



TEST REPORT NO: RU1196/6596
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ISSUE NO: 1
FCC ID: Q639601

**REPORT ON THE CERTIFICATION TESTING OF AN
IRIDIUM SATELLITE LLC
SBD TRANSCEIVER
WITH RESPECT TO
THE FCC RULES CFR 47, PART 25**

TEST DATE: 4th October 2005 – 14th October 2005

TESTED BY: D WINSTANLEY

APPROVED BY: P GREEN
PRODUCT MANAGER
EMC

DATE: 3rd November 2005.....

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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: Q639601
PURPOSE OF TEST: Certification
TEST SPECIFICATION: FCC Rules CFR 47, Part 25
TEST RESULT: Compliant to Specification
ITU EMISSIONS DESIGNATOR 41K7V7W
EQUIPMENT UNDER TEST: SBD Transceivers
MODEL TESTED 9601
EQUIPMENT TYPE: Satellite Communications Module
MAXIMUM OUTPUT 9601 Model = 1.6dBW
ANTENNA TYPE: External SMA connector. For test purposes applicant declared a Fixed Mast Antenna with a gain of 3dBi
CHANNEL SPACING: 41.667 kHz
NUMBER OF CHANNELS: 252
MODULATION TYPE: V7W
POWER SOURCE(s): +5 Vdc
TEST DATE(s): 4th October 2005 – 14th October 2005
ORDER No(s): 025675/MC3
APPLICANT: Iridium Satellite LLC
ADDRESS: 6701 Democracy Blvd.
Suite 500
Bethesda
United States of America
MD 20817

TESTED BY: ----- D WINSTANLEY
APPROVED BY: ----- P GREEN
PRODUCT
MANAGER EMC

EQUIPMENT TEST / EXAMINATIONS REQUIRED

1.	TEST/EXAMINATION	FCC Part 2	FCC Part 25	APPLICABILITY	RESULT
	RF Power Output	-	25.204 (a)	YES	PASS
	Emissions Limitations	-	25.202 (f)	YES	PASS
	Spurious Emissions at Antenna Terminals	2.1051	25.202 (f) 25.213	YES	PASS
	Protection of the Radio Navigation Satellite Service	-	25.216(c) 25.216(f)	YES	PASS
	Spurious Emissions Radiated	2.1053	25.202 (f) 25.213	YES	PASS
	Frequency Stability Temperature	2.1055	25.202 (d)	YES	PASS
	Frequency Stability Voltage	2.1055	25.202 (d)	YES	PASS

Note: The SBD Transceiver is subject to FCC Part 25 & Part 2 for FCC Certification for units marketed within the United States. The above tests, as specified in FCC Part 2, with limits as defined in FCC Part 25 were performed on the SBD Transceiver.

- 2. Product Use: Satellite Data Communications
- 3. Emission Designator: 41k7V7W
- 4. Temperatures: Ambient (Tnom) 20°C
- 5. Supply Voltages: Vnom +5 Vdc

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

- 6. Equipment Category:
 - Single channel
 - Two channel
 - Multi-channel
- 7. Channel spacing:
 - Narrowband 41.667 kHz
 - Wideband
- 8. Test Location
 - TRL Compliance Services
 - Up Holland
 - Long Green
- 9. Modifications made during test program No modifications were performed.

Product Description

The satellite communications module consists of an L-Band Transceiver (LBT) capable of simultaneous transmit and receive (duplex) operation covering the frequency range of 1616MHz to 1626.5MHz. The frequency accesses used for duplex channels are organised into sub-bands each of which contains eight frequency accesses. Each sub-band, therefore occupies 333.33 kHz (i.e. $8 \times 41.667\text{kHz}$). Up to 30 sub-bands containing 240 frequency accesses may be used for duplex channels.

Standard References

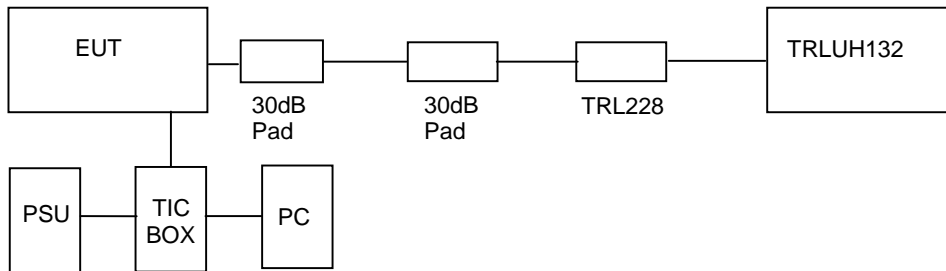
- 47 CFR 2 Code of Federal Regulations, Title 47, Part 2, "Frequency allocations and Radio Telemetry Matters;
10-1-03 Edition General Rules and Regulations"
- 47 CFR 25 Code of Federal Regulations, Title 47, Part 25, "Sattelite Communications" Subpart C,
10-1-03 Edition "Technical Matters"
- C63.4-2003 American National Standards Institute (ANSI), "Methods of Measurement of Radio Noise Emissions
from Low Voltage Electrical and Electronic Equipment in the Range 9 kHz to 40 GHz"

COMPLIANCE TESTS

TRANSMITTER TESTS

RF OUTPUT POWER – CONDUCTED – PART 25.204 (a)

Ambient temperature	=	22°C	Radio Laboratory
Relative humidity	=	66%	
Supply voltage	=	+5 Vdc	
Channel number	=	See test results	



See Annex C for full list of test equipment

The test setup was as per the above diagram. The unit was tested on four channels. The unit was set to operate at maximum power and with a random modulating signal using the TX_test application supplied (See Annex D for explanation of TX_test application commands). Power is supplied to the EUT via the TIC box. The antenna gain, included in the table below, represents the highest gain of any antennas that are used with this system.

Mode	Channel Number	Attenuator and cable loss dB	Level at Power Meter dBm	Antenna Gain dB	Duty Cycle Factor dB (See Annex D)	Carrier power dBm	Carrier power dBW	Limit dBW
9601	Channel 1	58.6	-39.94	3	10.4	32.06	2.06	40
9601	Channel 75	58.6	-39.95	3	10.4	32.05	2.05	40
9601	Channel 150	58.6	-39.95	3	10.4	32.05	2.05	40
9601	Channel 240	58.6	-39.96	3	10.4	32.04	2.04	40

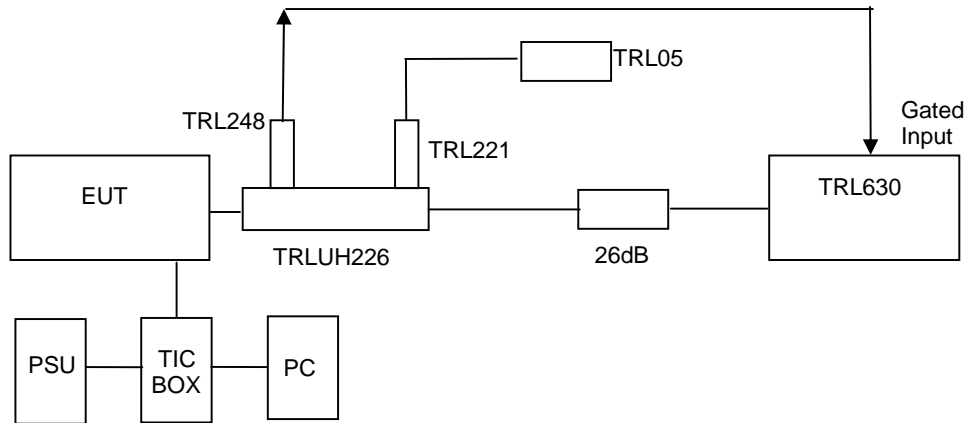
- Notes:
1. Duty Cycle Factor = $10 \times \log(1/X)$ Where $X = (T_{on} / T_{frame})$. See Annex E for duty cycle plots
 2. Correction Factor for dBm to dBW = -30dB
 3. Antenna gain of 3dBi is the worst case gain over an isotropic antenna

TRANSMITTER TESTS

EMISSIONS LIMITATIONS – CONDUCTED – PART 25.202 (f)

Ambient temperature = 20°C
 Relative humidity = 54%
 Supply voltage = +5 Vdc

Radio Laboratory



See Annex C for full list of test equipment

The test setup was as per the above diagram. The unit was tested on four channels. The unit was set to operate at maximum power and with a random modulating signal using the TX_test application supplied (See Annex D for explanation of TX_test application commands). Power is supplied to the EUT via the TIC box.

To enable an average measurement to be taken the gated input trigger of the spectrum analyser was used.

The Spurious limit is as follows:

On any frequency removed from the assigned frequency by the following percentage of the authorised bandwidth

±50%	-	100%	-25 dBc
±100%	-	250 %	-35 dBc
> ±250%			At least 43 + 10 log PdB

$$(10\log P_{\text{watts}}) - (43 + 10\log (P_{\text{watts}} * 1000)) = \text{LIMIT} = -13 \text{ dBm}$$

Where the Authorised Bandwidth = 41.667 kHz

The 3 kHz to 4 kHz bandwidth correction has been taken into account in the Ref level offset figure.

RESULT

The SBD Transceivers were found to comply with the limits

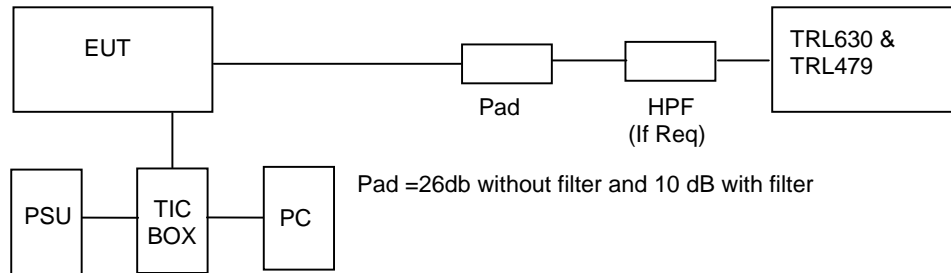
See plots in Annex F.

TRANSMITTER TESTS

SPURIOUS EMISSIONS – CONDUCTED – PART 25.202 (f) & 25.213

Ambient temperature = 24°C
 Relative humidity = 58%
 Supply voltage = +5 Vdc

Radio Laboratory



For measurements in the bands 1559MHz – 1605MHz and 1605MHz - 1610MHz use same test setup as per emissions limitations. For measurements below 1559MHz and above band edge of 1628.5MHz use the above test setup

See Annex C for full list of test equipment

The test setup was as per the above diagram. The unit was tested on four channels. The unit was set to operate at maximum power and with a random modulating signal using the using the TX_test application supplied (See Annex D for explanation of TX_test application commands). Power is supplied to the EUT via the TIC box.

The Spurious limit was calculated as follows:

On any frequency removed from the assigned frequency by more that 250% of the authorised bandwidth

At least $43 + 10 \log (P)$ dB

$$(10 \log P_{\text{watts}}) - (43 + 10 \log (P_{\text{watts}} * 1000)) = \text{LIMIT} = -13 \text{ dBm}$$

RESULTS

Frequency Range (MHz)	Ch N°	Freq. of Emission	Spectrum Analyser Level (dBm)	Attenuator & Cable Losses (dB)	Spurious Emission Level (dBm)	Limit dBm
30MHz – 1559MHz	No significant emissions within 10 dB's of the limit					-13
1559MHz – 1605MHz	240	1587.577	-81.75	27.6	-54.15	-40
1605MHz – 1610MHz	240	1605.070	-81.61	27.6	-54.01	-40 to -10
1628.5MHz – 16.3 GHz	No significant emissions within 10 dB's of the limit					-13

Notes :

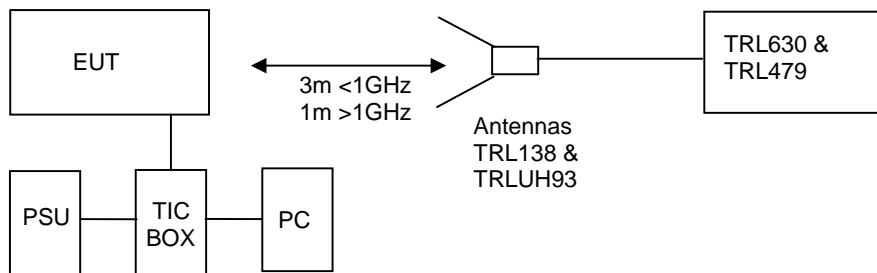
1. Emissions Checked up to 10 times Fc
2. Reference level offset of Scan plots in Annex G already have approximate attenuator losses taken into account
3. Average measurement in a carrier on state were taken in the bands 1599MHz to 1605MHz and 1605MHz -1610MHz. All other scans were peak hold for worst case.
4. -40 to -10 Linearly interpolated in dBm Vs frequency offset.
5. Correction Factor for dBm to dBW = -30dB

The SBD Transceivers were found to comply with the limits. See Annex G for plots

TRANSMITTER TESTS

SPURIOUS EMISSIONS – RADIATED – PART 25.202 (f) & 25.213

Ambient temperature = 18°C
 Relative humidity = 55%
 Conditions = OATS
 Supply voltage = +5 Vdc
 Supply Frequency = N/A



See Annex C for full list of test equipment

The test setup was as per the above diagram. The unit was tested on four channels. The unit was set to operate at maximum power and with a random modulating signal using the TX_test application supplied (See Annex D for explanation of TX_test application commands). Power is supplied to the EUT via the TIC box. The unit was mounted on a turntable and rotated through 360° to find the worst case emission.

The Spurious limit was calculated as follows:

On any frequency removed from the assigned frequency by more than 250% of the authorised bandwidth

At least $43 + 10 \log P_{dB}$

$$(10 \log P_{\text{watts}}) - (43 + 10 \log (P_{\text{watts}} * 1000)) = \text{LIMIT} = -13 \text{ dBm}$$

RESULTS

Frequency Range (MHz)	Ch N°	Freq. of Emission	Spectrum Analyser Level (dBm)	Attenuator & Cable Losses (dB)	Spurious Emission Level (dBm)	Limit dBm
30MHz – 1559MHz					No significant emissions within 10 dB's of the limit	-13
1559MHz – 1605MHz					No significant emissions within 10 dB's of the limit	-40
1605MHz – 1610MHz					No significant emissions within 10 dB's of the limit	-40 to 10
1628.5MHz – 16.3 GHz					No significant emissions within 10 dB's of the limit	-13

Notes :

1. Emissions Checked up to 10 times Fc
2. Scan plots of channels 1 & 240 with receive antenna in vertical polarization in annex H.
3. The unit was mounted on a turntable and rotated through 360° and in 3 orthogonal planes to find the worst case emission.
4. -40 to -10 Linearly interpolated in dBm Vs frequency offset.
5. Correction Factor for dBm to dBW = -30dB

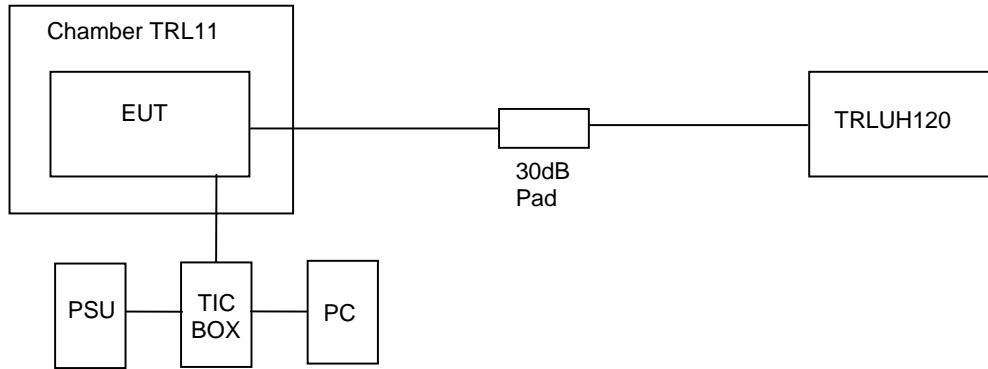
The SBD Transceiver was found to comply with the limits. See annex H for plots

TRANSMITTER TESTS

FREQUENCY STABILITY – CONDUCTED – TEMPERATURE – PART 25.202 (d)

Ambient temperature = 28°C
 Relative humidity = 49%
 Supply voltage = +5 Vdc

Radio Laboratory



See Annex C for full list of test equipment

The test setup was as per the above diagram. The unit was tested on four channels .The unit was set to operate at maximum power and with a random modulating signal using the using the TX_test application supplied (See Annex D for explanation of TX_test application commands). Power is supplied to the EUT via the TIC box. The Analyser was set to max hold.

RESULTS

TEMP °C	Frequency (MHz)			
	Channel 1	Channel 75	Channel 150	Channel 240
+60	1616.0180	1619.1010	1616.2260	1625.9758
+50	1616.0174	1619.1008	1622.2256	1625.9756
+40	1616.0172	1619.1008	1622.2258	1625.9758
+30	1616.0174	1619.1008	1622.2258	1625.9758
+20	1616.0172	1619.1014	1622.2262	1625.9760
+10	1616.0176	1619.1010	1622.2258	1625.9760
0	1616.0174	1619.1006	1622.2258	1625.9756
-10	1616.0212	1619.1044	1622.2295	1625.9796
-20	1616.0210	1619.1043	1622.2293	1625.9793
-30	1616.0210	1619.1043	1622.2293	1625.9793

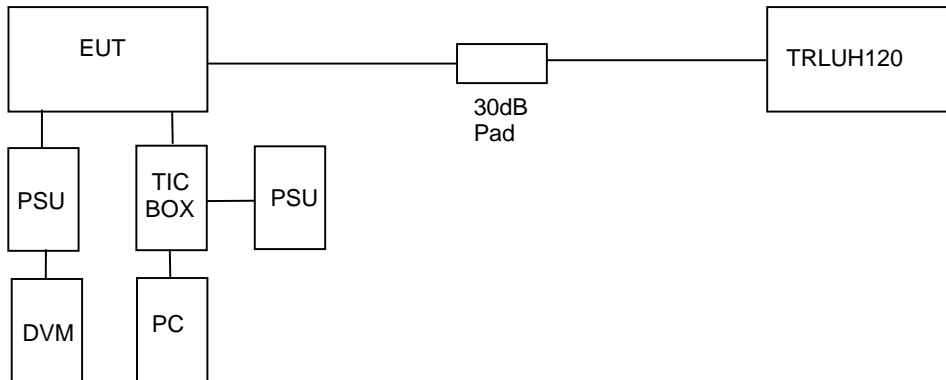
Notes: 1.Limit ± 10 ppm (See Annex I for plots verses limit)

The SBD Transceiver was found to comply with the limits

TRANSMITTER TESTS

FREQUENCY STABILITY – CONDUCTED – VOLTAGE – PART 25.202 (d)

Ambient temperature = 24°C Radio Laboratory
 Relative humidity = 41%
 Supply voltage = +5 Vdc



See Annex C for full list of test equipment

The test setup was as per the above diagram. The unit was tested on four channels .The unit was set to operate at maximum power and with a random modulating signal using the using the TX_test application supplied (See Annex D for explanation of TX_test application commands). Power is supplied to the EUT via the TIC box has been disabled and a separate power supply used to allow the voltage to be varied. The Analyser was set to max hold

RESULTS

VOLTAGE	Frequency (MHz)			
	Channel 1	Channel 75	Channel 150	Channel 240
85	1616.0216	1619.1056	1622.2306	1625.9792
90	1616.0220	1619.1056	1622.2306	1625.9794
95	1616.0220	1619.1056	1622.2297	1625.9794
100	1616.0220	1619.1056	1622.2296	1625.9794
105	1616.0220	1619.1052	1622.2297	1625.9794
110	1616.0220	1619.1056	1622.2269	1625.9794
115	1616.0220	1619.1052	1622.2296	1625.9794

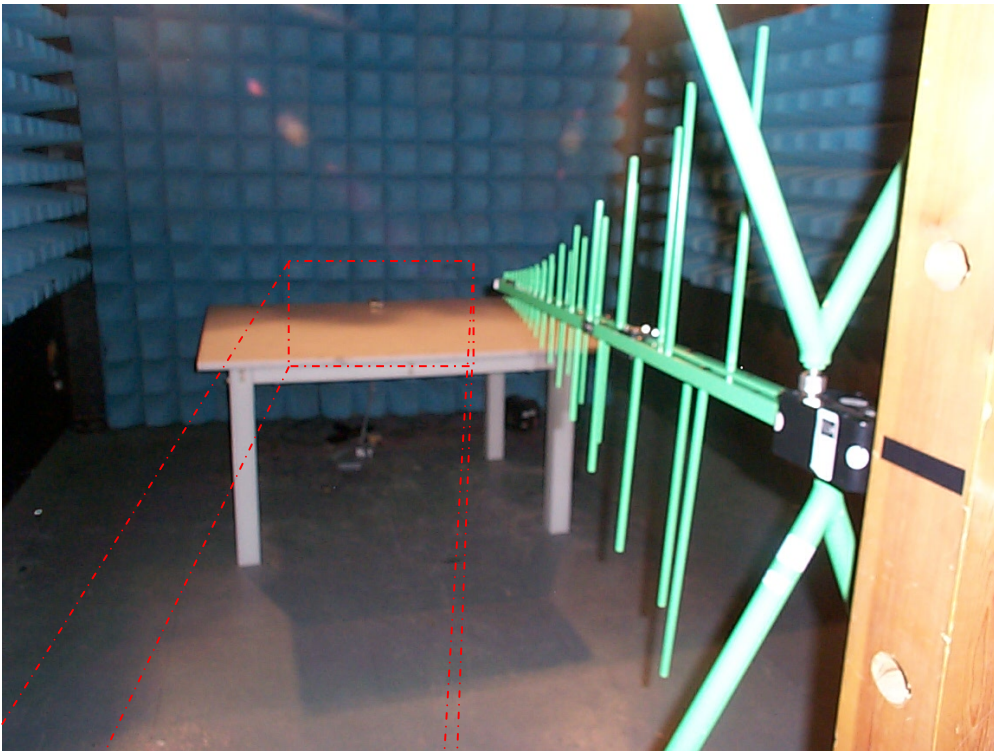
Notes: 1.Limit ± 10ppm (See Annex J for plots verses limit)

The SBD Transceiver was found to comply with the limits

ANNEX A
PHOTOGRAPHS

PHOTOGRAPH 1.

RADIATED TEST SETUP



PHOTOGRAPH 2.

CONDUCTED TEST SETUP



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	[]
		-	Rx	[]
		-	PSU	[]
		-	AUX	[]
i.	COMPONENT LOCATION	-	Tx	[]
		-	Rx	[]
		-	PSU	[]
		-	AUX	[]
j.	PCB TRACK LAYOUT	-	Tx	[]
		-	Rx	[]
		-	PSU	[]
		-	AUX	[]
k.	BILL OF MATERIALS	-	Tx	[]
		-	Rx	[]
		-	PSU	[]
		-	AUX	[]
l.	USER INSTALLATION / OPERATING INSTRUCTIONS	-		[X]

ANNEX C
TEST EQUIPMENT LIST

TYPE OF EQUIPMENT	MAKER/SUPPLIER	MODEL No	SERIAL No	TRL No
SPECTRUM ANALYSER	R & S	ESIB 7	100182	630
SPECTRUM ANALYSER	ANRITSU	MS2665C	MT26089	479
PSU	MANSON	EP-603	60316619	149
PSU	THURLBY THANDAR	PL320QMD	N/A	N/A
RF DIODE	SUHNER	H7	1001.17.A	248
HORN	EMCO	3115	9010-3580	138
HORN	EMCO	3115	9010-3581	139
BIDIRECTIONAL COUPLER	NARDA	3022	72622	UH226
CABLE	ROSENBERGER	MICRO COAX	N/A	280
ENVIRONMENTAL CHAMBER(TEMP)	SHARTREE	TCC125-815P	CS 203	11
POWER METER	MARCONI	6960B	236997010	UH96
POWER SENSOR	MARCONI	6920	1227	179
LOOP ANTENNA 9kHz - 30MHz	R & S	HFH2	881058 - 53	07
MULTIMETER	KEITHLEY	2000	0588183	S018
LOAD	SUHNER	65 BNC-50-0-1	N/A	05
20dB ATTENUATOR	BIRD	8340-200-N	MFC 70998	221
30 dB ATTENUATOR	NARDA	776C-30	619	N/A
30 dB ATTENUATOR	NARDA	776C-30	577	N/A
EXTERNAL KEYPAD	CCL	ORPHEUS	C7032-011a/V1	N/A
HIGH PASS FILTER	AFL	N/A	N/A	N/A

ANNEX D
TX TEST APPLICATION SETUP

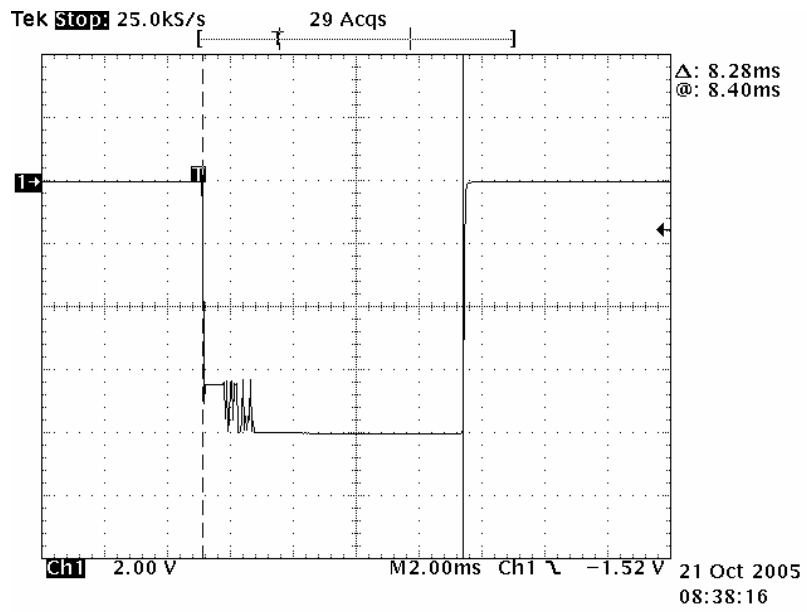
TEST SETUP SELECTION

Command Function	Selection Options	selection
Channel	1 – 240	1, 75, 150 or 240
Time Slot	1 – 4	3
Frame Tick	0 (internal), 1 (External)	0 (internal)
BER Loopback	0 (Random Data), 1 (Loopback Data)	0 (Random Data)
Register Seed	0 (Carrier), 1(Random data)	1 (Random Data)
Propagation Delay	1820 μ s - 11480 μ s	5000 μ s
SV Doppler Frequency	-40,000 – 40,000Hz	0

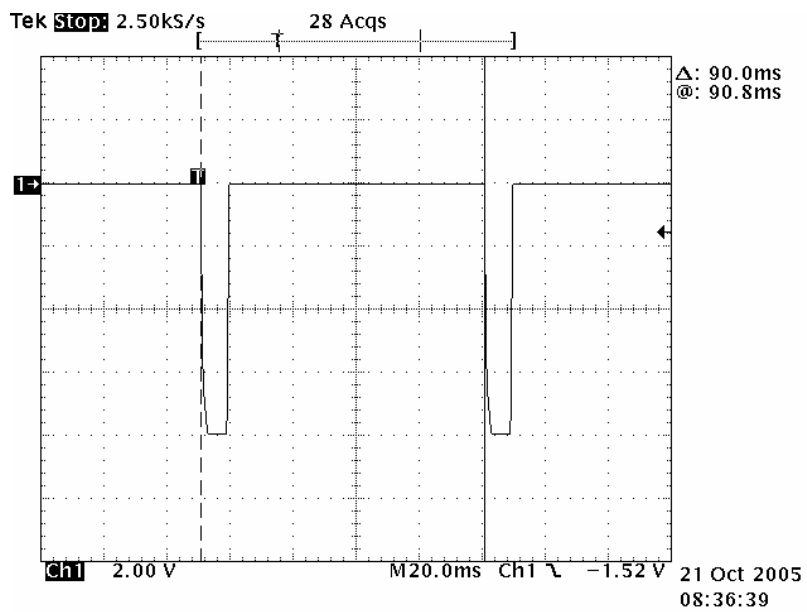
Notes: TX Test is an application supplied to allow easy alteration to the units operation

ANNEX E
DUTY CYCLE

Duty Cycle Plots

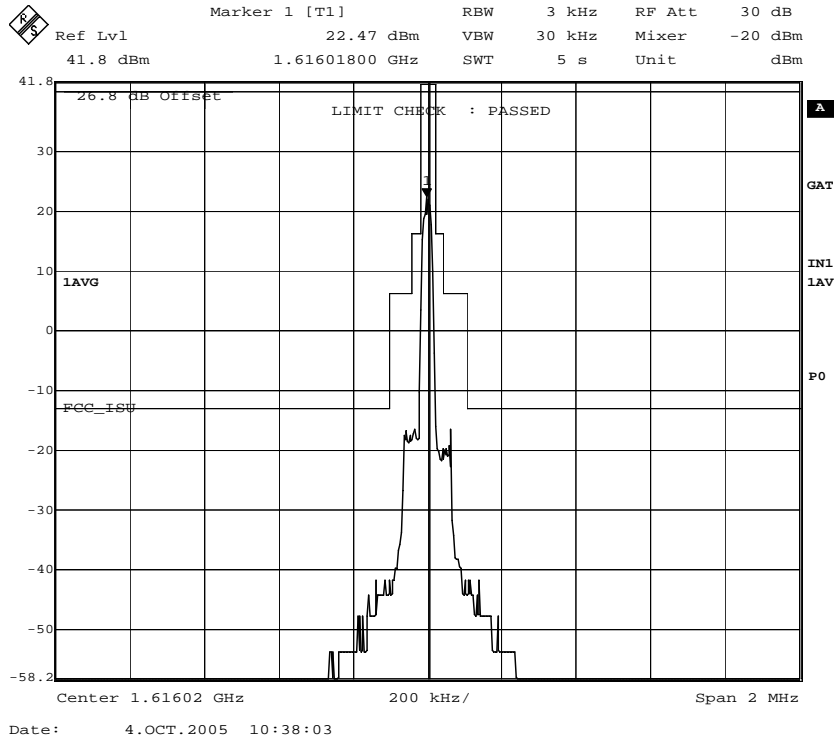


$$T_{on} = 8.28\text{mS}$$

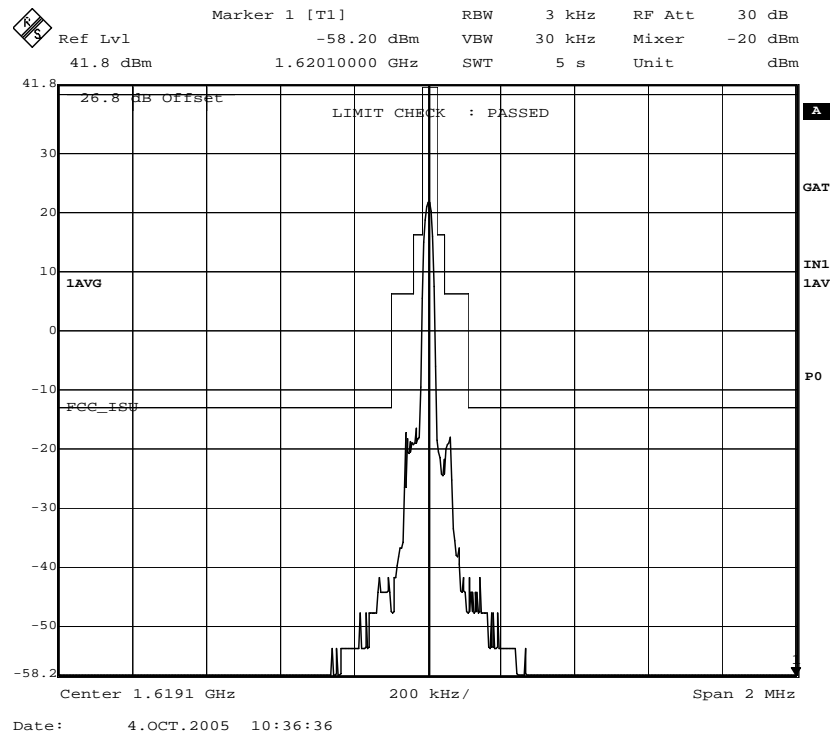


$$T_{frame} = 90\text{mS}$$

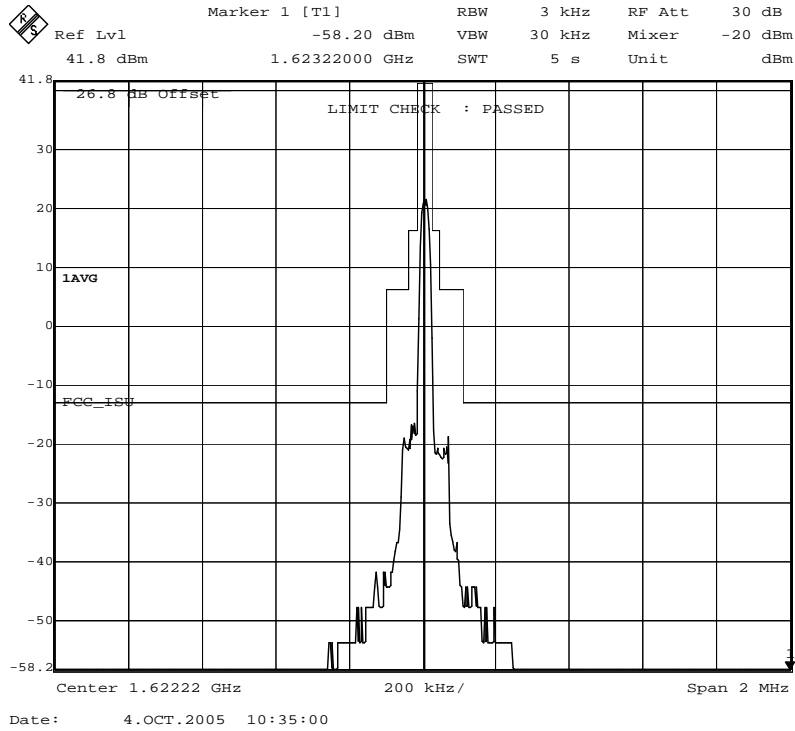
ANNEX F
EMISSIONS LIMITATIONS



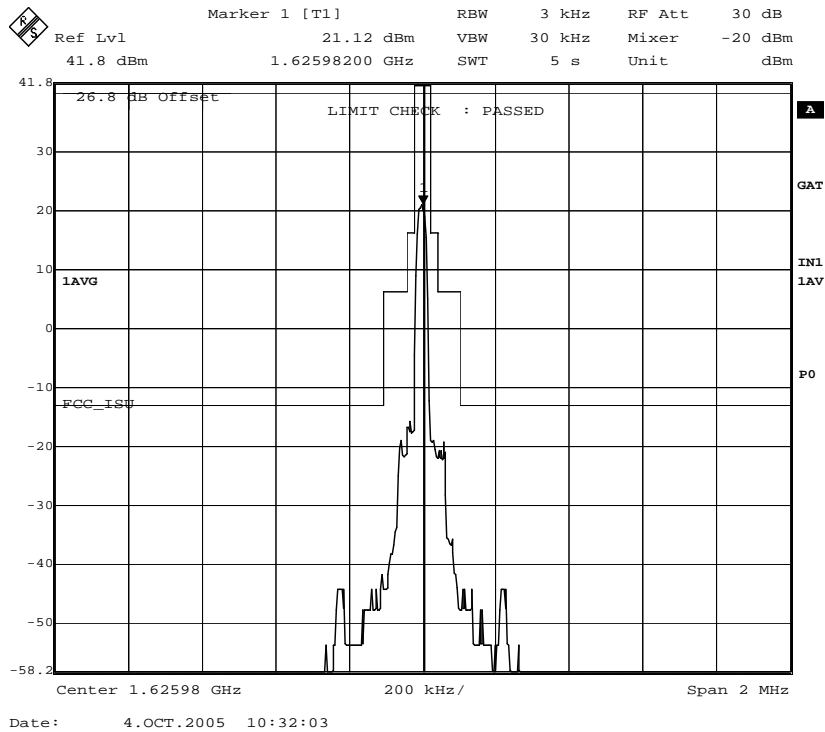
Channel 1



Channel 75



Channel 150

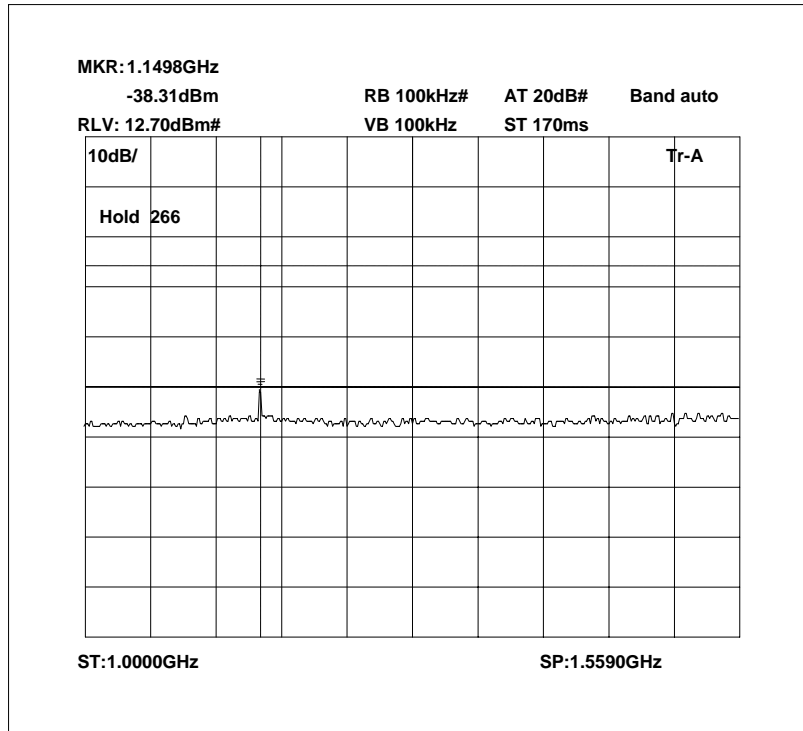


Channel 240

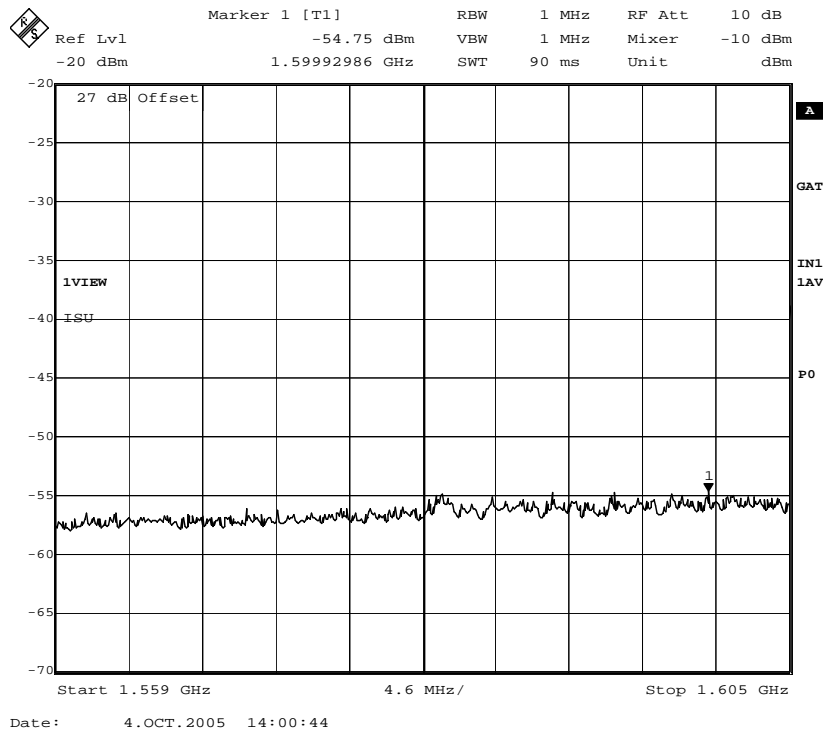
ANNEX G
TRANSMITTER SPURIOUS EMISSIONS - Conducted

TRANSMITTER SPURIOUS EMISSIONS – Conducted

Channel 1



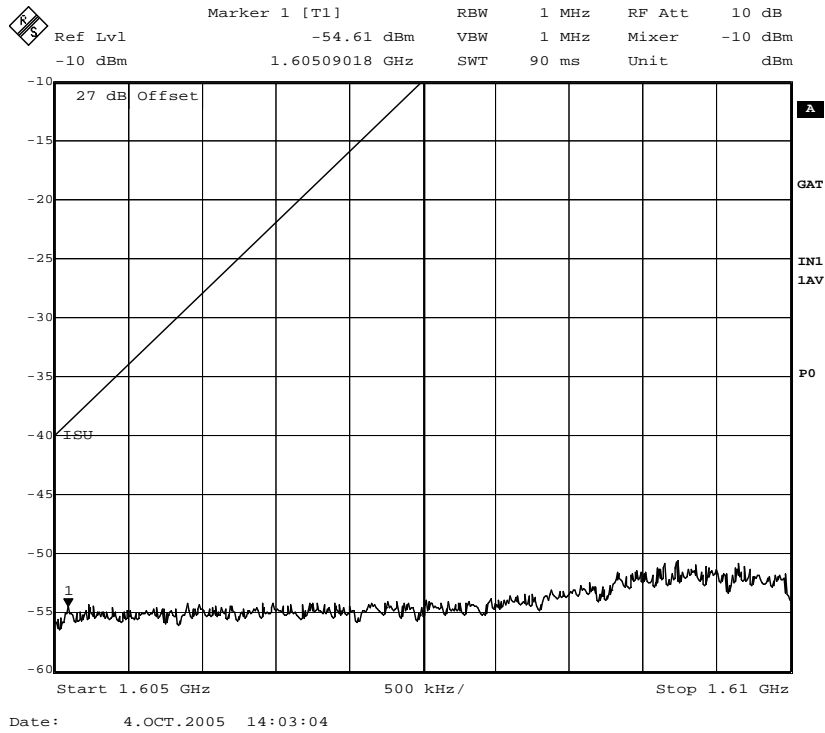
1000MHz – 1559MHz



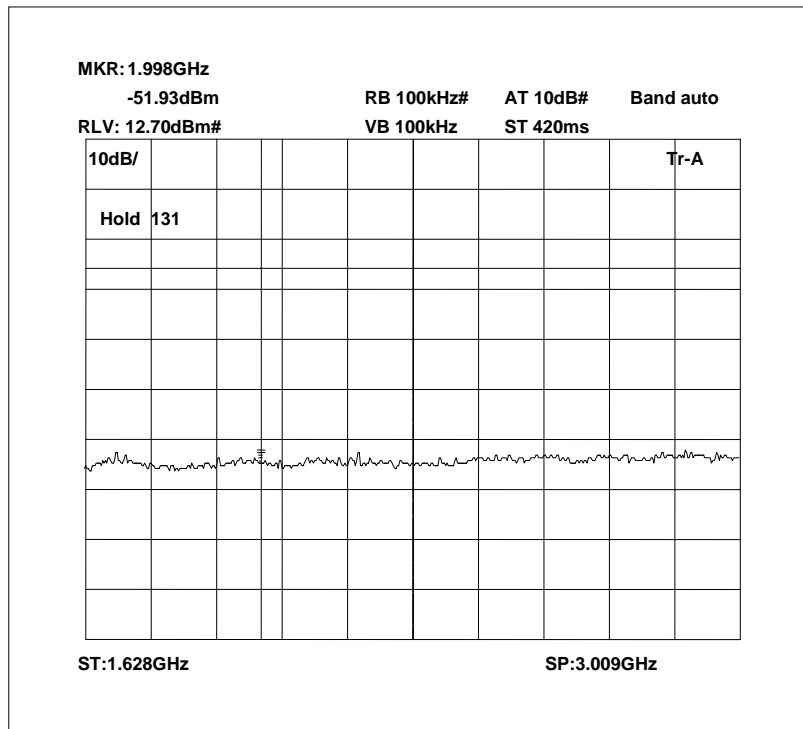
1559MHz – 1605MHz

TRANSMITTER SPURIOUS EMISSIONS – Conducted

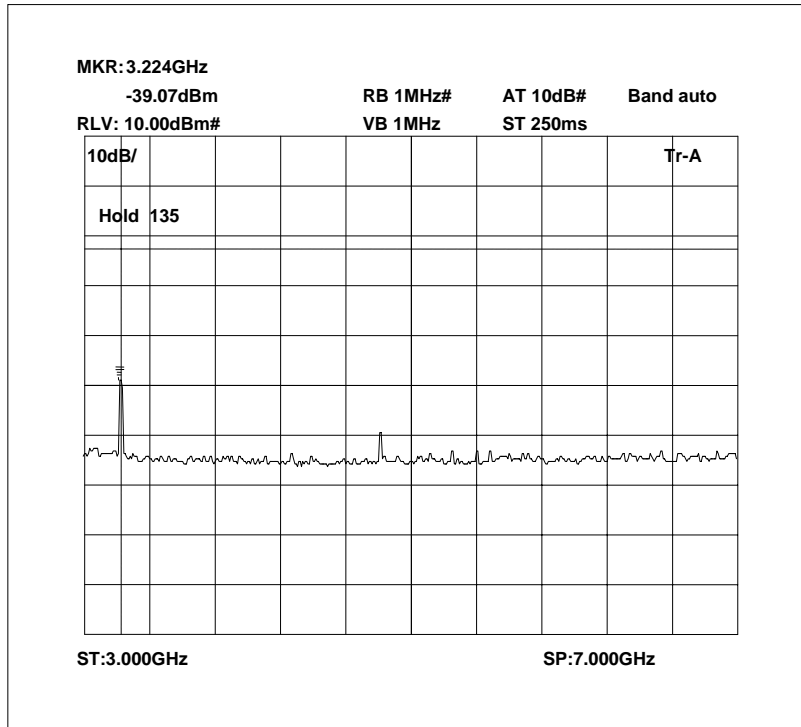
Channel 1



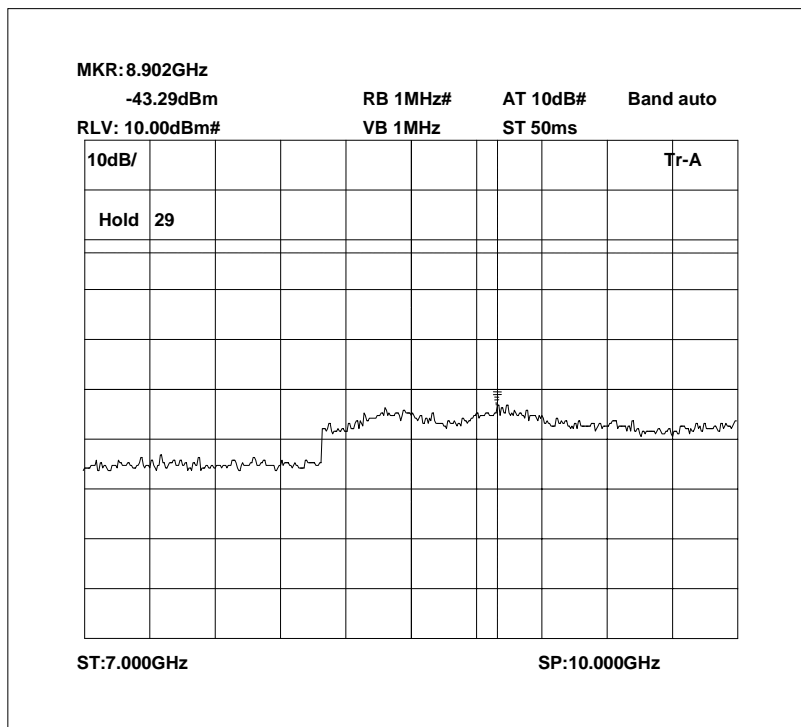
1605MHz – 1610MHz



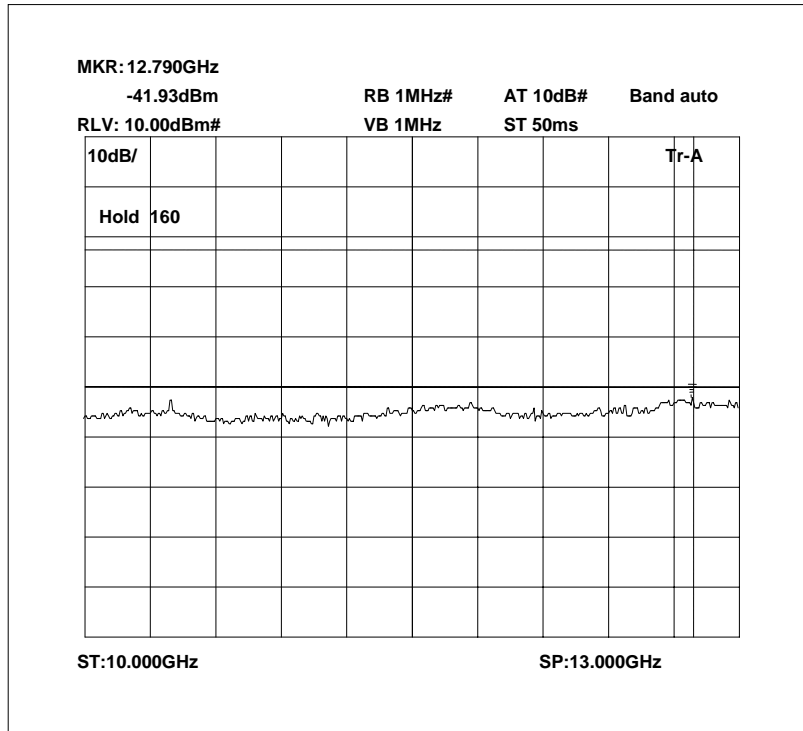
1628.5MHz – 3000MHz



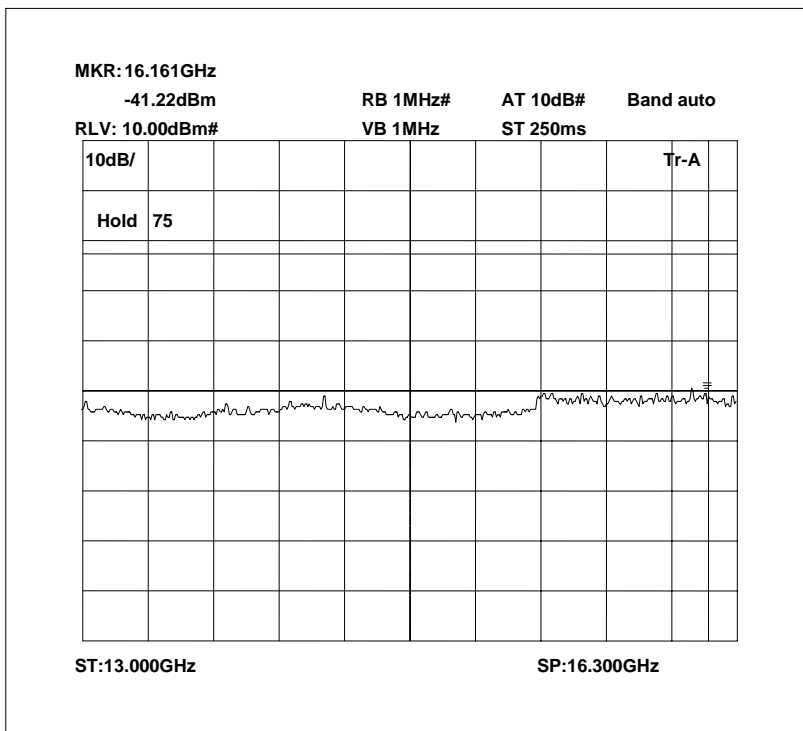
3GHz – 7GHz



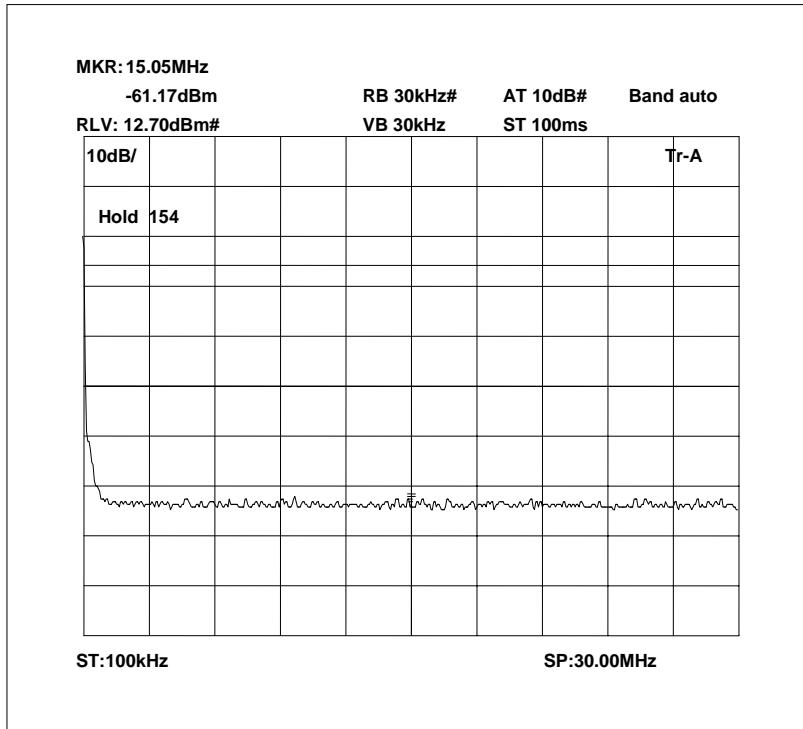
7GHz – 10GHz



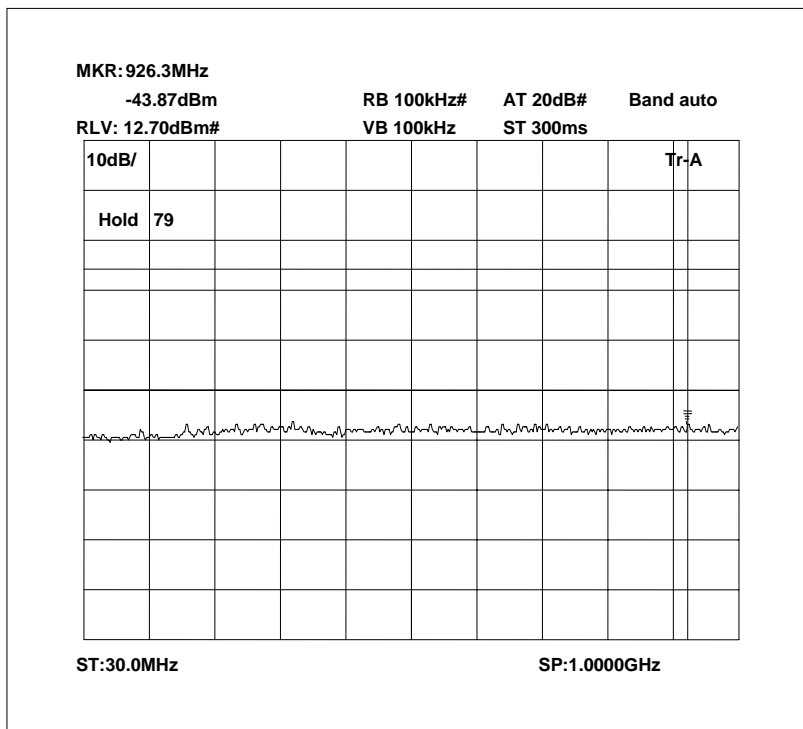
10GHz – 13GHz



13GHz – 16.3GHz



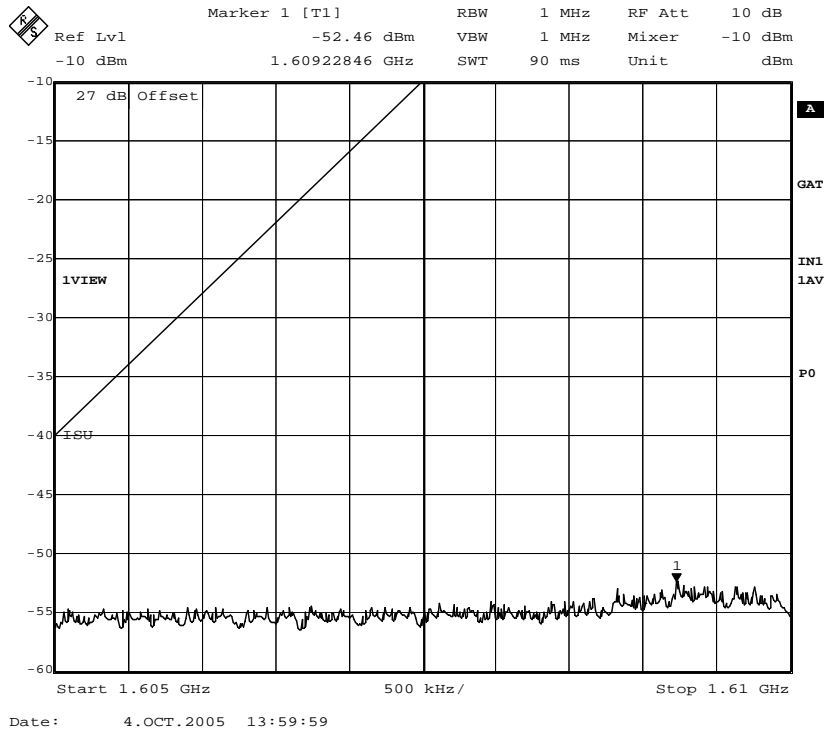
100 kHz – 30MHz



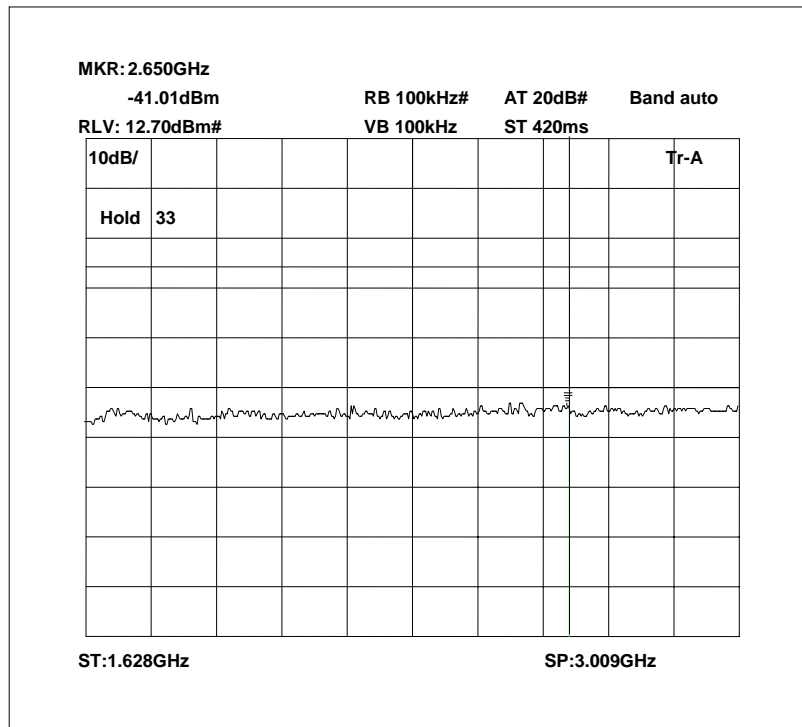
30MHz – 1000MHz

TRANSMITTER SPURIOUS EMISSIONS – Conducted

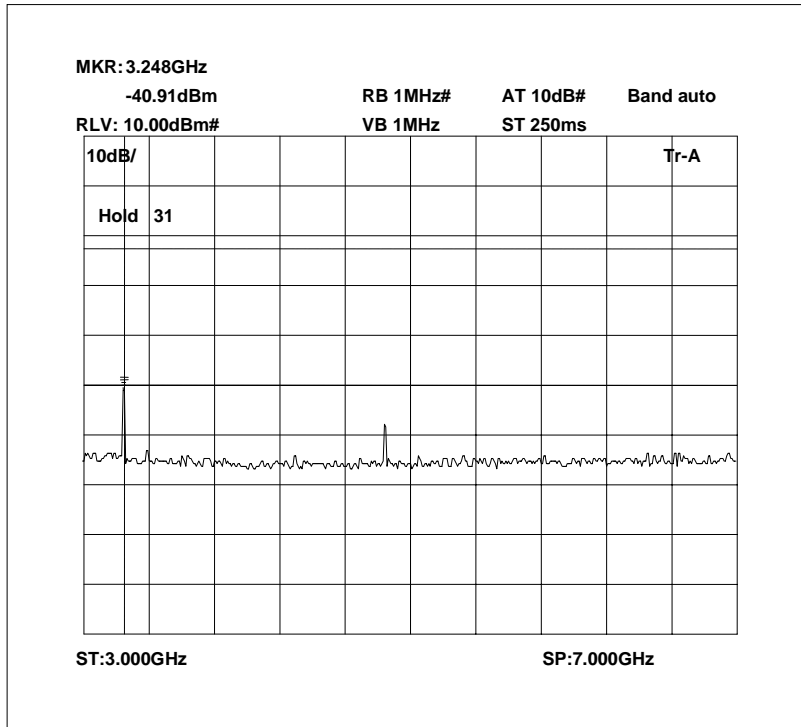
Channel 240



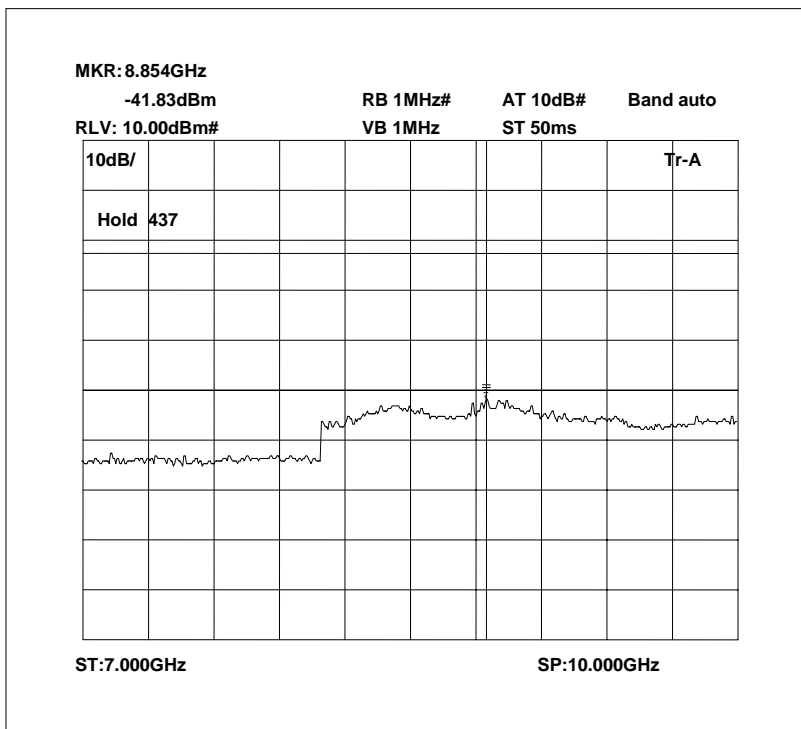
1605MHz – 1610MHz



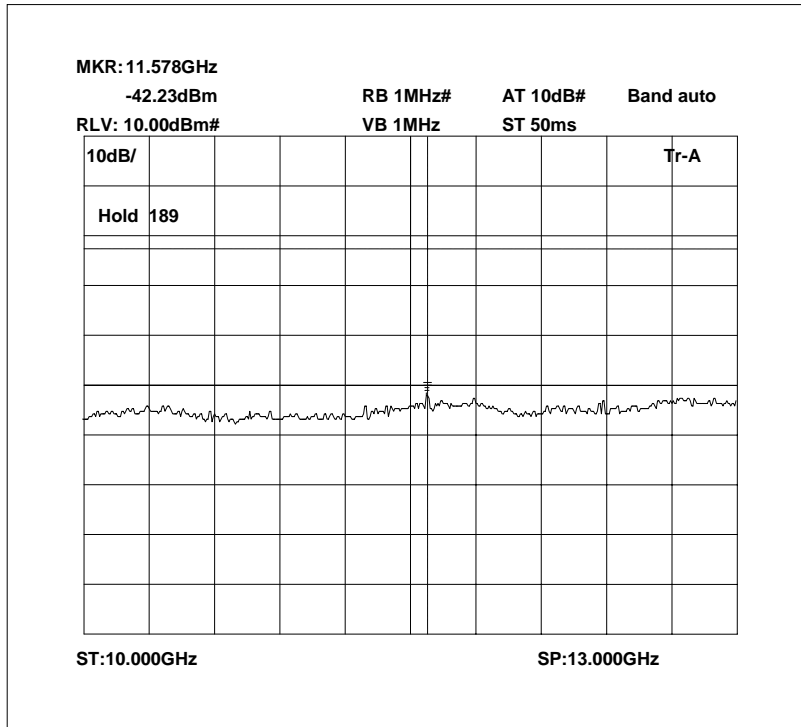
1628.5MHz – 3000MHz



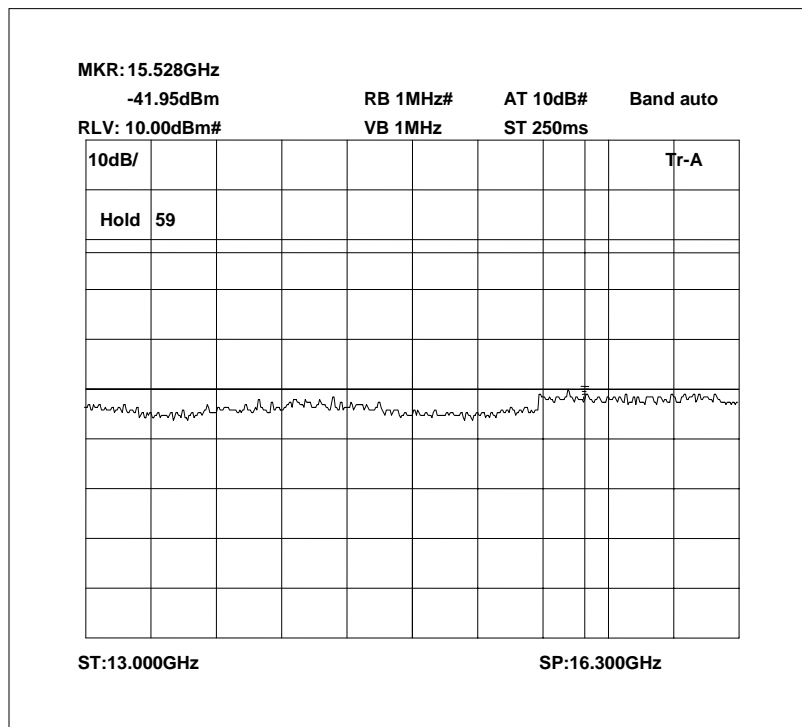
3GHz – 7GHz



7GHz – 10GHz

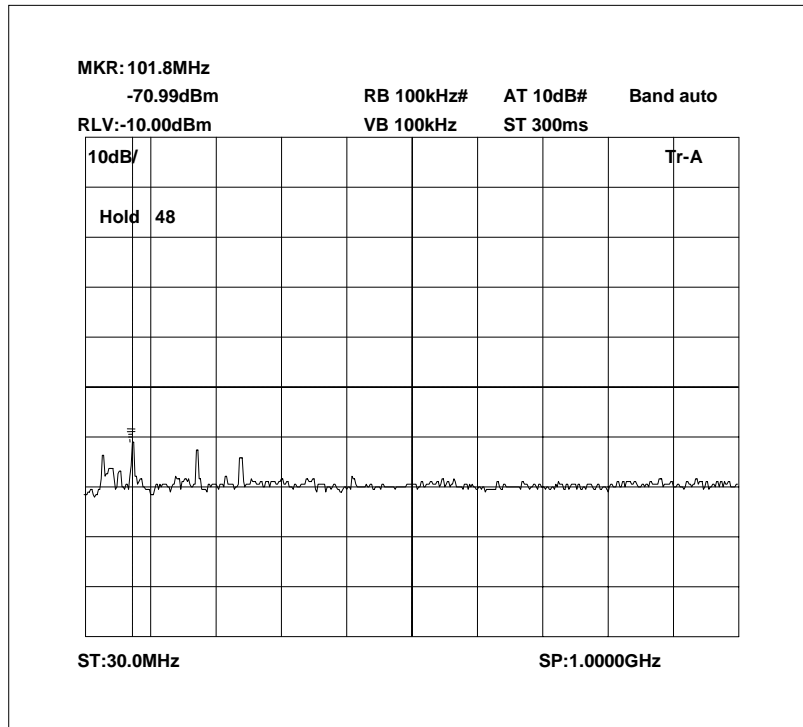


10GHz – 13GHz

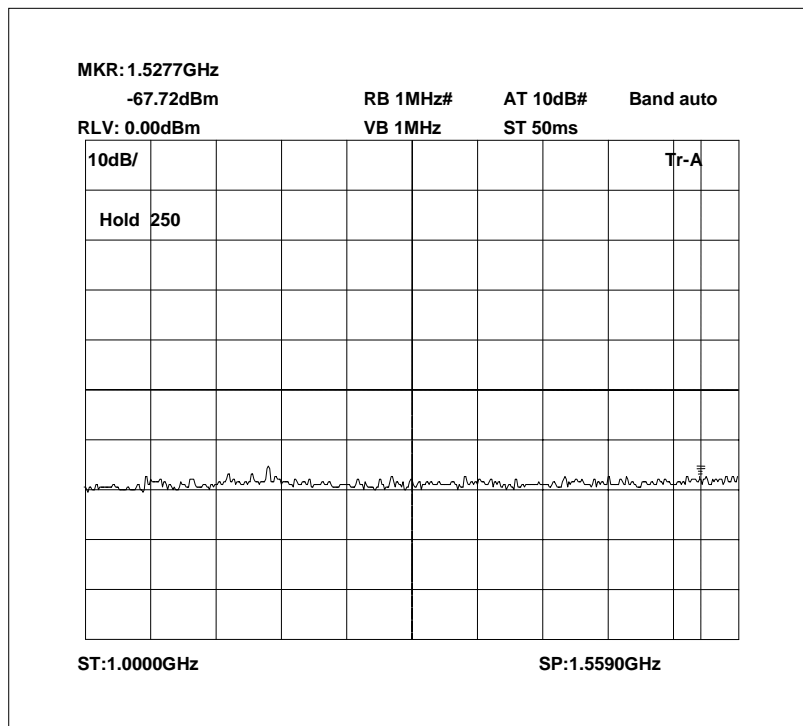


13GHz – 16.3GHz

ANNEX H
TRANSMITTER SPURIOUS EMISSIONS - Radiated



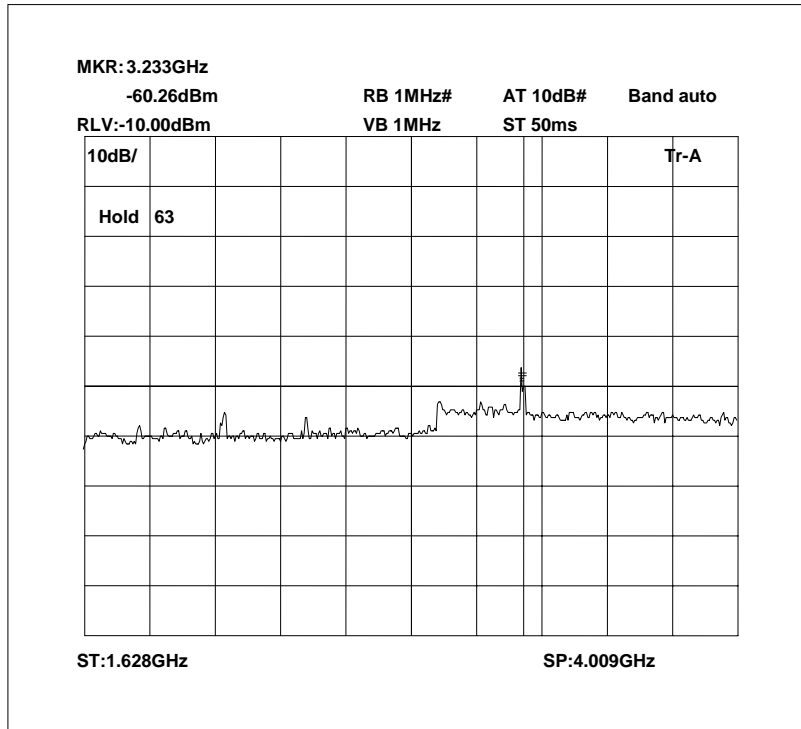
30MHz – 1000MHz



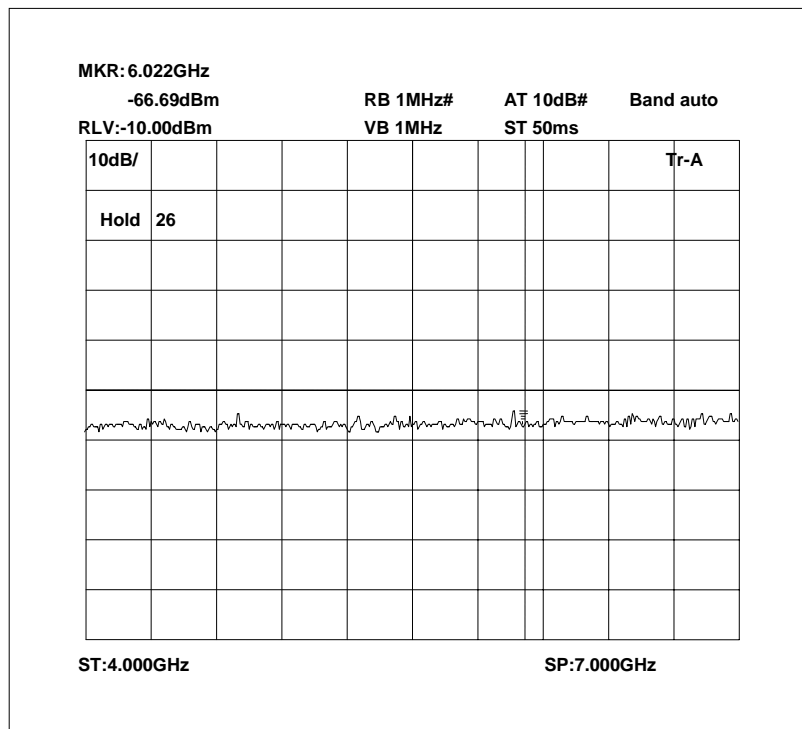
1000MHz – 1559MHz
RU1196/6596

TRANSMITTER SPURIOUS EMISSIONS – Radiated

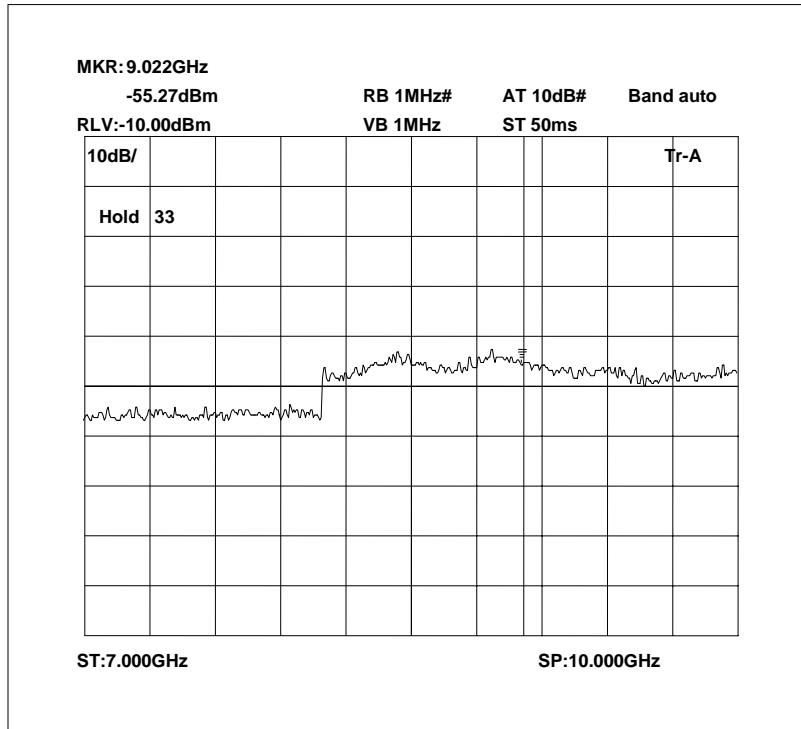
Channel 1



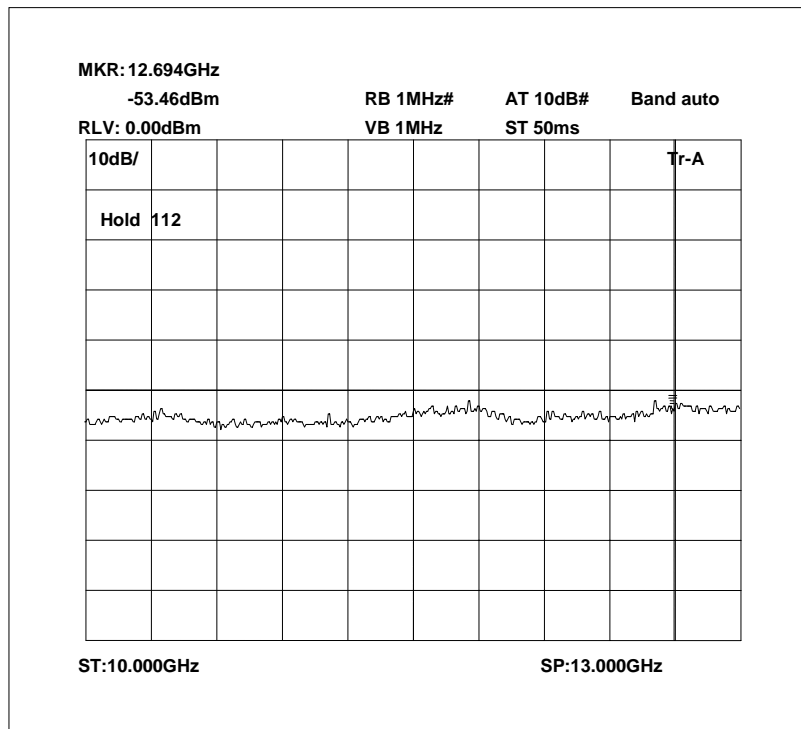
1628.5MHz – 4000MHz



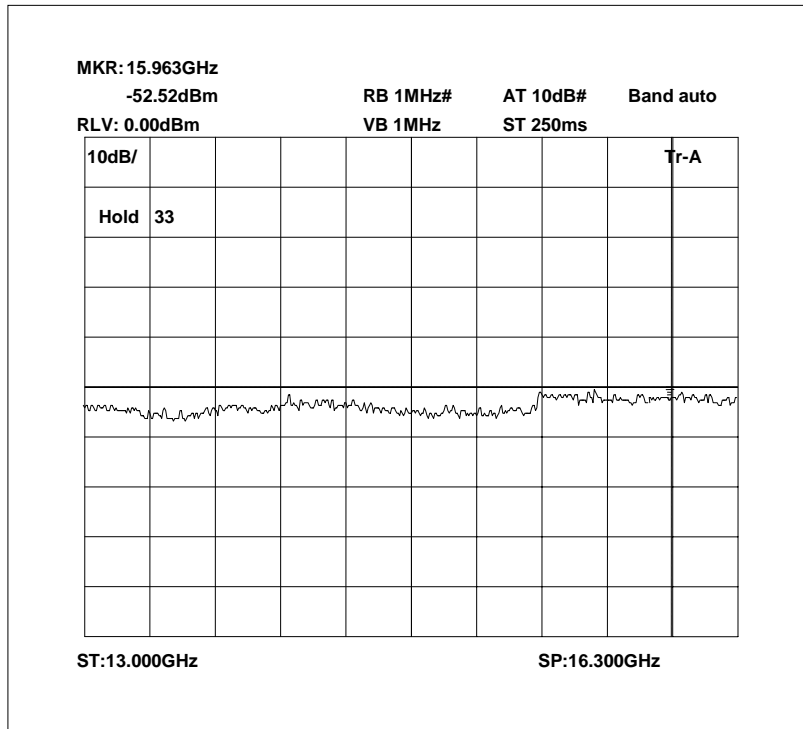
4GHz – 7GHz



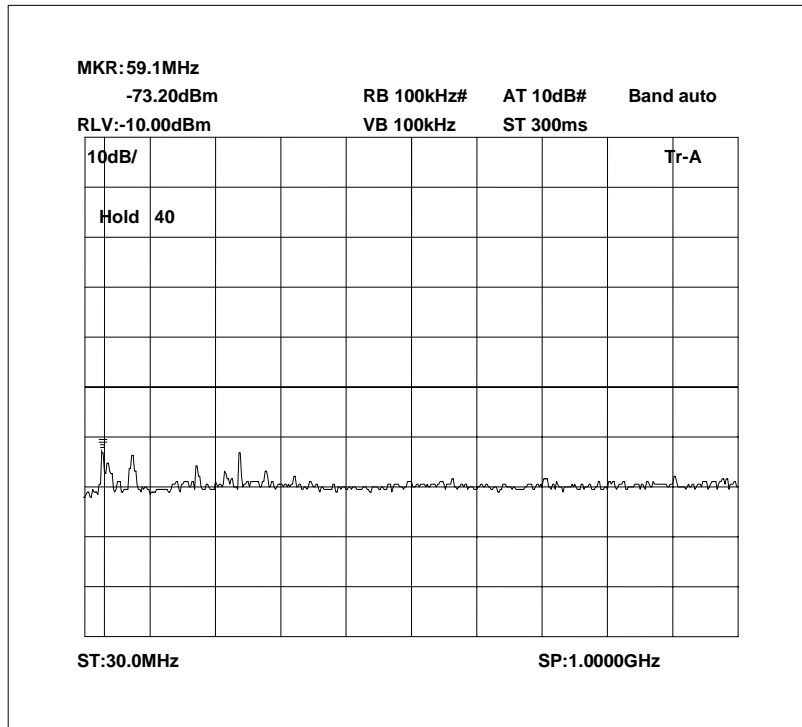
7GHz – 10GHz



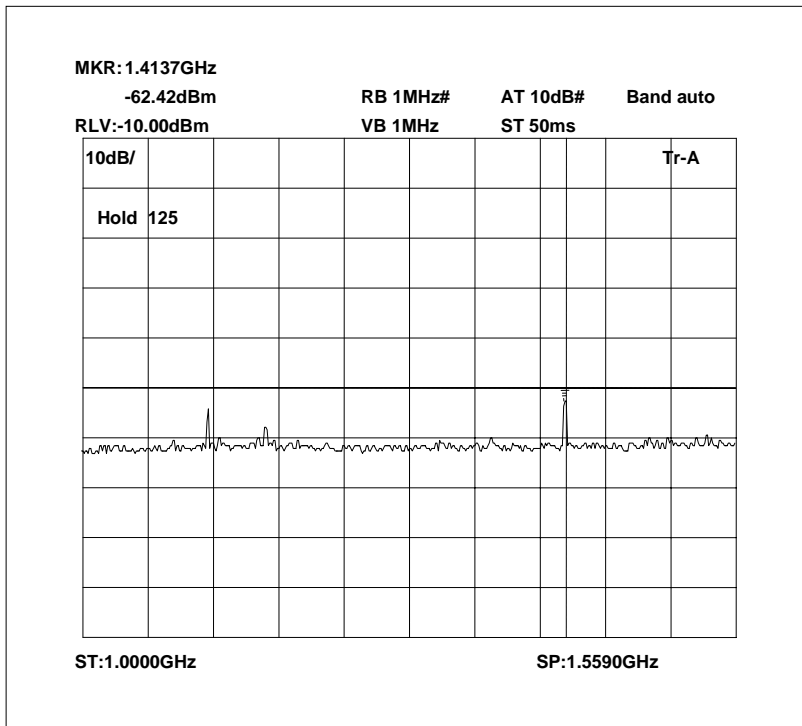
10GHz – 13GHz



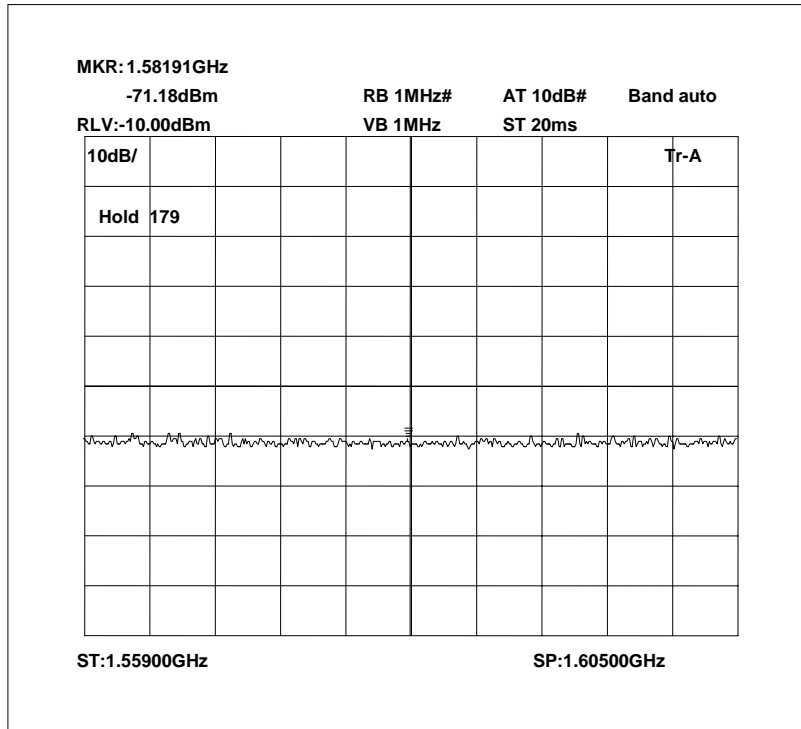
13GHz – 16.3GHz



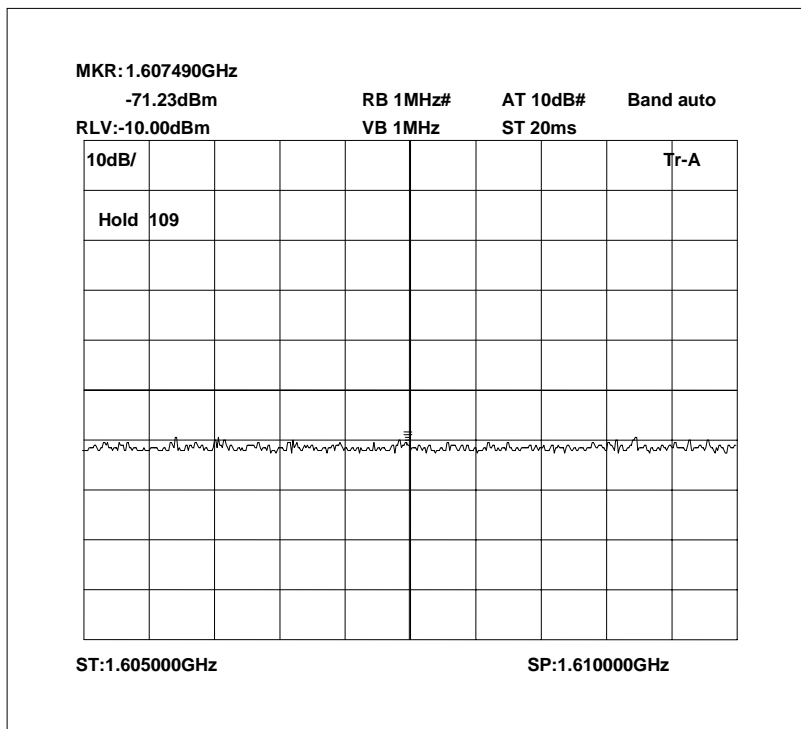
30MHz – 1000MHz



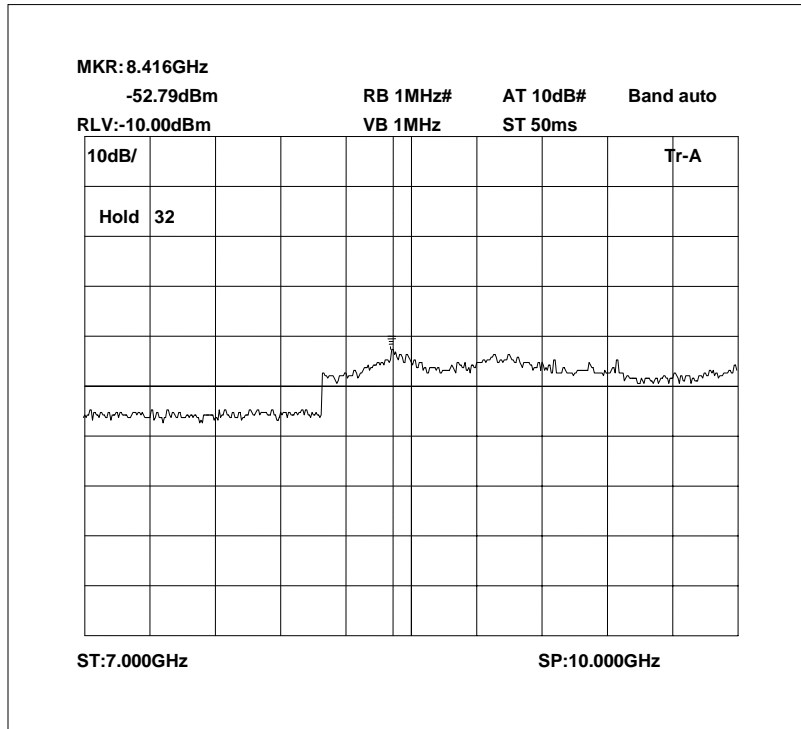
1000MHz – 1559MHz
RU1196/6596



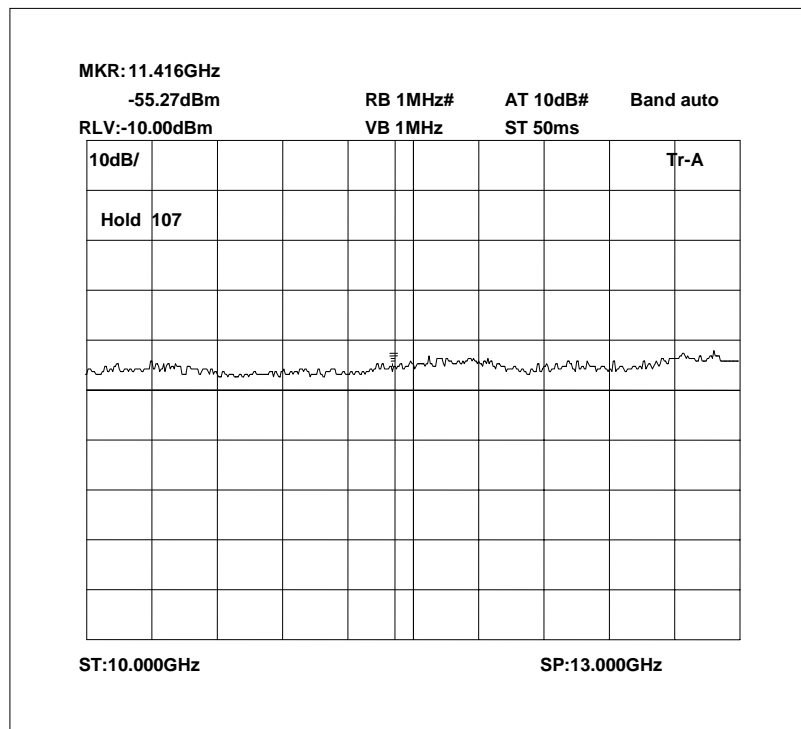
1559MHz – 1605MHz



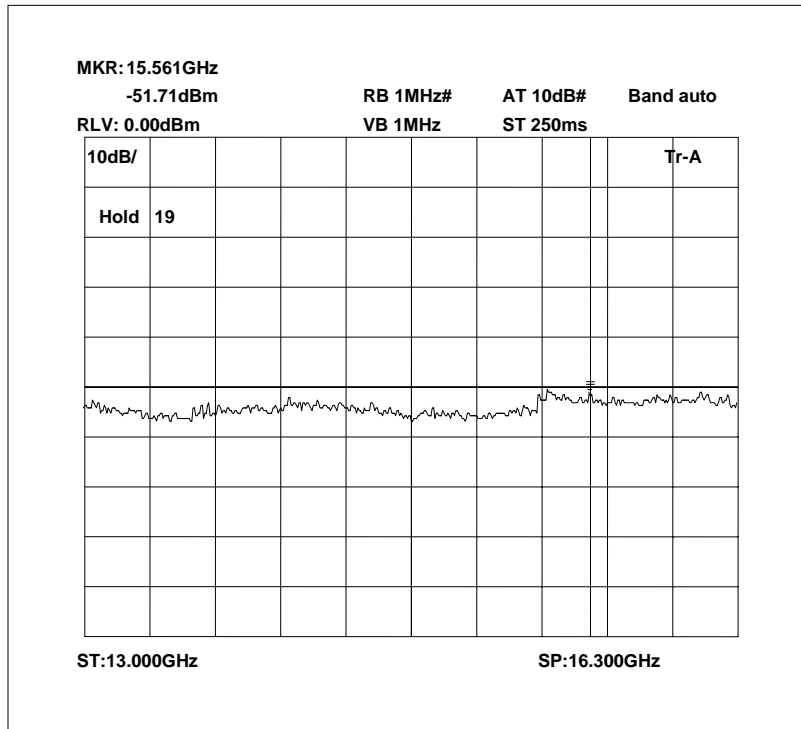
1605MHz – 1610MHz



7GHz – 10GHz



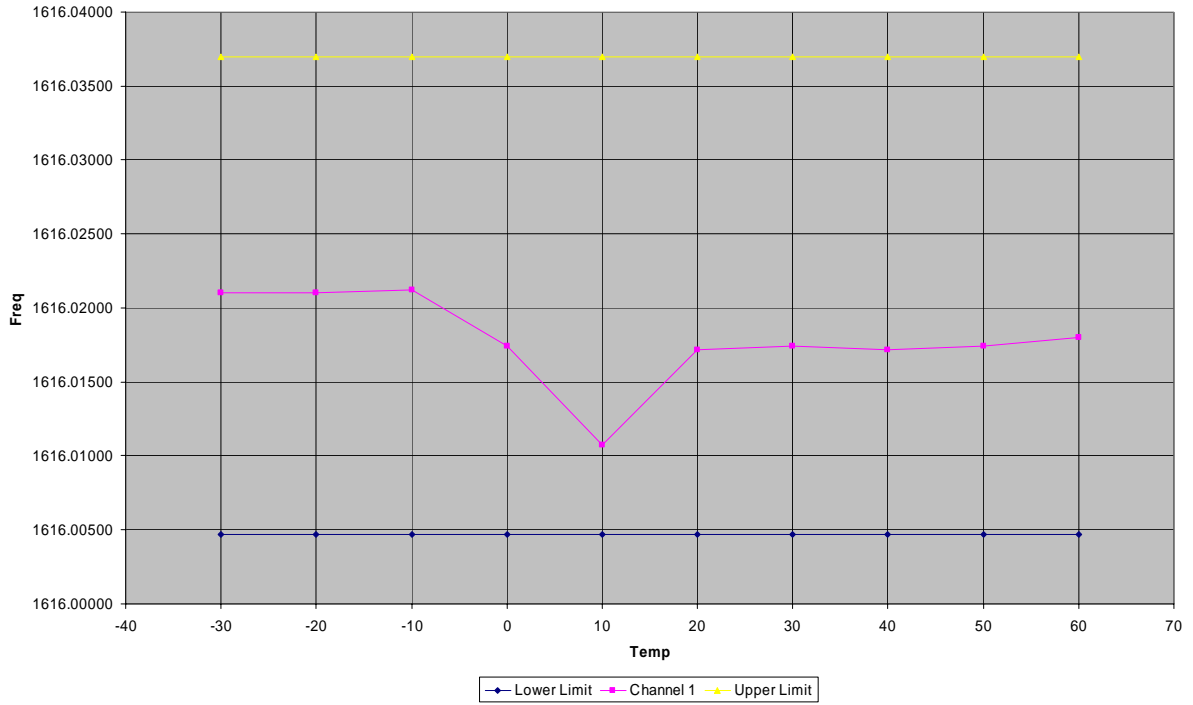
10GHz – 13GHz



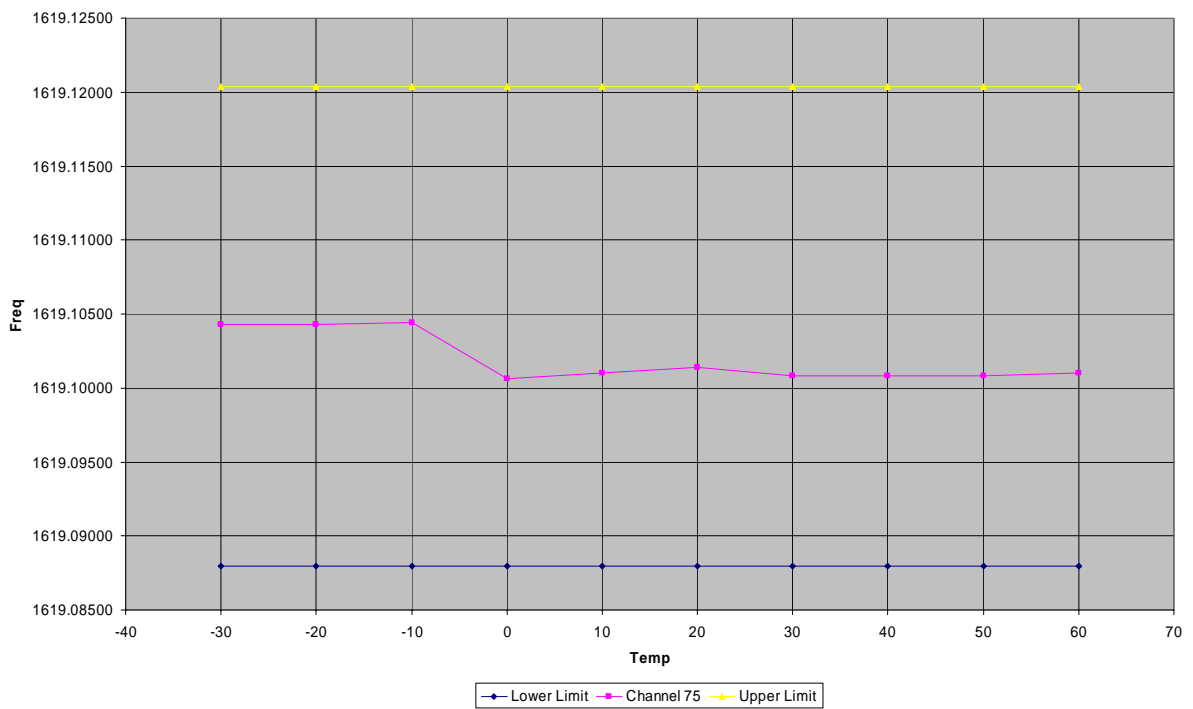
13GHz – 16.3GHz

ANNEX I
FREQUENCY STABILITY - Temperature

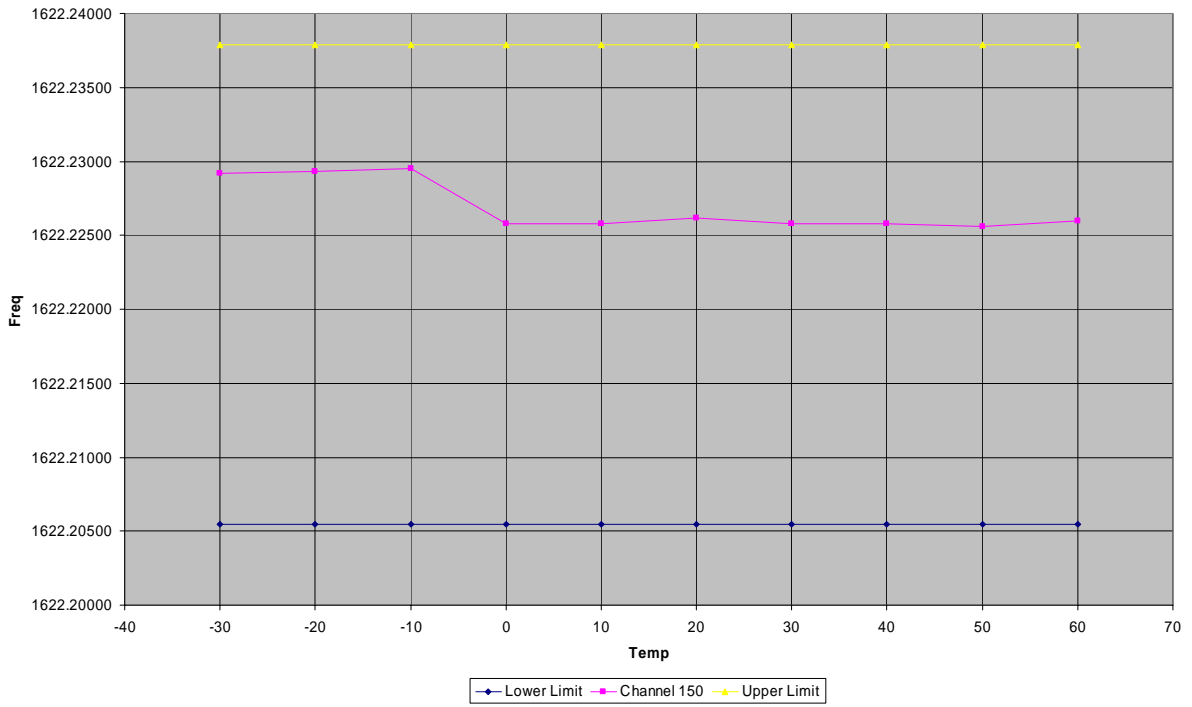
Channel 1 Frequency Stability - Temperature



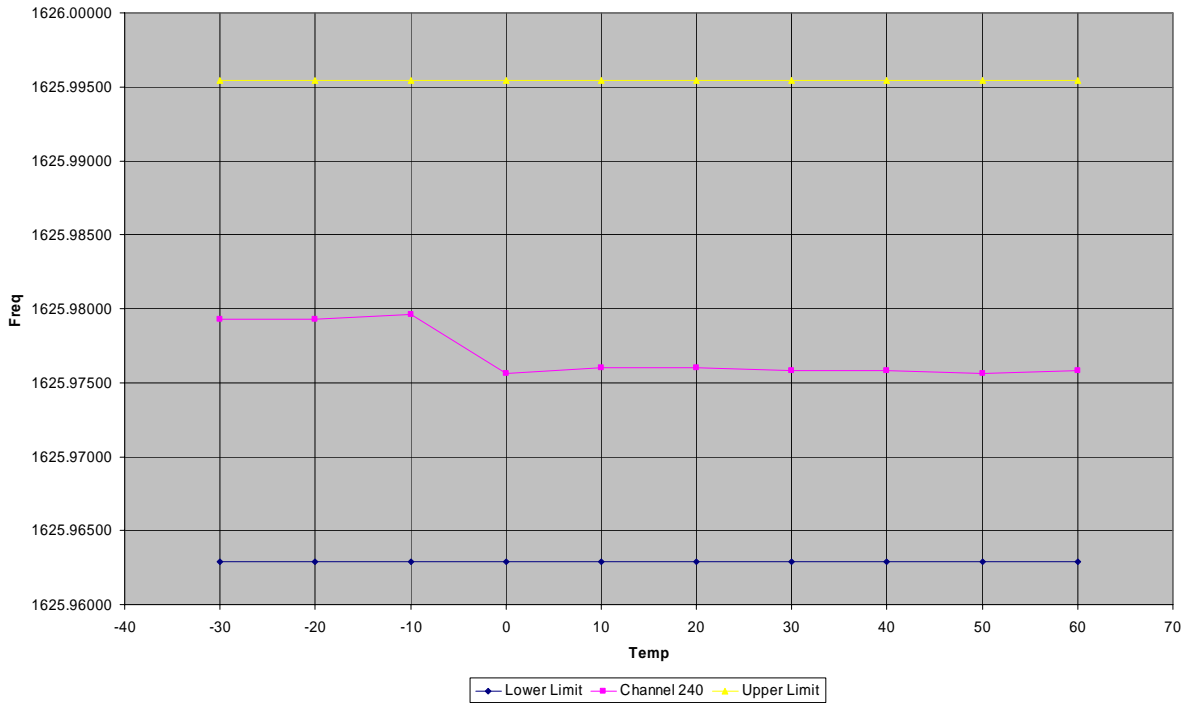
Channel 75 Frequency Stability - Temperature



Channel 150 Frequency Stability - Temperature

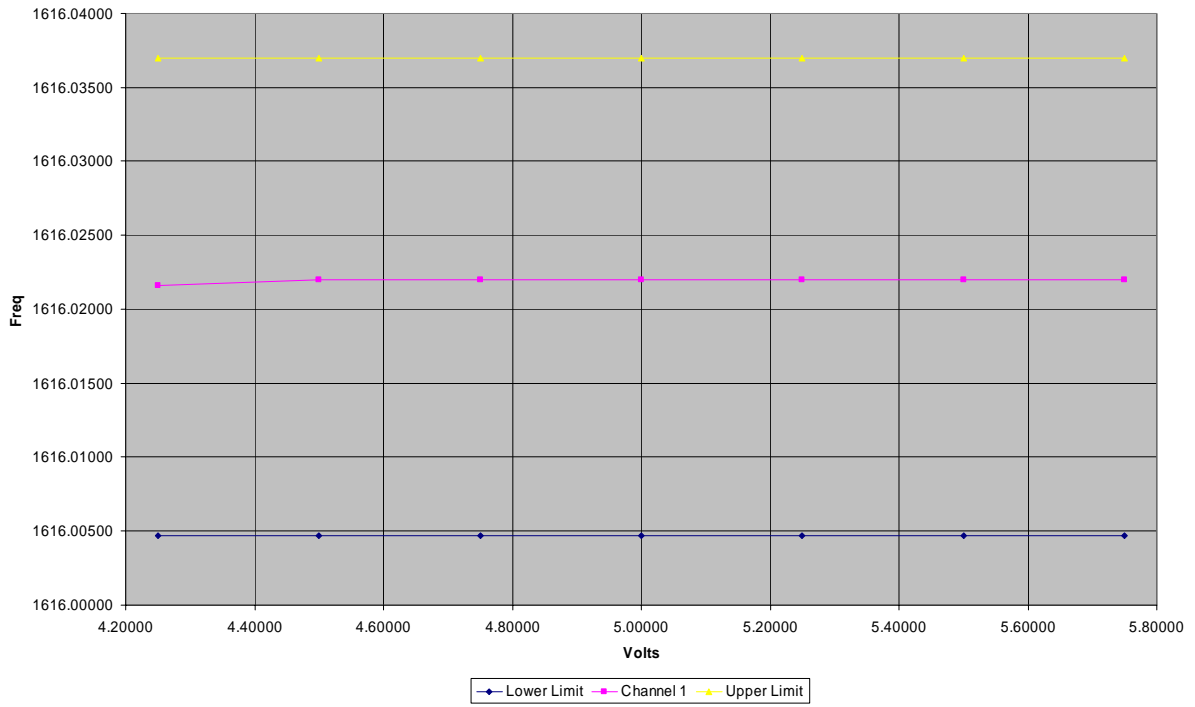


Channel 240 Frequency Stability - Temperature

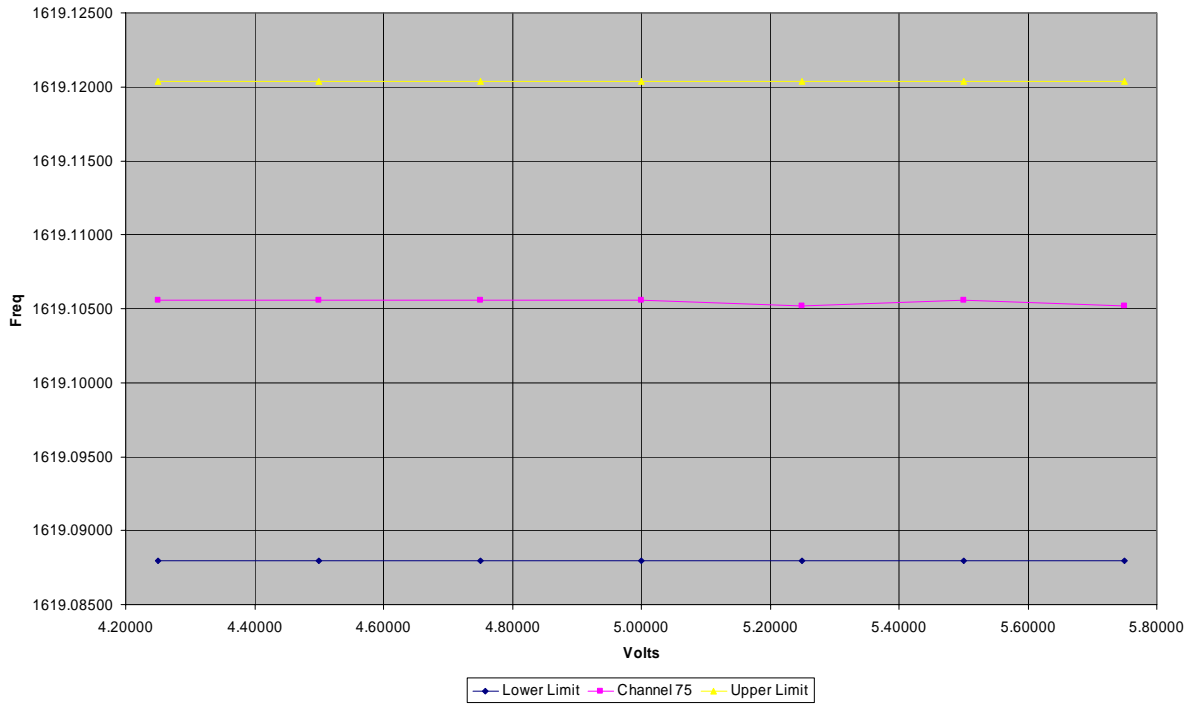


ANNEX J
FREQUENCY STABILITY – Voltage

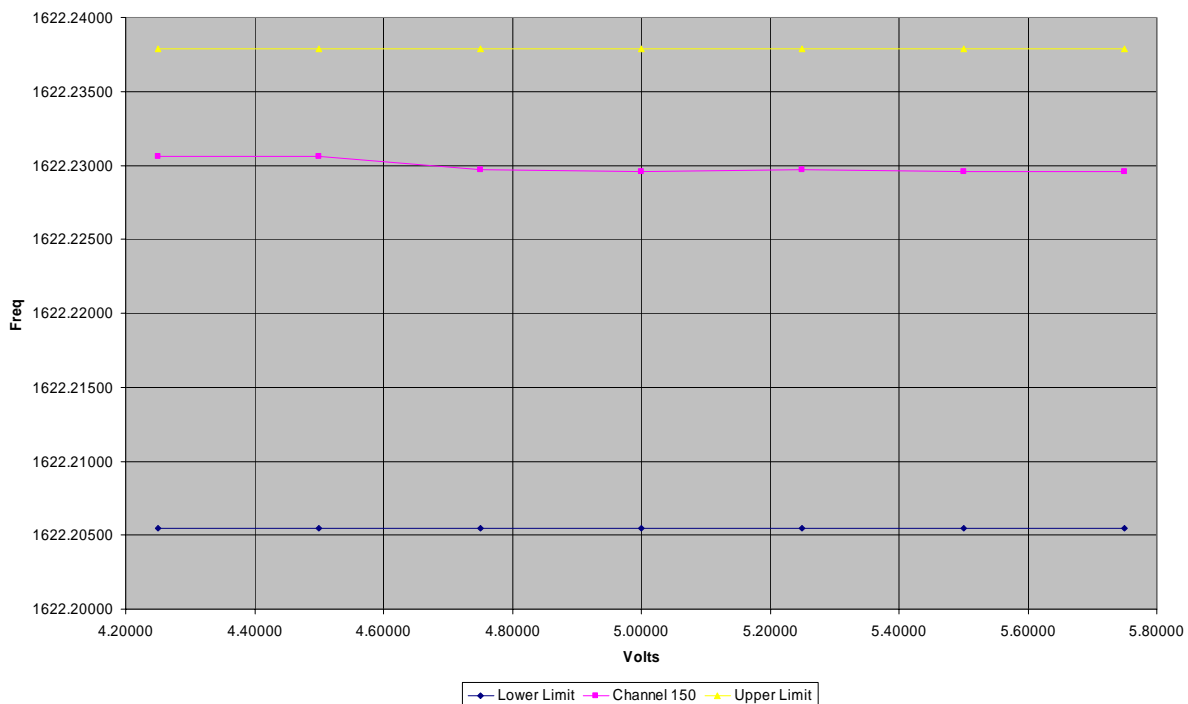
Channel 1 Frequency Stability - Voltage



Channel 75 Frequency Stability - Voltage



Channel 150 Frequency Stability - Voltage



Channel 240 Frequency Stability - Voltage

