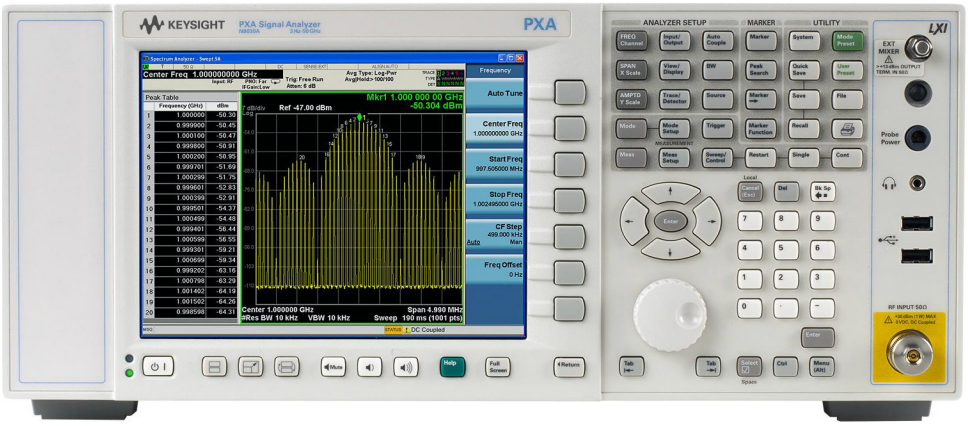
Keysight Technologies
Digital Cable TV
X-Series Measurement Application
N6152A & W6152A

Technical Overview



KEYSIGHT TECHNOLOGIES

Digital Cable TV Measurement Application

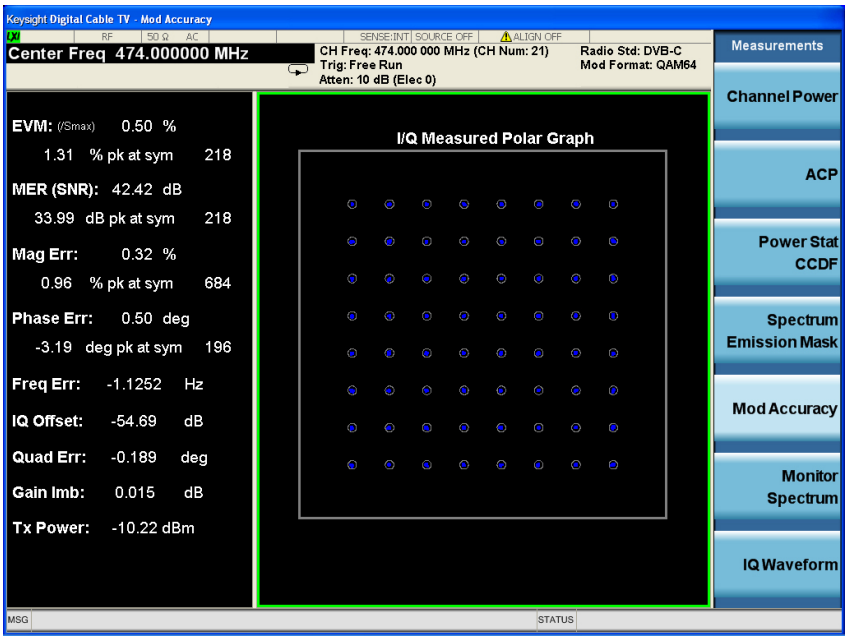


Figure 1. DVB-C modulation accuracy.

- Measure digital cable TV RF transmitter, modulator, tuner, or amplifier performance
- Easy-to-use, standard-based preset settings
- One-button tests with pass/fail limit per J.83/A (DVB-C), J.83/B (DOCSIS DS), and J.83/C (ISDB-C) standards
- Hardkey/softkey manual user interface or SCPI remote control
- Built-in, context-sensitive help
- Transportable license between X-Series signal analyzers

The Keysight Technologies, Inc. N/W6152A provides one-button, standard-based power and modulation analysis capabilities to help your design, evaluation, and manufacturing of digital cable TV modulators, transmitters, amplifiers, and tuners. With the optional analog baseband IQ inputs in the PXA or MXA signal analyzer, it can also provide the flexibility of measuring signal quality and modulation accuracy with RF input or analog IQ input.

The N/W6152A measurement application is just one in a common library of more than 25 advanced measurement applications in the Keysight X-Series. The Keysight X-Series is 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 consistent 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

- Radio standards: DVB-C (J.83/A), J.83/B, and J.83/C
- Symbol rate with standard default and settable by users
- Modulation: 16/32/64/128/256QAM for DVB-C and J.83/C and 64/256/1024QAM for J.83/B
- Adaptive equalizer with filter length and convergence settings
- Advanced settings: Meas interval, low SNR enhancement, out-of-band filter, and more.
- Input: RF or analog IQ (only available in the N9030A PXA or N9020A MXA) for signal quality and modulation accuracy measurements

Digital Cable TV Standards Overview

The digital cable TV measurement application includes three standards of digital video broadcasting over cable: DVB-C (J.83 Annex A), J.83 Annex B, and J.83 Annex C.

DVB-C (J.83 Annex A)

DVB-C is the DVB European consortium standard for the broadcast transmission of digital television over cable, mainly used in Europe and Asia with 8 MHz bandwidth.

J.83 Annex B (DOCSIS DS)

J.83/B, widely used in North America as digital television over cable and the same as the DOCSIS DS physical layer, has a greater difference in FEC coding and occupies a bandwidth of 6 MHz.

J.83 Annex C (ISDB-C)

J.83/C, mainly used in Japan as digital television over cable and also called ISDB-C, has identical structure as DVB-C, except for the channel bandwidth (6 MHz for J.83/C and 8 MHz for DVB-C) and roll-off factor of the baseband filter.

Table 1. Key parameters in digital cable TV standards

	J.83 Annex A (DVB-C)	J.83 Annex B (DOSSIS DS)	J.83 Annex C (ISDB-C)
Frequency	VHF, UHF	VHF, UHF	VHF, UHF
Bandwidth	8 MHz	6 MHz	6 MHz
Modulation	16QAM, 32QAM, 64QAM, 128QAM, 256QAM	64QAM, 256QAM, 1024QAM	16QAM, 32QAM, 64QAM, 128QAM, 256QAM
Randomization	Polynomial for PRBS $1 + x^{14} + x^{15}$	Polynomial for PRBS 3-word polynomial for PRBS $x^3 + x + \alpha^3$ over GF (128), where $\alpha^7 + \alpha^3 + 1 = 0$	Polynomial for PRBS $1 + x^{14} + x^{15}$
FEC	RS (204,188) over GF (256)	RS (128,122) over GF (128) concatenated with convolutional coding	RS (204,188) over GF (256)
Trellis coding	No	Yes	No
Interleaving	Convolutional interleaving, depth: I = 12	Convolutional interleaving, depth: I = 128, 64, 32,16, 8 J = 1, 2, 3, 4, 5, 6, 7, 8, 16	Convolutional interleaving, depth: I = 12
Roll-off factor	0.15	0.18 for 64QAM, 0.12 for 256QAM, 1024QAM	0.13
Stream	MPEG-2 TS	Modified MPEG-2 TS, with the sync byte replaced by a parity checksum	MPEG-2 TS

RF Transmitter Tests

Standard-based RF transmitter tests

The RF transmitter test requirements for DVB-C is defined in the ETSI TR 101 290 standard. Table 2 shows the required base station RF transmitter tests along with the corresponding measurement applications.

Table 2.
Required RF transmitter measurements and the corresponding measurements in N/W6152A

ETSI TR101 290 v.1.2.1 paragraph number	Transmitter test	X-Series N/W6152A measurement application
6.1	System availability	N/A
6.2	Link availability	N/A
6.3	BER before RS decoder	Modulation accuracy (BER view)
6.3.1	BER - out of - service	Modulation accuracy (BER view)
6.3.2	BER - in - service	Modulation accuracy (BER view)
6.4	Error events logging	N/A
6.5	Transmitter symbol clock jitter and accuracy	N/A
6.6	RF/IF signal power	Channel power measurement
6.7	Noise power	Spectrum analyzer mode
6.8	Bit error count after RS	Modulation accuracy (BER view)
6.9.1	I/Q analysis definition	N/A
6.9.2	Modulation error ratio	Modulation accuracy (result metrics view)
6.9.3	System target error	N/A
6.9.4	Carrier suppression	Modulation accuracy (result metrics view)
6.9.5	Amplitude imbalance	Modulation accuracy (result metrics view)
6.9.6	Quadrature error	Modulation accuracy (result metrics view)
6.9.7	Residual target error	N/A
6.9.8	Coherent interferer	N/A
6.9.9	Phase jitter	N/A
6.9.10	Signal-to-noise ratio (SNR)	Modulation accuracy (result metrics view)
6.10	Interference	Spectrum analyzer mode
7.1	Noise margin	Modulation accuracy (BER view)
7.2	Estimated noise margin	Modulation accuracy (BER view)
7.3	Signal quality margin test	Modulation accuracy (BER view)
7.4	Equivalent noise degradation (END)	Modulation accuracy (BER view)
7.5	BER vs. Eb/N0	Modulation accuracy (BER view)
7.6	Phase noise of RF carrier	Phase noise mode
7.7	Amplitude, phase, and impulse response of the channel	Modulation accuracy (channel frequency response)
7.8	Out - of - band emissions	Spectrum emission mask measurement

Measurement details

All of the RF transmitter measurements as defined by the digital cable TV standard, as well as a wide range of additional measurements and analysis tools, are available with a press of a button (Table 3). 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 measurements.

Table 3. One-button measurements provided by the N/W6152A measurement application

Technology	**DVB-C (J.83 Annex A/C)**	**J.83 Annex B (DOCSIS DS)**
Measurements	**N6152A-2FP, W6152A-2FP**	**N6152A-3FP, W6152A-3FP**
Adjacent channel power	●	●
Spectrum emission mask	●	●
Power statistic CCDF	●	●
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	●	●
IQ offset (dB)	●	●
Frequency error (Hz)	●	●
Clock error	●	●
Tx power (dBm)	●	●
Quadrature error (deg)	●	●
Amplitude imbalance (%)	●	●
EVM vs. symbols (%)	●	●
Mag error vs. symbols (dB)	●	●
Phase error vs. symbols (deg)	●	●
Amplitude vs. frequency (dB)	●	●
Phase vs. frequency (deg)	●	●
Group delay vs. frequency (ns)	●	●
Channel impulse response (dB)	●	●
BER results	●	●

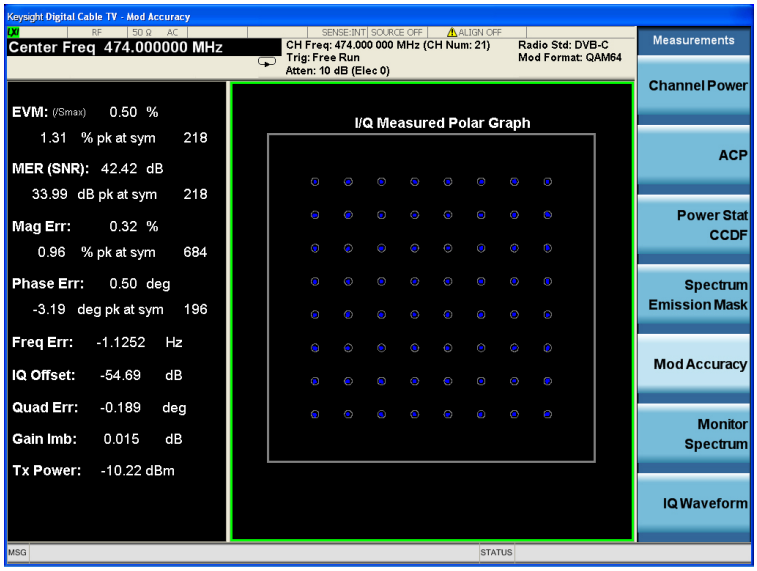


Figure 2.
DVB-C constellation and MER results



Figure 3.
DVB-C IQ quad view

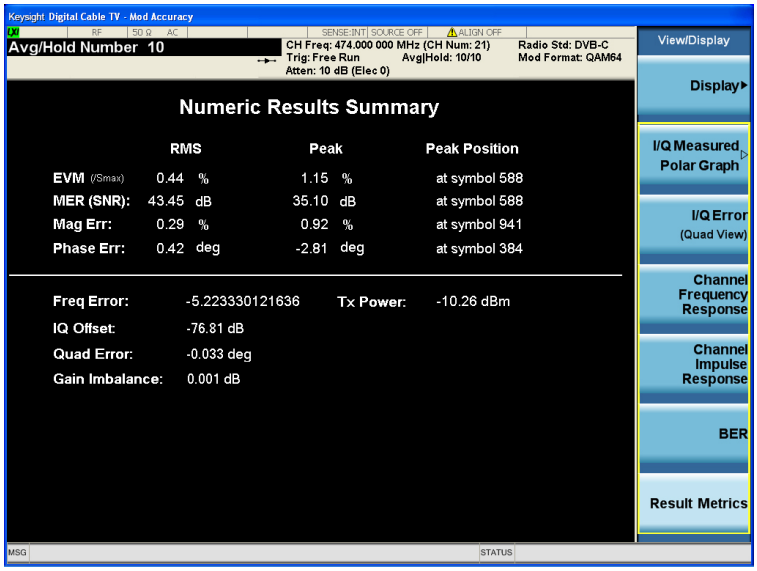


Figure 4.
DVB-C result metrics view

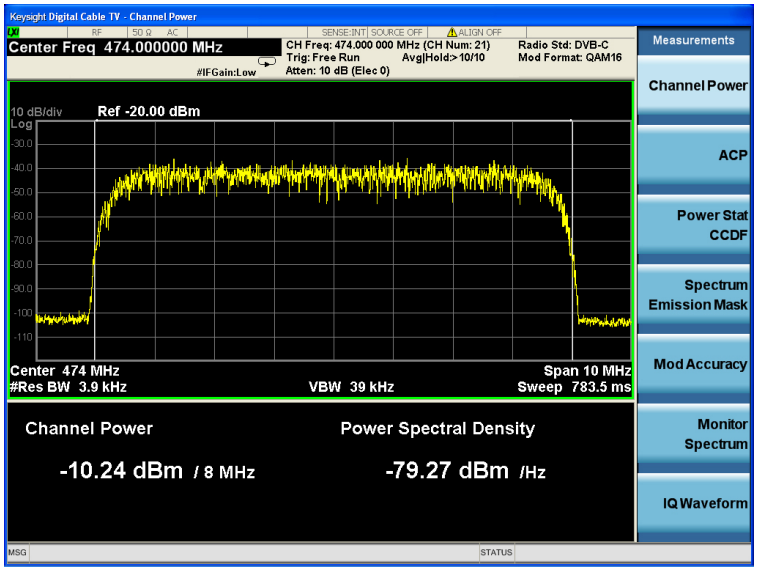


Figure 5.
DVB-C channel power

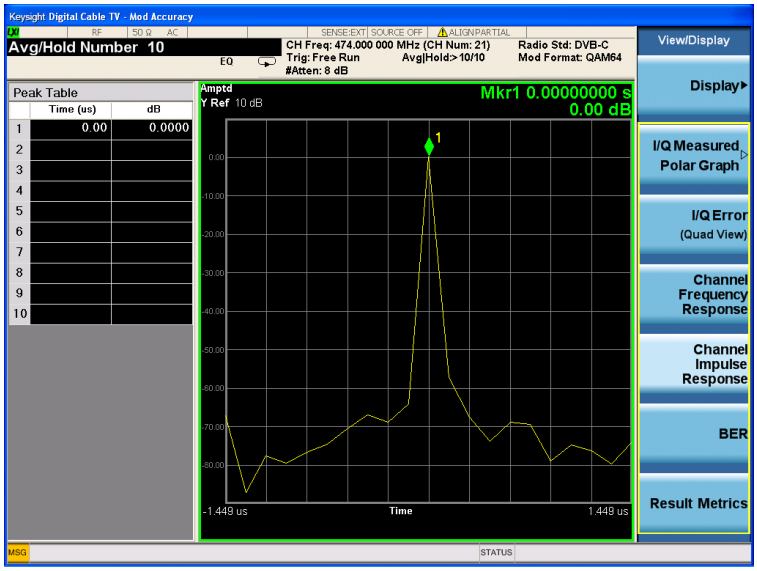


Figure 6.
DVB-C channel impulse response view

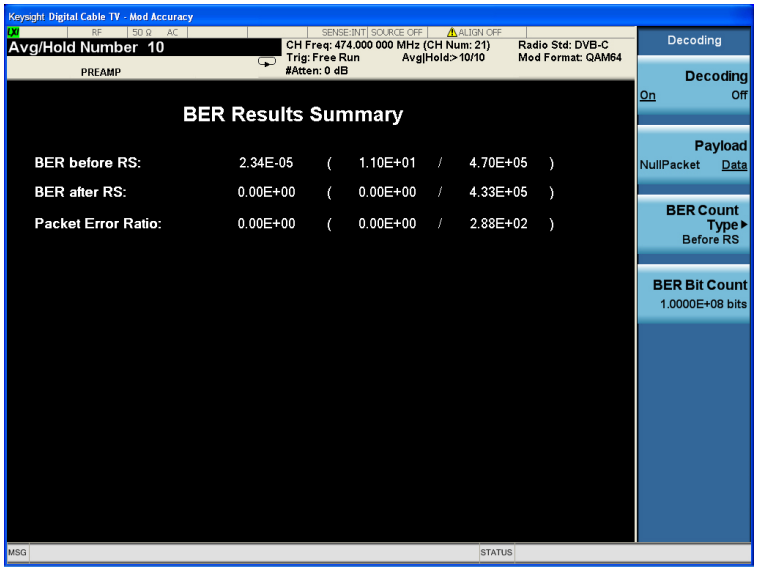


Figure 6.
DVB-C BER view

Key Specifications

Definitions

– Specifications describe the performance of parameters covered by the product warranty.

– 95th percentile values indicate the breadth of the population (≈2σ) 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 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

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

You Can Upgrade!

Options can be added after your initial purchase.

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

Description	PXA (N9030A)	MXA (N9020A)	EXA (N9010A)	CXA (N9000A)
Channel power				
8 MHz integration BW	–50 dBm (nom)	–50 dBm (nom)	–50 dBm (nom)	–50 dBm (nom)
Absolute power accuracy 20 to 30 °C	± 0.61 (± 0.19 dB 95%)	± 0.82 (± 0.23 dB 95%)	± 0.94 (± 0.27 dB 95%)	± 1.33 (± 0.61 dB 95%)
Measurement floor	–85.7 dBm (typ)	–82.7 dBm (typ)	–78.7 dBm (typ)	–75.7 dBm (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	8.0 MHz noise bandwidth, method = IBW			
Offset frequency 8 MHz	± 0.21 dB	± 0.46 dB	± 0.98 dB	± 1.43 dB

Description	PXA (N9030A)	MXA (N9020A)	EXA (N9010A)	CXA (N9000A)
Spectrum emission mask	**6.9 MHz Integration BW, RBW = 3.9 kHz**			
4.2 MHz offset				
Dynamic range, relative	97.8 (102.7 typ)	92.1 (98.5 dB typ)	86.9 dB (94.0 dB typ)	84.5 dB (91.7 dB typ)
Sensitivity, absolute	–114.5 (–118.5 dBm typ)	–110.5 (–115.5 dBm typ)	–105.5 (–111.5 dBm typ)	–102.5 (–108.5 dBm typ)
Accuracy				
Relative	± 0.10 dB	± 0.18 dB	± 0.18 dB	± 0.27 dB
Absolute, 20 – 30 °C	± 0.62 (± 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	101.9 (106.8 dB typ)	96.1 (101.8 dB typ)	90.8 (97.1 dB typ)	88.7 (96.3 dB typ)
Sensitivity, absolute	–114.5 (–118.5 dBm typ)	–110.5 (–115.5 dBm typ)	–105.5 (–111.5 dBm typ)	–102.5 (–108.5 dBm typ)
Accuracy				
Relative	± 0.12 dB	± 0.22 dB	± 0.22 dB	± 0.37 dB
Absolute	± 0.62 (± 0.20 dB 95%)	± 0.88 (± 0.23 dB 95%)	± 1.05 dB (± 0.31 dB 95%)	± 1.53 dB (± 0.64 dB 95%)
Modulation accuracy	DVB-C 64QAM EVM, symbol rate = 6.9 MHz, ML[1] = –20 dBm, 20 to 30 °C			
EVM (Smax)				
Operating range	0 to 5%	0 to 5%	0 to 5%	0 to 5% (nom)
Floor	0.51% (adaptive EQ Off)	0.57% (adaptive EQ Off)	0.63% (adaptive EQ Off)	0.63% (adaptive EQ Off) (nom)
MER				
Operating range	≥ 22 dB	≥ 22 dB	≥ 22 dB	≥ 22 dB (nom)
Floor	43 dB (adaptive EQ Off)	42 dB (adaptive EQ Off)	41 dB (adaptive EQ Off)	41 dB (adaptive EQ Off) (nom)
Frequency error[2]				
Range	–150 kHz to 150 kHz	–150 kHz to 150 kHz	–150 kHz to 150 kHz	–150 kHz to 150 kHz
Accuracy	± 10 Hz + tfa[3]	± 10 Hz + tfa[3]	± 10 Hz + tfa[3]	± 10 Hz + tfa[3]
Quad error				
Range	–5 deg to 5 deg	–5 deg to 5 deg	–5 deg to 5 deg	–5 deg to 5 deg (nom)
Gain Imbalance				
Range	–1 to +1 dB	–1 to +1 dB	–1 to +1 dB	–1 to +1 dB (nom)
BER before RS	For DVB-C (J.83 Annex A/C) and J.83/B (DOCSIS DS)			
Range	0 to 1.0 x 10^{-1}	0 to 1.0 x 10^{-1}	0 to 1.0 x 10^{-1}	0 to 1.0 x 10^{-1} (nom)
BER after RS	For DVB-C (J.83 Annex A/C) and J.83/B (DOCSIS DS)			
Range	0 to 1.0 x 10^{-3}	0 to 1.0 x 10^{-3}	0 to 1.0 x 10^{-3}	0 to 1.0 x 10^{-3} (nom)
Packet error ratio	For DVB-C(J.83 Annex A/C) and J.83/B (DOCSIS DS)			
Range	0 to 1.0	0 to 1.0	0 to 1.0	0 to 1.0 (nom)
Clock error	Increasing symbol length to more than 5000 can significantly improve the clock error accuracy			

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

2. The accuracy specification applies at the EVM = 1%s

3. tfa = transmitter frequency × frequency reference accuracy

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.

Try Before You Buy!

Free 30-day trials of X-Series measurement applications provide unrestricted use of each application's features and functionality on your X-Series analyzer. Redeem a trial license on-line today:
www.keysight.com/find/X-Series_trial

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

N6152A & W6152A digital cable TV X-Series measurement application

Description	Model-Option		Additional information
	PXA, MXA, EXA	CXA	
DVB-C (J.83 Annex A/C)	N6152A-2FP	W6152A-2FP	
J.83 Annex B	N6152A-3FP	W6152A-3FP	
Latest enhancements	N6152A-MEU	W6152A-MEU	

X-Series Measurement Application Updates

To update a previously purchased N6152A/W6152A measurement application to include the latest feature updates, you can purchase the N6152A-MEU or W6152A-MEU minor enhancement update.

For more information, visit:
www.keysight.com/find/N6152A-MEU for PXA, MXA

Hardware configuration

N9030A PXA signal analyzer

Description	Model-Option	Additional information
3.6, 8.4, 13.6, 26.5, 43, 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, 26.5, 42.98, 44, or 50 GHz	N9030A-P03, -P08, -P13, -P26, -P43, -P44, or P50	One recommended
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 or -B40	One optional
Wideband IF output	N9020A-CR3	Optional
Programmable IF output	N9020A-CRP	Optional
Dual-core, high-performance processor, removable SSD	N9020A-PC4	Recommended for faster BER

N9010A EXA signal analyzer

Description	Model-Option	Additional information
3.6, 7.0, 13.6, or 26.5 GHz frequency range	N9020A-503, -508, -513, or -526	One required
Precision frequency reference	N9010A-PFR	Recommended
Electronic attenuator, 3.6 GHz	N9010A-EA3	One recommended
Preamplifier, 3.6 or 7.0 GHz	N9010A-P03, -P07	Recommended
Analysis bandwidth to 25 or 40 MHz	N9010A-B25 or -B40	One optional
Wideband IF output	N9010A-CR3	Optional
Programmable IF output	N9010A-CRP	Optional
Dual-core, high-performance processor, removable SSD	N9010A-PC4	Recommended for faster BER

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
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
Analysis bandwidth to 25 MHz	N9000A-B25	Optional
Wideband IF output	N9000A-CR3	Optional
Tracking generator, 9 kHz to 3 GHz or 6 GHz	N9000A-T03 or T06	One optional

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Related Literature

N6152A & W6152A Digital Cable TV Measurement Application, Self-Guided Demonstration, literature number 5990-6792EN

N6152A & W6152A Digital Cable TV Measurement Application, Measurement Guide, part number N6152-90002

N6152A & W6152A Digital Cable TV Measurement Application, User's and Programmer's Reference, part number N6152-90001

Web

Product page:
www.keysight.com/find/N6152A and www.keysight.com/find/W6152A

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