

Anritsu Advancing beyond

O/E Calibration Module

MN4765B



Introduction

The MN4765B is a characterized, unamplified photodiode module. It is used as an optical receiver with the Anritsu VectorStar™ MS4640B Series VNA, and ShockLine™ MS4652xB Series VNA to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E). Model MN4765B is the base calibration module part number only. Customers are required to also order an option to configure the bandwidth and wavelength coverage. These options consist of an InGaAs photodiode that converts modulated optical signals to electrical signals, and includes additional circuitry for temperature and bias stability.

Configuration Options

- MN4765B-0040 (Option 40) Configured for 70 kHz to 40 GHz range, with 850 nm wavelength coverage
- MN4765B-0042 (Option 42) Configured for 70 kHz to 40 GHz range, with 850 and 1060 nm wavelength coverage
- MN4765B-0043 (Option 43) Configured with 70 kHz to 40 GHz range, with 850/1060/1310/1550 nm wavelength coverage
- MN4765B-0070 (Option 70) Configured for 70 kHz to 70 GHz range, with 1550 nm wavelength coverage
- MN4765B-0071 (Option 71) Configured for 70 kHz to 70 GHz range, with 1310 nm wavelength coverage
- MN4765B-0072 (Option 72) Configured for 70 kHz to 70 GHz range, with 1310 and 1550 nm wavelength coverage
- MN4765B-0110 (Option 110) Configured for 70 kHz to 110 GHz range, with 1550 nm wavelength coverage
- MN4765B-0111 (Option 111) Configured for 70 kHz to 110 GHz range, with 1310 nm wavelength coverage
- MN4765B-0112 (Option 112) Configured for 70 kHz to 110 GHz range, with 1310 and 1550 nm wavelength coverage
- MN4765B-0140 (Option 140) Configured for 70 kHz to 145 GHz range, with 1550 nm wavelength coverage

Calibration Options

- MN4765B-0098 (Option 98) Standard Calibration
Standard Calibration, ISO 17025 compliant, without data.
- MN4765B-0099 (Option 99) Premium Calibration
Premium Calibration, ISO 17025 compliant, with data.

Features

- **Fast and Accurate Optoelectronic Measurements:** The VectorStar and ShockLine series VNAs, when calibrated using the MN4765B module, enable error-corrected Transfer Function, Group Delay, and Return Loss measurements of E/O and O/E, and O/O components and subsystems.
- **National Institute of Standards and Technology Derived Characterization:** Magnitude and phase characterization is obtained using primary standards characterized by NIST or other National Metrology Institutes or related bodies and held in the Anritsu Calibration Lab. The magnitude and phase data is provided on a USB drive with the module. Data for the 1060 nm wavelength (-0042 and -0043 options) is obtained by interpolation of standards-based transfer measurements.
- **Temperature Stable:** The MN4765B is thermally stabilized to eliminate drift in photodiode performance over temperature.
- **Internal Biasing:** Accurate bias voltage to the photodiode is maintained internally. An external, multi-country, AC adapter is included for easy operation.
- **High Linearity:** Linear operating range to +6 dBm (+2 dBm for MN4765B-004x) for transfer function measurement uncertainties of:
 - < 0.5 dB at 40 GHz (Typical specifications for MN4765B-0043 at 1550 or 1310 nm)
 - < 1 dB at 40 GHz (Typical specifications for MN4765B-004x at 850 nm)
 - < 2 dB at 40 GHz (Typical specifications for MN4765B-0042 and MN4765B-0043 at 1060 nm)
 - < 0.45 dB at 50 GHz and < 0.7 dB at 70 GHz (Typical specifications for MN4765B-0070 and MN4765B-0072 at 1550nm)
 - < 0.35 dB at 40 GHz and < 1 dB at 70GHz (Typical specifications for MN4765B-0071 and MN4765B-0072 at 1310 nm)
 - < 0.5 dB at 70 GHz and < 0.75 dB at 110 GHz (Typical specifications for MN4765B-0110 and MN4765B-0112 at 1550 nm)
 - < 0.6 dB at 70 GHz and < 0.9 dB at 110 GHz (Typical specifications for MN4765B-0111 and MN4765B-0112 at 1310 nm)
 - < 1 dB at 145 GHz (Typical specifications for MN4765B-0140 at 1550 nm)
- **High Responsivity:**¹
 - > 0.2 A/W for MN4765B-0040 at 850 nm
 - > 0.2 A/W for MN4765B-0042 at 850 nm and > 0.6 A/W at 1060 nm
 - > 0.2 A/W for MN4765B-0043 at 850 nm, >0.6 A/W at 1060 nm, >0.7 A/W at 1310 nm and >0.8 A/W at 1550 nm
 - > 0.7 A/W for MN4765B-0070
 - > 0.45 A/W for MN4765B-0071
 - > 0.45 A/W for MN4765B-0072 at 1310 nm
 - > 0.65 A/W for MN4765B-0072 at 1550 nm
 - > 0.5 A/W for MN4765B-0110 and MN4765B-0112 at 1550 nm
 - > 0.4 A/W for MN4765B-0111 and MN4765B-0112 at 1310 nm (typical specification)
 - >0.35 A/W for MN4765B-0140 at 1550 nm (typical specification)

¹.Typical Specifications

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Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:	
Temperature Range	Over 23 °C ±5°C temperature range for operating characteristics and 23 °C ±3 °C temperature range for calibrated characteristics.
Typical Specifications	Typical specifications represent the measured performance of an average unit. They do not include guard-bands and are not covered by the product warranty.
Uncertainty	A coverage factor of K=2 is applied to the measurement uncertainties. Uncertainties do not include drift in other parts of the optical system (laser power, modulator bias, etc.). No specifications or uncertainties include multi-mode effects that might be present in a given user setup.
Calibration Cycle	Recommended calibration cycle is 12 months.
All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com	

Typical Specifications (All Specifications Typical)**MN4765B-0040**

Frequency Range	70 kHz to 40 GHz
Operating Wavelength Range	800 nm to 900 nm
Characterized Wavelength	850 ± 20 nm
Linear Optical Input Power	< 2 dBm
Maximum Optical Input Power	7 dBm
Electrical Return Loss	< -10 dB at < 18 GHz < -3 dB from 18 GHz to 40 GHz
Optical Return Loss	< -20 dB
DC Responsivity	> 0.2 A/W (850 ± 20 nm)
RF OUT Connector	K male (2.92 mm)

MN4765B-0042

Frequency Range	70 kHz to 40 GHz
Operating Wavelength Range	800 nm to 1100 nm
Characterized Wavelength	850 ± 20 nm, 1060 ± 20 nm
Linear Optical Input Power	< 2 dBm
Maximum Optical Input Power	7 dBm
Electrical Return Loss	< -10 dB at < 18 GHz < -3 dB from 18 GHz to 40 GHz
Optical Return Loss	< -20 dB
DC Responsivity	> 0.2 A/W (850 ± 20 nm), > 0.6 A/W (1060 ± 20 nm)
RF OUT Connector	K male (2.92 mm)

MN4765B-0043

Frequency Range	70 kHz to 40 GHz
Operating Wavelength Range	800 nm to 1700 nm
Characterized Wavelength	850 ± 20 nm, 1060 ± 20 nm, 1319 ± 20 nm, and 1550 ± 20 nm
Linear Optical Input Power	< 2 dBm
Maximum Optical Input Power	7 dBm
Electrical Return Loss	< -10 dB at < 18 GHz < -3 dB from 18 GHz to 40 GHz
Optical Return Loss	< -20 dB
DC Responsivity	> 0.2 A/W (850 ± 20 nm), > 0.6 A/W (1060 ± 20 nm), > 0.7 A/W (1319 ± 20 nm), and > 0.8 A/W (1550 nm ± 20 nm)
RF OUT Connector	K male (2.92 mm)

MN4765B-0070

Frequency Range	70 kHz to 70 GHz
Operating Wavelength Range	1480 nm to 1620 nm
Characterized Wavelength	1550 nm ± 20 nm (Over the operating wavelength range, the characterization has typically been observed to vary by less than 0.5 dB.)
Linear Optical Input Power	< 6 dBm
Maximum Optical Input Power	10 dBm
Electrical Return Loss	< -8 dB at < 50 GHz < -5 dB from 50 GHz to 70 GHz
Optical Return Loss	< -24 dB
DC Responsivity	> 0.7 A/W (1550 nm ± 20 nm)
RF OUT Connector	V male (1.85 mm)

MN4765B-0071

Frequency Range	70 kHz to 70 GHz
Operating Wavelength Range	1260 nm to 1330 nm
Characterized Wavelength	1319 nm ± 10 nm (Over the operating wavelength range, the characterization has typically been observed to vary by less than 0.5 dB.)
Linear Optical Input Power	< 6 dBm
Maximum Optical Input Power	10 dBm
Electrical Return Loss	< -8 dB at < 50 GHz < -5 dB from 50 GHz to 70 GHz
Optical Return Loss	< -24 dB
DC Responsivity	> 0.45 A/W (1319 nm ± 10 nm)
RF OUT Connector	V male (1.85 mm)

MN4765B-0072

Frequency Range	70 kHz to 70 GHz
Operating Wavelength Range	1260 nm to 1620 nm
Characterized Wavelength	1319 nm $\pm$ 10 nm and 1550 nm $\pm$ 20 nm (Over the operating wavelength range, the characterization has typically been observed to vary by less than 0.5 dB.)
Linear Optical Input Power	< 6 dBm
Maximum Optical Input Power	10 dBm
Electrical Return Loss	< -8 dB at < 50 GHz < -5 dB from 50 GHz to 70 GHz
Optical Return Loss	< -24 dB
DC Responsivity	> 0.45 A/W (1319 nm $\pm$ 10 nm) and (1550 nm $\pm$ 20 nm)
RF OUT Connector	V male (1.85 mm)

MN4765B-0110

Frequency Range	70 kHz to 110 GHz
Operating Wavelength Range	1480 nm to 1620 nm
Characterized Wavelength	1550 nm $\pm$ 20 nm (Over the operating wavelength range, the characterization has typically been observed to vary by less than 0.5 dB.)
Linear Optical Input Power	< 6 dBm
Maximum Optical Input Power	10 dBm
Electrical Return Loss	< -6 dB at < 50 GHz < -4 dB from 50 GHz to 110 GHz
Optical Return Loss	< -24 dB
DC Responsivity	> 0.5 A/W (1550 nm $\pm$ 20 nm)
RF OUT Connector	W male (1.0 mm)

MN4765B-0111

Frequency Range	70 kHz to 110 GHz
Operating Wavelength Range	1260 nm to 1330 nm
Characterized Wavelength	1319 $\pm$ 10 nm (Over the 1300-1330 nm wavelength range, the characterization has typically been observed to vary by less than 1 dB.)
Linear Optical Input Power	< 6 dBm
Maximum Optical Input Power	10 dBm
Electrical Return Loss	< -6 dB at < 50 GHz < -4 dB from 50 GHz to 110 GHz
Optical Return Loss	< -24 dB
DC Responsivity	> 0.25 A/W (1319 $\pm$ 10 nm) and > 0.5 A/W (1550 $\pm$ 20 nm)
RF OUT Connector	W male (1.0 mm)

MN4765B-0112

Frequency Range	70 kHz to 110 GHz
Operating Wavelength Range	1260 nm to 1620 nm
Characterized Wavelength	1319 $\pm$ 10 nm and 1550 $\pm$ 20 nm (Over the 1300-1620 nm wavelength range, the characterization has typically been observed to vary by less than 2 dB.)
Linear Optical Input Power	< 6 dBm
Maximum Optical Input Power	10 dBm
Electrical Return Loss	< -6 dB at < 50 GHz < -4 dB from 50 GHz to 110 GHz
Optical Return Loss	< -24 dB
DC Responsivity	> 0.25 A/W (1319 $\pm$ 10 nm) and > 0.5 A/W (1550 $\pm$ 20 nm)
RF OUT Connector	W male (1.0 mm)

MN4765B-0140

Frequency Range	70 kHz to 145 GHz
Operating Wavelength Range	1480 nm to 1620 nm
Characterized Wavelength	1550 nm $\pm$ 20 nm (Over the operating wavelength range, the characterization has typically been observed to vary by less than 0.5 dB.)
Linear Optical Input Power	< 6 dBm
Maximum Optical Input Power	10 dBm
Electrical Return Loss	< -7 dB to 70 GHz < -4 dB from 70 to 145 GHz
Optical Return Loss	< -24 dB
DC Responsivity	> 0.35 A/W (1550 $\pm$ 20 nm)
RF OUT Connector	0.8 mm male

General Specifications

Optical IN	FC/APC
AC Adapter	100 V to 240 V (50 Hz to 60 Hz) input, +12 VDC output
Power LED	On when the AC adapter is plugged in and the internal photodiode is properly biased
Operate LED	On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations and measurements
Dimensions	33 H x 51 W x 127 D mm (1.3 H x 2.0 W x 5.0 D in)

Environmental Specifications

Calibrated temperature	23 °C ± 3 °C
Operating Temperature	18 °C to 28 °C
Storage Temperature	-20 °C to 70 °C (-15 °C to 60 °C for -004x)
Relative Humidity	5% to 95%
EMC	Conforms to the EMC Directive, 2004/108/EC per EN 61326-1:2013
Emissions	EN55011, Class A, Group 1
Immunity	EN61000-4-2/3/4/5/6/11

Regulatory Compliance

European Union	EMC 2014/30/EU, EN 61326:2013, CISPR 11/EN 55011, IEC/EN 61000-4-2/3/4/5/6/8/11 Low Voltage Directive 2014/35/EU Safety EN 61010-1:2010 RoHS Directive 2011/65/EU & Amendment 2015/863
United Kingdom	EMC SI 2016/1091; BS EN 55011 & BS EN 61000-4-2/3/4/5/6/8/11 Consumer Protection (Safety) SI 2016/1101; BS EN 61010-1:2010 Environmental Protection SI 2012/3032; 2011/65/EU & 2015/863
Canada	CAN ICES-1(A)/NMB-1(A)
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	R-R-A2J-1013

Warranty

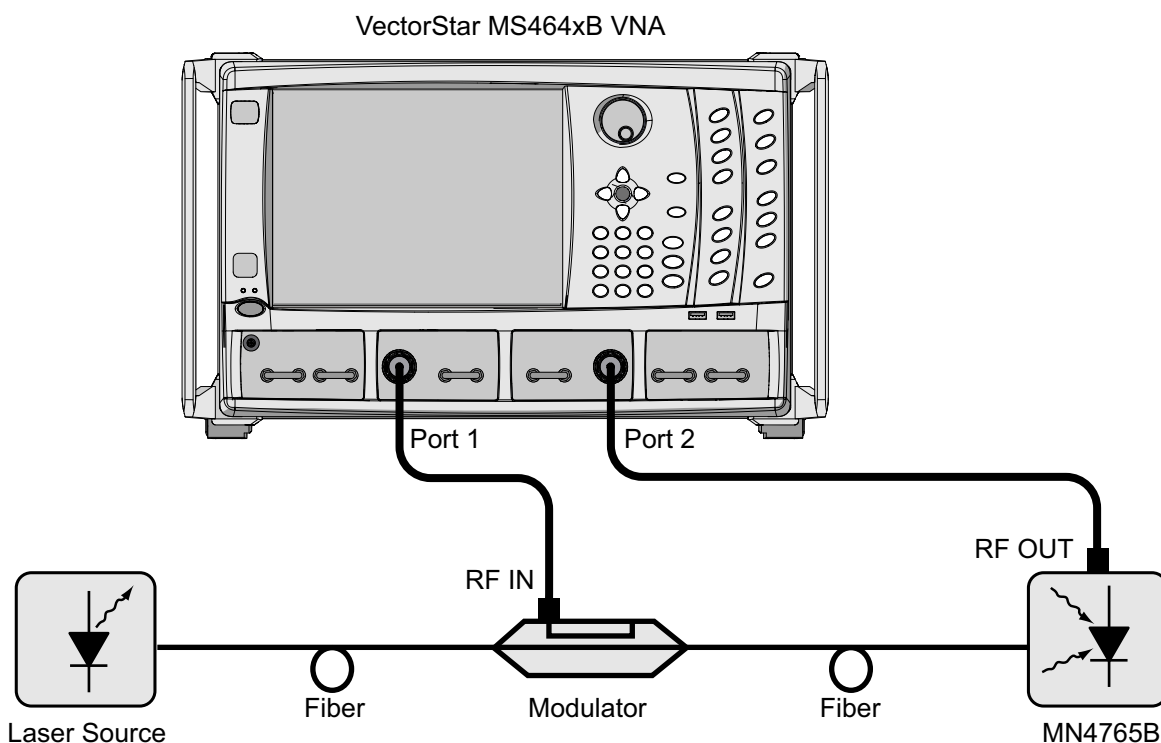
Standard Warranty	One year from the date of shipment
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MN4765B Example Measurement Setup and Module Frequency Response

Full frequency use of the Option 70/71/72 module requires a MS4647B 70 GHz VNA although lower frequency VNAs can be used for their portion of the MN4765B-0070/-0071/-0072 frequency range, and for all of the MN4765B-0040/0042/0043 frequency range. Full use of the frequency range of the Option 110 /111/112/140 module requires a ME7838x broadband system. Below is an example of the general E/O or O/E measurement setup. Frequency response traces for the different options are shown on the pages following.

Note

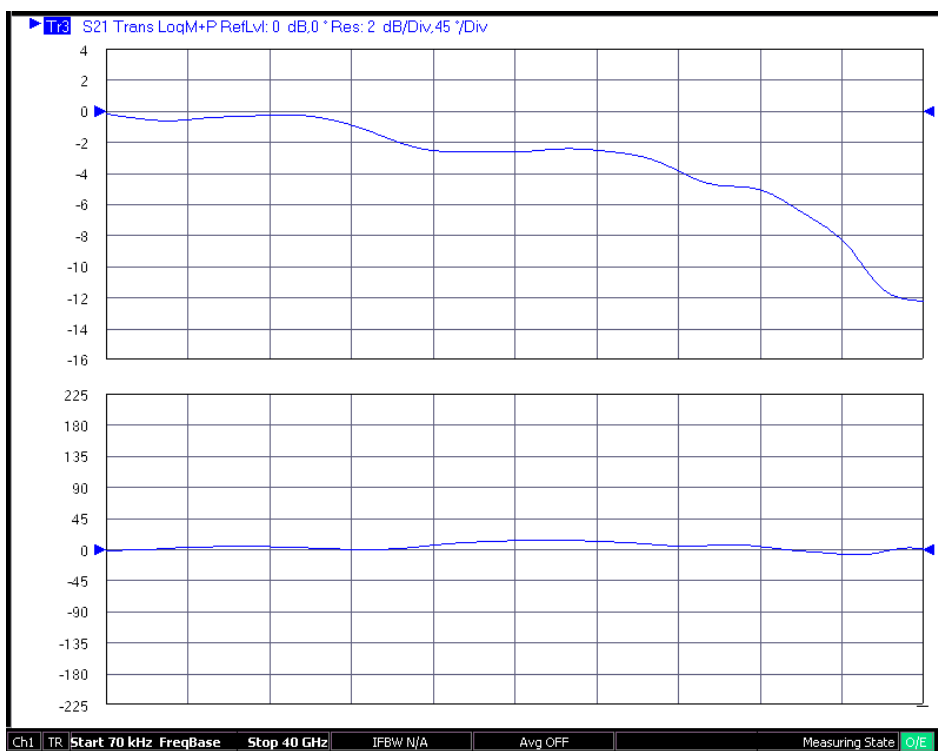
Frequency response of individual modules will vary in shape but will have same stability and general immunity from the noise floor.



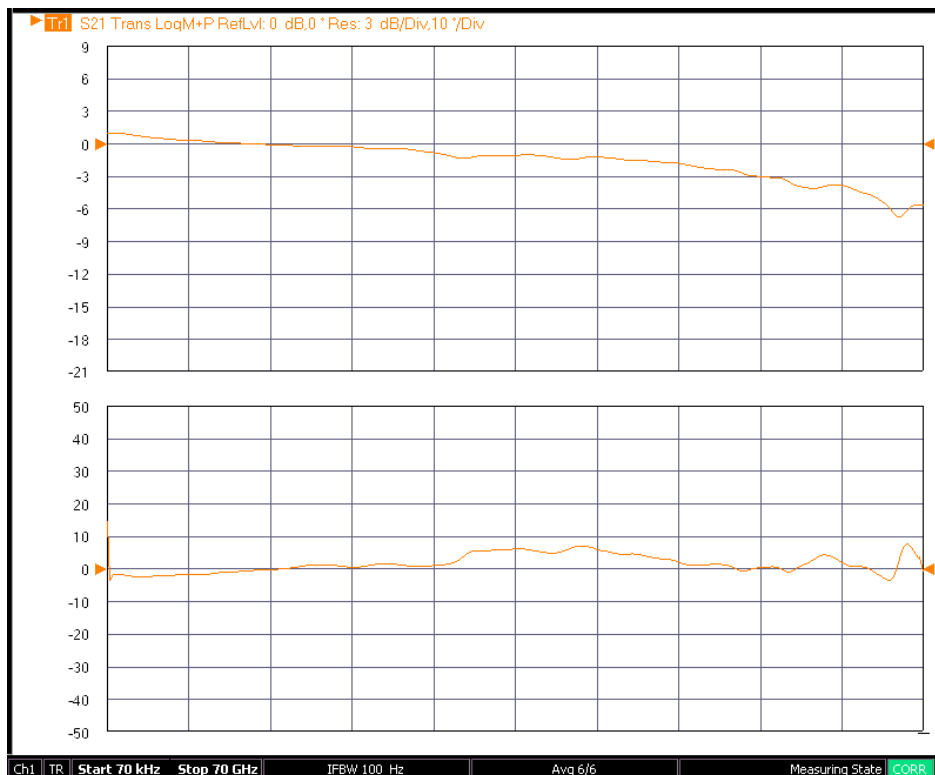
MN4765B Frequency Response Measurement Setup Using MS464xB VNA (Refer to Application Note 11410-00798)

The MN4775A series of E/O converters can be used in lieu of the laser source and/or modulator in the above figure. The MN4775A combines both in one unit with an integrated bias controller. Overall system specifications for the ME7848A-02xx system include the MS464xB VNA, an MN4765B O/E calibration module, and an MN4775A E/O converter

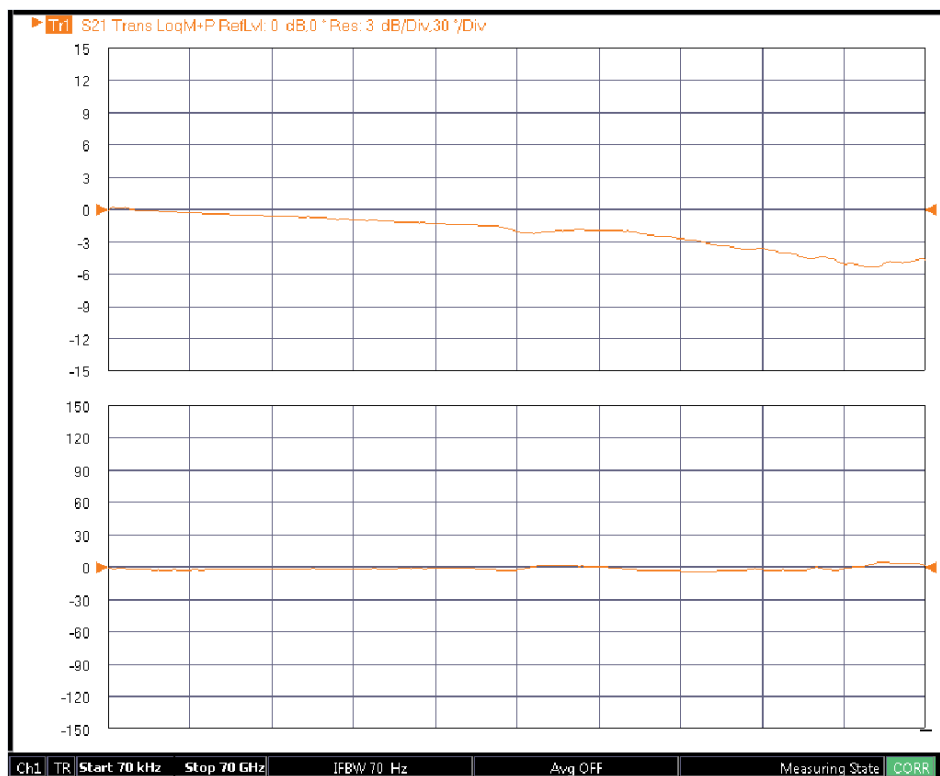
Note: Frequency response of individual modules will vary in shape but will have same stability and general immunity from the noise floor.



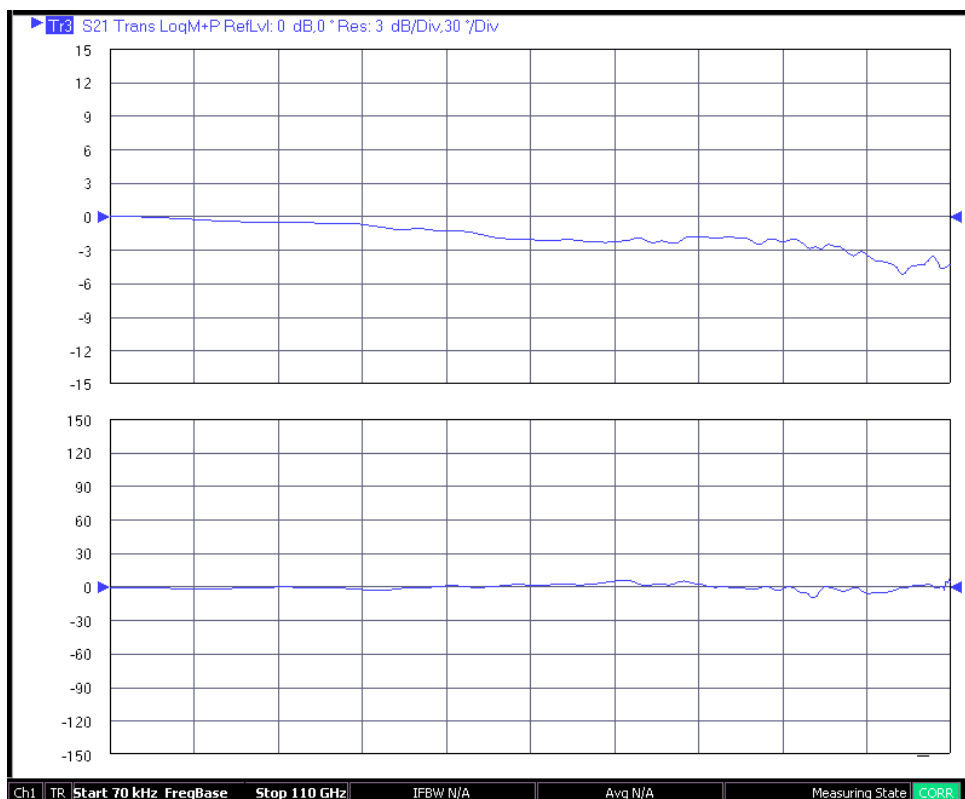
Example of Typical Frequency Response – Option 40/42/43, 850 nm (MN4765B-0040/0042/0043)



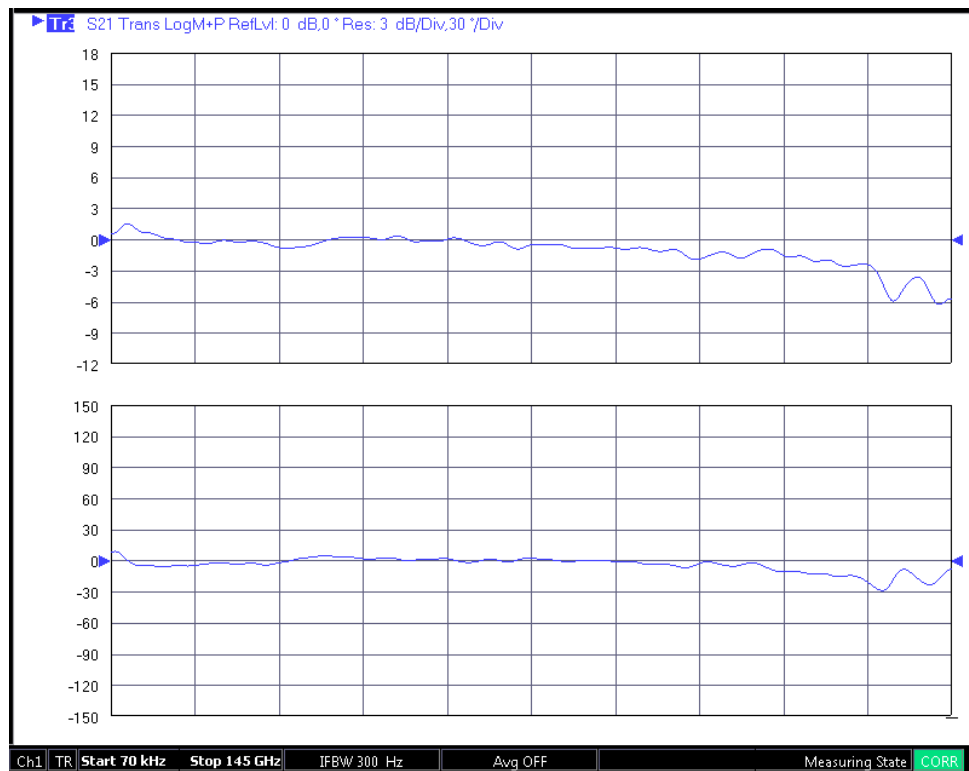
Example of Typical Frequency Response – Option 70, 1550 nm (MN4765B-0070)



Example of Typical Frequency Response – Option 71 or Option 72 at 1310 nm (MN4765B-0071/0072)



Example of Typical Frequency Response – Option 110, 1550 nm (MN4765B-0110)



Example of Typical Frequency Response – Option 140, 1550 nm (MN4765B-0140)

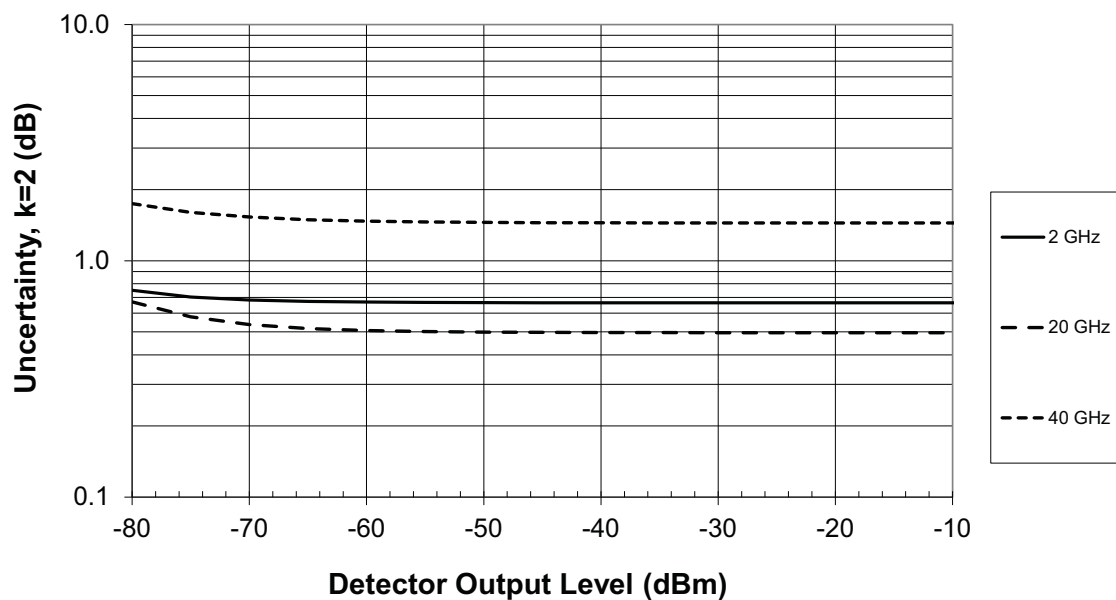
Uncertainties

Uncertainty computations are typical and include initial characterization and transfer uncertainties, VNA basic measurement uncertainties (including calibration residuals) and connector repeatability. They do not include drift, effect of bias stability on any modulator, or effects of connector (RF or optical) cleanliness deficiencies.

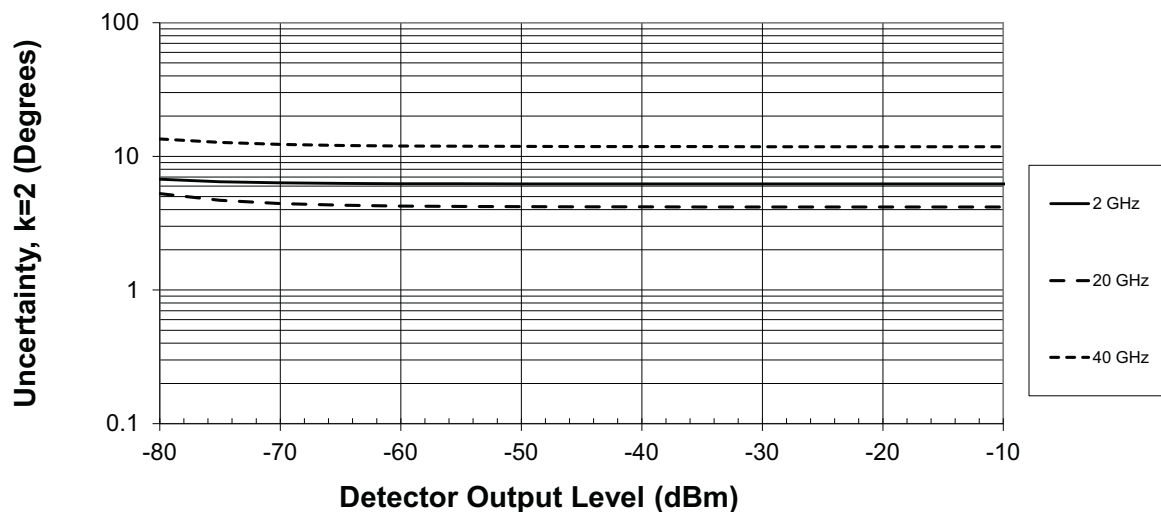
Measurement Uncertainties for Option 40, Option 42, or Option 43 (850 nm)

Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval. Analysis based on a $9\text{ }\mu\text{m}$ fiber connecting devices. See the section: ["Notes on Multimode Operation"](#) for information on use with large core diameters.

E/O Magnitude Uncertainty; MN4765B-004x, 850 nm, 95% Confidence

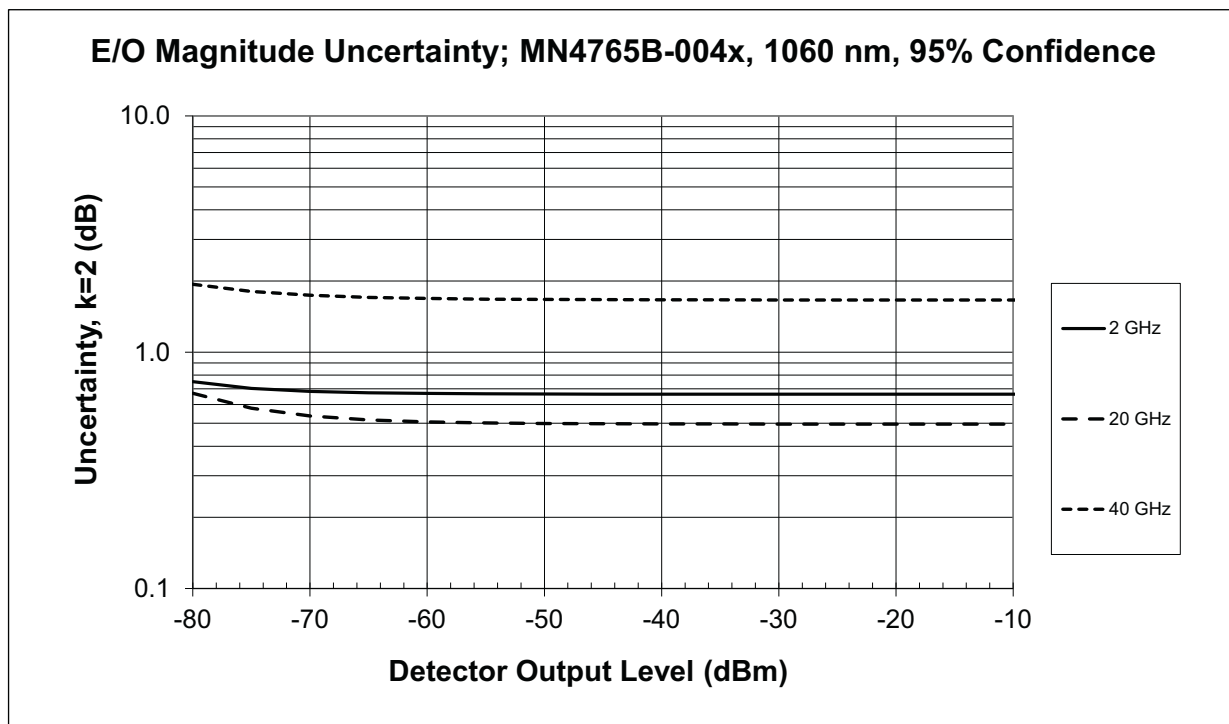
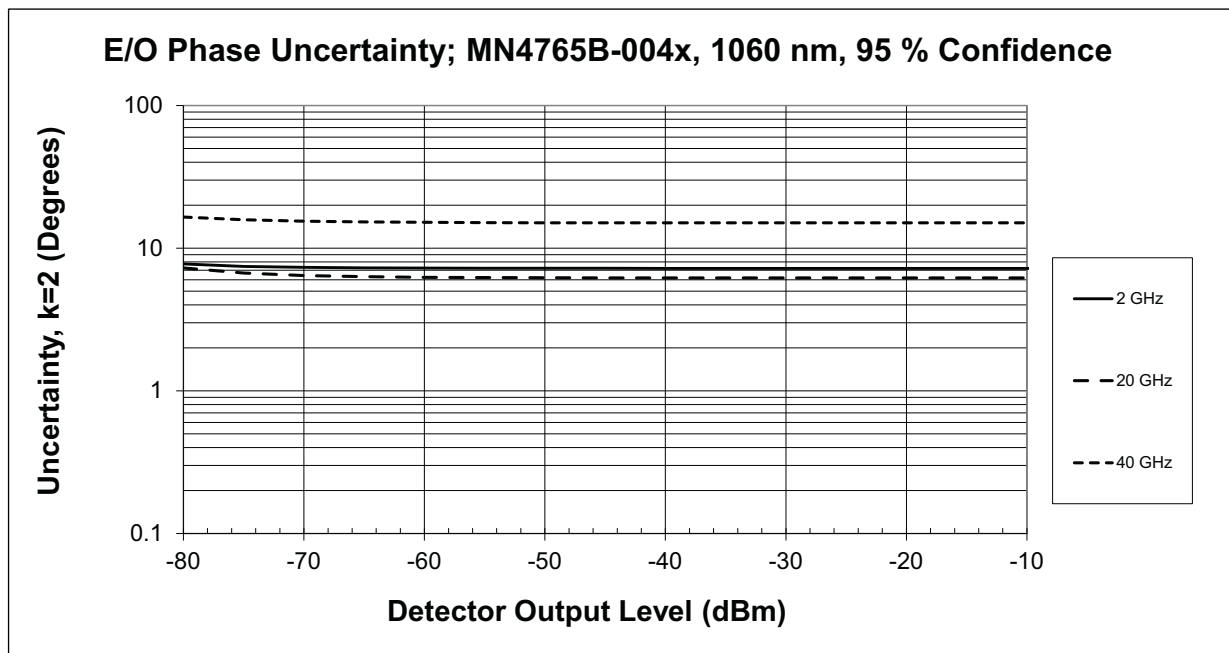


E/O Phase Uncertainty; MN4765B-004x, 850 nm, 95 % Confidence



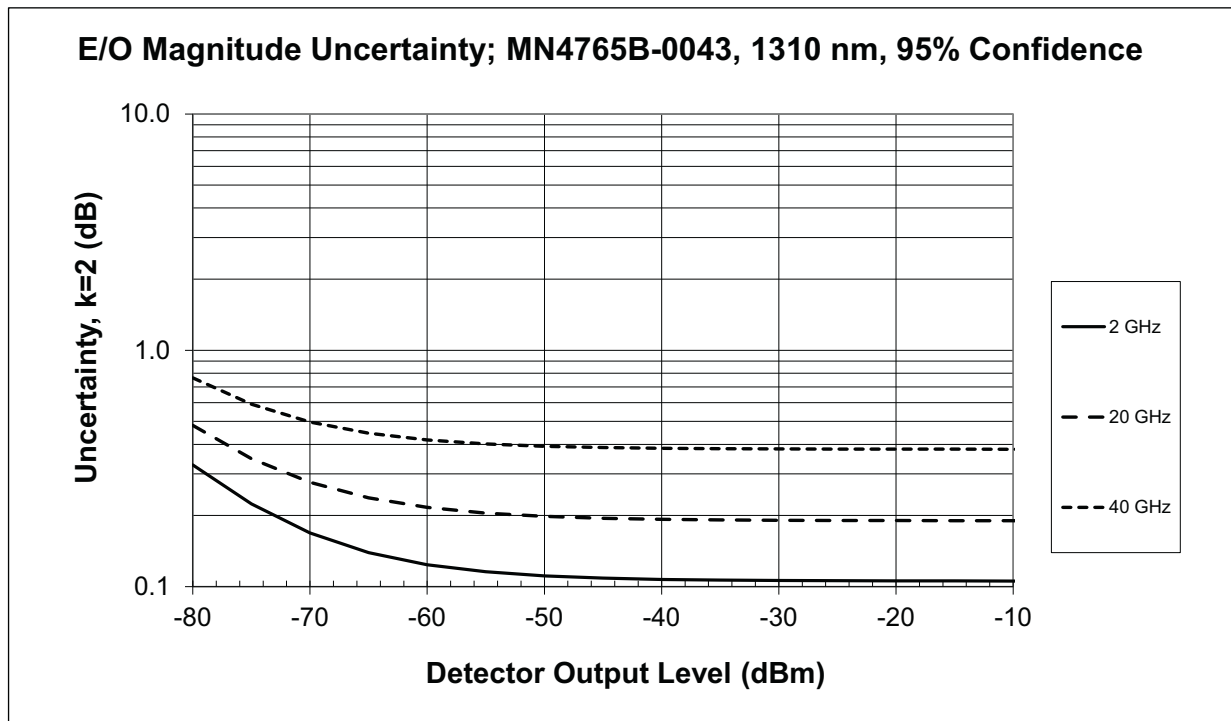
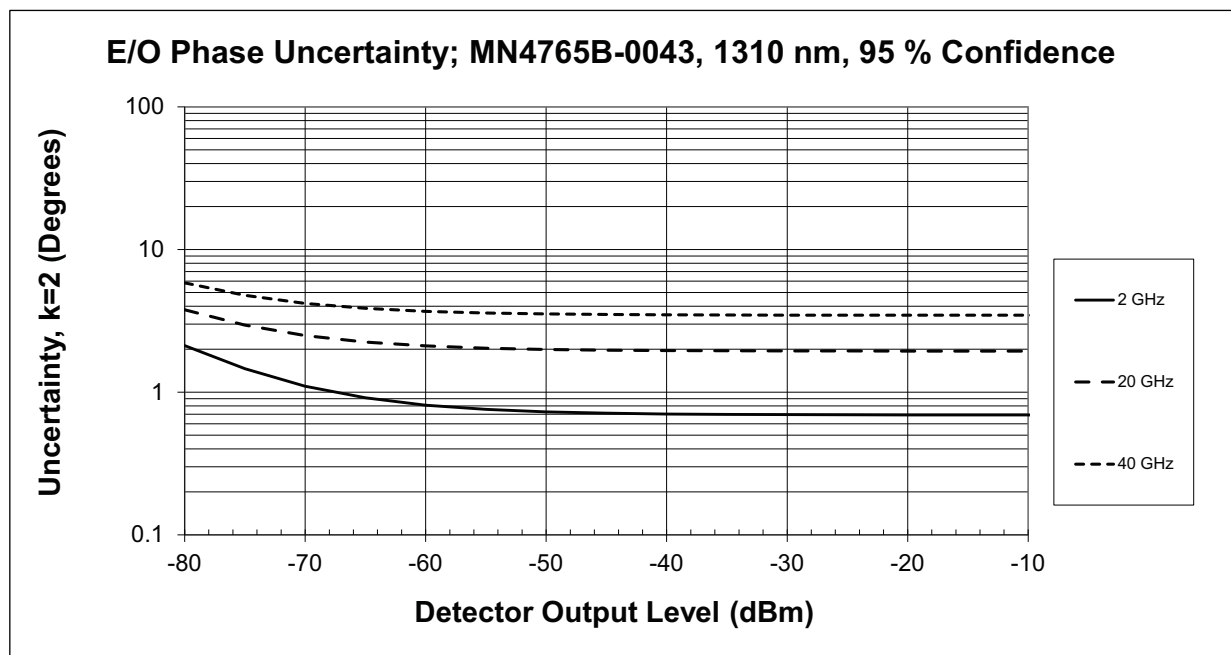
Measurement Uncertainties for Option 42, or Option 43 (1060 nm)

Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval. Derived from interpolation and wavelength dependence information. Analysis based on a 9 μm fiber connecting devices. See the section: ["Notes on Multimode Operation"](#) for information on use with large core diameters.



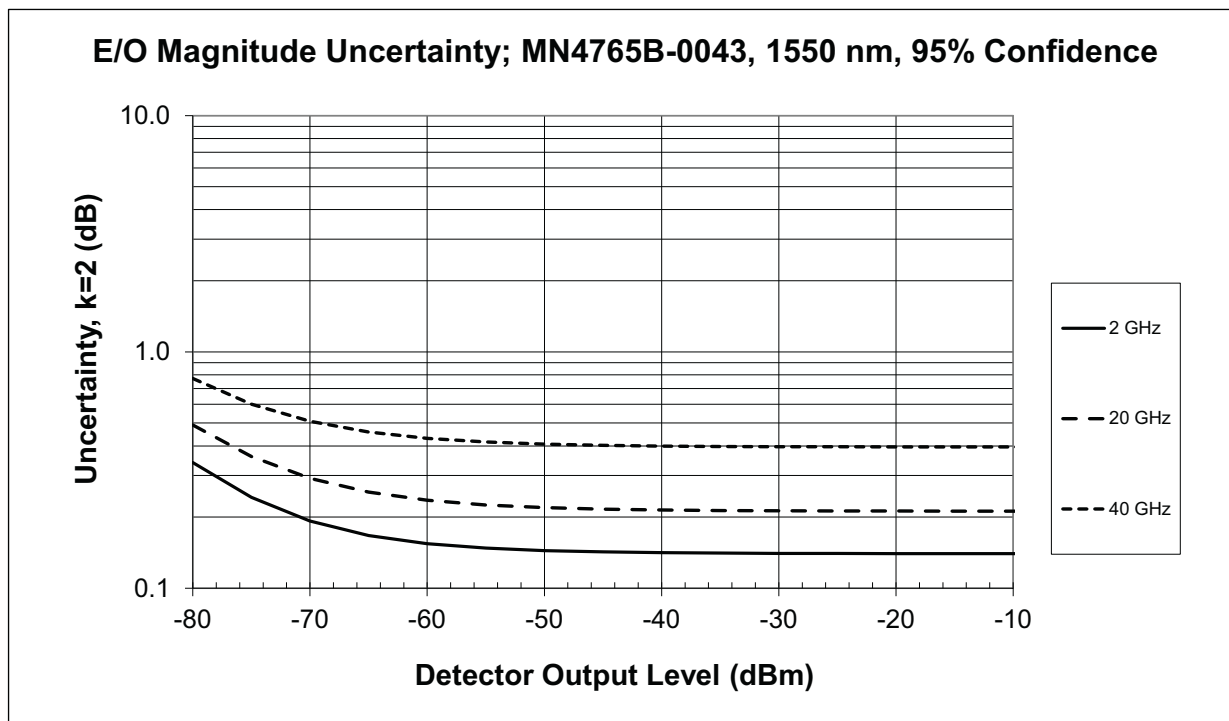
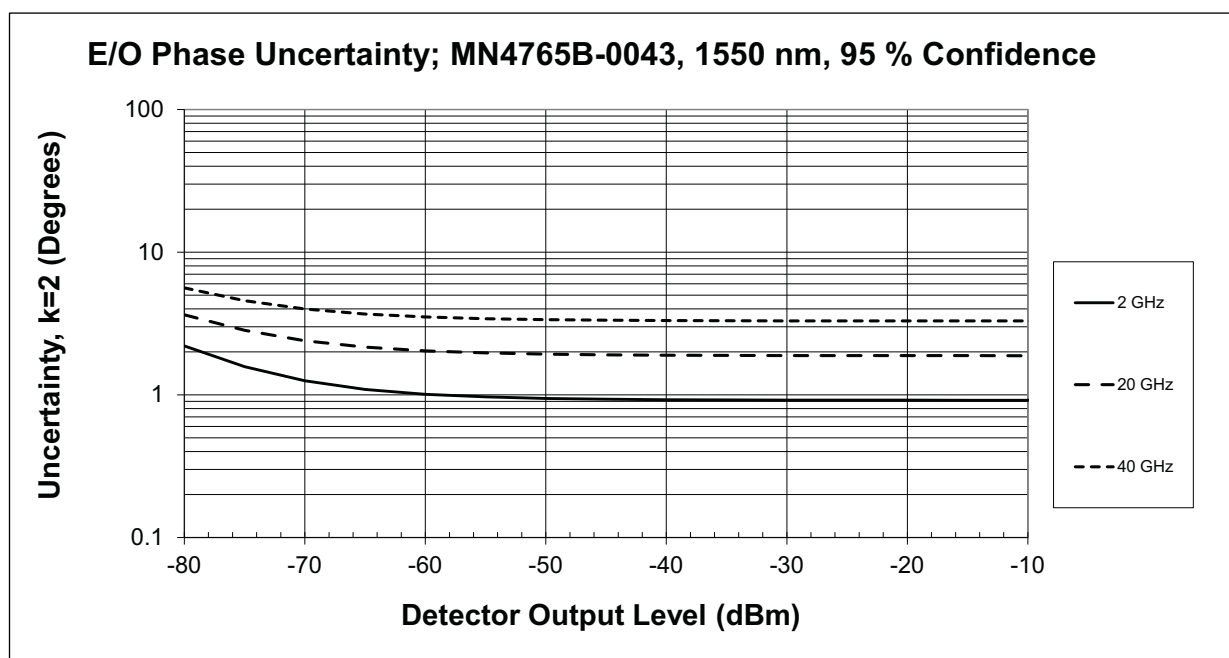
Measurement Uncertainties for Option 43 (1310 nm)

Uncertainty curves apply for temperatures of $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval.



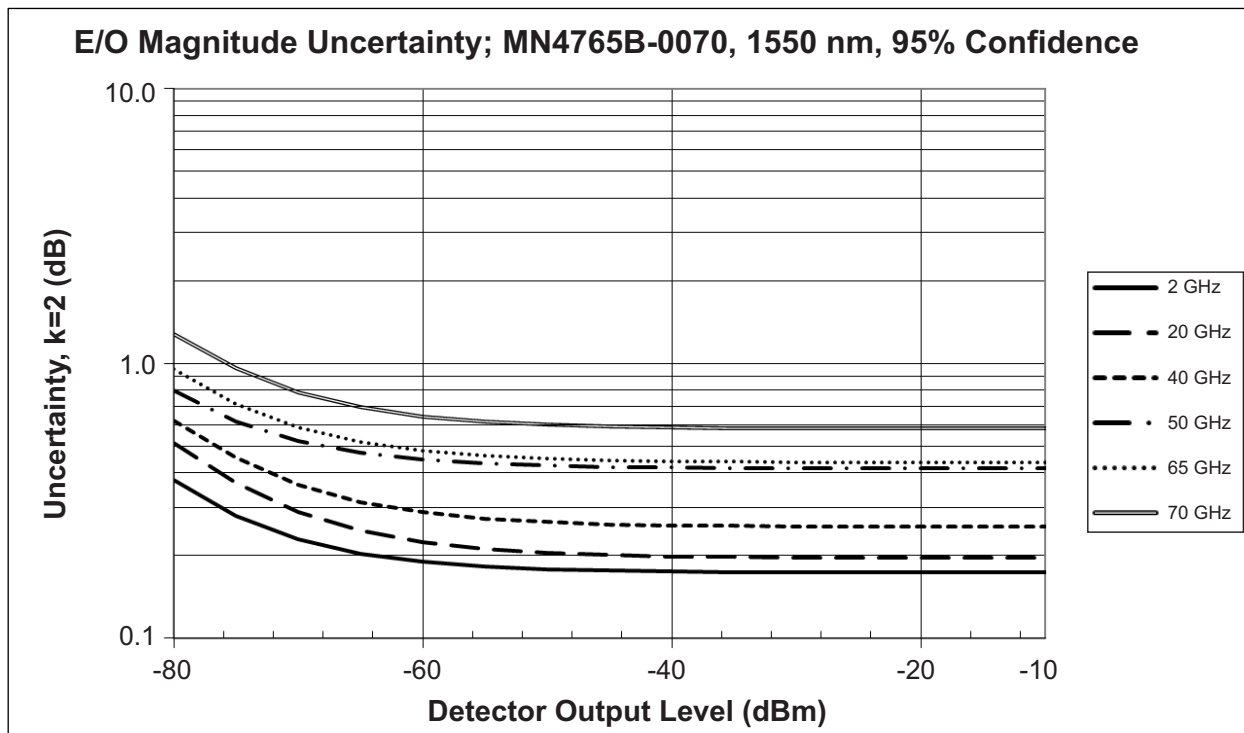
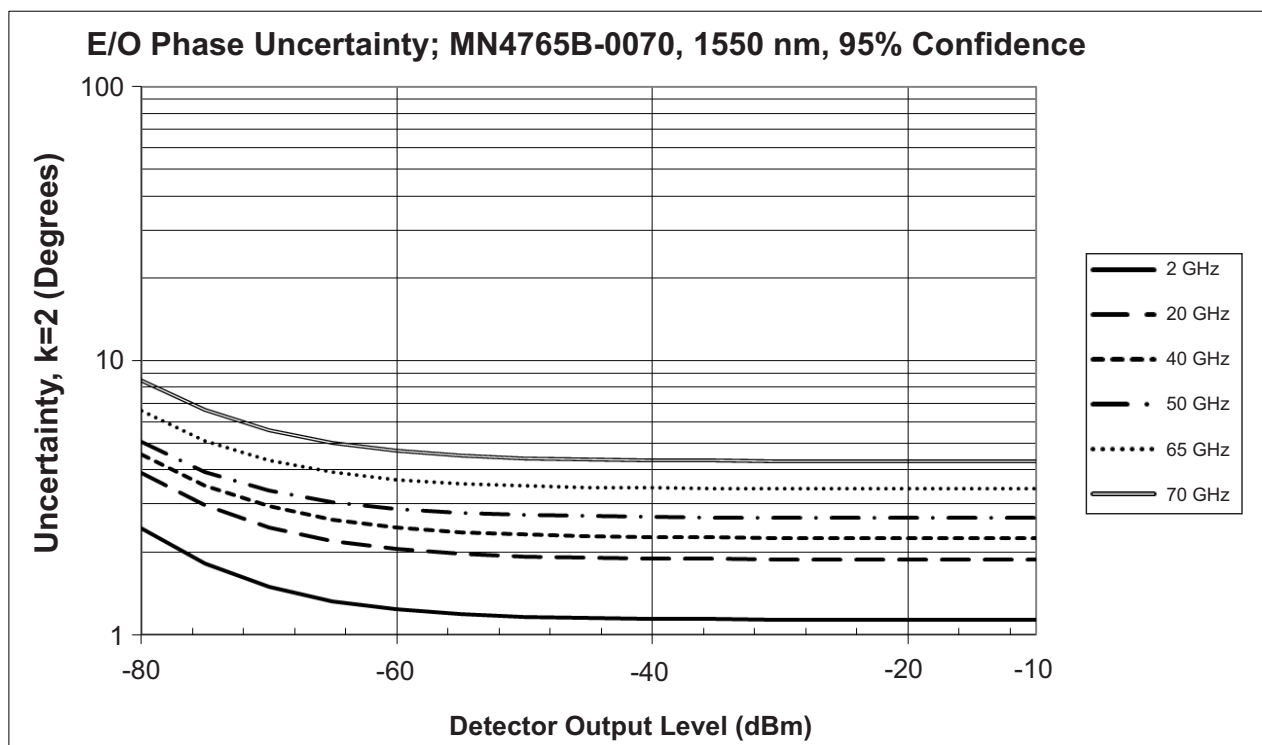
Measurement Uncertainties for Option 43 (1550 nm)

Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval.



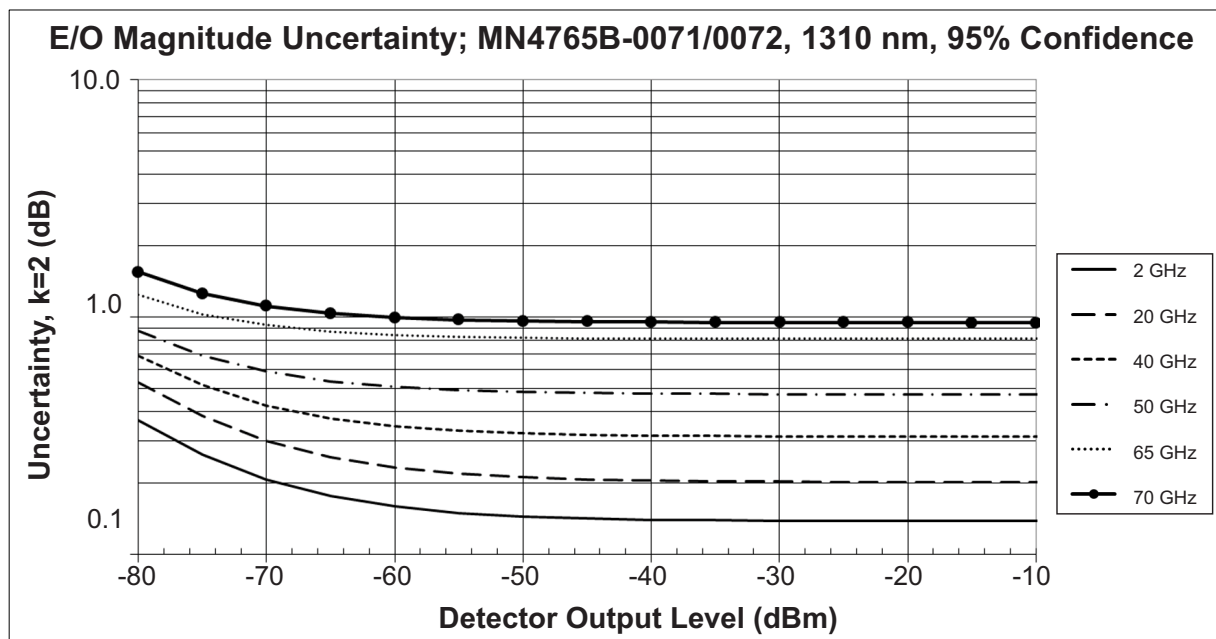
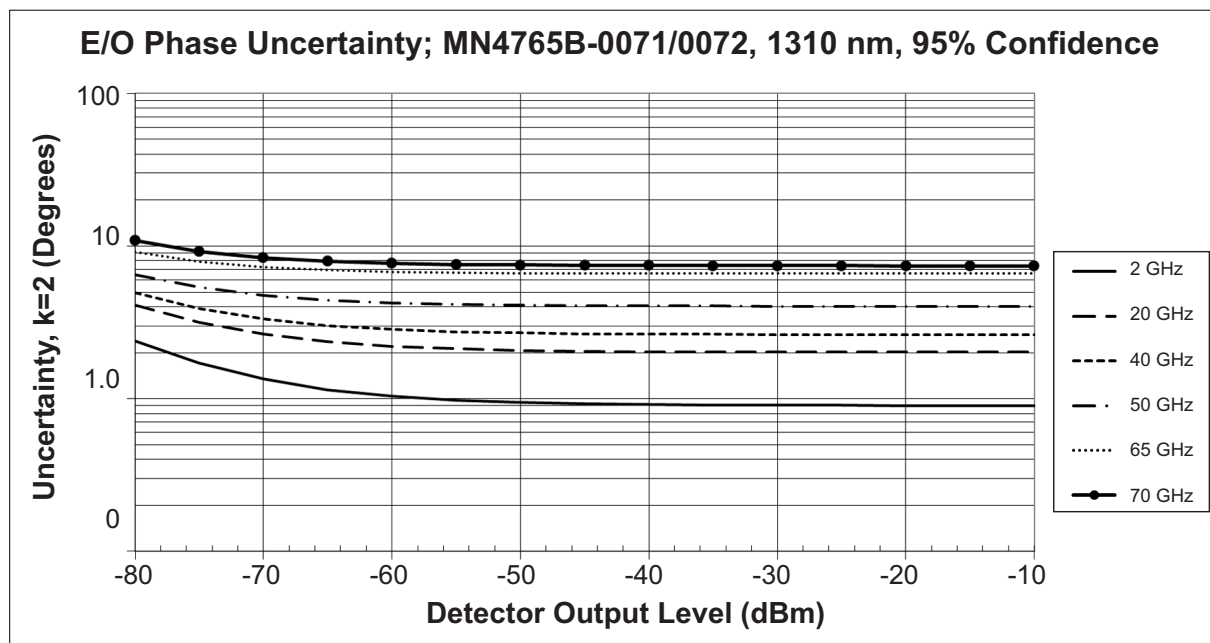
Measurement Uncertainties for Option 70 or Option 72 (1550 nm)

Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval.



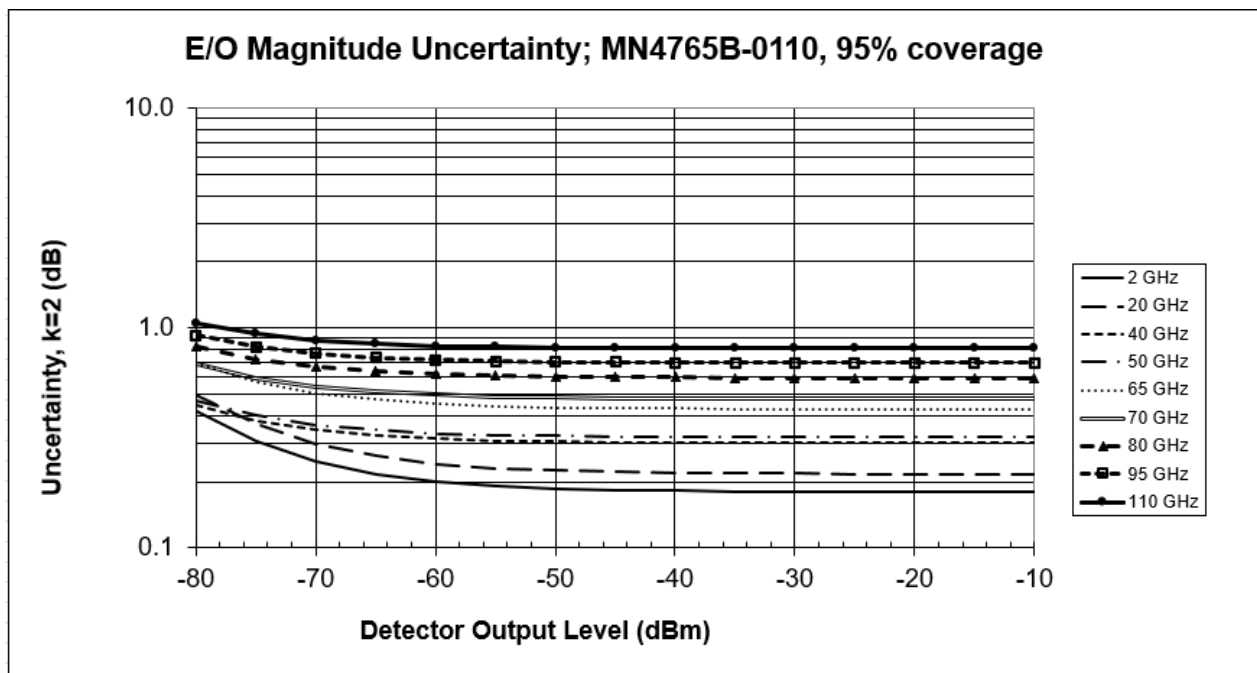
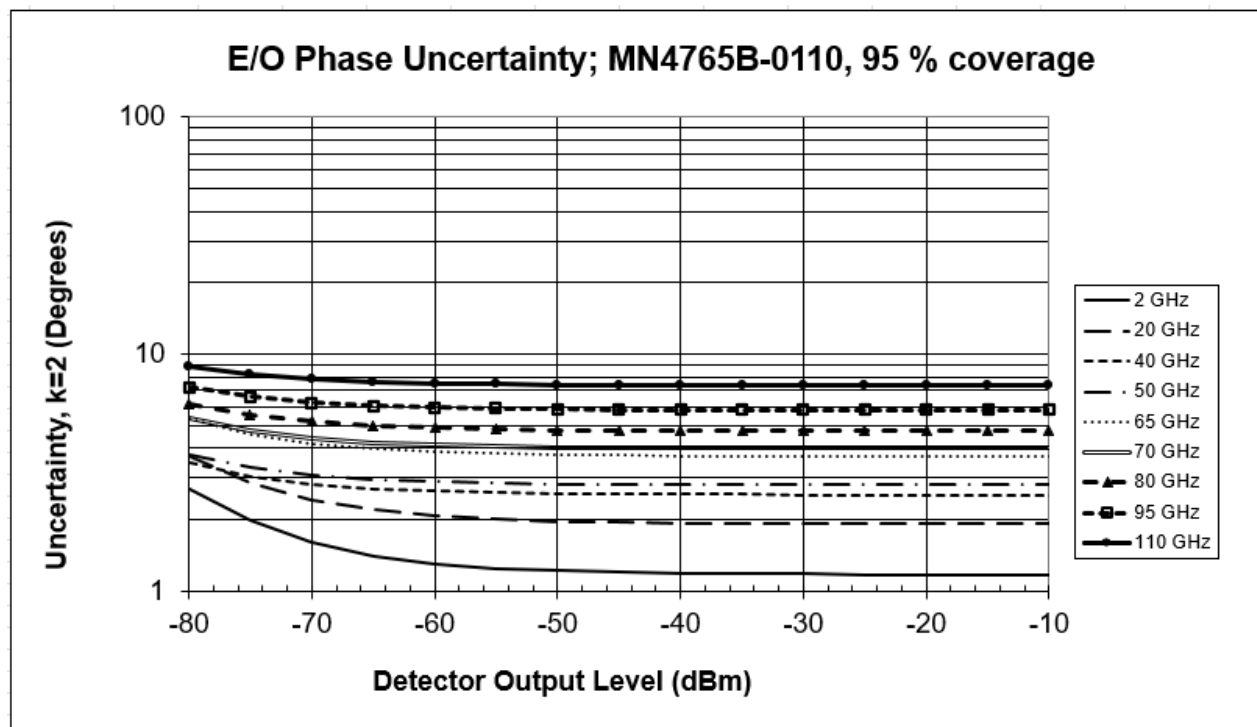
Measurement Uncertainties for Option 71 or Option 72 (1310 nm)

Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval. Magnitude uncertainty values above 40 GHz and phase uncertainty values are based on a 1550-1310 nm transfer model.



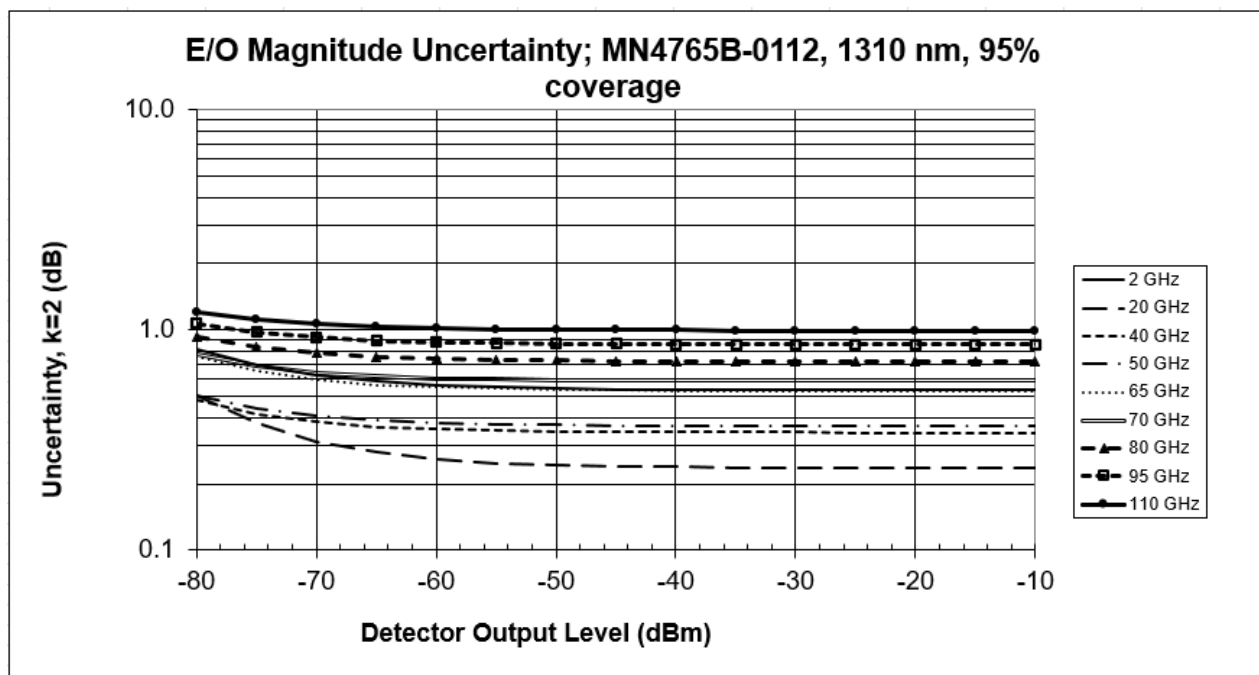
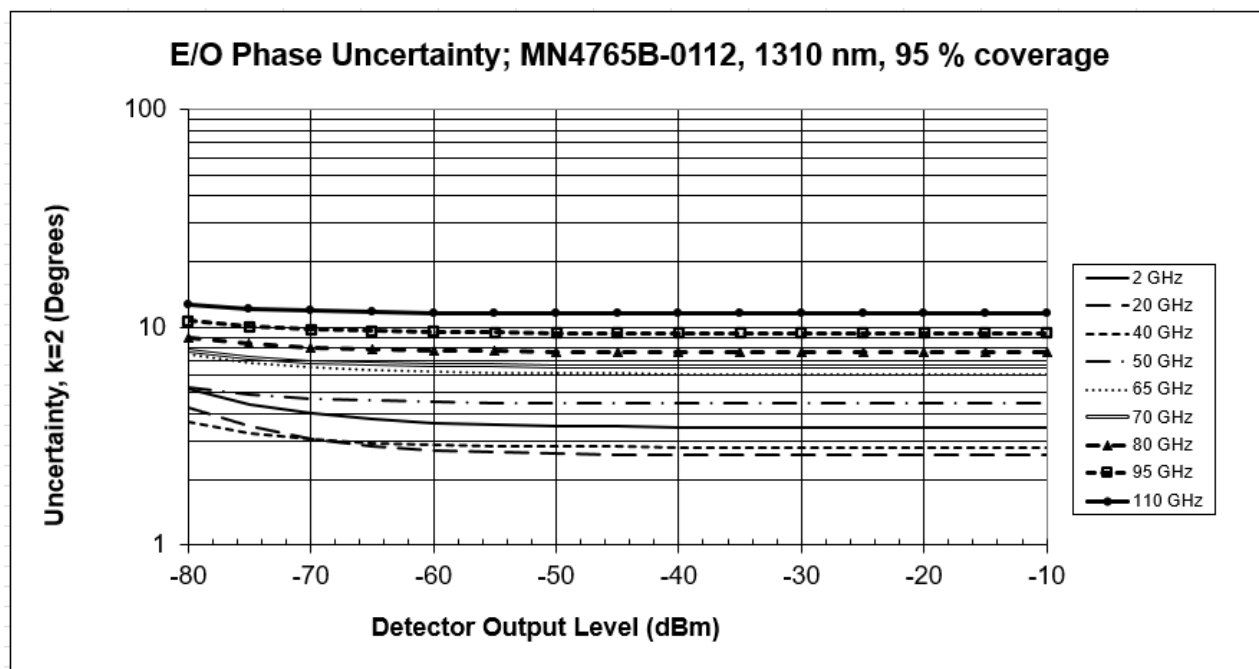
Measurement Uncertainties for Option 110 or 112 (1550 nm)

Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval.



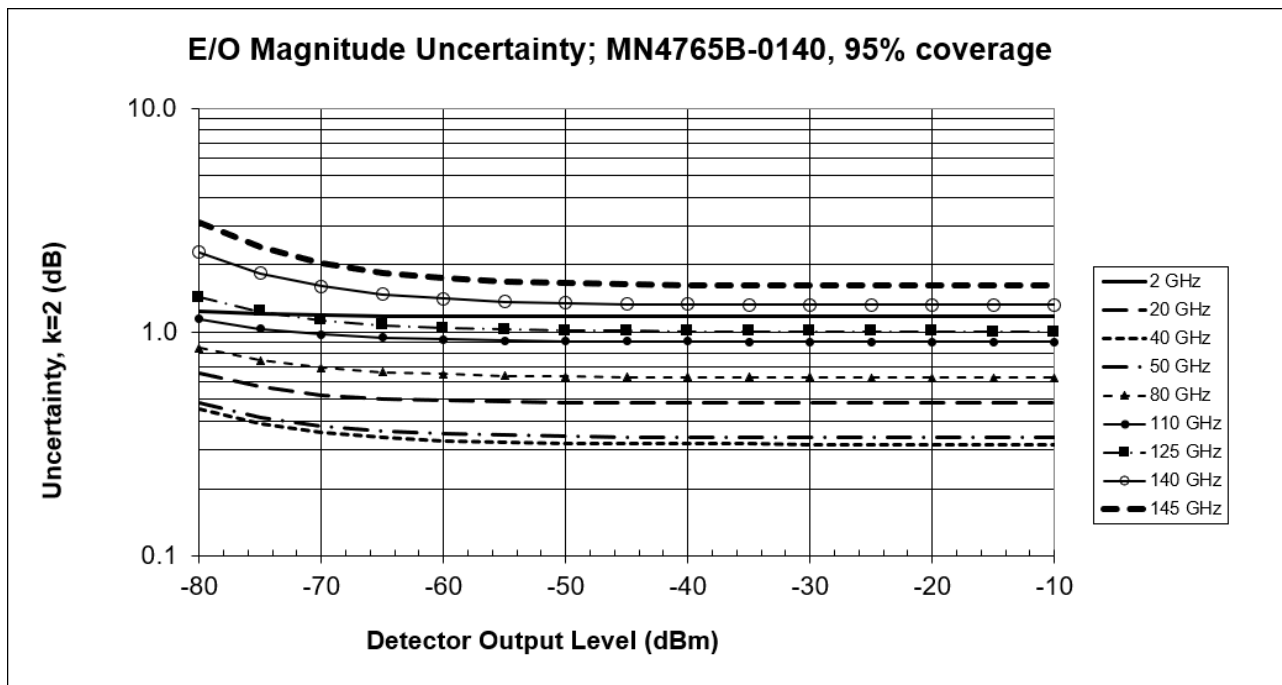
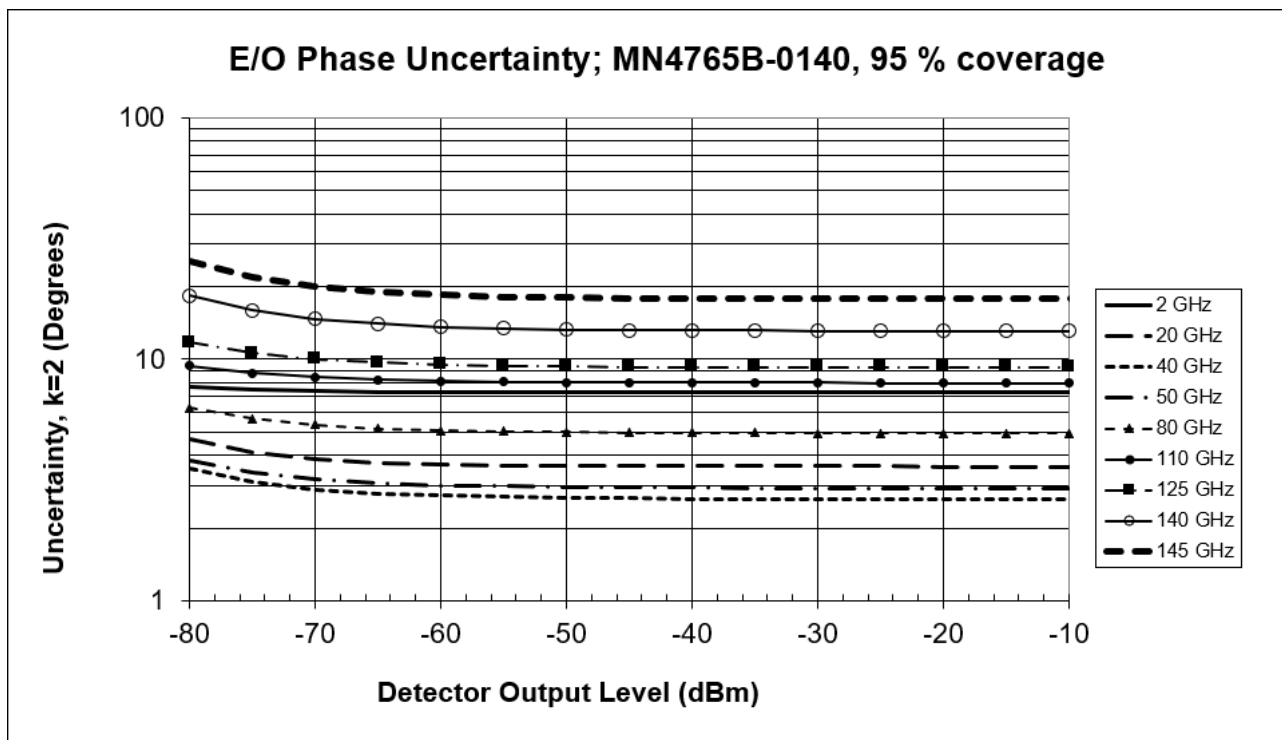
Measurement Uncertainties for Option 111 or 112 (1310 nm)

Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval.



Measurement Uncertainties for Option 140 (1550 nm)

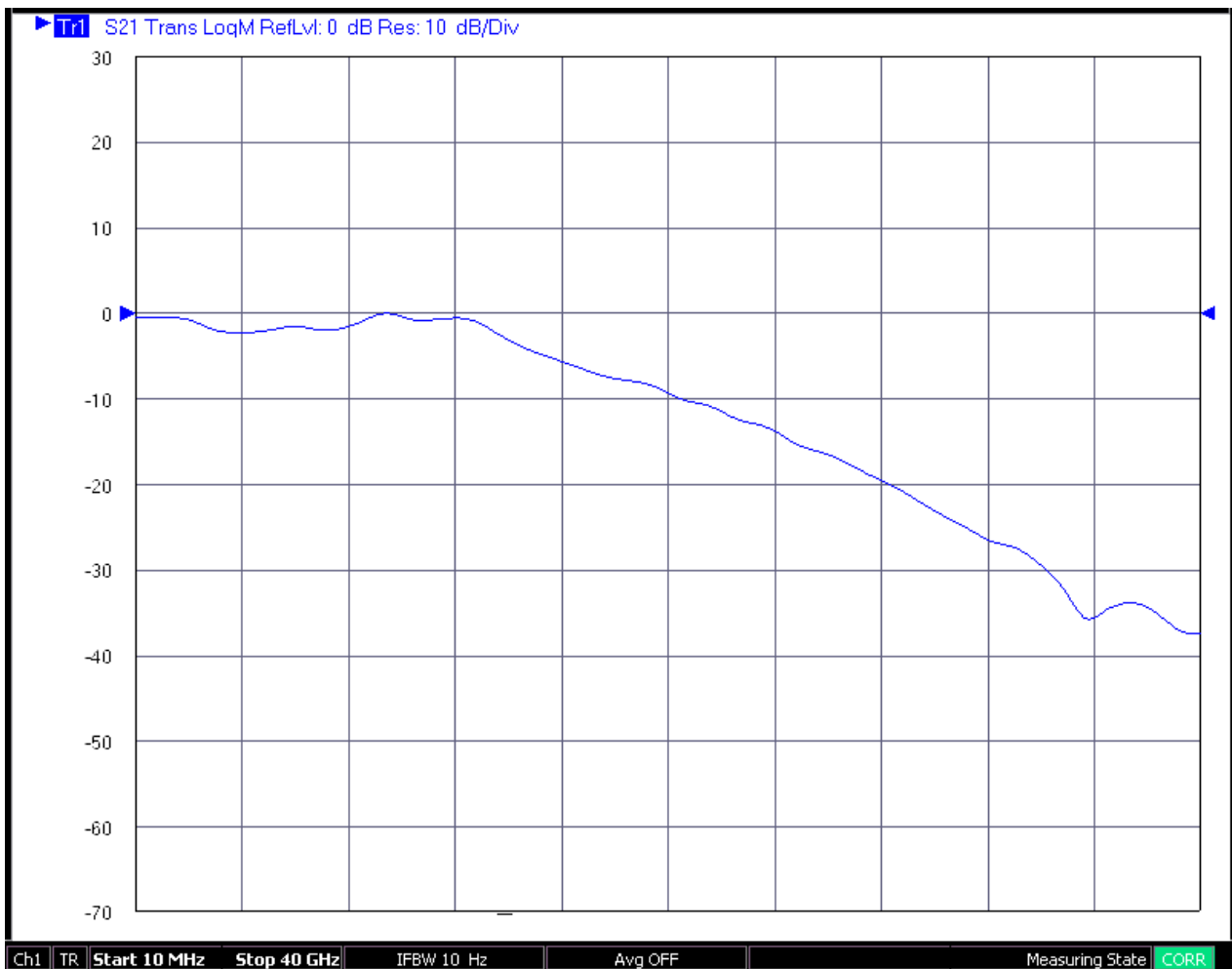
Uncertainty curves apply for temperatures of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95 % confidence interval.



Notes on Multimode Operation

Particularly at the shorter wavelengths (850 nm and 1060 nm), multimode (25 μm , 50 μm , or other core diameters) fibered devices are popular and the characteristics discussed in this data sheet so far are based on a single mode (or near single mode) fibered setup. When using a multimode modulator or VCSEL as part of the setup, the primary effect is a loss of coupled optical power which drops the output level of the MN4765B by 10 dB to 20 dB typically.

This may mean that a lower IF Bandwidth should be selected depending on the dynamic range requirements of the measurement but rarely will it preclude a deep frequency response analysis. As an example, the frequency response of a lower frequency VCSEL with a 50 μm multimode fiber output as measured with the MN4765B-0040 at 850 nm is shown below. A 10 Hz IF Bandwidth was used (10 Hz was used for all of the uncertainty curves in this technical data sheet) and structures nearly 40 dB down in amplitude are still observable. Additional range is possible using direct receiver access on the VNA (with Options 51 or 6x).



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