

## Optical Jitter & Wander Modules for NIC Platform

Jitter & Wander testing up to 10.7Gbps

### PLATFORMS



NIC Plus



NIC EP

The Network Information Computer (NIC) Jitter & Wander modules provides jitter test functionality for SONET/SDH and OTN interfaces up to 10.7Gbps

- OC3 / STM-1
- OC12 / STM-4
- OC48 / STM-16
- OC192 / STM-64
- OTU-1
- OTU-2

The Digital Lightwave patented Digital Phase Analysis (DPA) technology was the first digital jitter solution available.

Digital edge placement and detection techniques provide fast and repeatable measurements with reduced settling times and less need for retesting directly resulting in faster test completion with increased accuracy over standard measurement techniques.

### KEY FEATURES

- Stable, repeatable digital jitter measurement
- Applicable to product design, production floor and field
- Wide jitter dynamic range
- Same high resolution for the entire jitter range
- Compliant to ITU-T 0.172, G.825, G.958 and Telcordia GR-253
- Patented Digital Phase Analysis (DPA) technology
- Automated Intrinsic Jitter, Jitter Transfer and Jitter Tolerance Testing
- Extremely fast jitter and wander test results with repeatability

## JITTER GENERATION SPECIFICATIONS

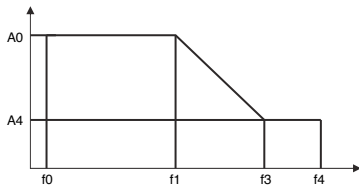
**Line Rates** OC-3/STM-1 (155.52 Mbps), STM-1e (155.52 Mbps), OC-12/STM-4 (622.08 Mbps), OC-48/STM-16 (2488.32 Mbps), OTU1 OTN (2666.06 Mbps), OC-192/STM-64 (9953.28 Mbps), OTU2 OTN (10709.00 Mbps)

**Automated Jitter Compliance Testing** **Jitter Tolerance:** Built in test limits per Telcordia, ITU, ANSI, and ETSI standards; user defined jitter tolerance masks (100 points max), jitter tolerance test types:  
 - Power penalty acceptance  
 - Power penalty measure  
 - Onset of errors acceptance  
 - Onset of errors measure

**Jitter Transfer:** Built in test limits per Telcordia, ITU, ANSI, and ETSI standards; user defined jitter transfer masks (100 points max); accuracy per 0.172

**Jitter Modulation** Built-in modulation generator (sinewave) frequency source 9 Hz to 80 MHz

**Jitter Amplitude** 0 to 3600 U<sub>lpp</sub>, resolution = 0.001 U<sub>lpp</sub>



Rate (Mb/s)	A0 (UI)	A4 (UI)	f0 (Hz)	f1 (Hz)	f3 (Hz)	f4 (Hz)
10709.0	3600	0.2	9	667	12M	80M
9953.28	3600	0.2	9	667	12M	80M
2666.06	900	0.3	10	2222	6.67M	20M
2488.32	900	0.3	10	2222	6.67M	20M
622.08	450	0.3	10	1111	1.67M	5M
155.52	450	0.3	10	289	433K	1.3M

**Jitter Generation Frequency Accuracy** For  $f_m < 10 \text{ MHz} \pm 1\%$   
 For  $10 \text{ MHz} < f_m < 60 \text{ MHz} \pm 5\%$   
 For  $60 \text{ MHz} < f_m < 80 \text{ MHz} \pm 6\%$

**Jitter Generator Amplitude Accuracy**  $\pm Q\%$  of amplitude setting  $\pm X$  U<sub>lpp</sub> X is the fixed error (defined per 0.172)

Rate	Q
10709.00 Mbps:	8% < 500 KHz 12% 500KHz–2MHz 15% >2 MHz
9953.28 Mbps:	8% < 500 KHz 12% 500KHz–2MHz 15% >2MHz
2666.06 Mbps:	8% < 500 KHz 12% > 500 KHz
2488.32 Mbps:	8% < 500 KHz 12% > 500 KHz
622.08 Mbps:	8% < 500 KHz 12% > 500 KHz
155.52 Mbps:	8% < 500 KHz 12% > 500 KHz

X is the fixed error defined per 0.172  
 0.02 UI @ 10709.00 Mbps, 9953.28 Mbps (typical)  
 0.02 UI @ 2488.32 Mbps, 2666.06 Mbps  
 0.01 UI @ 622.08 Mbps, 155.52 Mbps

**Jitter Generator Intrinsic**

10709.00 Mbps:	0.040 U <sub>lpp</sub> <sup>6,7</sup>
9953.28 Mbps:	0.040 U <sub>lpp</sub> <sup>5,6</sup>
2666.06 Mbps:	0.050 U <sub>lpp</sub> <sup>1,7</sup>
2488.32 Mbps:	0.040 U <sub>lpp</sub> <sup>1,5</sup>
622.08 Mbps:	0.030 U <sub>lpp</sub> <sup>2,5</sup>
155.52 Mbps:	0.020 U <sub>lpp</sub> <sup>3,5</sup>
STM-1e:	0.030 U <sub>lpp</sub> <sup>4,5</sup>

**Notes:**

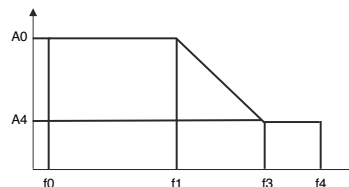
- Optical output, measurement BW 5 kHz - 20 MHz (typical)
- Optical output, measurement BW 1 kHz - 5 MHz (typical)
- Optical output, measurement BW 500 Hz - 1.3 MHz (typical)
- STM1e output, 0 dB Gain, measurement BW 500 Hz - 1.3 MHz (typical)
- Intrinsic values assume a structured STM-Nc signal with a payload of PRBS 2<sup>23</sup> -1
- Optical output, measurement BW 20 KHz - 80 MHz (typical)
- Intrinsic values assume a structured OTU-N signal with a structured SDH payload. The SDH payload is comprised of an STM-Nc signal with a payload of PRBS 2<sup>23</sup> -1. N is 16 for OTU1. N is 64 for OTU2.

## JITTER MEASUREMENT SPECIFICATIONS

**Line Rates** OC-3/STM-1 (155.52 Mbps), STM-1e (155.52 Mbps), OC-12/STM-4 (622.08 Mbps), OC-48/STM-16 (2488.32 Mbps), OTU1 OTN (2666.06 Mbps), OC-192/STM-64 (9953.28 Mbps), OTU2 OTN (10709.00 Mbps)

**Automated Jitter Compliance Testing** **Jitter Generation:** Built in test limits per Telcordia, ITU, ANSI, and ETSI standards; user defined jitter generation

**Jitter Measurement Range**



Rate (Mb/s)	A0 (UI)	A4 (UI)	f0 (Hz)	f1 (Hz)	f3 (Hz)	f4 (Hz)
10709.0	3600	0.2	9	667	12M	80M
9953.28	3600	0.2	9	667	12M	80M
2666.06	900	0.3	10	2222	6.67M	20M
2488.32	900	0.3	10	2222	6.67M	20M
622.08	450	0.3	10	1111	1.67M	5M
155.52	450	0.3	10	289	433K	1.3M

Measurement Resolution

0.001 UI for peak-to-peak jitter  
0.0001 UI for RMS jitter

Measurement Bandwidths

Bit Rate (Mb/s)	HPF -3dB freq	LPF -3dB freq
10709.00	10 KHz	80 MHz
10709.00	20 KHz	80 MHz
10709.00	50 KHz	80 MHz
10709.00	4 MHz	80 MHz
9953.28	10 KHz	80 MHz
9953.28	20 KHz	80 MHz
9953.28	50 KHz	80 MHz
9953.28	4 MHz	80 MHz
2666.06	5KHz	20 MHz
2666.06	12 KHz	20 MHz
2666.06	1 MHz	20 MHz
2488.32	5KHz	20 MHz
2488.32	12 KHz	20 MHz
2488.32	1 MHz	20 MHz
622.08	1 KHz	5 MHz
622.08	12 KHz	5 MHz
622.08	250 KHz	5 MHz
155.52	500 Hz	1.3 MHz
155.52	12 KHz	1.3 MHz
155.52	65 KHz	1.3 MHz

Ulrms is available on 12 kHz filter at 2666.06 Mbps, 2488.32 Mbps, 622.08 Mbps, and 155.52 Mbps

Ulrms is available on 50 kHz filter at 9953.28 Mbps, 10709.00 Mbps

Frequency Response Of Measurement Function

All high-pass filters (HPF) are first-order (-20 dB/dec); All low-pass filters (LPF) are third-order (-60 dB/dec) maximally flat; HPF -3dB Frequency Error < ±5%; LPF -3dB Frequency Error < ±10%

Measurement filter characteristics meet or exceed requirements of ITU recommendation 0.172

Jitter Measurement Result Accuracy

Peak to peak: ±R% of reading ±W  
RMS: ±R% of reading ±.005 UI  
R = 5% for all bit rates and measurement bandwidths

Jitter Measurement Result Accuracy

Peak to peak: ±R% of reading ±W  
RMS: ±R% of reading ±.005 UI  
R = 5% for all bit rates and measurement bandwidths

Bit Rate (Mb/s)	Measurement Bandwidth	W			
		U <sub>lpp</sub> (1,2,3)	U <sub>lpp</sub> (Max)	U <sub>lrms</sub>	U <sub>lrms</sub> (Max)
STM-1e	500Hz - 1.3MHz	0.030	0.035		
STM-1e	12KHz - 1.3MHz	0.030	0.035	0.005	0.005
STM-1e	65KHz - 1.3MHz	0.025	0.025		
155.52	500Hz - 1.3MHz	0.030	0.035		
155.52	12KHz - 1.3MHz	0.030	0.035	0.005	0.005
155.52	65KHz - 1.3MHz	0.030	0.035		
622.08	1KHz - 5MHz	0.030	0.035		
622.08	12KHz - 5MHz	0.030	0.035	0.005	0.005
622.08	250KHz - 20MHz	0.030	0.035		
2488.32	5KHz - 20 MHz	0.045	0.050		
2488.32	12KHz - 20MHz	0.045	0.050	0.005	0.005
2488.32	1MHz - 20MHz	0.045	0.050		
2666.06	5KHz - 20MHz	0.045	0.050		
2666.06	12KHz - 20MHz	0.045	0.050	0.005	0.005
2666.06	1MHz - 20MHz	0.045	0.050		
9953.28	10KHz - 80MHz	0.035	0.050		
9953.28	20KHz - 80MHz	0.035	0.050	0.005	0.005
9953.28	50KHz - 80MHz	0.035	0.050		
9953.28	4MHz - 80MHz	0.035	0.050		
10709.00	10KHz - 80MHz	0.035	0.050		
10709.00	20KHz - 80MHz	0.035	0.050	0.005	0.005
10709.00	50KHz - 80MHz	0.035	0.050		
10709.00	4MHz - 80MHz	0.035	0.050		

Notes:

- 1) Typical
- 2) All SONET/SDH values are for a STM-Nc structured signal containing a payload of PRBS 2<sup>23</sup>-1
- 3) All OTN values are assumed a structured OTU-N signal with a structured SDH payload. The SDH payload is comprised of an STM-Nc signal containing a payload of PRBS 2<sup>23</sup>-1. N is 16 for OTU1. N is 64 for OTU2.

Measurement Capabilities

Sliding window of 1 second, 60 seconds, or infinite size (max hold) Peak-to-peak jitter (UI)

Positive peak jitter (UI)  
Negative peak jitter (UI)  
RMS jitter (UI)  
Jitter hit count  
Jitter hit seconds (variable threshold over entire measurement range)  
Loss of signal seconds count

Notes:

- 1) For structured data signals per 0.172 Annex A
- 2) For optical input power levels between -10 dBm and -12 dBm per 0.172 section 9.4.1 clause b

## INTERNAL TRANSMIT CLOCK

Frequency Deviation

±4.6 ppm

**TRANSMITTER INPUTS & OUTPUTS**

Optical Transmit	Wavelength: 1290-1320 nm / 1529.55-1563.05 nm Average output power: > -2 dBm, 0 dBm typical Extinction Ratio: >10 dB @ 1550 nm; >8.2 dB @ 1310nm; Max power: 5mW (continuous wave)	Reference Clock Output	Frequency: 622.08 MHz Amplitude: >60 mVpp, 800 mVpp typical Coupling: AC Connector: SMA Impedance: 50 ohm
STM-1E Transmit	Amplitude: ~1V Coupling: AC, non-Isolated Connector: BNC Impedance: 75 ohm Line Coding: CMI	Trigger Output	Frequency: 622.08 MHz Amplitude: >60 mVpp, 800 mVpp typical Coupling: AC Connector: SMA Impedance: 50 ohm

**RECEIVER INPUTS & OUTPUTS**

Optical Receive	Sensitivity: -22 dBm at bit rates < 2488.32 Mbps (PRBS23, 1x10 <sup>-10</sup> BER) -15 dBm at 9953.32 Mbps (PRBS23, 1x10 <sup>-10</sup> BER) -15 dBm at 10709.00 Mbps (PRBS23, 1x10 <sup>-10</sup> BER) Overload: > 0 dBm (1 dBm typical) Optical Return Loss: <27 dB Wavelength: 1250-1600nm Optical Jitter Measurement range: -10 dBm to -12 dB	STM-1E Receive	Amplitude: 1V Max Coupling: AC, non-Isolated Connector: BNC Impedance: 75 ohm Line Coding: CMI Selectable Gain: Normal (0dB) or monitor (-20dB)
		Recovered Clock Output	Amplitude: >600mVpp, 800mVpp typical Coupling: AC Connector: SMA Impedance: 50 ohm
		Demodulated Output	Max Amplitude: 1.0 Vpp +/- 5% Selectable Sensitivity: 1UIpp/V, 4UIpp/V, 16UIpp/V, 64UIpp/V, 256UIpp/V, 1024UIpp/V, 4096UIpp/V, Coupling: DC Connector: SMA Impedance: 50 ohm

**WANDER**

Bit Rates	OC-3/STM-1 (155.52 Mbps), STM-1e (155.52 Mbps), OC-12/STM-4 (622.08 Mbps), (OC-48/STM-16) 2488.32 Mbps, (OC-192/STM-64) 9953.28 Mbps, (OTN) 10709.00 Mbps	Sample Rate: 50 Hz Sample storage intervals: 20 ms, 1 sec, 10 secs Input frequency: 0 to 10 Hz Anti-alias filter: 10 Hz ± 0.1% first-order roll off Maximum slew rate: ±100,000 ns/sec	
Output Filter	10 Hz ± 0.1% first-order roll off	TIE, MTIE, MRTIE, TDEV measurement range: Unlimited for signals with ±100,000 ns/sec max slew rate	
Maximum Slew Rate	±100,000 ns/sec	Noise: ± 2.5 ns Amplitude Accuracy: ± 1% ± 2.5 ns Bandwidth: 0 Hz to 10 Hz Resolution: 1 nanosecond Observation time: 0.02 to 10,000,000 second Test Masks: Masks from various standards are displayed along with the measurement graphs and tests for pass or fail are performed Integration Time: 0.02 to 167000 second Frequency Offset and Frequency Drift measurements: Calculation and display of frequency offset and drift rate from TIE data	
Wander Patterns	Sine Wave: Modulation frequency range: 1 µHz to 24.9 Hz Resolution: 1 µHz Amplitude range: 0 to 100,000 ns pp @ f <sub>m</sub> < 1Hz, 0 to x@f <sub>m</sub> > 1Hz where x =(100,000nssp/f <sub>m</sub> ) Accuracy: ± 0.1% of setting ± 1 ns Trapezoid wave, triangle wave: Similar to sine wave but has linear slews TDEV noise patterns: TDEV tolerance, SSU Type 1 TDEV tolerance Phase transients: Fixed transients: Duration: 16.37 ms Height: 1000 ns or 1200 ns Transient Ramp: User selectable height and duration Duration: 0.02 – 1,000,000 sec Height: 1 – 20,000 ns	Frequency Drift	Range: 0-867.480 ppm/sec Accuracy: < 1% ± 0.01 ppm/sec Bandwidth: 0 Hz to 0.5 Hz Resolution: 0.001 ppm/sec
Wander Patterns	Measurement duration: Min: 10 seconds Max: Limited only by external PC available disk space. Disk space used at approximately 1.42 Mbytes per hour (20 ms storage interval).	Frequency Offset Resolution	0.0000001 ppm