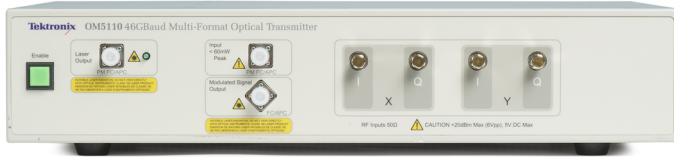


46 GBaud Multi-Format Optical Transmitter

OM5110 Datasheet



The OM5110 Multi-Format Optical Transmitter is a C- and L-Band transmitter capable of providing the most common coherent optical modulation formats such as PM-QPSK and PM-16QAM up to 46 GBaud. When combined with a signal source, such as the Tektronix AWG70001A Arbitrary Waveform Generator or the Tektronix PPG3204 32 Gb/s Programmable Pattern Generator, the OM5110 offers a complete coherent optical test signal generation system.

Features and benefits

- Multi-format optical transmitter supports modulation of formats such as BPSK, PM-QPSK, and PM-16QAM
- Excellent linearity supports modulation of multi-level signals
- Modulates single or dual-polarization signals
- Built-in C or L-band lasers for setup convenience
- Supports external laser sources
- Supports manual and automatic bias control of amplifiers and modulator
- Remotely control all setup and operations over Ethernet

Applications

- Testing coherent optical receivers
- Golden reference coherent optical transmitter
- Transmitter for multi-carrier superchannel systems

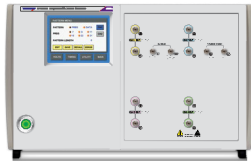
100G / 400G / 1Tb/s Coherent optical test system

The OM5110 Multi-Format Optical Transmitter is a C- and L-Band transmitter capable of modulating the most common coherent optical modulation formats such as PM-QPSK and PM-16QAM up to 46 GBaud. When combined with a signal source, such as the Tektronix AWG70001A Arbitrary Waveform Generator or the Tektronix PPG3204 32 Gb/s Programmable Pattern Generator, the OM5110 offers a complete coherent optical test signal generation system. The flexibility to automatically or manually set all amplifier and modulator bias points provides the user the freedom to simulate less-than-ideal performance of their device.

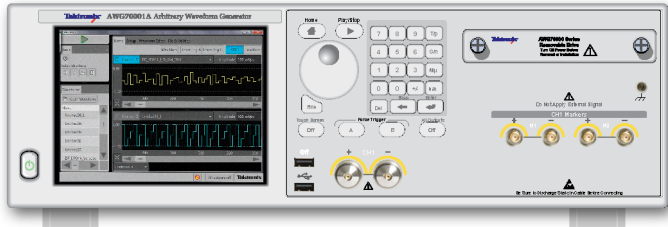
Coherent optical transmitter or transceiver manufacturers can use the OM5110 as a golden reference against which to compare module designs. For transmitters under development, use the Tektronix OM4245 Optical Modulation Analyzer to measure transmitter performance, and then compare the results against the OM5110 reference transmitter.

Coherent optical receiver manufacturers can also use the OM5110 as the ideal transmitter with which to test their receiver's performance and prove functionality under best-case conditions. Used along with the AWG70001A Arbitrary Waveform Generator, the user can add optical impairments to the signal to test the receiver under a wide range of real-world scenarios.

Alternatively, the PPG3204 32 Gb/s Pattern Generator can be used to generate X-I, X-Q, Y-I, and Y-Q instead of the AWG70001A.



AWG70001A Arbitrary Waveform Generator

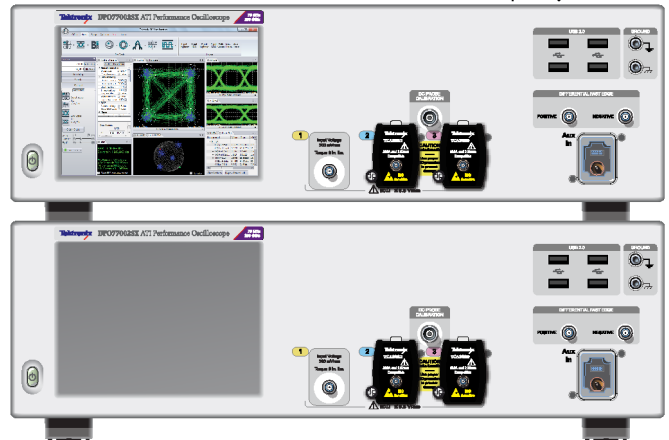


coax: X-I, X-Q, Y-I, Y-Q

OM5110 46GBaud Multi-Format Optical Transmitter



DPO77004SX 70GHz ATI Performance Oscilloscope System



coax: X-I, X-Q, Y-I, Y-Q

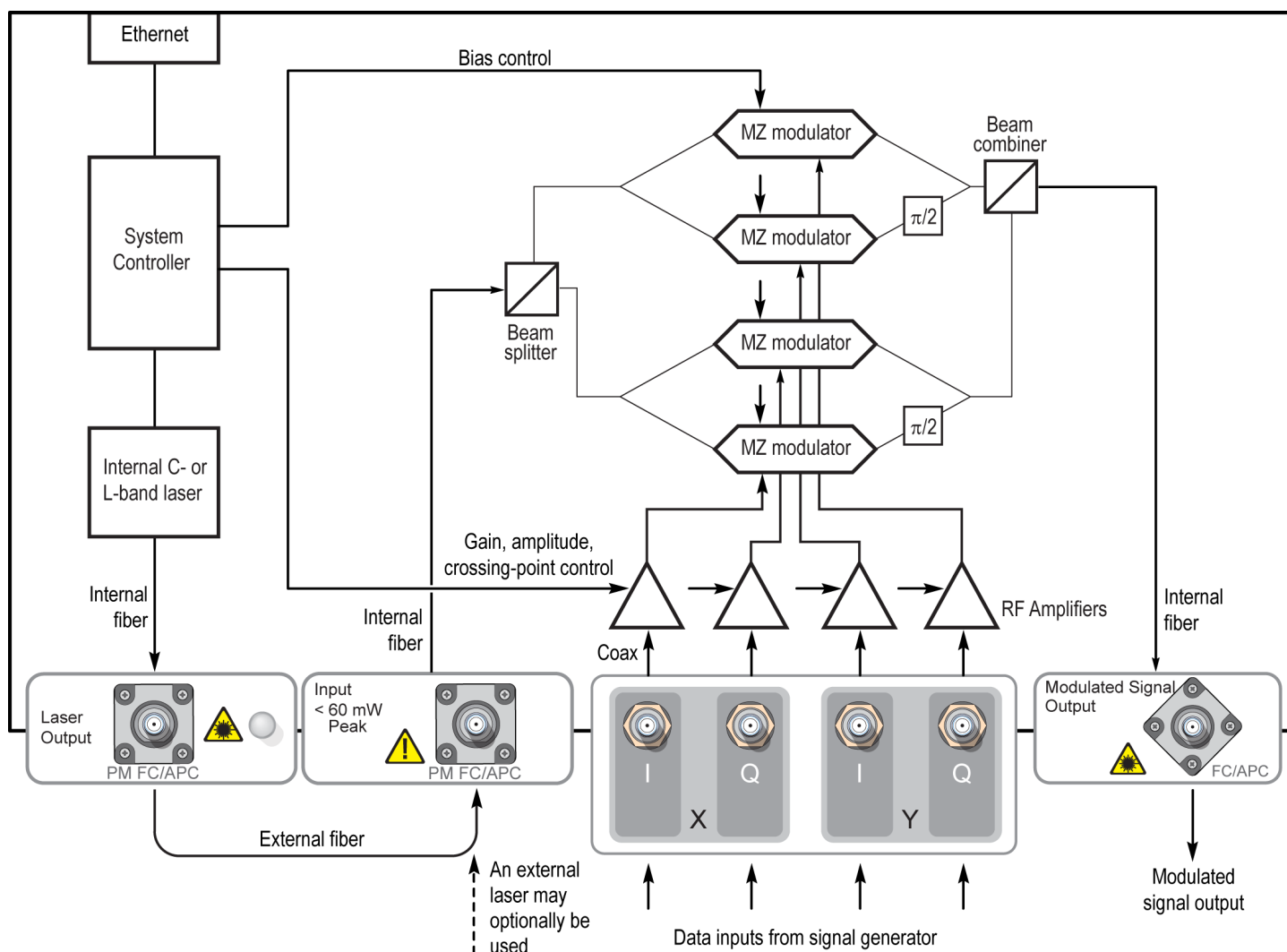
OM4245 45GHz Optical Modulation Analyzer



fiber: modulated signal

As the demand for network bandwidth has increased, new transmission schemes such as multi-carrier “superchannels” are under investigation. The OM5110 can function as the heart of a superchannel system. Multiple optical carriers can be externally combined and used as the laser source to the OM5110 using the external signal input. Tektronix offers external laser sources, such as the OM2012 Tuneable Laser Source, which can be used to create a superchannel system. With such a configuration, systems with aggregate data rates such as 400G, 1Tb/s, and beyond, can be created.

The OM5110 offers the convenience of built-in laser sources, either C-band or L-band. Setup and operation of the laser, such as wavelength and optical power, can all be controlled remotely over Ethernet. Alternatively, an external laser source may be connected to the front panel of the instrument in place of the built-in lasers.



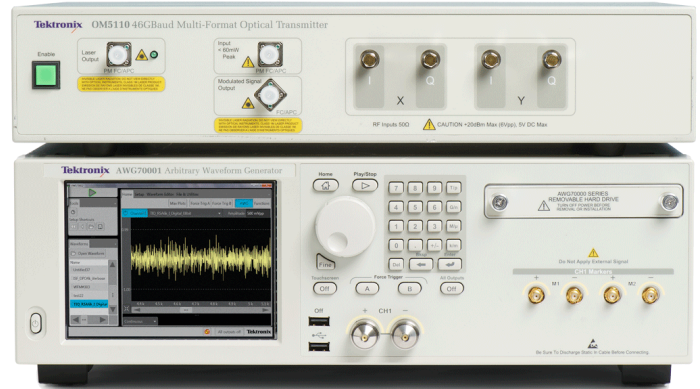
The data from the external signal generator is first amplified by four, high-linearity amplifiers. The bias points for these amplifiers can be monitored and automatically controlled by the included Tektronix control software. The user may also take control of the bias points and set the amplifier bias voltages manually. The high-linearity of these amplifiers makes them ideal for multi-level signals such as 16QAM. For two-level signals, such as QPSK, the amplifiers can be driven into saturation so that the modulator drive is less sensitive to input drive level variations due to external rf cable losses.

The output of either the on-board laser, or a customer-supplied external laser is passed through a beam splitter and then fed to each of the four internal Mach-Zehnder modulators. Like the amplifiers, each Mach-Zehnder modulator has bias controls that can be automatically controlled or manually set by the user. The amplified signals feed these four modulators whose outputs are optically combined to create a complex, dual-polarized optical signal available on the front-panel of the instrument.

Coherent optical signal generation system

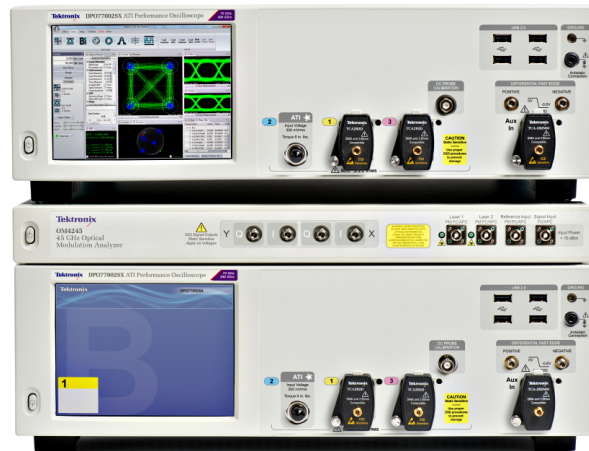
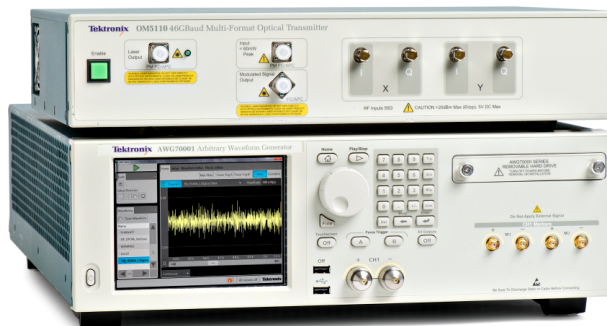
The OM5110 is a key part of a coherent optical signal generation system. The other major component is the signal generator itself. The Tektronix PPG3000 series programmable pattern generators and the Tektronix AWG70000 Series Arbitrary Waveform Generators (AWG) offer the flexibility to choose the type of signal generation instrument suited to the test requirements.

The PPG3000 Series can generate patterns up to 32 Gb/s and offers 1, 2, or 4 channels in a single instrument. The patterns may be standard PRBS patterns or user-defined. Using a 4-channel pattern generator makes creating dual-polarization I-Q waveforms very simple.



Coherent optical signal generation is one of the more demanding applications for an AWG. The requirements in terms of number of channels sampling rate, bandwidth, record length, and timing and synchronization quality can be only met by the highest performance instruments, such as the Tektronix AWG70000 Series. The unique capability of generating ideal or distorted signals and the ease to add new modulation schemes and signal processing algorithms without the need to add any extra hardware make AWGs an ideal tool for coherent optical communication research and development.

The AWG70000 Series can reach sampling rates as high as 50 GS/s with 10 bits vertical resolution. Such level of performance allows for the direct generation of IQ basebands signals required by modern coherent optical communication systems. The arbitrary waveform generation capabilities of the AWG70000 Series makes it possible to create multi-level signals such as 16QAM, add impairments to a signal, or to create waveforms that are precompensated for the real-world effects of the test system.



Specifications

Values stated in the following tables are typical unless stated otherwise.

System characteristics

Maximum symbol rate	46 GBaud: for binary formats such as BPSK, QPSK 34 GBaud: for multi-level formats such as 16QAM
Modulation formats	3-State OOK, BPSK, PM-BPSK, QPSK, PM-QPSK, 16QAM, PM-16QAM Higher order formats are possible depending on baud rate and frequency compensation available.

Absolute maximum ratings

Input Optical Power	18 dBm
Input Electrical Signal, AC	6 V _{p-p}
Input Electrical Signal, DC	5 V _{DC}

Electrical characteristics

3 dB bandwidth relative to 2 GHz	23 GHz
6 dB bandwidth relative to 2 GHz (specification)	> 30 GHz
Modulation percent of 2 π at 1 V _{p-p} , 23 GHz input	> 90%
EVM, 25 GBaud 16QAM	<10%

Optical characteristics

External input wavelength range	1526.6 nm to 1609.6 nm
Modulator insertion loss (specification)	< 14 dB
DC extinction ratio	> 20 dB
Optical return loss	> 27 dB
PDL (typical)	< 0.8 dB
Power readout accuracy	\pm 2 dB

Internal laser optical characteristics

Internal laser wavelength range	
C-Band	1526.6 nm to 1567.5 nm
L-Band	1567.5 nm to 1609.6 nm
Output power	
	> 13 dBm
Minimum grid spacing	
	10 GHz
Minimum frequency step	
	100 MHz
Absolute wavelength accuracy	
	10 pm
Linewidth (short term)	
	100 kHz
Sidemode suppression ratio	
	55 dB

Power requirements

Power requirements	100 - 240 V _{RMS} ±10%, 50/60 Hz, 100 W
Fuse rating	Slo-Blo 3.15 A, 250 V _{AC}

Physical characteristics

Dimensions	
Height	89 mm, 3.5 in.
Width	432 mm, 17 in.
Depth	298.5 mm 11.75 in.
Weight	
Net	7.4 kg, 16.3 lb.
Shipping	14.6 kg, 32.2 lb.

Environmental characteristics

Temperature	
Operating	+10 °C to +35 °C
Non-operating	-20 °C to +60 °C
Humidity	
Operating	10% to 85% RH up to +35 °C, noncondensing
Non-operating	10% to 85% RH up to +35 °C, noncondensing
	10% to 45% RH up to +60 °C, noncondensing
Altitude	
Operating	3000 meters; derate maximum operating temperature by 1 °C per 300 meters above 1500 meters altitude
Non-operating	12,000 meters

Environmental characteristics

Vibration

Operating Sine: 0.33 mm pk-pk (0.013 inch p-p) constant displacement, 5-55 Hz, 3 axes

Random: 0.24 GRMS, 5-500 Hz, 10 minutes per axis

Non-operating Random: 2.22 GRMS, 5-500 Hz, 10 minutes per axis

Mechanical shock

Half-sine mechanical shocks, 30g peak amplitude, 11 second duration, 3 drops in each direction of each axis

EMC, environment, and safety

Immunity IEC61326, IEC61000-4-2/3/4/5/6/11

Emissions CISPR11, Class A, EN 61000-3-2, EN61000-3-3

Safety UL61010-1, CAN/CSA-22.2, No.61010-1, EN61010-1, IEC61010-1, 21

Laser Safety: CFR1040.10 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007. IEC60825-1-1

Ordering information

Models

OM5110 46 GBaud Multi-Format Optical Transmitter

Instrument options

OM5110 options

Opt. C Built-in C-band laser

Opt. L Built-in L-band laser

Opt. NL No built-in lasers. Requires external laser source

Power plug options

Opt. A0 North America power plug (115 V, 60 Hz)

Opt. A1 Universal Euro power plug (220 V, 50 Hz)

Opt. A2 United Kingdom power plug (240 V, 50 Hz)

Opt. A3 Australia power plug (240 V, 50 Hz)

Opt. A5 Switzerland power plug (220 V, 50 Hz)

Opt. A6 Japan power plug (100 V, 50/60 Hz)

Opt. A10 China power plug (50 Hz)

Opt. A11 India power plug (50 Hz)

Opt. A12 Brazil power plug (60 Hz)

User manual options

Opt. L0 English manual

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R5	Repair Service 5 Years (including warranty)

Installation options

OMINSTALL AMR	On-site OM-series install for the Americas
OMINSTALL JPN	On-site OM-series install for Japan
OMINSTALL EMEA	On-site OM-series install for Europe, Middle East, and Africa
OMINSTALL APAC	On-site OM-series install for the Asia Pacific

Recommended accessories

Related products

OM4245	45 GHz Optical Modulation Analyzer
OM4245 MCS	Adds multi-carrier Superchannel support
OM4225	25 GHz Optical Modulation Analyzer
OM1106	Optical Modulation Analyzer Software, included with OM4225 and OM4245
OM2210	Coherent Receiver Calibration Source
OM2012	Tunable Laser Source
AWG70001A	Tektronix Arbitrary Waveform Generator
PPG3204	Tektronix 32 Gb/s Programmable Pattern Generator
DPO73304DX	Tektronix 33 GHz Digital Phosphor Oscilloscope



Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

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* European toll-free number. If not accessible, call: +41 52 675 3777

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