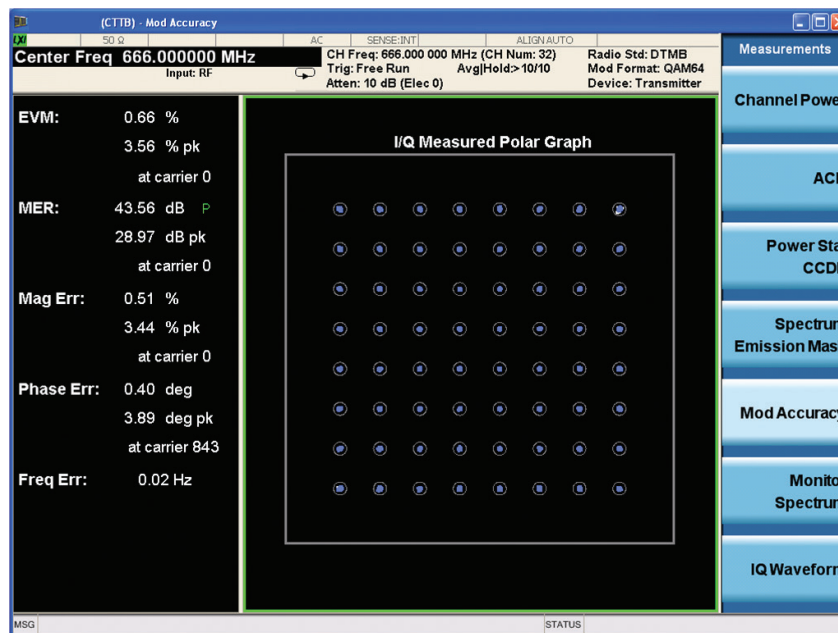


Keysight Technologies

DTMB (CTTB)

X-Series Measurement App, Traditional UI N6156EMOD

Technical Overview



- 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
- Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers

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.

X-Series measurement applications can help you:

- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).

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

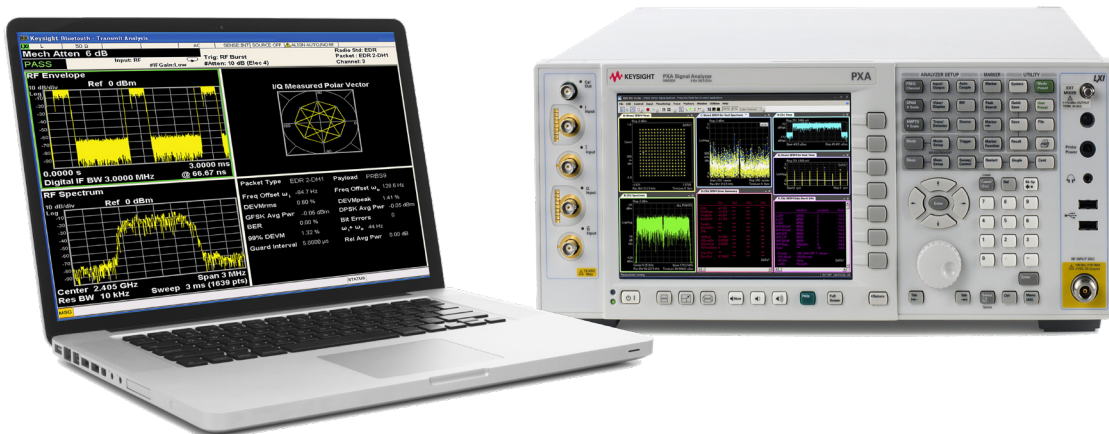
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Technology Overview

Digital terrestrial/television multimedia 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 better sensitivity especially at

higher code rate. Time domain synchronized orthogonal frequency division multiplexing (TDS-OFDM) is implemented to deliver fast system synchronization and precise channel estimation.

The DTMB (CTTB) measurement application gives more convenience to your DTMB (CTTB) system development and manufacturing, including both multi-carrier and single-carrier schemes with one-button measurements including standard presets and remote SCPI programming capabilities on X-Series signal analyzers.

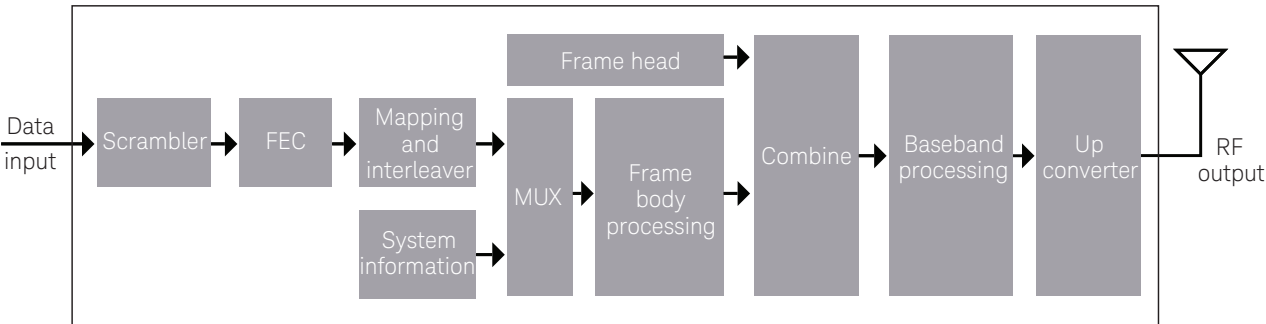


Figure 1. Block diagram of DTMB (CTTB) system

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 N6156EM0D and other modes

Test item	GY/T 229.4 2008 (For transmitter measurement)	GY/T 229.2 2008 (For exciter measurement)	N6156EM0D 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 measurements 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 controllable 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 measurements include all of the modulation quality plus I/Q waveform and CCDF measurements.

Table 2. One-button measurements provided by the N6156EM0D 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)

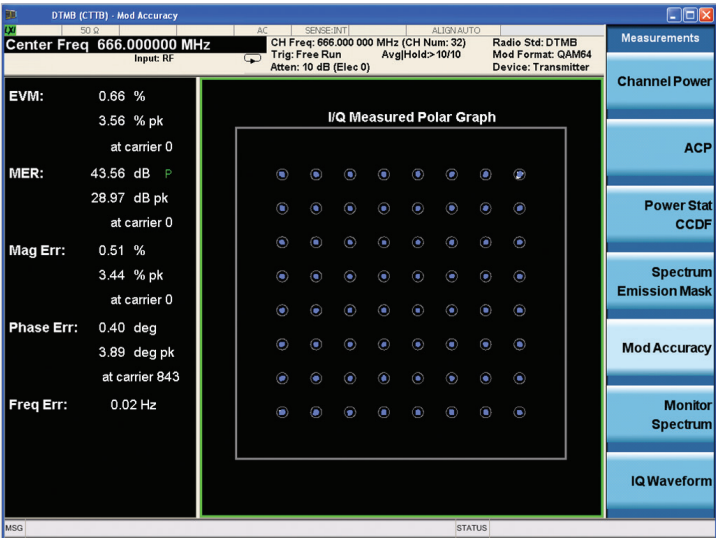


Figure 2. DTMB (CTTB) constellation and MER results

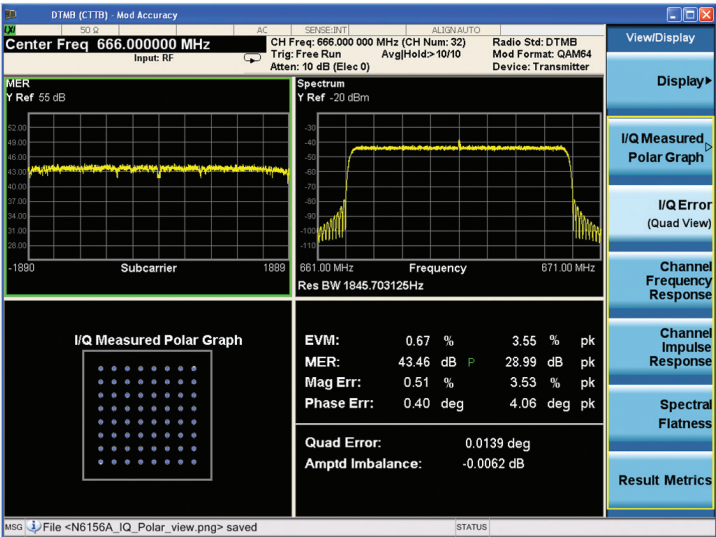


Figure 3. DTMB (CTTB) IQ quad view

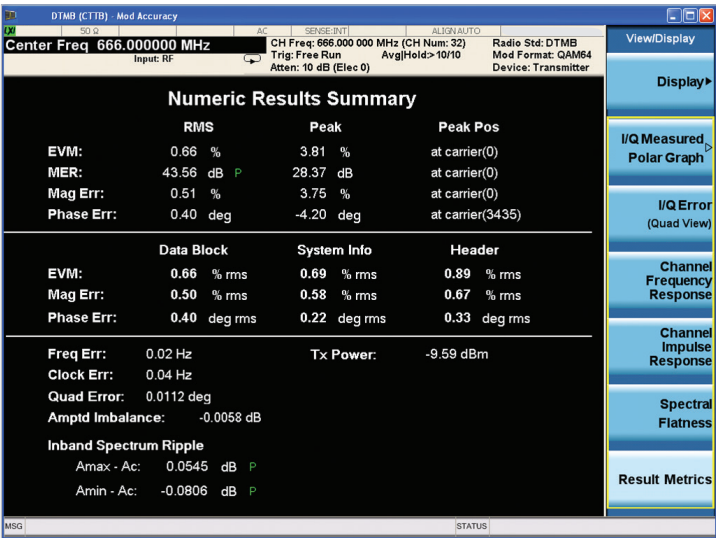


Figure 4. DTMB (CTTB) result metrics view

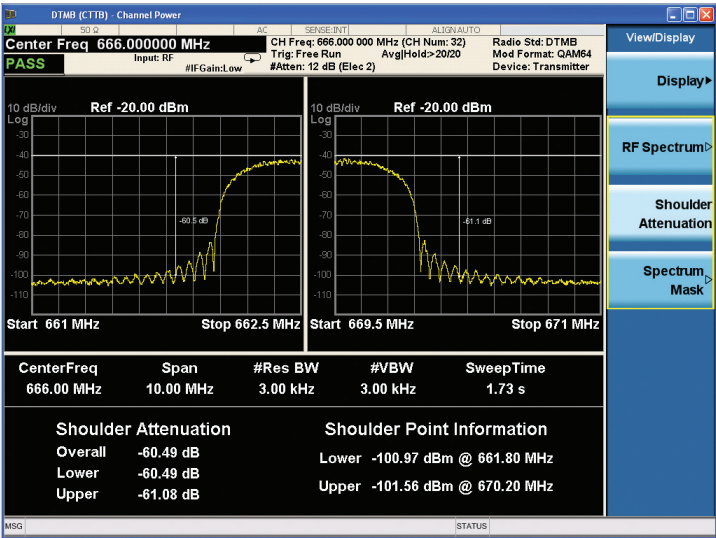


Figure 5. DTMB (CTTB) shoulder attenuation

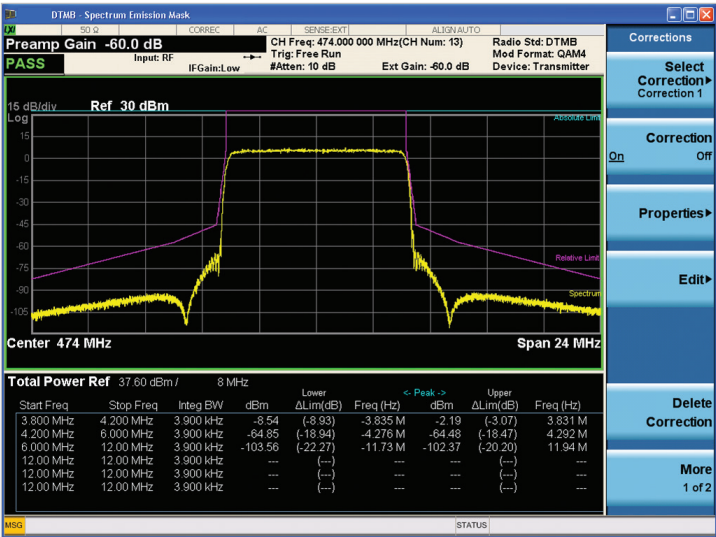


Figure 6. DTMB (CTTB) spectrum emission mask

Key Specifications

Definitions

- Specifications describe the performance of parameters covered by the product warranty.
- 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. These values are not covered by the product warranty.
- Typical values are designated with the abbreviation "typ." These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.
- 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, but is not covered by the product warranty.
- 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

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)	-105.5 dBm (-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, ML¹ = -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, ML¹ = -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

Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

You Can Upgrade!

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



DTMB (CTTB) measurement application (N6156EM0D)

Model	Software License Type	Support Contract	Support Subscription (12-month) ^{1,2}
N6156EM0D-1FP	Node-locked perpetual	R-Y5C-001-A ²	R-Y6C-001-L ²
N6156EM0D-1FL	Node-locked 12-month	R-Y4C-001-L ¹	Included
N6156EM0D-1TP	Transportable perpetual	R-Y5C-004-D ²	R-Y6C-004-L ²
N6156EM0D-1TL	Transportable 12-month	R-Y4C-004-L ¹	Included
N6156EM0D-1NP	Floating perpetual	R-Y5C-002-B ²	R-Y6C-002-L ²
N6156EM0D-1NL	Floating 12-month	R-Y4C-002-L ¹	Included
N6156EM0D-1UP	USB portable perpetual	R-Y5C-005-E ²	R-Y6C-005-L ²
N6156EM0D-1UL	USB portable 12-month	R-Y4C-005-L ¹	Included

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One month software support subscription extensions ³

Model	Description
R-Y6C-501 ³	1-month of software support subscription for node-locked license
R-Y6C-502 ³	1-month of software support subscription for floating license
R-Y6C-504 ³	1-month of software support subscription for transportable license
R-Y6C-505 ³	1-month of software support subscription for USB portable license

1. All time-based X-Series measurement application licenses includes a 12-month support contract which also includes the 12-month software support subscription as same duration.
2. Support contract must bundle software support subscription for all perpetual licenses in the first year. All software upgrades and Keysight support are provided for software licenses with valid support subscription.
3. After the first year, software support subscription may be extended with annual or monthly software support subscription extension.

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

To learn more about compatible platforms and required configurations, please visit: www.keysight.com/find/X-Series_apps_platform

Software Models & Options

To learn more about X-Series measurement application licensing, model numbers and options, please visit: www.keysight.com/find/X-Series_apps_model

Hardware Configuration

For optimizing the DTMB (CTTB) measurement application, Keysight recommends a minimum level of instrument hardware functionality at each instrument performance point. Supported instruments include:

Benchtop:

- PXA N9030A - EXA N9010A
- MXA N9020A - CXA N9000A

N90x0A X-Series signal analyzer

Capability	Instrument Option	Benefit
Analysis bandwidth	10 or 25 MHz as default or higher	Required: Wider analysis bandwidth options such as 25/40/85/160 MHz can be selected depending on the specified signal analyzer model
Precision frequency reference	-PFR	Recommended: For enhanced frequency accuracy and repeatability for lower measurement uncertainty
Electronic attenuator	-EA3	Recommended: Fast and reliable attenuation changes ideal for manufacturing without the wear associated with mechanical attenuators up to 3.6 GHz in 1 dB steps
Pre-amplifier	3.6 GHz (-P03) or higher	Recommended: For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	Recommended: Useful for maximizing useable dynamic range to see signals
Analog baseband I/Q inputs	-BBA on PXA and MXA only	Optional: To extend measurements at baseband if required by device under test

Related Literature

Description	Publication number
N6156A and W6156A DTMB (CTTB) Measurement Application, Demonstration Guide	5990-5933EN
N6156A & W6156A DTMB(CTTB) Measurement Application, Measurement Guide	N6156-90004
N6156A & W6156A DTMB(CTTB) Measurement Application, User's and Programmer's Reference	N6156-90001

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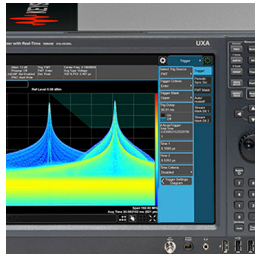
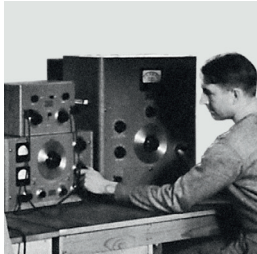
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