RF Test Report:

Airspan 700 MHz SCRT

SC_TR02_A

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1 Revision History

Revision	Originator	Date	Comment
Draft 1	Sulis Consultants	13 April 2010	Issued to Airspan as work in progress
A	Sulis Consultants	19 April 2010	Results reviewed, Test plan added and issued as 1st release

2 Purpose

This document details the preliminary RF tests performed on the Airspan 700 MHz SCRT. The tests were used to determine worst-case frequency/modulation combinations to be tested by RFI Global services under proposal 77581JD01. These were included in Test Plan SC_AIR_TP01_A, which is included at the end of this document.

3 Reference Documents

[Ref 1]	47CFR2	Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunications network equipment, ElectroMagnetic Compatibility (EMC) requirements
[Ref 2]	47 CRF27	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
[Ref 3]	TIA-603-C	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards

4 Product Description

The SCRT operates at supports operation with 5 MHz and 10 MHz bandwidths, comprising 512 and 1024 subcarriers respectively. Each of these subcarriers can be modulated in a number of modes:

- BPSK ½
- QPSK ½ and ¾
- 16 QAM ½ and ¾
- 64 QAM ½ and ¾

The following four modulation schemes will be used during testing:

- BPSK ½
- QPSK ¾
- 16 QAM ¾
- 64 QAM ¾

5 Tests performed

Testing was carried out at Airspan Communications offices in Uxbridge between 12th and 13th March 2010 by C F J Blackham BEng(Hons) CEng MIET, director of Sulis Consultants Ltd.

Part	Bandwidth	Channels	Modulation
2.1049 Occ bandwidth	5.0	Bottom Middle Top	All four Worst case(s) Worst case(s)
	10.0	Bottom Middle Top	All four Worst case(s) Worst case(s)
27.50(c)(3) Peak Power density at antenna port	5.0	Bottom Middle Top	All four Worst case(s) Worst case(s)
	10.0	Bottom Middle Top	All four Worst case(s) Worst case(s)
2.1046 Burst power	5.0	Bottom Middle Top	All four Worst case(s) Worst case(s)
	10.0	Bottom Middle Top	All four Worst case(s) Worst case(s)
27.53(g) 2.1051 Conducted Band Edge	5.0	Bottom Top	All four All four
	10.0	Bottom Top	All four All four
27.53(g) 2,1051 CSE	5.0	Bottom Top	Worst case from band edge Worst case from band edge
	10.0	Bottom Top	Worst case from band edge Worst case from band edge

Table 1: Summary of tests performed

6 Test Configuration

6.1 Test sample and Operating mode

The equipment under test (EUT) was:

Manufacturer	Name	Model Number	Serial Number
Airspan	700 MHz SCRT	SCRT-1-700T	T1204900T0A0101

Table 2: Equipment under test

6.2 Support equipment

The support equipment was:

Description	Manufacturer	Name	Serial Number
SDR	Airspan	SDR-Micro	S00041930T0619D
Laptop	Dell	Latitude 610	AIRN005943
Mains – 48 V PSU	TTI	PL330DP	AIRN005533

Table 3: Support Equipment

6.3 Test equipment

Description	Manufacturer	Name	Serial Number	Calibration certificate
Receiver	Rohde & Schwarz	FSQ 8	100206	R&S 25037
Network Analyser	Rohde & Schwarz	ZVB20		R&S 24684
Attenator	Weinschel	33L-30-34	none	Calibrated in-situ using ZVB20
RF cable	Sucoflex	104	123420/4	

Table 4: Test Equipment

6.4 Equipment set-up

Equipment was configured as per figure 1:

- A "putty" sessions running on the laptop allows the SDR and SCRT to be controlled and set to required frequency, bandwidth, modulation and power.
- The insertion loss of the Attenuator and Co-ax cable were measured using a Network Analyser and their path-loss was programmed into the FSQ as an offset of 30.3 dB.

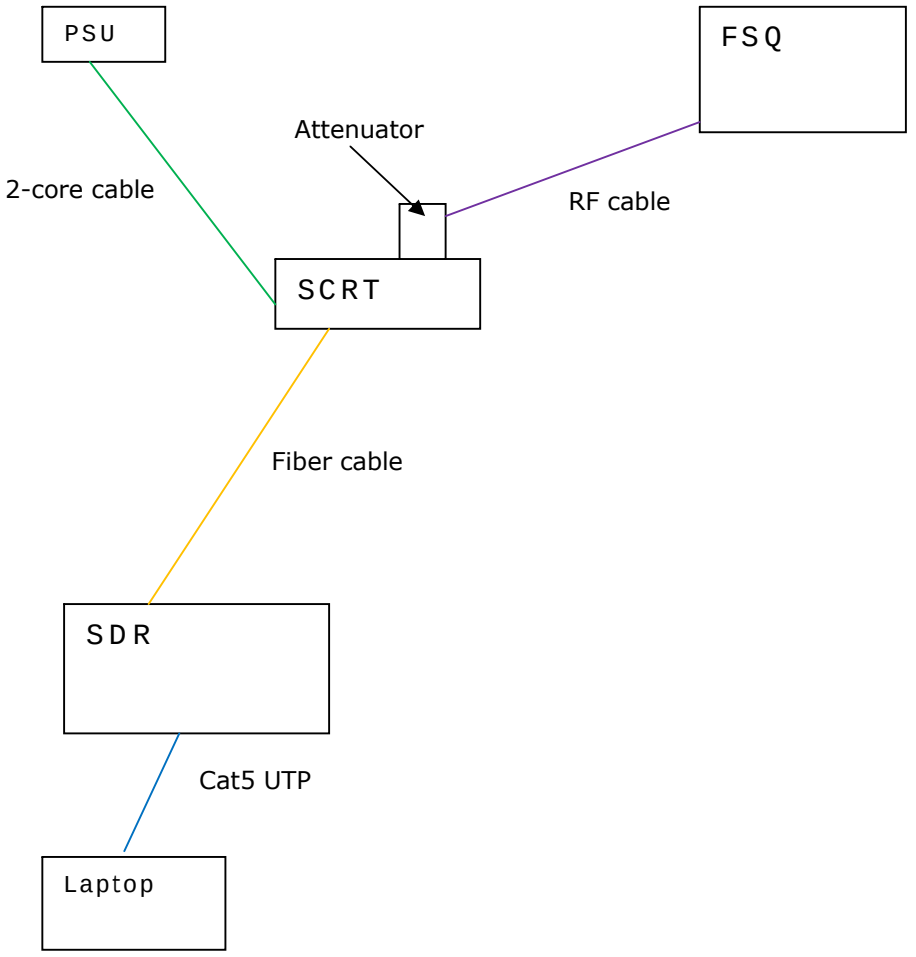

Figure 1: LI Probe test configuration: Emissions

7 Occupied Bandwidth: 47CFR2.1049

The occupied bandwidth was measured using the inbuilt function on the FSQ. Measurements were made on the channel/bandwidth/modulation combinations detailed in table 5 below.

Measurements were performed on bottom channel for each bandwidth, with the four modulation schemes under test. The worst case modulation scheme(s) for each bandwidth was then used for measurement on middle and top channels.

Channel	Bandwidth (MHz)	Frequency (MHz)	Modulation	Bandwidth (MHz)
Bottom	5	701.0	BPSK ½	4.5513
			QPSK ¾	4.5833
			16 QAM ¾	4.5673
			64 QAM ¾	4.5833
Middle	5	719.0	QPSK ¾	4.5833
			64 QAM ¾	4.5833
Top	5	743.0	64 QAM ¾	4.5833
Bottom	10	704.0	BPSK ½	9.2949
			QPSK ¾	9.3269
			16 QAM ¾	9.3269
			64 QAM ¾	9.2628
Middle	10	722.0	QPSK ¾	9.2949
			16 QAM ¾	9.3269
Top	10	740.0	16 QAM ¾	9.2949

Table 5: Occupied Bandwidth test results

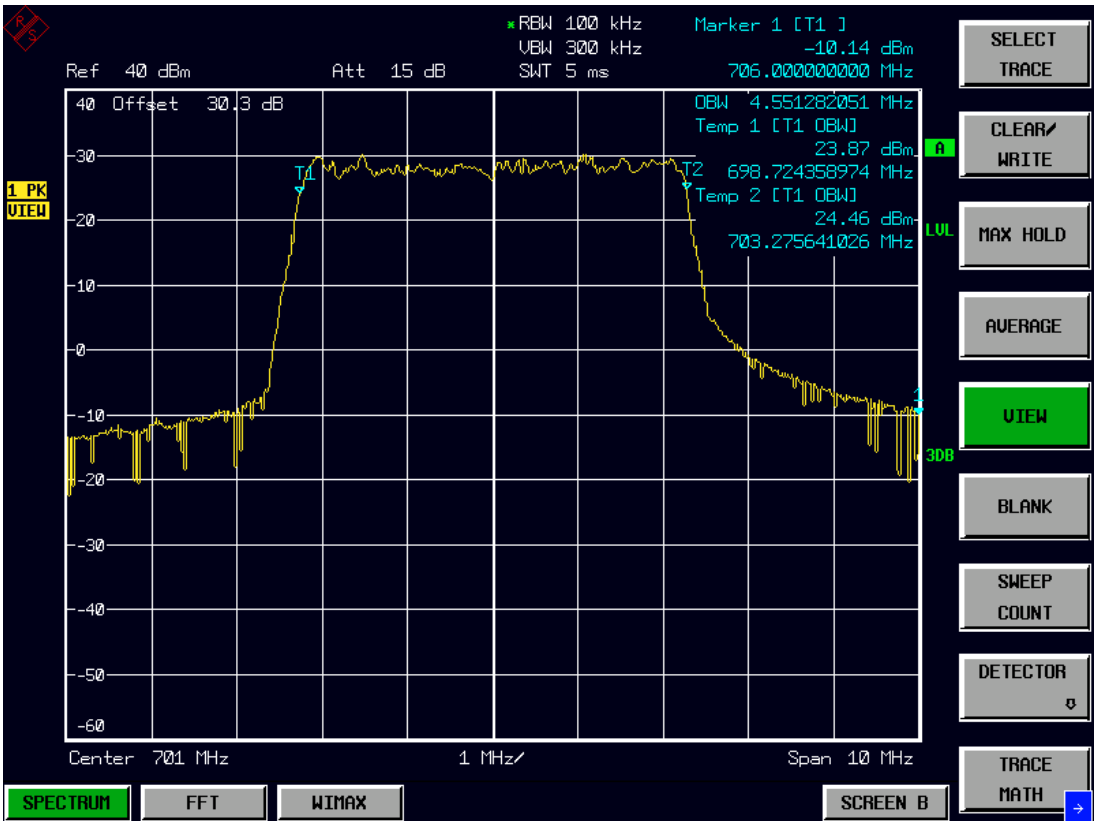

Figure 2: Occupied Bandwidth, 5MHz, 701.0 MHz, BPSK ½

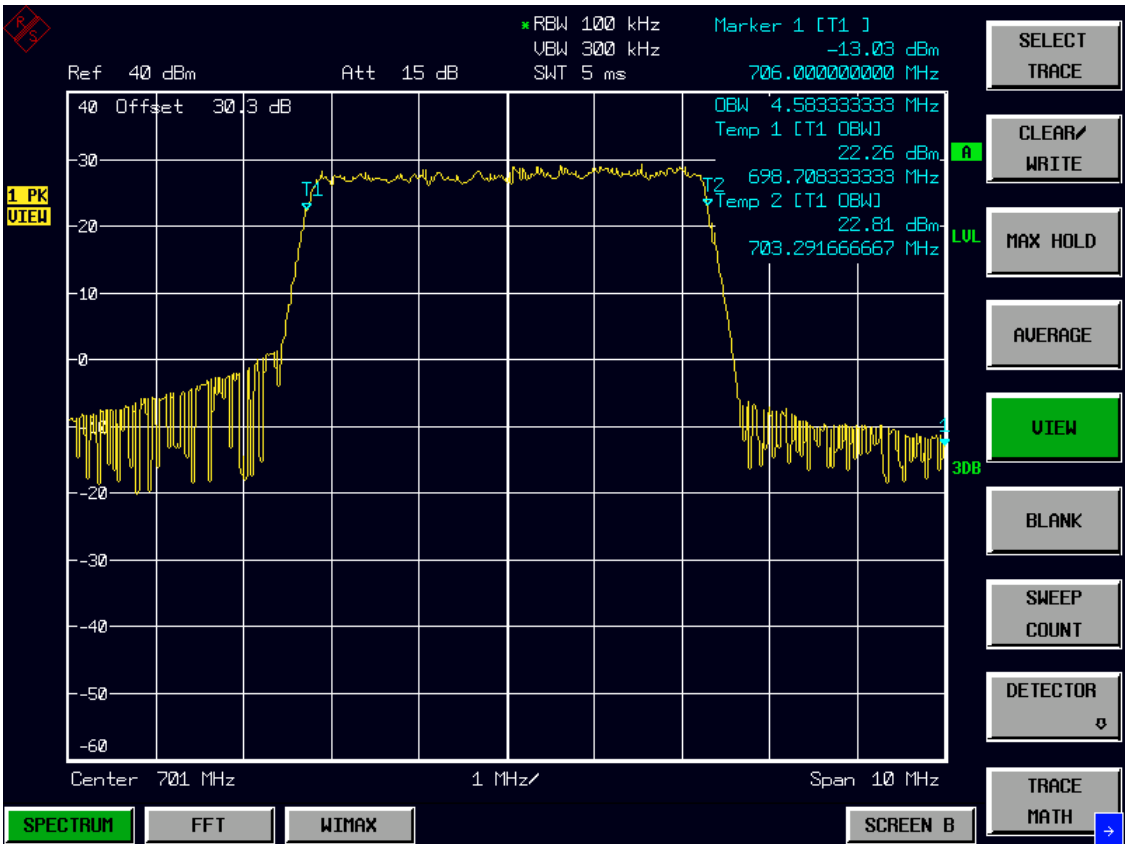

Figure 3: Occupied Bandwidth, 5MHz, 701.0 MHz, QPSK ¾

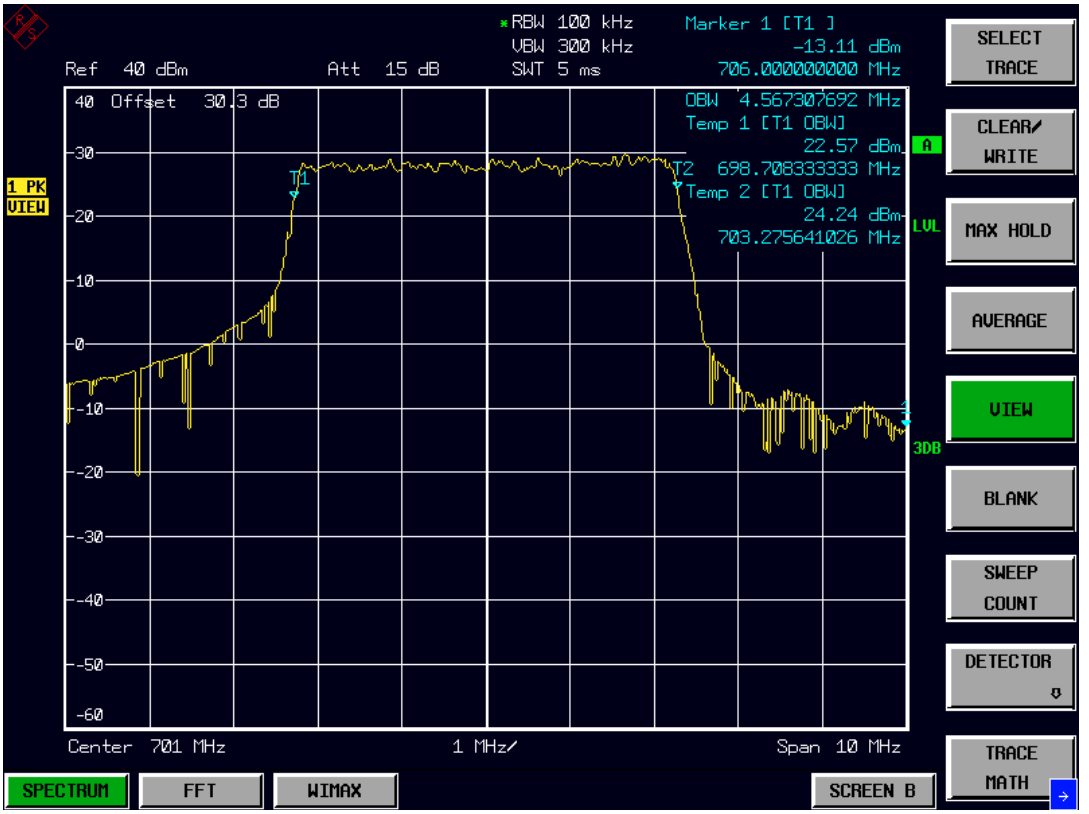

Figure 4: Occupied Bandwidth, 5MHz, 701.0 MHz, 16 QAM ¾

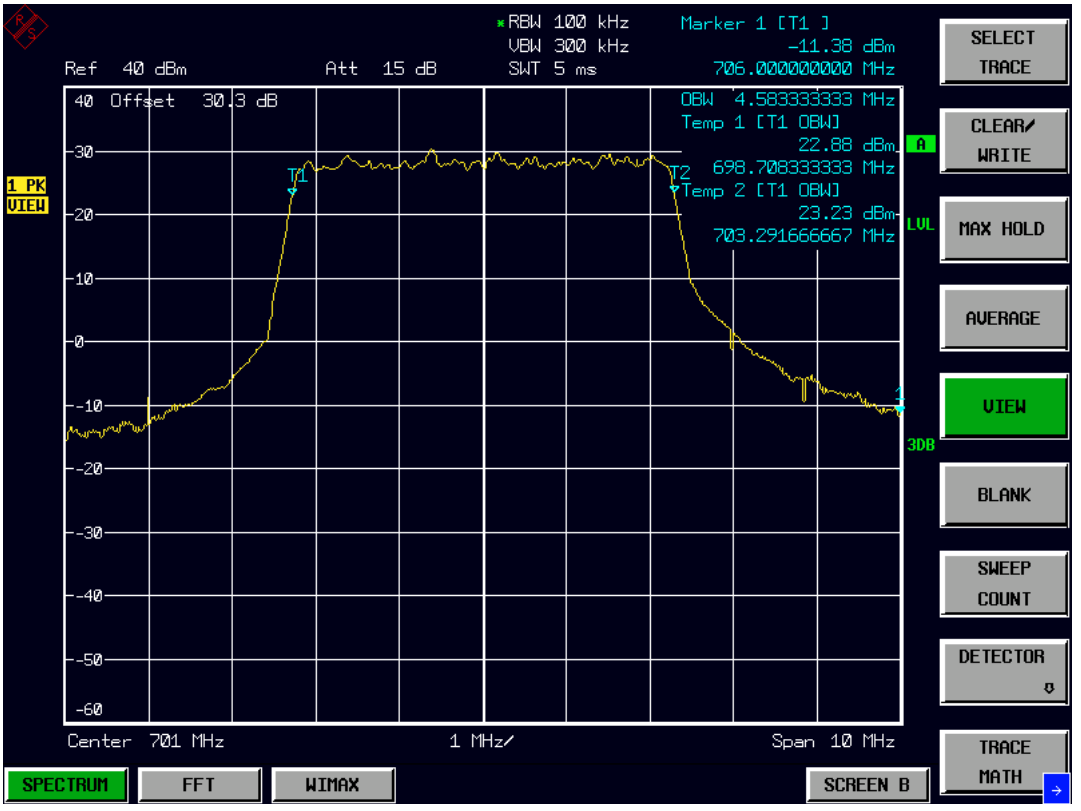

Figure 5: Occupied Bandwidth, 5MHz, 701.0 MHz, 64 QAM ¾

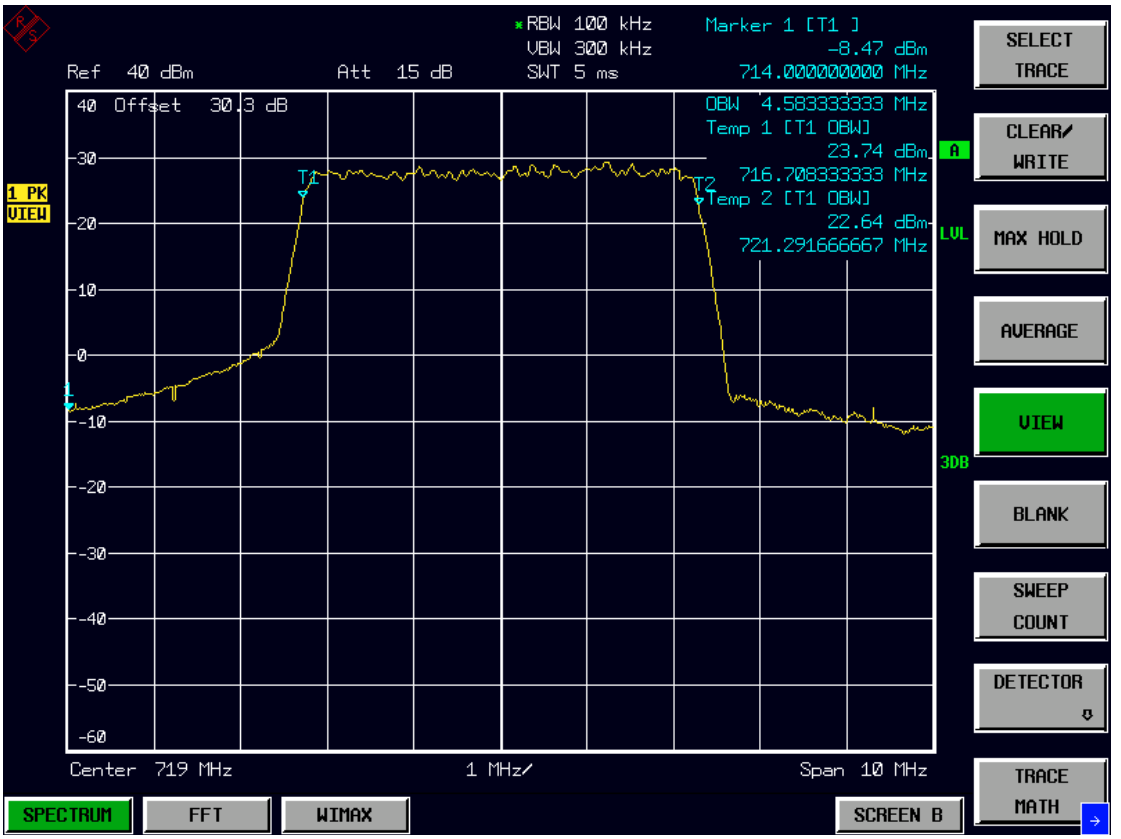

Figure 6: Occupied Bandwidth, 5MHz, 719.0 MHz, QPSK ¾

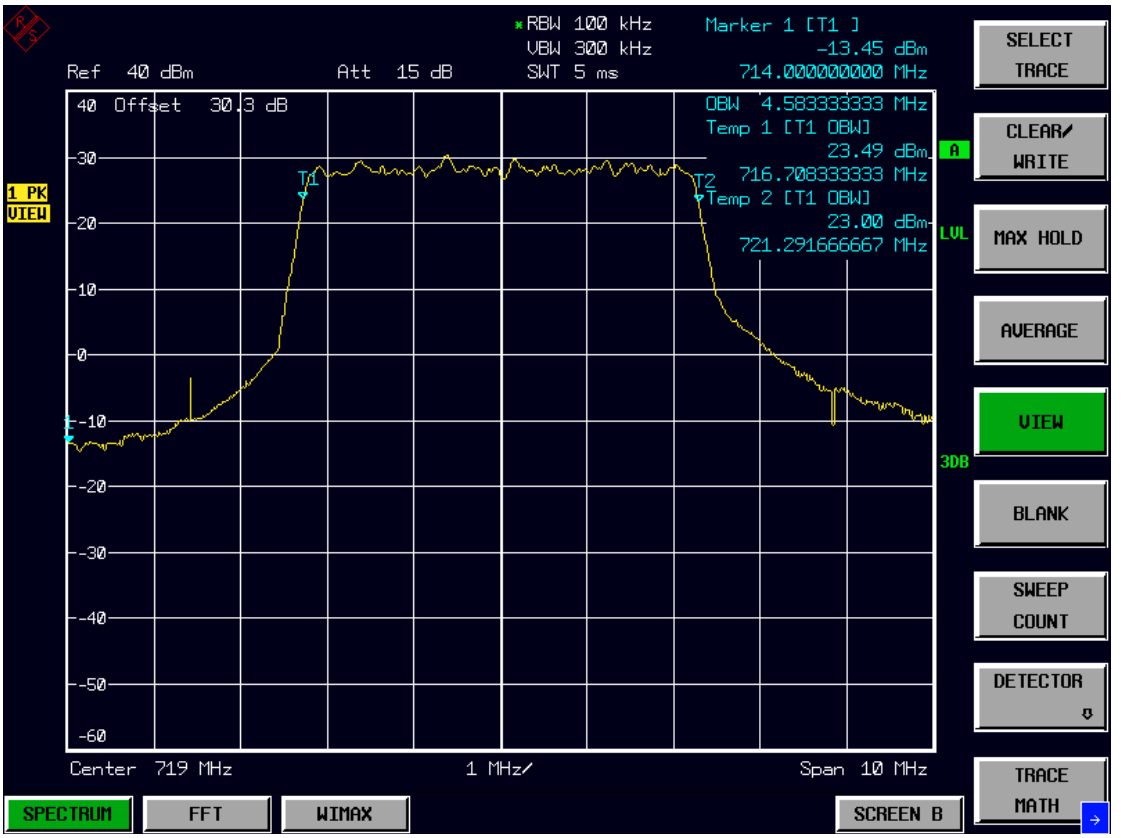

Figure 7: Occupied Bandwidth, 5MHz, 719.0 MHz, 64 QAM ¾

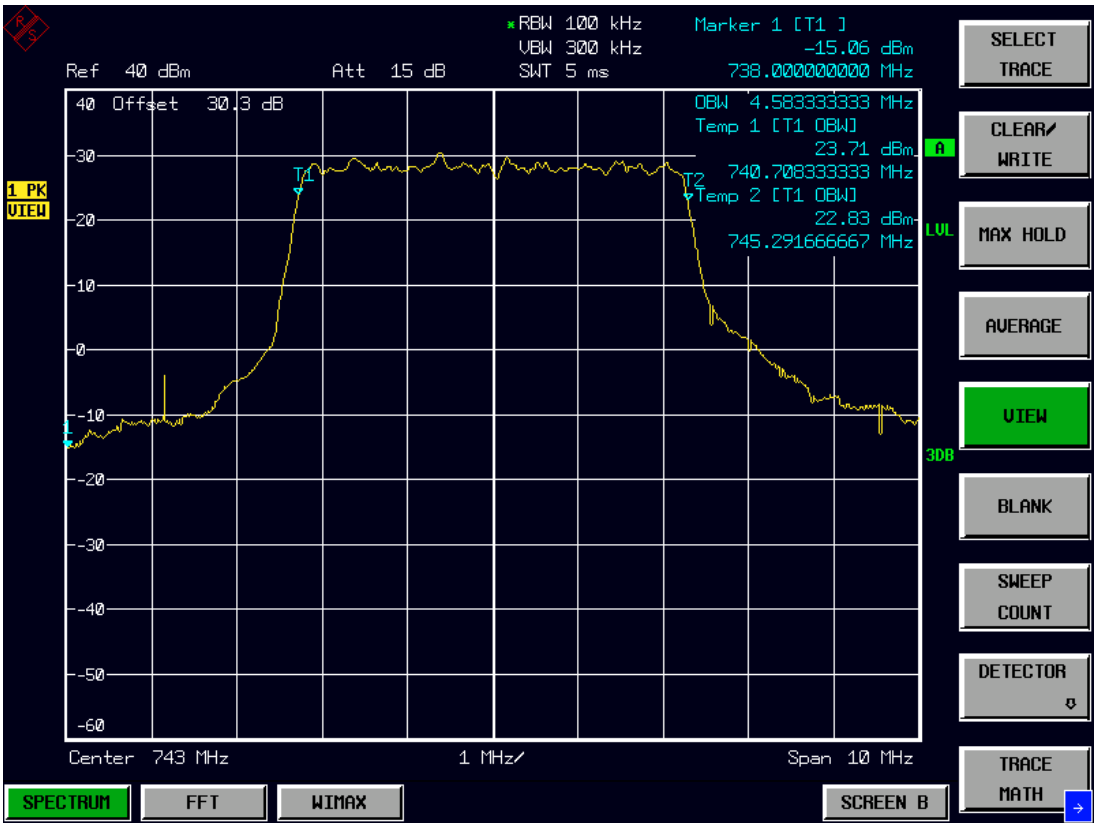

Figure 8: Occupied Bandwidth, 5MHz, 743.0 MHz, 64 QAM ¾

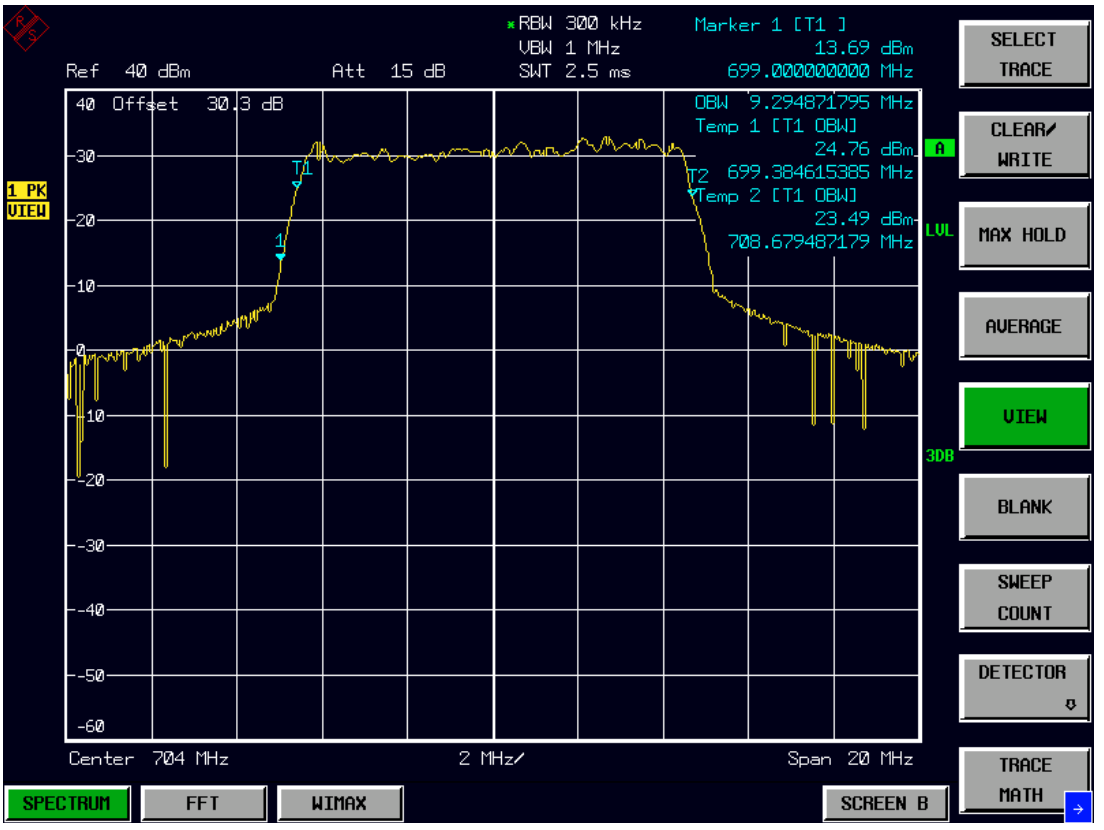

Figure 9: Occupied Bandwidth, 10MHz, 704.0 MHz, BPSK ½

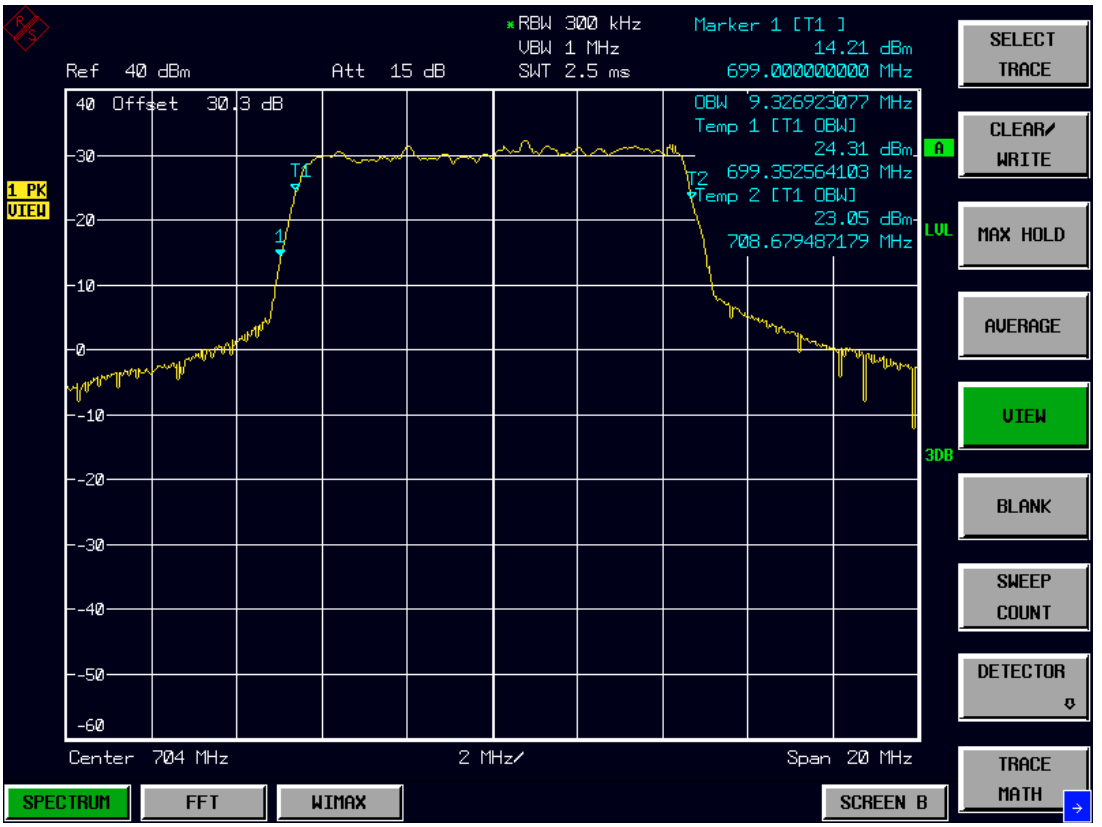

Figure 10: Occupied Bandwidth, 10MHz, 704.0 MHz, QPSK ¾

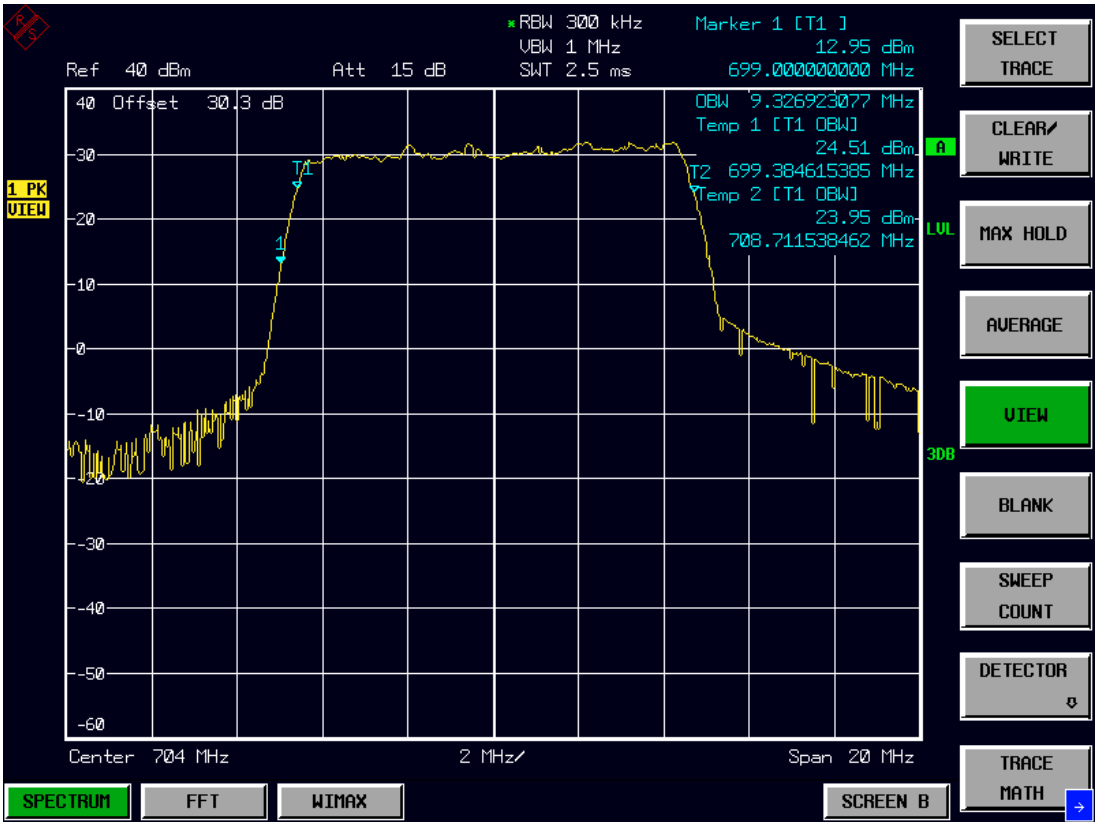

Figure 11: Occupied Bandwidth, 10MHz, 704.0 MHz, 16 QAM ¾

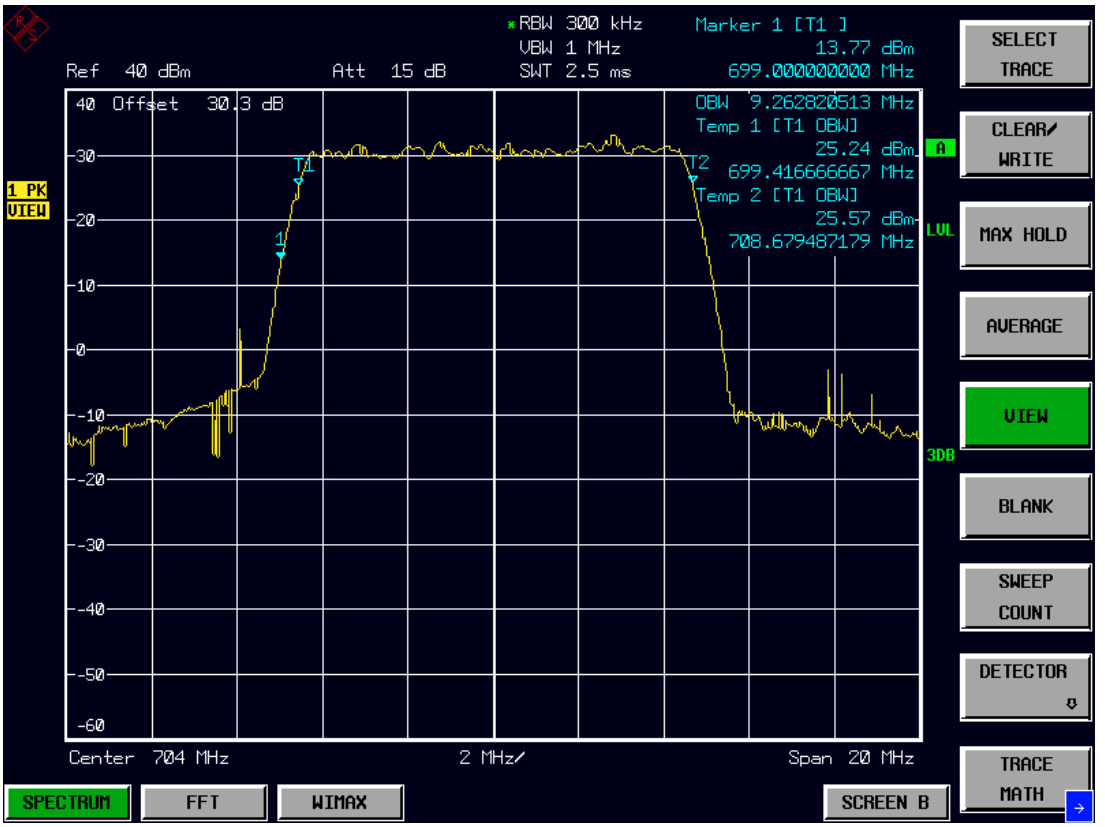

Figure 12: Occupied Bandwidth, 10MHz, 704.0 MHz, 64 QAM ¾

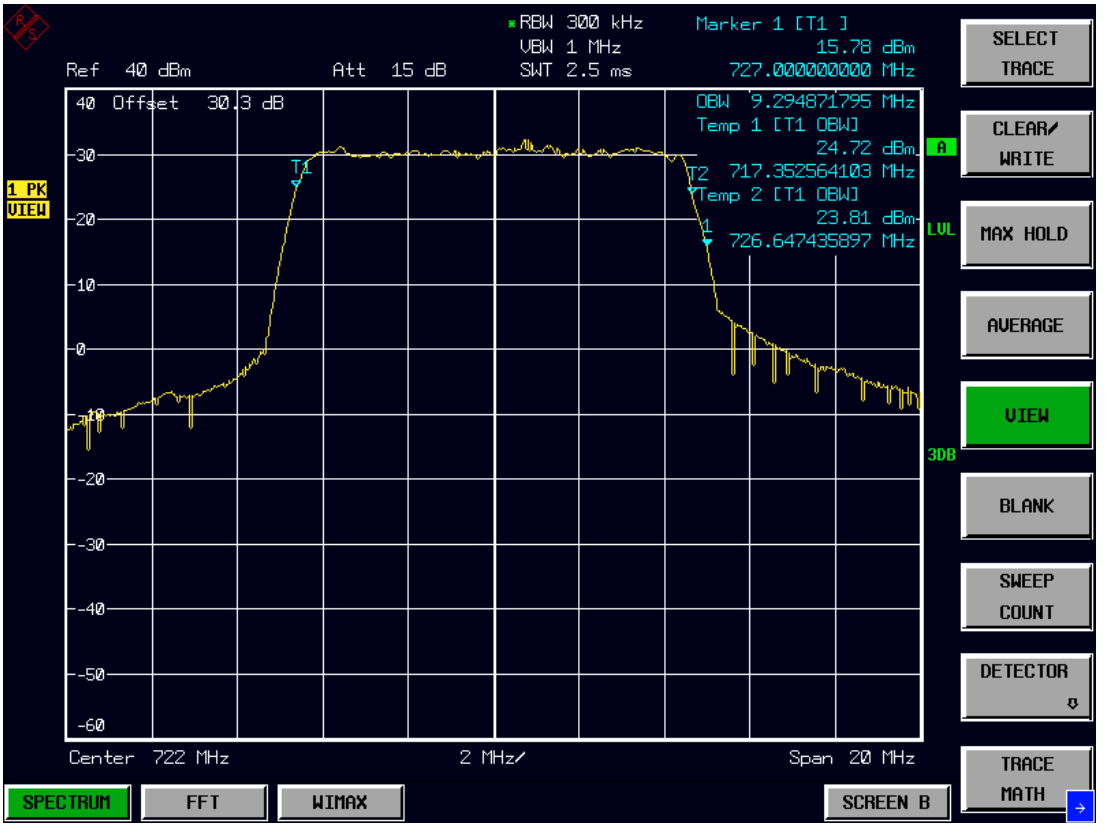

Figure 13: Occupied Bandwidth, 10MHz, 722.0 MHz, QPSK ¾

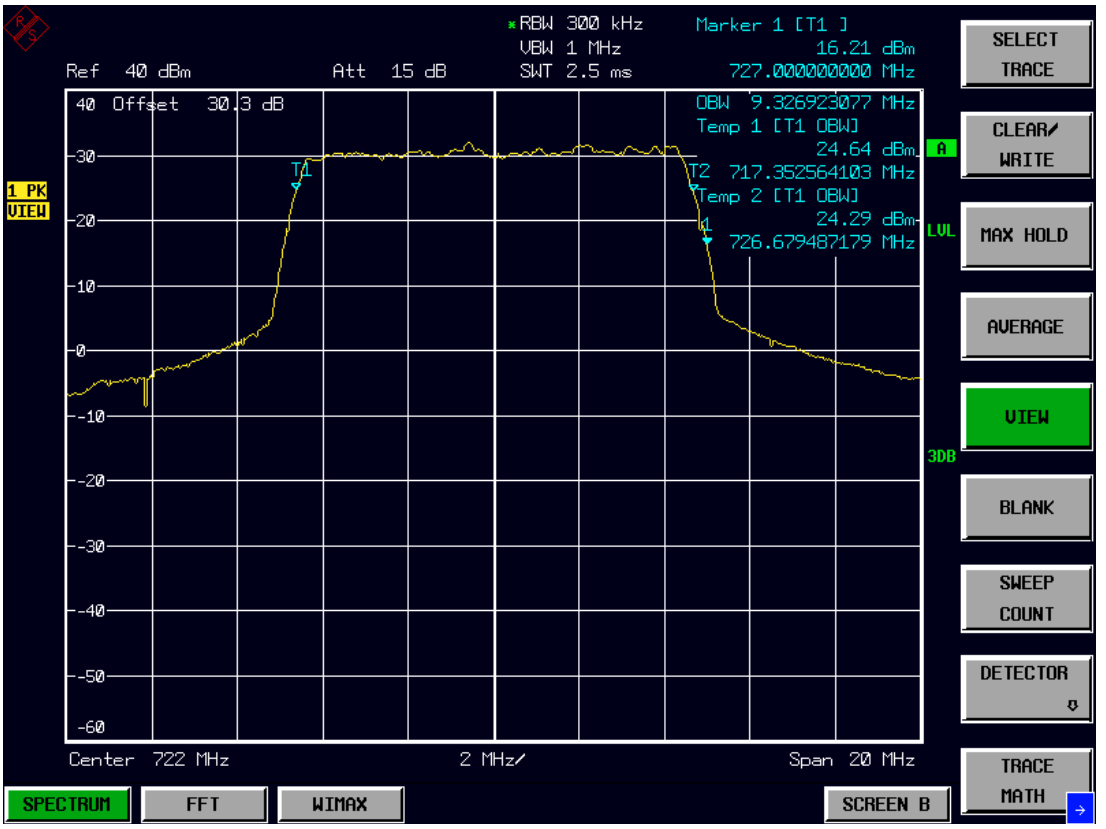

Figure 14: Occupied Bandwidth, 10MHz, 722.0 MHz, 16 QAM ¾

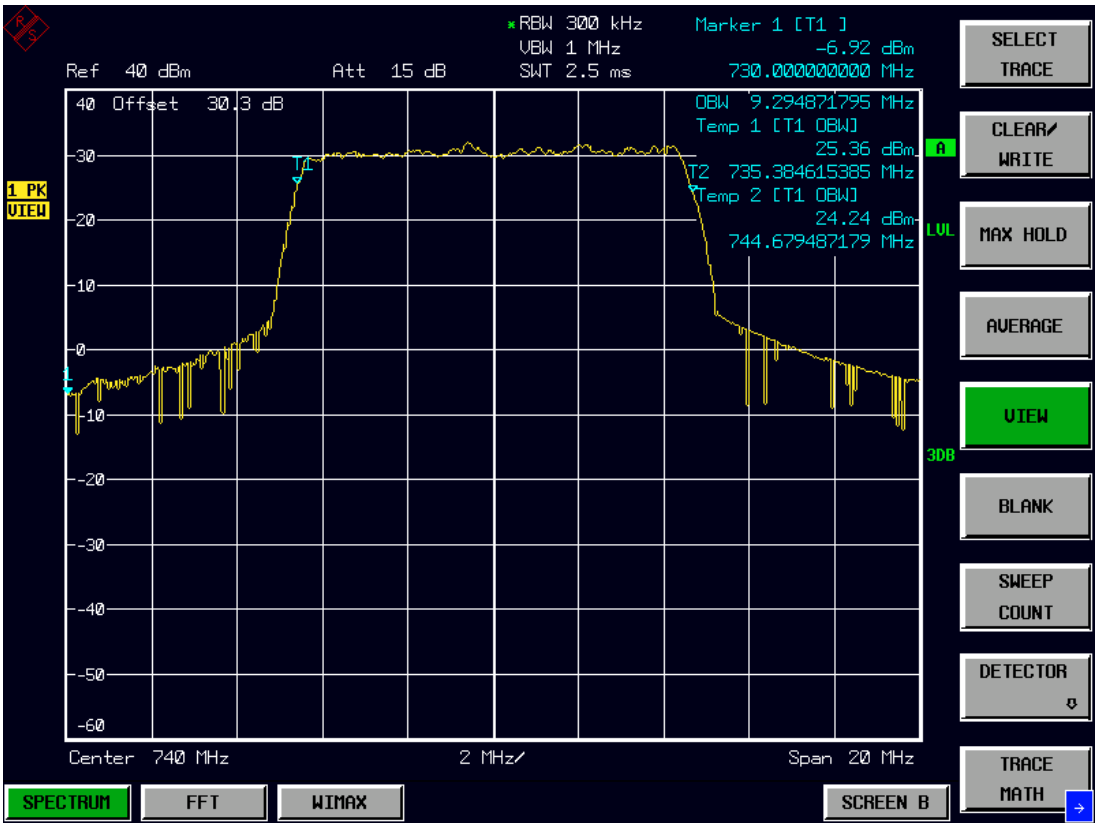

Figure 15: Occupied Bandwidth, 10MHz, 740.0 MHz, 16 QAM ¾

8 Transmit Power density 47CFR27.50(c)(3)

The equipment was configured as per figure 1 and the measurements made using the RMS detector of the FSQ.

An offset of 33.3 dB was used during the test by mistake instead of 30.3 dB. This is deducted in the table below.

TX power conducted is then converted to EIRP by adding 14.5dBi.

Channel	Bandwidth (MHz)	Frequency (MHz)	Modulation	TX power (dBm)	Corrected TX power (dBm)	EIRP (dBm)
Bottom	5	701.0	BPSK ½	30.1	27.1	41.6
			QPSK ¾	30.1	27.1	41.6
			16 QAM ¾	30.2	27.2	41.7
			64 QAM ¾	30.1	27.1	41.6
Middle	5	719.0	16 QAM ¾	30.2	27.2	41.7
Top	5	743.0	16 QAM ¾	30.2	27.2	41.7
Bottom	10	704.0	BPSK ½	27.4	24.4	38.9
			QPSK ¾	27.5	24.5	39
			16 QAM ¾	27.4	24.4	38.9
			64 QAM ¾	27.4	24.4	38.9
Middle	10	722.0	QPSK ¾	27.6	24.6	39.1
Top	10	740.0	QPSK ¾	26.9	23.9	38.4

Table 6: Transmit Power Density test results

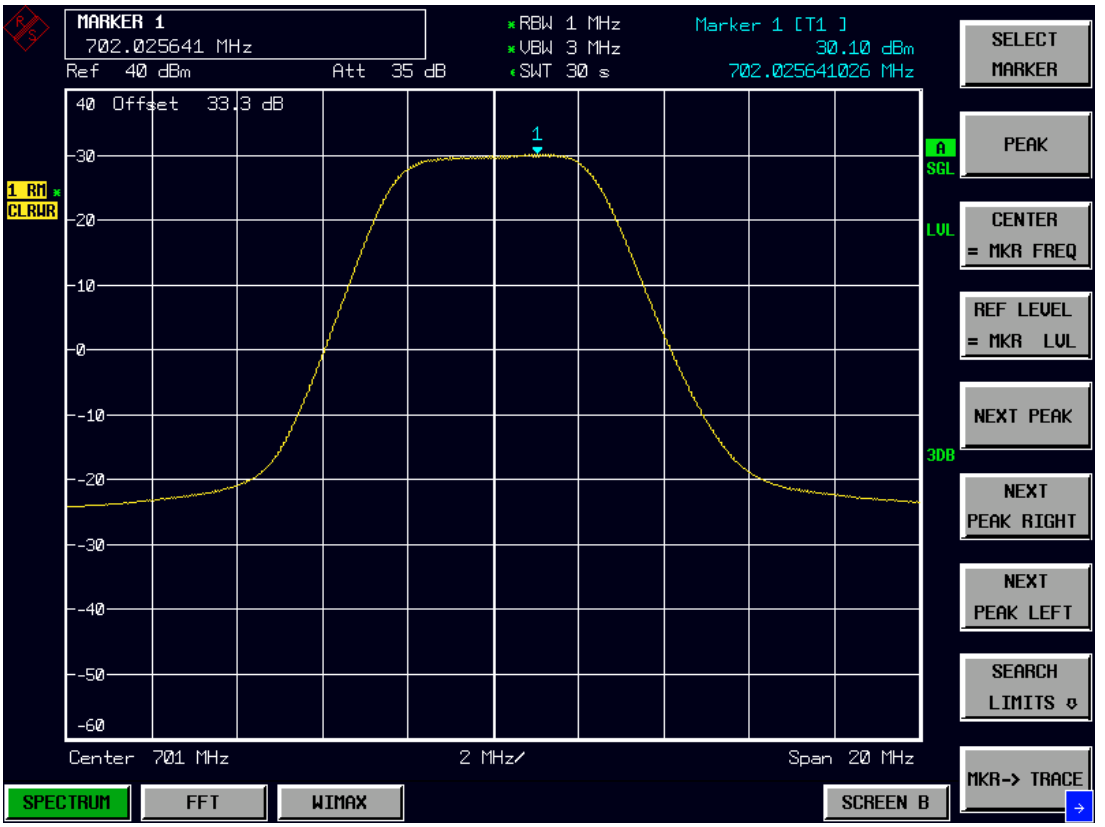

Figure 16: TX power density, 5MHz, 701.0 MHz, BPSK ½

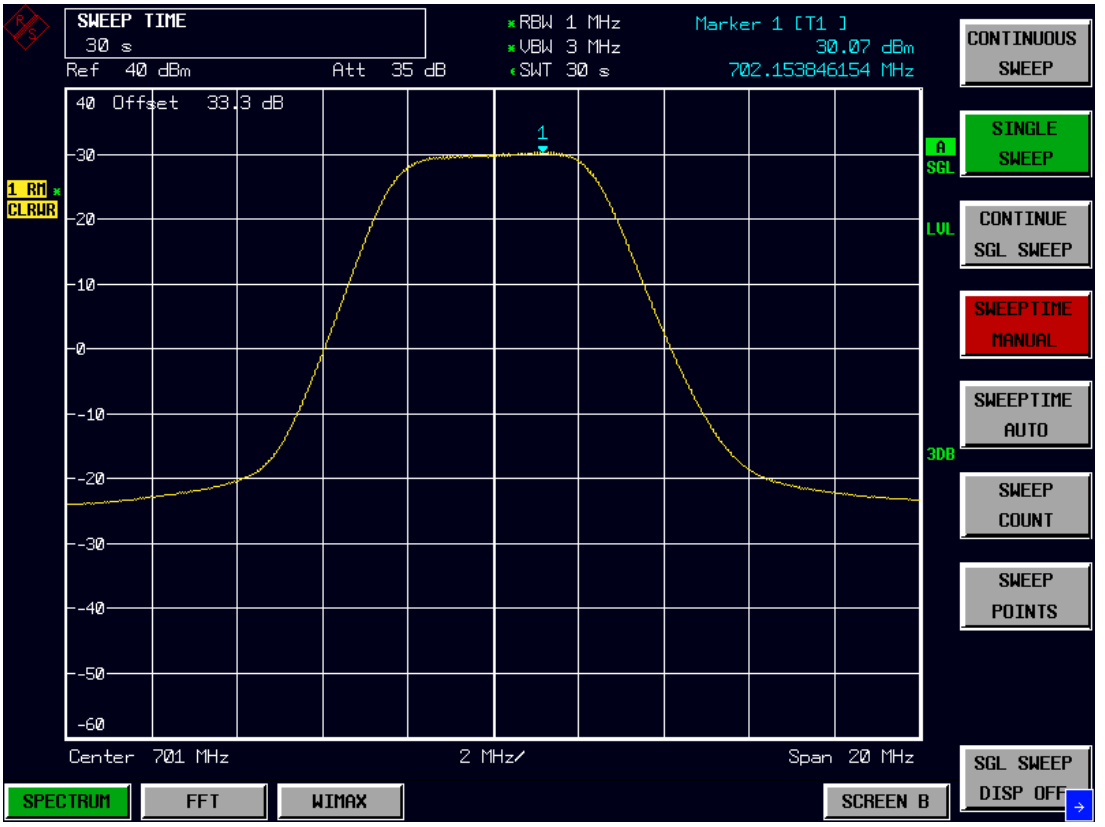

Figure 17: TX power density, 5MHz, 701.0 MHz, QPSK ¾

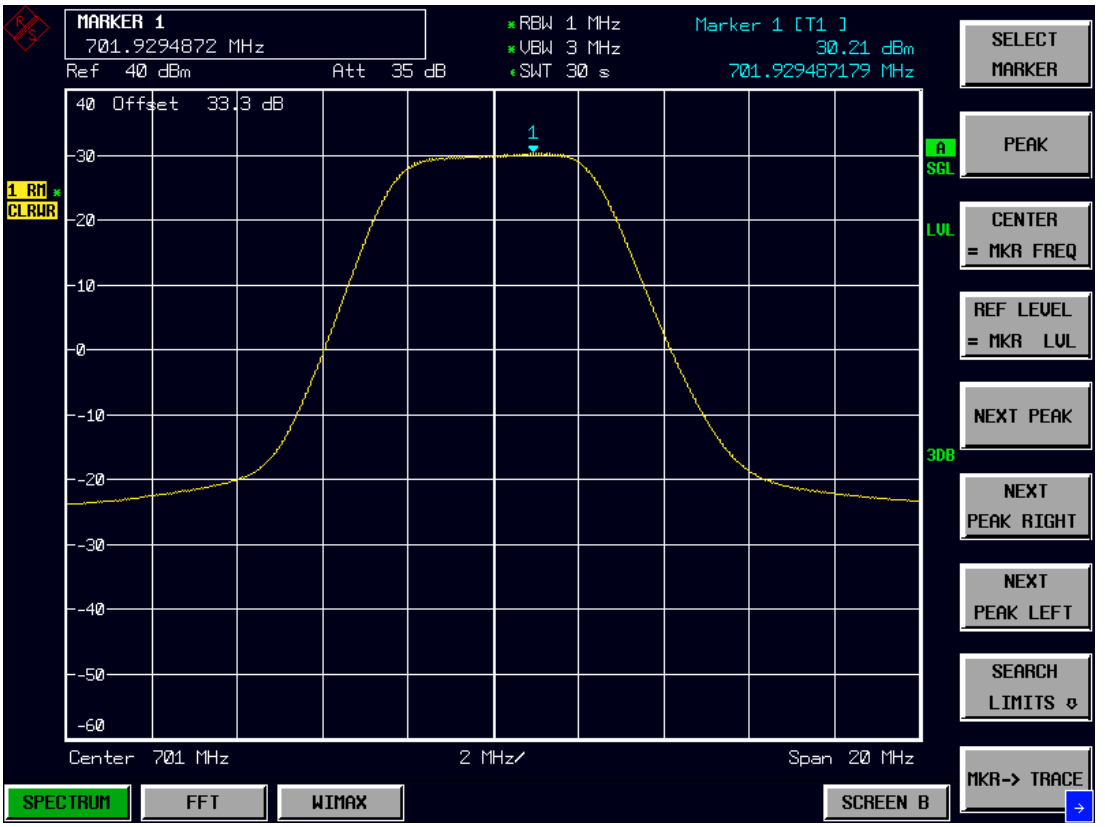

Figure 18: TX power density, 5 MHz, 701.0 MHz, 16 QAM ¾

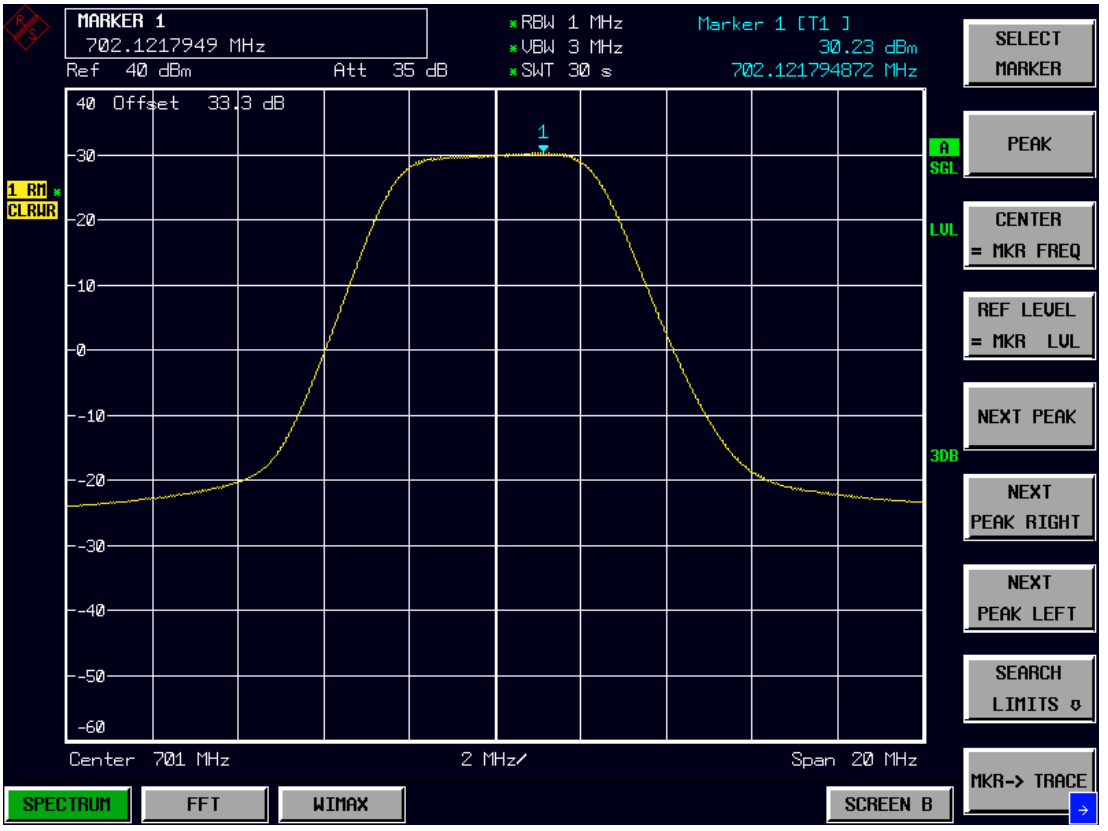

Figure 19: TX power density, 5 MHz, 701.0 MHz, 64 QAM ¾

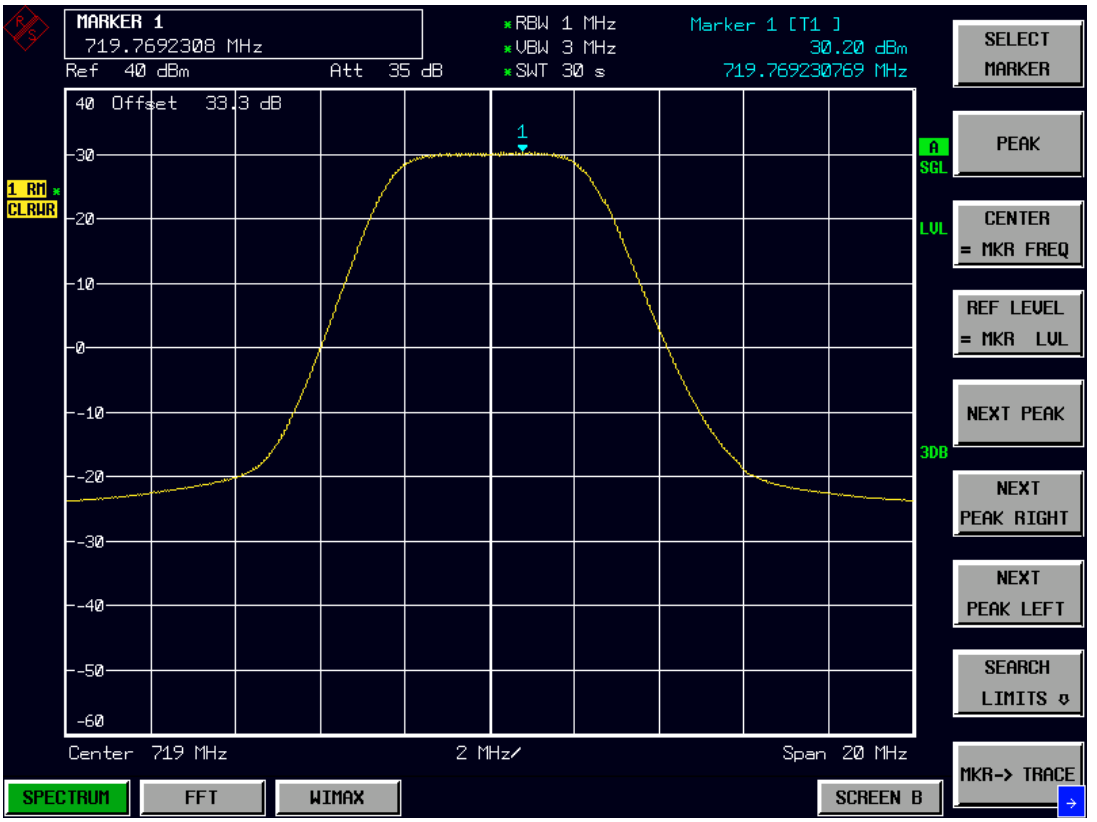

Figure 20: TX power density, 5MHz, 719.0 MHz, 16 QAM ¾

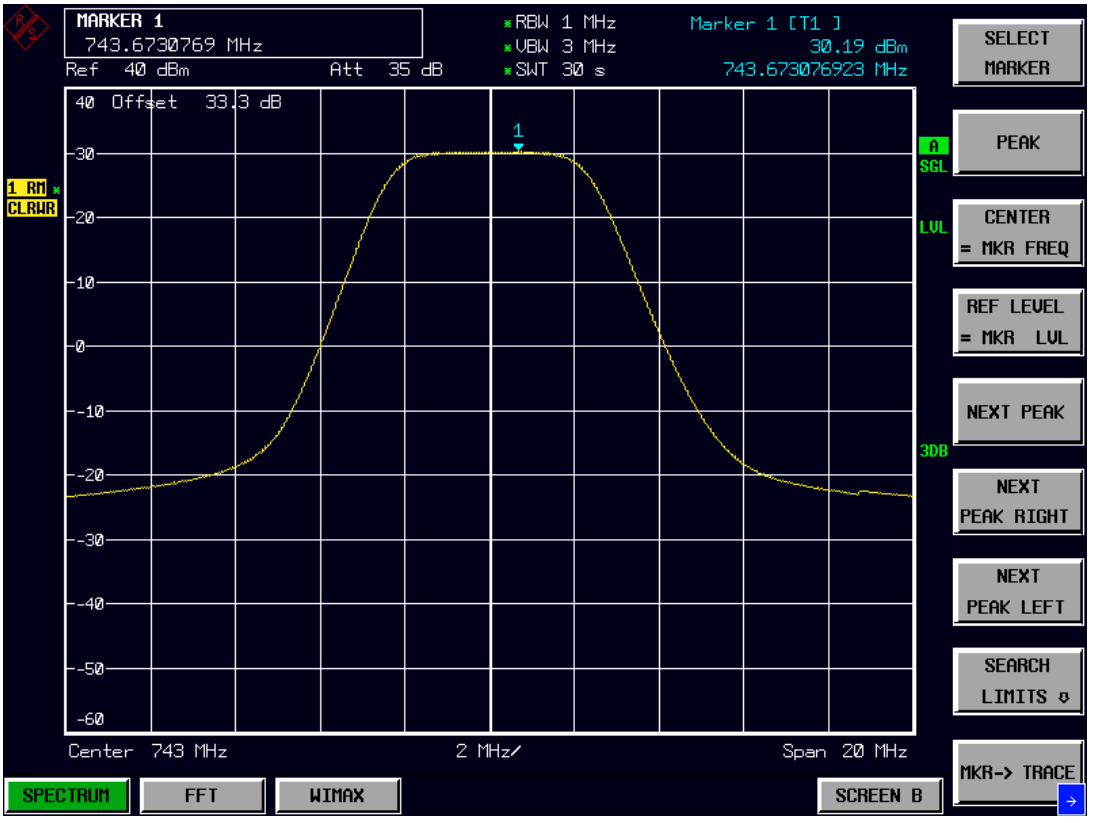

Figure 21: TX power density, 5MHz, 743.0 MHz, 16 QAM ¾

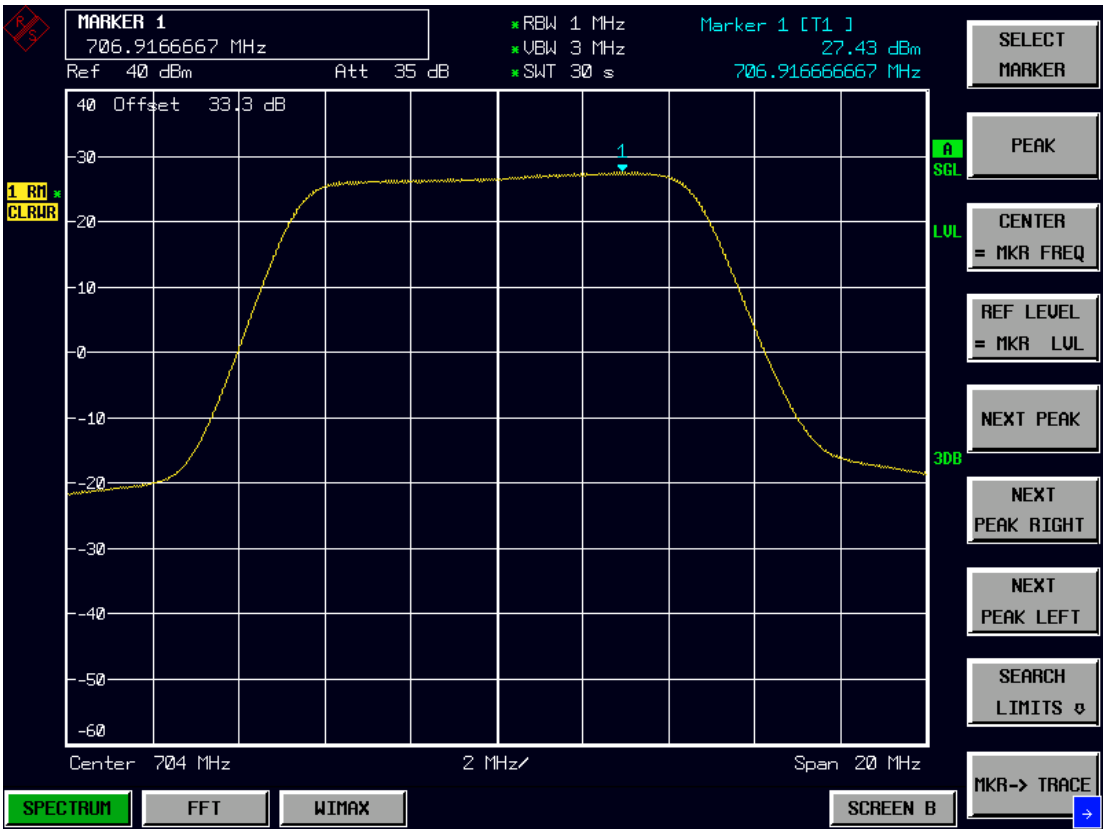

Figure 22: TX power density, 10MHz, 704.0 MHz, BPSK ½

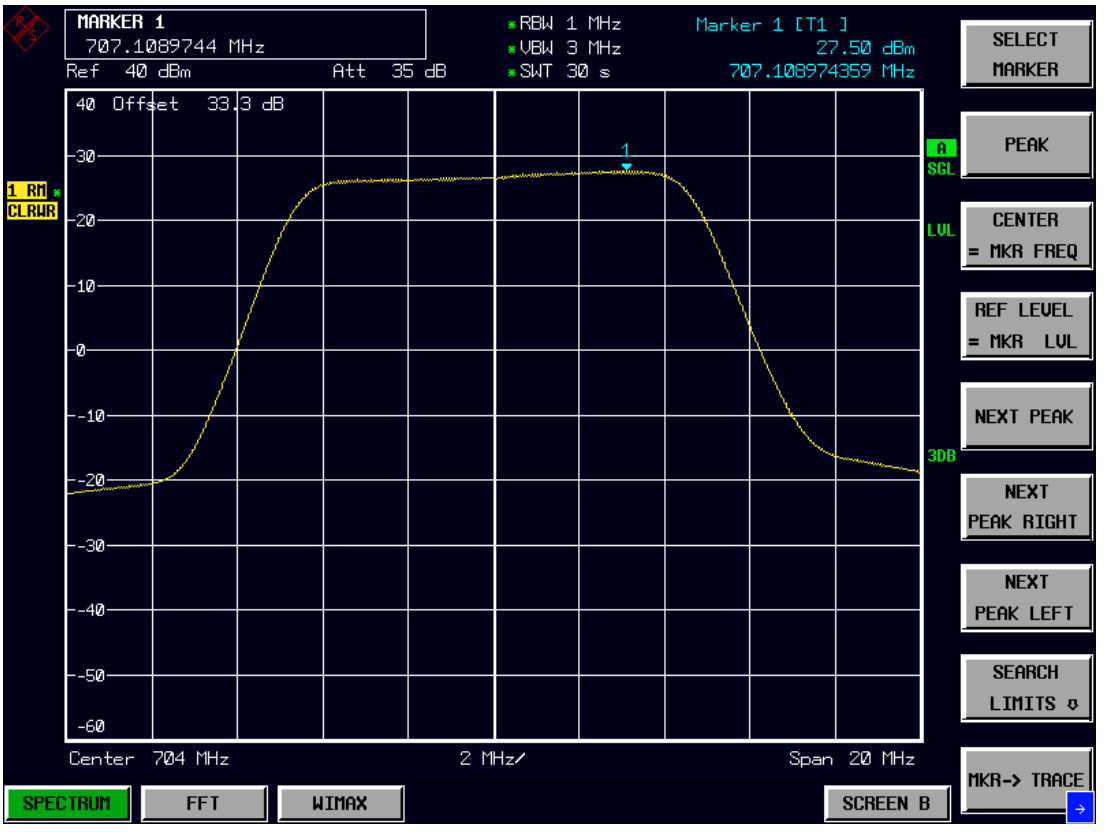

Figure 23: TX power density, 10MHz, 704.0 MHz, QPSK ¾

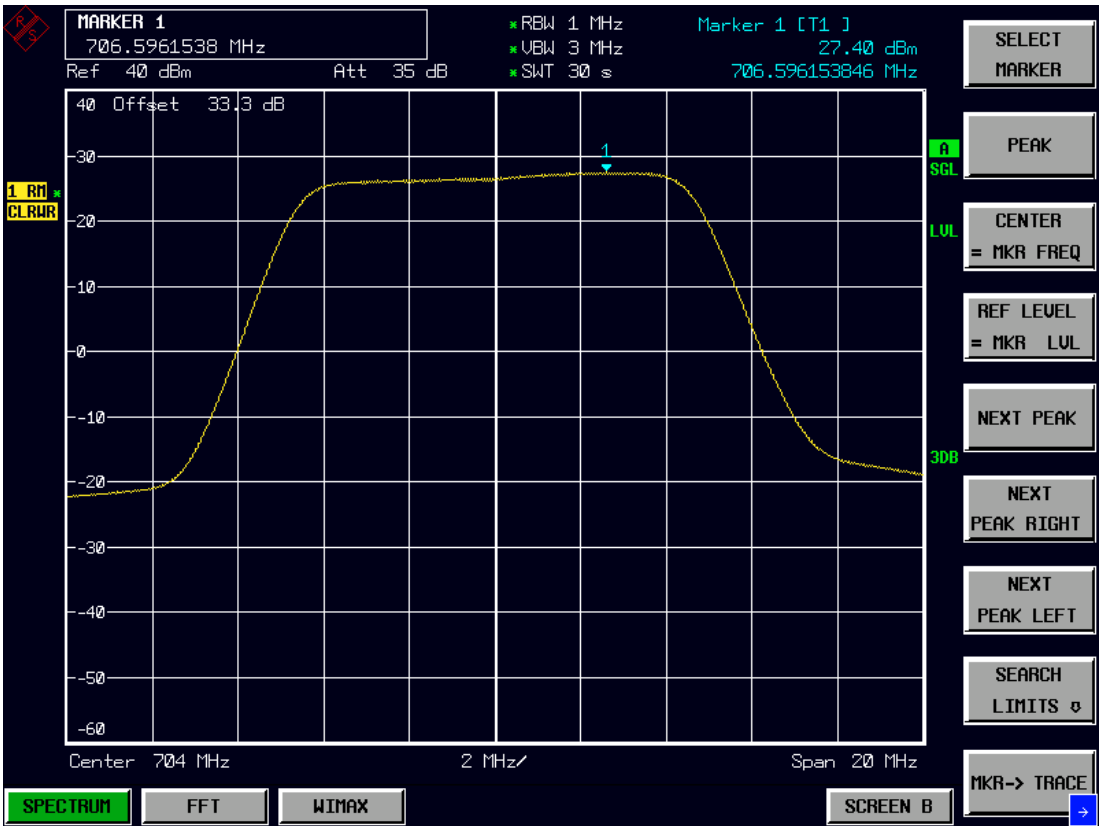

Figure 24: TX power density, 10MHz, 704.0 MHz, 16 QAM ¾

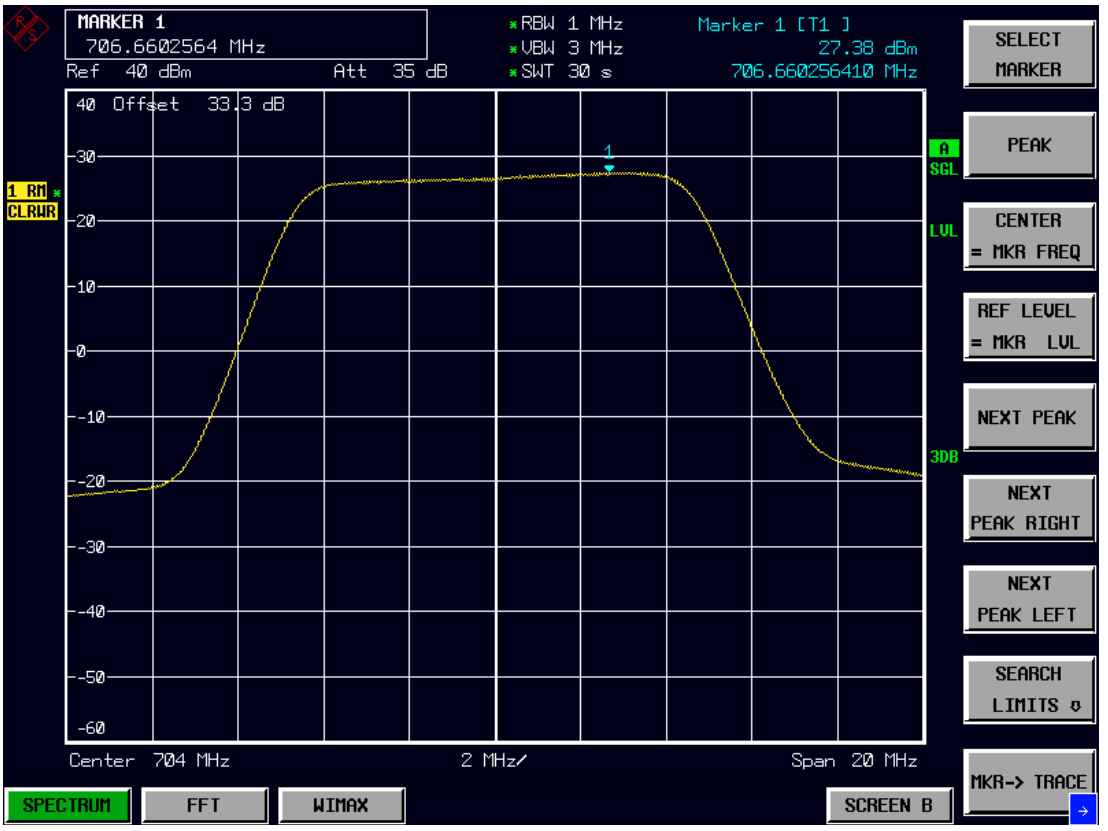

Figure 25: TX power density, 10MHz, 704.0 MHz, 64 QAM ¾

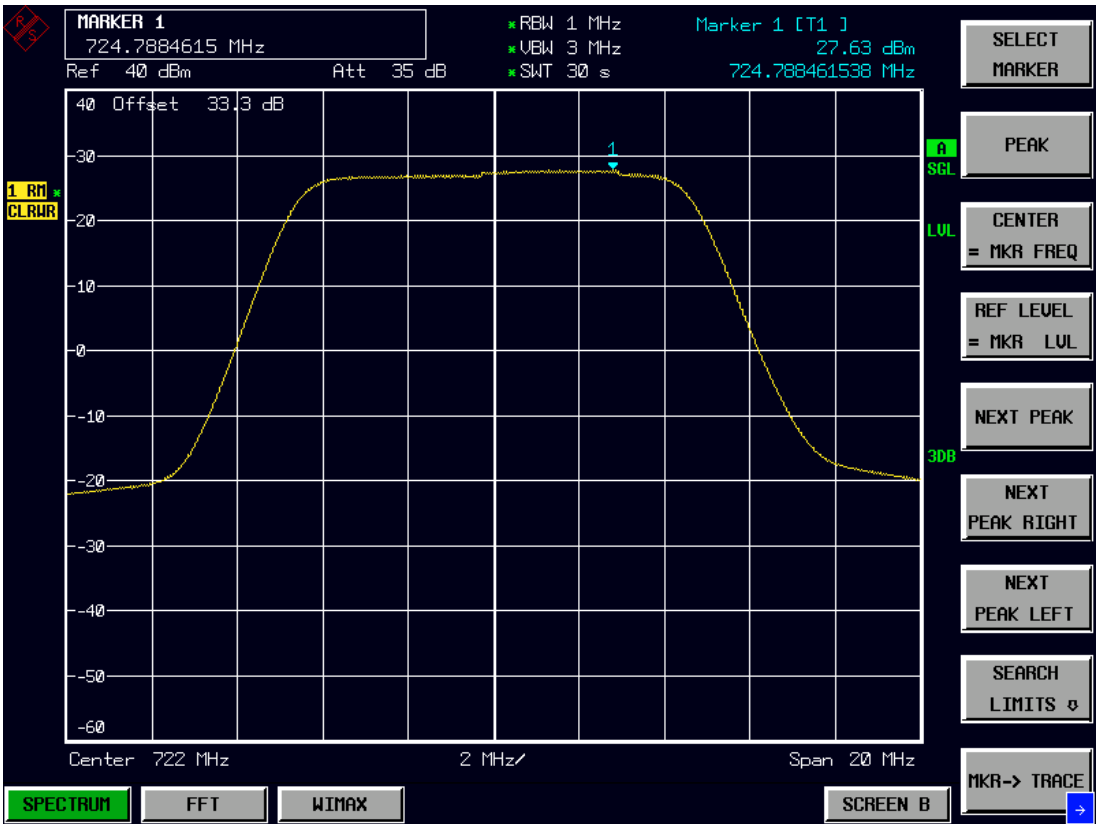

Figure 26: TX power density, 10MHz, 704.0 MHz, QPSK ¾

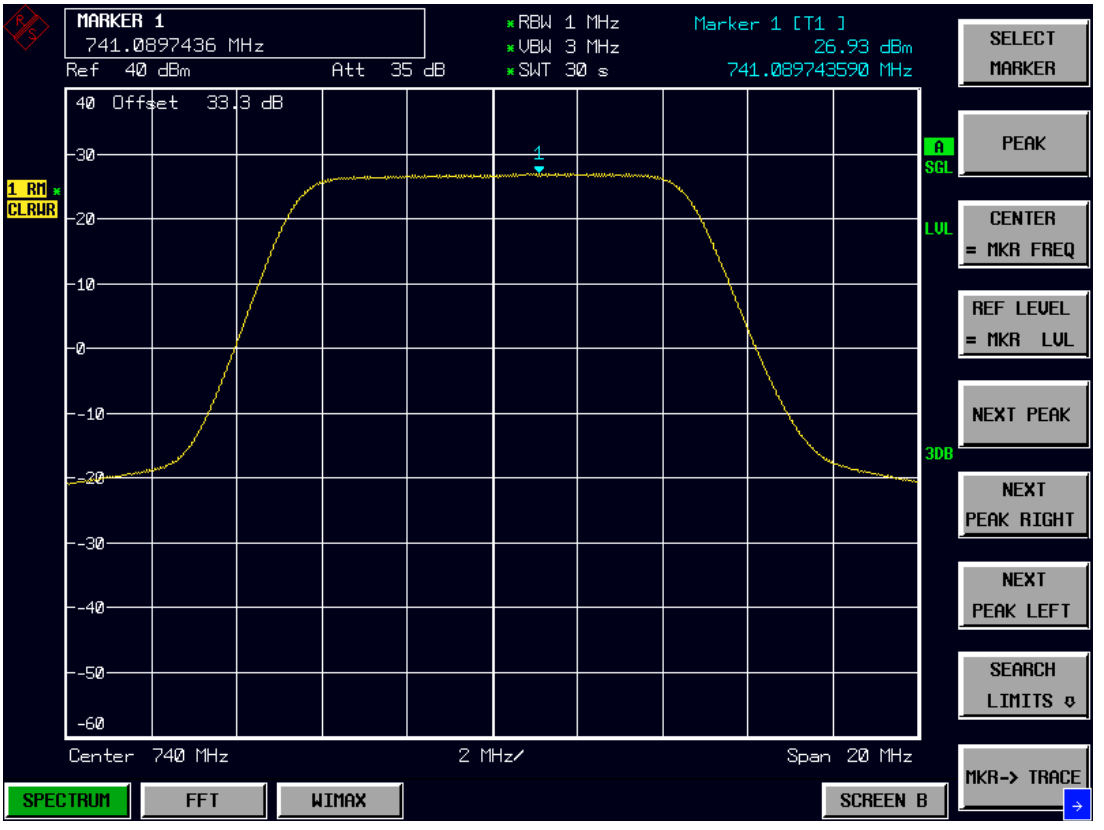

Figure 27: TX power density, 10MHz, 704.0 MHz, QPSK ¾

9 Transmit Burst Power

The equipment was configured as per figure 1 and the measurements made using the Burst Power detector of the FSQ8 operating in WiMAX mode.

Measurements were performed on bottom channel for each bandwidth, with the four modulation schemes under test. The worst case modulation scheme(s) for each bandwidth was then used for measurement on middle and top channels.

Measured antenna port was then converted to EIRP by adding 14.5dBi.

Channel	Bandwidth (MHz)	Frequency (MHz)	Modulation	TX power (dBm)	EIRP (dBm)
Bottom	5	701.0	BPSK ½	35.46	50.0
			QPSK ¾	35.46	50.0
			16 QAM ¾	35.44	49.9
			64 QAM ¾	35.39	49.9
Middle	5	719.0	QPSK ¾	35.54	50.0
Top	5	743.0	QPSK ¾	35.51	50.0
Bottom	10	704.0	BPSK ½	35.44	49.9
			QPSK ¾	35.35	49.9
			16 QAM ¾	35.32	49.8
			64 QAM ¾	35.32	49.8
Middle	10	722.0	QPSK ¾	35.34	49.8
Top	10	740.0	QPSK ¾	35.36	49.9

Table 7: Transmit Power Density test results

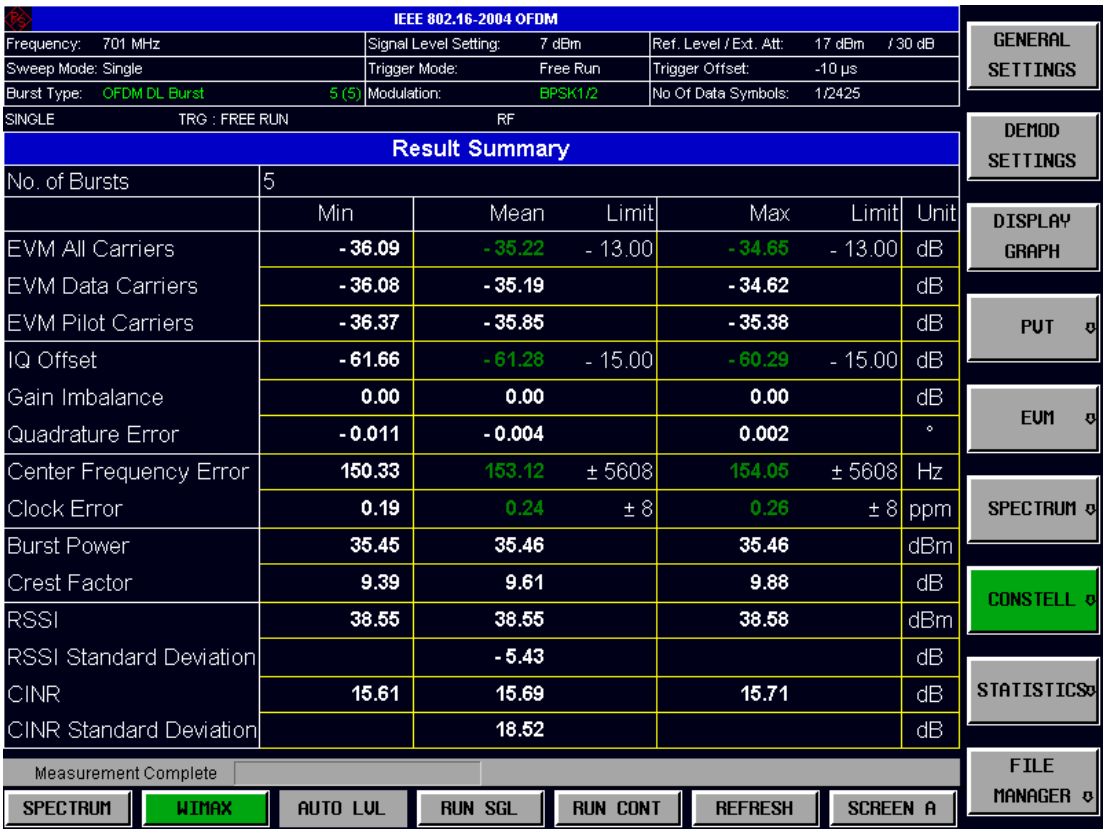

Figure 28: TX burst power, 5MHz, 701.0 MHz, BPSK ½

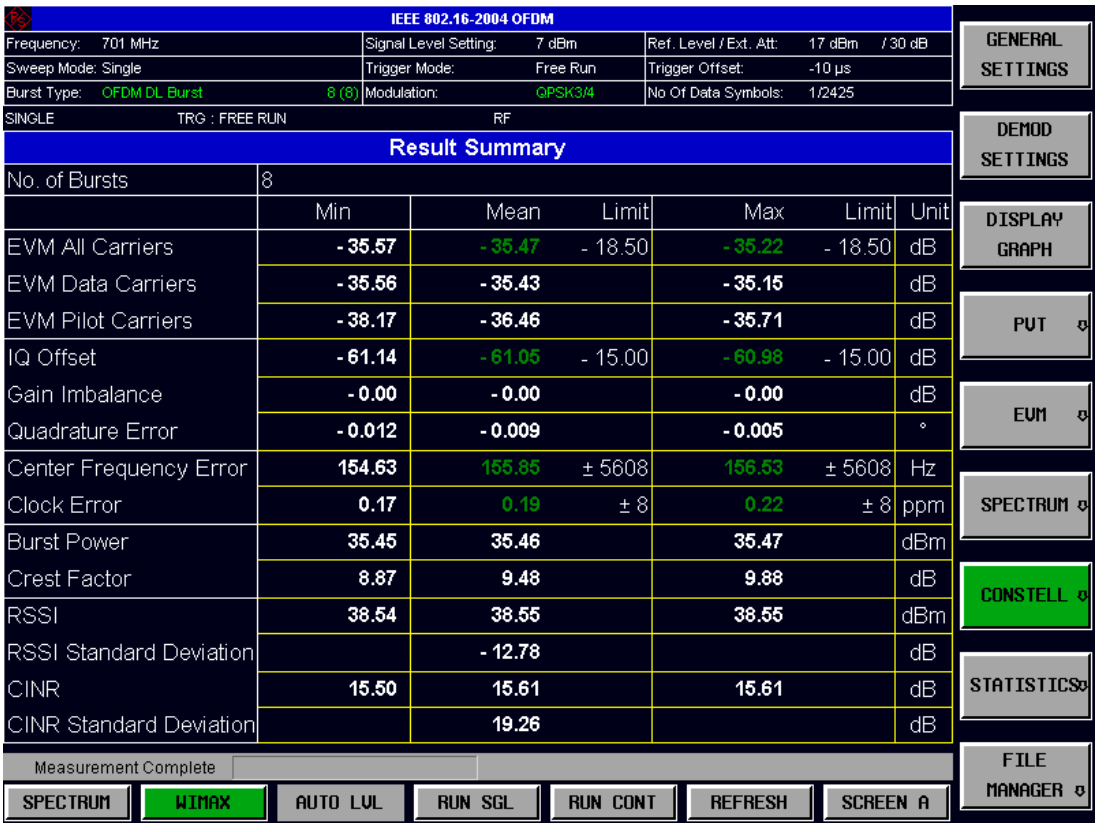

Figure 29: TX Burst Power, 5MHz, 701.0 MHz, QPSK ¾

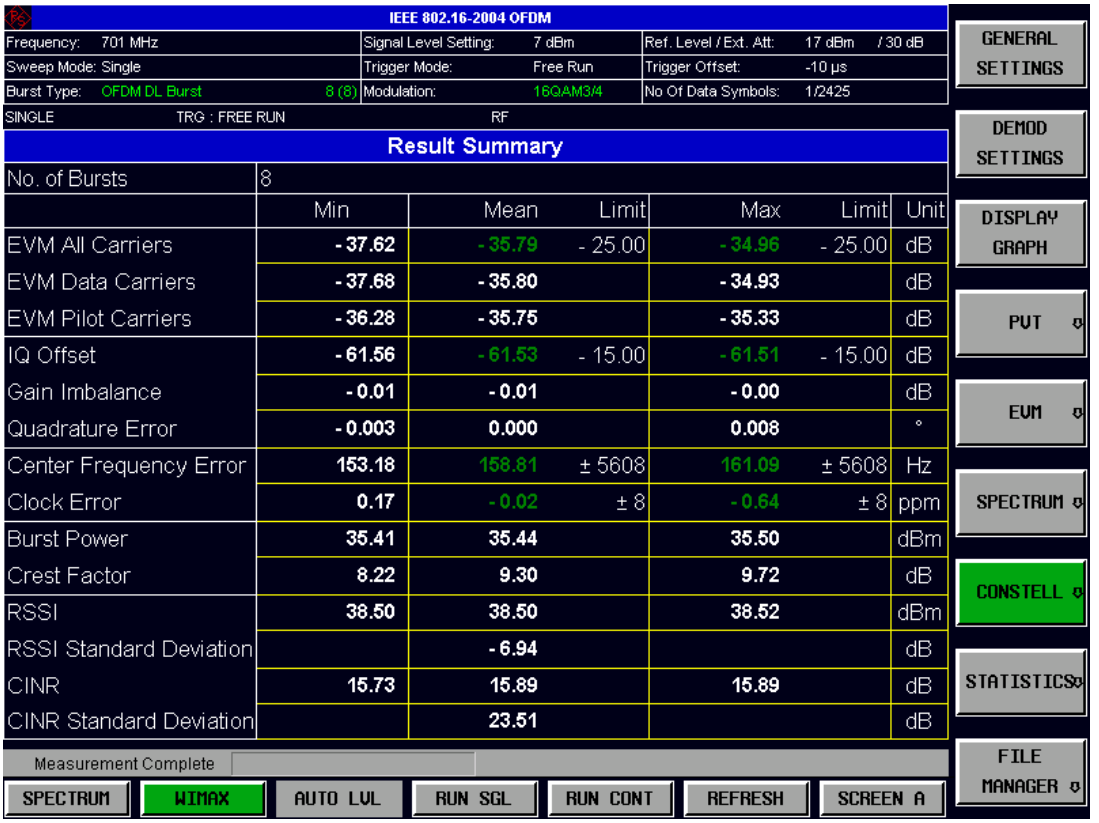

Figure 30: TX Burst Power, 5MHz, 701.0 MHz, 16 QAM ¾

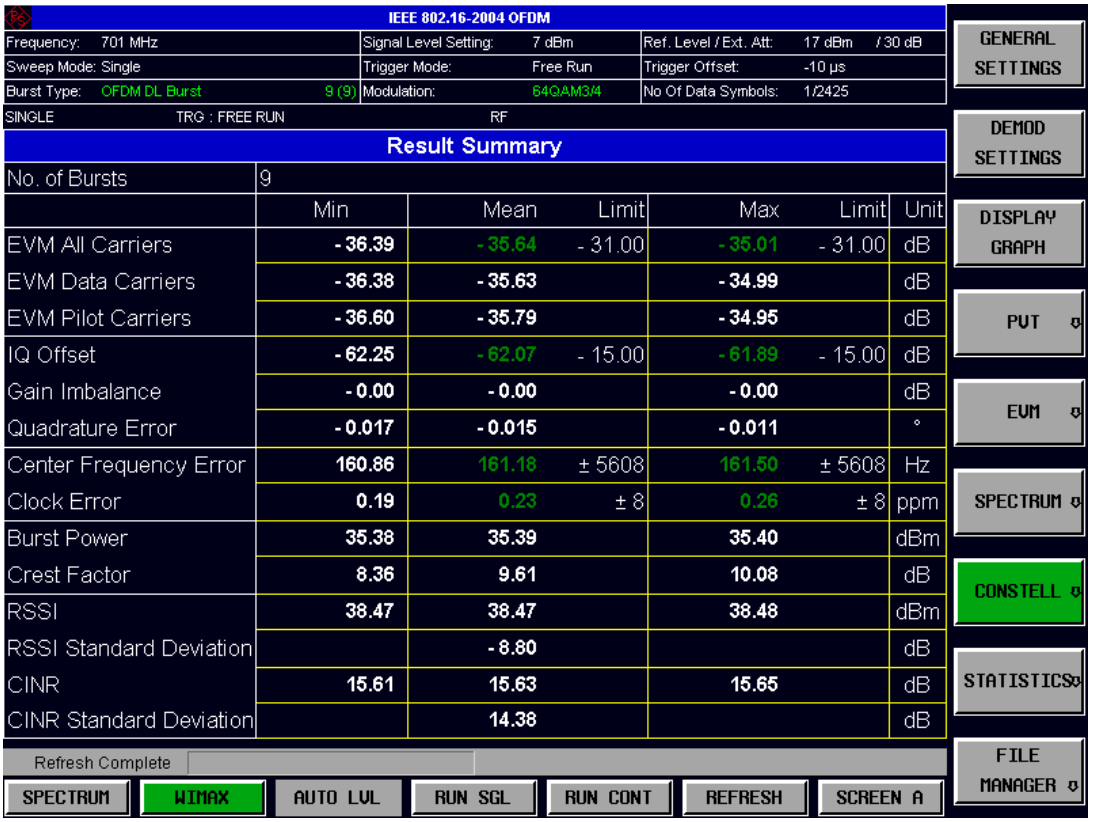

Figure 31: TX Burst Power, 5MHz, 701.0 MHz, 64 QAM ¾

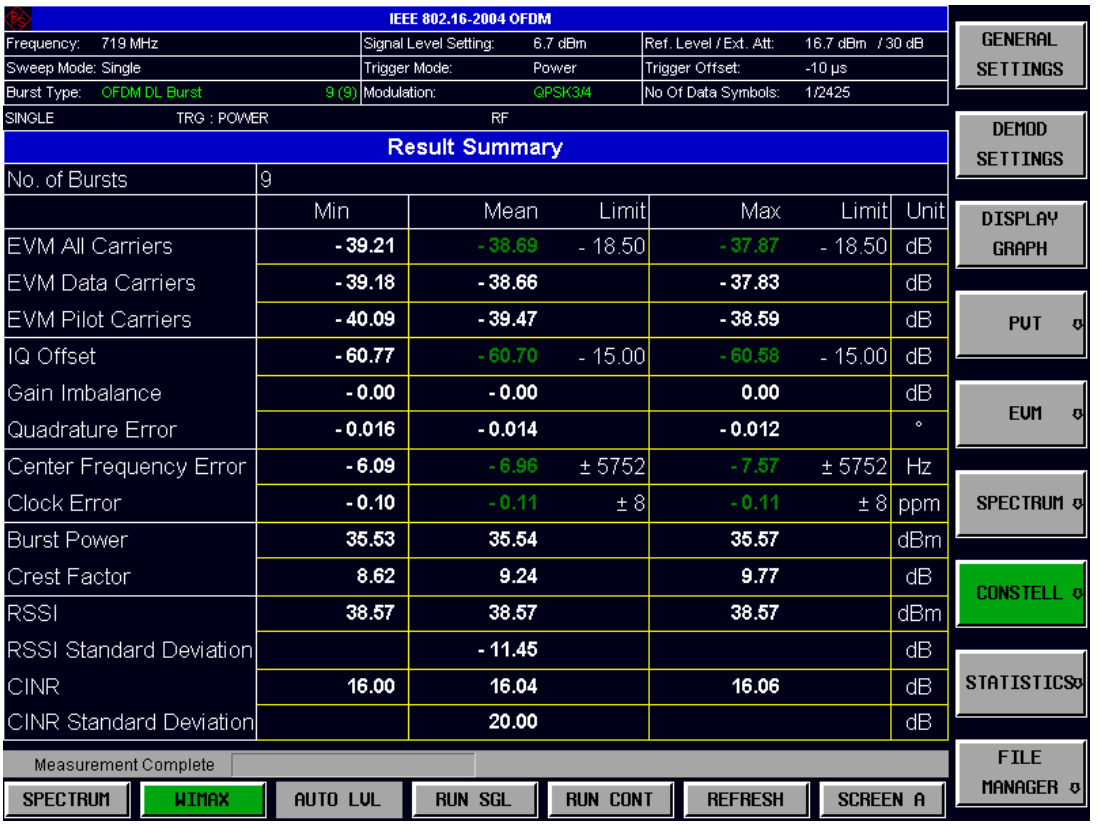

Figure 32: TX Burst Power, 5MHz, 719.0 MHz, QPSK ¾

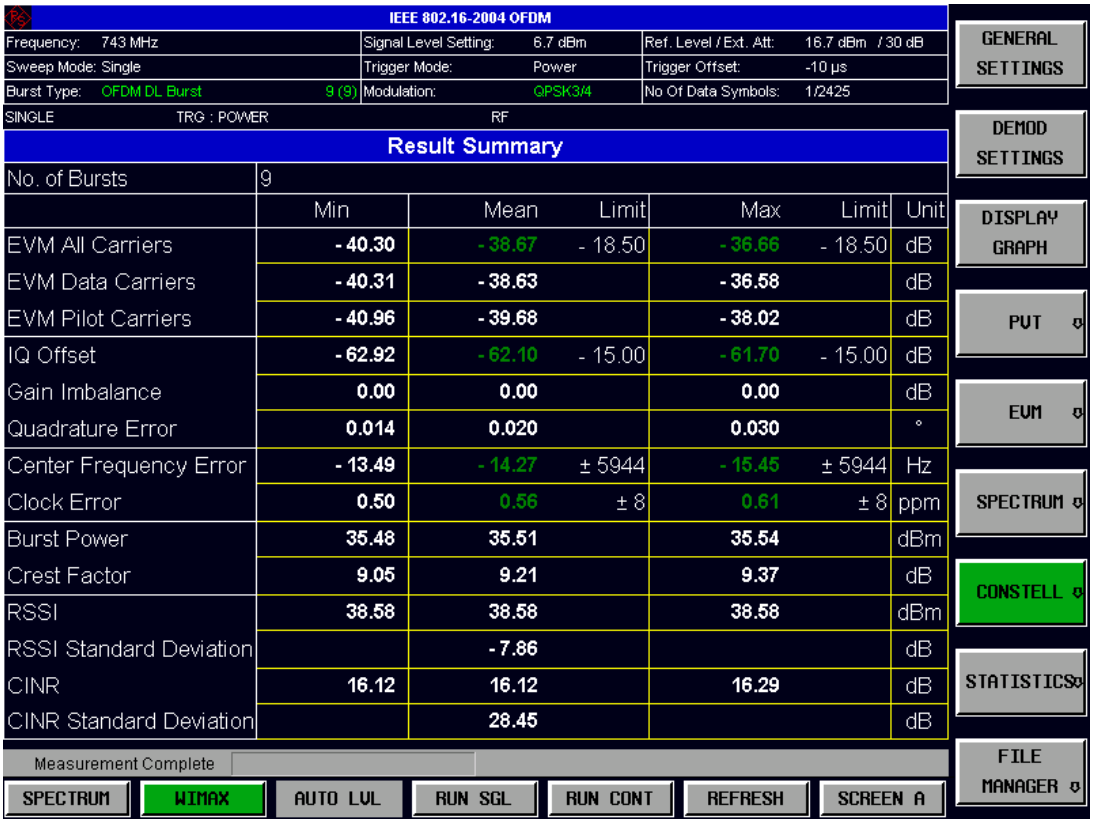

Figure 33: TX Burst Power, 5MHz, 743.0 MHz, QPSK ¾

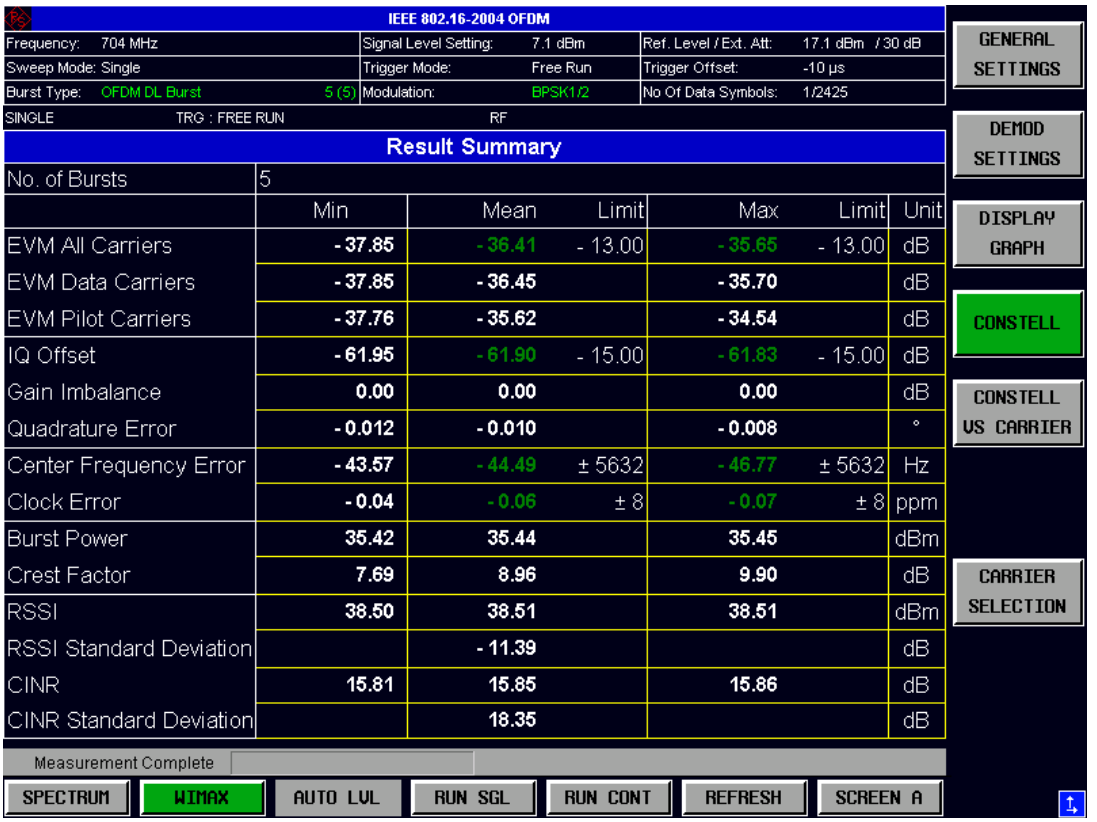

Figure 34: TX Burst Power, 10MHz, 704.0 MHz, BPSK ½

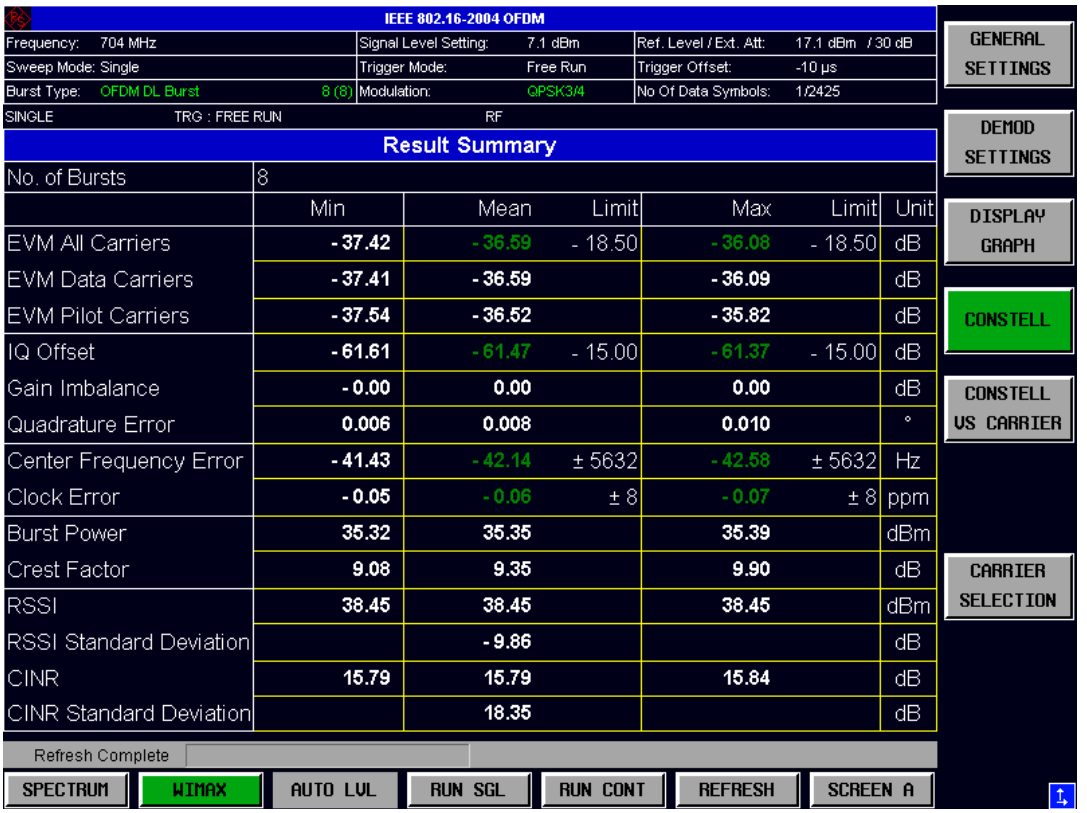

Figure 35: TX Burst Power, 10MHz, 704.0 MHz, QPSK ¾

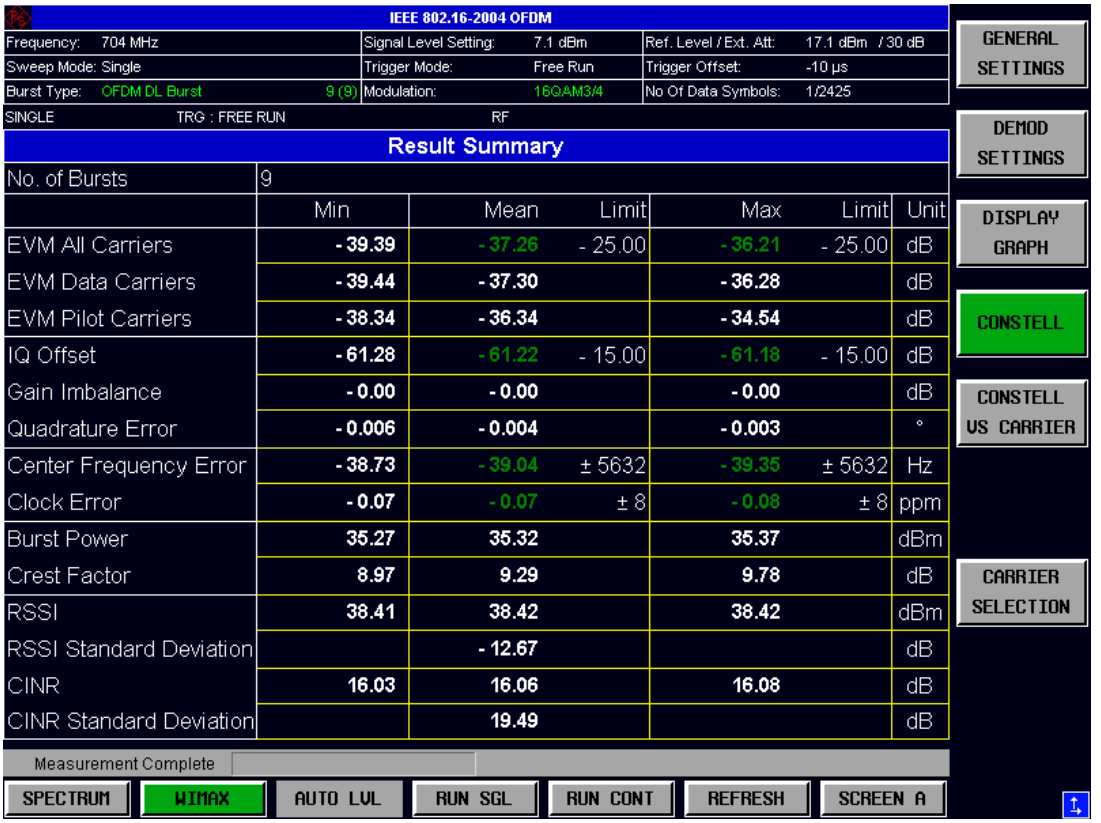

Figure 36: TX Burst Power, 10MHz, 704.0 MHz, 16 QAM ¾

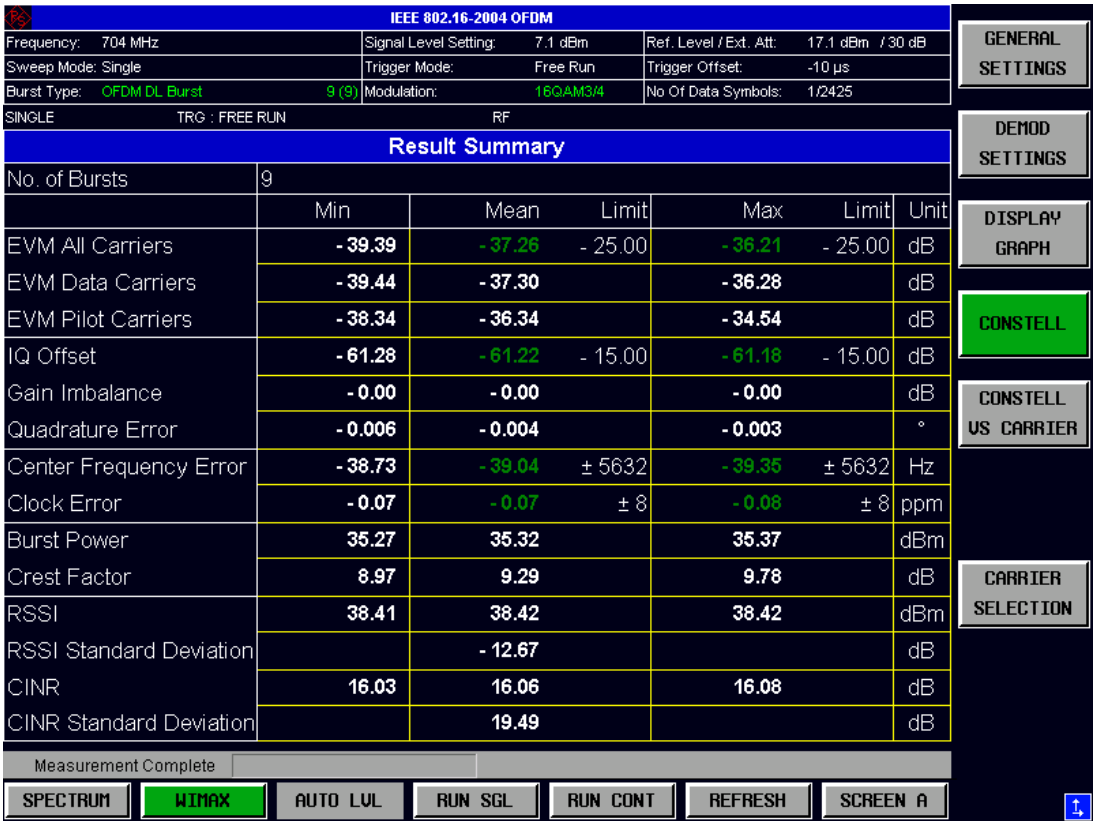

Figure 37: TX Burst Power, 10MHz, 704.0 MHz, 64 QAM ¾

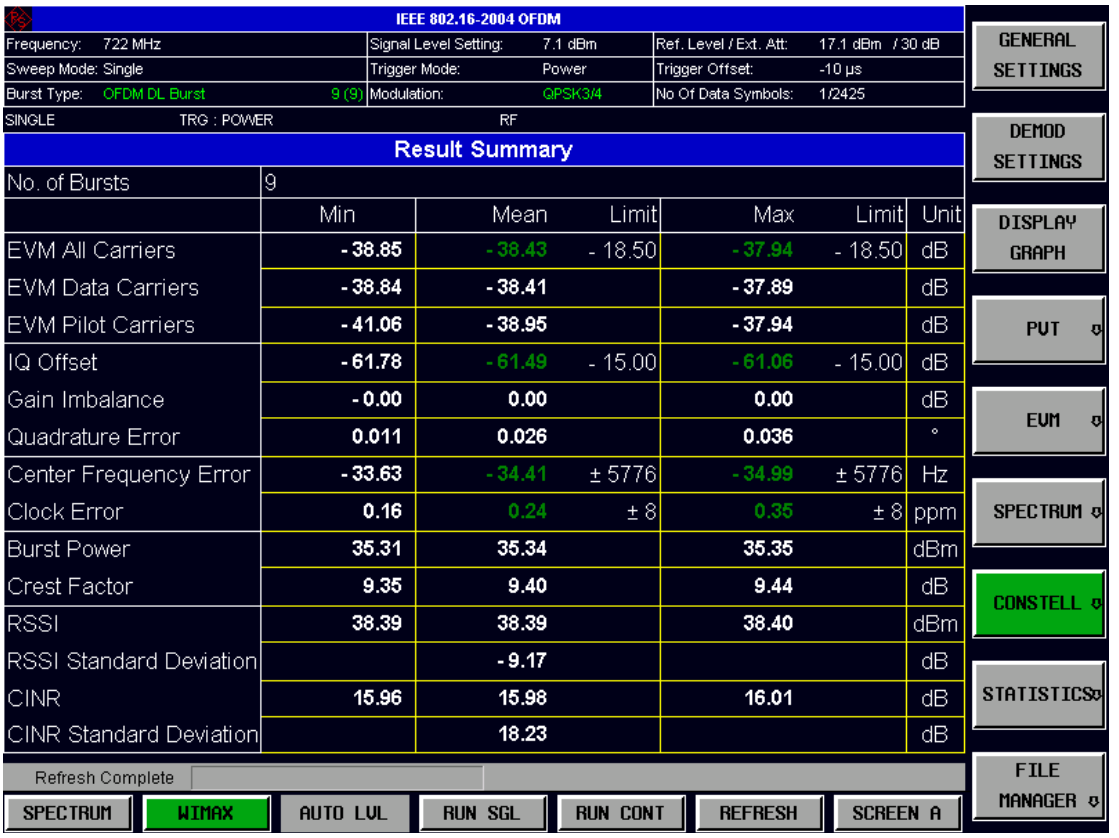

Figure 38: TX Burst Power, 10MHz, 722.0 MHz, QPSK ¾

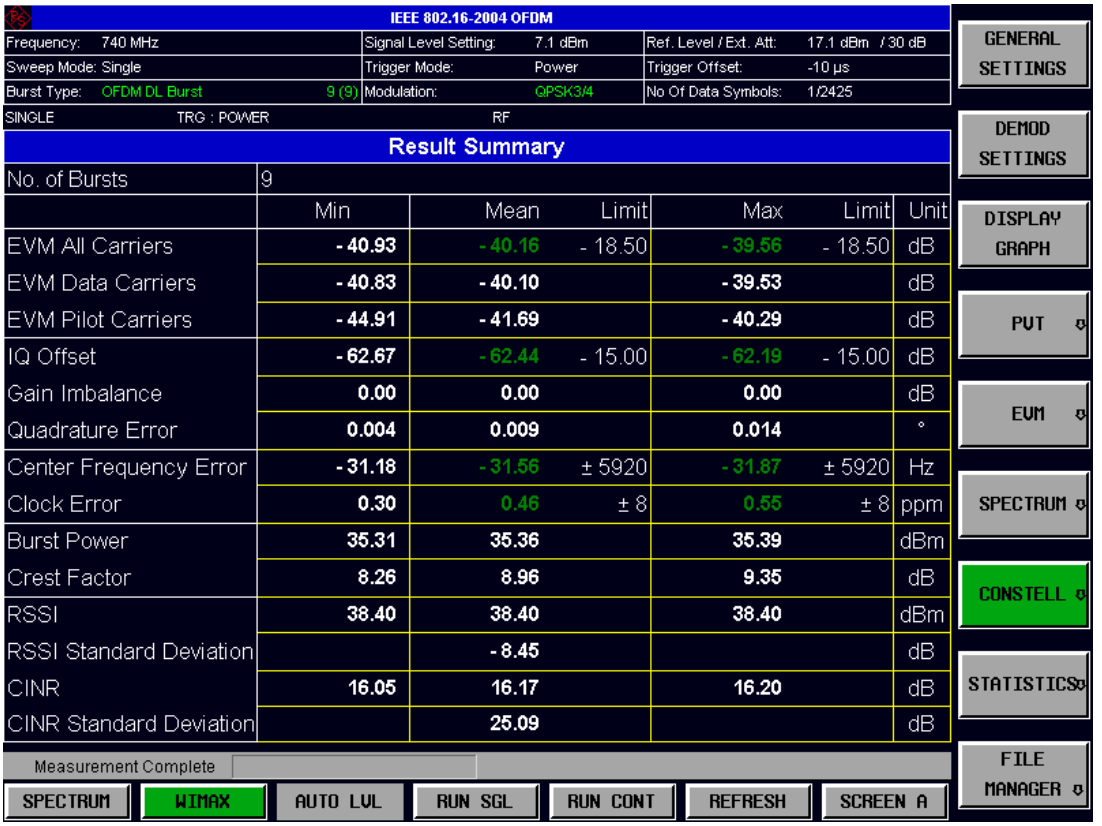

Figure 39: TX Burst Power, 10MHz, 740.0 MHz, QPSK ¾

10 Conducted Band Edge – 47CFR27.53(g)

This test was used to determine worst case modulation schemes to be tested by RFI and so highest emissions in the 100kHz band was determined using a 30kHz resolution bandwidth.

This test was performed with each of the four test modulation schemes for both bandwidths at top and bottom of the band.

The total power in the 100 kHz band for the worst cases was then measured by RFI.

Channel	Bandwidth (MHz)	Frequency (MHz)	Modulation	Max Emission (dBm)	Limit (dBm)
Bottom	5	701.0	BPSK ½	-21.46	-13.0
			QPSK ¾	-21.76	-13.0
			16 QAM ¾	-21.29	-13.0
			64 QAM ¾	-21.67	-13.0
Top	5	743.0	BPSK ½	-16.17	-13.0
			QPSK ¾	-18.31	-13.0
			16 QAM ¾	-18.99	-13.0
			64 QAM ¾	-17.21	-13.0
Bottom	10	704.0	BPSK ½	-26.84	-13.0
			QPSK ¾	-26.48	-13.0
			16 QAM ¾	-25.65	-13.0
			64 QAM ¾	-26.42	-13.0
Bottom	10	740.0	BPSK ½	-21.93	-13.0
			QPSK ¾	-19.81	-13.0
			16 QAM ¾	-22.13	-13.0
			64 QAM ¾	-21.56	-13.0

Table 8: Conducted Band Edge Emissions

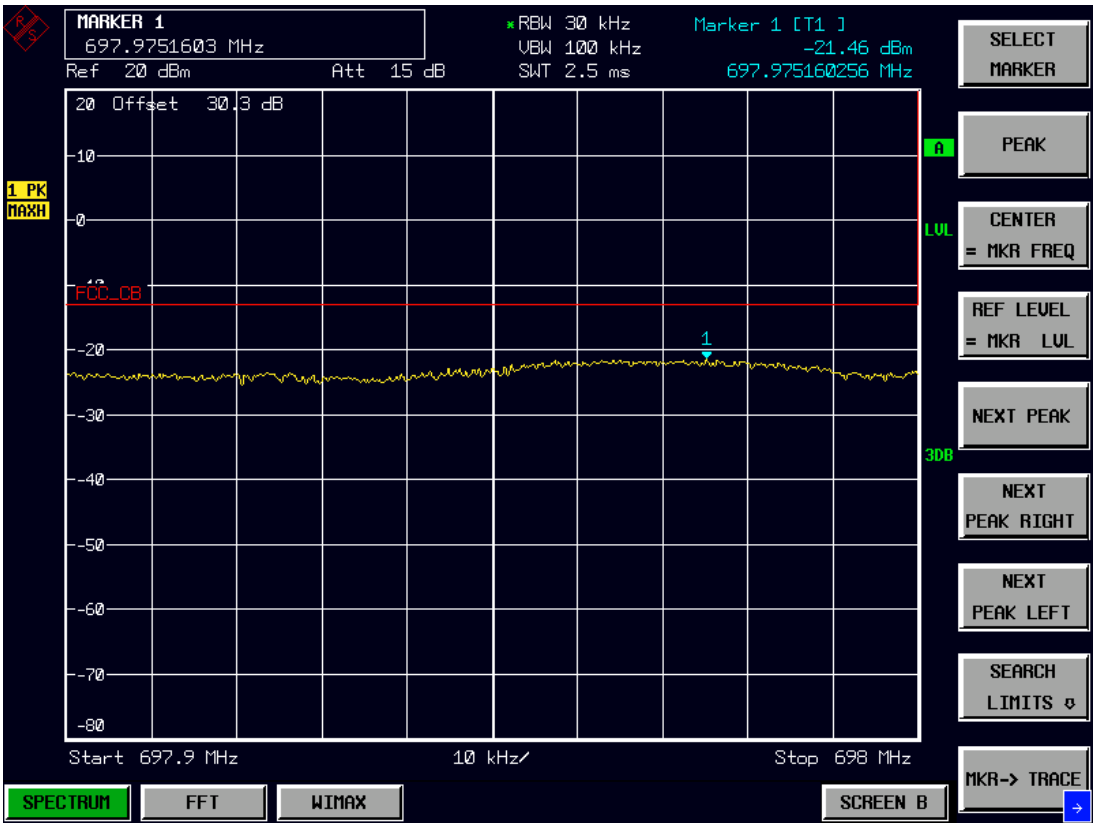

Figure 40: TX band edge, 5MHz, 701.0 MHz, BPSK ½

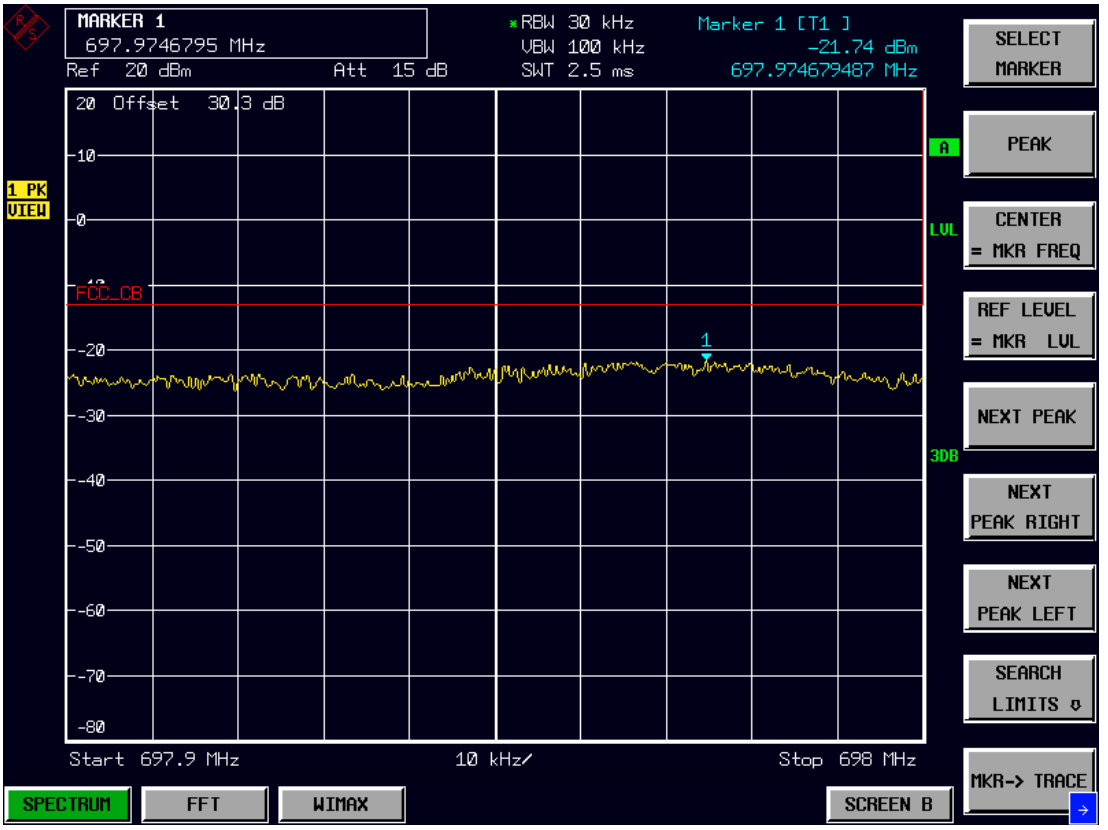

Figure 41: TX band edge, 5MHz, 701.0 MHz, QPSK ¾

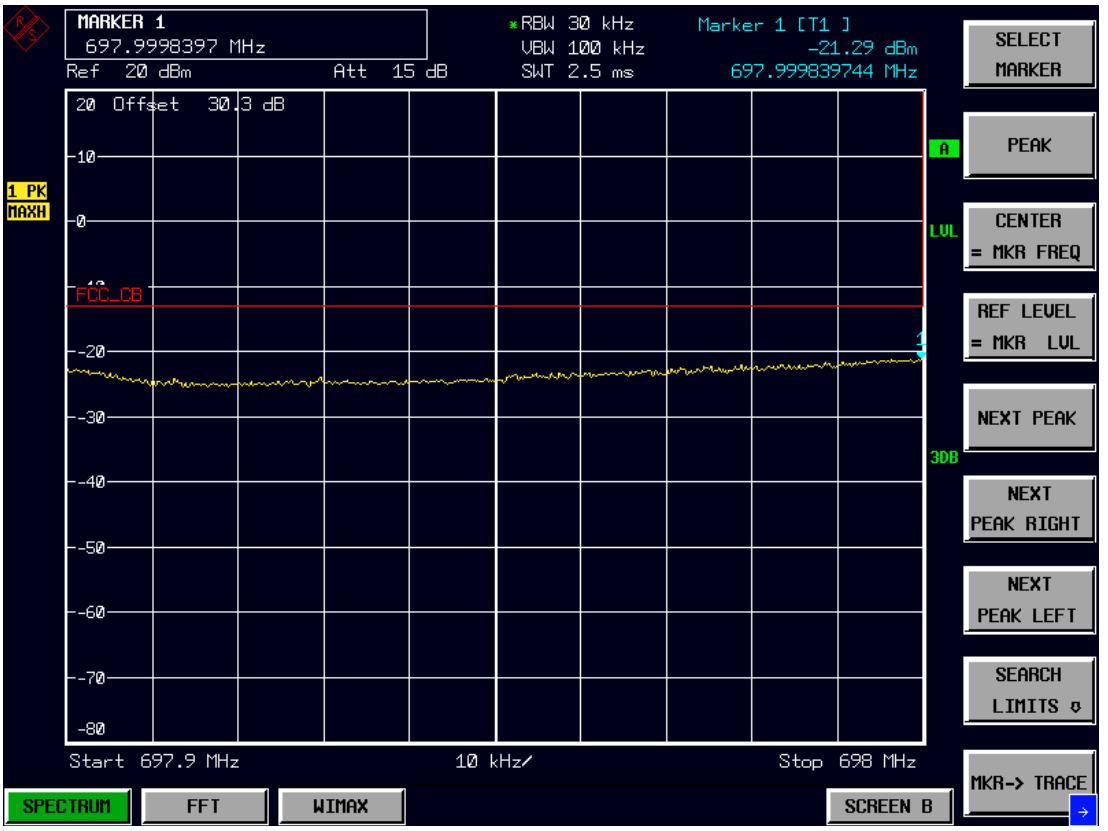

Figure 42: TX band edge, 5MHz, 701.0 MHz, 16 QAM ¾

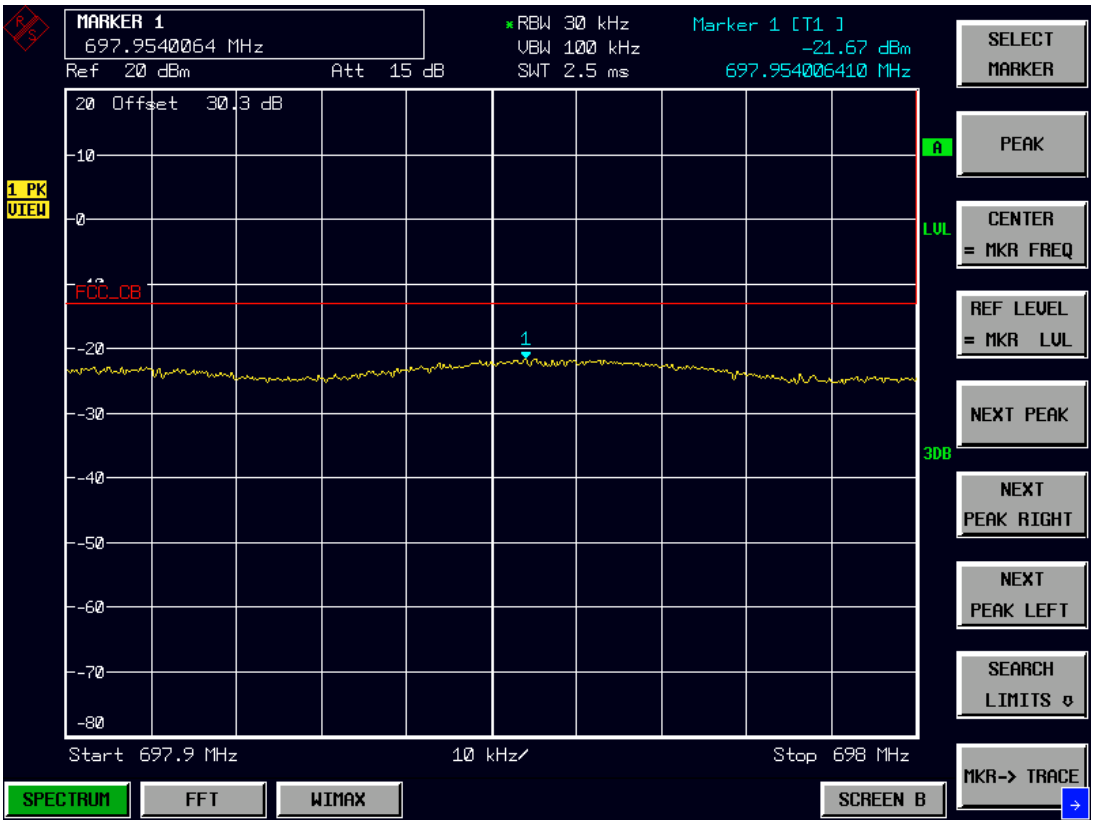

Figure 43: TX band edge, 5MHz, 701.0 MHz, 64 QAM ¾

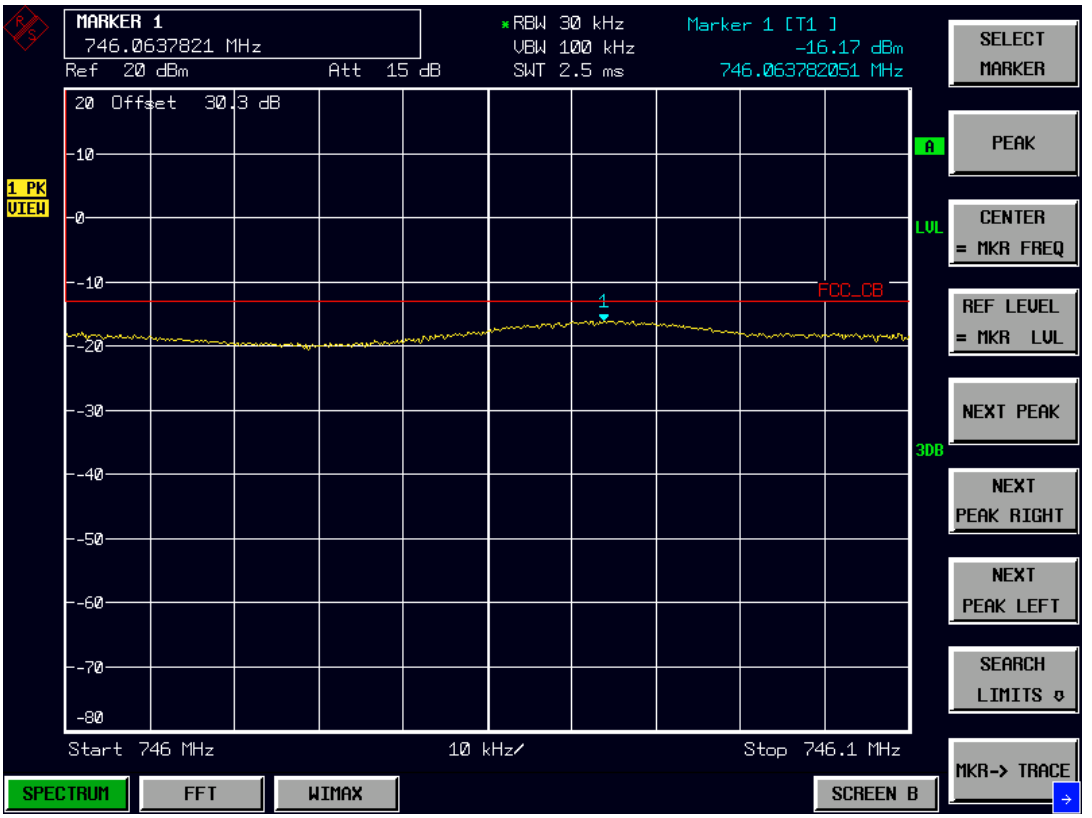

Figure 44: TX band edge, 5MHz, 743.0 MHz, BPSK ½

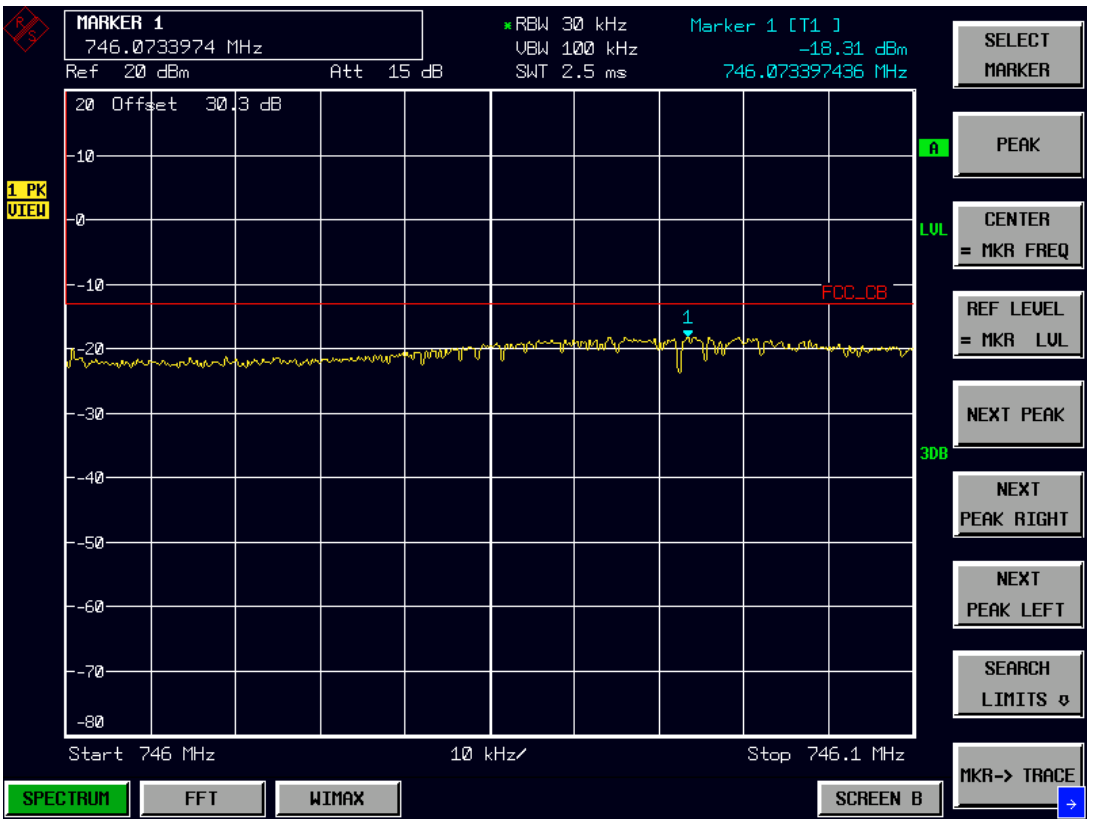

Figure 45: TX band edge, 5MHz, 743.0 MHz, QPSK ¾

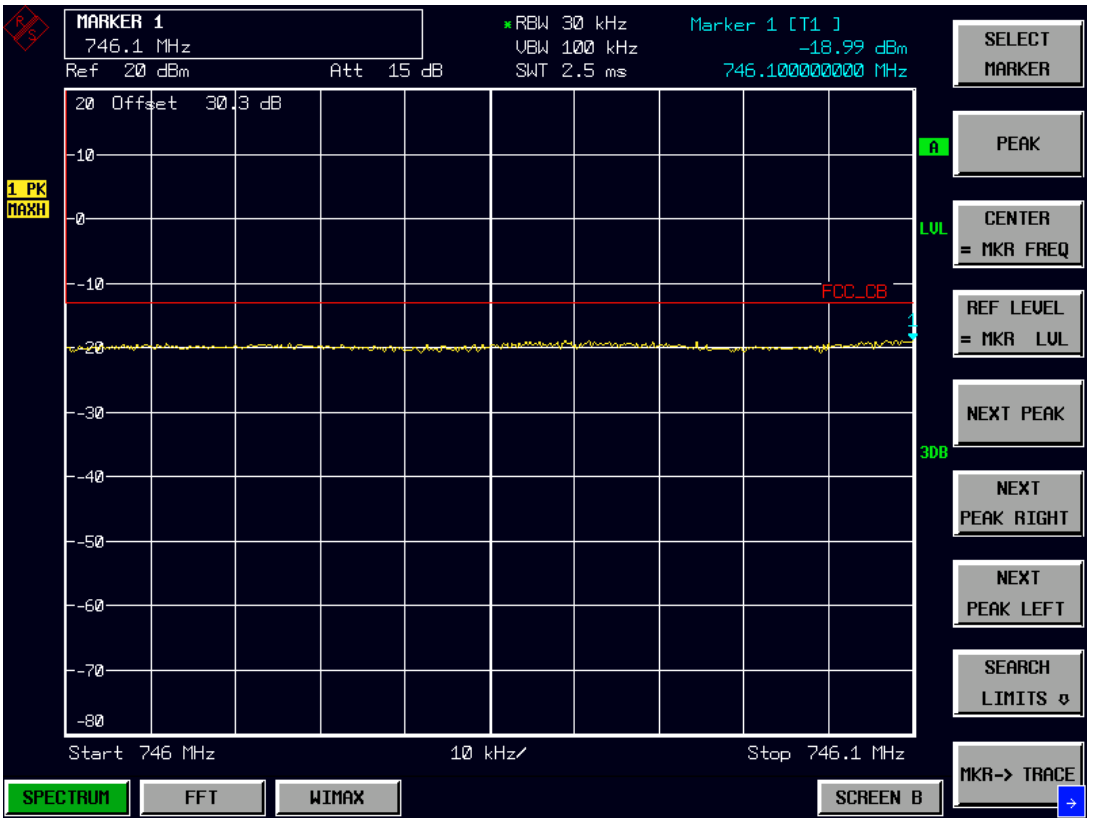

Figure 46: TX band edge, 5MHz, 743.0 MHz, 16 QAM ¾

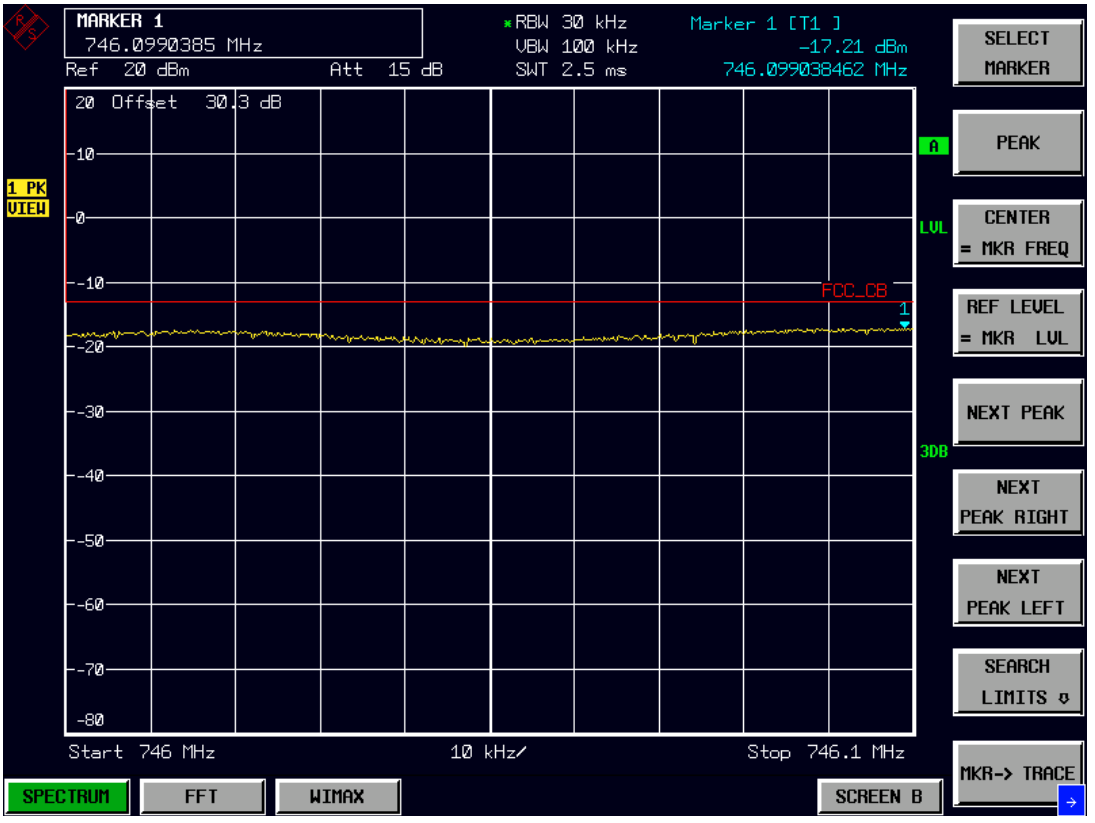

Figure 47: TX band edge, 5MHz, 743.0 MHz, 64 QAM ¾

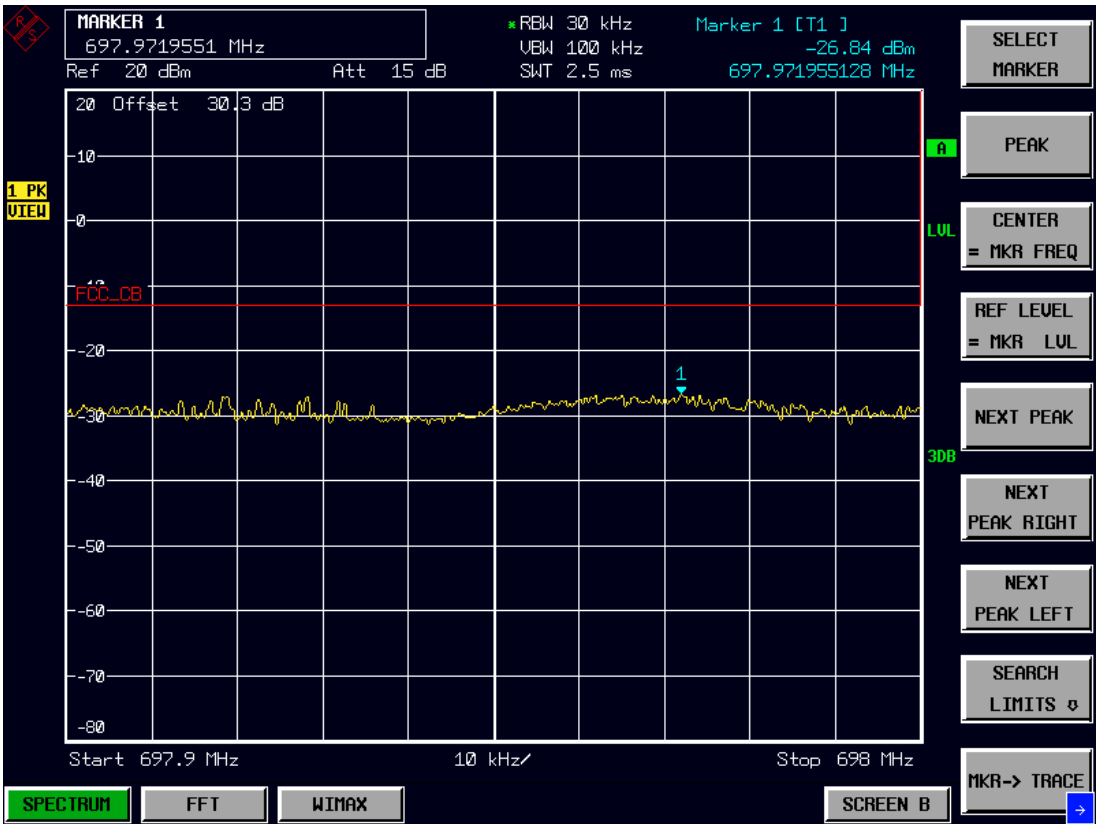

Figure 48: TX band edge, 10MHz, 704.0 MHz, BPSK ½

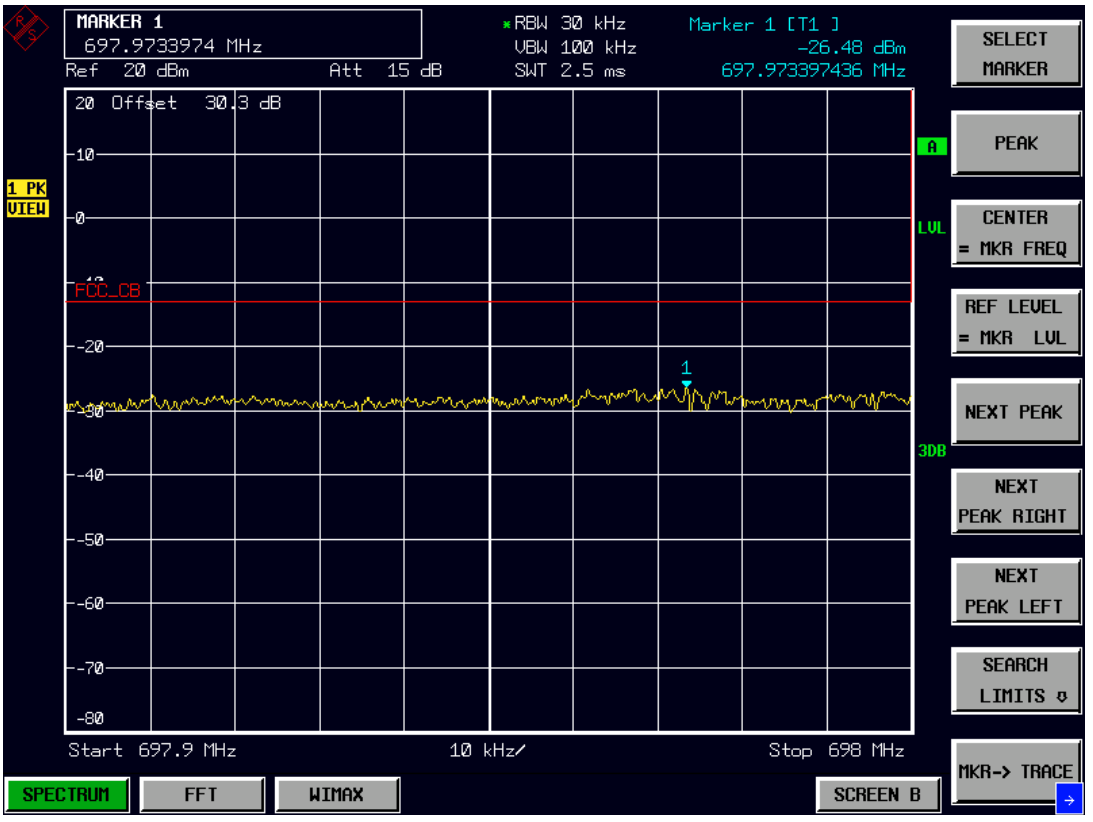

Figure 49: TX band edge, 10MHz, 704.0 MHz, QPSK ¾

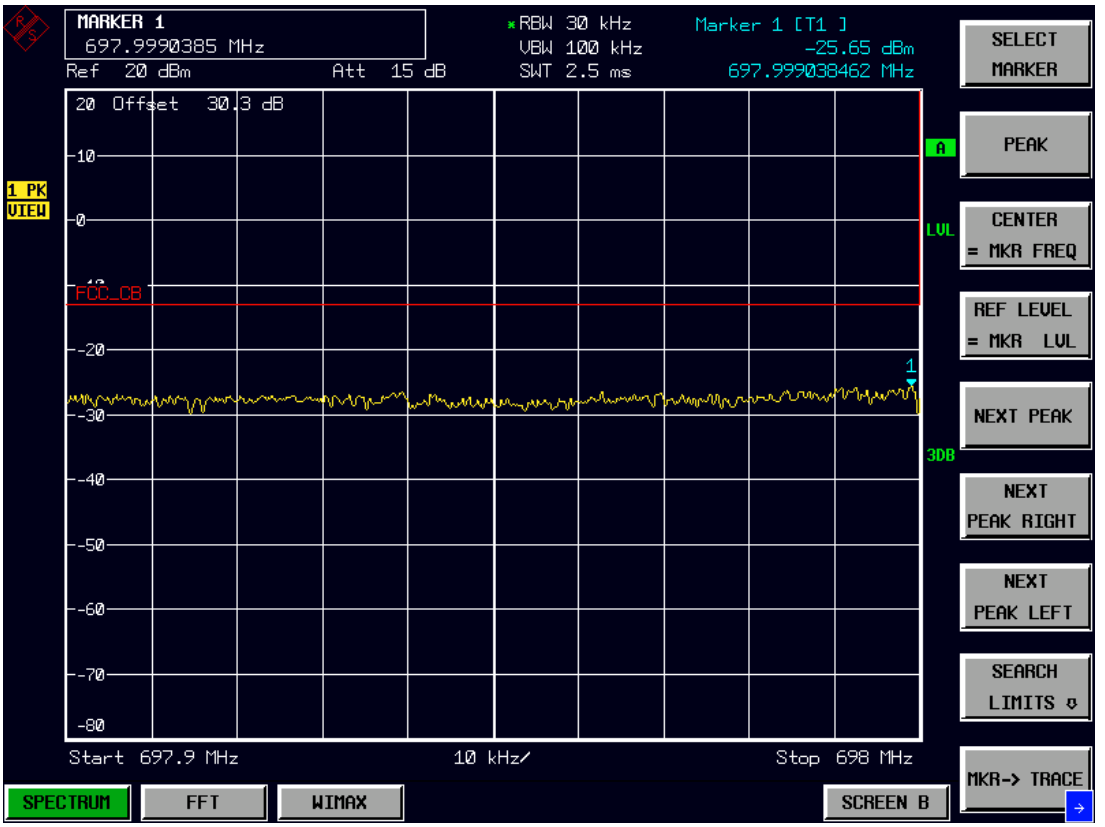

Figure 50: TX band edge, 10MHz, 704.0 MHz, 16 QAM ¾

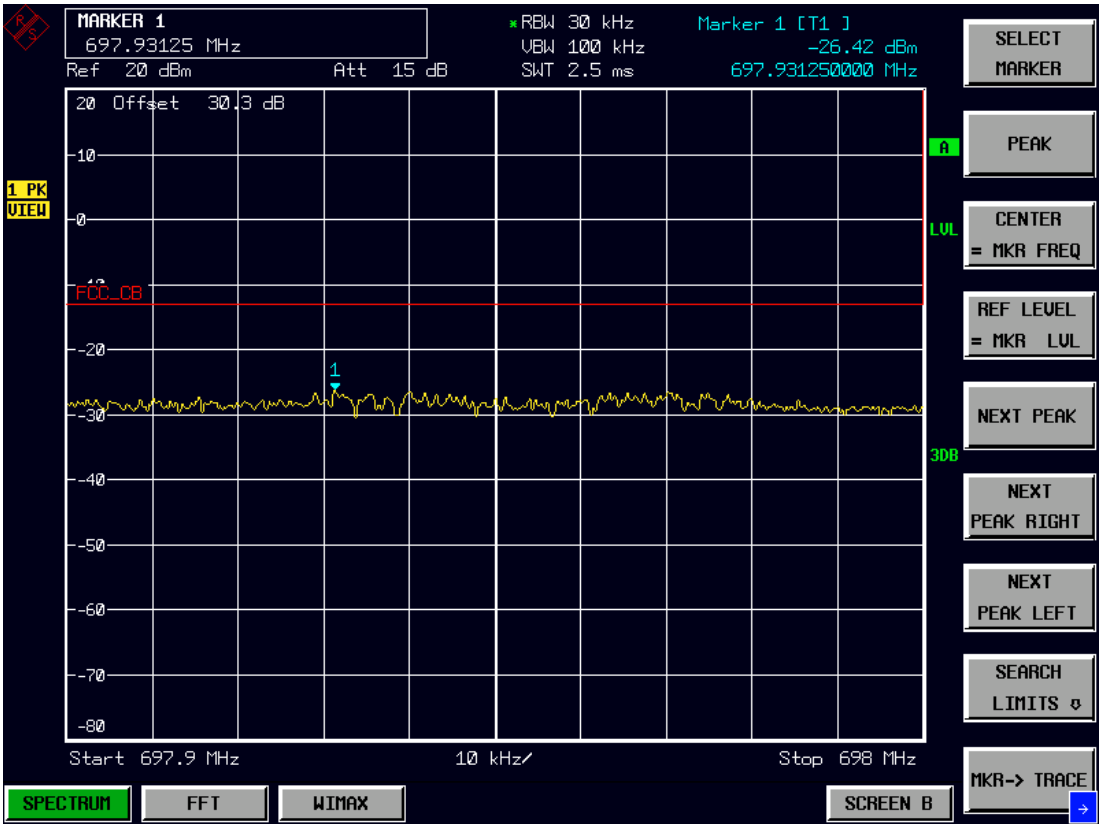

Figure 51: TX band edge, 10MHz, 704.0 MHz, 64 QAM ¾

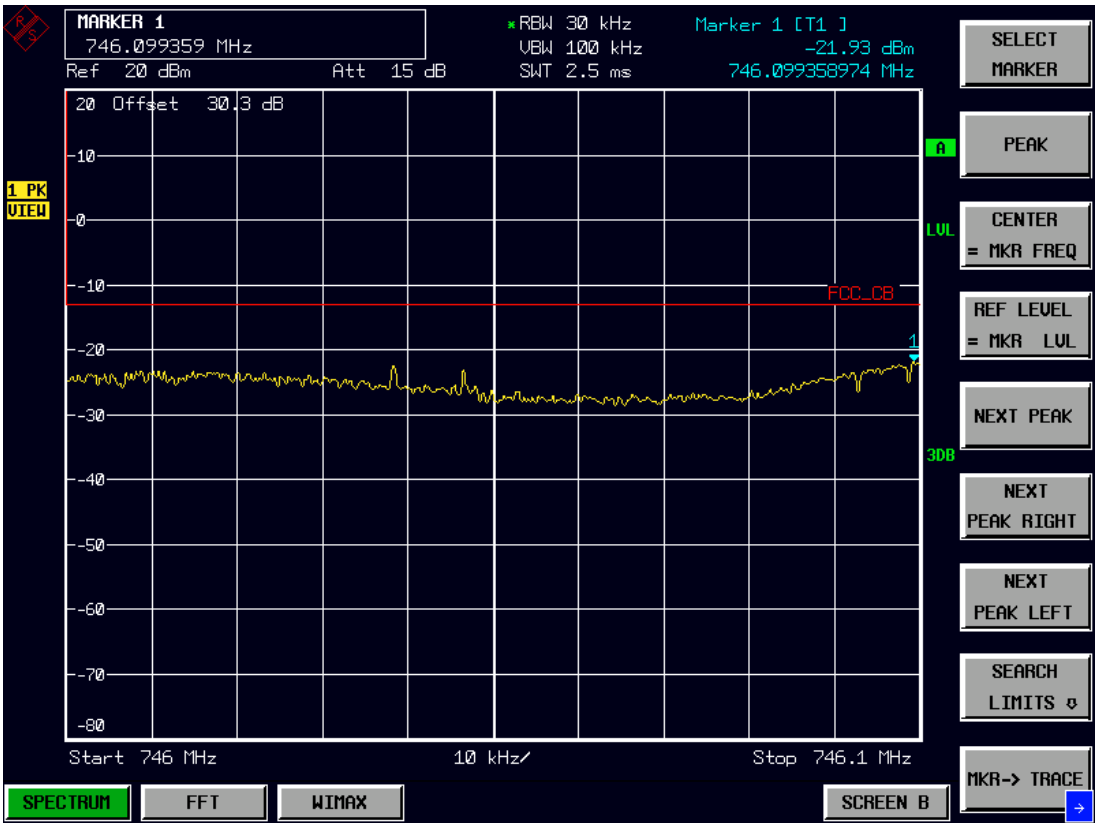

Figure 52: TX band edge, 10MHz, 740.0 MHz, BPSK ½

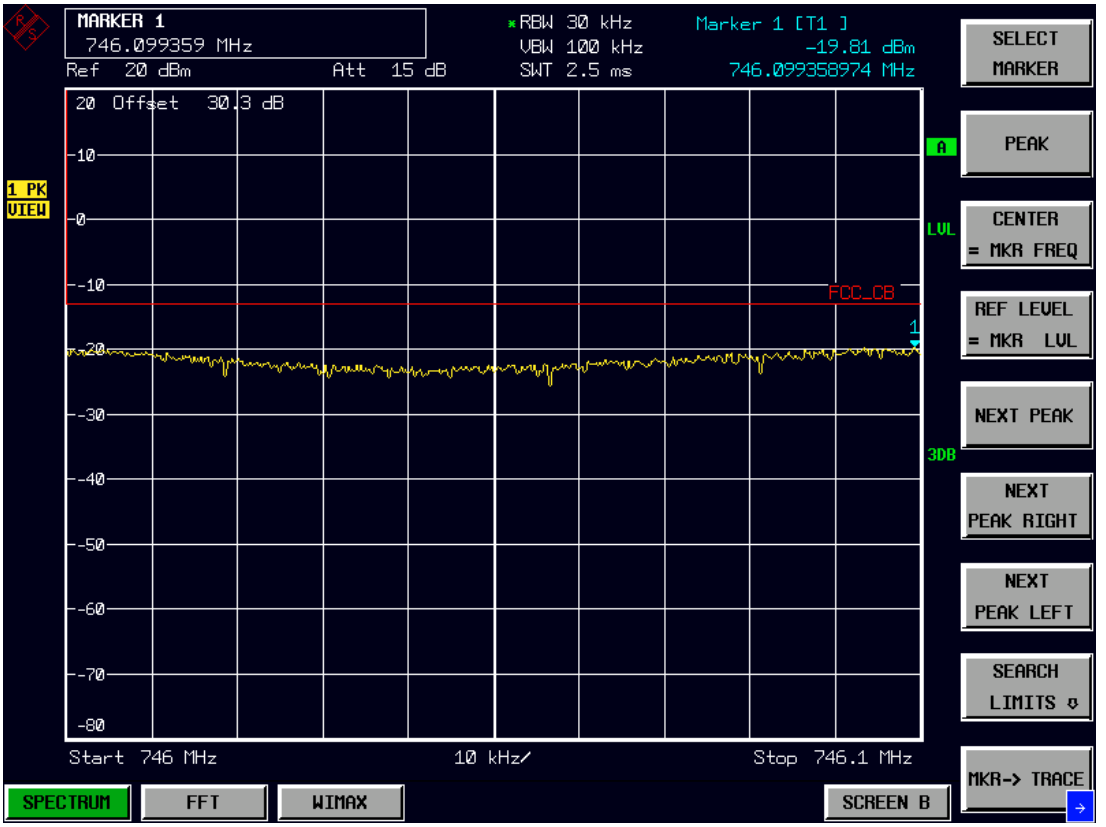

Figure 53: TX band edge, 10MHz, 740.0 MHz, QPSK ¾

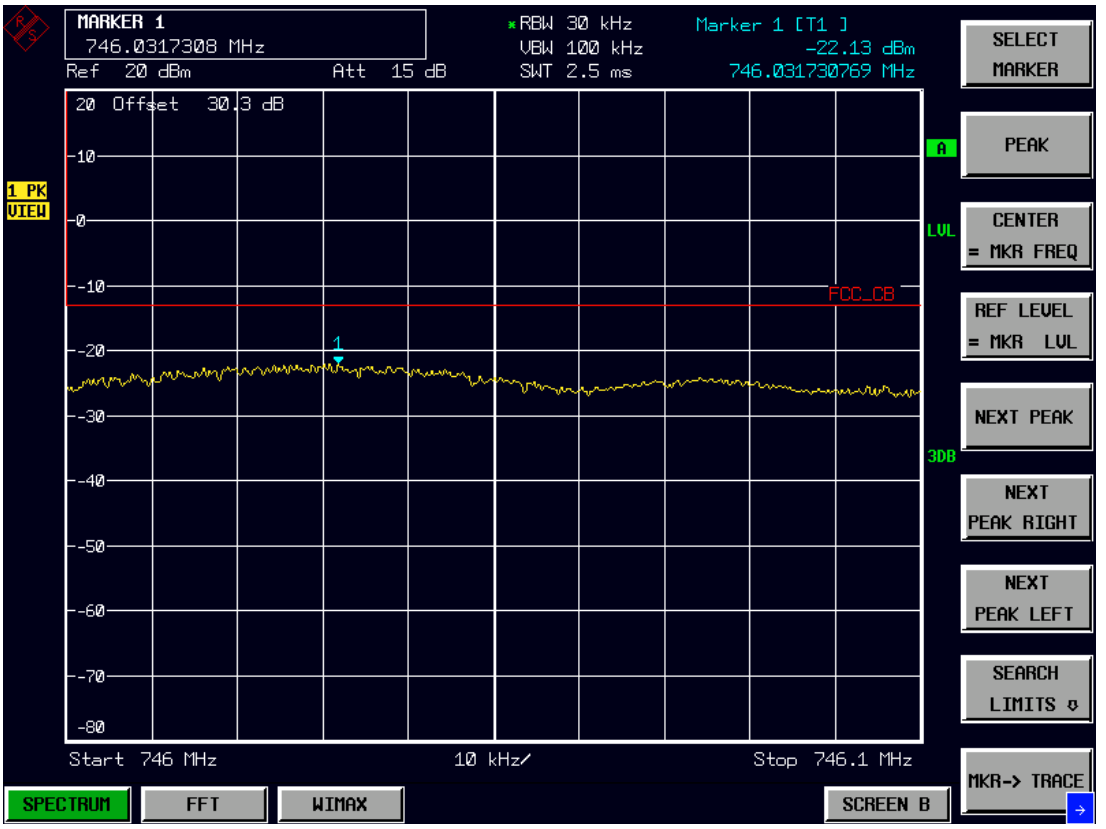

Figure 54: TX band edge, 10MHz, 740.0 MHz, 16 QAM ¾

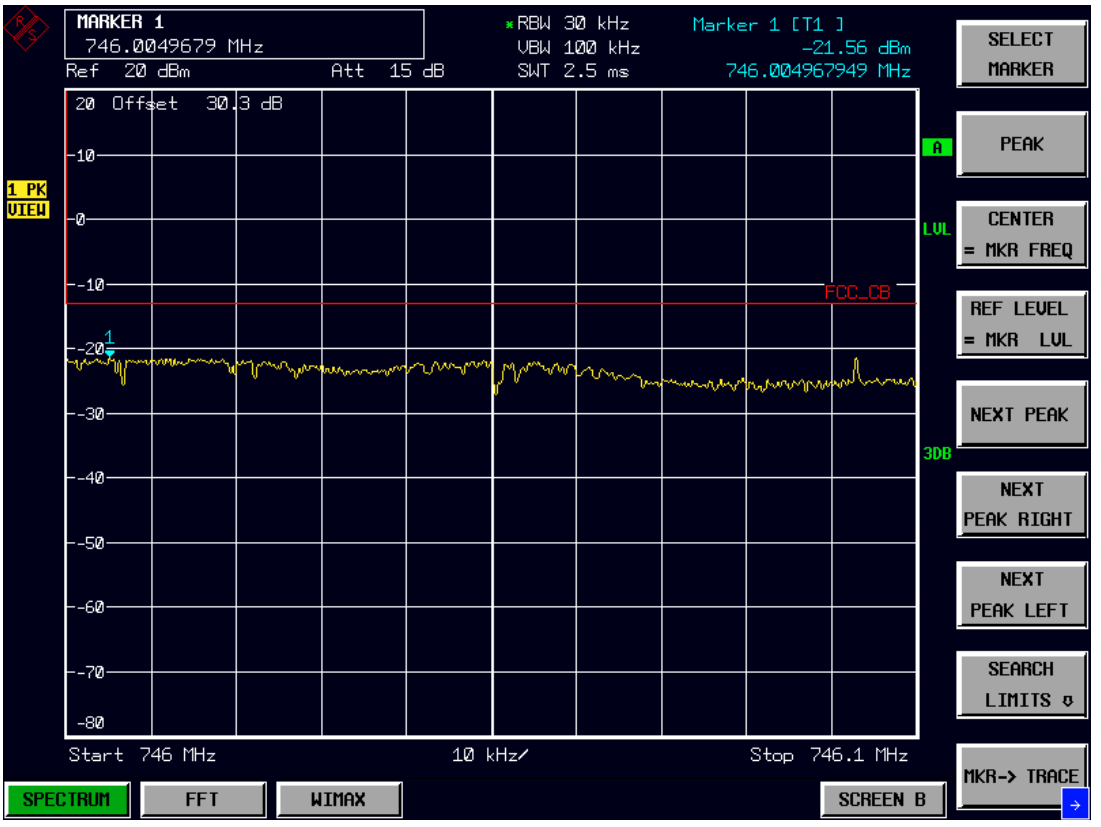

Figure 55: TX band edge, 10MHz, 740.0 MHz, 64 QAM ¾

11 Conducted Spurious Emissions – 47CFR27.53(g)

This test was performed on top and bottom channels for each bandwidth of operation using the worst case modulation identified in band-edge spurious emissions in section 10.

This pre-testing was performed using a 100 kHz resolution bandwidth the whole band to provide a good noise floor margin.

Channel	Bandwidth (MHz)	Frequency (MHz)	Modulation	Max Emission (dBm)	Limit (dBm)
Bottom	5	701.0	16 QAM ¾	-17.28	-13.0
Top	5	743.0	64 QAM ¾	-32.46	-13.0
Bottom	10	704.0	16 QAM ¾	-19.92	-13.0
Top	10	740.0	QPSK ¾	-32.51	-13.0

Table 9: Conducted spurious emissions 30MHz – 679.9 MHz

Channel	Bandwidth (MHz)	Frequency (MHz)	Modulation	Max Emission (dBm)	Limit (dBm)
Bottom	5	701.0	16 QAM ¾	-28.87	-13.0
Top	5	743.0	64 QAM ¾	-14.21	-13.0
Bottom	10	704.0	16 QAM ¾	-28.09	-13.0
Top	10	740.0	QPSK ¾	-13.62	-13.0

Table 10: Conducted Spurious emissions 746.1 – 7500 MHz

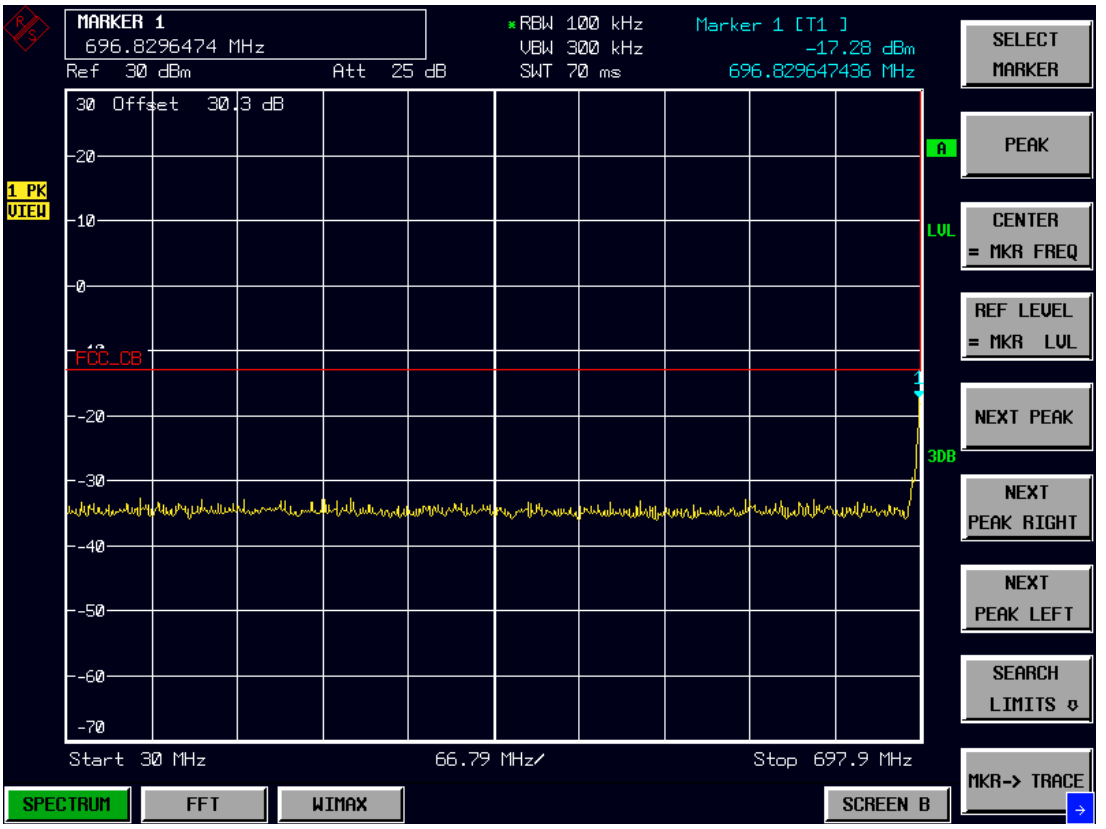

Figure 56: CSE, 30.0 - 679.9 MHz, 5MHz, 701.0 MHz, 16 QAM ¾

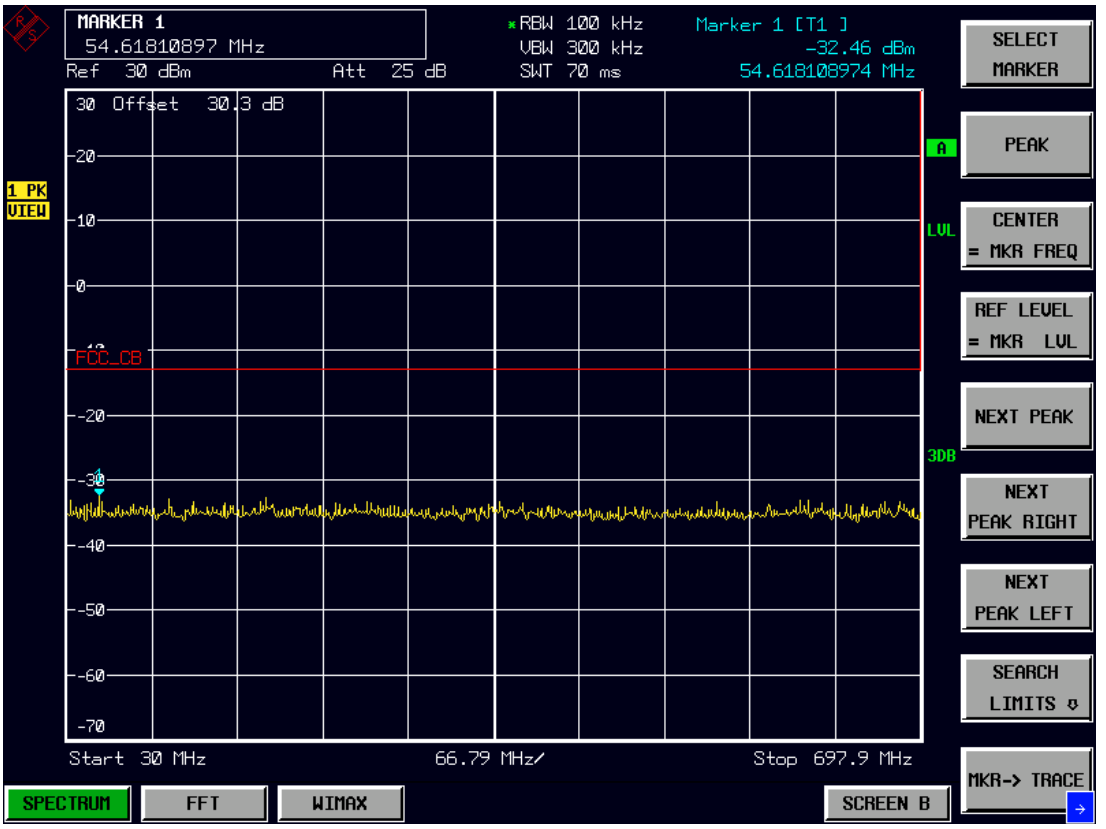

Figure 57: CSE, 30.0 - 679.9 MHz, 5MHz, 743.0 MHz, 64 QAM ¾

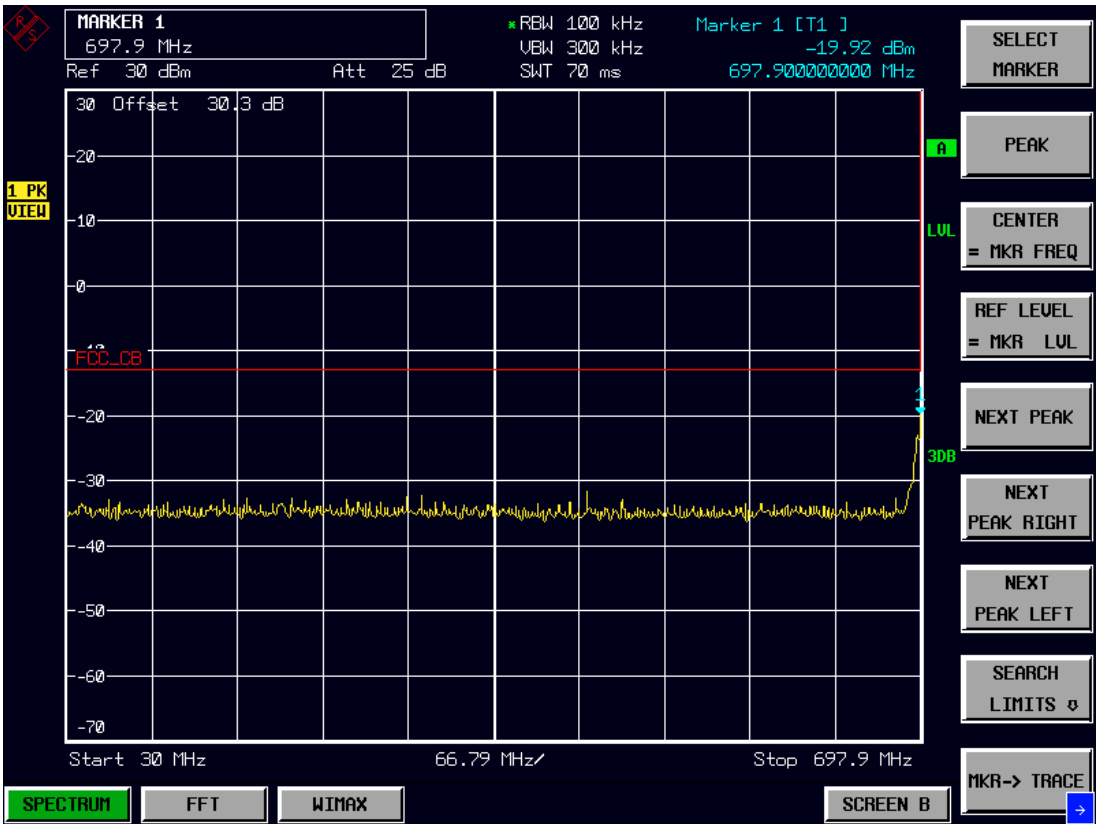

Figure 58: CSE, 30.0 - 679.9 MHz, 10MHz, 704.0 MHz, 16 QAM ¾

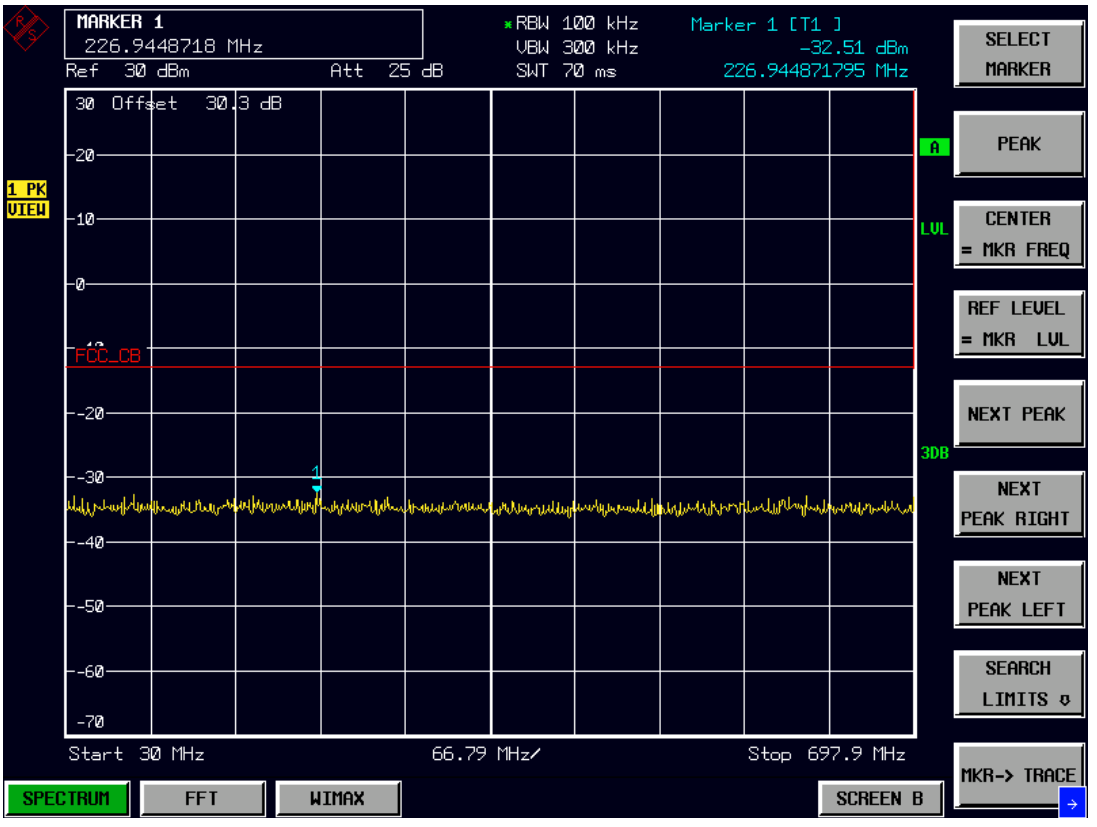

Figure 59: CSE, 30.0 - 679.9 MHz, 10MHz, 740.0 MHz, QPSK ¾

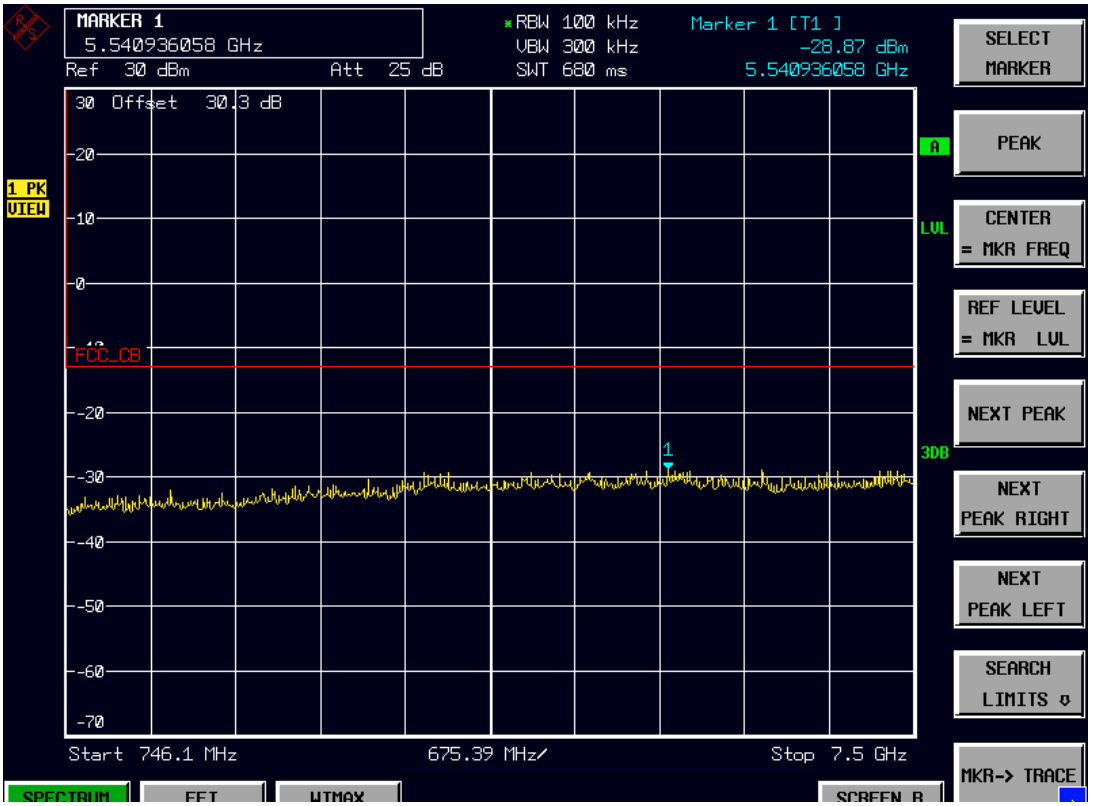

Figure 60: CSE, 746.1 – 7500.0 MHz, 5MHz, 701.0 MHz, 16 QAM ¾

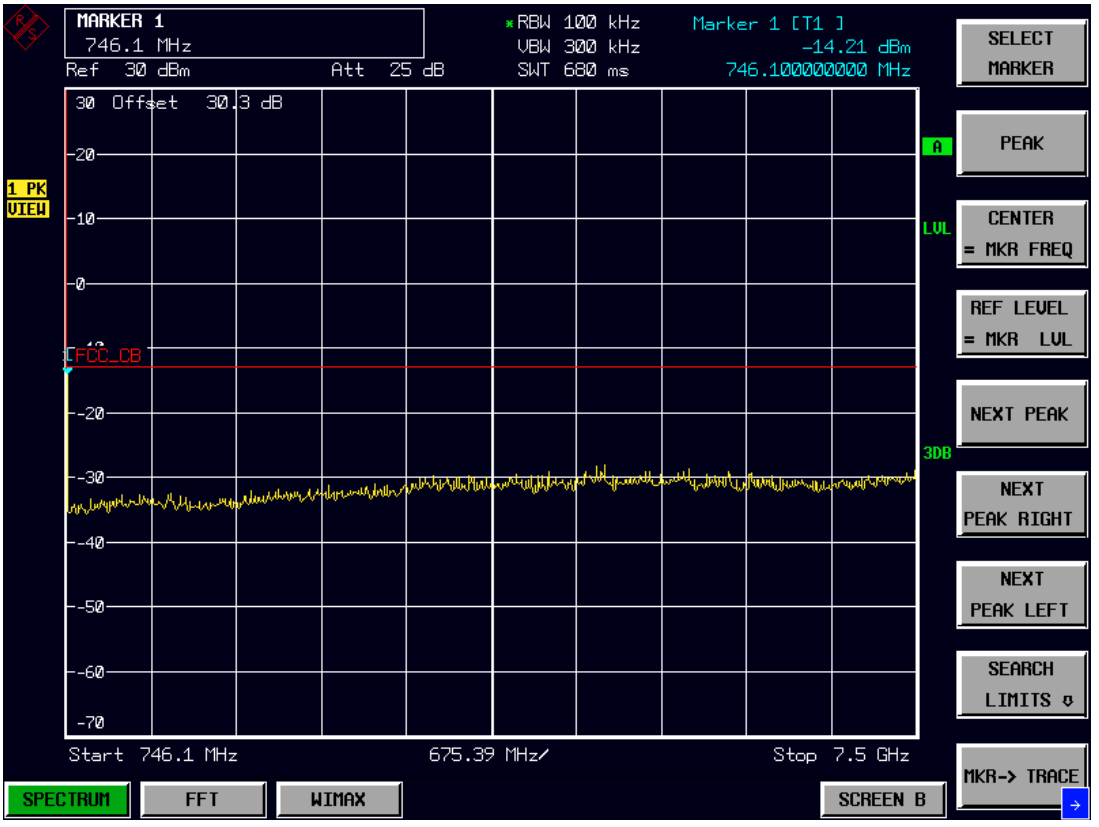

Figure 61: CSE, 746.1 – 7500.0 MHz, 5MHz, 743.0 MHz, 64 QAM ¾

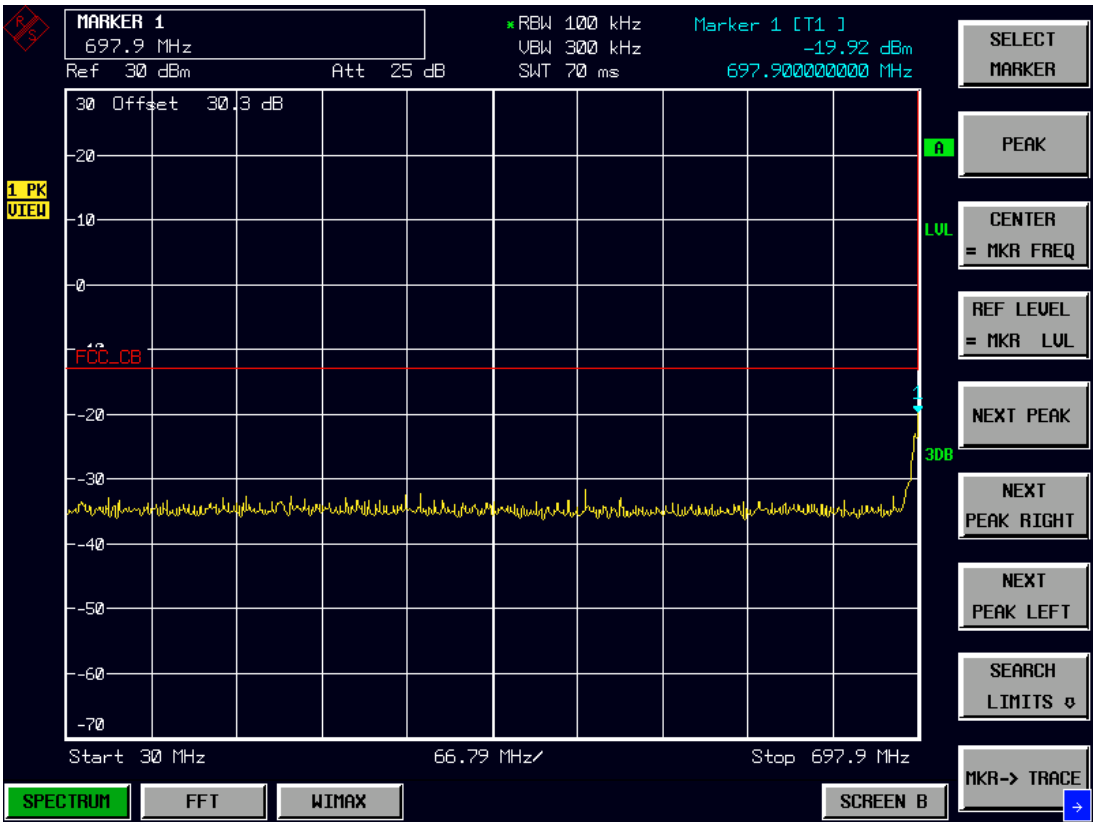

Figure 62: CSE, 746.1 – 7500.0 MHz, 10MHz, 704.0 MHz, 16 QAM ¾

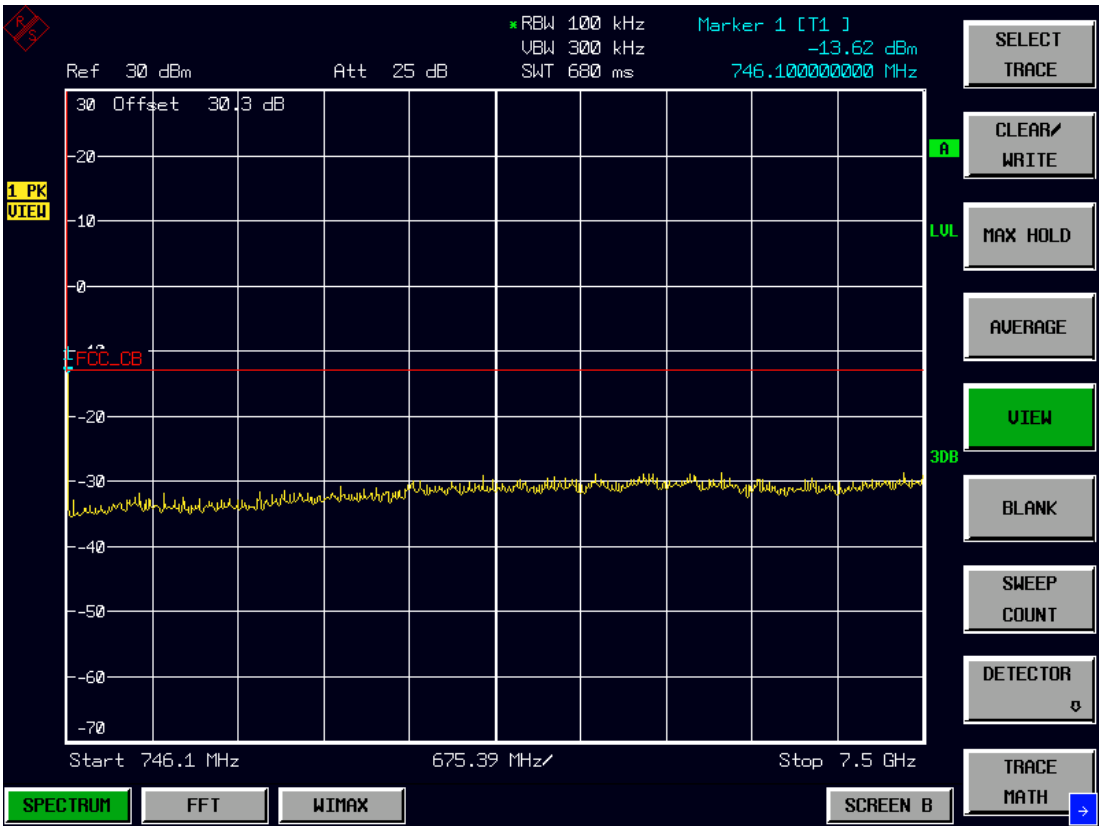

Figure 63: CSE, 746.1 – 7500.0 MHz, 10MHz, 740.0 MHz, QPSK ¾

12 Test Plan SC_AIR_TP01_A

700 MHz SCRT FCC Test Plan – testing performed at RFI
SC_TR02_A

Following review of pre-testing, the following tests shall be performed at RFI

Part	Bandwidth	Channels	Modulation
2.1049 Occ bandwidth	5.0	701.0 743.0	64 QAM ¾ 64 QAM ¾
	10.0	704.0 740.0	16 QAM ¾ 16 QAM ¾
27.50(c)(3) Peak Power density at antenna port	5.0	701.0 719.0 743.0	16 QAM ¾ 16 QAM ¾ 16 QAM ¾
	10.0	704.0 722.0 740.0	QPSK ¾ QPSK ¾ QPSK ¾
2.1046 Burst power	5.0	701.0 719.0 743.0	QPSK ¾
	10.0	704.0 722.0 740.0	QPSK ¾
27.53(g) 2.1051 Conducted Band Edge	5.0	701.0 743.0	16 QAM ¾ 64 QAM ¾
	10.0	704.0 740.0	16 QAM ¾ QPSK ¾
27.53(g) 2,1051 CSE	5.0	701.0 743.0	16 QAM ¾ 64 QAM ¾
	10.0	704.0 740.0	16 QAM ¾ QPSK ¾
27.53(g) / 2,1053 RSE	5.0 10.0	Worst CSE Worst CSE	Worst CSE Worst CSE
27.54 2.1055 Frequency Stability	5.0	701.0	64 QAM ¾

Table 11: Summary of tests to be performed at RFI

14th April 2010