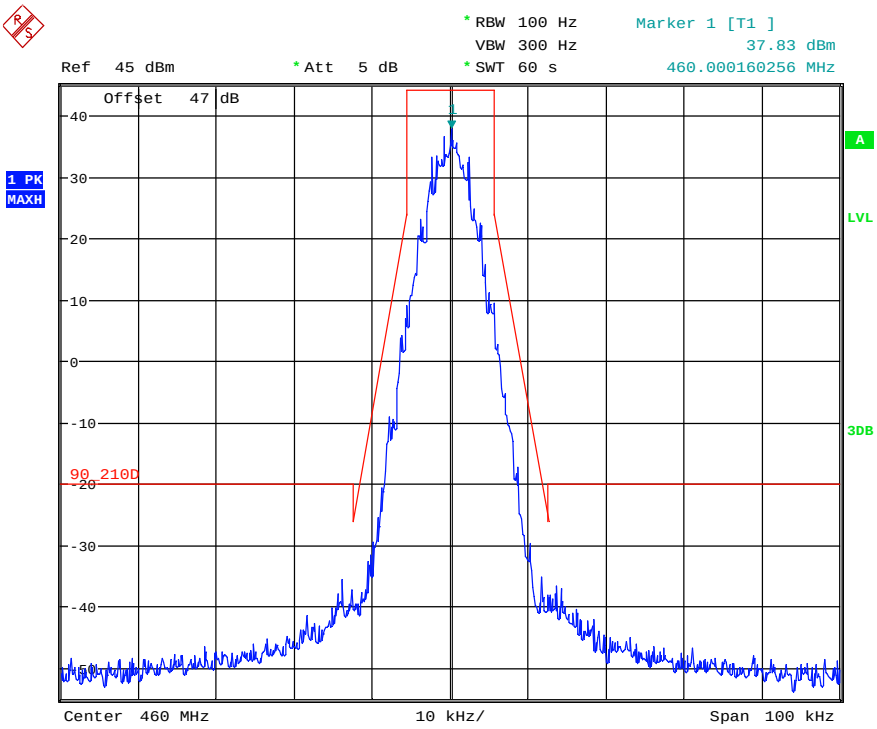
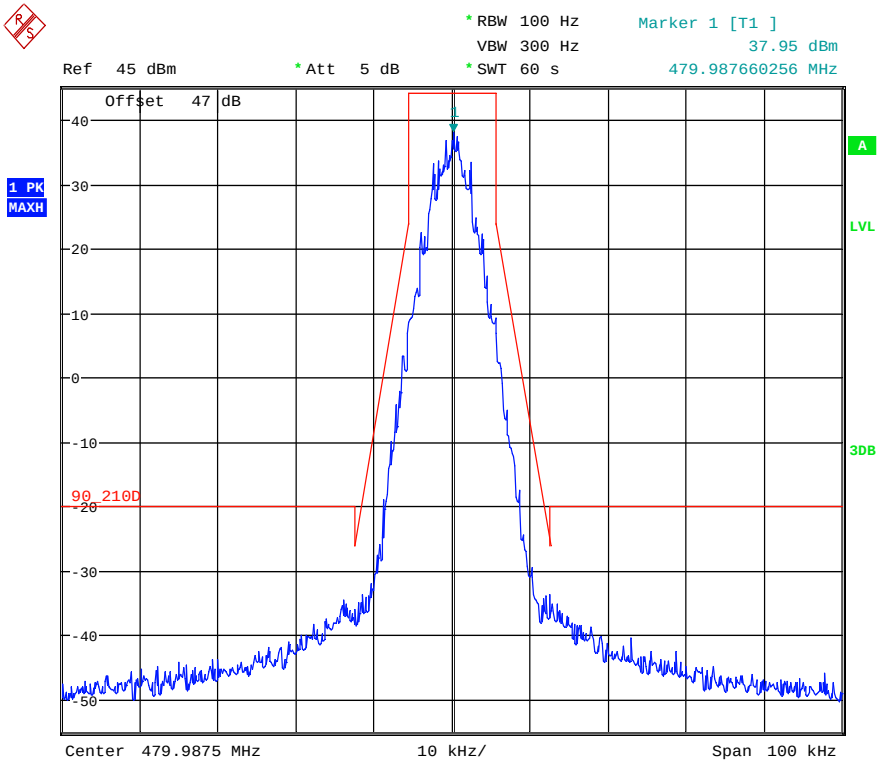
## 460.00MHz: 12.5kHz channel spacing Emission Mask D (DMR)




Date: 6.JUN.2013 11:10:34

479.9875MHz: 12.5kHz channel spacing Emission Mask D (DMR)

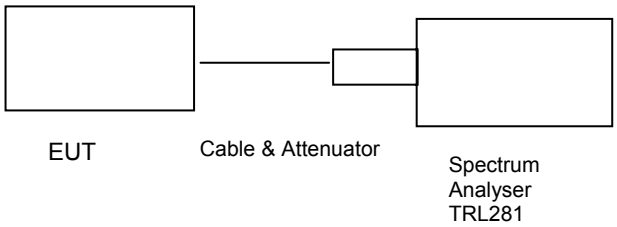



Date: 6.JUN.2013 11:23:00

## TRANSMITTER TESTS

### SPURIOUS EMISSIONS – CONDUCTED – Part 2.1053

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |




The test was set up as per the diagram. The unit was tested operating at maximum power.

The Spurious limit was calculated as follows:

On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (fd in kHz) of more than12.5kHz:At least 50+10log(P) or 70dB whichever is the lesser attenuation.

50+10log(25W)= 64dBc 64.0- 44.0 = -20dBm

Note: Emission preview plots were taken in a 100kHz resolution bandwidth to reduce the noise floor. Any emissions relating to the DUT were re measured using a 1MHz resolution bandwidth ≥1GHz.

The plots in this report are indication of worse case results, testing was performed on all modulation types. The plots shown are without the notch filter fitted.

### RESULTS

400.0125MHz

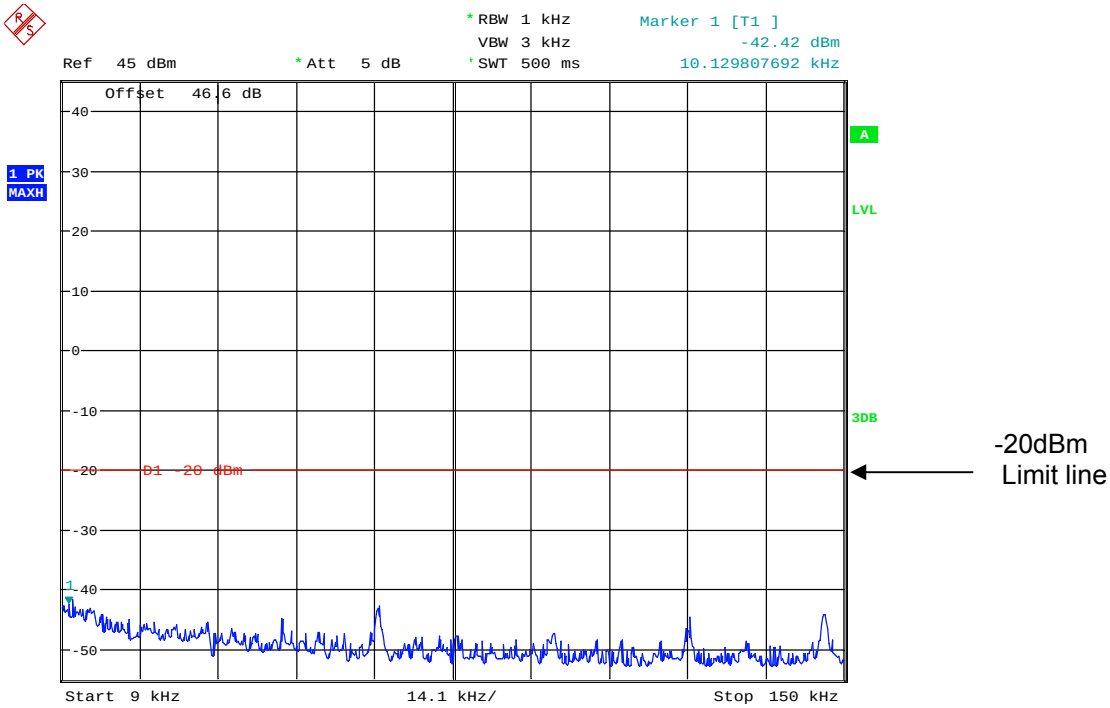
| FREQUENCY RANGE | FREQ. (GHz) | MEASURED LEVEL (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 9kHz – 10GHz | No significant emissions within 20dB of the limit | | -20 |

The test equipment used for the Transmitter Conducted Emissions:

| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | TRAC No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| SPECTRUM ANALYSER | RHODE & SCHWARZ | FSU46 | 200034 | UH281 | **X** |
| CABLE | TRAC | N/A | N/A | UH271 | **X** |
| CABLE | TRAC | N/A | N/A | UH272 | **X** |
| ATTENUATOR | SPINNER | 745357 | N/A | TRLUH225 | **X** |
| ATTENUATOR | - | - | - | 20Db | **X** |
| ATTENUATOR | BIRD | 8304-100-N | N/A | 222 | **X** |
| FILTER H | TELONIC BERKELEY | TTR375-3EE | 60011-3 | TRLUH265 | **X** |

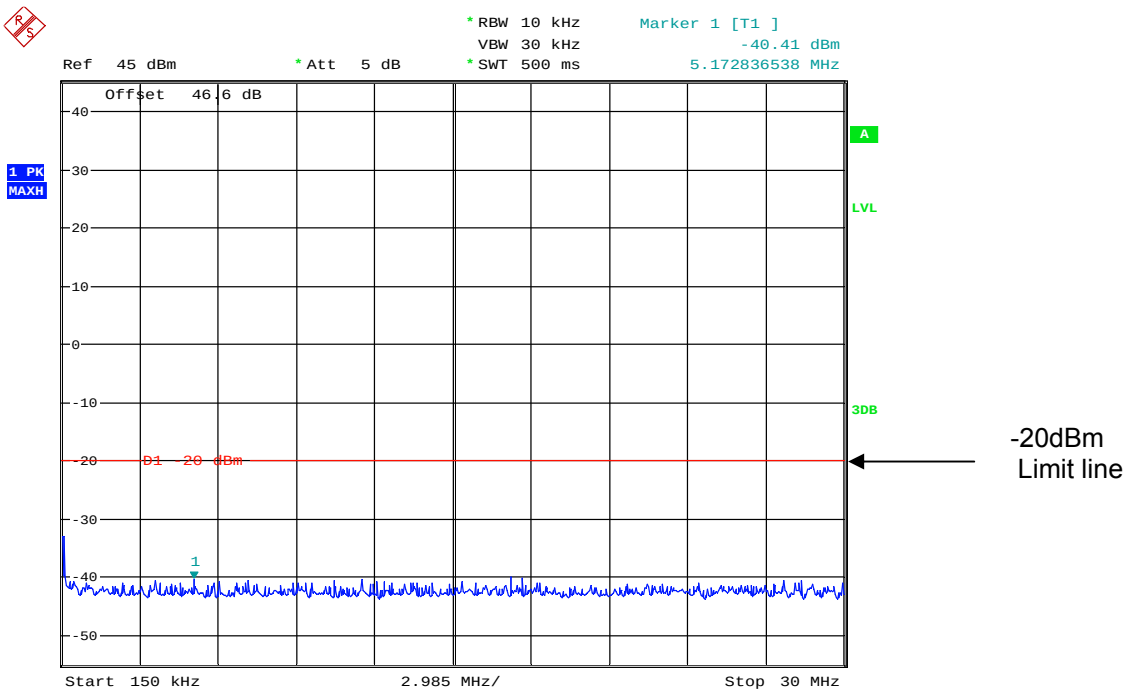
Conducted emissions 400.0125MHz

400.0125MHz 9kHz – 150kHz



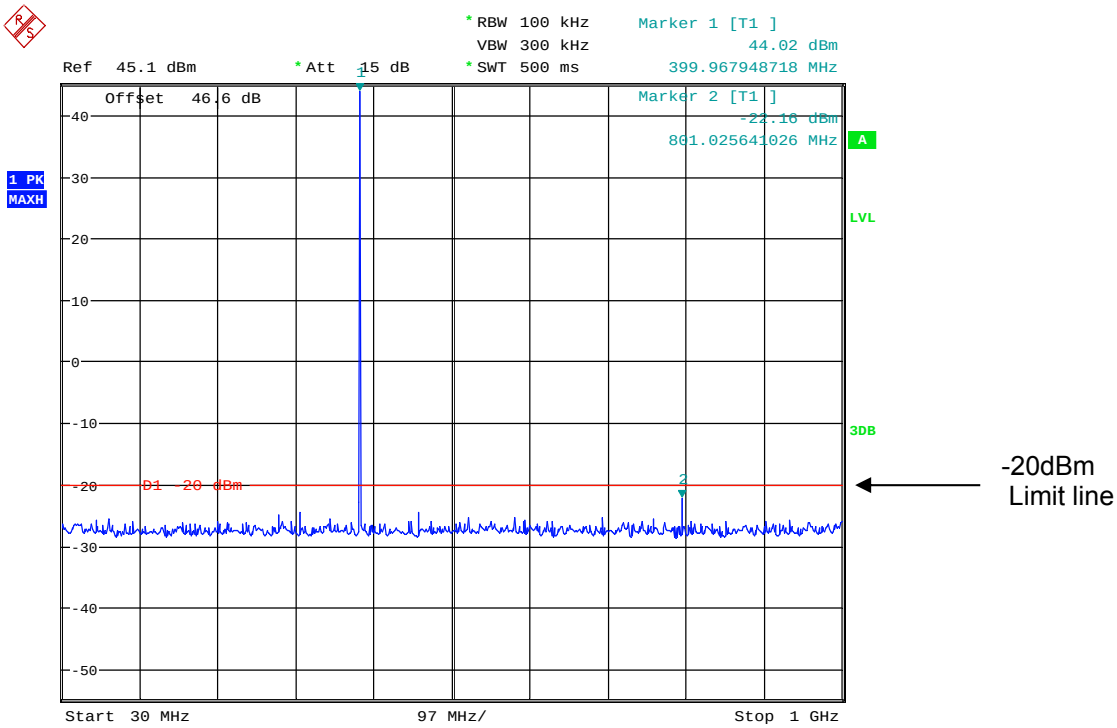

Date: 5.JUN.2013 16:41:44

400.0125MHz 150kHz-30MHz



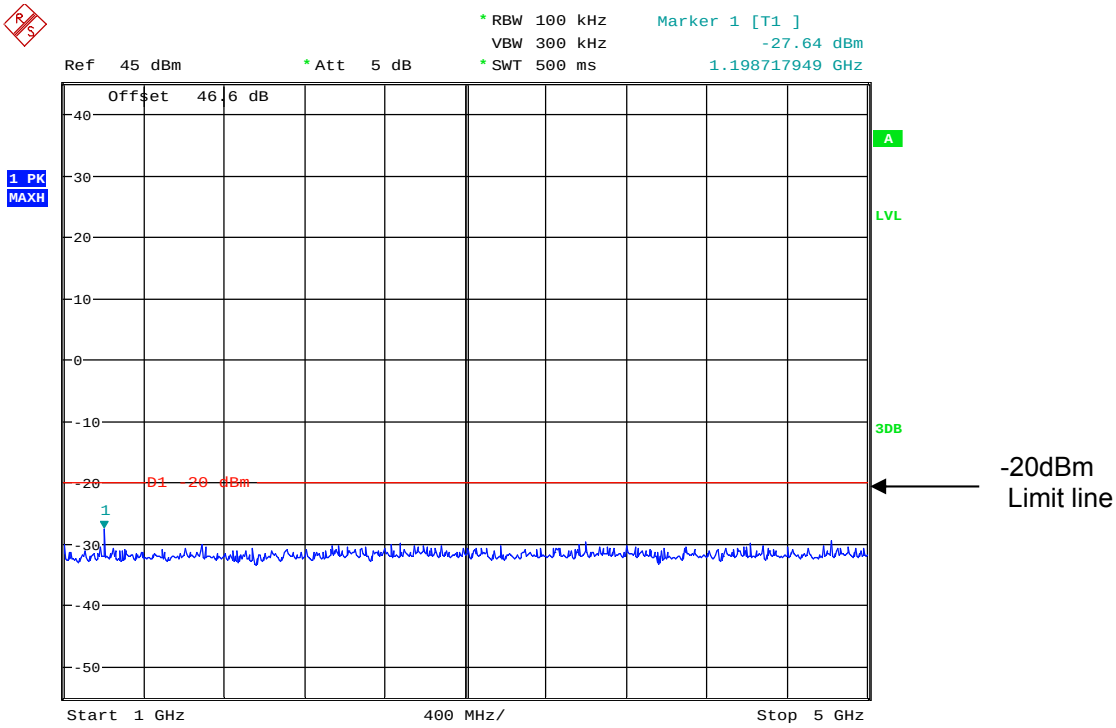

Date: 5.JUN.2013 16:42:54

400.0125MHz 30MHz-1GHz



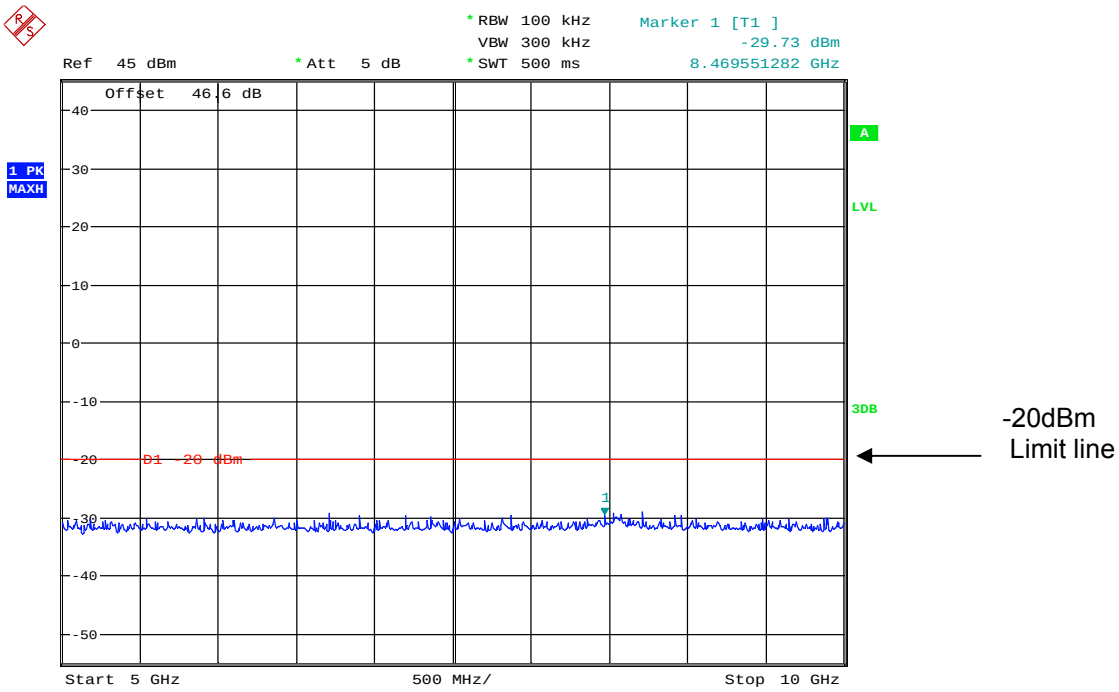

Date: 5.JUN.2013 16:39:42

400.0125MHz 1GHz – 5GHz




Date: 5.JUN.2013 16:44:23

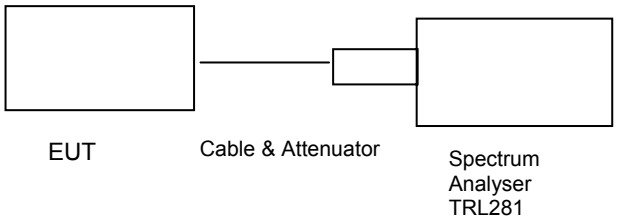
400.0125MHz 5GHz-10GHz




Date: 5.JUN.2013 16:47:11

**SPURIOUS EMISSIONS – CONDUCTED – Part 2.1053**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |




The test was set up as per the diagram. The unit was tested operating at maximum power.

The Spurious limit was calculated as follows:

On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (fd in kHz) of more than12.5kHz:At least 50+10log(P) or 70dB whichever is the lesser attenuation.

50+10log(25W)= 64dBc 64.0- 44.0 = -20dBm

Note: Emission preview plots were taken in a 100kHz resolution bandwidth to reduce the noise floor. Any emissions relating to the DUT were re measured using a 1MHz resolution bandwidth ≥1GHz.

The plots in this report are indication of worse case results, testing was performed on all modulation types. The plots shown are without the notch filter fitted.

**RESULTS**

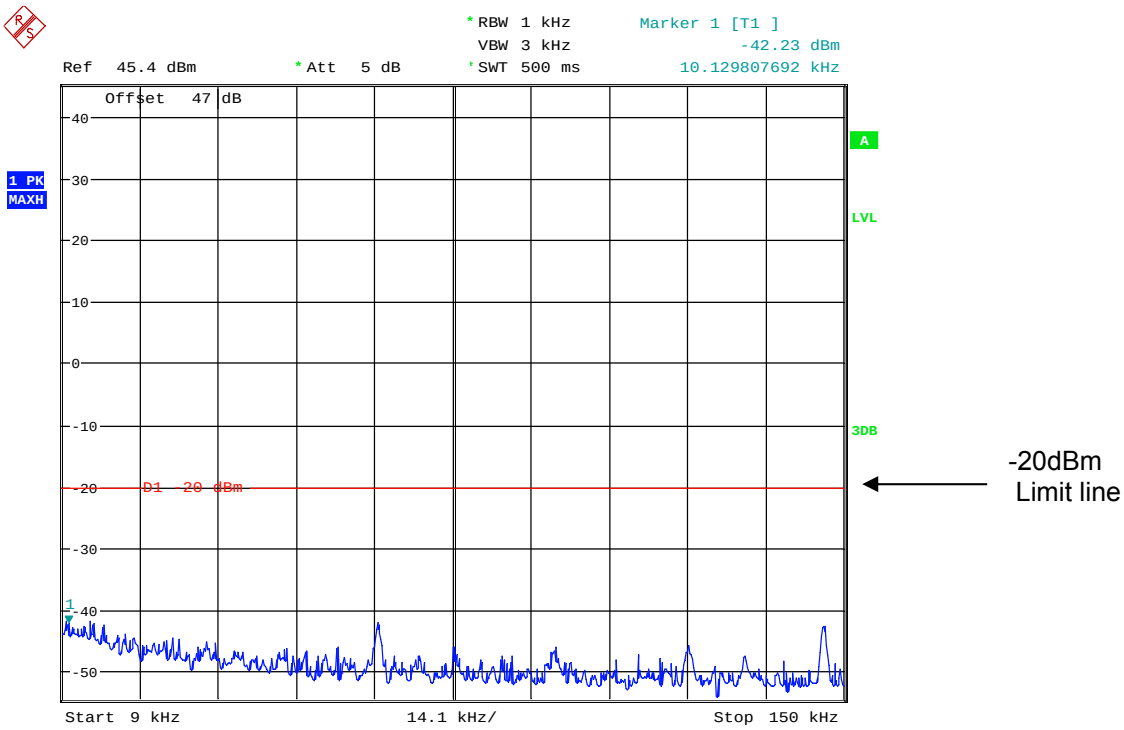
411.00MHz

| FREQUENCY RANGE | FREQ. (MHz) | MEASURED LEVEL (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 9kHz – 10GHz | 1233.0080<br>1644.1280 | -36.8<br>-36.1 | -20<br>-20 |

The test equipment used for the Transmitter Conducted Emissions:

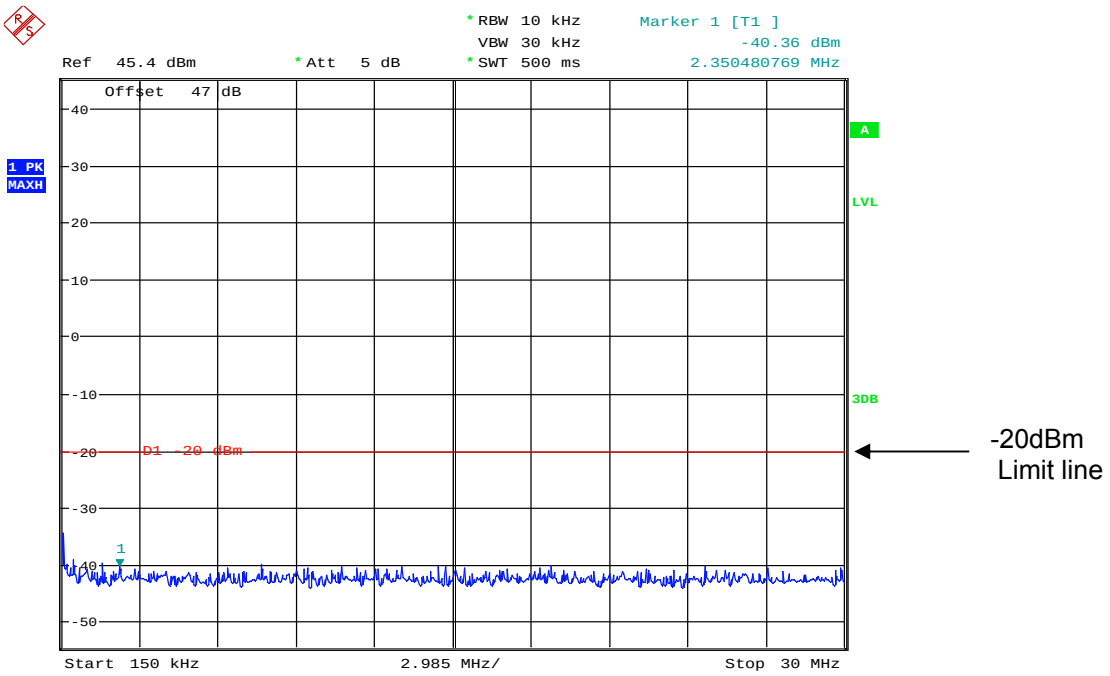
| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | TRAC No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| SPECTRUM ANALYSER | RHODE & SCHWARZ | FSU46 | 200034 | UH281 | **X** |
| CABLE | TRAC | N/A | N/A | UH271 | **X** |
| CABLE | TRAC | N/A | N/A | UH272 | **X** |
| ATTENUATOR | SPINNER | 745357 | N/A | TRLUH225 | **X** |
| ATTENUATOR | - | - | - | 20Db | **X** |
| ATTENUATOR | BIRD | 8304-100-N | N/A | 222 | **X** |
| FILTER H | TELONIC BERKELEY | TTR375-3EE | 60011-3 | TRLUH265 | **X** |

411.00MHz 9kHz – 150kHz



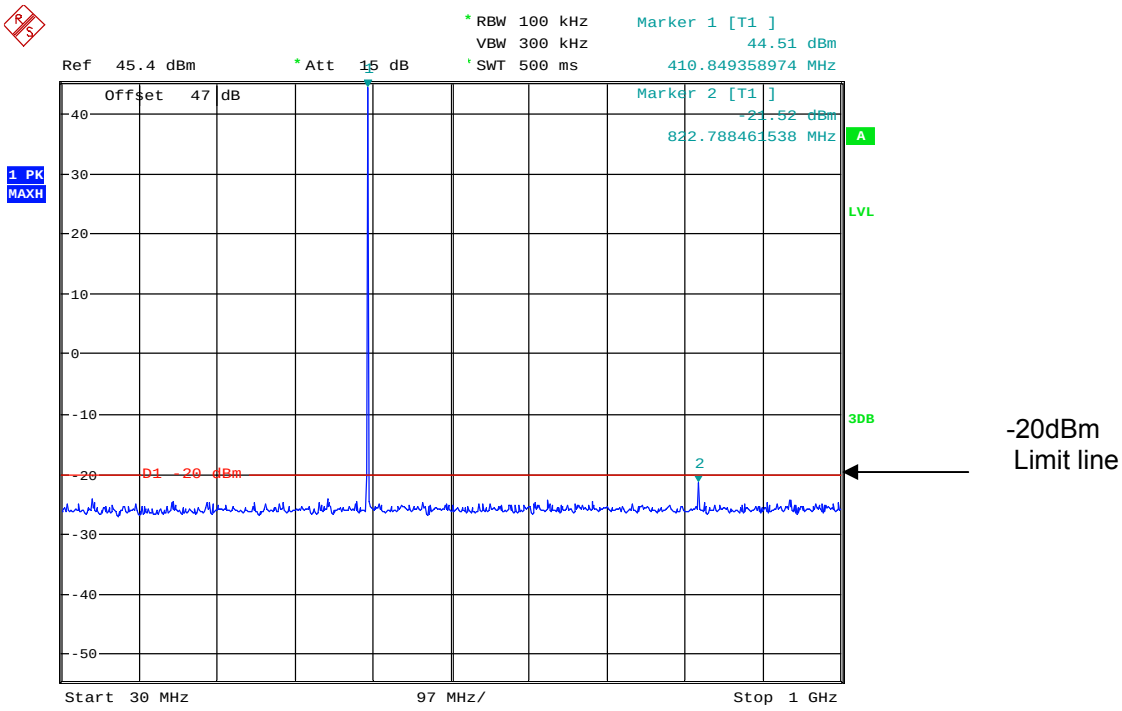

Date: 5.JUN.2013 16:56:02

411.00MHz 150kHz – 30MHz



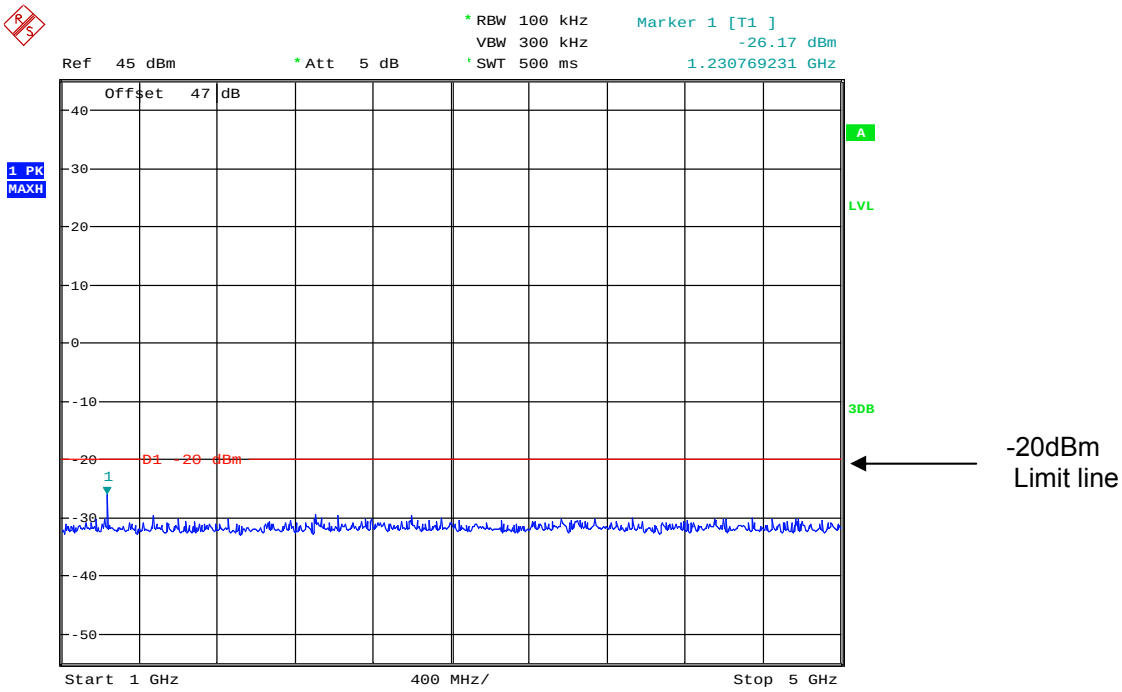

Date: 5.JUN.2013 16:57:11

411.00MHz 30MHz- 1GHz



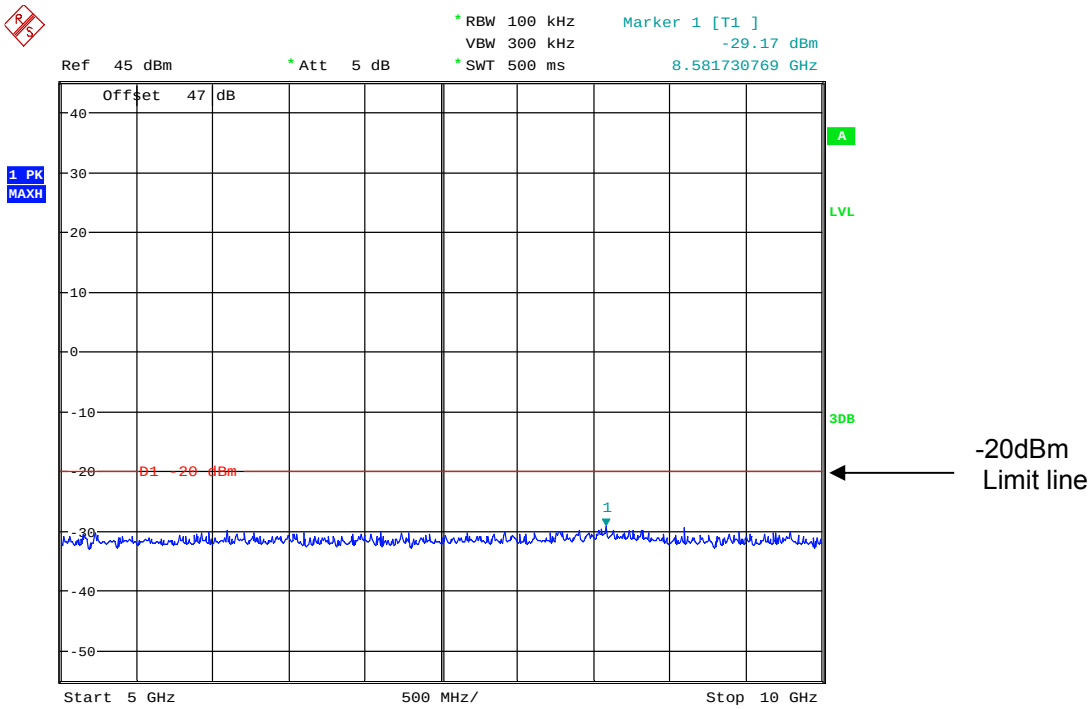

Date: 5.JUN.2013 16:55:07

411.00MHz 1GHz – 5GHz




Date: 5.JUN.2013 16:58:46

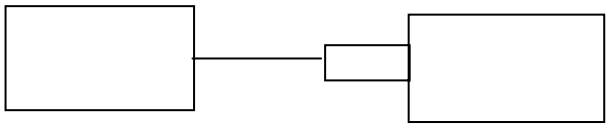
411.00MHz 5GHz – 10GHz




Date: 5.JUN.2013 17:00:12

**SPURIOUS EMISSIONS – CONDUCTED – Part 2.1053**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |




The test was set up as per the diagram. The unit was tested operating at maximum power .

The Spurious limit was calculated as follows:

On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (fd in kHz) of more than12.5kHz:At least 50+10log(P) or 70dB whichever is the lesser attenuation.

50+10log(25W)= 64dBc 64.0- 44.0 = -20dBm

Note: Emission preview plots were taken in a 100kHz resolution bandwidth to reduce the noise floor. Any emissions relating to the DUT were re measured using a 1MHz resolution bandwidth ≥1GHz.

The plots in this report are indication of worse case results, testing was performed on all modulation types. The plots shown are without the notch filter fitted.

**RESULTS**

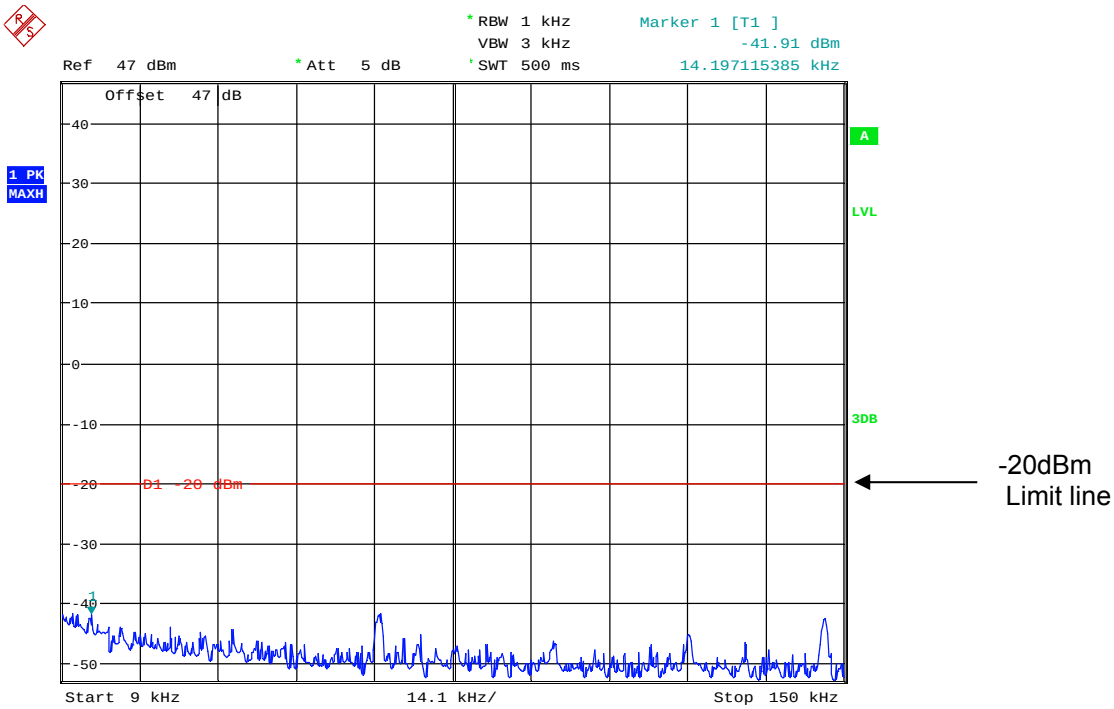
440.0125MHz

| FREQUENCY RANGE | FREQ. (MHz) | MEASURED LEVEL (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 9kHz – 10GHz | 1320.0490<br>1760.6120 | -36.6<br>-36.5 | -20<br>-20 |

The test equipment used for the Transmitter Conducted Emissions:

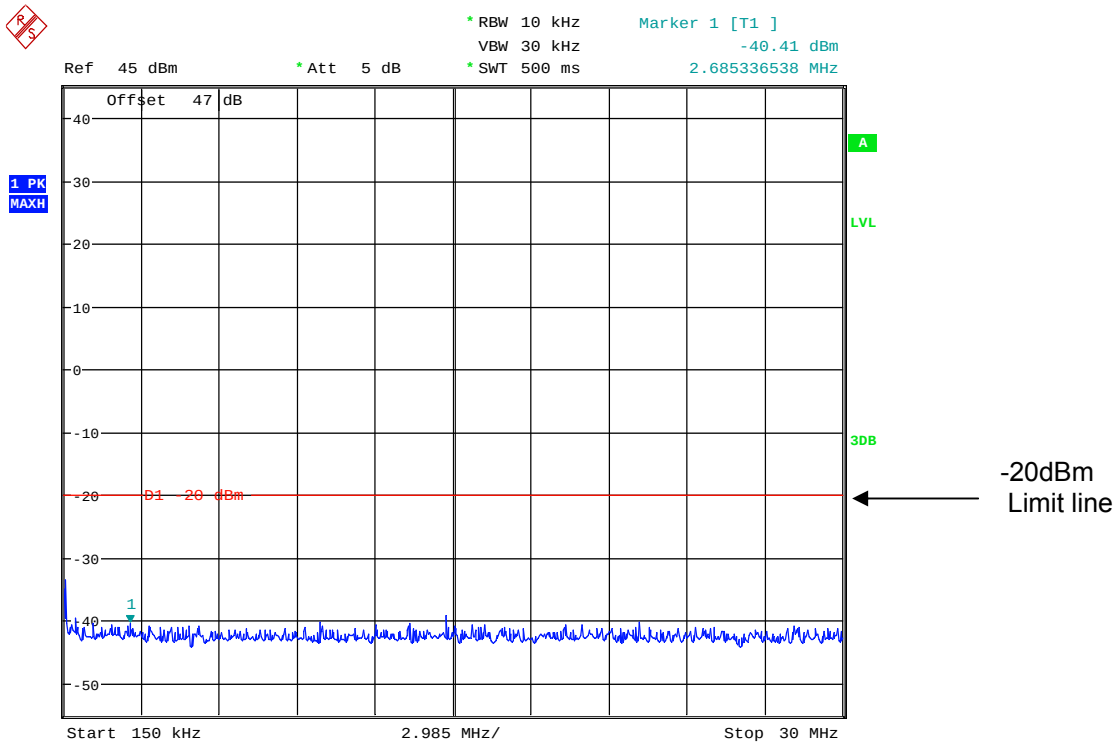
| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | TRAC No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| SPECTRUM ANALYSER | RHODE & SCHWARZ | FSU46 | 200034 | UH281 | **X** |
| CABLE | TRAC | N/A | N/A | UH271 | **X** |
| CABLE | TRAC | N/A | N/A | UH272 | **X** |
| ATTENUATOR | SPINNER | 745357 | N/A | TRLUH225 | **X** |
| ATTENUATOR | - | - | - | 20dB | **X** |
| ATTENUATOR | BIRD | 8304-100-N | N/A | 222 | **X** |
| FILTER H | TELONIC BERKELEY | TTR375-3EE | 60011-3 | TRLUH265 | **X** |

440.0125MHz 9kHz – 150kHz



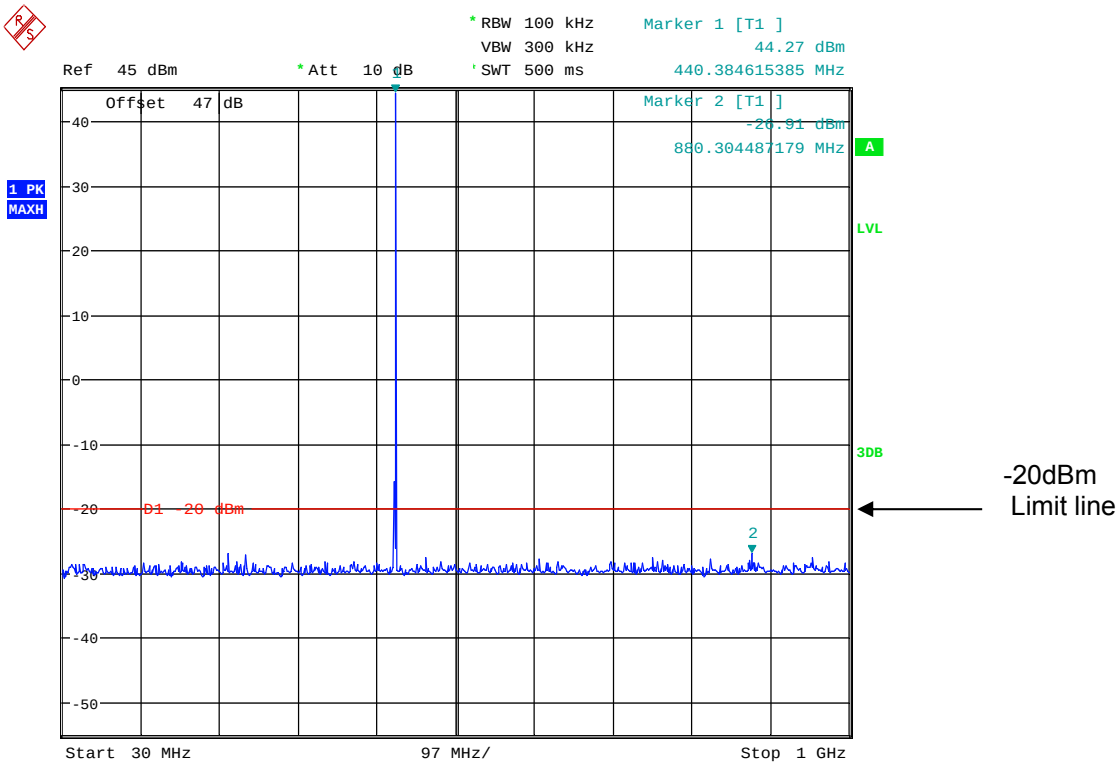

Date: 5.JUN.2013 17:07:29

440.0125MHz 150kHz -30MHz



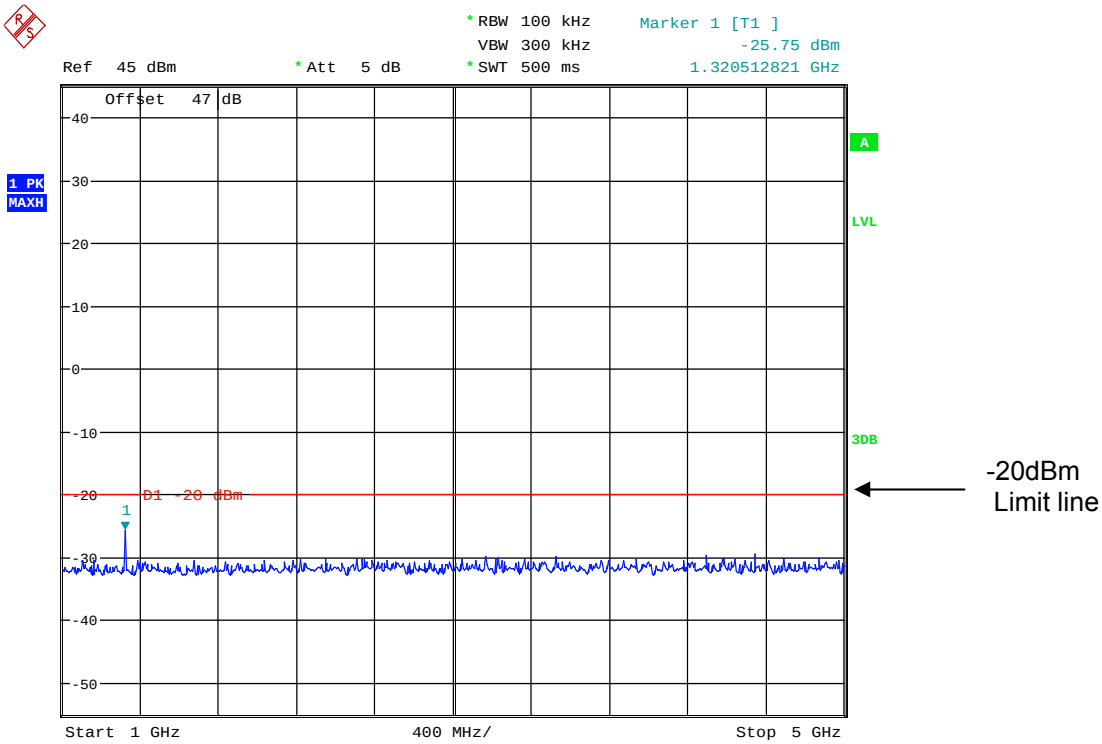

Date: 5.JUN.2013 17:08:46

440.0125MHz 30MHz-1GHz



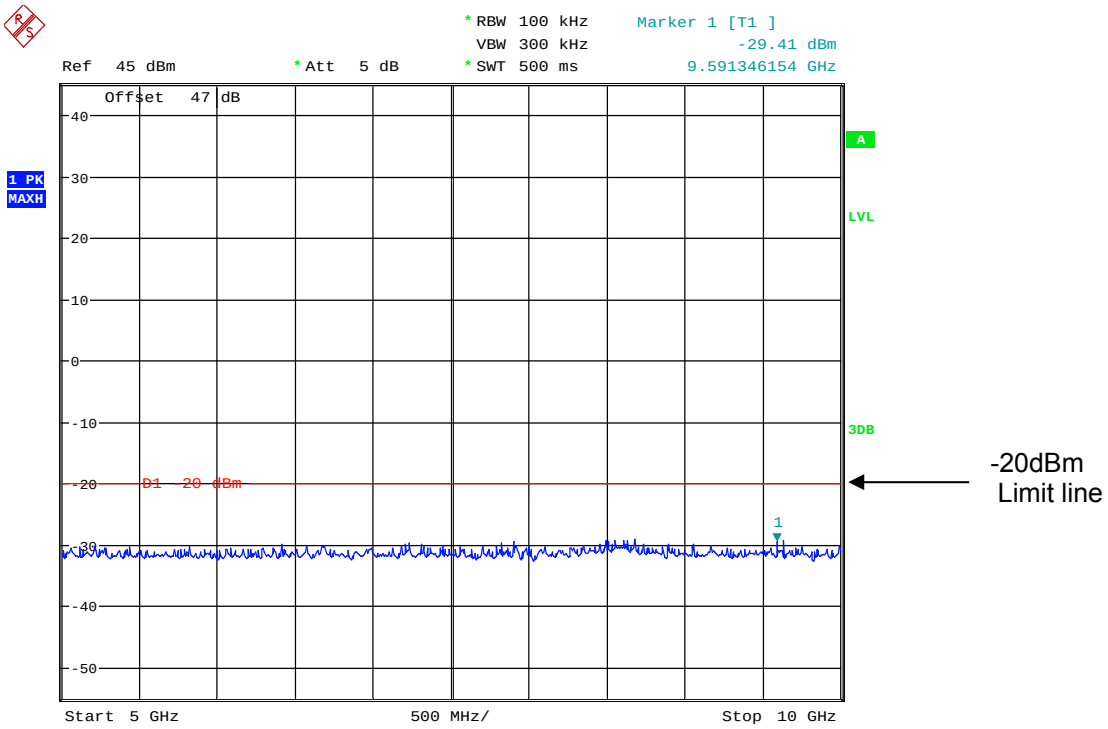

Date: 5.JUN.2013 17:06:18

440.0125MHz 1GHz – 5GHz




Date: 5.JUN.2013 17:09:42

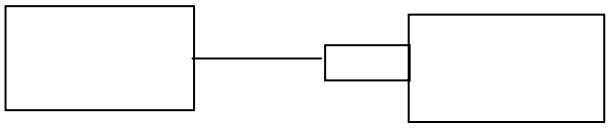
440.0125MHz 5GHz – 10GHz




Date: 5.JUN.2013 17:11:14

**SPURIOUS EMISSIONS – CONDUCTED – Part 2.1053**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |




The test was set up as per the diagram. The unit was tested operating at maximum power .

The Spurious limit was calculated as follows:

On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (fd in kHz) of more than12.5kHz:At least 50+10log(P) or 70dB whichever is the lesser attenuation.

50+10log(25W)= 64dBc 64.0- 44.0 = -20dBm

Note: Emission preview plots were taken in a 100kHz resolution bandwidth to reduce the noise floor. Any emissions relating to the DUT were re measured using a 1MHz resolution bandwidth ≥1GHz.

The plots in this report are indication of worse case results, testing was performed on all modulation types. The plots shown are without the notch filter fitted.

**RESULTS**

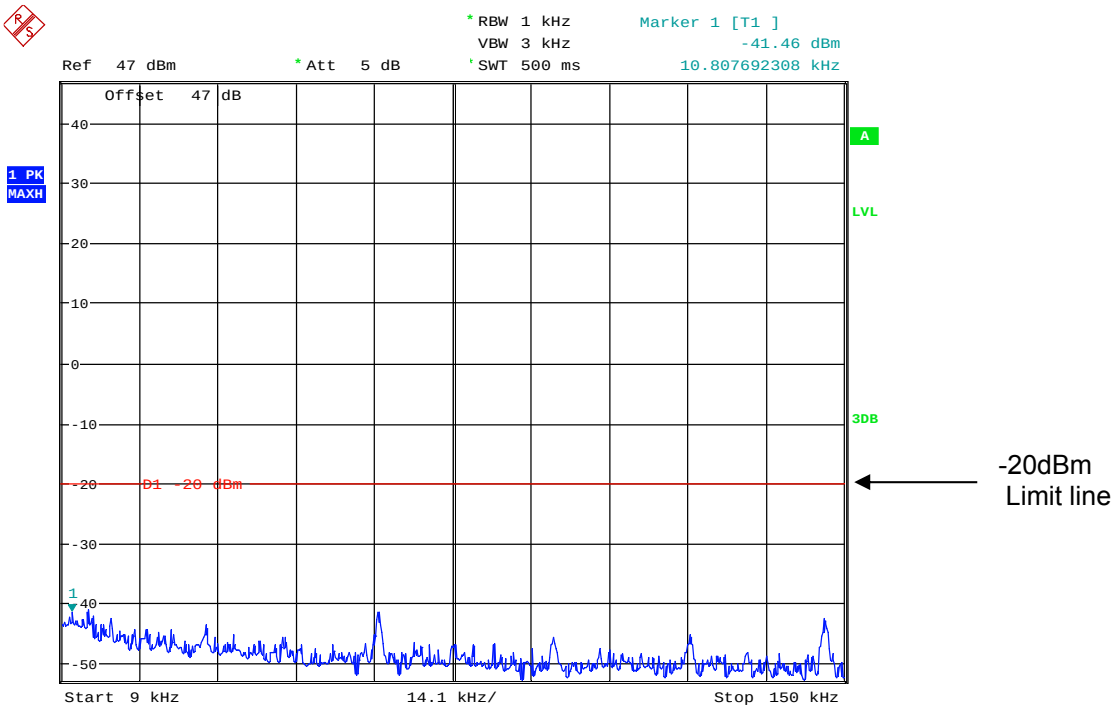
460.00MHz

| FREQUENCY RANGE | FREQ. (MHz) | MEASURED LEVEL (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 9kHz – 10GHz | No significant emissions within 20dB of the limit | | -20 |

The test equipment used for the Transmitter Conducted Emissions:

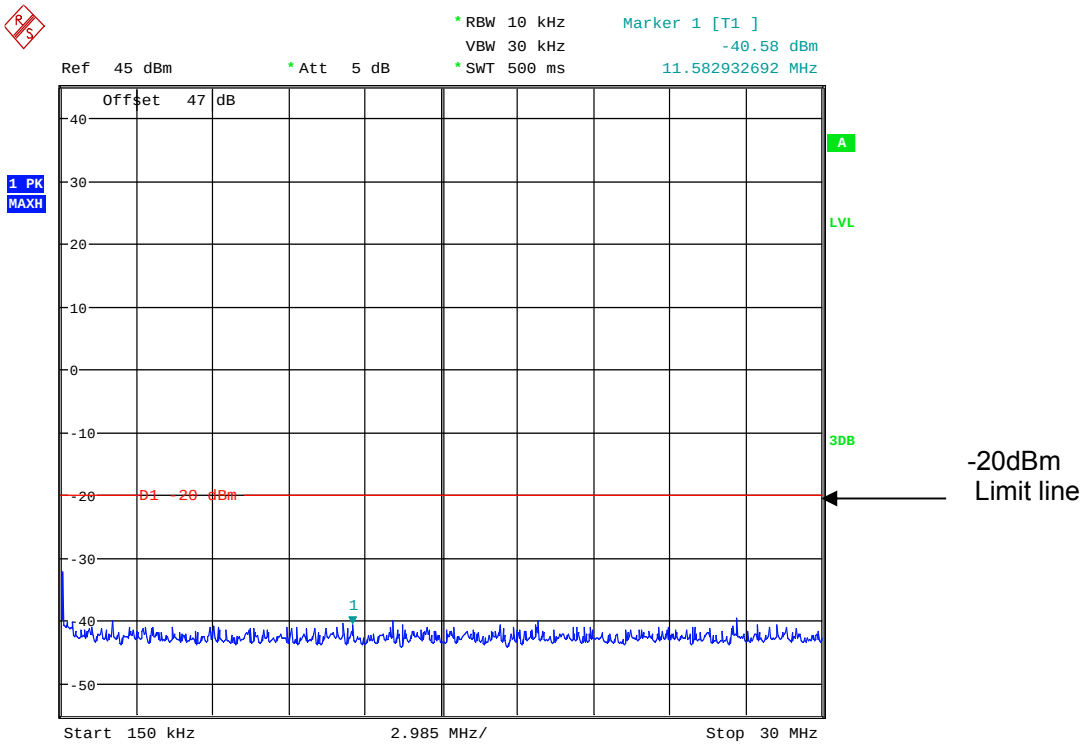
| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | TRAC No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| SPECTRUM ANALYSER | RHODE & SCHWARZ | FSU46 | 200034 | UH281 | **X** |
| CABLE | TRAC | N/A | N/A | UH271 | **X** |
| CABLE | TRAC | N/A | N/A | UH272 | **X** |
| ATTENUATOR | SPINNER | 745357 | N/A | TRLUH225 | **X** |
| ATTENUATOR | - | - | - | 20dB | **X** |
| ATTENUATOR | BIRD | 8304-100-N | N/A | 222 | **X** |
| FILTER H | TELONIC BERKELEY | TTR375-3EE | 60011-3 | TRLUH265 | **X** |

460.00Hz 9kHz – 150kHz



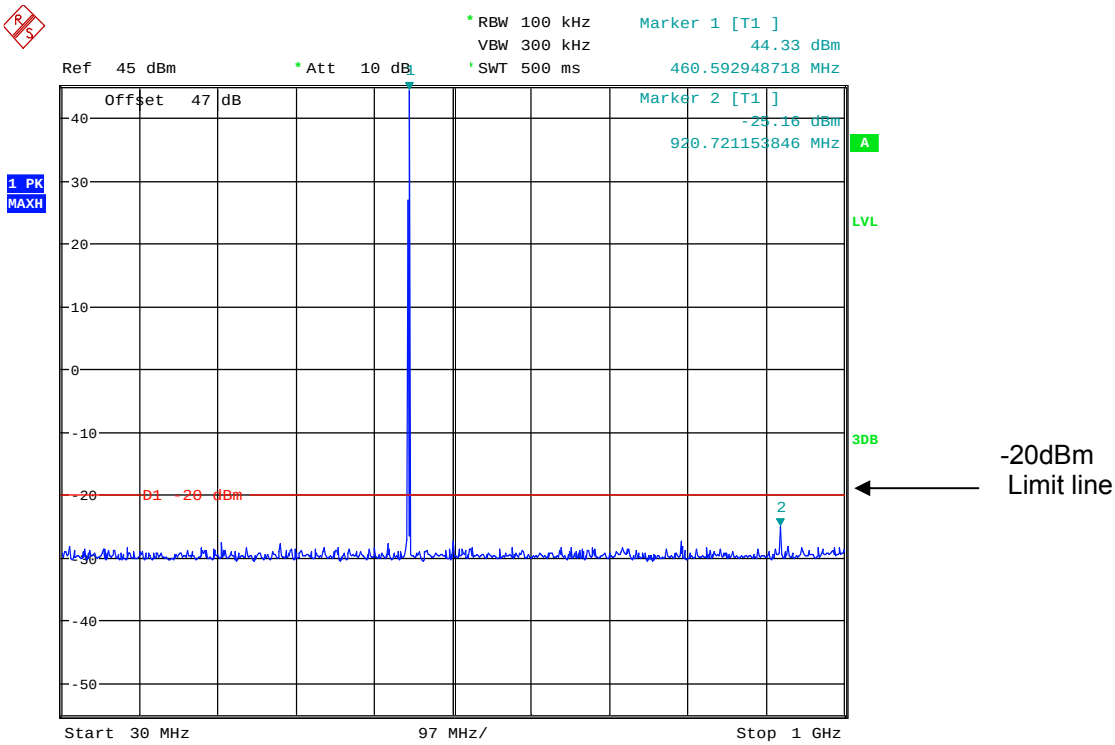

Date: 6.JUN.2013 09:41:32

460.00MHz 150kHz -30MHz



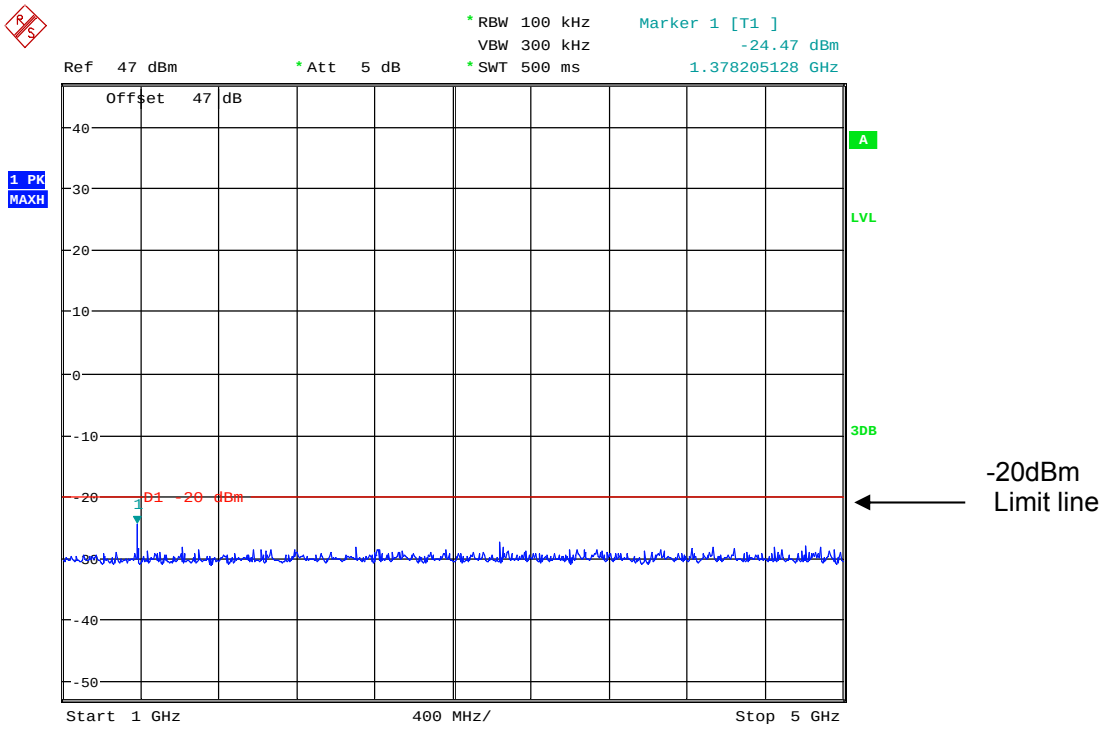

Date: 6.JUN.2013 09:44:03

460.00MHz 30MHz-1GHz



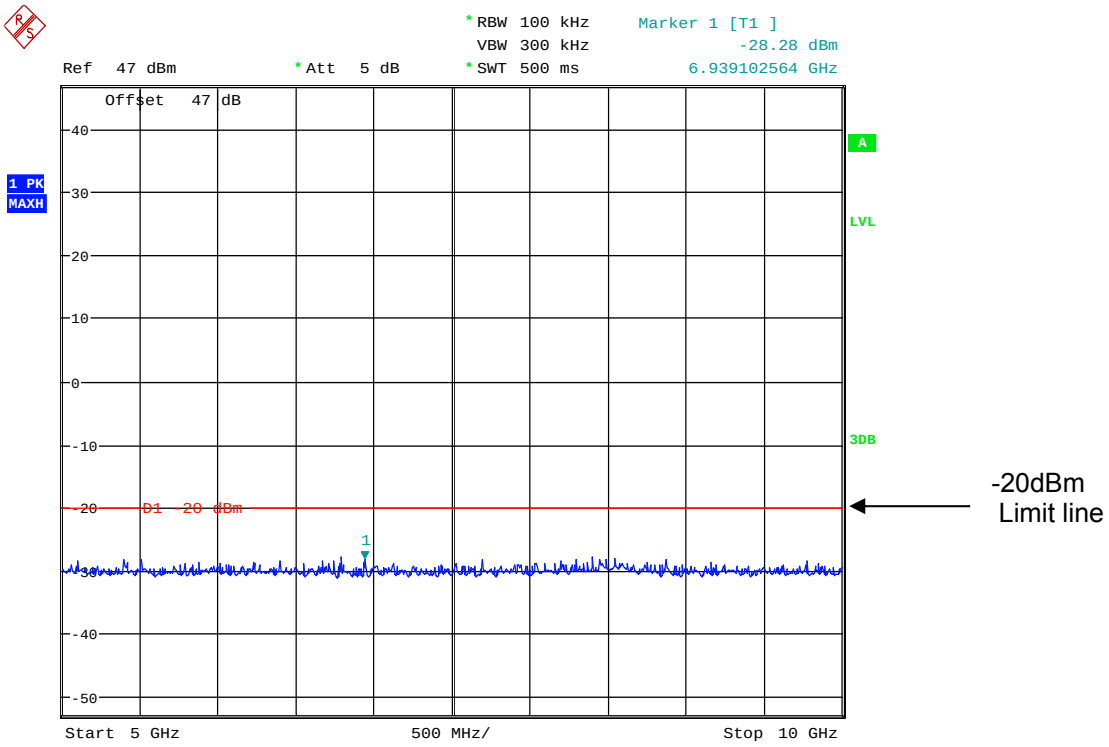

Date: 6.JUN.2013 09:39:46

460.00MHz 1GHz – 5GHz




Date: 6.JUN.2013 09:44:50

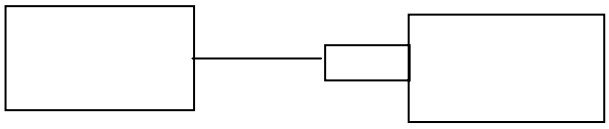
460.00 5GHz – 10GHz




Date: 6.JUN.2013 09:46:32

**SPURIOUS EMISSIONS – CONDUCTED – Part 2.1053**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |




The test was set up as per the diagram. The unit was tested operating at maximum power .

The Spurious limit was calculated as follows:

On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (fd in kHz) of more than12.5kHz:At least 50+10log(P) or 70dB whichever is the lesser attenuation.

50+10log(25W)= 64dBc 64.0- 44.0 = -20dBm

Note: Emission preview plots were taken in a 100kHz resolution bandwidth to reduce the noise floor. Any emissions relating to the DUT were re measured using a 1MHz resolution bandwidth ≥1GHz.

The plots in this report are indication of worse case results, testing was performed on all modulation types. The plots shown are without the notch filter fitted.

**RESULTS**

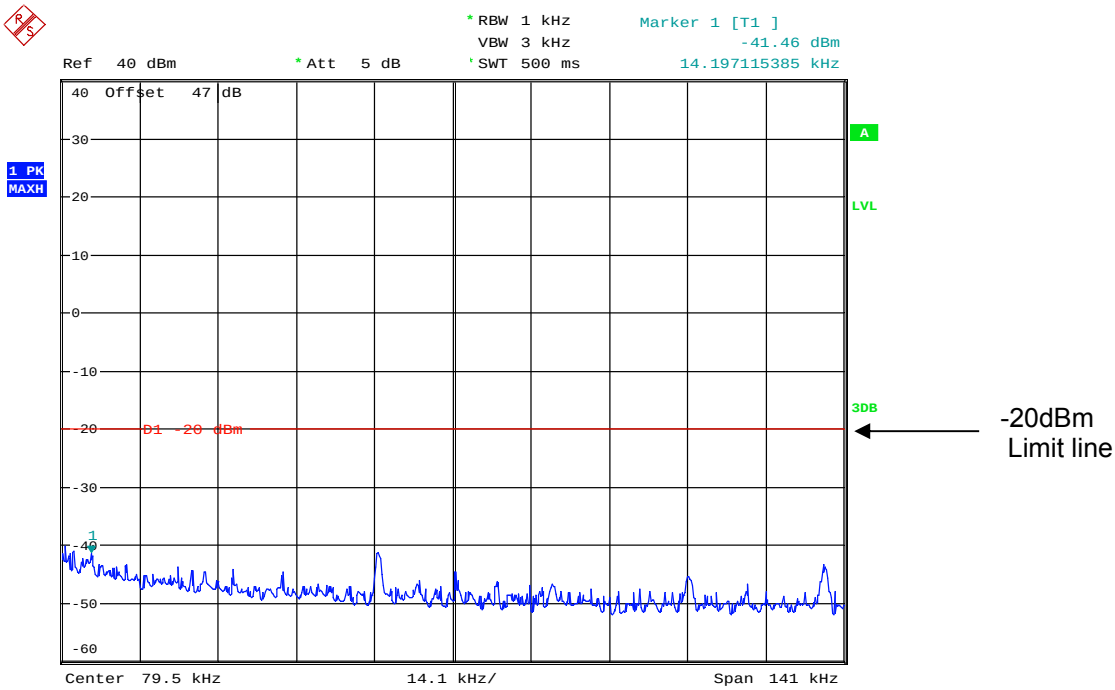
479.9875MHz

| FREQUENCY RANGE | FREQ. (MHz) | MEASURED LEVEL (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 9kHz – 10GHz | 1439.965 | -39.1 | -20 |

The test equipment used for the Transmitter Conducted Emissions:

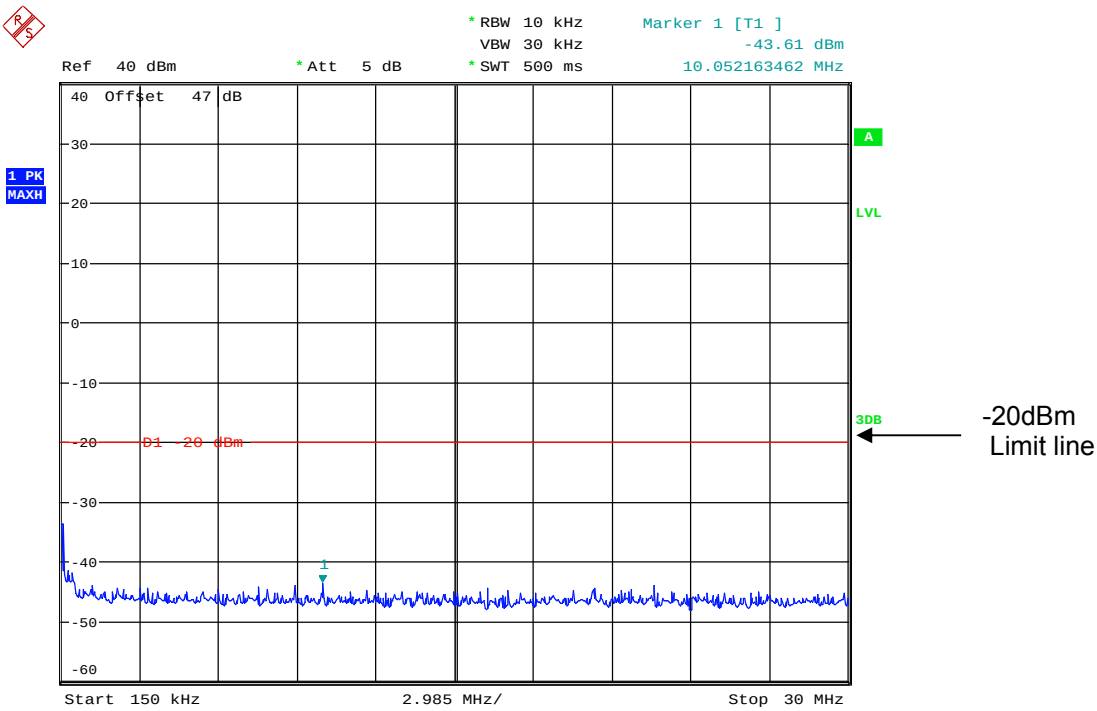
| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | TRAC No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| SPECTRUM ANALYSER | RHODE & SCHWARZ | FSU46 | 200034 | UH281 | **X** |
| CABLE | TRAC | N/A | N/A | UH271 | **X** |
| CABLE | TRAC | N/A | N/A | UH272 | **X** |
| ATTENUATOR | SPINNER | 745357 | N/A | TRLUH225 | **X** |
| ATTENUATOR | - | - | - | 20dB | **X** |
| ATTENUATOR | BIRD | 8304-100-N | N/A | 222 | **X** |
| FILTER H | TELONIC BERKELEY | TTR375-3EE | 60011-3 | TRLUH265 | **X** |

479.9875MHz 9kHz – 150kHz



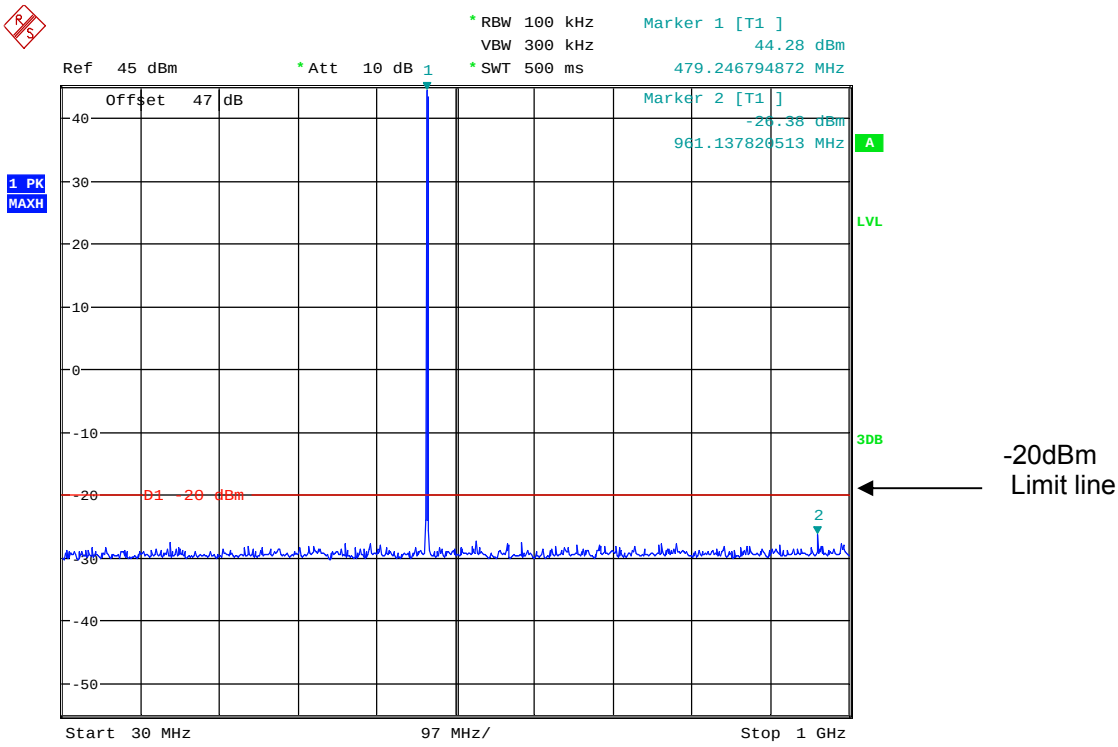

Date: 6.JUN.2013 09:52:51

479.9875MHz 150kHz -30MHz



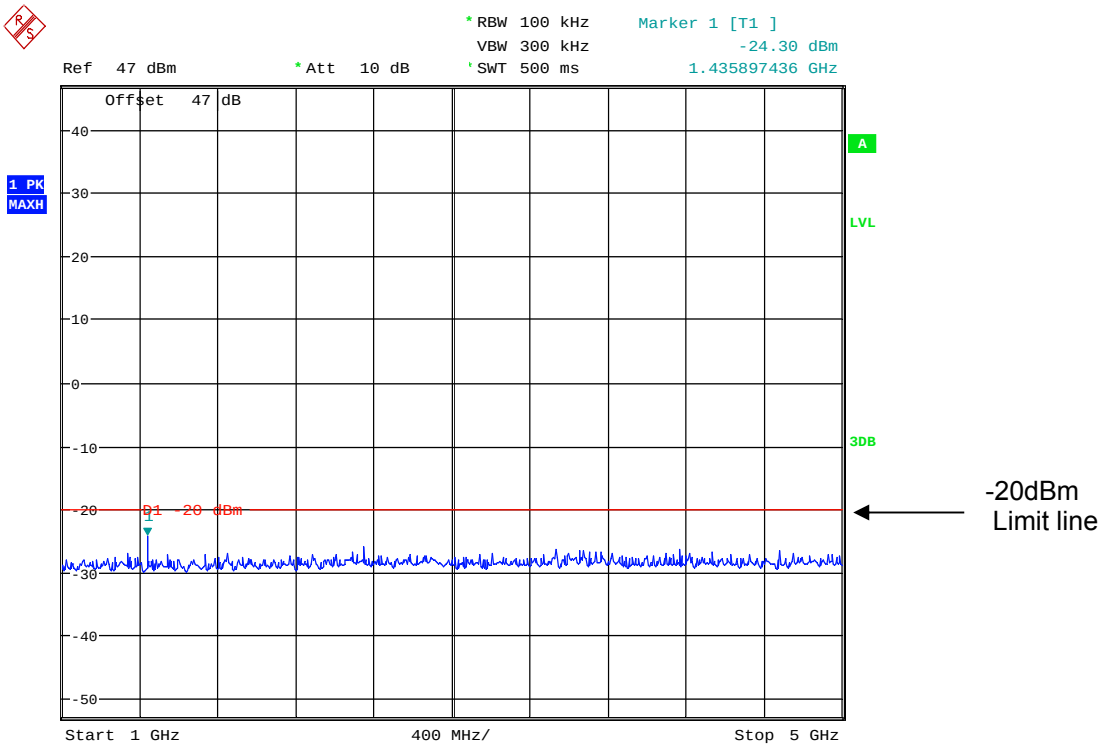

Date: 6.JUN.2013 09:54:25

479.9875MHz 30MHz-1GHz



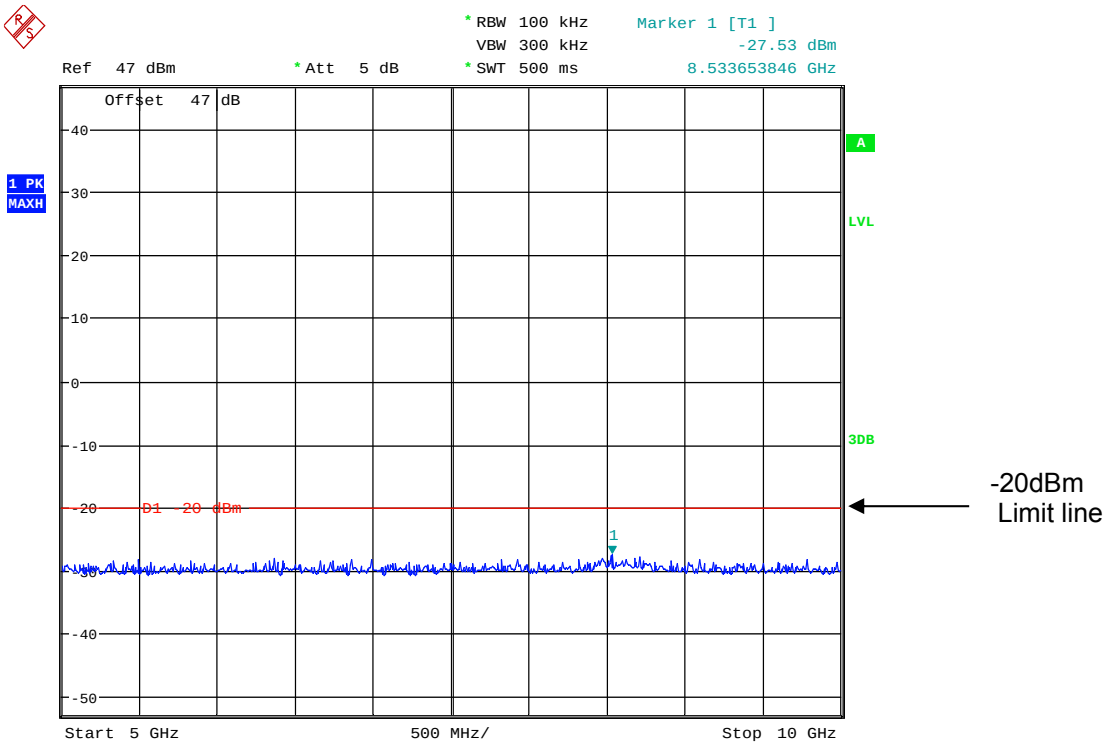

Date: 6.JUN.2013 09:51:38

479.9875MHz 1GHz – 5GHz




Date: 6.JUN.2013 09:56:27

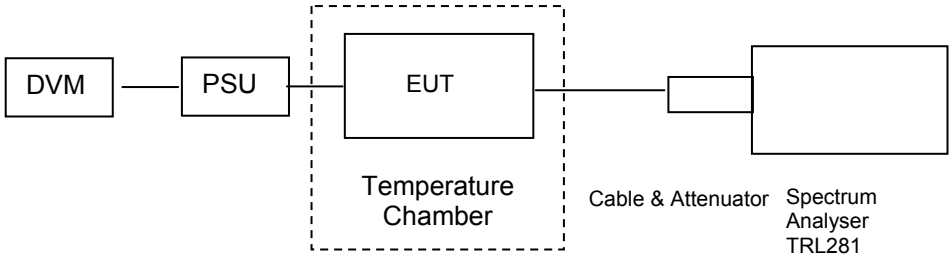
479.9875MHz 5GHz – 10GHz




Date: 6.JUN.2013 09:59:04

**FREQUENCY STABILITY – CONDUCTED – Part 90.213**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |




400.0125MHz

| Temperature °C | Vnom (Vdc) | Measured Frequency (MHz) | Frequency Difference (Hz) | ppm | Limit ± 1.5ppm Pass/Fail |
|---|---|---|---|---|---|
| +50 | 13.8 | 400.01244 | -0.0300 | -0.07 | Pass |
| +40 | 13.8 | 400.01246 | -0.0100 | -0.02 | Pass |
| +30 | 13.8 | 400.01246 | -0.0100 | -0.02 | Pass |
| +20 | 13.8 | 400.01240 | -0.0700 | -0.17 | Pass |
| +10 | 13.8 | 400.01236 | -0.1100 | -0.27 | Pass |
| 0 | 13.8 | 400.01239 | -0.0800 | -0.20 | Pass |
| -10 | 13.8 | 400.01243 | -0.0400 | -0.10 | Pass |
| -20 | 13.8 | 400.01239 | -0.0800 | -0.20 | Pass |
| -30 | 13.8 | 400.01232 | -0.1500 | -0.37 | Pass |

| Tnom 21 °C | 85%= 11.7Vdc | 115%= 15.9Vdc |
|---|---|---|
| Frequency (MHz) | 400.012450 | 400.012480 |
| Frequency Difference (kHz) | -0.02 | 0.01 |
| ppm | -0.049 | 0.024 |
| Limit ± 1.5 ppm Pass/Fail | Pass | Pass |

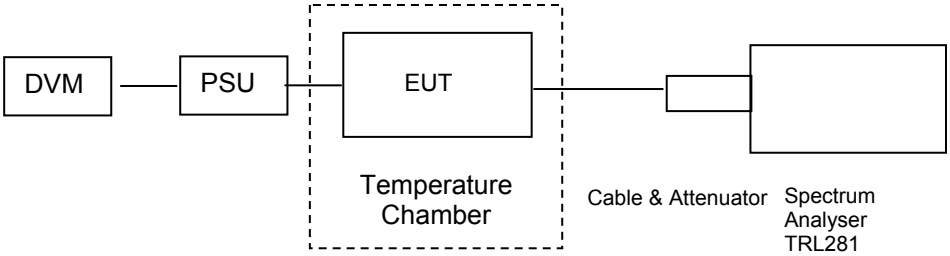
Frequency stability measurements were between -30°C and +50°C in 10°C increments.

At each temperature the transmitter was given a period of 60 minutes to stabilise. The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Measurements were also made with the supply voltage varied between 115% and 85% of the nominal supply voltage(13.8Vdc).

Ambient temperature = 21°C
Relative humidity = 39%
Supply voltage = +13.8Vdc

Radio Laboratory
Test Signal = F3E




411.00MHz

| Temperature °C | Vnom (Vdc) | Measured Frequency (MHz) | Frequency Difference (Hz) | ppm | Limit ± 1.5 ppm Pass/Fail |
|---|---|---|---|---|---|
| +50 | 13.8 | 410.99995 | -0.0200 | -0.05 | Pass |
| +40 | 13.8 | 410.99997 | 0.0000 | 0.00 | Pass |
| +30 | 13.8 | 410.99996 | -0.0100 | -0.02 | Pass |
| +20 | 13.8 | 410.99990 | -0.0700 | -0.17 | Pass |
| +10 | 13.8 | 410.99988 | -0.0900 | -0.22 | Pass |
| 0 | 13.8 | 410.99987 | -0.1000 | -0.24 | Pass |
| -10 | 13.8 | 410.99992 | -0.0500 | -0.12 | Pass |
| -20 | 13.8 | 410.99990 | -0.0700 | -0.17 | Pass |
| -30 | 13.8 | 410.99985 | -0.1200 | -0.29 | Pass |

| Tnom 21.5°C | 85%= 11.7Vdc | 115%= 15.9Vdc |
|---|---|---|
| Frequency (MHz) | 410.999950 | 410.999950 |
| Frequency Difference (kHz) | -0.02 | -0.02 |
| ppm | -0.45 | -0.45 |
| Limit ± 1.5 ppm Pass/Fail | Pass | Pass |

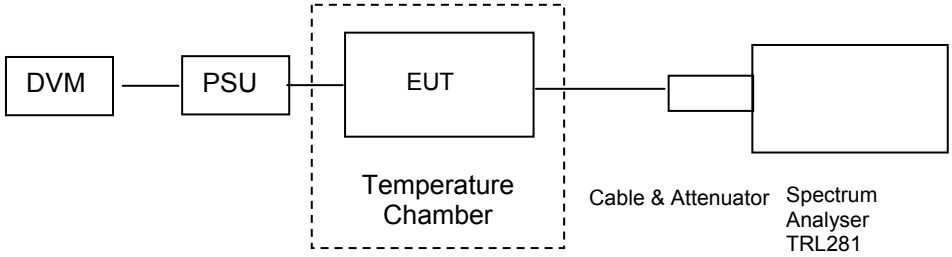
Frequency stability measurements were between -30°C and +50°C in 10°C increments.

At each temperature the transmitter was given a period of 60 minutes to stabilise. The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Measurements were also made with the supply voltage varied between 115% and 85% of the nominal supply voltage(13.8Vdc).

Ambient temperature = 21°C
Relative humidity = 39%
Supply voltage = +13.8Vdc

Radio Laboratory
Test Signal = F3E




440.0125MHz

| Temperature °C | Vnom (Vdc) | Measured Frequency (MHz) | Frequency Difference (Hz) | ppm | Limit ± 1.5 ppm Pass/Fail |
|---|---|---|---|---|---|
| +50 | 13.8 | 440.01244 | -0.0300 | -0.07 | Pass |
| +40 | 13.8 | 440.01247 | 0.0000 | 0.00 | Pass |
| +30 | 13.8 | 440.01246 | -0.0100 | -0.02 | Pass |
| +20 | 13.8 | 440.01243 | -0.0400 | -0.09 | Pass |
| +10 | 13.8 | 440.01236 | -0.1100 | -0.25 | Pass |
| 0 | 13.8 | 440.01235 | -0.1200 | -0.27 | Pass |
| -10 | 13.8 | 440.01241 | -0.0600 | -0.14 | Pass |
| -20 | 13.8 | 440.01243 | -0.0400 | -0.09 | Pass |
| -30 | 13.8 | 440.01234 | -0.1300 | -0.30 | Pass |

| Tnom 21.5°C | 85%= 11.7Vdc | 115%= 15.9Vdc |
|---|---|---|
| Frequency (MHz) | 440.012450 | 440.012450 |
| Frequency Difference (kHz) | -0.02 | -0.02 |
| ppm | -0.045 | -0.045 |
| Limit ± 1.5 ppm Pass/Fail | Pass | Pass |

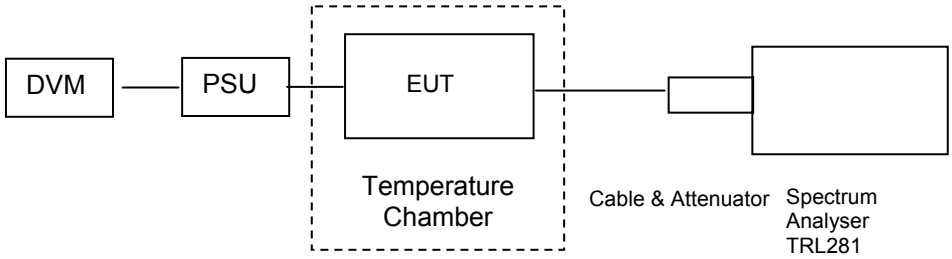
Frequency stability measurements were between -30°C and +50°C in 10°C increments.

At each temperature the transmitter was given a period of 60 minutes to stabilise. The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Measurements were also made with the supply voltage varied between 115% and 85% of the nominal supply voltage(13.8Vdc).

Ambient temperature = 21°C
Relative humidity = 39%
Supply voltage = +13.8Vdc

Radio Laboratory
Test Signal = F3E




460.00MHz

| Temperature °C | Vnom (Vdc) | Measured Frequency (MHz) | Frequency Difference (Hz) | ppm | Limit ± 1.5 ppm Pass/Fail |
|---|---|---|---|---|---|
| +50 | 13.8 | 459.99993 | 0.4300 | 0.93 | Pass |
| +40 | 13.8 | 460.00000 | 0.5000 | 1.09 | Pass |
| +30 | 13.8 | 459.99995 | 0.4500 | 0.98 | Pass |
| +20 | 13.8 | 459.99994 | 0.4400 | 0.96 | Pass |
| +10 | 13.8 | 459.99984 | 0.3400 | 0.74 | Pass |
| 0 | 13.8 | 459.99986 | 0.3600 | 0.78 | Pass |
| -10 | 13.8 | 459.99990 | 0.4000 | 0.87 | Pass |
| -20 | 13.8 | 459.99992 | 0.4200 | 0.91 | Pass |
| -30 | 13.8 | 459.99986 | 0.3600 | 0.78 | Pass |

| Tnom 21.5°C | 85%= 11.7Vdc | 115%= 15.9Vdc |
|---|---|---|
| Frequency (MHz) | 459.99997 | 459.999950 |
| Frequency Difference (kHz) | 0.02 | 0 |
| ppm | 0.043 | 0 |
| Limit ± 1.5 ppm Pass/Fail | Pass | Pass |

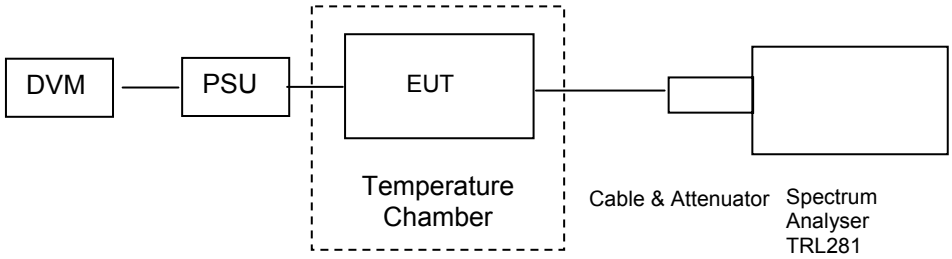
Frequency stability measurements were between -30°C and +50°C in 10°C increments.

At each temperature the transmitter was given a period of 60 minutes to stabilise. The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Measurements were also made with the supply voltage varied between 115% and 85% of the nominal supply voltage(13.8Vdc).

Ambient temperature = 21°C
Relative humidity = 39%
Supply voltage = +13.8Vdc

Radio Laboratory
Test Signal = F3E




479.9875MHz

| Temperature °C | Vnom (Vdc) | Measured Frequency (MHz) | Frequency Difference (Hz) | ppm | Limit ± 1.5 ppm Pass/Fail |
|---|---|---|---|---|---|
| +50 | 13.8 | 479.98742 | -0.0300 | -0.06 | Pass |
| +40 | 13.8 | 479.98745 | 0.0000 | 0.00 | Pass |
| +30 | 13.8 | 479.98745 | 0.0000 | 0.00 | Pass |
| +20 | 13.8 | 479.98745 | 0.0000 | 0.00 | Pass |
| +10 | 13.8 | 479.98737 | -0.0800 | -0.17 | Pass |
| 0 | 13.8 | 479.98734 | -0.1100 | -0.23 | Pass |
| -10 | 13.8 | 479.98738 | -0.0700 | -0.15 | Pass |
| -20 | 13.8 | 479.98742 | -0.0300 | -0.06 | Pass |
| -30 | 13.8 | 479.98735 | -0.1000 | -0.21 | Pass |

| Tnom 21.5°C | 85%= 11.7Vdc | 115%= 15.9Vdc |
|---|---|---|
| Frequency (MHz) | 479.987450 | 479.987450 |
| Frequency Difference (kHz) | 0.0 | 0 |
| ppm | 0.0 | 0 |
| Limit ± 1.5 ppm Pass/Fail | Pass | Pass |

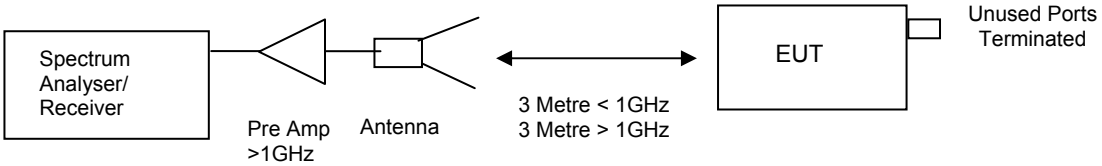
Frequency stability measurements were between -30°C and +50°C in 10°C increments.

At each temperature the transmitter was given a period of 60 minutes to stabilise. The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Measurements were also made with the supply voltage varied between 115% and 85% of the nominal supply voltage(13.8Vdc).

**INTENTIONAL RADIATOR SPURIOUS EMISSIONS – RADIATED – Part 2.1053**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 24°C | Test Signal | = | F3E |
| Relative humidity | = | 56% | | | |
| Conditions | = | ATS | | | |
| Supply voltage | = | +13.8Vdc/+28.0Vdc | | | |
| Supply Frequency | = | N/A | | | |




The test was set up as per the diagram. The unit was tested operating maximum power on three test frequencies with a 50 ohm load on the output.
The Spurious limit was calculated as follows:

On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (fd in kHz) of more than12.5kHz:At least 50+10log(P) or 70dB whichever is the lesser attenuation.

50+10log(25W)= 64dBc 64.0- 44.0 = -20dBm

Note: Emission preview plots were taken in a 100kHz resolution bandwidth to reduce the noise floor. Any emissions relating to the DUT were re measured using a 1MHz resolution bandwidth ≥1GHz.

The plots in this report are indication of worse case results, testing was performed on all modulation types.

**RESULTS**

| FREQUENCY RANGE | FREQ. 400.0125 | Measured (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 30MHz – 10GHz | No significant emissions within 20 dB of the limit | | -20 |

| FREQUENCY RANGE | FREQ. 411.00 | Measured (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 30MHz – 10GHz | No significant emissions within 20 dB of the limit | | -20 |

| FREQUENCY RANGE | FREQ. 440.0125 | Measured (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 30MHz – 10GHz | No significant emissions within 20 dB of the limit | | -20 |

| FREQUENCY RANGE | FREQ. 460.00 | Measured (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 30MHz – 10GHz | No significant emissions within 20 dB of the limit | | -20 |

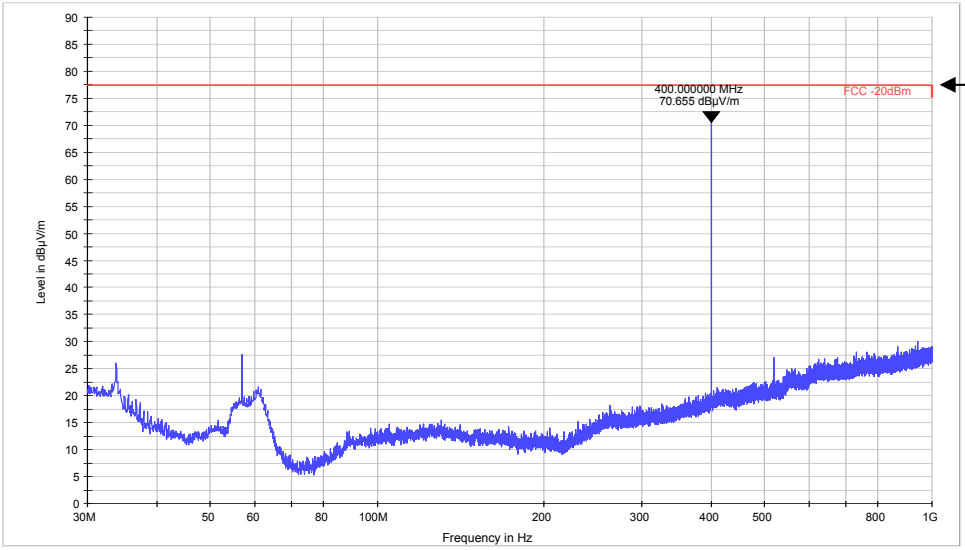
| FREQUENCY RANGE | FREQ. 479.9875 | Measured (dBm) | LIMIT (dBm) |
|---|---|---|---|
| 30MHz – 10GHz | No significant emissions within 20 dB of the limit | | -20 |

The test equipment used for the Transmitter Spurious Emissions:

| TYPE OF EQUIPMENT | MAKER/ SUPPLIER | MODEL No | SERIAL No | TRAC No | ACTUAL EQUIPMENT USED |
|---|---|---|---|---|---|
| HORN | EMCO | 3115 | 9010-3580 | 138 | **X** |
| SPECTRUM ANALYSER | R&S | FSU46 | 200034 | TRL281 | **X** |
| PRE AMPLIFIER | HP | 8449B | 3008A016 | 572 | **X** |
| ANTENNA | YORK | CBL611/A | 1618 | UH191 | **X** |
| RECEIVER | R&S | ESVS10 | 825892/006 | UH04 | **X** |

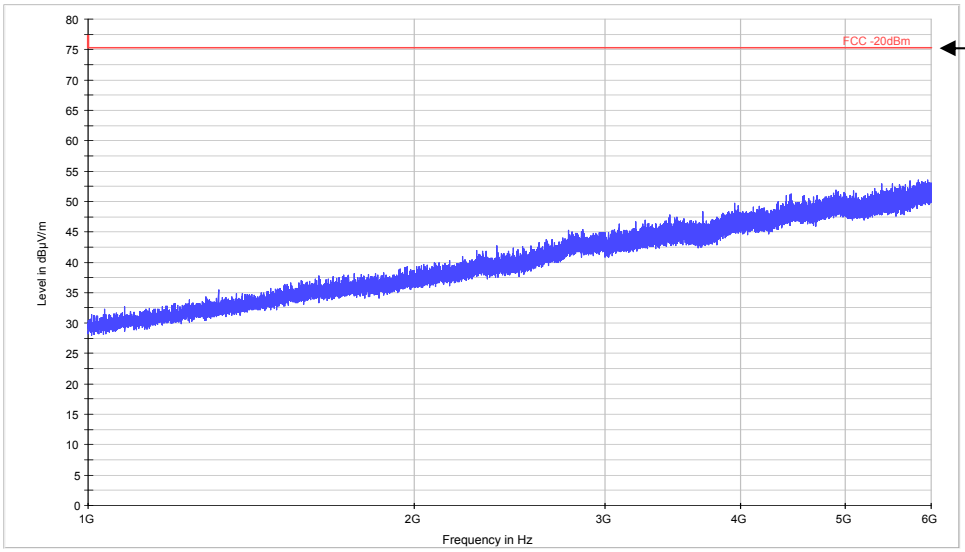
Radiated emissions

400.0125MHz 30MHz – 1GHz



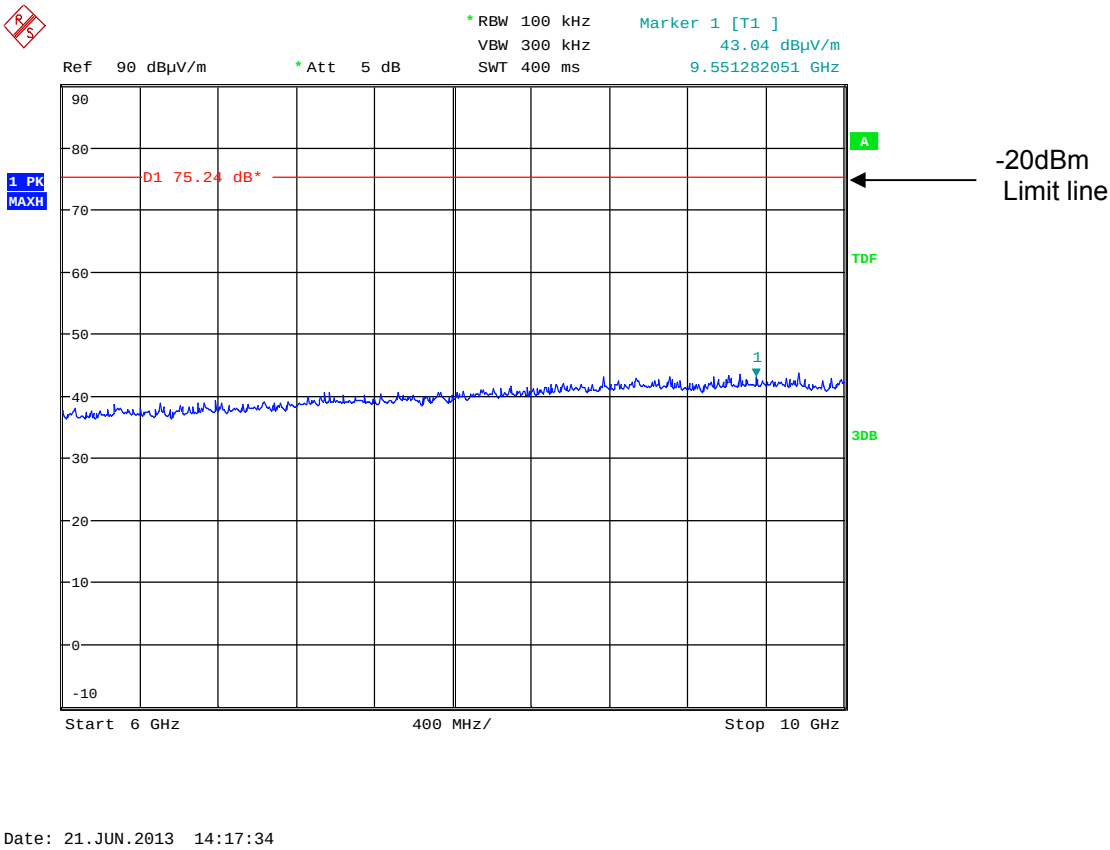

-20dBm
Limit line

400.0125MHz 1GHz – 6GHz



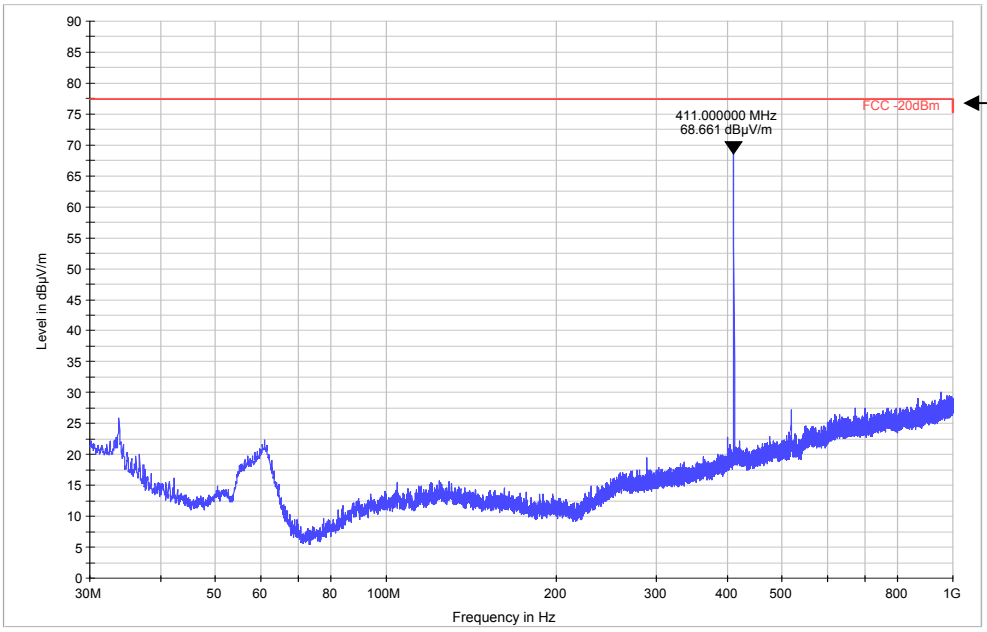

-20dBm
Limit line

400.0125MHz 6GHz – 10GHz



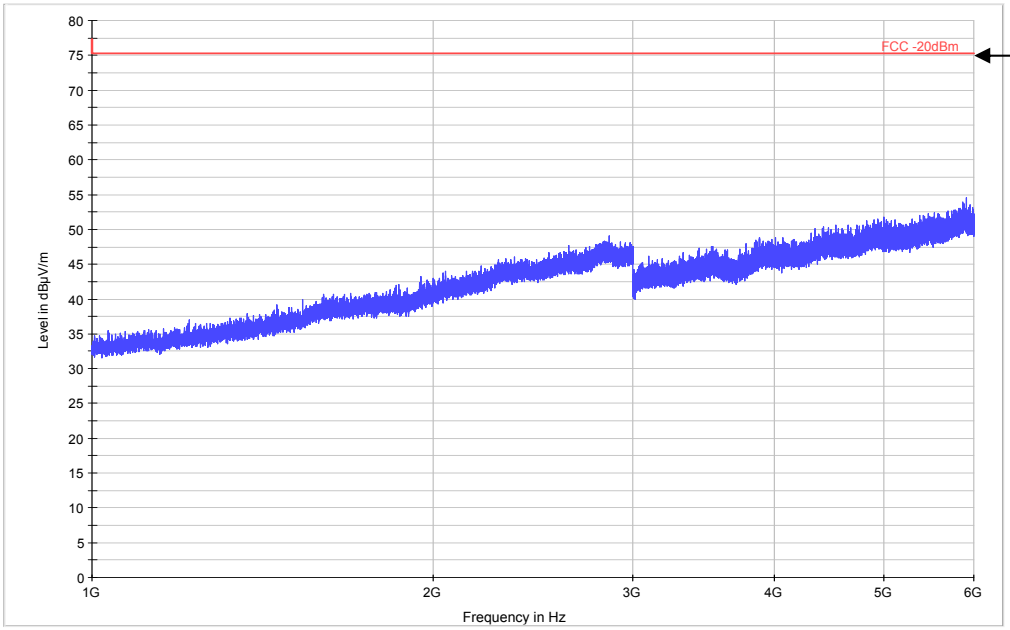

The above test results show that there were no emissions within 20dBs of the –20dBm limit.

411.00MHz 30MHz – 1GHz



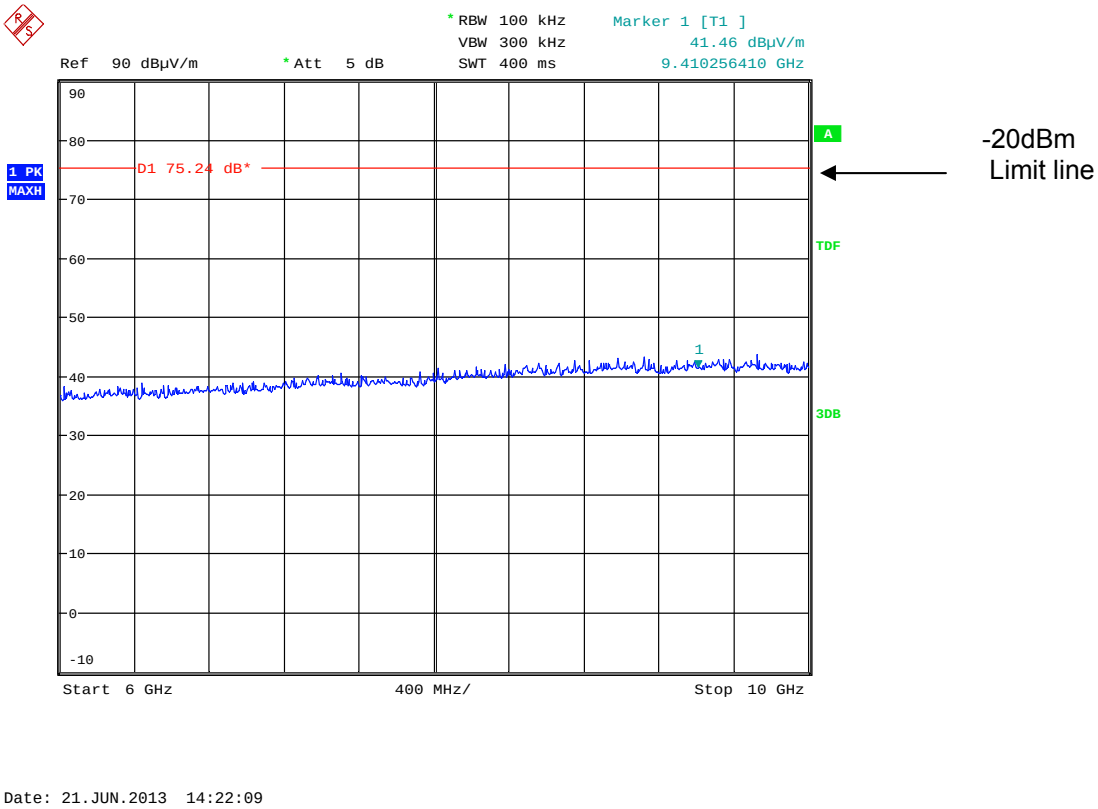

-20dBm
Limit line

411.00MHz 1GHz – 6GHz



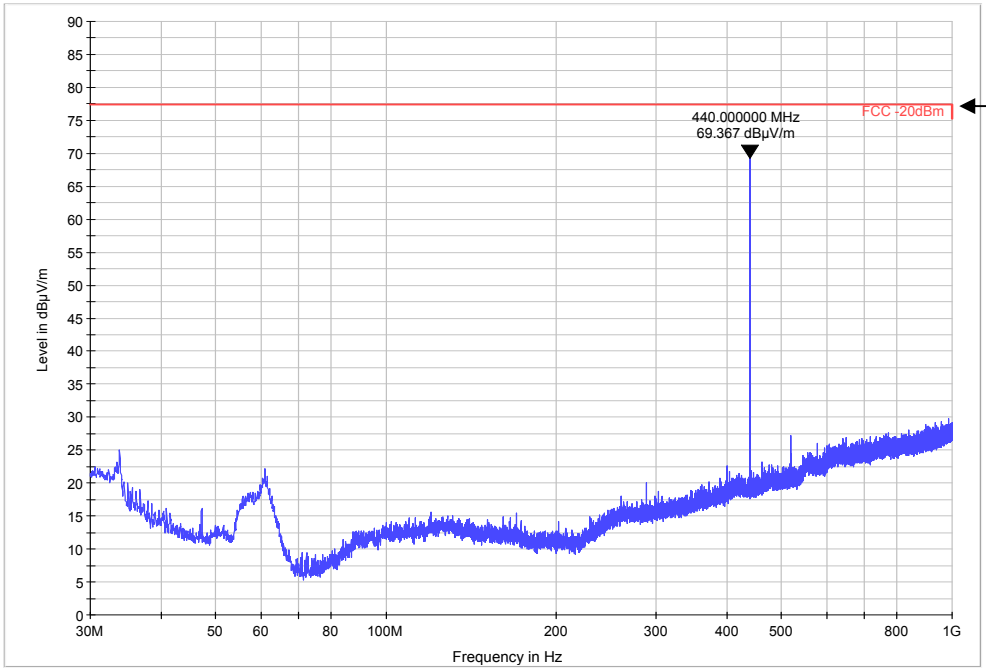

-20dBm
Limit line

411.00MHz 6GHz – 10GHz



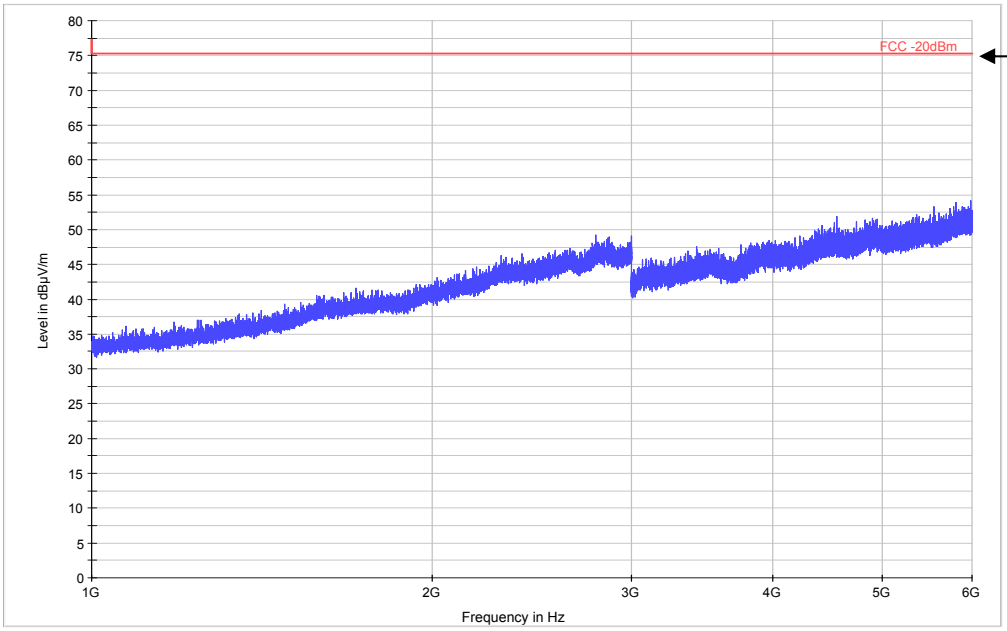

The above test results show that there were no emissions within 20dBs of the –20dBm limit.

440.0125MHz 30MHz – 1GHz



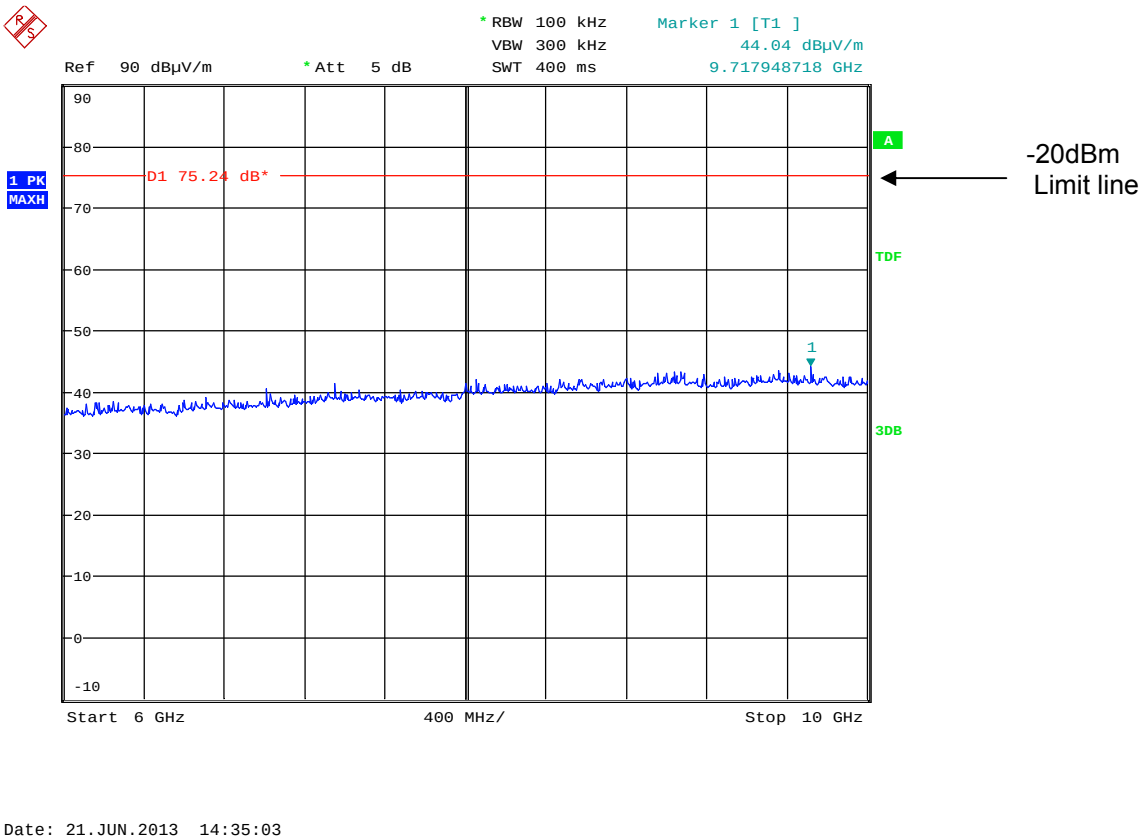

-20dBm
Limit line

440.0125MHz 1GHz - 6GHz




-20dBm
Limit line

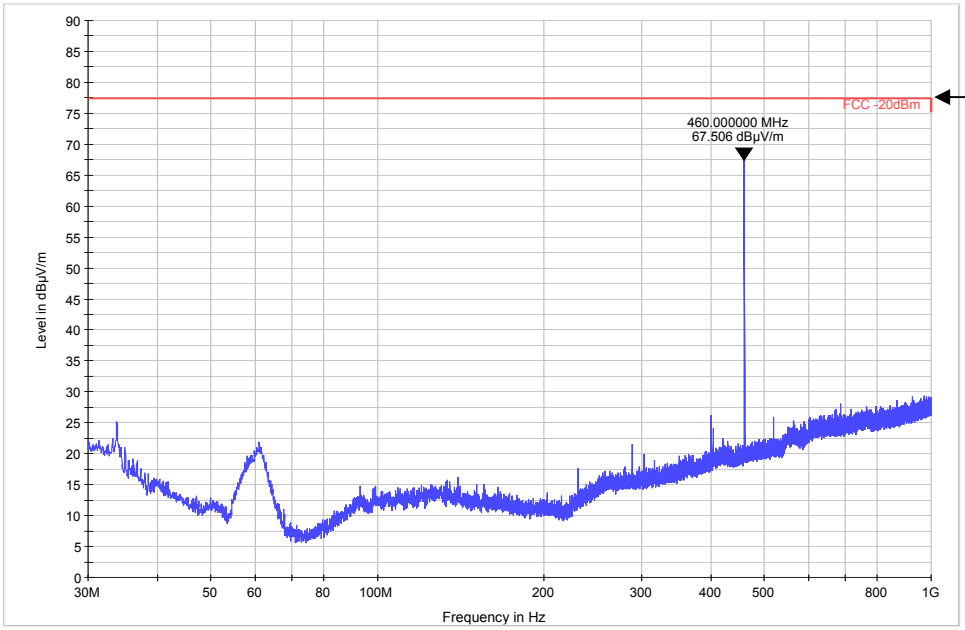
440.0125MHz 6GHz – 10GHz




The above test results show that there were no emissions within 20dBs of the –20dBm limit.

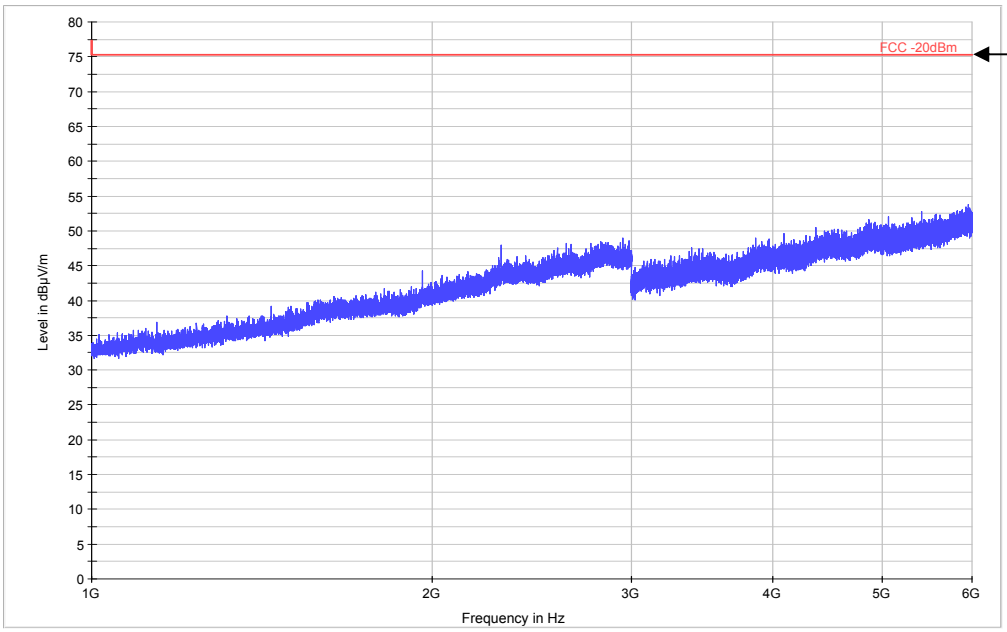
-13dBm
Limit line

460.00MHz 30MHz – 1GHz



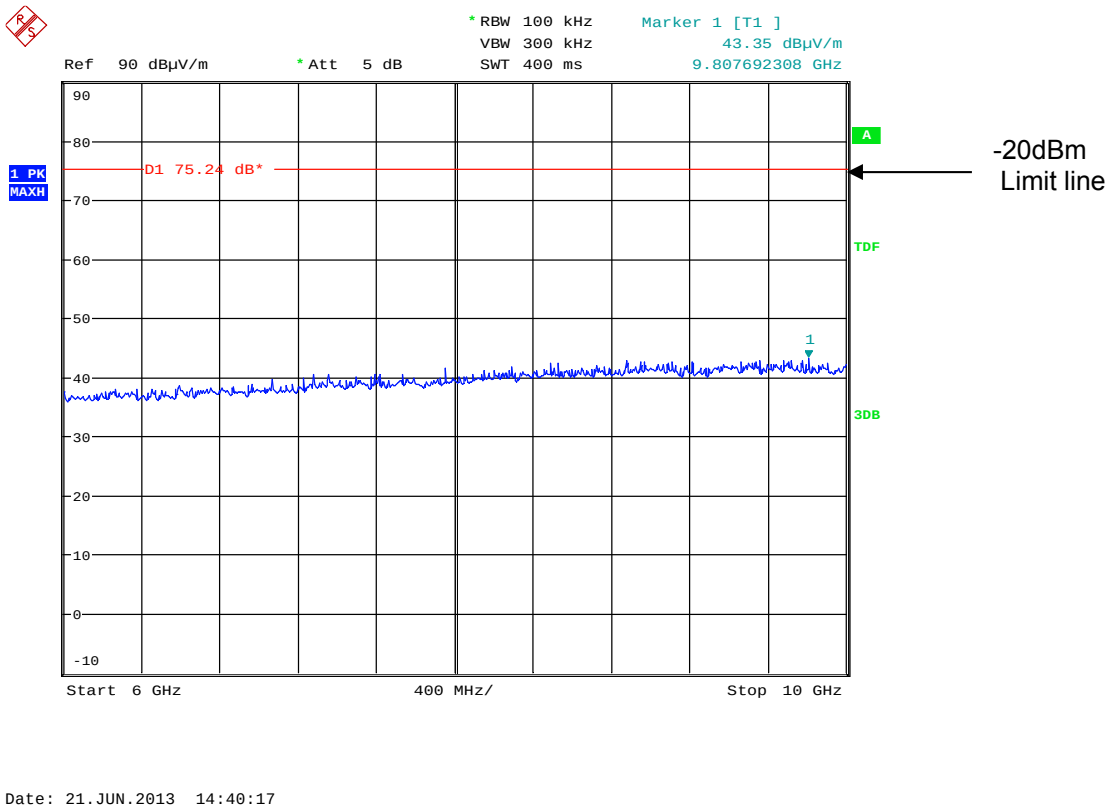

-20dBm
Limit line

460.00MHz 1GHz – 6GHz



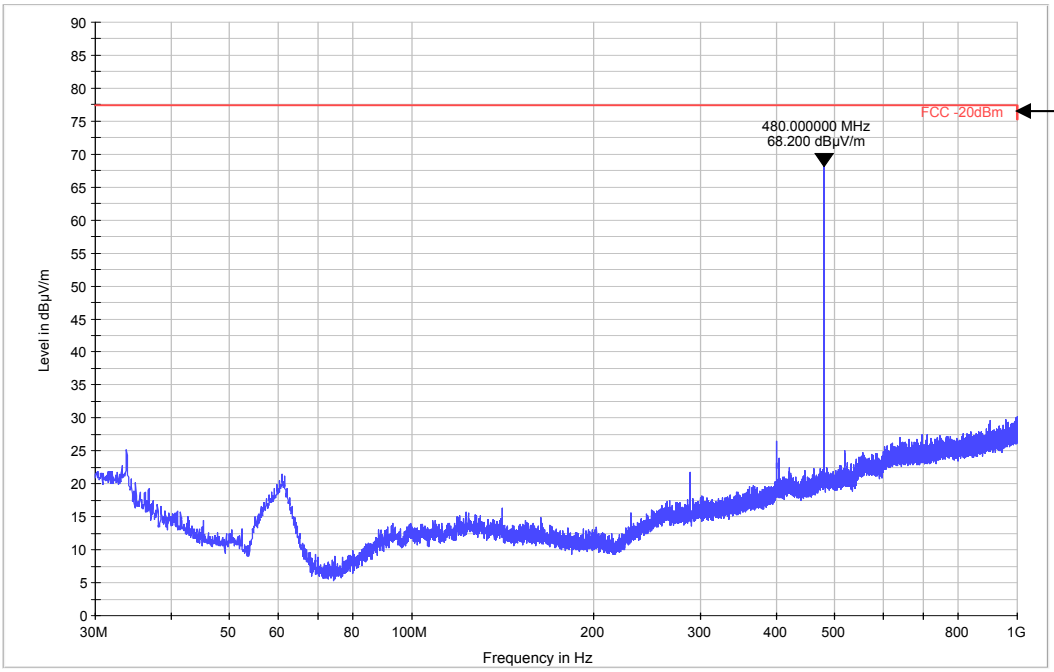

-20dBm
Limit line

460.00MHz 6GHz – 10GHz



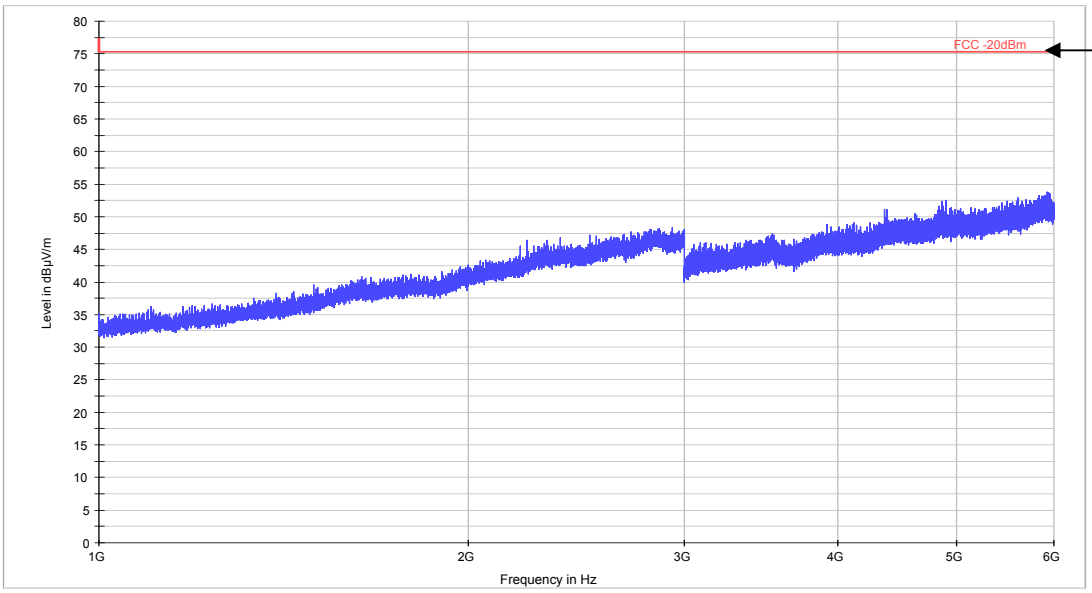

The above test results show that there were no emissions within 20dBs of the –20dBm limit.

479.9875MHz 30MHz -1GHz




-20dBm
Limit line

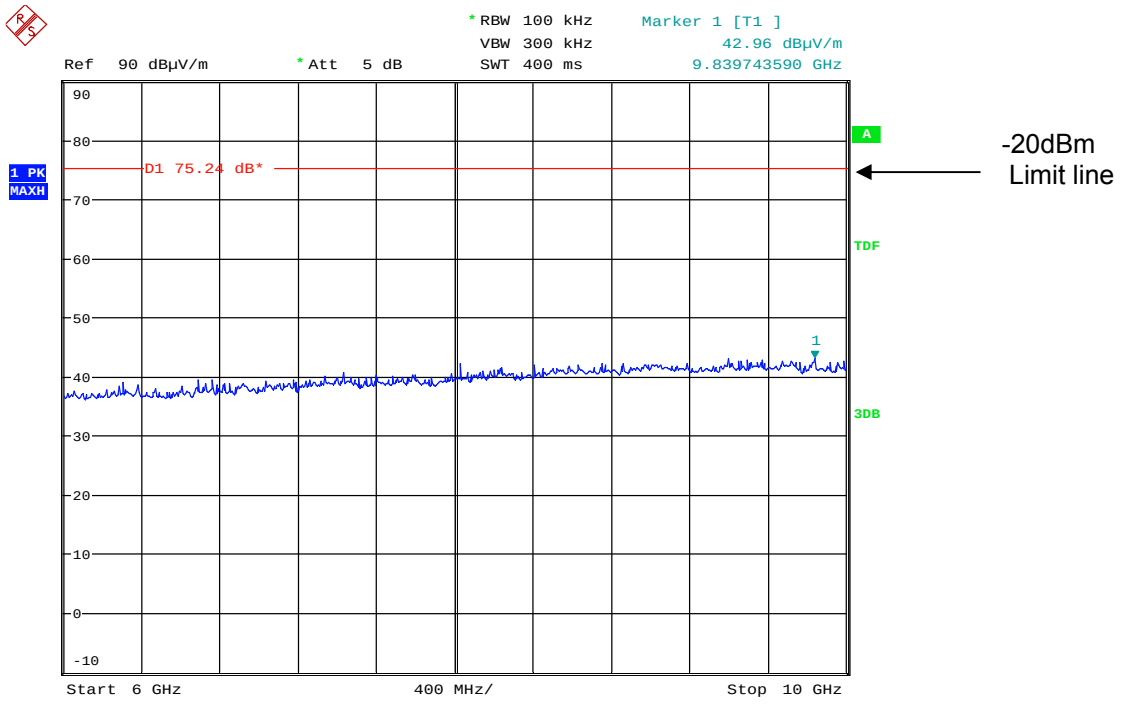
479.9875MHz 1GHz – 6GHz




-20dBm
Limit line

.

479.9875MHz 6GHz – 10GHz



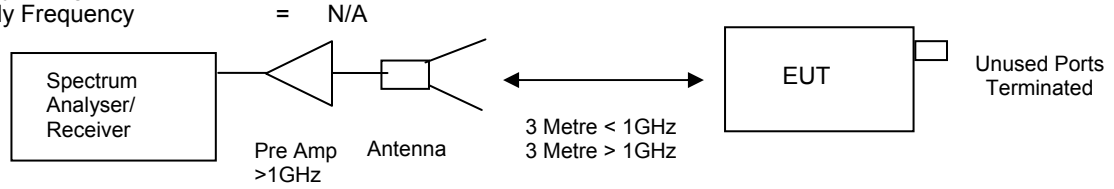

Date: 21.JUN.2013 14:45:08

The above test results show that there were no emissions within 20dBs of the –20dBm limit.

**UN-INTENTIONAL RADIATOR SPURIOUS EMISSIONS – RADIATED – Part 15:109**

Ambient temperature = 24°C
Relative humidity = 56%
Supply voltage = +13.8Vdc
Supply Frequency = N/A

Test Signal = F3E




The test was set up as per the diagram, the receiver was tested while in receive mode while attached to a dummy load.

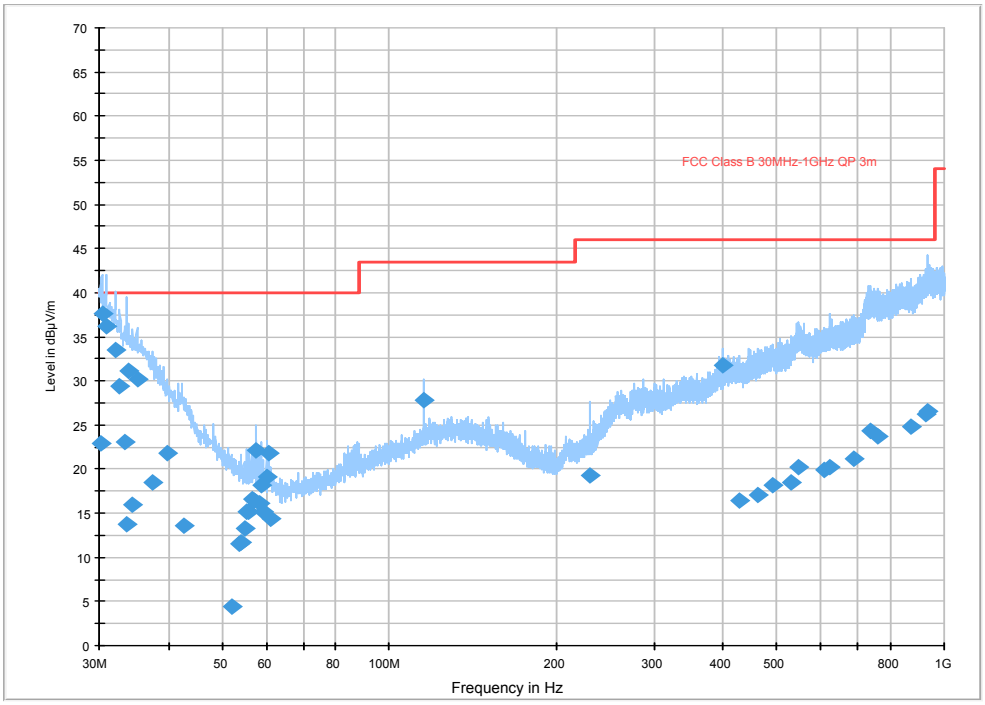
Note: Emission preview plots were taken in a 100kHz resolution bandwidth to reduce the noise floor. Any emissions relating to the DUT were re measured using a 1MHz resolution bandwidth ≥1GHz.

30MHz -1GHz worse case Rx mode

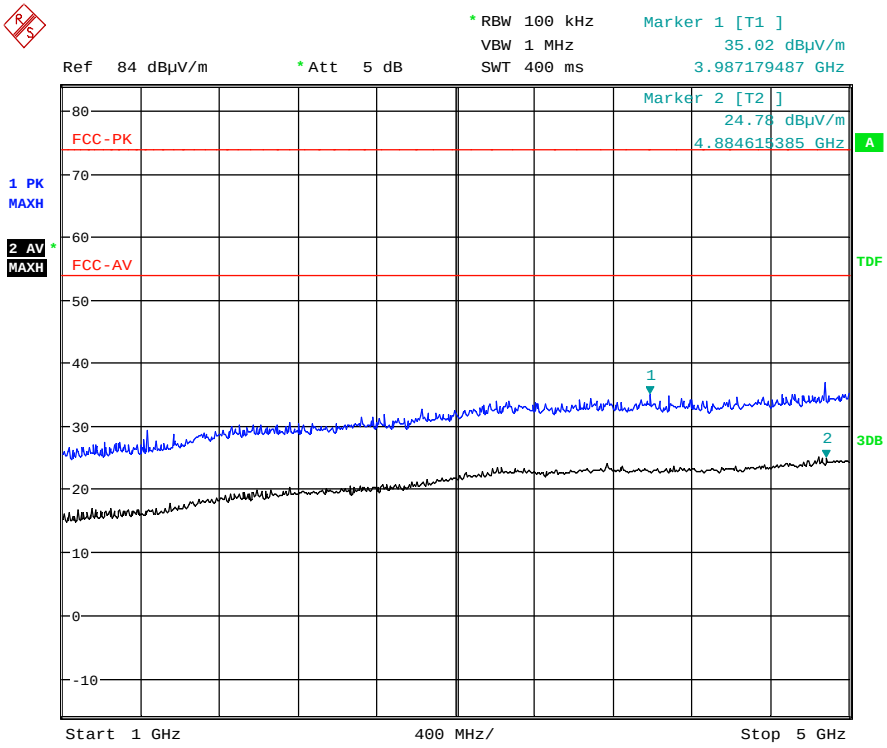
| FREQ. (MHz) | MEAS. Rx. (dBµV) | Cable Loss (dB) | Ant Factor | Pre Amp (dB) | FIELD STRENGTH (dBµV/m) | FIELD STRENGTH (µV/m) | Limit (dBµV/m) | Limit (µV/m) |
|---|---|---|---|---|---|---|---|---|
| 30.15 | 4.60 | 0.5 | 17.8 | - | 22.9 | 13.96 | 40.00 | 100 |
| 30.35 | 19.3 | 0.5 | 17.7 | - | 37.5 | 74.98 | 40.00 | 100 |
| 30.95 | 18.20 | 0.5 | 17.4 | - | 36.1 | 63.82 | 40.00 | 100 |
| 32.10 | 16.30 | 0.5 | 16.8 | - | 33.6 | 47.86 | 40.00 | 100 |
| 32.70 | 12.40 | 0.5 | 16.5 | - | 29.4 | 29.51 | 40.00 | 100 |
| 33.35 | 6.40 | 0.5 | 16.1 | - | 23.1 | 14.28 | 40.00 | 100 |
| 33.90 | 14.60 | 0.6 | 15.9 | - | 31.0 | 35.48 | 40.00 | 100 |
| 35.10 | 14.40 | 0.6 | 15.2 | - | 30.2 | 32.35 | 40.00 | 100 |
| 39.85 | 8.60 | 0.6 | 12.6 | - | 21.8 | 12.30 | 40.00 | 100 |
| 57.65 | 15.70 | 0.8 | 5.6 | - | 22.0 | 12.58 | 40.00 | 100 |
| 60.65 | 15.80 | 0.8 | 5.2 | - | 21.8 | 12.30 | 40.00 | 100 |
| 115.2 | 15.00 | 1.4 | 11.4 | - | 27.8 | 24.54 | 43.50 | 150 |
| 400.0 | 13.20 | 2.6 | 15.9 | - | 31.7 | 38.45 | 46.00 | 200 |
| No further emissions within 20dB of the limit | | | | | | | | |

## Rx 30MHz-1GHz

FCC RE Class B 30MHz-1GHz ESVS10 + UH191 - 10thFeb2011

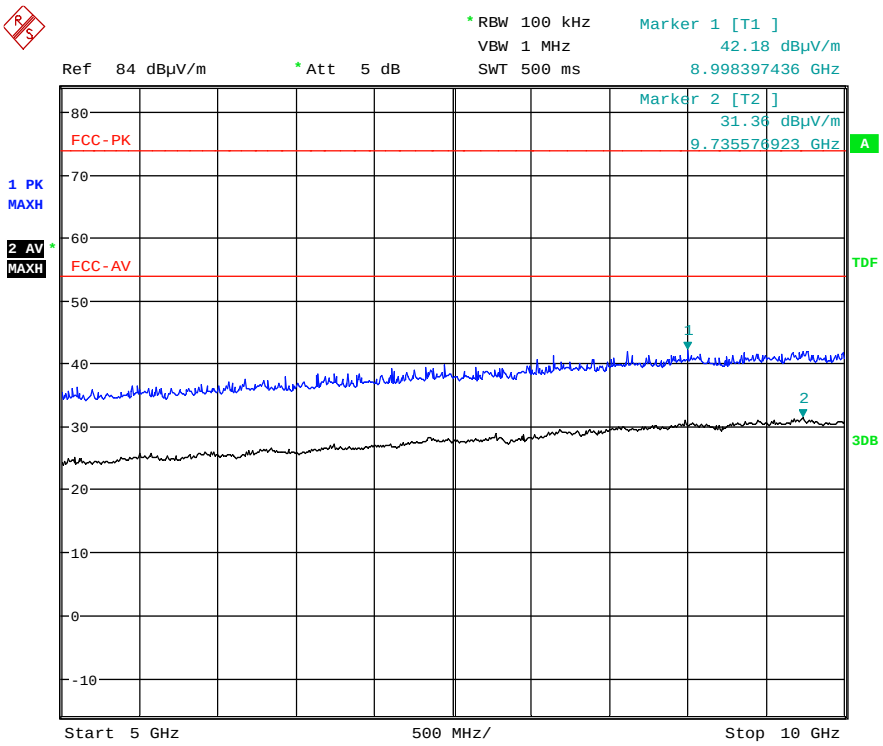



## Rx 1GHz – 5GHz




Date: 21.JUN.2013 12:47:41

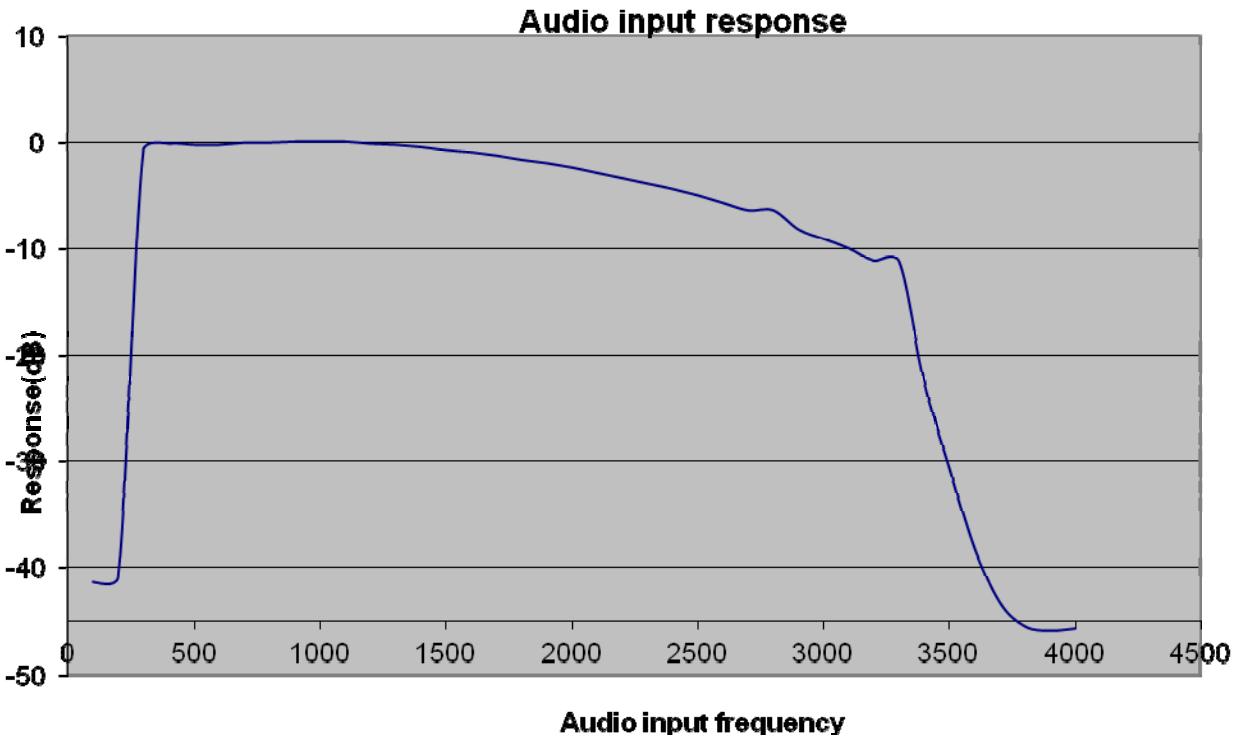
Rx 5GHz – 10GHz




Date: 21.JUN.2013 12:49:19

**Modulation Characteristics: 2.1047 (a)**

| | | | | | |
|---|---|---|---|---|---|
| Ambient temperature | = | 21°C | Radio Laboratory | | |
| Relative humidity | = | 39% | Test Signal | = | F3E |
| Supply voltage | = | +13.8Vdc | | | |




Note: The SDB670 TU Band DMR Base Station unit is capable of transmitting analogue speech and DMR digital audio modulation.

There are no transmitter audio frequency inputs available via a microphone socket or any other audio frequency input.

The transmitter was tested whilst operating under the following conditions:

1) A signal generator was connected into the receiver RF input, tuned to the receiver frequency, and the deviation level set to 2.5kHz, the audio frequency was then varied between 100Hz and 5kHz.

2) testing was carried out with the talk through feature enabled.
(therefore the audio response will take into account the pre emphasis and de emphasis of the receiver and transmitter).

3) A 1kHz audio signal was applied which was used as a 0dB response reference.

The above plot shows the audio response of the transmitter.

**Modulation Characteristics: 2.1047 (b)**

Note: The TU Band DMR Base Station is capable of transmitting analogue speech and DMR digital audio modulation.

There are no transmitter external audio inputs available via a microphone socket etc, and therefore the test was not performed. The external audio is via the receiver RF input or the digital audio input.

**Transient frequency Behaviour: Part 90.214**

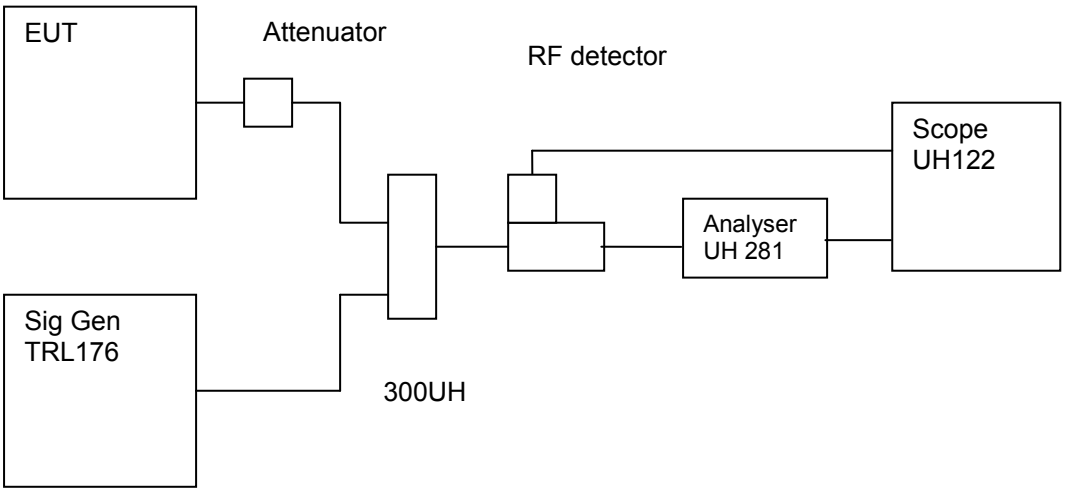
Tnom = 22°C

RHnom = 56%

Tx Pnom = 25W

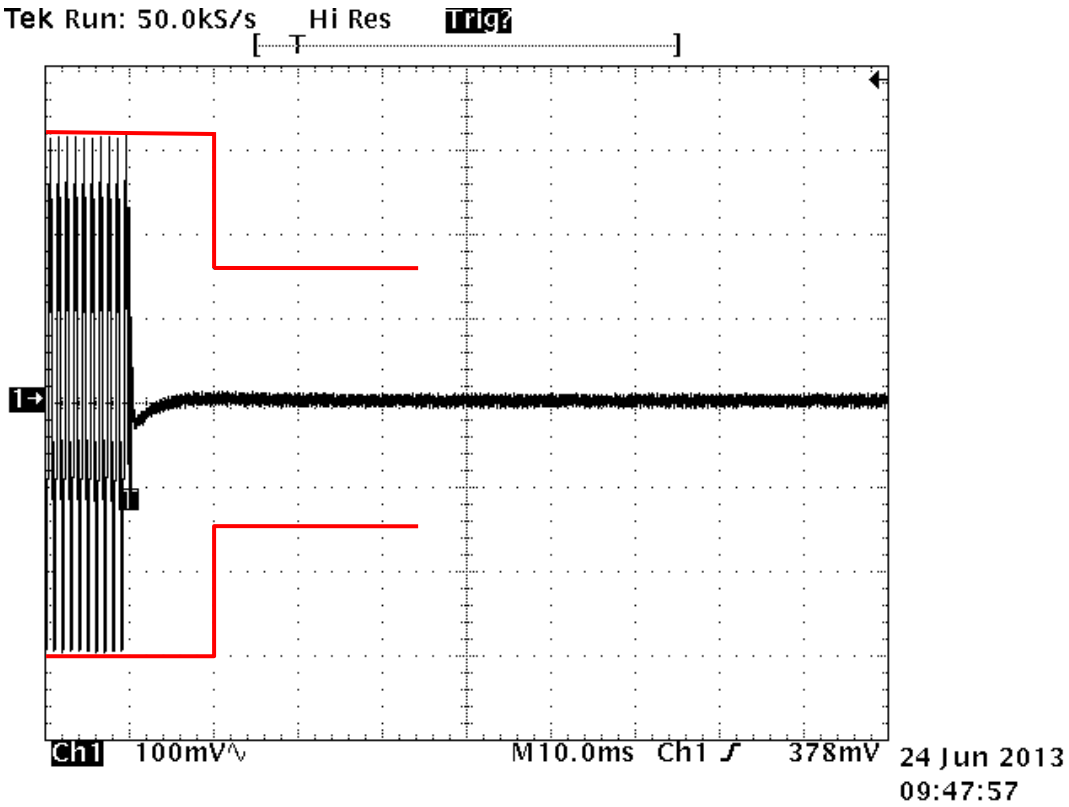
Method

Channel Spacing = 12.5kHz

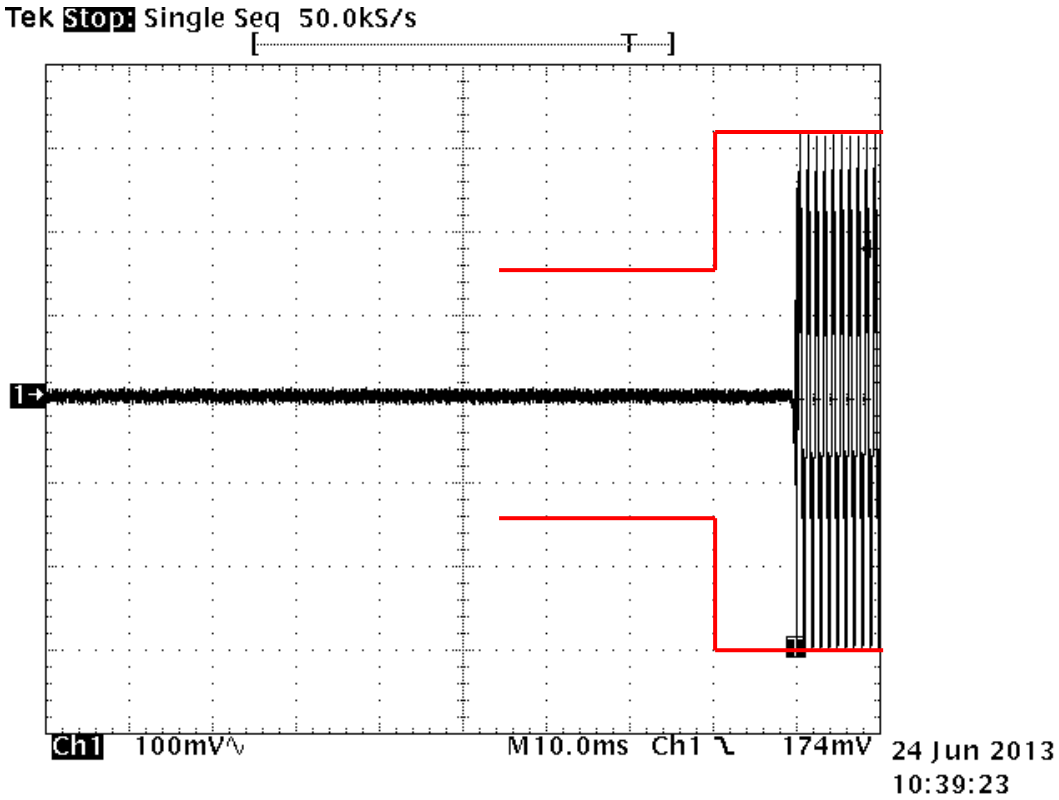



| Channel | | 400.0125 MHz | 411.0 MHz | 440.0125 MHz | 460.00 MHz | 479.9875 MHz |
|---|---|---|---|---|---|---|
| Time, t1 Transient Frequency | | Compliant | Compliant | Compliant | Compliant | Compliant |
| Time, t2 Transient Frequency | | Compliant | Compliant | Compliant | Compliant | Compliant |
| Time, t3 Transient Frequency | | Compliant | Compliant | Compliant | Compliant | Compliant |
| Limits Clause | t1 | 10ms @ 12.5kHz | | | | |
| | t2 | 25ms @ 6.25kHz | | | | |
| | t3 | 10ms @ 12.5kHz | | | | |

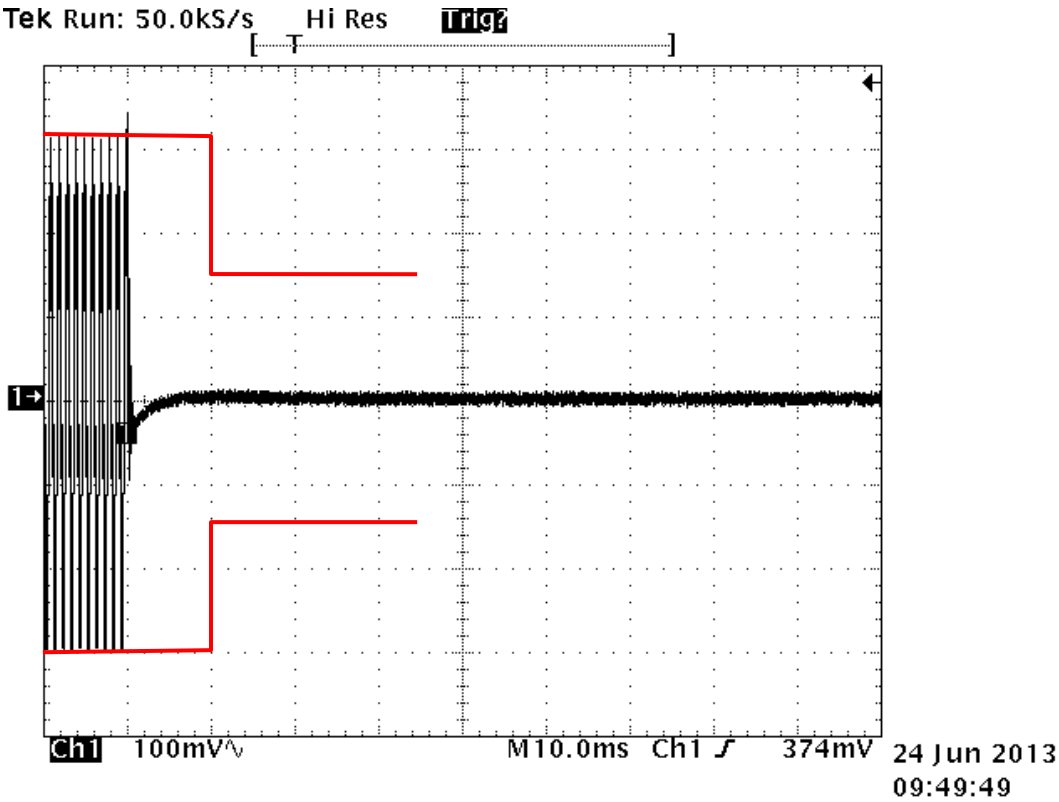
400.0125MHz Tx on



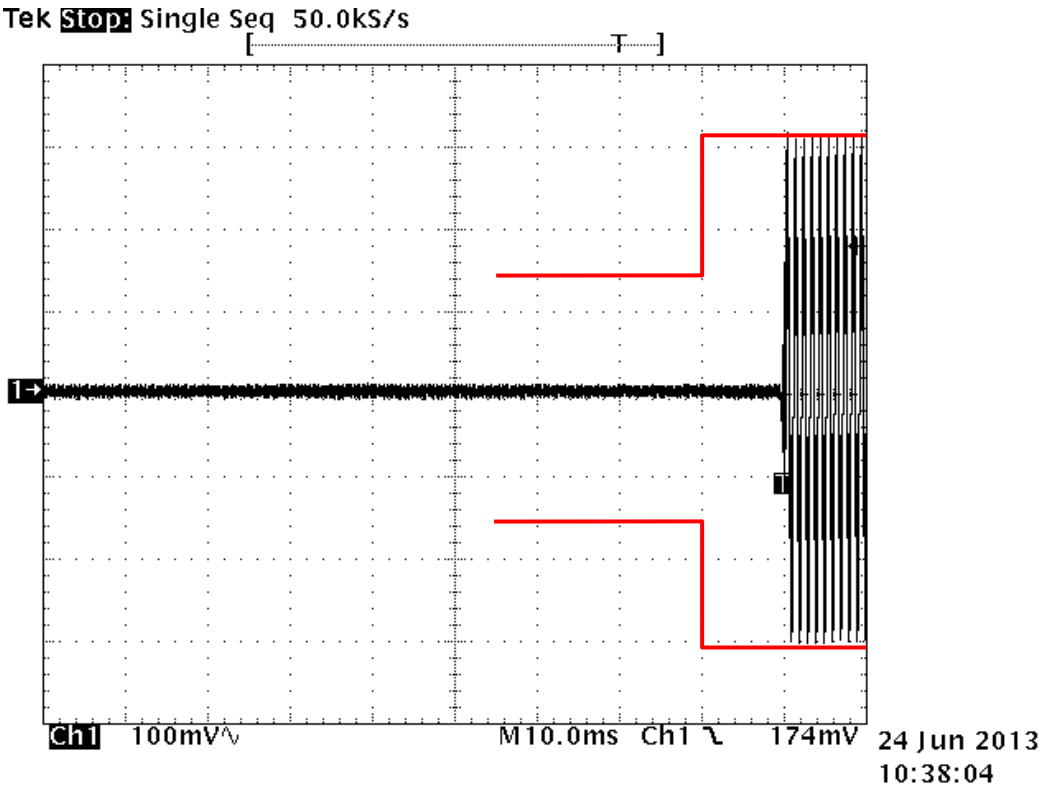

400.0125MHz Tx off



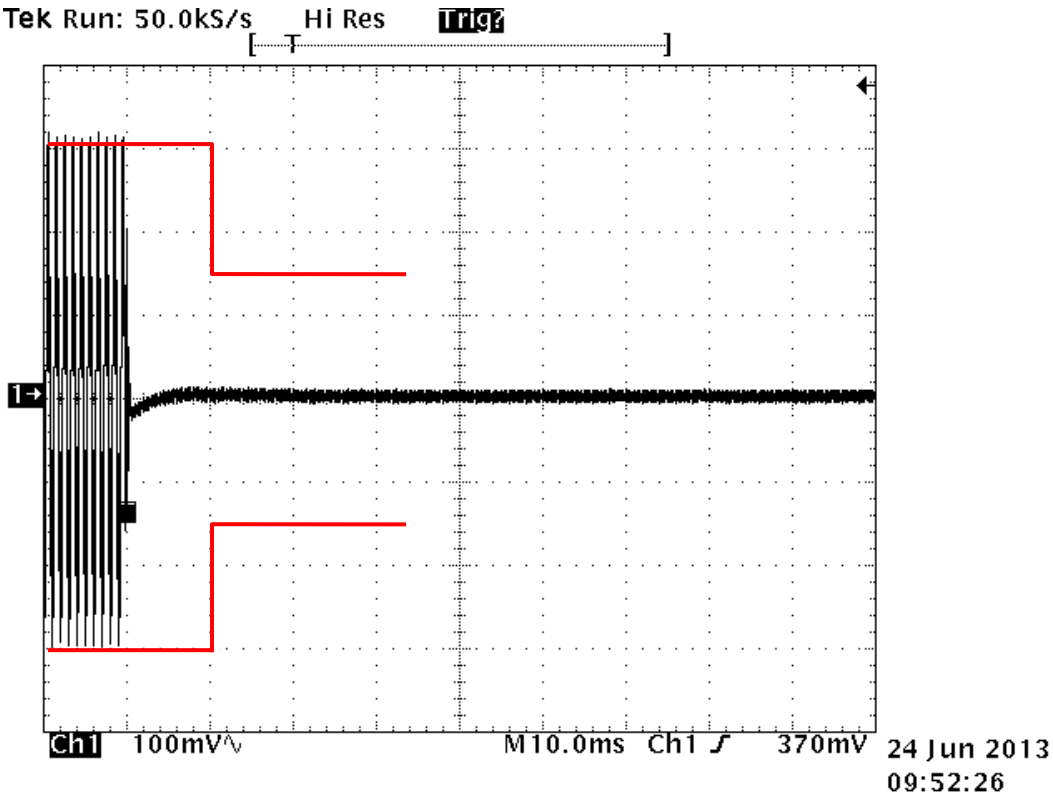
411.00MHz Tx on



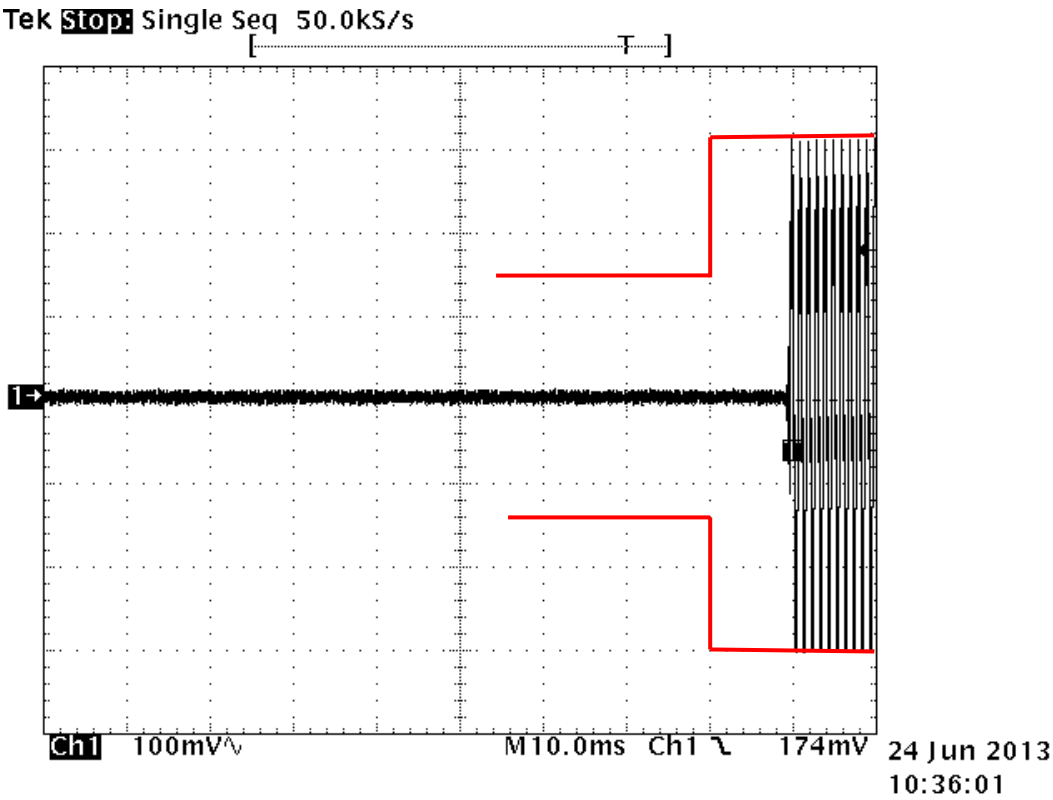

411.00MHz Tx off



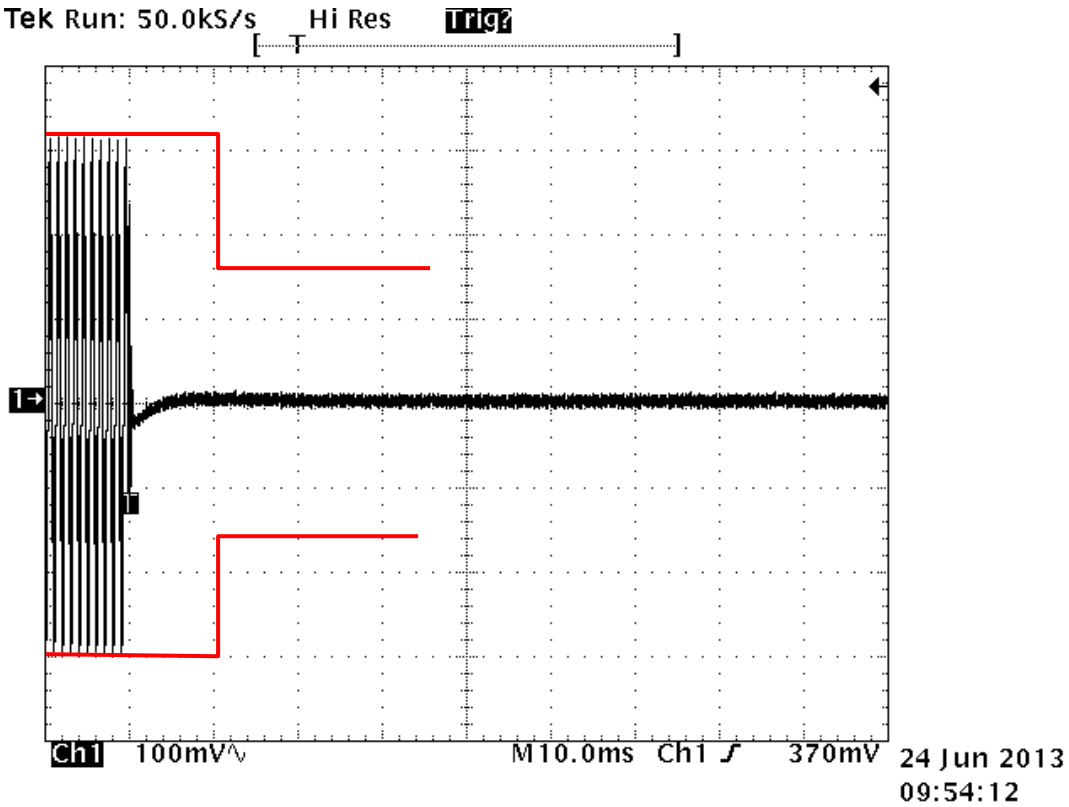
440.0125.00MHz Tx on



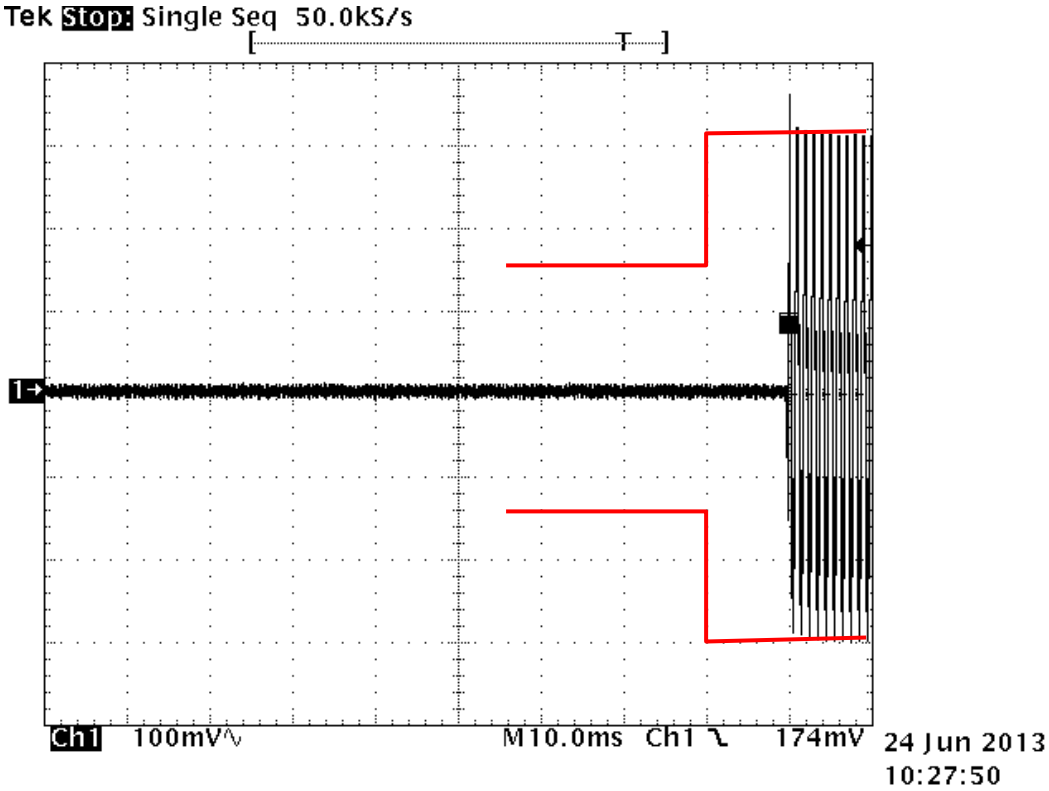

440.0125.00MHz Tx off



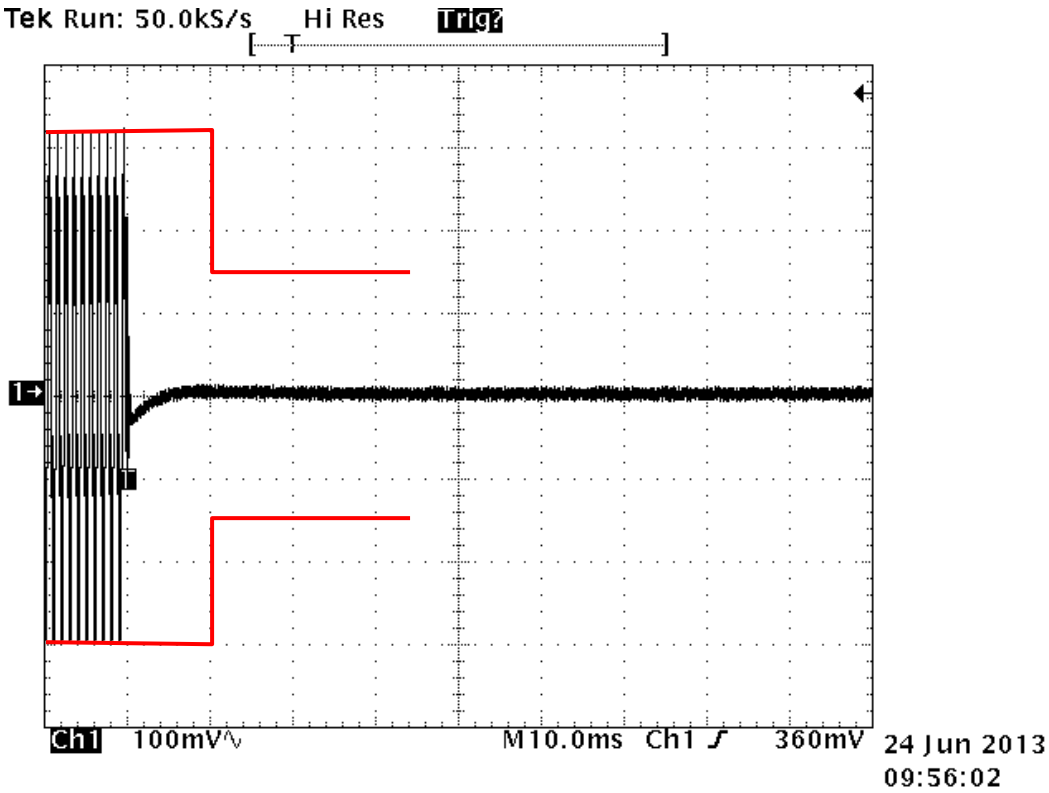
460.00MHz Tx on



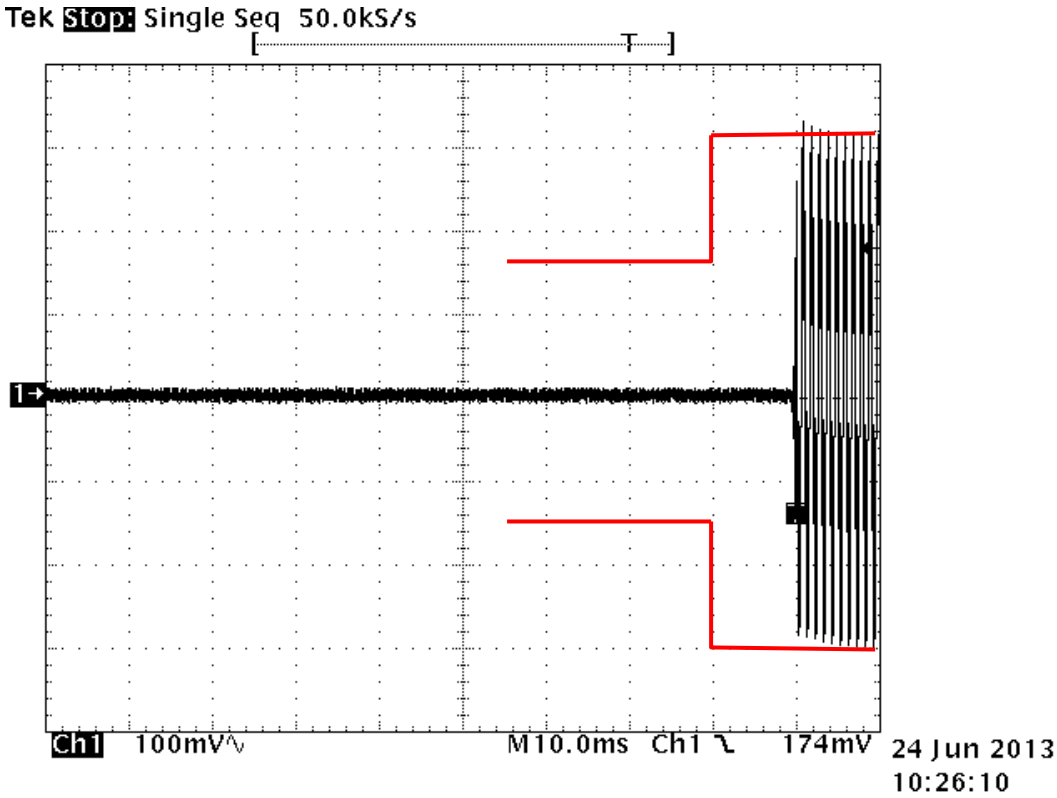

460.00MHz Tx off



479.9875MHz Tx on



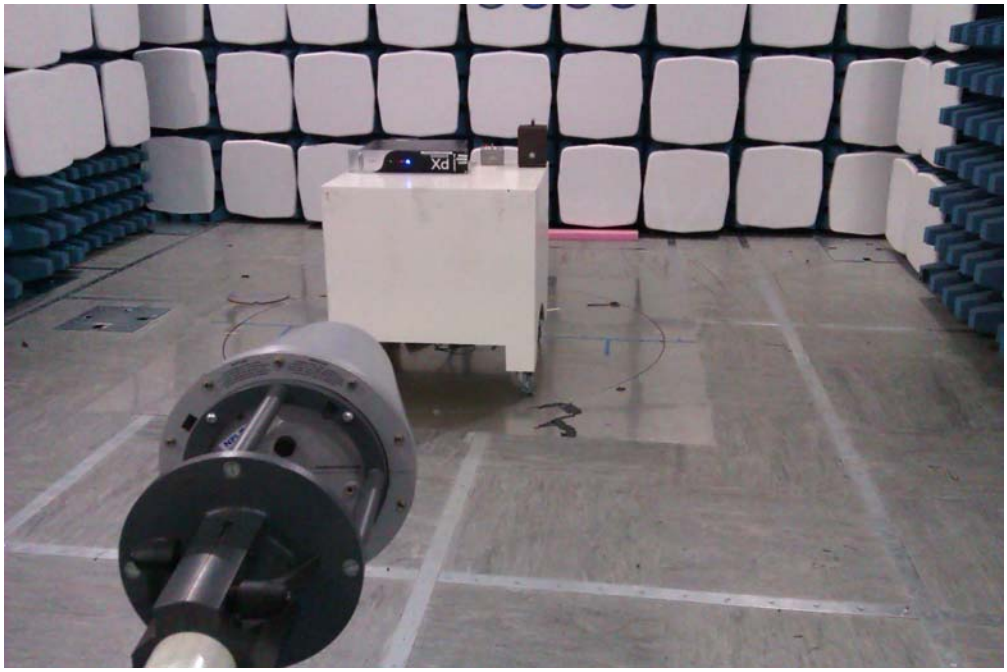

479.9875MHz Tx off



## ANNEX A

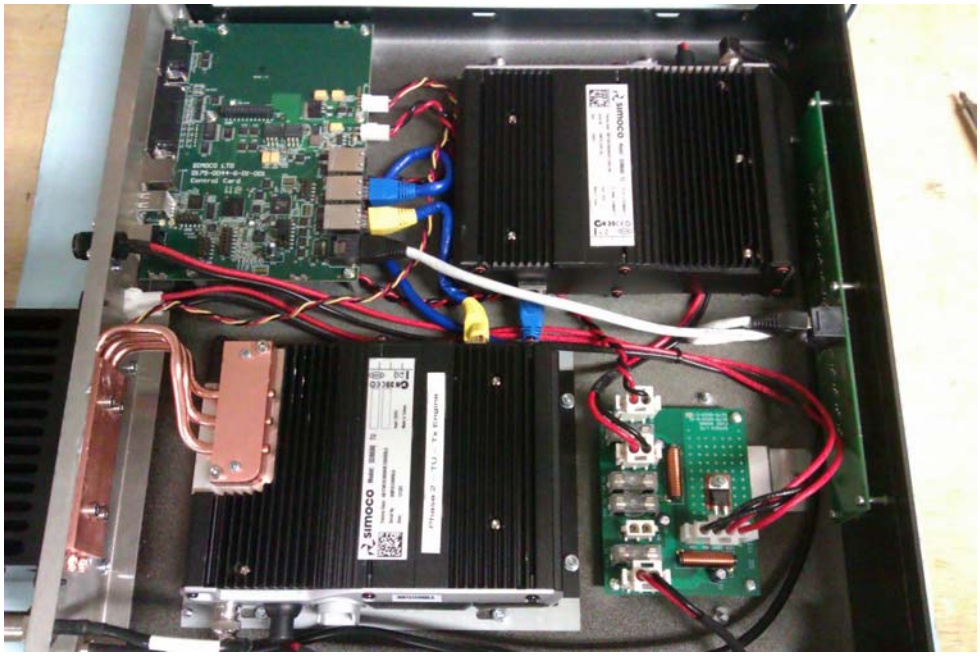
## PHOTOGRAPHS

Photograph 1&2: Test Setup



Photograph 3&4: Equipment overview

Photograph 5



## ANNEX B

## APPLICANT'S SUBMISSION OF DOCUMENTATION LIST

## APPLICANT'S SUBMISSION OF DOCUMENTATION LIST

| | | | | |
|---|---|---|---|---|
| a. | TCB | - | APPLICATION | [X] |
| | | - | FEE | [X] |
| b. | AGENT'S LETTER OF AUTHORISATION | - | | [X] |
| c. | MODEL(s) vs IDENTITY | - | | [ ] |
| d. | ALTERNATIVE TRADE NAME DECLARATION(s) | - | | [ ] |
| e. | LABELLING | - | PHOTOGRAPHS | [ ] |
| | | - | DECLARATION | [ ] |
| | | - | DRAWINGS | [ ] |
| f. | TECHNICAL DESCRIPTION | - | | [X] |
| g. | BLOCK DIAGRAMS | - | Tx | [X] |
| | | - | Rx | [ ] |
| | | - | PSU | [ ] |
| | | - | AUX | [ ] |
| h. | CIRCUIT DIAGRAMS | - | Tx | [X] |
| | | - | Rx | [ ] |
| | | - | PSU | [ ] |
| | | - | AUX | [ ] |
| i. | COMPONENT LOCATION | - | Tx | [ ] |
| | | - | Rx | [ ] |
| | | - | PSU | [ ] |
| | | - | AUX | [ ] |
| j. | PCB TRACK LAYOUT | - | Tx | [ ] |
| | | - | Rx | [ ] |
| | | - | PSU | [ ] |
| | | - | AUX | [ ] |
| k. | BILL OF MATERIALS | - | Tx | [X] |
| | | - | Rx | [ ] |
| | | - | PSU | [ ] |
| | | - | AUX | [ ] |
| l. | USER INSTALLATION / OPERATING INSTRUCTIONS | - | | [X] |

# ANNEX C

# EQUIPMENT CALIBRATION

| TRAC Ref | Type | Description | Manufacturer | Date Calibrated. |
|---|---|---|---|---|
| TRL281 | FSU46 | Spectrum Analyser | Rhode & Schwarz | 06/03/2013 |
| TRL139 | 3115 | Horn Antenna | EMCO | 14/09/2011 |
| TRL572 | 8449B | Pre amp | Agilent | 12/12/2012 |
| TRLUH04 | ESVS10 | Receiver | Rhode & Schwarz | 11/02/2013 |
| TRLUH191 | CBL611A | Antenna | Chase | 13/12/2012 |
| TRL222 | 8304-100-N | ATTENUATOR | BIRD | Cal In Use |
| TRLUH225 | 745357 | ATTENUATOR | SPINNER | Cal In Use |
| REF916 | SMBV100A | Signal Generator | Rhode & Schwarz | 23/07/2012 |
| TRL426 | 52 Series 11 | Temperature Indicator | Fluke | 29/04/2013 |
| TRL11 | - | Environmental Chamber | Sharetree | USE TRL426 |
| REF976 | 34405A | Multimeter | Agilent | 26/04/2013 |
| TRLUH194 | AP60/50 | Power Supply | Farnell | USE REF976 |
| TRLUH265 | TTR375-3EE | FILTER (h) | Telonic Berkeley | Cal In Use |
| L005 | CMTA 52 | Communications Analyser | Rhode & Schwarz | 27/03/2013 |

# ANNEX D

# MEASUREMENT UNCERTAINTY

## Radio Testing – General Uncertainty Schedule

*All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.*

***[1] Adjacent Channel Power***

Uncertainty in test result = **1.86dB**

***[2] Carrier Power***

Uncertainty in test result (Power Meter) = **1.08dB**
Uncertainty in test result (Spectrum Analyser) = **2.48dB**

***[3] Effective Radiated Power***

Uncertainty in test result = **4.71dB**

***[4] Spurious Emissions***

Uncertainty in test result = **4.75dB**

***[5] Maximum frequency error***

Uncertainty in test result (Power Meter) = **0.113ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

***[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field***

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,
Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

***[7] Frequency deviation***

Uncertainty in test result = **3.2%**

***[8] Magnetic Field Emissions***

Uncertainty in test result = **2.3dB**

***[9] Conducted Spurious***

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result – Up to 26GHz = **3.14dB**

***[10] Channel Bandwidth***

Uncertainty in test result = **15.5%**

***[11] Amplitude and Time Measurement – Oscilloscope***

Uncertainty in overall test level = **2.1dB**,
Uncertainty in time measurement = **0.59%,**
Uncertainty in Amplitude measurement = **0.82%**

***[12] Power Line Conduction***

Uncertainty in test result = **3.4dB**

***[13] Spectrum Mask Measurements***

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

***[14] Adjacent Sub Band Selectivity***

Uncertainty in test result = **1.24dB**

***[15] Receiver Blocking – Listen Mode, Radiated***

Uncertainty in test result = **3.42dB**

***[16] Receiver Blocking – Talk Mode, Radiated***

Uncertainty in test result = **3.36dB**

***[17] Receiver Blocking – Talk Mode, Conducted***

Uncertainty in test result = **1.24dB**

***[18] Receiver Threshold***

Uncertainty in test result = **3.23dB**

***[19] Transmission Time Measurement***

Uncertainty in test result = **7.98%**