

**Annex acc. to FCC Title 47 CFR Part 95 M
relating to
Hexagon Geosystems Services AG, Zweigniederlassung Hexagon Mining
QR4000**

Annex no. 3 Test results Channel occupancy/ bandwidth

**Title 47 - Telecommunication
Part 95 - Personal Radio Services
Subpart M – The 76 – 81 GHz Band Radar Service
Measurement Procedure:
ANSI C63.26-2015**

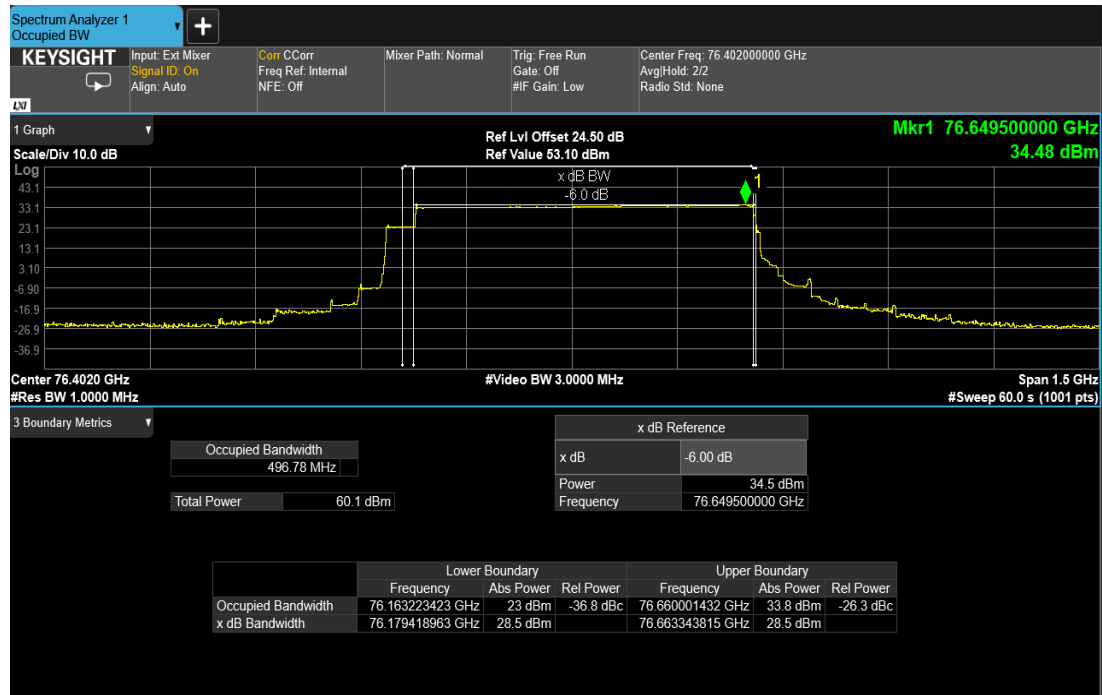


Deutsche
Akkreditierungsstelle
D-PL-12053-01-03

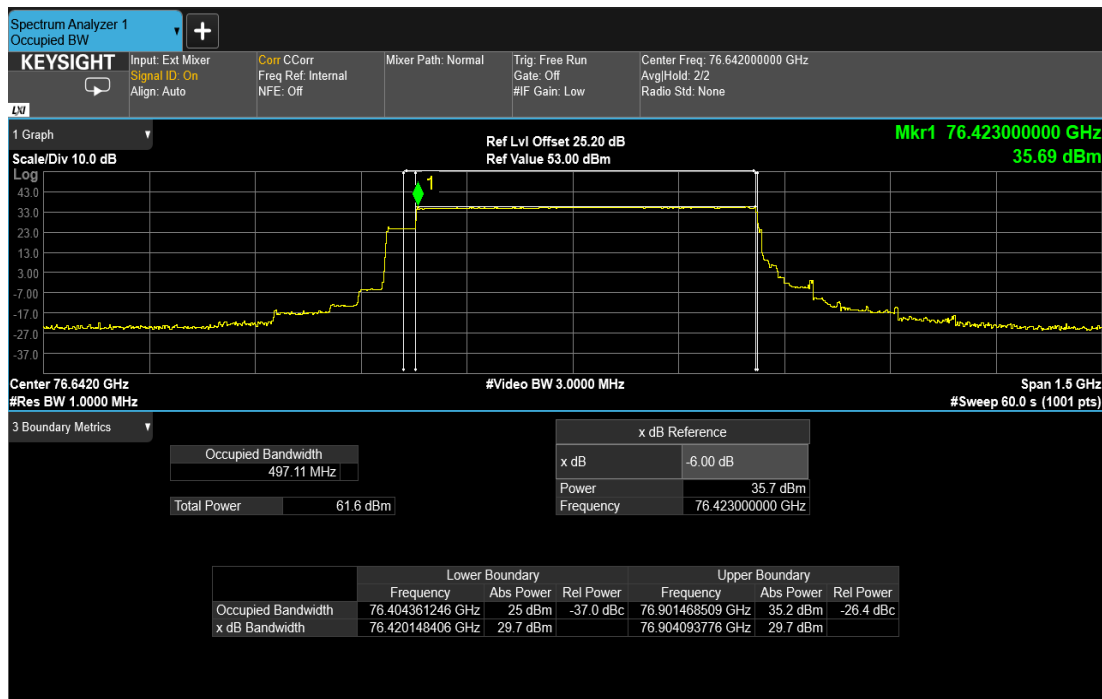
Version	Applied changes	Date of release
00	Initial release	2024-07-31

Test plots – Measured 6 dB Bandwidth (Waveform 0)

@ 76.365 GHz



@ 76.605 GHz



Test plots – Measured 6 dB Bandwidth (Waveform 1)

@ 76.125 GHz



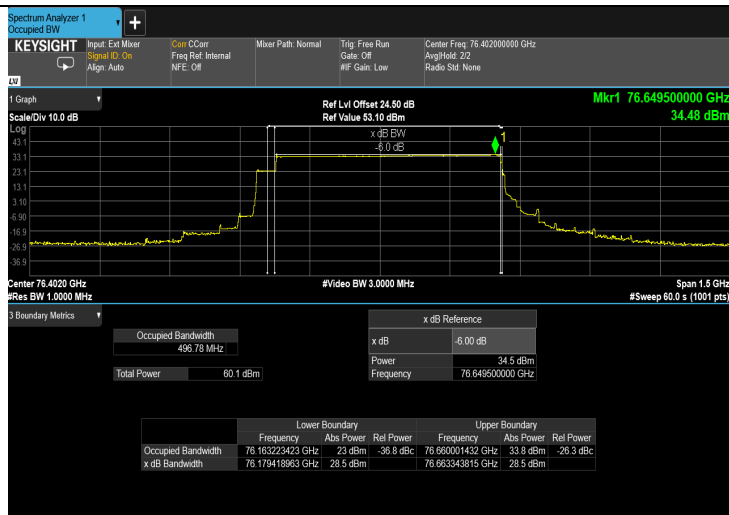
@ 76.845 GHz



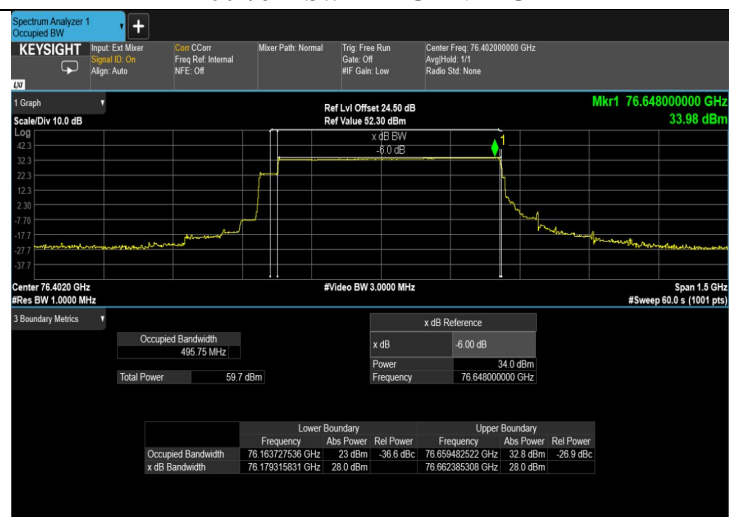
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EUT: QR4000---RADIO---
FCC ID: ZKS-QR4000---RADIO---
FCC Title 47 CFR Part 95 M---RADIO---
EUT: QR4000

Test plots – Frequency stability (Waveform 0 @ 76.365 GHz)

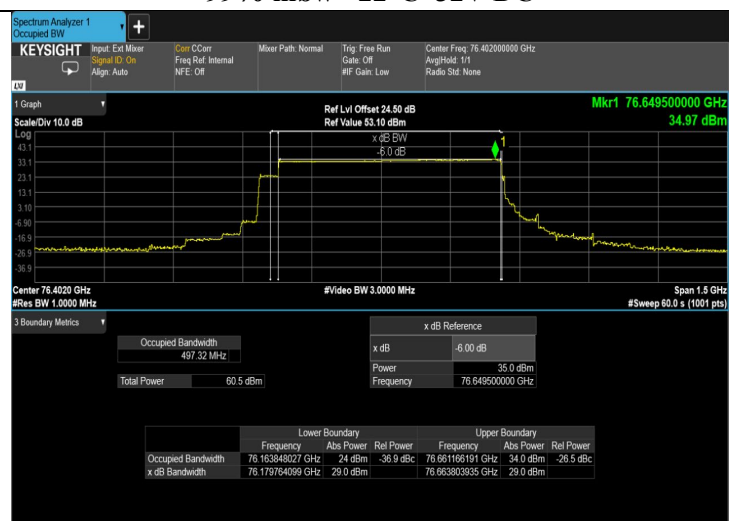
99% mbw +22°C 24V DC



99% mbw +22°C 7V DC



99% mbw +22°C 32V DC



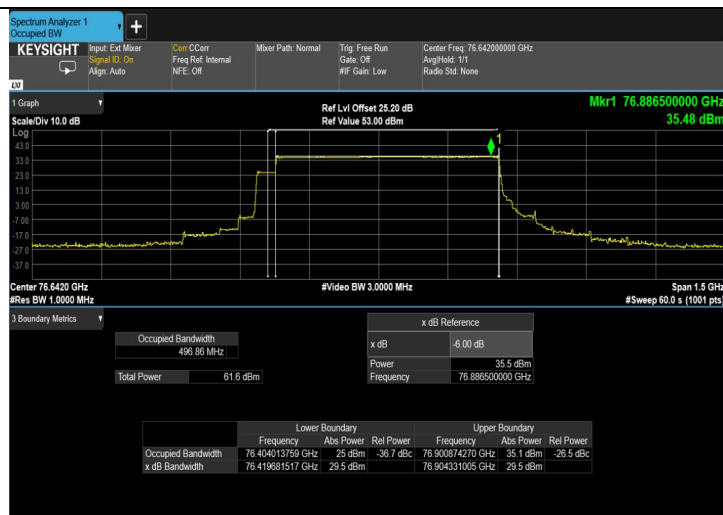
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Test plots – Frequency stability (Waveform 0 @ 76.605 GHz)

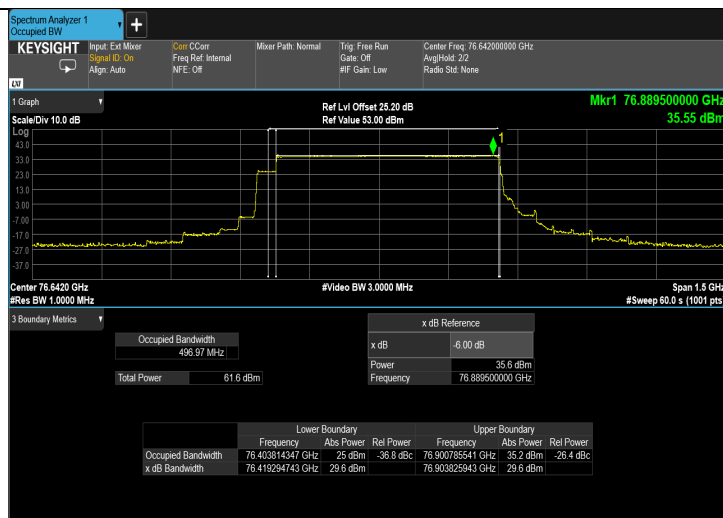
99% mbw +22°C 24V DC



99% mbw +22°C 7V DC



99% mbw +22°C 32V DC



---RADIO---
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FCC Title 47 CFR Part 95 M---RADIO---
EUT: QR4000

Test plots – Frequency stability (Waveform 1 @ 76.125 GHz)

99% mbw +22°C 24V DC



99% mbw +22°C 7V DC



99% mbw +22°C 32V DC



EUT: QR4000

FCC ID: ZKS-QR4000

FCC Title 47 CFR Part 95 M

EUT: QR4000

Test plots – Frequency stability (Waveform 1 @ 76.845 GHz)

99% mbw +22°C 24V DC



99% mbw +22°C 7V DC



99% mbw +22°C 32V DC



RADIO
EUT: QR4000RADIO
FCC ID: ZKS-QR4000RADIO
FCC Title 47 CFR Part 95 MRADIO
EUT: QR4000

Test plots – Frequency stability (Waveform 0 @ 76.365 GHz)

-40°C with 24 V DC



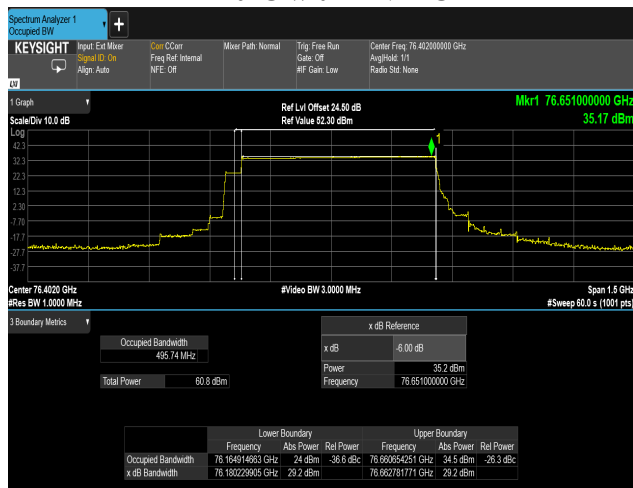
-20°C with 24V DC



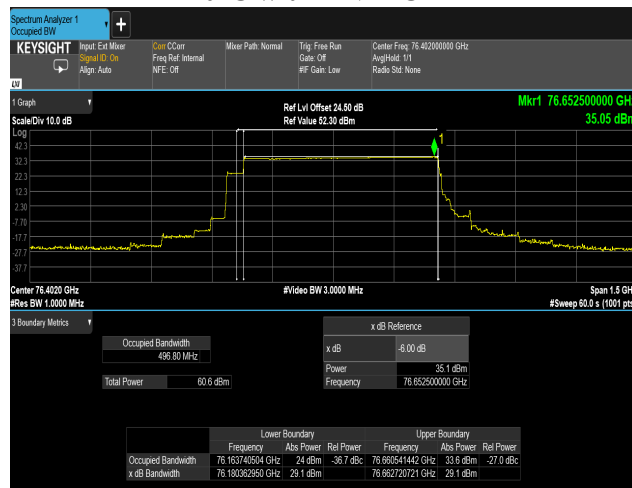
-10°C with 24V DC



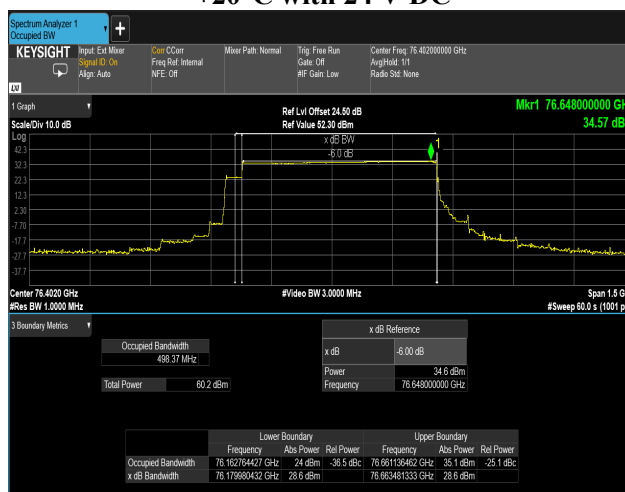
0°C with 24V DC



+10°C with 24V DC



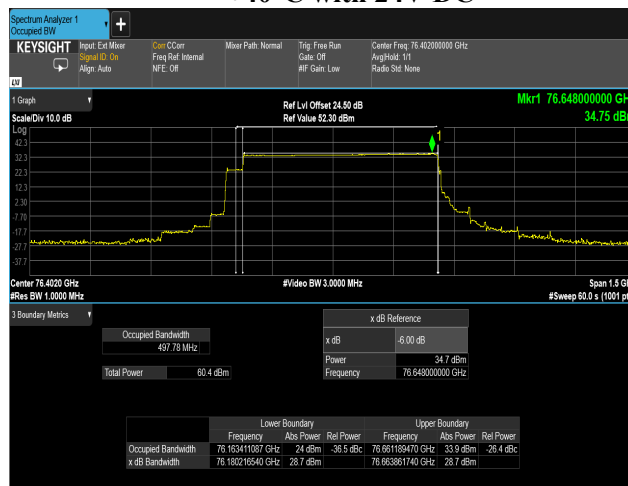
+20°C with 24 V DC



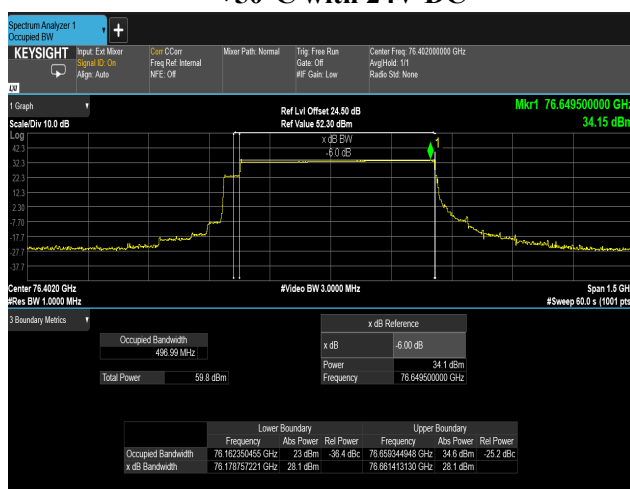
+30°C with 24V DC



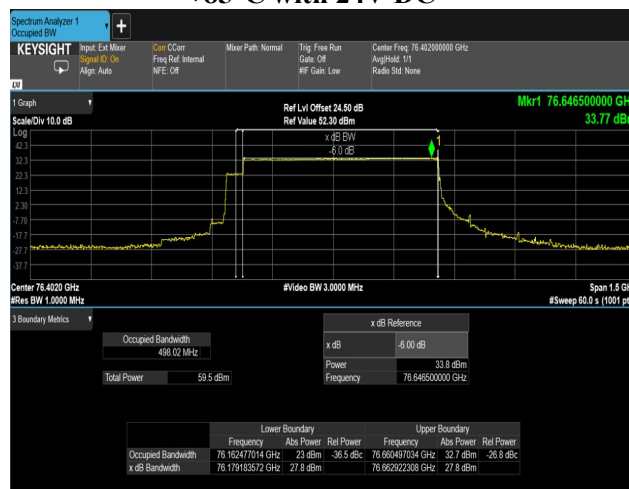
+40°C with 24V DC



+50°C with 24V DC



+85°C with 24V DC



Test plots – Frequency stability (Waveform 0 @ 76.605 GHz)

-40°C with 24 V DC



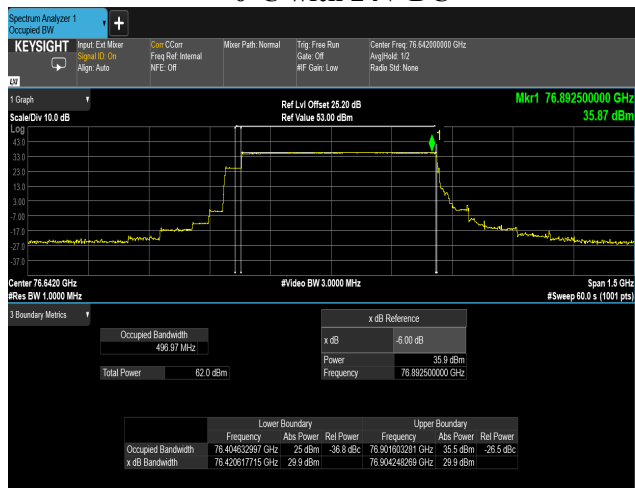
-20°C with 24V DC



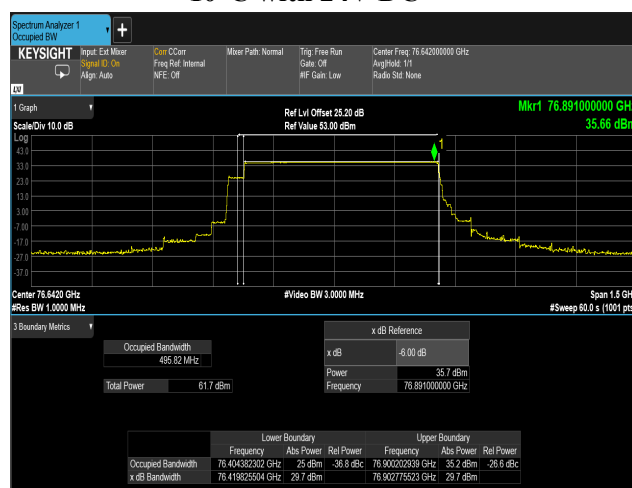
-10°C with 24V DC



0°C with 24V DC



+10°C with 24V DC



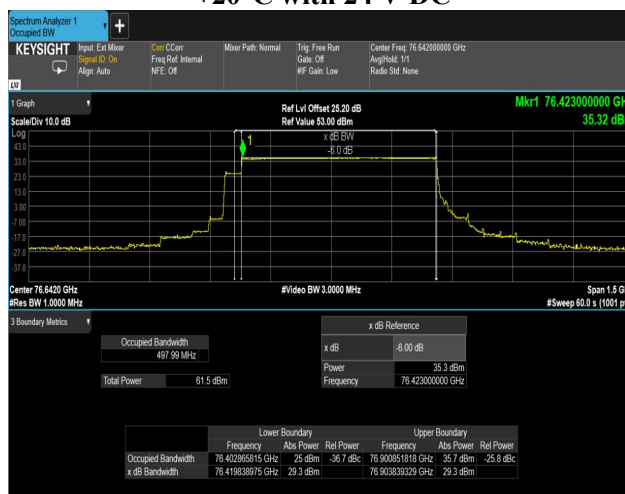
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FCC ID: ZKS-QR4000

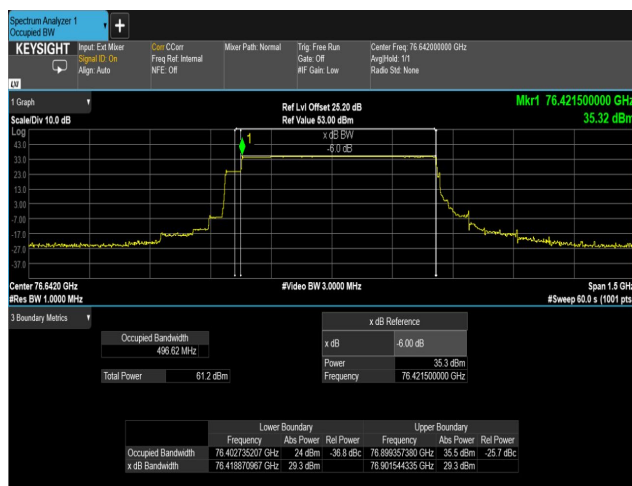
FCC Title 47 CFR Part 95 M

EUT: QR4000

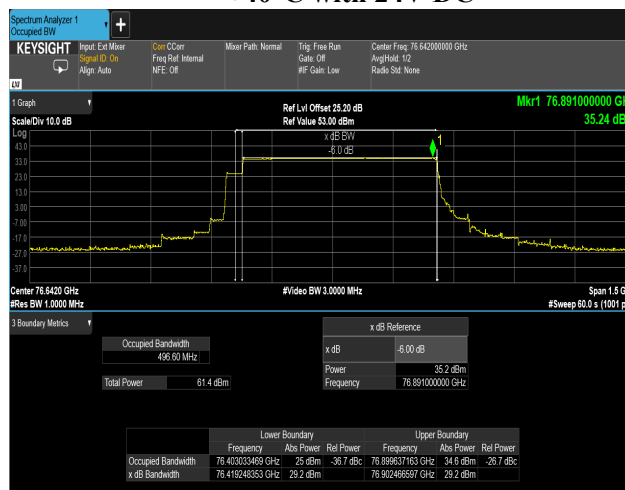
+20°C with 24 V DC



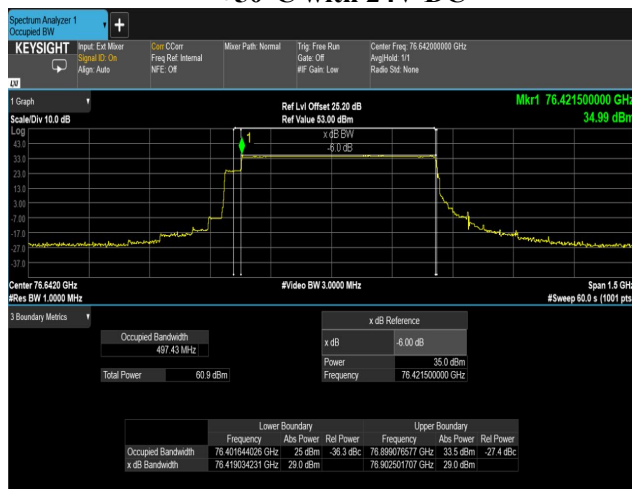
+30°C with 24V DC



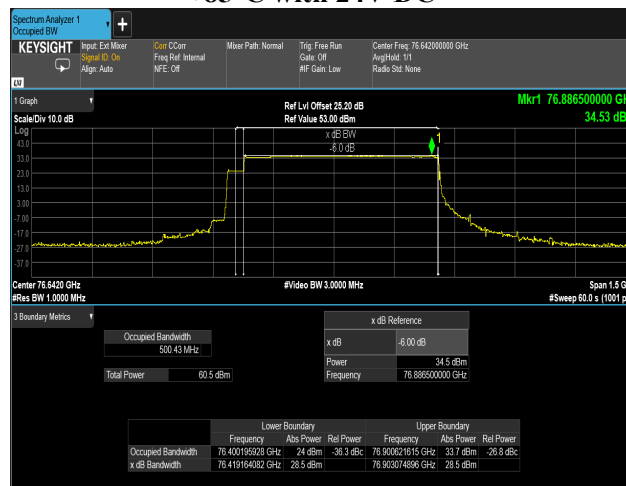
+40°C with 24V DC



+50°C with 24V DC



+85°C with 24V DC



Test plots – Frequency stability (Waveform 1 @ 76.125 GHz)

-40°C with 24 V DC



-20°C with 24V DC



-10°C with 24V DC



0°C with 24V DC



+10°C with 24V DC



EUT: QR4000

FCC ID: ZKS-QR4000

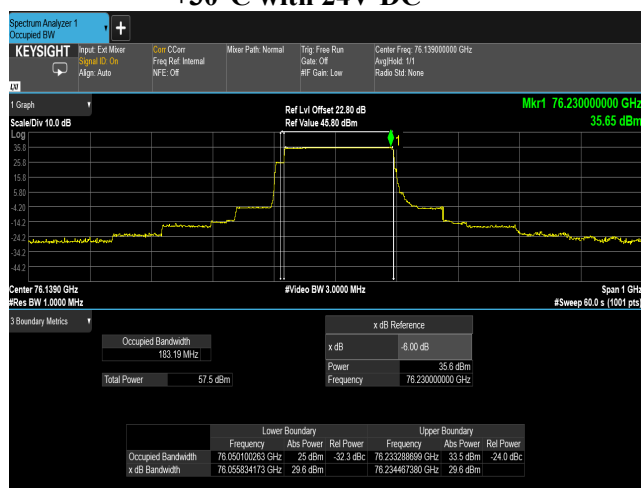
FCC Title 47 CFR Part 95 M

EUT: QR4000

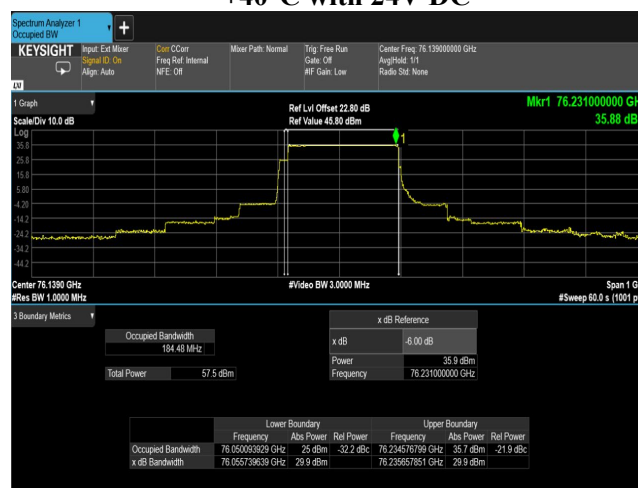
+20°C with 24 V DC



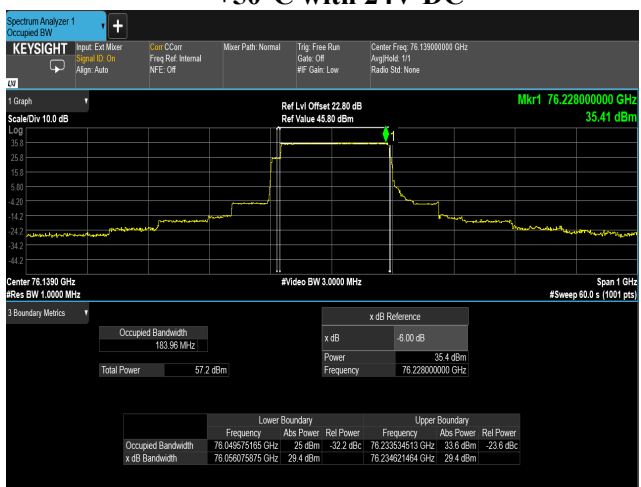
+30°C with 24V DC



+40°C with 24V DC



+50°C with 24V DC



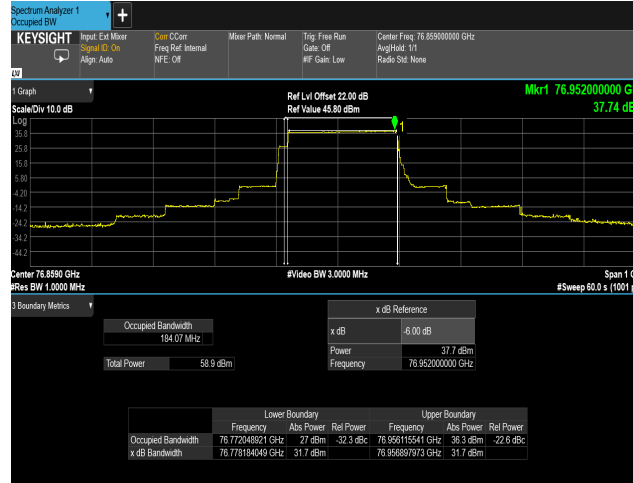
+85°C with 24V DC



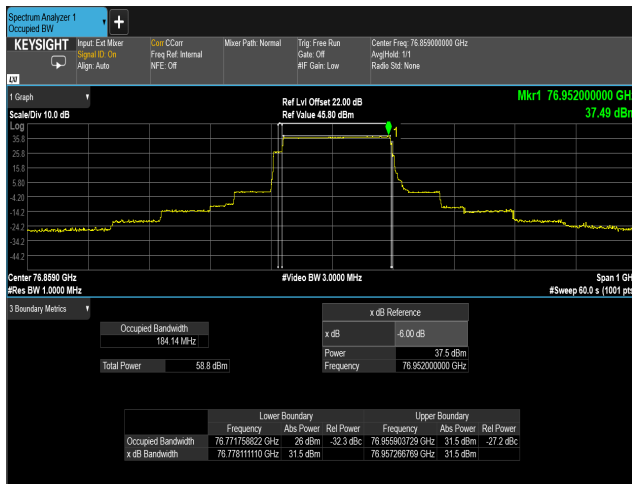
#

Test plots – Frequency stability (Waveform 1 @ 76.845 GHz)

-40°C with 24 V DC



-20°C with 24V DC



-10°C with 24V DC



0°C with 24V DC



+10°C with 24V DC



Spectrum Analyzer 1
 Crossed BW

KEYSIGHT Input Ext Mixer Digital On Align Auto Core Ccorr Freq Ref Internal NFE Off Mixer Path Normal Trig Free Run Gate Off AIF Gain Low Center Freq 76.95000000 GHz AvgHold 1/1 Radio Stat None

Graph
 Scale/Div 10.0 dB
 Ref Lvl Offset 22.00 dB
 Ref Value 45.80 dBm
 Center 76.9500 GHz
 #Res BW 1.0000 MHz
 #Video BW 3.0000 MHz
 Span 1 GHz
 #Sweep 60.0 s (1001)

Boundary Metrics

Occupied Bandwidth		x dB Reference	
155.09 MHz		x dB	-6.00 dB
Total Power	57.7 dBm	Power	36.4 dBm
		Frequency	76.955619493 GHz

Lower Boundary				Upper Boundary			
Occupied Bandwidth	Frequency	Abs Power	Rel Power	Frequency	Abs Power	Rel Power	
x dB Bandwidth	76.78948232 GHz	-26 dBm	-32.1 dBc	76.955619451 GHz	33.2 dBm	-24.5 dBc	
	76.77847552 GHz	30.4 dBm		76.955619493 GHz	30.4 dBm		

Spectrum Analyzer 1
Decoded BW

KEYSIGHT

Input Ext Mode: Digital On, De Align: Auto
Core Ccm: Freq Ref: Internal, NFE: Off
Master Path: Normal
Tsp: Free Run, Gate: Off, #F Gain: Low
Center Freq: 76.85900000 GHz, AutoHold: 1/1, Radio Stk: None

1 Graph
Scale/Div: 10.0 dB
Log
Ref Lvl Offset: 22.00 dB
Ref Value: 45.80 dBm
Mkr1 76.55000000 GHz 36.02 dBm
Center: 76.8590 GHz
#Res BW: 1.0000 MHz
#Video BW: 3.0000 MHz
Span: 1 GHz
#Sweep: 50.0 s (1001 pts)

3 Boundary Metrics

x dB Reference	
Occupied Bandwidth	195.26 MHz
Total Power	57.5 dBm

Lower Boundary		Upper Boundary	
Frequency	Rel Power	Frequency	Rel Power
76.769620851 GHz	25 dBm	76.955097057 GHz	27.9 dBm
x dB Bandwidth	30.0 dBm	76.956602872 GHz	30.0 dBm

Spectrum Analyzer 1
Occupied BW

KEYSIGHT Input: Lvl Mixer Signal: On Align: Auto

Center Freq: 76.85900000 GHz Avg/Hold: 1/1 Radio Std: None

Miner Path: Normal Trig: Free Run Gate: Off RF Gain: Low

1 Graph

Scale/Div 10.0 dB

Log

Ref Lvl Offset 22.00 dB
Ref Value 45.80 dBm

Mkr1 76.951000000 GHz 36.00 dB

Center 76.8590 GHz
#Res BW 1.0000 MHz

#Video BW 3.0000 MHz

Span 1 GHz
#Sweep 60.0 s (1001 p)

3 Boundary Metrics

Occupied Bandwidth	
185.20 MHz	

Total Power 57.5 dBm

x dB Reference	
x dB	-6.00 dB
Power	36.0 dBm
Frequency	76.951000000 GHz

Lower Boundary			Upper Boundary		
Frequency	Abs Power	Ref Power	Frequency	Abs Power	Ref Power
76.789529367 GHz	25 dBm	-32.1 dBm	76.954728835 GHz	35.0 dBm	-22.5 dBm
76.776271765 GHz	30.0 dBm		76.855748794 GHz	30.0 dBm	

Occupied Bandwidth x dB Bandwidth

Spectrum Analyzer 1
Occupied BW

KEYSIGHT Input: Ext Mixer Cal: Corr Mixer Path: Normal Trig: Free Run Center Freq: 76.95000000 GHz
Signal ID: On Freq Ref: Internal Gate: Off Auphold: 1/1
Align: Auto NFE: Off #F Gain: Low Radio Std: None

1 Graph Scale/Div 10.0 dB Ref Lvl Offset 22.00 dB **Mkr1 76.950000000 GHz**
Ref Value 45.80 dBm **36.08 dBm**

Center 76.8990 GHz #Video BW 3.0000 MHz Span 1 GHz
#Sweep 60.0 s (1001 pts)

3 Boundary Metrics

x dB Reference	
x dB	-5.00 dB
Power	36.1 dBm
Frequency	76.95000000 GHz

Lower Boundary				Upper Boundary			
Occupied Bandwidth	Frequency	Abs Power	Ref Power	Frequency	Abs Power	Ref Power	
	76.769519628 GHz	-25 dBm	-32.1 dBc	76.953606373 GHz	34.6 dBm	-22.7 dBc	
x dB Bandwidth	76.776100787 GHz	30.1 dBm		76.954625829 GHz	30.1 dBm		

Occupied Bandwidth: 184.20 MHz
Total Power: 57.3 dBm

Spectrum Analyzer 1
Occupied BW

KEYSIGHT Input: Ext Mixer Signal ID: On Align: Auto Corr: Corr Freq Ref: Internal NFE: Off Mixer Path: Normal Trig: Free Run Gate: Off RF Gain: Low Center Freq: 76.95000000 GHz Avg Hold: 1/1 Radio Stat: None

1 Graph

Scale Div 10.0 dB

Ref Lvl Offset 22.00 dB
Ref Value 45.80 dBm

Mkr1 76.951000000 GHz
35.33 dBm

Center 76.8950 GHz
Span 1 GHz
#Video BW 3.0000 MHz
#Sweep 60.0 s (1001 pts)

3 Boundary Metrics

Occupied Bandwidth		x dB Reference	
183.94 MHz		x dB	-6.00 dB
Total Power	56.7 dBm	Power	35.3 dBm
		Frequency	76.951000000 GHz

Lower Boundary				Upper Boundary			
	Frequency	Abs Power	Rel Power	Frequency	Abs Power	Rel Power	
Occupied Bandwidth	76.769735676 GHz	25 dBm	-32.1 dBc	76.953679446 GHz	31.9 dBm	-24.7 dBc	
x dB Bandwidth	76.776291463 GHz	29.3 dBm		76.954519462 GHz	29.3 dBm		