80C00 Optical Modules for DSA8300 Sampling Oscilloscope Datasheet

The Tektronix 80C00 optical sampling modules, when installed in DSA8300 Digital Serial Analyzer sampling oscilloscopes [1], provide complete optical test solutions for telecom (125 Mb/s to 44.50 Gb/s) and datacom (gigabit Ethernet, 10 GbE, 40 GbE, 50G/100G/200G/400G Ethernet, Fibre Channel, and InfiniBand) applications, as well as general-purpose optical component testing. Other module features include an optical-to-electrical converter, average power monitor, one or more reference receiver filters, a full bandwidth optical path, optional integrated clock recovery [2], optional electrical clock recovery signal pickoff [3], and a universal optical input connector.

Notice to EU customers

The 80C17, 80C18, 80C20, and 80C21 modules comply with the RoHS 2 Directive 2011/65/EU and will be shipped to the EU. These two modules are qualified for CE Marking.

All other 80C00 modules are not updated to comply with the RoHS 2 Directive 2011/65/EU and will not be shipped to the EU. Customers may be able to purchase products from inventory that were placed on the EU market prior to July 22, 2017 until supplies are depleted. Tektronix is committed to helping you with your solution needs. Please contact your local sales representative for further assistance or to determine if alternative product(s) are available. Tektronix will continue service to the end of worldwide support life.

Key performance specifications

- Optical bandwidths up to >80 GHz
- Single and multi-mode, short and long wavelength optical signal support
- Optical mask test solutions with sensitivities to -22 dBm
- Optical reference receivers (ORR) [4] support specified requirements for standards-mandated compliance testing

1 Also compatible with DSA8200, TDS/CSA8200, TDS/CSA8000B, and TDS/CSA8000 sampling oscilloscopes.

2 80C07B, 80C08D, and 80C11B modules.

3 80C10C (with opt. CRTP), 80C12B, 80C14, 80C15, 80C17, and 80C18 modules.

4 The Optical Reference Receiver (ORR) is a 4th-order Bessel-Thomson filter, with a frequency response and tolerances as defined by the standards. Tektronix optimizes the response for best nominal fit and highest quality mask test results.

Key features

- **PAM4 for 400G/200G/100G/50G applications and NRZ/PAM2 for 100G/50G/10G and slower applications**
  - **80C10C** 80 GHz optical bandwidth and low noise capability for performance testing and signal characterization:
    - **80C10C Option F1** provides 70 GHz full bandwidth and fully integrated selectable reference receiver filtering, enabling conformance testing at either 1310 nm or 1550 nm region for 25.781 Gb/s (100GBASE-ER4 and 100GBASE-LR4), 27.952 Gb/s (OTU-4), 39.813 Gb/s (OC-768/STM-256, VSR-2000 G.693, 40G NRZ G.959.1), 41.25 Gb/s (40GBASE-FR), 43.018 Gb/s (OTU3, VSR-2000 w/ FEC, 4x10G LAN PHY OTU3), 44.5 Gb/s (OTU3), 53.125 GBd (PAM4 Ethernet 100G per lane, TDECQ), and 57.8 GBd (64GFC) in a single module
    - **80C10C Option F2** provides 55 GHz full bandwidth and fully integrated selectable reference receiver filtering, enabling conformance testing at either 1310 nm or 1550 nm for 27.952 Gb/s (OTU-4), 25.781 Gb/s (100GBASE-LR4 and 100GBASE-ER4)
    - **80C10C Option F3** provides 80 GHz full bandwidth and fully integrated selectable reference receiver filtering, enabling conformance testing of 39.813 Gb/s (OC-768/STM-256, VSR-2000 G.693, 40G NRZ G.959.1), 41.25 Gb/s (40GBASE-FR), 43.018 Gb/s (OTU3, VSR-2000 w/ FEC, 4x10G LAN PHY OTU3), 44.5 Gb/s (OTU3), 53.125 GBd (PAM4 Ethernet 100G per lane, TDECQ), and 57.8 GBd (64GFC)
    - **80C10C** Clock Recovery for 25-44.5 Gb/s rates is supported by the **CR286A-HS** or similar [5] (sold separately) and **Option CRTP and HSPR** (electrical signal outputs to 44.5 Gb/s)
  - **80C15** provides 32 GHz full bandwidth and fully integrated optical reference receivers (ORR) [6], enabling conformance testing of both single and multi-mode conformance testing at 850,1310 and 1550 nm. The module includes bandwidth filters which support the following rates: 25.781 Gb/s (100GBASE-SR4, Inifiniband EDR, TDEC), 27.952 Gb/s (OTU-4), and 28.05 Gb/s (32G Fibre Channel)
    - **80C15 Option CRTP** provides a second, high-sensitivity optical input to drive Clock Recovery Trigger Pickoff (CRTP) electrical differential outputs for clock recovery functions or error detection.
  - **80C17** and **80C18** provide >30 GHz full bandwidth and fully integrated optical reference receivers (ORR) [6], enabling conformance testing of both single and multi-mode conformance testing at 850, 1310 and 1550 nm. The module includes bandwidth filters which support the following rates: 25.781 Gb/s (100GBASE-ER4, -LR4, -SR4, Inifiniband EDR); 26.5625 (PAM4 50G per lane), TDECQ, TDEC (100GBASE-SR4), 27.952 Gb/s (OTU-4), and 28.05 Gb/s (32G Fibre Channel), and 53.125 GBd [7] PAM4/TDECQ.
    - **80C17** and **80C18 Option CRTP** provides an additional, high-sensitivity optical input to drive Clock Recovery Trigger Pickoff (CRTP) electrical differential outputs for clock recovery functions or error detection up to 28.05 GBd.
  - **80C20** and **80C21** provide up to 53 GHz of optical bandwidth and lowest noise capability for performance. Used in conjunction with the bandwidth enhancements feature of 80SJNB or 400G-M4 applications, the 80C20 and 80C21 provide reference receiver filtering, enabling conformance testing at either 1310 nm or 1550 nm region for 25.781 Gb/s (100GBASE-ER4 and 100GBASE-LR4), TDECQ, 26.56 Gb/s (OTU-4), 39.813 Gb/s (OC-768/STM-256, VSR-2000 G.693, 40G NRZ G.959.1), 43.018 Gb/s (OTU3, VSR-2000 w/ FEC, 4x10G LAN PHY OTU3), 44.5 Gb/s (OTU3), and 53.125 GBd (PAM4 Ethernet 100G per lane, TDECQ) in a single module
- **10 Gb/s Telecom and Datacom**
  - Highly accurate ER calibrated (Extinction ratio) measurement option for increased repeatability and transferability of the measurement. ER Adjusted is also available (for any symbol rate)
  - **80C14** - Low-noise, high optical sensitivity, broad wavelength conformance testing for 10GbE, 40GbE (R4), 100GbE (X10) LAN, WAN, FEC, 10G Fibre Channel, 16G Fibre Channel (14.025 Gb/s), 14G Infiniband FDR (14.06250 Gb/s)
  - **80C08D** and **80C12B** (w/ **Option 10G or 10GP**) – low-noise, high optical sensitivity, and broad wavelength conformance testing for 10 GbE, 40 GbE (R4), 100 GbE (X10) LAN, WAN, FEC, 10G fibre channel, and 10 Gb/s telecom standards and FEC rates
  - **80C11B** 30 GHz optical bandwidth conformance testing and characterization for 10 Gb/s telecom and datacom standards and FEC rates
  - Clock Recovery solutions for 10 Gb/s applications
    - **80C14** clock recovery for rates ≥8.5 Gb/s is supported by CR175A (Sold separately)
    - **80C08D** and **80C11B** Integrated Clock Recovery supports all current 10 Gb/s standards or user-defined rates from 9.8 Gb/s to 12.6 Gb/s (CR4)
    - **80C12B** clock recovery for 10 Gb/s rate is supported by the 80A05 module or CR125A clock recovery instrument (Sold separately)

5 Contact Tektronix for details.

6 The Optical Reference Receiver (ORR) is a 4th-order Bessel-Thomson filter, with a frequency response and tolerances as defined by the standards. Tektronix optimizes the response for best nominal fit and highest quality mask test results.

7 53.125G PAM4 rate requires the use of the 400G-M4 or 80SJNB software applications and option IMP. Uses DSP and patterns only.

- **Tributary Telecom and Datacom**
  - **80C07B** and **80C12B** provide excellent optical sensitivity and broad wavelength test capability
  - **80C07B** and **80C12B** multirate telecom conformance testing solutions from 125 Mb/s [8] (OC-3/STM-4) through 11.317 Gb/s (10GFC w/ FEC) and multirate datacom conformance testing solutions for Fibre Channel, gigabit Ethernet, and Infiniband standards

Applications

- High-speed optical communications testing
- Extinction ratio and Q-factor measurements
- Eye, pattern, and pulse shape analysis
- Relaxation oscillation testing
- Optical signal analysis
- Compliance testing
- NRZ, RZ, and optical duobinary signal characterization

80C07B Multirate, datacom and telecom

The 80C07B module is a broad wavelength (700 to 1650 nm) optical sampling module optimized for testing multirate datacom telecom signals from 125 to 2500 Mb/s.

With its amplified O/E converter design, this module provides excellent signal-to-noise performance, allowing users to examine low-power optical signals. The 80C07B can be optionally configured with clock recovery that supports 125, 155, 622, 1063, 1250, 2125, 2488, 2500, and 2666 Mb/s rates.

80C08D Multirate, broad wavelength, high sensitivity 10 Gb/s

The 80C08D module is a broad wavelength (700 to 1650 nm) multirate optical sampling module providing datacom rate testing for 10GbE, 40GbE-R4, 100GbE-SR10 applications at 9.953, 10.3125, 11.0957 Gb/s and 10G Fibre Channel applications at 10.51875 Gb/s and 11.317 Gb/s. The 80C08D also provides telecom rate testing at 9.953, 10.664, and 10.709 Gb/s.

With its amplified O/E converter design, this module provides excellent signal-to-noise performance and high optical sensitivity, allowing users to examine low power level optical signals. The 80C08D can be optionally configured with clock recovery options that can support any standard or user-defined rate in the continuous range from 9.8 to 12.6 Gb/s

80C10C Multirate datacom and telecom 25 Gb/s, 40 Gb/s, and 100 Gb/s

The 80C10C module provides integrated and selectable reference receiver filtering, enabling conformance testing at either 1310 nm or 1550 nm of all standard 25, 40, 100 PAM4, and 100 (4 x 25) Gb/s standard rates. The 80C10C has the following configurations:

- **Option F1**: Provides standard compliant optical reference receivers [9] for the following rates (standards):
  - 25.781 Gb/s (100GBASE-LR4 and 100GBASE-ER4)
  - 27.952 Gb/s (OTU4)
  - 28.05 Gb/s (28G Infiniband EDR)
  - 39.813 Gb/s (OC-768/STM-256, VSR2000 G.693, 40G NRZ G. 959.1)
  - 41.25 Gb/s (40GBASE-FR)
  - 43.018 Gb/s (G.709 FEC, OTU3 4×10G LAN PHY)
  - 44.5 Gb/s (OTU3)
  - 53.125 GBd (PAM4 Ethernet 100G per lane), TDECQ
  - 57.8 GBd (64GFC)
- **Option F2**: Provides standard compliant optical reference receivers [9] for the following rates (standards):
  - 25.781 Gb/s (100GBASE-LR4 and 100GBASE-ER4)
  - 26.5625 (PAM4 50G per lane)
  - 28.05 Gb/s (28G Infiniband EDR)
  - 27.952 Gb/s (OTU4)

8 125 Mb/s is supported by selecting 155 Mb/s rate.

9 The Optical Reference Receiver (ORR) is a 4th-order Bessel-Thomson filter, with a frequency response and tolerances as defined by the standards. Tektronix optimizes the response for best nominal fit and highest quality mask test results.

- **Option F3**: Provides standard compliant optical reference receivers[9] for the following rates (standards):
  - 39.813 Gb/s (OC-768/STM-256, VSR2000 G.693, 40G NRZ G.959.1)
  - 41.25 Gb/s (40GBASE-FR)
  - 43.018 Gb/s (G.709 FEC, OTU3 4×10G LAN PHY)
  - 44.5 Gb/s (OTU3)
  - 53.125 GBd (PAM4 Ethernet 100G per lane), TDECQ
  - 57.8 GBd (64GFC)

Alternatively to the filter rates, the user may select bandwidths for the 80C10C for optimal noise versus bandwidth performance for accurate signal characterization.

When equipped with **Option CRTP**, an electrical signal from an internal pickoff is provided for clock recovery. Clock recovery to 28.6 Gb/s is available with Tektronix' CR286A-HS clock recovery instrument (sold separately).

When equipped with **Option HSPR**, a separate high-sensitivity optical input is provided with independent electrical outputs that can be used with external equipment (such as a Tektronix clock recovery unit or, for NRZ, an error detector such as a Tektronix BERTScope).

The 80C10C is also optionally available in a bundled ordering configuration which includes a 70+ GHz electrical sampling channel.

80C11B Multirate, 10 Gb/s datacom and telecom

The 80C11B module is a long wavelength (1100 to 1650 nm) multirate optical sampling module optimized for testing 10 Gb/s datacom and telecom standard rates at 9.953, 10.3125, 10.51875, 10.664, 10.709, 11.0957, 11.317, 12.50, and 14.025 Gb/s. With its high optical bandwidth of up to 30 GHz (typical) it is well suited for general-purpose high-performance 10 Gb/s optical component testing.

The 80C11B can be optionally configured with clock recovery options that can support any standard or user-defined rate in the continuous range from 9.8 to 12.6 Gb/s.

80C12B Multirate, broad wavelength, high sensitivity datacom and telecom

The 80C12B module is a broad wavelength (700 to 1650 nm) multirate optical sampling module providing telecom and datacom testing for standards from 155 Mb/s to 11.4 Gb/s. This highly flexible module can be configured to support a wide variety of 10 Gb/s applications, lower data rate applications (155 Mb/s to 7.4 Gb/s), or a combination of 10G and lower data rate standards.

The low data rate applications include: Telecom applications from 155 to 2666 Mb/s, 1G, 2G, and 4G Fibre Channel, multilane standards such as 10GBASE-X4 and 4-Lane 10 Gb/s Fibre Channel, and Infiniband SDR and DDR rates.

The supported 10 Gb/s application includes both datacom and telecom standards. The supported 10 Gb/s datacom applications include 10GbE, 40GbE-R4, 100GbE-SR10 applications at 9.953, 10.3125, 11.0957 Gb/s and 10G Fibre Channel applications at 10.51875 Gb/s and 11.317 Gb/s. The 80C12B also provides telecom rate testing at 9.953, 10.664, and 10.709 Gb/s.

With its amplified O/E converter design, this module provides excellent signal-to-noise performance and high optical sensitivity, allowing users to examine low-power optical signals. The 80C12B provides an electrical clock recovery output (AC coupled) to beyond 12 Gb/s data rates, which is compatible with the CR125A-HS or 80A05 (sold separately).

80C14 Multirate, high sensitivity, datacom and telecom 8.5 Gb/s, 10 Gb/s, and 14 Gb/s

The 80C14 module is a broad wavelength (700 to 1650 nm) multirate optical sampling module providing 8Gb/s, 10Gb/s, and 16Gb/s telecom and datacom testing. The supported 10 Gb/s datacom applications include: 10GbE, 40GbE-R4, 100GbE-SR10 applications at 9.953, 10.3125, and 11.0957 Gb/s. Fibre Channel applications include: 8.500, 10.51875, 11.317, and 14.025 Gb/s. The 80C14 also provides telecom rate testing at 9.953, 10.664, 10.709, and 12.5 Gb/s.

With its amplified O/E converter design, this module provides excellent signal-to-noise performance and high optical sensitivity, allowing users to examine low power level optical signals. The CR175A-HS and CR286A-HS (sold separately) are examples of instruments that can provide clock recovery for the 80C14.

80C15 Single/multi-mode multirate datacom and telecom 25 Gb/s, 100 Gb/s for applications

The 80C15 modules provides integrated and selectable reference receiver filtering, enabling conformance testing at either 850, 1310 nm or 1550 nm of all standard 25, and 100 (4 x 25) Gb/s standard rates. The 80C15 provides bandwidth filtering for the following rates:

- 25.781 Gb/s (100GBASE-SR4, 100GBASE-LR4, 100GBASE-ER4 and Infiniband EDR)
- TDEC (100GBASE-SR4)

- 27.952 Gb/s (OTU4)
- 28.05 Gb/s (32G Fibre Channel)

Alternatively to the filter rates, you can select bandwidths for the 80C15 for optimal noise versus bandwidth performance for accurate signal characterization.

80C15 Option CRTP provides a second, high-sensitivity optical input to drive Clock Recovery Trigger Pickoff (CRTP) electrical differential outputs for clock recovery functions or error detection.

80C17/18 Single/multi-mode multirate datacom and telecom 25 Gb/s, 100 Gb/s, and PAM4 for 50G/100G/200G/400G applications

The 80C17/18 modules provides integrated and selectable reference receiver filtering, enabling testing from 750 to 1650 nm. The 80C17/18 provides bandwidth filtering with Bessel-Thomson 4th order filter hardware (works on any signal) for the following rates:

- 25.781 Gb/s (100GBASE-SR4, 100GBASE-LR4, 100GBASE-ER4 and Infiniband EDR)
- 26.5625 (PAM4 50G per lane), TDECQ
- 53.125 GBd (PAM4 Ethernet 100G per lane), TDECQ [10]
- TDEC (100GBASE-SR4)
- 27.952 Gb/s (OTU4)
- 28.05 Gb/s (32G Fibre Channel)

In addition to the filter rates, you can also select bandwidths for the 80C17/18 for optimal noise versus bandwidth performance for accurate signal characterization.

Option IMP enables DSP enhancement that can be used to extend optical channel optical bandwidth up to 36.2 GHz (-3dBo) and electrical bandwidth up to 26.5625 GHz (-3dBe). DSP enhancement can also be used to improve accuracy of the optical channel frequency response. Option IMP requires 400G-M4 or 80SJNB software applications and pattern signal.

Option CRTP provides an additional, high-sensitivity optical input to drive Clock Recovery Trigger Pickoff (CRTP) electrical differential outputs for clock recovery functions or error detection up to 28.05 GBd.

80C20/21 Single-mode multirate datacom and telecom 25 Gb/s, 40 Gb/s, 100 Gb/s, and PAM4 for 200G/400G applications

The 80C20 and 80C21 modules, when used with the 80SJNB PAM4 and DSA8300 400G-M4 software applications, provides selectable receiver filtering enabling testing from 1200 nm to 1650 nm. The modules provide the following hardware filters. [11]

- 25.781 Gb/s (100GBASE-LR4, 100GBASE-ER4)
- 27.952 Gb/s (OTU4)
- 39.813 Gb/s (OC-768/STM-256, VSR2000 G.693, 40G NRZ G.959.1)
- 41.25 Gb/s (40GBASE-FR)
- 43.018 Gb/s (G.709 FEC, OTU3 4x10G LAN PHY)
- 53.125 GBd (PAM4 Ethernet 100G per lane, TDECQ)

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

10 53.125G PAM4 rate requires the use of the 400G-M4 or 80SJNB software applications and option IMP. Uses DSP patterns only.

11 Reference receiver filtering enabling conformance testing at either 1310 nm or 1550 nm requires the use of DSP, bandwidth enhancement available in 400G-M4 or 80SJNB software applications, patterns only.

Selection guide for 10Gb/s telecom and datacom applications

	80C08D	80C11B	80C12B			80C14
			F0-F12	10G	10GP	
Wavelength range (nm)	700-1650	1100-1650	700-1650			700-1650
Calibrated wavelength (± 20 nm)	780 850 1310 1550	1310 1550	850 1310 1550			850 1310 1550
Unfiltered optical bandwidth	12.5 GHz	30 GHz	12 GHz [12]			>13 GHz
Fiber input (µm) [13]	62.5	9	62.5			62.5
Typical mask test sensitivity (dBm)	-16 [14]	-10 [14]	-19 [15]	-15	-15	-15
RMS optical noise (typical at 1310 nm) [16]	1.7 µw	5.5 µw (≤14 Gb/s) 7.0 µw (14 Gb/s) 10.0 µw (20 GHz) 20.0 µw (30 GHz)	0.7 µw (≤2 Gb/s) 0.9 µw (>2 Gb/s, ≤4.5 Gb/s) 1.2 µw (> 4.5 Gb/s, ≤7.4 Gb/s) 1.7 µw (>7.4 Gb/s, ≤8.5 Gb/s) 2.0 µw (>8.5 Gb/s)			1.3 µw (≤12.5 Gb/s) 1.9 µw (>12.5 Gb/s)
RMS optical noise (max at 1310 nm) [16]	3.0 µw	8.0 µw (≤14 Gb/s) 10.0 µw (14 Gb/s) 14.0 µw (20 GHz) 30.0 µw (30 GHz)	1.3 µw (≤2 Gb/s) 1.5 µw (>2 Gb/s, ≤4.5 Gb/s) 2.2 µw (>4.5 Gb/s, ≤7.4 Gb/s) 2.7 µw (>7.4 Gb/s, ≤8.5 Gb/s) 3.6 µw (>8.5 Gb/s)			2.5 µw (≤12.5 Gb/s) 3.5 µw (>12.5 Gb/s)
Optical return loss -single-mode (dB)	>24	>30	>24			>24
Optical return loss -multi-mode (dB)	>14	N/A	>14			>14
Power meter range [17]	0 dBm to -30 dBm	+4 dBm to -30 dBm	+0 dBm to -30 dBm			+0 dBm to -30 dBm

12 When ordered with only F1-F12 filter options, the maximum optical bandwidth of the 80C12B is constrained by the highest bit-rate filter.

13 Modules with fiber inputs of 62.5 µm can accommodate 9 µm (single-mode) as well as 50 µm and 62.5 µm (multi-mode) fibers.

14 When ordered with clock recovery options, the mask test sensitivity of the 80C08D and 80C11B is reduced by 1 dBm.

15 The mask test sensitivity of the 80C12B is -22 dBm for filter rates < 1.250 Gb/s.

16 The RMS optical noise (both typical and maximum) for wavelengths other than 1310 nm is obtained by multiplying the values in the table above by the following factors: 1 × for 1550 nm, 2 × for 850 nm

17 Power meter accuracy = 5% of reading + connector uncertainty for 1550 nm ±20 nm and 1310 nm ±20 nm.

Selection guide for PAM4 for 50G/100G/200G/400G applications, PAM2/NRZ for 100 Gb/s and 40 Gb/s telecom and datacom applications

	80C10C			80C15	80C17, 80C18	80C20, 80C21
	F1	F2	F3			
Wavelength range (nm)	1290 - 1620			800 - 1600	800 - 1600	1200 - 1650
Calibrated wavelength (± 20 nm)	1310 1550			850 1310 1550	850 1310 1550	1310 1550
Unfiltered optical bandwidth	70 GHz	55 GHz	80 GHz	>32 GHz	>30 GHz	53 GHz
Fiber input(µm) [18]	9			62.5	50	9
Typical mask test sensitivity (dBm)	-6 at 1310 nm [19], [20]			-8 at 1310 nm [21]	-14 at 1310 nm [21]	-10 at 1310 nm
RMS optical noise (typical at 1310 nm) [22]	15.6 µw (25.78 Gb/s) 16.9 µw (27.95, 28.0 Gb/s) 18.2 µw (32 GHz) 23.4 µw (39.81, 43.02 Gb/s) 29.9 µw (55 GHz) 46.8 µw (70 GHz) 71.5 µw (80 GHz)			10.3 µw (25.78 Gb/s) 10.3 µw (26.5625 Gb/s) 10.3 µw (TDECQ) 10.3 µw (27.95, 28.0 Gb/s) 12.2 µw (32 GHz)	3.1 µw (TDEC 16.8 GHz) 3.9 µw (25.78 Gb/s) 4.2 µw (26.5625 Gb/s) 4.3 µw (27.95 Gb/s, 28.05 Gb/s) 3.2µw (17 GHz) 3.5 µw (22 GHz) 5.4 µw (30 GHz)	9.3 µw (27.78 Gb/s, 26.5625 Gb/s) 9.3 µw (27.95 Gb/s, 28.05 Gb/s) 9.6 µw (35 GHz) 9.8 µw (39.81 Gb/s, 41.25 Gb/s) 10.3 µw (43.02 Gb/s) 12.3 µw (53 GHz)
RMS optical noise (max at 1310 nm) [22]	23.4 µw (25.78 Gb/s) 26.0 µw (27.95, 28.0 Gb/s) 28.6 µw (32 GHz) 37.7 µw (39.81, 43.02 Gb/s) 52.0 µw (55 GHz) 84.5 µw (70 GHz) 130.0 µw (80 GHz)			12.2 µw (TDEC 16.8 GHz) 12.2 µw (25.78 Gb/s) 12.2 µw (26.5625 Gb/s) 12.2 µw (27.95, 28.0 Gb/s) 14.1 µw (32 GHz)	3.6 µw (TDEC 16.8 GHz) 4.5 µw (25.78 Gb/s) 4.8 µw (26.5625 Gb/s) 5.0 µw (27.95 Gb/s, 28.05 Gb/s) 3.6 µw (17 GHz) 4.0 µw (22 GHz) 6.7 µw (30 GHz)	11.8 µw (27.78 Gb/s, 26.5625 Gb/s) 11.8 µw (27.95 Gb/s, 28.05 Gb/s 12.7 µw (35 GHz) 12.7 µw (39.81 Gb/s, 41.25 Gb/s) 13.7 µw (53 GHz) 13.3 µw (43.02 Gb/s)
Optical return loss -single-mode (dB)	>30			>24	>16	>25
Optical return loss -multi-mode (dB)	N/A			>14	>16	NA
Acquisition delay adjustment range on each channel	N/A			N/A	±65 ps	±65 ps
Power meter range [23]	+13 dBm to -21 dBm			+0 dBm to -30 dBm	+6 dBm to -38 dBm	+6 dBm to -38 dBm

18 Modules with fiber inputs of 62.5 µm can accommodate 9 µm (single-mode) as well as 50 µm and 62.5 µm (multi-mode) fibers. Modules with fiber inputs of 50 µm can accommodate 9 µm (single-mode) fibers.

19 When ordered with clock recovery trigger pick-off option (option CRTP), the mask test sensitivity of the 80C10C is reduced by 1 dBm.

20 Low ER signals (ER ≤ 6 dB): signal passes 802.3ae-like mask (scaled horizontally for bit rate); 105 samples in mask. High ER signals (ER > 6 dB): signal passes OC-192-like mask (scaled horizontally for bit rate); 105 samples in mask. Sensitivity expressed as minimum AOP of a high ER signal that passes an ideal signal.

21 The mask test sensitivity of the 80C15/17/18 is reduced by 3 dB for 850 nm signals.

22 The RMS optical noise (both typical and maximum) for wavelengths other than 1310 nm is obtained by multiplying the values in the table above by the following factors— 80C10C: 0.77 for 1550 nm, 80C15: 1.06 for 1550 nm and 0.67 for 850 nm, 80C17/18: 1.1 for 1550 nm, 1.66 for 850 nm.

23 Power meter accuracy = 5% of reading + connector uncertainty for 1550 nm ±20 nm and 1310 nm ±20 nm.

Selection guide for tributary telecom and datacom applications

	80C07B	80C12B		
		F0-F12	10G	10GP
Wavelength range (nm)	700-1650	700-1650		
Calibrated wavelength (± 20 nm)	780 850 1310 1550	850 1310 1550		
Unfiltered optical bandwidth	2.5 GHz	12 GHz [24]		
Fiber input (µm) [25]	62.5	62.5		
Typical mask test sensitivity (dBm)	-22	-19 [26]	-15	-15
RMS optical noise (typical at 1550 nm) [27]	0.5 µw (≤1.25 Gb/s) 0. 7 µw (>1.25 Gb/s)	0.7 µw (≤2 Gb/s) 0.9 µw (>2 Gb/s, ≤4.5 Gb/s) 1.2 µw (> 4.5 Gb/s, ≤7.4 Gb/s) 1.7 µw (>7.4 Gb/s, ≤8.5 Gb/s) 2.0 µw (>8.5 Gb/s)		
RMS optical noise (max at 1550 nm) [27]	1.0 µw (≤1.25 Gb/s) 1.5 µw (>1.25 Gb/s)	1.3 µw (≤2 Gb/s) 1.5 µw (>2 Gb/s, ≤4.5 Gb/s) 2.2 µw (>4.5 Gb/s, ≤7.4 Gb/s) 2.7 µw (>7.4 Gb/s, ≤8.5 Gb/s) 3.6 µw (>8.5 Gb/s)		
Optical return loss -single-mode (dB)	>24	>24		
Optical return loss -multi-mode (dB)	>14	>14		
Power meter range [28]	+4 dBm to -30 dBm	+0 dBm to -30 dBm		

Supported filter rates and clock recovery

Standard	Rate	80C07B [29]	80C08D	80C10C			80C11B	80C12B			80C14	80C15
				F1	F2	F3		F0-F12 [30]	10G	10GP [31]		
OC3, STM1	155 Mb/s	■						■		■		
OC12, STM4	622 Mb/s	■						■		■		
Fibre Channel	1.063 Gb/s	■						■		■		
Gigabit Ethernet	1.250 Gb/s	■						■		■		
2G Fibre Channel	2.125 Gb/s	■						■		■		
OC48, STM16	2.488 Gb/s	■						■		■		
2G Ethernet	2.500 Gb/s	■						■		■		
2.5G G.709 FEC	2.66 Gb/s							■		■		
XAUI, 10GBase-X	3.125 Gb/s							■		■		

24 When ordered with only F1-F12 filter options, the maximum optical bandwidth of the 80C12B is constrained by the highest bit-rate filter.

25 Modules with fiber inputs of 62.5 µm can accommodate 9 µm (single-mode) as well as 50 µm and 62.5 µm (multi-mode) fibers.

26 The mask test sensitivity of the 80C12B is -22 dBm for filter rates < 1.250 Gb/s.

27 The RMS optical noise (both typical and maximum) for wavelengths other than 1550 nm is obtained by multiplying the values in the table above by the following factors: 1 × for all calibrated wavelengths

28 Power meter accuracy = 5% of reading + connector uncertainty for 1550 nm ±20 nm and 1310 nm ±20 nm.

29 2.488 and 2.500 Gb/s filters are standard with 80C7B. Select any two of the additional four filter rates when ordering (see Ordering information).

30 You can configure 80C12B to support any 4 of the 12 < 10 Gb/s rates indicated (see Ordering information).

31 Use option 10GP to configure the 80C12B to support any 3 of the 12 <10 Gb/s rates indicated, as well as the 10-12 Gb/s rates (see Ordering information).

Supported filter rates and clock recovery

Standard	Rate	80C07B [29]	80C08D	80C10C			80C11B	80C12B			80C14	80C15
				F1	F2	F3		F0-F12 [30]	10G	10GP [31]		
10 G Fibre Channel x4	3.188 Gb/s							■		■		
4G Fibre Channel	4.250 Gb/s							■		■		
OBSAI	6.144 Gb/s							■		■		
CPRI	7.373 Gb/s							■		■		
8G Fibre Channel [32]	8.500 Gb/s							■	■	■	■	
OC192, STM64, 10GBase-W	9.953 Gb/s		■				■		■	■	■	
10GBase-R [32]	10.31 Gb/s		■				■		■	■	■	
10G Fibre Channel	10.52 Gb/s		■				■		■	■	■	
G.975 FEC	10.66 Gb/s		■				■		■	■	■	
G.709 FEC	10.71 Gb/s		■				■		■	■	■	
10 GbE w, FEC	11.10 Gb/s		■				■		■	■	■	
Super FEC	12.50 Gb/s		■				■		■	■	■	
16G Fibre Channel	14.025 Gb/s										■	
14G Infiniband FDR	14.063 Gb/s										■	
TDECQ, PAM4	26.56 Gb/s											
100GBASE -SR4 and TDEC and 25G Infiniband EDR	25.78 Gb/s											■
OTU-4	27.95 Gb/s			■	■							■
32G Fibre Channel	28.05 Gb/s											■
OC768, STM256	39.81 Gb/s			■		■						
40GBase-FR	41.25 Gb/s			■		■						
OTU-3, VSR-200G. 693, G.959.1 FEC	43.02 Gb/s			■		■						
OTU3	44.5 Gb/s			■		■						
PAM4 TDECQ	53.125 GBd			■		■						
64GFC	57.8 GBd			■		■						
Clock recovery support		Internal (option)	Internal (option)	External (requires option CRTP or option HSPR; maximum speed 44 Gb/s PAM2 or 28.05 GBd PAM4)			Internal (option)	External (for example, CR125A)			External (for example, CR286A-HS)	External (for example, CR286A-HS; requires option CRTP)

29 2.488 and 2.500 Gb/s filters are standard with 80C7B. Select any two of the additional four filter rates when ordering (see Ordering information).

30 You can configure 80C12B to support any 4 of the 12 < 10 Gb/s rates indicated (see Ordering information).

31 Use option 10GP to configure the 80C12B to support any 3 of the 12 <10 Gb/s rates indicated, as well as the 10-12 Gb/s rates (see Ordering information).

32 Draft version of 8.5 G Fibre Channel. New 8.5 GFC filter is identical to the 10GBASE-R 10.31 Gb/s filter.

Supported filter rates and clock recovery

Standard	Rate	80C17 80C18	80C20 80C21 [33]
PAM4	26.5625 GBd (TDECQ)	■	■
	53.125 GBd (TDECQ)	■ [34], [33]	■
NRZ	25.78 GBd (TDEC-MM)	■	
	25.78 GBd	■	■
	28.05 GBd	■	■
	27.95 GBd	■	■
Clock recovery support		External (for example, CR286A-HS; requires option CRTP, maximum speed 28.05 GBd NRZ and PAM4 [35])	

Extinction ratio calibration accuracy

Extinction ratio calibrated accuracy (Opt. 01 ER calibrated) [36]

Module [37]	Reference filter in range (Gb/s)	Repeatability, typical (to itself and to other 80Cxx-Opt. 01)	Accuracy
80C08D, 80C11B	9.9 - 12.5	±0.6% (–0.39 dB / +0.42 dB at 12 dB)	±1.2% (–0.76 dB / +0.92 dB at 12 dB)
80C12B	0.155 - 11.3		

Dimensions and weight

	Width	Height	Depth
All 80C00 modules	165 mm (6.5 in)	25 mm (1.0 in)	305 mm (12.0 in)

	Weight
80C07B	<1.36 kg (<3.0 lbs)
80C08D 80C11B	<1.22 kg (<2.7 lbs)
80C10C 80C12B 80C14 80C15 80C17 80C18 80C20 80C21	<2.61 kg (<5.75 lbs)

33 Reference receiver filtering enabling conformance testing at either 1310 nm or 1550 nm requires the use of DSP, bandwidth enhancement available in 400G-M4 or 80SJNB software applications, patterns only.

34 Requires option IMP.

35 28.05 GBd PAM4 clock recovery requires > -12dBm OMA outer at CRTP input when used with CR286A-HS.

36 Low ER signals (ER ≤ 6 dB): signal passes 802.3ae-like mask (scaled horizontally for bit rate); 10^5 samples in mask. High ER signals (ER > 6 dB): signal passes OC-192-like mask (scaled horizontally for bit rate); 10^5 samples in mask.

37 Opt. 01 not available for 80C7B, 80C10C, or 80C14.

Ordering information

For more detailed information about the 80C00 Optical Sampling Modules, download the *DSA8300 Digital Serial Analyzer, 80C00 Series Sampling Modules, 80E00 Series Sampling Modules, 80A00 Modules Specifications Technical Reference* (Tektronix part number 077-0571-xx) from www.tek.com.

80C00 models

80C07B	Multirate datacom and telecom optical sampling module
80C08D	Multirate, broad wavelength, high sensitivity 10 Gb/s
80C10C	Multirate datacom and telecom 25 Gb/s, 40 Gb/s, and 100 Gb/s
80C11B	Multirate, 10 Gb/s datacom and telecom
80C12B	Multirate, broad wavelength, high sensitivity datacom and telecom
80C14	Multirate, high sensitivity datacom and telecom 10 Gb/s and 14 Gb/s
80C15	Single/multi-mode, multirate datacom and telecom 25 Gb/s and 100 Gb/s
80C17	Single-mode, multirate datacom and telecom 25 Gb/s, 100 Gb/s, and PAM4 for 50G/100G/200G/400G
80C18	Dual-mode, multirate datacom and telecom 25 Gb/s, 100 Gb/s, and PAM4 for 50G/100G/200G/400G
80C20	Single-mode, multirate datacom and telecom 25 Gb/s, 40 Gb/s, 100 Gb/s, and PAM4 for 200G/400G
80C21	Dual-mode, multirate datacom and telecom 25 Gb/s, 40 Gb/s, 100 Gb/s, and PAM4 for 200G/400G

Options

Following are the options available for each module.

80C07B

2.488 Gb/s and 2.500 Gb/s filters are standard with the 80C07B. In addition, the user must select any one (1) of the following filter options:

Opt. F1	155, 622 Mb/s
Opt. F2	155, 1063 Mb/s
Opt. F3	155, 1250 Mb/s
Opt. F4	155, 2125 Mb/s
Opt. F5	622, 1063 Mb/s
Opt. F6	622, 1063 Mb/s
Opt. F7	622, 2125 Mb/s
Opt. F8	1063, 1250 Mb/s
Opt F9	1063, 2125 Mb/s
Opt F10	1250, 2125 Mb/s
Opt. CR1	155, 622, 1063,1250, 2125, 2488, 2500, and 2666 Mb/s clock/data recovery

80C08D

Opt. CR4	Continuous rate clock recovery supporting any standard or user-definable rate in the range from 9.8 to 12.6 Gb/s

80C10C

The 80C10C has three configurations (Option F1, F2, or F3). User must order one of these options with the module.

Opt. F1	25.781, 26.5625, 27.952, 28.05, 39.813, 41.25, 43.018, 44.5 Gb/s filters, 70 GHz full bandwidth, 53.125 TDECQ, 57.8 filters
Opt. F2	25.781, 27.952 Gb/s filters, 55 GHz full bandwidth
Opt. F3	39.813, 41.25, 43.018, 44.5, 53.125 TDECQ, 57.8 Gb/s filters, 80 GHz full bandwidth, 53.125 TDECQ filters
Opt. HSPR	Option HSPR (High Sensitivity Photo Receiver) provides a second, more sensitive single-mode optical input that supports typical power levels for the 40 Gb/s and 100 (4 x 25) Gb/s standards. The option also provides differential electrical outputs (50 Ω, AC coupled, differential 2.92 mm female connectors) on the module front panel, to 44.5 Gb/s, with a maximum 1 ps differential skew. A typical use for Option HSPR is to provide optical BER testing when using a Tektronix BERTScope. This option is compatible with options F1-F3, but is mutually exclusive from Opt. CRTP
Opt. CRTP	The option provides differential clock recovery trigger pick-off (CRTP) electrical outputs (50 Ω, AC coupled, differential 2.92 mm female connectors) on the module front panel, to 44.5 Gb/s, with a maximum 1 ps differential skew. This option is compatible with options F1-F3, but is mutually exclusive from Opt. HSPR

80C10CE2

Bundle	Bundled ordering configuration includes 80C10C plus one 80E11X1 single-channel 70+ GHz electrical module (This bundle has the same ordering options as the 80C10C).

80C11B

Opt. CR3	9.953, 10.71 Gb/s clock recovery
Opt. CR4	Continuous rate clock recovery supporting any standard or user-definable rate in the range from 9.8 to 12.6 Gb/s
Opt. 01	ER Calibrated (when ordered with new module); module will only work on mainframe with Windows XP or Windows 7 and oscilloscope FW V 5.0 and higher. ER Calibrated can be ordered as an upgrade to an existing module; order Opt. 01 + Opt. IFC (factory installation); factory installation is required; module will only work on mainframe with Windows XP and oscilloscope FW V 5.0 and higher.

80C12B

The 80C12B module provides user-selected filter options for measuring specified sets of standards. Three module configurations are available that must be specified when ordering:

- Option 10G provides Optical Reference Receiver (ORR) filters for all standard rates between 8.5 and 11.4 Gb/s
- Options F0-F12 provide four "tributary" filters for standards at data rates from 155 Mb/s to 7.373 Gb/s. Select the four filter options when ordering the module.
- Option 10GP plus any three F1-F12 filters provides Optical Reference Receiver (ORR) [38] filters for all standard rates between 8.5 and 11.3 Gb/s plus the three selected tributary standard rates.

Opt. F0	Unfiltered 12 GHz bandwidth and 8.5 Gb/s [39]
Opt. F1	155.52 Mb/s
Opt. F2	622 Mb/s
Opt. F3	1.0625 Gb/s
Opt. F4	1.250 Gb/s

38 The Optical Reference Receiver (ORR) is a 4th-order Bessel-Thompson filter, with a frequency response and tolerances as defined by the standards. Tektronix optimizes the response for best nominal fit and highest quality mask test results.

39 Option 10GP and F0 are mutually exclusive, as Option 10GP already includes Option F0.

Opt. F5	2.125 Gb/s
Opt. F6	2.488, 2.500 Gb/s
Opt. F7	2.666 Gb/s
Opt. F8	3.125, 3.188 Gb/s
Opt. F9	4.250 Gb/s
Opt. F10	5.000 Gb/s
Opt. F11	6.144 Gb/s
Opt. F12	7.373 Gb/s
Opt. 10G/10GP [39]	8.500, 9.95, 10.31, 10.51, 10.66, 10.71, 11.1, 11.3 Gb/s, unfiltered 12 GHz bandwidth
Opt. 01	ER Calibrated (when ordered with new module); module will only work on mainframes with Windows XP or Windows 7 and oscilloscope FW V 5.0 and higher. ER Calibrated can be ordered as an upgrade to an existing module; order Opt. 01 and Opt. IFC (factory installation)

80C14

No options

80C15

Opt. CRTP	CRTP (Clock Recovery Trigger Pickoff) for 80C15 Optical Module. Does not include optical splitter
Opt. CRTP-MM	CRTP (Clock Recovery Trigger Pickoff) for 80C15 Optical Module. Includes 62.5 µm MM 10/90 optical splitter
Opt. CRTP-SM	CRTP (Clock Recovery Trigger Pickoff) for 80C15 Optical Module. Includes SM 10/90 optical splitter.

80C17, 80C18

Opt. IMP	Impulse response correction. In conjunction with DSA8300 400G-M4, may be used to extend optical channel optical bandwidth up to 36.2 GHz (-3dBo) and electrical bandwidth up to 26.5625 GHz (-3dBe). Suitable for TDECQ testing on PAM4 rates up to 53.125 GBd.
Opt. CRTP	CRTP (Clock Recovery Trigger Pickoff) for the 80C17 and 80C18 Optical Modules. Does not include optical splitter.
Opt. CRTP-MM	CRTP (Clock Recovery Trigger Pickoff) for 80C17 and 80C18 Optical Modules. Includes 50 µm MM 10/90 optical splitter.
Opt. CRTP-SM	CRTP (Clock Recovery Trigger Pickoff) for 80C17 and 80C18 Optical Modules. Includes SM 10/90 optical splitter.

80C20, 80C21

No options

Service options (available for all 80C00 optical modules)

CA1 [40]	Provides a single calibration event or coverage for the designated calibration interval, whichever comes first.
Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 Years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
G3 [41]	Three Year Gold Care Plan. Includes expedited repair of all product failures including ESD and EOS, access to a loaner product during repair or advanced exchange to reduce downtime, and priority access to Customer Support among others.
G5 [41]	Five Year Gold Care Plan. Includes expedited repair of all product failures including ESD and EOS, access to a loaner product during repair or advanced exchange to reduce downtime, and priority access to Customer Support among others.
Opt. R3	Repair Service 3 Years (including warranty)
Opt. R5	Repair Service 5 Years (including warranty)

Recommended accessories

Input connector adapters

While the FC/PC connector is standard with the 80C00 Series optical sampling modules, the input connector type can be interchanged with any of the following standard adapters:

Biconic	119-4515-xx
D4/PC	119-4514-xx
DIAMOND 3.5	119-4558-xx
DIN/PC 47256	119-4546-xx
FC/PC	119-5115-xx
HP/PC	119-4556-xx
SC/PC	119-5116-xx
SMA	119-4557-xx
SMA 2.5	119-4517-xx
ST/PC	119-4513-xx

Note: For LC connector please use LC to FC/PC patch cable and connect to the default FC/PC.

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

40 80C14 only

41 80C15/17/18 only

ASEAN / Australasia (65) 6356 3900
Belgium 00800 2255 4835*
Central East Europe and the Baltics +41 52 675 3777
Finland +41 52 675 3777
Hong Kong 400 820 5835
Japan 81 (3) 6714 3086
Middle East, Asia, and North Africa +41 52 675 3777
People's Republic of China 400 820 5835
Republic of Korea +822 6917 5084, 822 6917 5080
Spain 00800 2255 4835*
Taiwan 886 (2) 2656 6688

Austria 00800 2255 4835*
Brazil +55 (11) 3759 7627
Central Europe & Greece +41 52 675 3777
France 00800 2255 4835*
India 000 800 650 1835
Luxembourg +41 52 675 3777
The Netherlands 00800 2255 4835*
Poland +41 52 675 3777
Russia & CIS +7 (495) 6647564
Sweden 00800 2255 4835*
United Kingdom & Ireland 00800 2255 4835*

Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Canada 1 800 833 9200
Denmark +45 80 88 1401
Germany 00800 2255 4835*
Italy 00800 2255 4835*
Mexico, Central/South America & Caribbean 52 (55) 56 04 50 90
Norway 800 16098
Portugal 80 08 12370
South Africa +41 52 675 3777
Switzerland 00800 2255 4835*
USA 1 800 833 9200

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

For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tek.com.

Copyright © Tektronix, Inc. All rights reserved. Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specification and price change privileges reserved. TEKTRONIX and TEK are registered trademarks of Tektronix, Inc. All other trade names referenced are the service marks, trademarks, or registered trademarks of their respective companies.

20 Feb 2019 85W-15964-42

www.tek.com

Tektronix®