Keysight Technologies
DTMB (CTTB)
X-Series Measurement Application
N6156A & W6156A

Technical Overview

KEYSIGHT
TECHNOLOGIES

Introduction

- Measure DTMB (CTTB) transmitters, exciters, modulators, gap-fillers, tuners, or amplifiers performance
- Perform one-button tests with pass/fail limit per DTMB (CTTB) standards
- Use hardkey/softkey manual user interface or SCPI remote user interface
- Leverage built-in, context-sensitive help
- Move the application between X-Series signal analyzers with transportable licensing
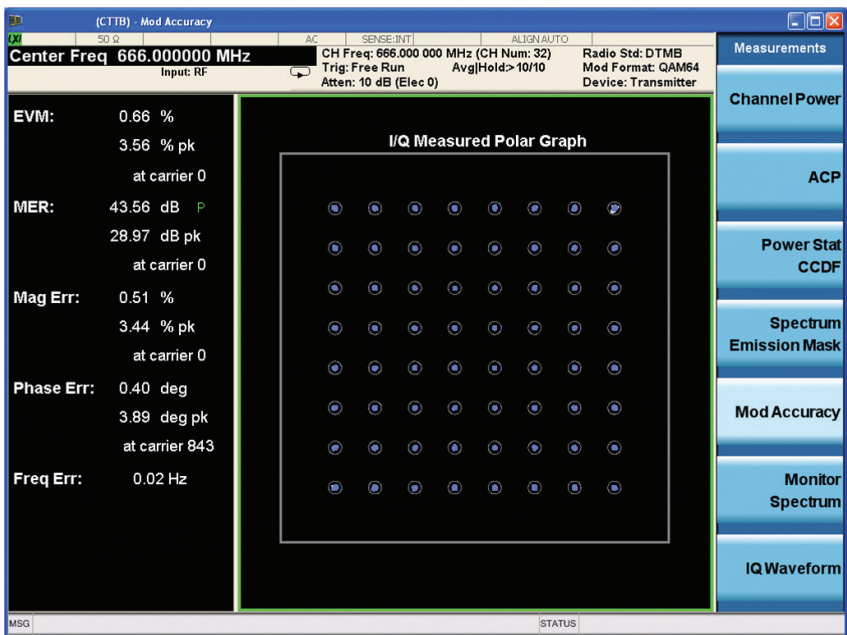
DTMB (CTTB) Measurement Application

The Keysight Technologies, Inc. DTMB (CTTB) measurement application provides one-button standard-based power and modulation analysis capabilities to help your design, evaluation, and manufacturing of DTMB (CTTB) modulators, transmitters, amplifiers, tuners, and gap-fillers/repeaters. Furthermore, with the optional analog baseband IQ inputs in the PXA or MXA signal analyzer, it can provide you the flexibility of measuring the signal quality and modulation accuracy with RF input or analog IQ input.

The DTMB (CTTB) measurement application is just one in a common library of more than 25 measurement applications in the Keysight X-Series, an evolutionary approach to signal analysis that spans instrumentation, measurements, and software. The X-Series analyzers, with upgradeable CPU, memory, disk drives, and I/O ports, enable you to keep your test assets current and extend instrument longevity. Proven algorithms, 100% code-compatibility, and a common UI across the X-Series create a consis-

tent measurement framework for signal analysis that ensures repeatable results and measurement integrity so you can leverage your test system software through all phases of product development. In addition to fixed, perpetual licenses for our X-Series measurement applications, we also offer transportable licenses which can increase the value of your investment by allowing to you transport the application to multiple X-Series analyzers.

Key parameter setup

– Carrier mode: OFDM (C = 3780) and single carrier (C = 1)
– Device type: Transmitter/exciter
– Bandwidth: 6 and 8 MHz
– Header type: PN 420/595/945
– Modulation: 4QAM-NR/4QAM/16QAM/32QAM/64QAM
– Input: RF or analog IQ (available in the N9030A PXA or N9020A MXA) for signal quality and modulation accuracy measurements

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Technology Overview

Digital terrestrial/television multi-media broadcasting (DTMB), also known as China terrestrial television broadcasting (CTTB), is the Chinese national terrestrial digital TV broadcasting standard which was announced on August 18, 2006 and implemented from August 1, 2007.

DTMB supports both multi-carrier (C=3780) and single-carrier (C=1) modulation scheme. Both schemes use low density parity check (LDPC) coding in forward error correction (FEC), which can provide superior error correction capability for a bet-ter sensitivity especially at higher code rate. Time domain synchronized orthogonal frequency division multi-plexing (TDS-OFDM) is implemented to deliver fast system synchronization and precise channel estimation.

The DTMB (CTTB) measurement ap-plication gives more convenience to your DTMB (CTTB) system develop-ment and manufacturing, including both multi-carrier and single-carrier schemes with one-button measure-ments including standard presets and remote SCPI programming capabili-ties on X-Series signal analyzers.
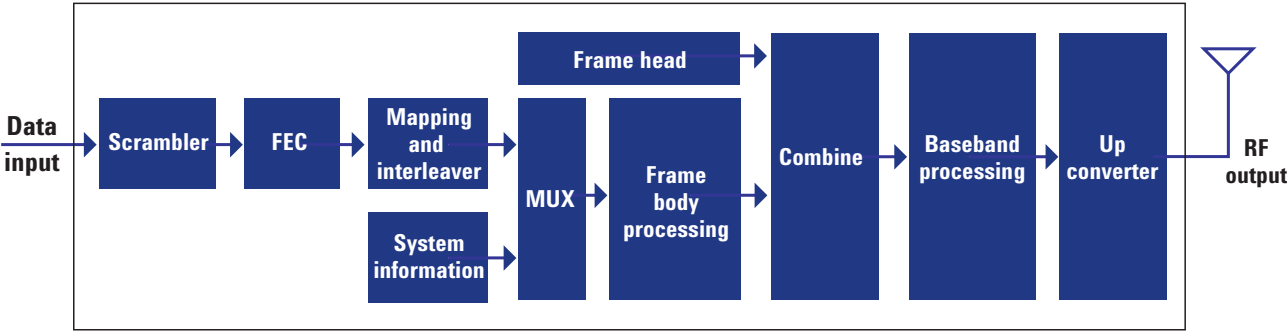
Figure 1. Block diagram of DTMB (CTTB) system

RF Transmitter Tests

The RF transmitter test requirements for DTMB transmitter and exciter are defined in GY/T 229.4 2008 and GY/T 229.2 2008 standards. Table 1 shows RF transmitter and exciter tests defined by the specification along with the corresponding measurements provided by the DTMB (CTTB) measurement application.

Table 1. Required RF transmitter and exciter measurements and the corresponding measurements in N/W6156A and other modes

Test item	GY/T 229.4 2008 (For transmitter measurement)	GY/T 229.2 2008 (For exciter measurement)	N/W6156A DTMB(CTTB) measurement application
Frequency adjustable step	●	●	Spectrum analyzer mode (marker counter function)
Frequency stability	●	●	Spectrum analyzer mode (marker counter function)
Frequency accuracy	●	●	Spectrum analyzer mode (marker counter)
RF power		●	Channel power (RF spectrum view)
RF power stability	●	●	Channel power (RF spectrum view)
RF effective bandwidth		●	Spectrum analyzer mode (marker counter function)
Roll factor		●	Spectrum analyzer mode (marker counter function)
Shoulder attenuation	●	●	Channel power (shoulder attenuation view)
Spectrum mask	●		Channel power (spectrum mask view) or spectrum emission mask
In-band spectrum flatness	●	●	Modulation accuracy (spectral flatness view)
Useless power in adjacent channel	●	●	ACP
Power outside adjacent channel	●	●	ACP
Phase noise	●	●	N/W9068A phase noise measurement application
Peak-to-average power ratio		●	Power stat CCDF
Modulation error ratio	●	●	Modulation accuracy (I/Q measured polar graph view)

Measurement details

All of the RF transmitter measure-ments as defined by the DTMB (CTTB) standard, as well as a wide range of additional measurements and analysis tools, are available with a press of a button (Table 2). These measurements are fully remote con-trollable via the IEC/IEEE bus or LAN, using SCPI commands.

Analog baseband measurements are available on the PXA or MXA signal analyzer equipped with BBIQ hardware. Supported baseband mea-surements include all of the modula-tion quality plus I/Q waveform and CCDF measurements.

Table 2. One-button measurements provided by the N/W6156A measurement application

| Technology	DTMB (CTTB)
Measurements	Channel power
	RF spectrum
	Shoulder attenuation
	Spectrum mask (with analog TV in adjacent channel)
	Adjacent channel power
	Spectrum emission mask
	Monitor spectrum
	IQ waveform
	Modulation accuracy
	RMS EVM (%)
	Peak EVM (%)
	Position of peak EVM
	RMS MER (dB)
	Peak MER (dB)
	Position of peak MER
	RMS mag error (%)
	Peak mag error (%)
	Position of peak mag error
	RMS phase error (deg)
	Peak phase error (deg)
	Position of peak phase error
	Frequency error (Hz)
	Clock error (Hz)
	Tx power (dBm)
	Quadrature error (deg)
	Amplitude imbalance (%)
	MER/EVM vs. subcarriers/frequency
	Ampt vs subcarriers (dB)
	Phase vs subcarriers (deg)
	Group Delay vs subcarriers (ns)
	Channel impulse response (dB)
	MER of data block (dB)
	MER of system info (dB)
	MER of header (dB)
	In-band spectrum ripple Amax-Ac (dB)
	In-band spectrum ripple Amin-Ac (dB)
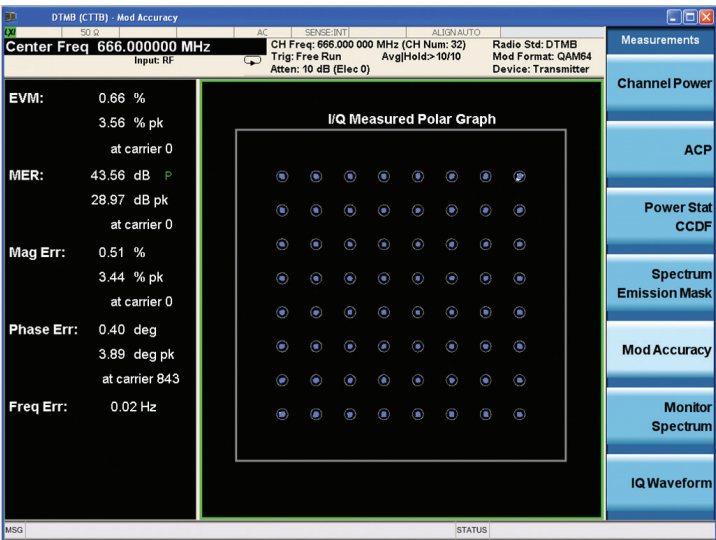
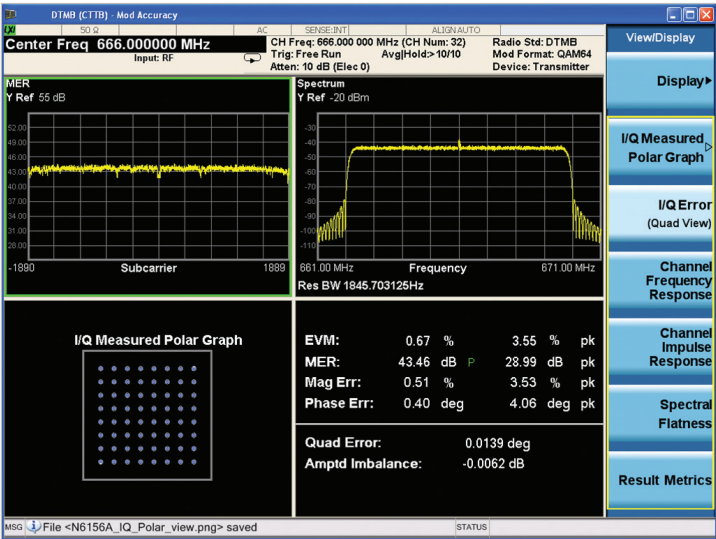Figure 2. DTMB (CTTB) constellation and MER results
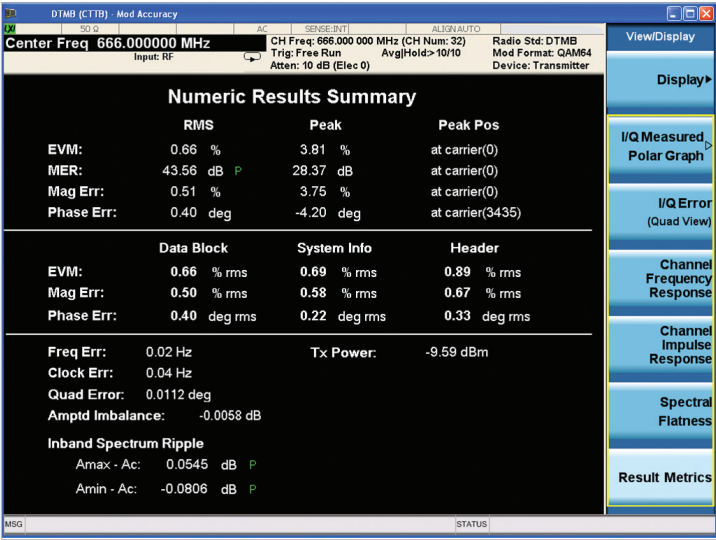

Figure 3. DTMB (CTTB) IQ quad view

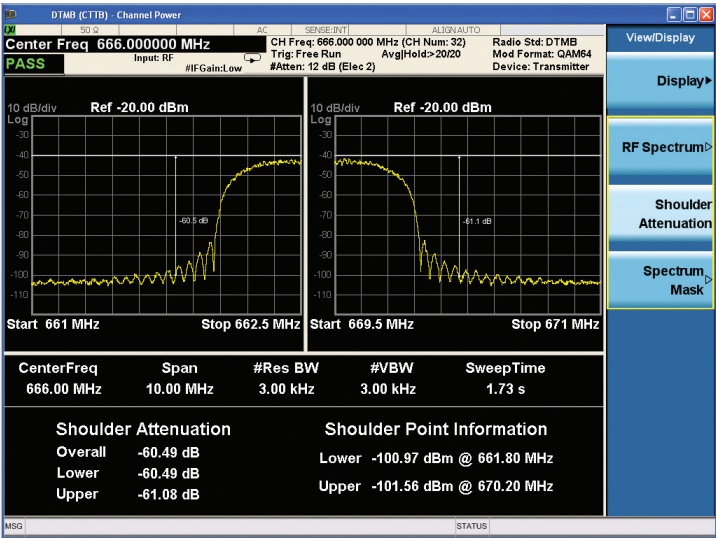Figure 4. DTMB (CTTB) result metrics view
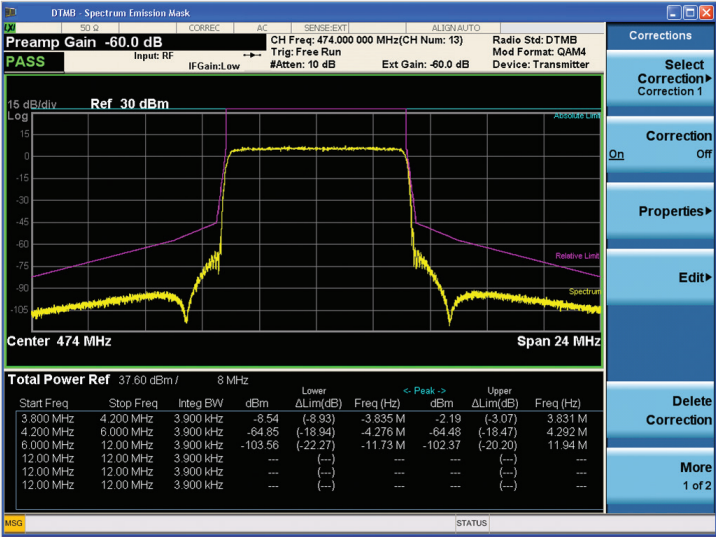
Figure 5. DTMB (CTTB) shoulder attenuation

Figure 6. DTMB (CTTB) spectrum emission mask

Key Specifications

Definitions

– Specifications describe the performance of parameters.
– 95th percentile values indicate the breadth of the population ($\approx 2\sigma$) of performance tolerances expected to be met in 95% of cases with a 95% confidence.
– Typical values are designated with the abbreviation "typ." These are performance beyond specification that 80% of the units exhibit with a 95% confidence.
– Nominal values are designated with the abbreviation "nom." These values indicate expected performance, or describe product performance that is useful in the application of the product.
– PXA and EXA specifications apply to analyzers with frequency options of 526 and lower. For analyzers with higher frequency options, specifications are not warranted but performance will nominally be close to that shown in this section.

Note: Data subject to change

You Can Upgrade!

Options can be added after your initial purchase.

All of our X-Series application options are license-key upgradeable.

UP GRADE

Description	PXA	MXA	EXA	CXA
Channel power				
8 MHz integration bandwidth	–50 dBm (nom)	–50 dBm (nom)	–50 dBm (nom)	–50 dBm (nom)
Absolute power accuracy				
20 to 30 °C	± 0.61 dB (± 0.19 dB 95%)	± 0.82 dB (± 0.23 dB 95%)	± 0.94 dB (± 0.27 dB 95%)	± 1.33 dB (± 0.61 dB 95%)
Measurement floor	–85.7 dBm	–82.7 dBm	–78.7 dBm	–75.7 dBm
Channel power with shoulder attenuation view				
7.61 MHz Integration bandwidth	ML[1] = –14.0 dBm (nom)	ML[1] = –16.0 dBm (nom)	ML[1] = –16.0 dBm (nom)	ML[1] = –15.0 dBm (nom)
Dynamic range, relative				
Offset frequency				
4.2 MHz	98.4 dB (103.7 dB typ)	92.2 dB (98.5 dB typ)	86.9 dB (94.0 dB typ)	84.5 dB (91.7 dB typ)
Power statistics CCDF				
Minimum power at RF input	–50 dBm (nom)	–50 dBm (nom)	–50 dBm (nom)	–50 dBm (nom)
Histogram resolution	0.01 dB	0.01 dB	0.01 dB	0.01 dB
Adjacent channel power				
Minimum power at RF Input; 0 to 55 °C	–36 dBm (nom)	–36 dBm (nom)	–36 dBm (nom)	–36 dBm (nom)
ACPR accuracy	7.56 MHz noise bandwidth, method = IBW			
Offset frequency 10 MHz	± 0.18 dB	± 0.44 dB	± 0.93 dB	± 1.36 dB

1. ML (mixer level) is RF input power minus attenuation

Description	PXA	MXA	EXA	CXA
Spectrum emission mask	7.56 MHz Integration BW, RBW=3.9 kHz			
4.2 MHz offset				
Dynamic range, relative	98.4 dB (103.7 dB typ)	92.2 dB (98.5 dB typ)	86.9 dB (94.0 dB typ)	84.5 dB (91.7 dB typ)
Sensitivity, absolute	–114.5 dB (–118.5 dBm typ)	–110.5 dBm (-115.5 dBm typ)	–105.5 dBm (–111.5 dBm typ)	–102.5 dBm (–108.5 dBm typ)
Accuracy				
Relative	± 0.10 dB	± 0.18 dB	± 0.18 dB	± 0.27 dB
Absolute, 20 to 30 °C	± 0.62 dB (± 0.20 dB 95%)	± 0.88 dB (± 0.23 dB 95%)	± 1.05 dB (± 0.31 dB 95%)	± 1.53 dB (± 0.64 dB 95%)
10.0 MHz offset				
Dynamic range, relative	100.8 dB (106.1 dB typ)	94.6 dB (100.6 dB typ)	89.3 dB (96.0 dB typ)	87.1 dB (95.0 dB typ)
Sensitivity, absolute	–114.5 dB (–118.5 dBm typ)	–110.5 dBm (–115.5 dBm typ)	–105.5dBm (–111.5 dBm typ)	–102.5 dBm (–108.5 dBm typ)
Accuracy				
Relative	± 0.12 dB	± 0.21 dB	± 0.21 dB	± 0.36 dB
Absolute	± 0.62 dB (± 0.20 dB 95%)	± 0.88 dB (± 0.23 dB 95%)	± 1.05 dB (± 0.31 dB 95%)	± 1.53 dB (± 0.64 dB 95%)
Mod accuracy				
16QAM EVM, ML[1] = –20 dBm, 20 to 30 °C				
Sub-carrier number: 3780, Frame header: PN420, Code rate: 0.8, Interleaver type: B=52, M=720, PN phase change: true				
EVM	EQ Off			
Operating range	0 to 7%	0 to 7%	0 to 7%	0 to 7%
Floor	0.27%	0.47%	0.60%	0.79%
Accuracy				
from 0.3 to 1.4% (from 0.5% for MXA, 0.6% for EXA)	± 0.20%	± 0.20%	± 0.30%	
from 1.4 to 2.0%	± 0.20%	± 0.30%	± 0.30%	
from 2.0 to 7.0%	± 0.70%	± 0.70%	± 0.70%	
MER	EQ Off			
Operating range	≥ 23 dB	≥ 23 dB	≥ 23 dB	≥ 23 dB
Floor	51 dB	47 dB	45 dB	42 dB
Accuracy				
from 37 to 51 dB (to 46 dB for MXA, 44 for EXA)	± 2.90 dB	± 2.88 dB	± 2.96 dB	
from 34 to 37 dB	± 0.82 dB	± 0.92 dB	± 1.09 dB	
from 23 to 34 dB	± 0.81 dB	± 0.84 dB	± 0.89 dB	
16QAM EVM, ML[1] = –20 dBm, 20 to 30 °C				
Sub-carrier number: 1, Frame header: PN595, Code rate: 0.8, Interleaver type: B=52, M=720, PN phase change: true, Insert pilot: false				
EVM	EQ Off			
Operating range	0 to 8%	0 to 8%	0 to 8%	0 to 8%
Floor	1.20%	1.28%	1.36%	1.10%
Accuracy				
from 1.2%/1.3%/1.4% (PXA/MXA/EXA) to 2.0%	± 0.50%	± 0.60%	± 0.60%	
from 2.0 to 8.0%	± 0.40%	± 0.40%	± 0.50%	
MER	EQ Off			
Operating range	≥ 22 dB	≥ 22 dB	≥ 22 dB	≥ 22 dB
Floor	39 dB	38 dB	38 dB	39.2 dB
Accuracy				
from 34 to 38 dB/37 dB/37 dB (PXA/MXA/EXA)	± 2.76 dB	± 2.59 dB	± 2.81 dB	
from 22 to 34 dB	± 1.30 dB	± 1.48 dB	± 1.62 dB	

1. ML (mixer level) is RF input power minus attenuation

Ordering Information

Software licensing and configuration

Choose from two license types:

- **Fixed, perpetual license:**
  This allows you to run the application in the X-Series analyzer in which it is initially installed.

- **Transportable, perpetual license:**
  This allows you to run the application in the X-Series analyzer in which it is initially installed, plus it may be transferred from one X-Series analyzer to another.

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The table below contains information on our fixed, perpetual licenses. For more information, please visit the product web pages.

N6156A & W6156A DTMB (CTTB) X-Series measurement application

Description	Model-Option	Model-Option	Additional information
	PXA, MXA, EXA	CXA/CXA-m[1]	
DTMB (CTTB)	N6156A-2FP	W6156A-2FP	

1. The CXA-m only supports transportable license. Visit the product web page for further information.

For a complete list of specifications refer to the appropriate specifications guide.

PXA: www.keysight.com/find/pxa/specifications
MXA: www.keysight.com/find/mxa/specifications
EXA: www.keysight.com/find/exa/specifications
CXA: www.keysight.com/find/cxa/specifications

Hardware Configurations

N9030A PXA signal analyzer

Description	Model-Option	Additional information
3.6, 8.4, 13.6, 42.98, 44 or 50 GHz frequency range	N9030A-503, -508, -513, -526, -543, -544, or -550	One required
Analog baseband IQ (BBIQ) inputs	N9030A-BBA	Required for analog baseband measurement
Precision frequency reference	N9030A-PFR	Recommended
Electronic attenuator, 3.6 GHz	N9030A-EA3	Recommended
Preamplifier, 3.6, 8.4, 13.6, 42.98, 44 or 50 GHz	N9030A-P03, -P08, -P13, -P26, -P43, -544, or -550	
Analysis bandwidth to 25, 40, or 160 MHz	N9030A-B25, -B40, or -B1X	One optional
Wideband IF output	N9030A-CR3	Optional
Programmable IF output	N9030A-CRP	Optional

N9020A MXA signal analyzer

Description	Model-Option	Additional information
3.6, 8.4, 13.6, or 26.5 GHz frequency range	N9020A-503, -508, -513, or -526	One required
Analog baseband IQ (BBIQ) inputs	N9020A-BBA	Required for analog baseband measurement
Precision frequency reference	N9020A-PFR	Recommended
Electronic attenuator, 3.6 GHz	N9020A-EA3	Recommended
Preamplifier, 3.6, 8.4, 13.6, or 26.5 GHz	N9020A-P03, -P08, -P13, or -P26	One recommended
Analysis bandwidth to 25 or 40 MHz	N9020A-B25, -B40	One optional
Wideband IF output	N9020A-CR3	Optional
Programmable IF output	N9020A-CRP	Optional

N9010A EXA signal analyzer

Description	Model-Option	Additional information
3.6, 7.0, 13.6, or 26.5 GHz frequency range	N9010A-503, -507, -513, or -526	One required
Precision frequency reference	N9010A-PFR	Recommended
Fine step attenuator	N9010A-FSA	Recommended
Electronic attenuator, 3.6 GHz	N9010A-EA3	Recommended
Preamplifier, 3.6 or 7.0 GHz	N9010A-P03 or -P07	One recommended
Analysis bandwidth to 25 or 40 MHz	N9010A-B25, -B40	One optional
Wideband IF output	N9010A-CR3	Optional
Programmable IF output	N9010A-CRP	Optional

N9000A CXA signal analyzer

Description	Model-Option	Additional information
3.0, 7.5, 13.6, or 26.5 GHz frequency range	N9000A-503, -507, -513, or -526	One required
Precision frequency reference	N9000A-PFR	Recommended
Analysis bandwidth to 25 MHz	N9000A-B25	Optional
Tracking generator, 9 kHz to 3GHz or 6 GHz	N9000A-T03 or T06	One optional
Fine step attenuator	N9000A-FSA	Recommended
Preamplifier, 3.0, 7.5, 13.6, or 26.5 GHz	N9000A-P03, -P07, -P13, or -P26	One recommended
Wideband IF output	N9000A-CR3	Optional

Related Literature

N6156A and W6156A DTMB (CTTB) Measurement Application, Demonstration Guide, literature number 5990-5933EN

N6156A & W6156A DTMB(CTTB) Measurement Application, Measurement Guide, part number N6156-90004

N6156A & W6156A DTMB(CTTB) Measurement Application, User's and Programmer's Reference, part number N6156-90001

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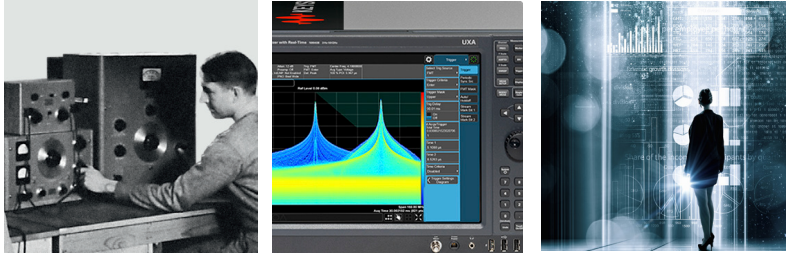**www.keysight.com/find/digitalvideo**

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