

# MP1763C/MP1764C/MP1764D

## Pulse Pattern Generator/Error Detector

50 Mbit/s to 12.5 Gbit/s



- *High-Quality, Low-Jitter, Low-Distortion Waveform Output*
- *Evaluation of Transmission Modules, Buses, Backplanes using Differential/CDR Option*
- *12.5 Gbit/s BERTS with Higher Performance and Lower Price*

# High-Speed/Wide Band, High Quality Waveform and Advanced Functions

Today's demand for transfer of large amounts of data, such as video, over the internet, is resulting in expansion of high-speed transmission circuits and other infrastructure. In addition to the previously used STM-64/OC-192 (9.95328 Gbit/s) standards, we are also seeing use of 10.709225 Gbit/s (OTU-2), which includes FEC coding, as well as 3.125 Gbit/s x 4 and 10.3125 Gbit/s in 10 Gbit Ethernet. Furthermore, the Fibre Channel file transfer protocol at 4.25 Gbit/s is also coming into actual use.

As these new standards are settled upon, there is an urgent need to be able to support evaluation of devices and circuits at these higher bit rates.

Our MP1763C Pulse Pattern Generator and MP1764C/1764D Error Detector are a BERTS (Bit Error Rate Test Set) supporting evaluation and testing of transmission equipment, high-speed devices, optical modules, etc., at every stage from R&D through to manufacturing and production at speeds from 50 Mbit/s to 12.5 Gbit/s.

## High-speed And Wide Band

One MP1763C/MP1764C can cover the band from STM-0/STS-1 to 10 Gbit Ethernet, STM-64/STS-192, OTU-2 and can be used with 4.25 Gbit/s Fibre Channel Systems.

## Many Patterns

- 8 Mbit programmable pattern (corresponding to six frames of STM-64/STS192)
- PRBS patterns from  $2^7 - 1$  to  $2^{31} - 1$
- PRBS pattern with randomness and mark ratio variance for rigorous testing
- Alternating pattern  
The MP1763C alternately sends normal and alarm patterns to a device for response testing.
- Zero substitution pattern  
This feature is effective for testing the clock regeneration of a 3R repeater.

## Location Changeable Pattern Synchronization Trigger

This feature makes it simple to monitor the waveform at any point in a long word pattern.

- High Q factor  
A high Q factor can be obtained by back to back connection (typical value at 10 Gbit/s, PRBS  $2^{23} - 1$ : 40 dB).

## 10 Gbit Ethernet I/O Interface Support

### • 1/4 Differential Output (MP1763C-08 Option)

This outputs differential data at a rate of 1/4 of the standard output (100 Mbit/s to 3.125 Gbit/s) as 4-bit parallel data. It can be used as a data signal for evaluating high-speed devices such as XAUI and SFI-4 P2 4 Lane devices used in 10 Gbit Ethernet and Fibre Channel, and for evaluating high-speed buses and backplanes such as PCI express.

### • Differential Input (MP1764C-02 Option)

This can be used for evaluation by inputting a high-speed differential signal used by XAUI, SFI-4P2 4Lane devices, PCI Express, etc.

### • Clock Recovery Function (MP1764C-03 Option)

The clock recovered from input data can be used as a trigger signal for error rate detection and waveform monitoring. Evaluation does not require an external clock, and when used jointly with differential input, high-speed differential devices can be evaluated without an external jig.

Bit rates from 62.5 Mbit/s to 11.1 Gbit/s are supported along with 4.25 Gbit/s used by Fibre Channel.

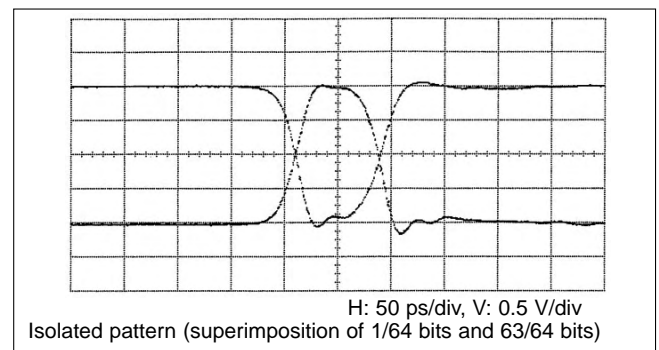
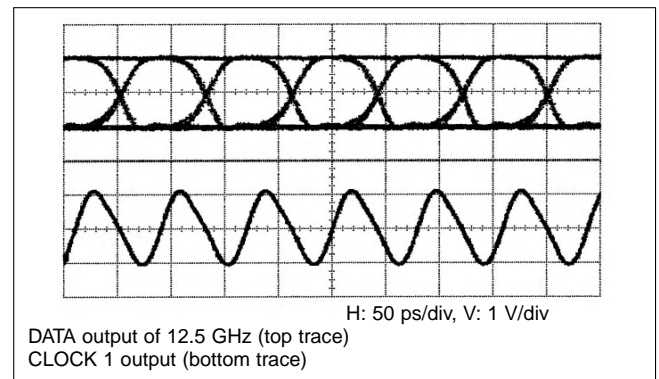
\*The MP1764D model ships with the MP1764C-02 (Differential input) and MP1764C-03 (Clock recovery) options installed.

## Pulse Pattern Generator

### High-quality Waveform

- $t_r/t_f$  (10% to 90%): 30 ps (typical)
- Jitter: 10 ps<sub>p-p</sub> (typical)
- Back termination for low waveform distortion
- A pattern of isolated pulses which do not depend on mark ratios.

MP1763C output waveform



### High Resolution Clock And Data Output

- Output amplitude: 0.25 to 2 V<sub>p-p</sub> (2 mV steps)
- Output offset: -2 to +2 V (1 mV steps)
- Delay (clock): -500 to +500 ps (1 ps steps)
- DATA/DATA independently variable

### Burst Signal Generation Using External Gate Signal

This feature is effective for optical fiber-loop testing, etc.

### Parallel Output I/F (1/8, 1/4, 1/4 Differential)

- 1/8 parallel output is standard. 1/4 parallel output (Option 03) or 1/4 differential output (Option 08) can be selected exclusively.
- It can be used as a MUX device and a data generator for WDM transmission.
- The 1/4 differential option provides 4-bit parallel output of differential data for the 1/4 rate standard output (100 Mbit/s to 3.125 Gbit/s). Similarly, a 1/4 rate clock can be output as a differential. This can be used for performing detailed inspection of specifications and performance by use as a data signal for evaluation of high-speed devices such as XAUI and SFI-4 P2 4 Lane devices used in 10 Gbit Ethernet and Fibre Channel, and for evaluation of high-speed buses and backplanes such as PCI express.

## Error Detector

### High Input Sensitivity And Wide Phase Margin

- Input sensitivity: 50 mVp-p  
(typical value at 10 Gbit/s, PRBS  $2^{23} - 1$ )
- Phase margin: 70 ps or more  
(typical value at 10 Gbit/s, PRBS  $2^{23} - 1$ )

### Eye Margin Measurement

The phase margin and threshold margin can be measured and displayed for any error rate.

### Burst Measurement

- The burst data can be measured even for the PRBS and programmable patterns.
- High-speed synchronization gain is achieved by a quick synchronous method (typical sync. gain time at 10 Gbit/s, programmable pattern length of 2048 bits, sync. threshold at  $10^{-2}$ : 850 ns).

### Selectivity BER Measurement In Bit Units

The bit errors can be measured for any block of 32-bit segments or any bit.

### Error Analysis Function (Option)

The pattern (256 bits in total) before and after a bit in which an error occurred can be displayed. Also, insertion and omission errors are displayed using different LED colors.

### Differential Input Support (Option)

- This supports direct input of high-speed differential signals used by high-speed devices, buses and backplanes, such as XAUI, SFI-4 P2 4 Lane and PCI Express.
- Detailed evaluation is possible because independent thresholds can be set for inverted and non-inverted data

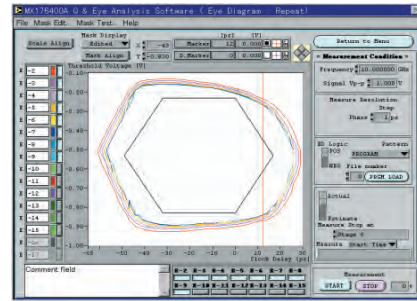
### Clock Recovery Function (Option)

- The clock is recovered from the input data for use as a trigger signal at error rate detection and waveform monitoring. Evaluation does not require an external clock and the recovered clock can also be used as an external clock, depending on the setting.
- A wide range of bit rates from 62.5 Mbit/s to 11.1 Gbit/s is supported, along with the 4.25 Gbit/s rate used by Fibre Channel.
- When used in conjunction with differential input, it is also possible to evaluate the latest high-speed differential devices that do not use a clock without the need for an external jig.

## Application Software

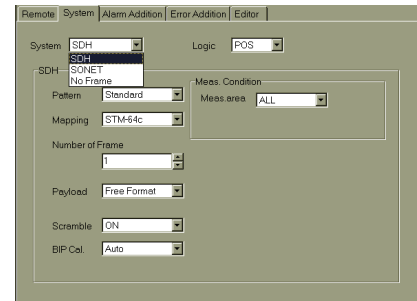
### MX176400A Q/Eye Analysis Software

- Eye diagram and eye margin automatic measurement
  - Displays a mask figure for the evaluation on the screen
  - Q-factor (ITU-T G.976) automatic measurement
- \* Single input unsupported; use at differential signal input is not supported.



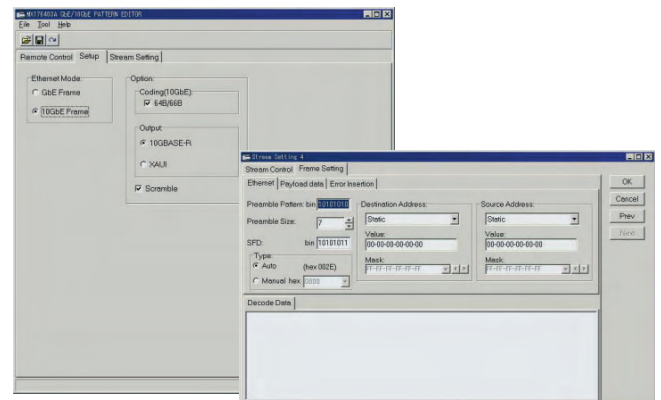
### MX176401A SDH/SONET Pattern Editor

- Support OC-1 (STM-0) to OC-192c (STM-64c) mapping
- Alarm addition (OOF, LOF, MS-AIS, REI, RDI)
- BIP error addition (B1, B2, B3)
- Support "No frame" pattern

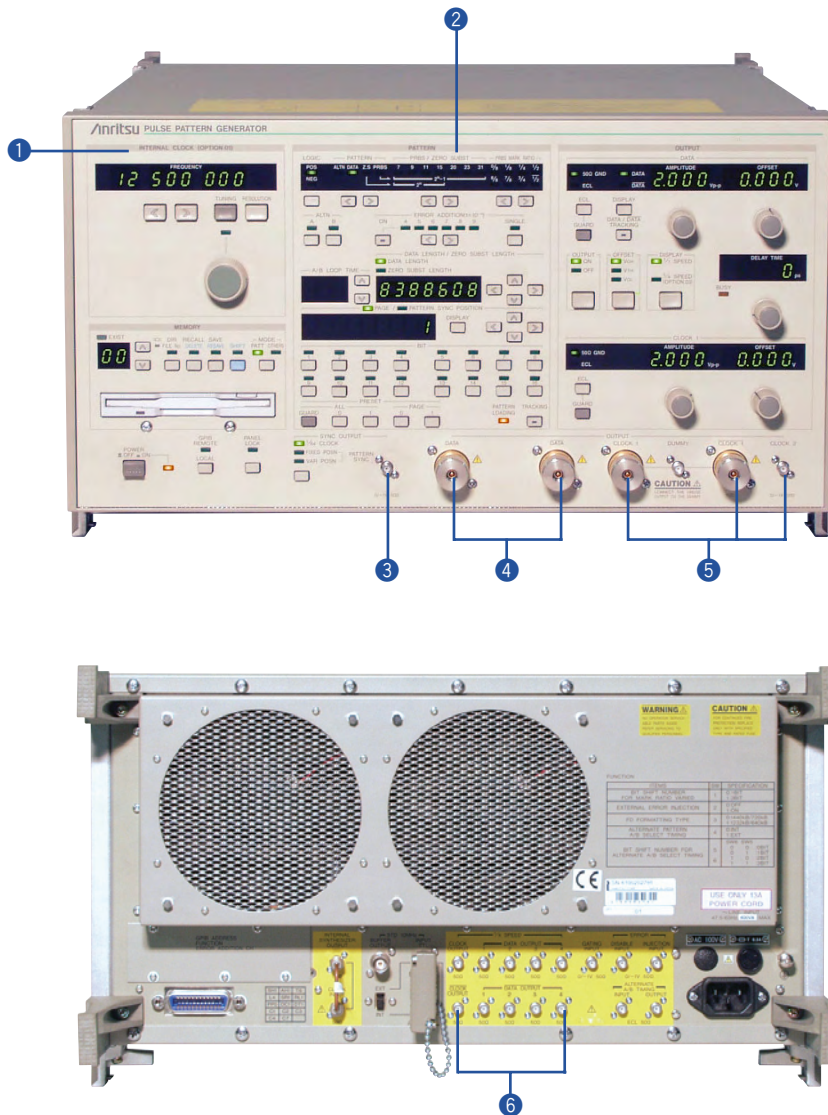


### MX176403A GbE/10GbE Pattern Editing Software (At Order Acceptance)

- Supports Gbit Ethernet, 10 Gbit Ethernet (10GBASE-R, XAUI) frames
- 8B/10B, 64B/66B ON/OFF
- Header, Payload editing function
- CRC Auto-calculation
- Bit Error, FCS Error insertion function



# MP1763C Pulse Pattern Generator



## 1 Internal Clock (Option 01)

Can be set in units of 1 kHz over the range from 50 MHz to 12.5 GHz

## 2 Programmable Patterns

- 8-Mbit programmable pattern (can set six STM-64 frames)
- 4-Mbit alternate pattern
- Zero substitution pattern
- PRBS pattern from  $2^7 - 1$  to  $2^{31} - 1$  selectable and its mark ratio can be varied.

## 3 Synchronous Output

The 1/64 clock or pattern SYNC selectable.  
The trigger position variable for the pattern SYNC

## 4 DATA Output

DATA/DATA complementary output with back termination

## 5 CLOCK Output

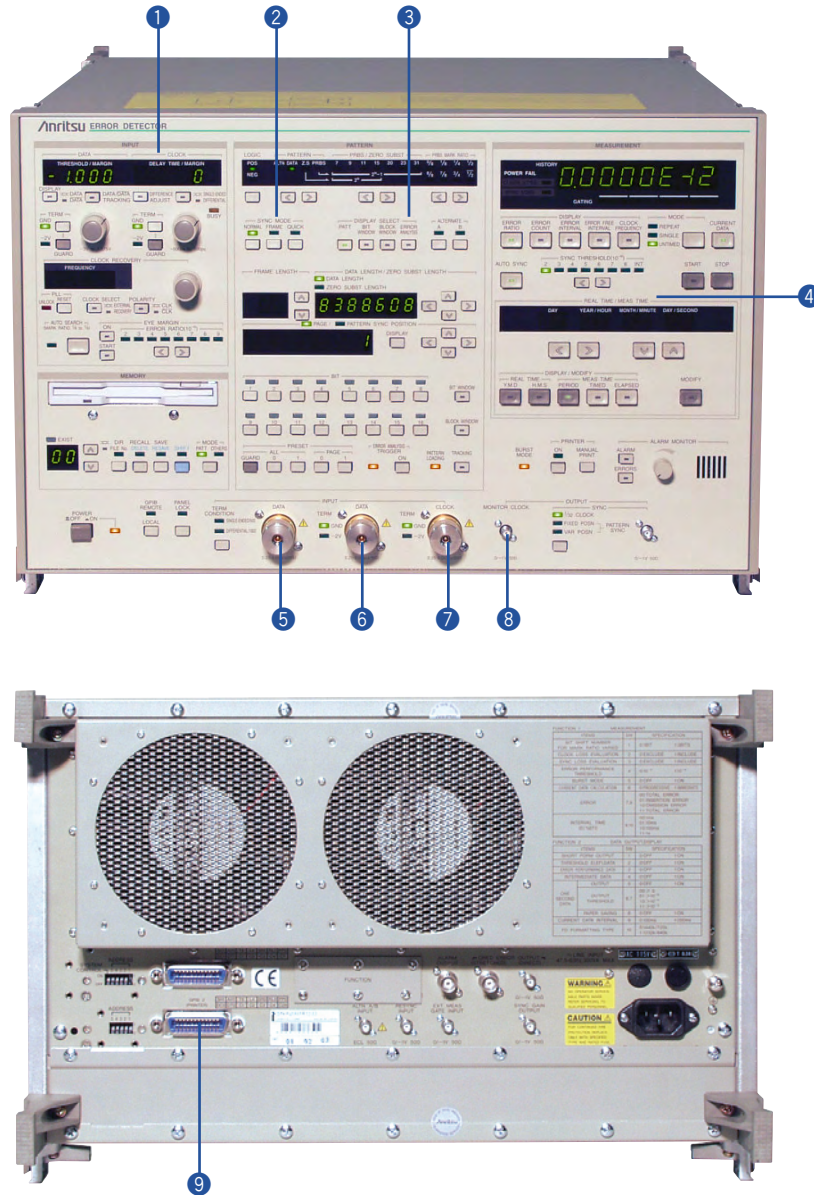
CLOCK 1/CLOCK 1, CLOCK 2 (3 systems)  
CLOCK 1/CLOCK 1 with back termination

## 6 Parallel Output

Useful for testing an 8:1 MUX  
(changeable to 1/4 speed output with option)

- 1/8 parallel output is standard. 1/4 parallel output (Option 03) or 1/4 differential output (Option 08) can be selected exclusively.
- It can be used as a data generator for evaluation of MUX devices, WDM transmission equipment, high-speed buses, back-planes, etc.

# MP1764D Error Detector



## 1 Eye Margin Measurement

Displays the phase margin and threshold margin.

## 2 Synchronous Mode

High-speed sync. gain is achieved in frame and quick synchronous modes.

## 3 Error Analysis (Option 01)

The input pattern before and after a bit in which an error occurred can be checked.

## 4 Synchronous Threshold

The sync. gain and sync. loss conditions can be set.

## 5 Non-Inverted DATA Input

Has a high input sensitivity of 50 mVp-p (typical value).

## 6 Inverted DATA Input (Option 02)

At differential input, this uses inverted DATA input.

## 7 CLOCK Input

Input CLOCK determining phase evaluation of 0 or 1  
Option 03 with CLOCK recovery function makes input unnecessary when inputting data with a supported bit rate.

## 8 Regenerated CLOCK Output (Option 03)

This outputs the CLOCK regenerated from DATA.

## 9 Two GPIB Connectors

One is used for an external printer.

# Specifications

## • MP1763C Pulse Pattern Generator

Operation frequency		0.05 to 12.5 GHz
Internal CLOCK (Option 01)		Frequency range: 0.05 to 12.5 GHz SSB phase noise: $\leq -85$ dBc/Hz (0.05 to 4 GHz), $\leq -80$ dBc/Hz (4 to 8 GHz), $\leq -75$ dBc/Hz (8 to 10 GHz), $\leq -70$ dBc/Hz (10 to 12.5 GHz) *At 10 kHz offset, 1 Hz bandwidth
External CLOCK input level		0.4 to 2.5 Vp-p
Pattern	Pseudorandom binary sequence pattern (PRBS)	Pattern: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8 (1/2, 3/4, 7/8, 8/8 are possible with logic inversion) Bit shifts number for mark ratio varied: 1, 3 bits selectable
	DATA pattern	DATA length: 2 to 8388608 bits
	Alternate pattern	A/B pattern DATA length: 128 to 4194304 bits (128 bit steps); Loop time: A, B pattern (1 to 127, 1 steps)
	Zero substitution pattern	Zero bit length: 1 to (pattern length - 1) bits; Pattern: $2^n$ (n: 7, 9, 11, 15)
	Error addition	Error rate: $10^{-n}$ (n: 4, 5, 6, 7, 8, 9), and single error External error injection: Provided
DATA output	Number of outputs	2 (DATA/DATA independently)
	Amplitude	0.25 to 2 Vp-p, 2 mV steps
	Offset voltage	V <sub>OH</sub> : -2 to +2 V, 1 mV steps Display: V <sub>OH</sub> , V <sub>TH</sub> or V <sub>OL</sub> selectable
	Rise/fall time	Typical 30 ps (10% to 90% of amplitude)
	Pattern jitter	$\leq 20$ psp-p, typical 10 psp-p
	Waveform distortion (0-peak)	$\leq 15\%$ or $\leq 150$ mV whichever is greater
	Gating input	Provided
	Load impedance	50 $\Omega$ (with back termination)
	Connector	APC-3.5
	Cross point adjustment function	DATA amplitude and offset voltage can be set to the same values as for DATA. The cross point of DATA/DATA outputs can be adjusted at semifixed resistor of side.
CLOCK output	Number of outputs	3 (CLOCK 1/CLOCK 1, CLOCK 2)
	Amplitude	CLOCK 1/CLOCK 1: 0.25 to 2 Vp-p (2 mV steps) CLOCK 2: 1 Vp-p
	Offset voltage	CLOCK 1/CLOCK 1: V <sub>OH</sub> -2 to +2 V (1 mV steps) CLOCK 2: V <sub>OH</sub> 0 V fixed
	Rise/fall time	Typical 30 ps (10% to 90% of amplitude)
	Load impedance	50 $\Omega$ (CLOCK 1/CLOCK 1: with back termination)
	Connector	CLOCK 1/CLOCK 1: APC-3.5, CLOCK 2: SMA
	Delay	$\pm 500$ ps (1 ps steps)
1/8 DATA and CLOCK output	Number of outputs	DATA 8, CLOCK 1
	Output level	ECL
	Connector	SMA
1/4 DATA and CLOCK output (Option 03)*1	Number of outputs	DATA: 4, CLOCK: 1
	Amplitude	0.5 to 2 Vp-p (2 mV steps)
	Offset voltage	V <sub>OH</sub> : -1.5 to +1.5 V (1 mV steps)
	Connector	SMA
1/4 Differential DATA, CLOCK output (Option 08)*1	Operation bit rate	1/4 DATA/DATA: 100 Mbit/s to 3.125 Gbit/s
	Number of outputs	1/4 DATA/DATA differential 4 system. 1/4 CLOCK/CLOCK differential 1 system
	Amplitude	0.5 to 2.0 Vp-p (2 mV steps), 1/4 DATA/DATA: All channels same settings
	Offset voltage	1/4 DATA/DATA: -1.0 to +2.5 V (V <sub>OH</sub> ) (1 mV steps, PRBS 50 $\Omega$ /GND termination) All channels same settings 1/4 CLOCK/CLOCK: -1.5 to +1.5 V (V <sub>OH</sub> ) (1 mV steps, PRBS 50 $\Omega$ /GND termination)
	Connector	SMA
Sync. signal output	Number of outputs	1 (1/64 CLOCK, fixed position pattern, or variable position pattern selectable)
	Output level	0/-1 V
	Connector	SMA
Parameter memory	Media: 3.5 inch FD (2HD, 2DD), Format: MS-DOS (Rev. 3.1)*2, Content: Pattern or other parameters	
Operating temperature range	0° to +50°C	
Dimensions and mass	426 (W) x 221 (H) x 450 (D) mm, $\leq 33$ kg	
Power	$\leq 400$ VA	
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)	
LVD	EN61010-1: 2001 (Pollution Degree 2)	

\*1: Select one type from three items

- 1/8 DATA and 1/8 CLOCK output
- 1/4 DATA and 1/4 CLOCK output (Option 03)
- 1/4 Differential DATA and 1/4 Differential CLOCK output (Option 08)

\*2: MS-DOS is a registered trademark of Microsoft Corporation.

• **MP1764C/MP1764D Error Detector**

Operation frequency		0.05 to 12.5 GHz
DATA/DATA input (MP1764D Option 02)	Input waveform	NRZ
	Input amplitude	0.25 to 2.0 Vp-p
	Threshold voltage variable range	-3.000 to +1.875 Vp-p (1 mV steps)
	Phase margin	≥70 ps (typical value at 10 Gbit/s, PRBS 2 <sup>23</sup> - 1, at single ended input amplitude of 1 Vp-p)
	Input sensitivity	50 mVp-p (typical value at 10 Gbit/s and PRBS 2 <sup>23</sup> - 1)
	Termination	Connected to GND or -2 V via a 50 Ω termination
	Connector	APC-3.5
CLOCK input	Input waveform	Rectangular wave (<0.5 GHz), rectangular or sine wave (≥0.5 GHz), duty factor: 50%
	Input voltage	0.25 to 2.0 Vp-p
	Input delay variable range	±500 ps (1 ps steps)
	Polarity inversion	CLOCK/CLOCK inversion possible
	Termination	Connected to GND or -2 V via a 50 Ω termination
	Connector	APC-3.5
CLOCK regeneration function (MP1764D Option 03)	Operation bit rate	62.5 to 100 Mbit/s, 125 to 200 Mbit/s, 250 to 400 Mbit/s, 500 to 800 Mbit/s, 1,000 to 1,600 Mbit/s, 2,000 to 3,200 Mbit/s, 4,250 Mbit/s ±50 ppm, 9,900 to 11,100 Mbit/s
	CLOCK selection	Internal/External
	Continuous 0 s tolerance (withstand)	72 bit min.
	Regenerated CLOCK output	Output level: 1.0 ±0.25 V (AC coupling)
Auto search function		Provided
Receive pattern	Pseudorandom binary sequence pattern (PRBS)	Pattern: 2 <sup>n</sup> - 1 (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8 (1/2, 3/4, 7/8, 8/8 are possible with logic inversion.) Number of AND bit shift at mark ratio setting: 1, 3 bits (selectable by using DIP switch on rear panel)
	DATA pattern	DATA length: 2 to 8388608 bits
	Alternate pattern	A/B pattern word length: 128 to 4194304 bits (128 bits steps), Number of loops: Controlled using external signal
	Zero substitution pattern	Zero bit length: 1 to (pattern length - 1) bits, Pattern length: 2 <sup>n</sup> (n: 7, 9, 11, 15)
Synchronous mode		Normal, frame, quick
Synchronous threshold		Preset value or 10 <sup>-n</sup> (n: 2, 3, 4, 5, 6, 7, 8)
Error detection mode		Omission insertion, total (selectable with DIP switch on rear panel)
Measurement item	Error rate	0.0000 x 10 <sup>-16</sup> to 1.0000 x 10 <sup>-0</sup>
	Number of errors	0 to 9.9999 x 10 <sup>16</sup>
	Error interval (asynchronous)	0 to 9999999 (interval: 1 ms, 10 ms, 100 ms, 1 s)
	Error free interval (EFI)	0.0000% to 100.0000%
	CLOCK frequency	0.05 to 12.5 GHz, (resolution: 1 kHz, accuracy: 10 ppm ±1 kHz)
Eye margin measurement function		Provided
Error performance DATA calculation function		Provided
Measurement CH mask		1 to 32 ch (settable independently)
Block window		Error for any block of 32-bit segments can be measured.
Error analysis (option 01)		Pattern (256 bits in total) before and after bit in which error occurred is stored.
Auxiliary output	Error output (direct)	1/128 OR error, Output level: 0/-1 V, Connector: SMA
	Error output (stretched)	Pulse width: 350 ns (typical), Output level: TTL, Connector: BNC
	Alarm output (CLOCK loss, sync. loss)	Output level: TTL Connector: BNC
	Sync. gain output	Output level: 0/-1 V; Connector: SMA
Auxiliary input	External mask input	Input level: 0/-1 V; Connector: SMA
	Resync. input	Input level: 0/-1 V; Connector: SMA
	Alternate A/B switching input	Input level: ECL; Connector: SMA
Sync. signal output	Number of outputs	1 (1/32 CLOCK, fixed position pattern, or variable position pattern selectable)
	Output level	0/-1 V
	Connector	SMA
Parameter memory		Media: 3.5 inch FD (2HD, 2DD), Format: MS-DOS (Rev. 3.1)*1. Content: Pattern or other parameters
Operating temperature range		0° to +50°C
Dimensions and mass		426 (W) x 221.5 (H) x 450 (D) mm, ≤30 kg (except Option 02, 03) 426 (W) x 266 (H) x 450 (D) mm, ≤35 kg (Option 02, 03)
Power		≤300 VA
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)

\*1: MS-DOS is a registered trade mark of Microsoft Corporation.

# Ordering Information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
MP1763C	<b>Main frame</b> Pulse Pattern Generator (50 Mbit/s to 12.5 Gbit/s)
	<b>Standard accessories</b>
J0500A	Semi-rigid cable (SMA-P · UT-141 · SMA-P), 0.5 m: 2 pcs
J0672F	Semi-rigid cable (SMA-P · UT-85 · SMA-P), 10 cm: 1 pc
J0693A	SMA cable (HRM202B-3D2W-HRM202B), 1 m: 1 pc
J0496	APC-3.5 J-J connector: 4 pcs
J0008	GPIB cable, 2 m: 1 pc
J0491	Power cord: 1 pc
Z0168	3.5-inch floppy disk (MF2HD-3.5MF): 2 pcs
Z0481	12.5G/3.2G BERTS application software demo: 1 pc
Z0306A	Wrist strap: 1 pc
F0014	Fuse, 6.3 A (T6.3A250V): 1 pc
B0021	Protective cover (for 1MW · 5U): 1 pc
W1848AE	MP1763C operation manual: 1 copy
W1849AE	MP1763C GPIB operation manual: 1 copy
	<b>Option</b>
MP1763C-01	12.5 GHz Synthesizer (50 MHz to 12.5 GHz)
J0672D	Semi-rigid cable (SMA-P · UT-85 · SMA-P), 7 cm
MP1763C-03	1/4 speed output
MP1763C-08	1/4 Differential Data Output Function (100 Mbit/s to 3.125 Gbit/s)
W2339AE	MP1763C-08 operation manual
W2340AE	MP1763C-08 GPIB operation manual
MP1764C	<b>Main frame</b> Error Detector (50 Mbit/s to 12.5 Gbit/s)
MP1764D	Error Detector (50 Mbit/s to 12.5 Gbit/s)
	<b>Standard accessories</b>
J0500A	Semi-rigid cable (SMA-P · UT-141 · SMA-P), 0.5 m: 2 pcs (MP1764C) 4 pcs (MP1764D)
J0693A	SMA cable (HRM202B-3D2W-HRM202B), 1 m: 3 pcs
J0496	APC-3.5 J-J connector: 2 pcs (MP1764C) 3 pcs (MP1764D)
J0008	GPIB cable, 2 m: 2 pcs
J0776D	BNC cable (BNC-P · 3W · 3D · 2W · BNC-P · 3W), 2 m: 2 pcs

Model/Order No.	Name
J0491	Power cord (13 A): 1 pc
Z0168	3.5-inch floppy disk (MF2HD-3.5MF): 2 pcs
F0014	Fuse, 6.3 A: 1 pc
Z0306A	Wrist strap: 1 pc
B0021*1	Protective cover (for 1MW · 5U): 1 pc
B0022*2	Front cover: 1 pc
W1850AE	MP1764C operation manual: 1 copy
W1851AE	MP1764C GPIB operation manual: 1 copy
W2341AE	MP1764D operation manual: 1 copy
W2342AE	MP1764D GPIB operation manual: 1 copy
	<b>Option</b>
MP1764C-01	Error Analysis
MP1764C-02	Differential Data Input Function
MP1764C-03	Clock Recovery Function
MP1764D-01	Error Analysis
W2373AE	MP1764C-02,03 operation manual
W2374AE	MP1764C-02,03 GPIB Programming operation manual
	<b>Application Software</b>
MX176400A	Q/Eye Analysis Software
MX176401A	SDH/SONET Pattern Editor
MX176403A	GbE/10GbE Pattern Editor
	<b>Optional accessories</b>
J0500B	Semi-rigid cable (SMA-P · SX-36 · SMA-P), 1 m
J0322A	Coaxial cable (SUCOFLEX104, 11SMA-11SMA), 0.5 m
J0322B	Coaxial cable (SUCOFLEX104, 11SMA-11SMA), 1 m
J0007	408JE-104 GPIB cable, 1 m
Z0054	3.5-inch floppy disk (MF2DD-3.5MF)
MB24B	Portable Test Rack (rating current of power cord and plug: 20 A)
B0413A	Carrying case
B0163	Portable Quilting
B0044	Rack mount kit (for 1MW · 5U panel)
Z0416	3.5-inch head cleaning disk
J0498	Coaxial code, 0.5 m
J0499	Coaxial code, 1 m
J1141	50 Ω Terminator

\*1: For MP1764C

\*2: For MP1764C-02,03 and MP1764D

# Anritsu

Specifications are subject to change without notice.

## ANRITSU CORPORATION

1800 Onna, Atsugi-shi, Kanagawa, 243-8555 Japan  
Phone: +81-46-223-1111  
Fax: +81-46-296-1264

### • U.S.A.

#### ANRITSU COMPANY

#### TX OFFICE SALES AND SERVICE

1155 East Collins Blvd., Richardson, TX 75081, U.S.A.  
Toll Free: 1-800-ANRITSU (267-4878)  
Phone: +1-972-644-1777  
Fax: +1-972-644-3416

### • Canada

#### ANRITSU ELECTRONICS LTD.

700 Silver Seven Road, Suite 120, Kanata,  
ON K2V 1C3, Canada  
Phone: +1-613-591-2003  
Fax: +1-613-591-1006

### • Brasil

#### ANRITSU ELETRÔNICA LTDA.

Praca Amadeu Amaral, 27 - 1 andar  
01327-010 - Paraiso, Sao Paulo, Brazil  
Phone: +55-11-3283-2511  
Fax: +55-11-3886940

### • U.K.

#### ANRITSU LTD.

200 Capability Green, Luton, Bedfordshire LU1 3LU, U.K.  
Phone: +44-1582-433280  
Fax: +44-1582-731303

### • Germany

#### ANRITSU GmbH

Grafenberger Allee 54-56, 40237 Düsseldorf, Germany  
Phone: +49-211-96855-0  
Fax: +49-211-96855-55

### • France

#### ANRITSU S.A.

9, Avenue du Québec Z.A. de Courtabœuf 91951 Les  
Ulis Cedex, France  
Phone: +33-1-60-92-15-50  
Fax: +33-1-64-46-10-65

### • Italy

#### ANRITSU S.p.A.

Via Elio Vittorini, 129, 00144 Roma EUR, Italy  
Phone: +39-06-509-9711  
Fax: +39-06-502-2425

### • Sweden

#### ANRITSU AB

Borgafjordsgatan 13 164 40 Kista, Sweden  
Phone: +46-853470700  
Fax: +46-853470730

### • Singapore

#### ANRITSU PTE LTD.

10, Hoe Chiang Road #07-01/02, Keppel Towers,  
Singapore 089315  
Phone: +65-6282-2400  
Fax: +65-6282-2533

### • Hong Kong

#### ANRITSU COMPANY LTD.

Suite 923, 9/F., Chinachem Golden Plaza, 77 Mody  
Road, Tsimshatsui East, Kowloon, Hong Kong, China  
Phone: +852-2301-4980  
Fax: +852-2301-3545

### • P. R. China

#### ANRITSU COMPANY LTD.

#### Beijing Representative Office

Room 1515, Beijing Fortune Building, No. 5 North  
Road, the East 3rd Ring Road, Chao-Yang District  
Beijing 100004, P.R. China  
Phone: +86-10-6590-9230

### • Korea

#### ANRITSU CORPORATION

8F Hyun Juk Bldg. 832-41, Yeoksam-dong,  
Kangnam-ku, Seoul, 135-080, Korea  
Phone: +82-2-553-6603  
Fax: +82-2-553-6604

### • Australia

#### ANRITSU PTY LTD.

Unit 3/170 Forster Road Mt. Waverley, Victoria, 3149,  
Australia  
Phone: +61-3-9558-8177  
Fax: +61-3-9558-8255

### • Taiwan

#### ANRITSU COMPANY INC.

7F, No. 316, Sec. 1, NeiHu Rd., Taipei, Taiwan  
Phone: +886-2-8751-1816  
Fax: +886-2-8751-1817

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