

Optimal Solution for 5G FR2 MFG

E6681A EXM-WB Wireless Test Set

Be Ready for the Future

Invest your manufacturing (MFG) capital budget wisely with a solution based on the E6681A EXM-WB. The hardware is ready for future requirements of 5G FR2 device MFG with up to 1.2 GHz bandwidth and support for all frequency range 2 (FR2) bands defined by the third-generation partnership project (3GPP) for 5G new radio (NR) operation up to 43.5 GHz.



Choose your bandwidth

3GPP currently defines 5G FR2 signal bandwidths up to 400 MHz. Chipsets and devices with 100-MHz signal bandwidth are common today and devices with higher bandwidths will be available soon. The EXM-WB solution offers three bandwidths for flexible investment options: 300 MHz, 600 MHz, and 1.2 GHz. Software licensing enables quick and easy upgrades to a higher bandwidth later without removing the EXM-WB hardware from the production line.

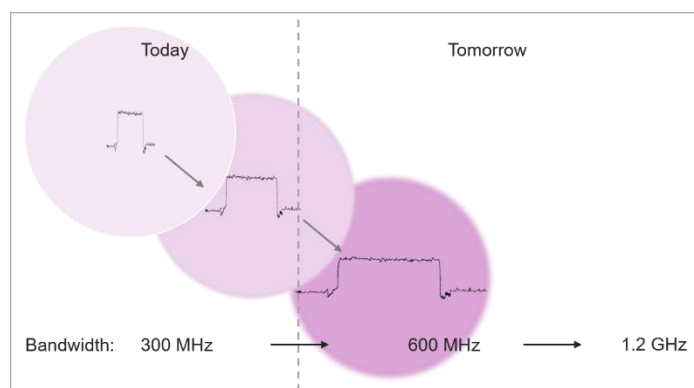


Figure 1. The EXM-WB has three bandwidth selections

The EXM-WB is ready for the future. Choose bandwidth based on your needs today and be confident that the solution will support your bandwidth needs tomorrow.



Solve mmWave test challenges

Keysight solutions overcome challenges created by testing at mmWave frequencies.

- Verify device performance at bandwidths up to 1.2 GHz
- Reduce system loss with a remote radio head
- Rely on the same measurement algorithms already proven at sub-6 GHz frequencies

Reduce Test Development Time

Start testing right away with pre-installed licenses and software applications on the embedded controller of the EXM-WB. The hardware is assembled and ready for you to use – just switch it on and go.

Save valuable test development time by re-using existing test code. The EXM-WB software applications are based on Keysight’s PathWave Signal Studio and PathWave X-Series Measurement Applications, the same as those used on the E6640A EXM and VXT platforms. Your existing test code from EXM or VXT applies almost directly to the EXM-WB solution.

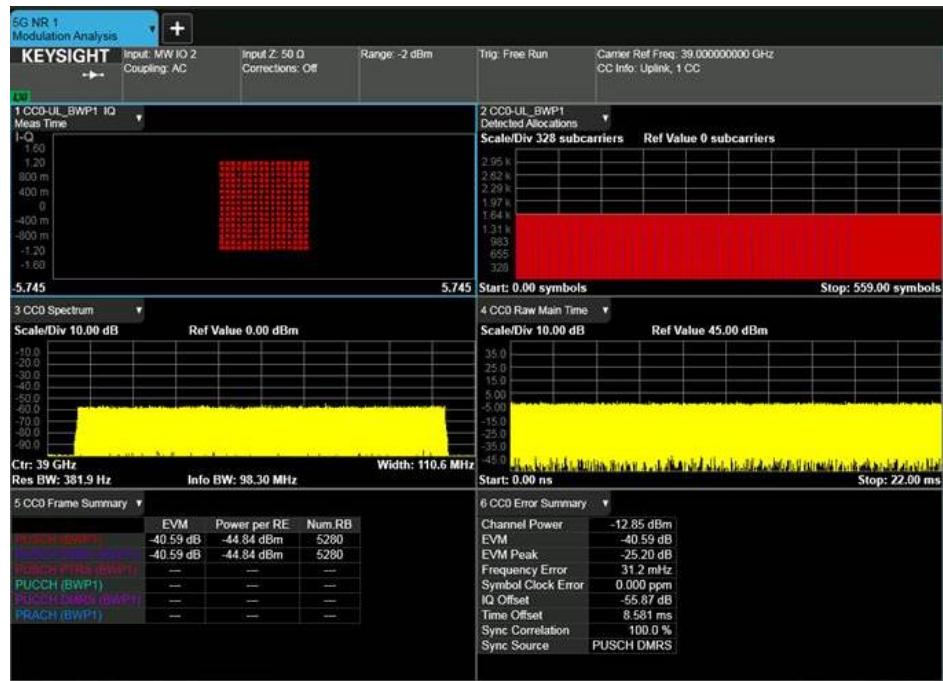


Figure 2. 5G NR modulation accuracy results with 256QAM at 39 GHz

Rely on measurement results proven in multiple Keysight platforms

Test confidently using the same industry-proven 5G NR measurement algorithms from sub-6 GHz frequencies. The 5G NR measurement application is used with many Keysight signal analyzers and transceivers and is enhanced regularly to support the latest 3GPP releases.

The following table summarizes the 3GPP TS 38.521-2 user equipment (UE) conformance specification; radio transmission and reception; part 2: range 2 standalone sections and the measurements within the 5G NR application that are used to verify the performance of a chipset or device.

3GPP	Transmitter test	OTA power	Y9085EM0E 5G NR application
6.2.1	UE maximum output power	EIRP, TRP	Channel power
6.2.2	UE maximum output power reduction (MPR)	EIRP	Channel power
6.2.3	UE maximum output power with additional requirements (A-MPR)	EIRP	Channel power
6.2.4	Configured transmitted power	EIRP, TRP	Channel power
6.3.1	Minimum output power	EIRP	Carrier power in ACP
6.3.2	Transmit OFF power	TRP	Transmit on/off power
6.3.3	Transmit ON/OFF time mask	EIRP	Transmit on/off power
6.4.1	Frequency error	EIRP	Mod. analysis error summary table
6.4.2.1	Error vector magnitude (EVM)	Θ & Φ - each	Mod. analysis error summary table
6.4.2.2	Carrier leakage	EIRP	Mod. analysis error summary table
6.4.2.3	In-band emissions (IBE)	EIRP	Mod. analysis trace selection
6.4.2.4	EVM equalizer spectrum flatness, EVM	Θ & Φ - each	Mod. analysis error summary table
6.2.5	EVM equalizer spectrum flatness for $\pi/2$ BPSK	Θ & Φ - each	Mod. analysis error summary table
6.5.1	Occupied bandwidth (OBW)	EIRP	Occupied BW
6.5.2.1	Spectrum emission mask (SEM)	TRP	Spectrum emission mask (SEM)
6.5.2.3	Adjacent channel leakage ratio (ACLR)	TRP	ACP
6.5.3	Spurious emissions	TRP	Spurious emissions (requires external signal generator)

Total radiated power (TRP) and effective isotropic radiated power (EIRP) are two types of measurements made over the air (OTA) in an anechoic chamber to measure the performance of antennas at mmWave frequencies. EIRP measures the performance of each antenna beam and is, therefore, a directional test. TRP measures the total power radiated by an antenna.

Theta (θ), also called elevation or vertical polarization, represents the variable angle at which antenna beams are transmitted. An antenna's transmission on a horizontal plane is represented as phi (Φ), also called azimuth or horizontal polarization. A positioner within the anechoic chamber is used to move the device under test (DUT) to fully characterize behavior in all dimensions. Depending on the complexity of the antenna or antenna array, characterization can require several hours.

More information about testing over the air is available in a Keysight white paper:

OTA Test for Millimeter-Wave 5G NR Devices and Systems - White Paper.

In device manufacturing, key device specifications are verified while keeping the overall test time and complexity to levels which meet cost targets. Therefore, a subset of the measurements defined in 3GPP TS 38.521-2 is performed in a manufacturing environment. Typical measurements might include maximum output power, OBW, SEM, ACLR, and EVM, measured with the device in one position using several horn antennas located within the chamber to capture the desired radiated power.

Optimize Throughput

Controlling a DUT is essential to verify performance. Non-signaling test solutions are typically preferred in manufacturing environments because the DUT responds more quickly. However, these solutions cannot use signaling to control a DUT. Instead, the EXM-WB makes use of the control software of chipset vendors. The EXM-WB is endorsed in QDART and integration with other chipset vendors is in progress.

Decrease test time with sequencing and parallel test

Sequencing is one method of decreasing overall test time. A set of test steps is prepared in one sequence and then initiated with a single trigger. Test speed increases since fewer commands are used. The sequence analyzer of the EXM-WB solution supports 5G NR measurement sequences with varying power levels and frequencies.

Measurement	Measurement Item	Result	P/F
NR5G ACP	Overall Pass/Fail	Pass	P
	Total Carrier Power	-19.88 dBm	---
	Ref Carrier Power	0.000 dBm	---
	Carrier 1 Rel Pwr	-19.88 dB	---
	Carrier 1 Abs Pwr	-19.88 dBm	---
	Lower A Rel Pwr	-62.11 dB	P
	Lower A Abs Pwr	-62.11 dBm	P
	Upper A Rel Pwr	-57.70 dB	P
	Upper A Abs Pwr	-57.70 dBm	P
	Lower B Rel Pwr	-65.82 dB	P
	Lower B Abs Pwr	-65.82 dBm	P
	Upper B Rel Pwr	-62.51 dB	P
	Upper B Abs Pwr	-62.51 dBm	P
	NR5G SEM	Overall Pass/Fail	Pass
Total Power Ref		-19.91 dBm	---
Peak Freq Ref		956.5 MHz	---
Lower A Abs Int Pwr		-65.14 dBm	---
Lower A Rel Int Pwr		-45.23 dB	---
Lower A Abs Peak Pwr		-77.72 dBm	---
Lower A Rel Peak Pwr		-57.81 dB	---
Lower A Peak Freq		-50.05 MHz	---
Lower A Δ Limit		-72.22 dB	P
Upper A Abs Int Pwr		-66.01 dBm	---
Upper A Rel Int Pwr		-46.10 dB	---
Upper A Abs Peak Pwr		-85.35 dBm	---
Upper A Rel Peak Pwr		-65.44 dB	---
Upper A Peak Freq		55.05 MHz	---
Upper A Δ Limit		-72.85 dB	P

Figure 3. 5G NR ACP and SEM results using the EXM-WB sequence analyzer

Parallel test is another method of decreasing overall test time. The new V9065EM2E parallel analysis of multiple devices software application runs with or without the sequence analyzer to provide fast test

speed. Test time is significantly reduced when data is analyzed while configuring the device for the next tests and acquiring the next sets of data.

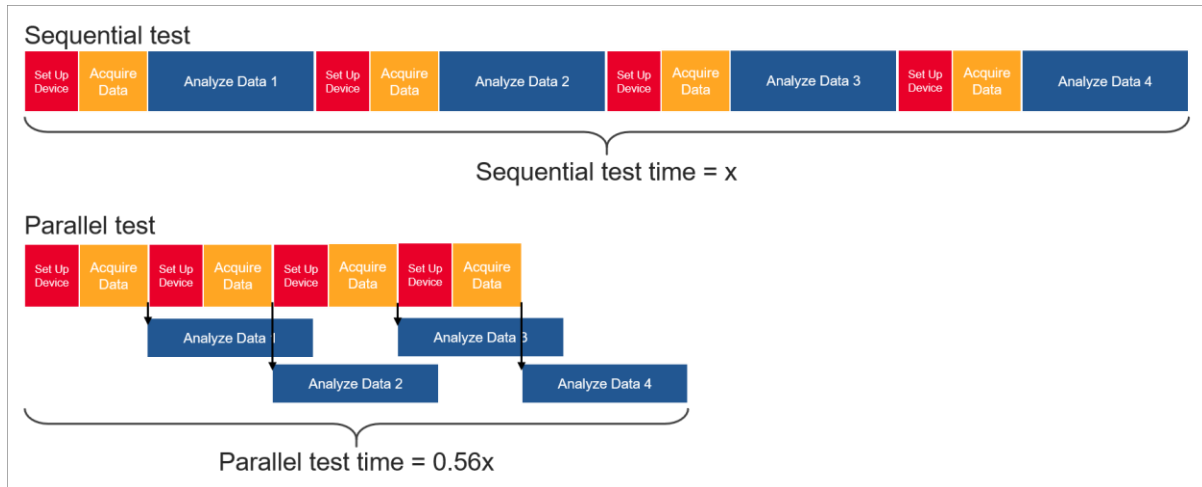


Figure 4. Example of speed improvement when using parallel test

Verify multiple devices with a flexible, compact solution

Connect once to test the RF performance of your 5G FR2 device. Many use cases are supported with the combination of the E6681A EXM-WB wireless test, the M1740A remote radio head (RRH), and optional OTA chamber with accessories. Choose the configuration that provides optimal throughput for your manufacturing area.

- Select one or two transceivers in a single E6681A EXM-WB chassis
 - With two transceivers, verify the RF performance of two devices independently with no need for synchronization
 - With one transceiver, verify the RF performance of two devices using parallel analysis

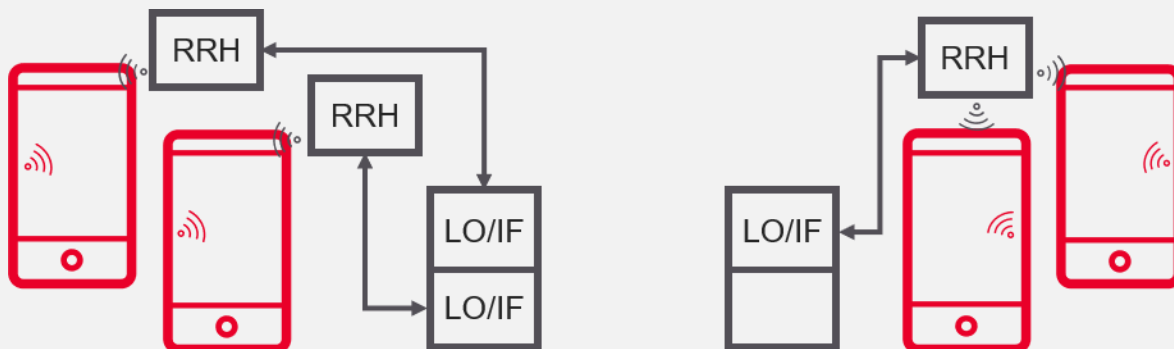


Figure 5. Two use cases for testing two devices with EXM-WB: independent test and parallel test

- Connect one or more M1740A RRH with each transceiver
- Verify RF performance of one or more device antennas using the two bi-directional RF ports on each RRH
 - Test a single channel of two antennas without reconnection or external switching
 - Test two polarizations of a single channel without reconnection or external switching
 - Test Tx and Rx independently at the same frequencies or at different frequencies
 - Loop back Tx and Rx with one RRH and one EXM-WB
- Add external switches to test more antennas and polarizations
- Use optional OTA chamber, switches, and horn antennas for a complete 5G FR2 solution

Ordering Information

Option number	Description	Requirements
E6681A-001	Transceiver 1	Mandatory
• E6681A-B3X	Bandwidth, 300 MHz	Default
• E6681A-B6X	Bandwidth, 600 MHz	Optional
• E6681A-B12	Bandwidth, 1.2 GHz	Optional
E6681A-002	Transceiver 2	Optional
• E6681A-B3X	Bandwidth, 300 MHz	Default
• E6681A-B6X	Bandwidth, 600 MHz	Optional
• E6681A-B12	Bandwidth, 1.2 GHz	Optional
Software applications		
V9065EM1E	Sequence analyzer for device applications	Included
V9065EM2E	Parallel analysis of multiple devices	Mandatory
V9085EM1E	PAvT measurement application	Optional
Y9085EM0E	5G NR non-signaling waveform and measurement application	Mandatory

Efficiently Verify 5G FR2 Devices in Manufacturing

The E6681A EXM-WB wireless test set, M1740A RRH, and optional OTA chamber are a quick and cost-effective solution for 5G FR2 chipset and device MFG test.

- Purchase what is needed today and be ready for tomorrow using software-only upgrades and three bandwidth options
- Start testing right away with licensing and software apps pre-installed on the embedded controller
- Reduce test development time by re-using existing test code from the E6640A EXM or VXT
- Optimize throughput with sequencing, chipset control, and flexible configurations

Conclusion

The E6681A EXM-WB is the optimal solution for your 5G FR2 device manufacturing needs.

More information is available at www.keysight.com/find/exmwb and at the following links.

M1740A mmWave transceiver for 5G (RRH): www.keysight.com/find/rrh

Keysight 5G solutions: www.keysight.com/find/5g

E6640A EXM mmWave non-signaling solution: [5G non-signaling manufacturing test solution](#)

E7760B mmWave non-signaling solution: www.keysight.com/find/e7760b

Learn more at: www.keysight.com

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