MP1764C
Error Detector
Operation Manual

Sixth Edition

For safety and warning information, please read this manual before attempting to use the equipment.
Keep this manual with the equipment.

ANRITSU CORPORATION

Document No.: M-W1850AE-6.0

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

Symbols used in manual

DANGER This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.

WARNING This indicates a hazardous procedure that could result in serious injury or death if not performed properly.

CAUTION This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

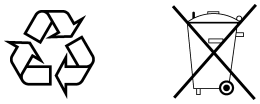
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.

This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.

This indicates a note. The contents are described in the box.



These indicate that the marked part should be recycled.

MP1764C
Error Detector
Operation Manual

1 April 2001 (First Edition)
22 September 2006 (Sixth Edition)

For Safety

WARNING ⚠

1. ALWAYS refer to the operation manual when working near locations at which the alert mark shown on the left is attached. If the advice in the operation manual is not followed there is a risk of personal injury or reduced equipment performance. The alert mark shown on the left may also be used with other marks and descriptions to indicate other dangers.

2. IEC 61010 Standard
   The IEC 61010 standard specifies four categories to ensure that an instrument is used only at locations where it is safe to make measurements. This instrument is designed for measurement category I (CAT I). DO NOT use this instrument at locations specified as category II, III, or IV as defined below.
   Measurement category I (CAT I):
   Secondary circuits of a device that is not directly connected to a power outlet.
   Measurement category II (CAT II):
   Primary circuits of a device that is directly connected to a power outlet, e.g., portable tools or home appliance.
   Measurement category III (CAT III):
   Primary circuits of a device (fixed equipment) to which power is supplied directly from the distribution panel, and circuits running from the distribution panel to power outlet.
   Measurement category IV (CAT IV):
   Building service-line entrance circuits, and circuits running from the service-line entrance to the meter or primary circuit breaker (distribution panel).

3. To ensure that the instrument is grounded, always use the supplied 3-pin power cord, and insert the plug into an outlet with a ground terminal. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

For Safety

WARNING ⚠

Repair

WARNING ⚠

4. This equipment cannot be repaired by the operator. DO NOT attempt to remove the equipment covers or unit covers or to disassemble internal components. Only qualified service personnel with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Calibration

5. The performance-guarantee seal verifies the integrity of the equipment. To ensure the continued integrity of the equipment, only Anritsu service personnel, or service personnel of an Anritsu sales representative, should break this seal to repair or calibrate the equipment. If the performance-guarantee seal is broken by you or a third party, the performance of the equipment cannot be guaranteed.

Falling Over

6. This equipment should always be positioned in the correct manner. If the cabinet is turned on its side, etc., it will be unstable and may be damaged if it falls over as a result of receiving a slight mechanical shock.
   Always set up the equipment in a position where the power switch can be reached without difficulty.

Battery Fluid

7. DO NOT short the battery terminals and never attempt to disassemble the battery or dispose of it in a fire. If the battery is damaged by any of these actions, the battery fluid may leak. This fluid is poisonous.
   DO NOT touch the battery fluid, ingest it, or get in your eyes. If it is accidentally ingested, spit it out immediately, rinse your mouth with water and seek medical help. If it enters your eyes accidentally, do not rub your eyes, rinse them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

For Safety

CAUTION ⚠

Fuse Replacement

CAUTION ⚠

1. Always remove the mains power cable from the power outlet before replacing blown fuses. There is a risk of electric shock if fuses are replaced with the power cable connected. Always use new fuses of the type and rating specified on the rear panel of the instrument. There is a risk of fire if a fuse of a different rating is used.

   T6.3A indicates a time-lag fuse.

Cleaning

2. Keep the power supply and cooling fan free of dust.
   - Clean the power inlet regularly. If dust accumulates around the power pins, there is a risk of fire.
   - Keep the cooling fan clean so that the ventilation holes are not obstructed. If the ventilation is obstructed, the cabinet may overheat and catch fire.

3. Use two or more people to lift and move this equipment, or use a trolley. There is a risk of back injury, if this equipment is lifted by one person.

For Safety

CAUTION ⚠

Replacing Memory Back-up Battery

This equipment uses a Poly-carbomonofluoride lithium battery to backup the memory. This battery must be replaced by service personnel when it has reached the end of its useful life; contact the Anritsu sales section or your nearest representative.

Note: The battery used in this equipment has a maximum useful life of 7 years. It should be replaced before this period has elapsed.

External Storage Media

This equipment uses memory cards as external storage media for storing data and programs.

If this media is mishandled or becomes faulty, important data may be lost. To prevent this chance occurrence, all important data and programs should be backed-up.

Anritsu will not be held responsible for lost data.

Pay careful attention to the following points.

- Never remove the memory card from the pulse tester while it is being accessed.
- The memory card may be damaged by static electric charges.
- The back-up battery in SRAM memory cards has a finite life. Replace the battery periodically. For details, refer to the explanation on the memory card later in this manual.

Equipment Certificate

Anritsu Corporation certifies that this equipment was tested before shipment using calibrated measuring instruments with direct traceability to public testing organizations recognized by national research laboratories, including the National Institute of Advanced Industrial Science and Technology, and the National Institute of Information and Communications Technology, and was found to meet the published specifications.

Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within one year after shipment due to a manufacturing fault, under the condition that this warranty is void when:

- The fault is outside the scope of the warranty conditions described in the operation manual.
- The fault is due to mishandling, misuse, or unauthorized modification or repair of the equipment by the customer.
- The fault is due to severe usage clearly exceeding normal usage.
- The fault is due to improper or insufficient maintenance by the customer.
- The fault is due to natural disaster including fire, flooding, earthquake, etc.
- The fault is due to use of non-specified peripheral equipment, peripheral parts, consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation will not accept liability for equipment faults due to unforeseen and unusual circumstances, nor for faults due to mishandling by the customer.

Anritsu Corporation Contact

In the event that this equipment malfunctions, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the CD version.

Notes On Export Management

This product and its manuals may require an Export License/Approval by the Government of the product's country of origin for re-export from your country.

Before re-exporting the product or manuals, please contact us to confirm whether they are export-controlled items or not.

When you dispose of export-controlled items, the products/manuals need to be broken/shredded so as not to be unlawfully used for military purpose.

FOR CALIFORNIA USA ONLY

This product contains a CR Coin Lithium Battery which contains Perchlorate Material – special handling may apply; See www.dtsc.ca.gov/hazardouswaste/perchlorate

Crossed-out Wheeled Bin Symbol

Equipment marked with the Crossed-out Wheeled Bin Symbol complies with council directive 2002/96/EC (the “WEEE Directive”) in European Union.

For Products placed on the EU market after August 13, 2005, please contact your local Anritsu representative at the end of the product's useful life to arrange disposal in accordance with your initial contract and the local law.

CE Conformity Marking

Anritsu affixes the CE Conformity marking on the following product(s) in accordance with the Council Directive 93/68/EEC to indicate that they conform to the EMC and LVD directive of the European Union (EU).

CE marking

CE

1. Product Model

Model: MP1764C Error Detector

2. Applied Directive

EMC: Council Directive 89/336/EEC
LVD: Council Directive 73/23/EEC

3. Applied Standards

- EMC: Emission: EN 61326: 1997 + A1: 1998 + A2: 2001 + A3: 2003 (Class A)
  Immunity: EN 61326: 1997 + A1: 1998 + A2: 2001 + A3: 2003 (Annex A)

	Performance Criteria*
IEC 61000-4-2 (ESD)	B
IEC 61000-4-3 (EMF)	A
IEC 61000-4-4 (Burst)	B
IEC 61000-4-5 (Surge)	B
IEC 61000-4-6 (CRF)	A
IEC 61000-4-11 (V dip/short)	B

*: Performance Criteria
A: During testing normal performance within the specification limits.
B: During testing temporary degradation, or loss of function or performance which is self-recovering.

Harmonic current emissions:
EN 61000-3-2: 2000 (Class A equipment)

- LVD: EN 61010-1: 2001 (Pollution Degree 2)

C-tick Conformity Marking

Anritsu affixes the C-tick marking on the following product(s) in accordance with the regulation to indicate that they conform to the EMC framework of Australia/New Zealand.

C-tick marking

1. Product Model

Model: MP1764C Error Detector

2. Applied Standards

EMC: Emission: EN 61326: 1997 + A1: 1998 + A2: 2001 + A3: 2003
(ISM, Group 1, Class A equipment)

Power Line Fuse Protection

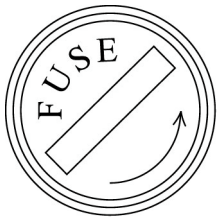
For safety, Anritsu products have either one or two fuses in the AC power lines as requested by the customer when ordering.

Single fuse: A fuse is inserted in one of the AC power lines.

Double fuse: A fuse is inserted in each of the AC power lines.

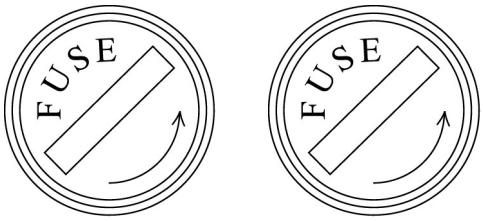
Example 1: An example of the single fuse is shown below:

Fuse Holder



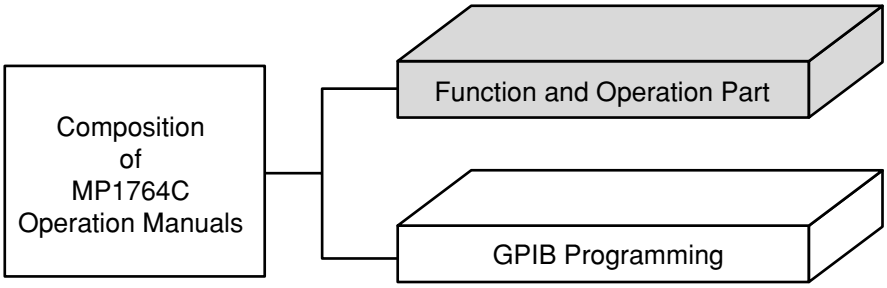
Example 2: An example of the double fuse is shown below:

Fuse Holders



Composition of MP1764C Operation Manuals

The MP1764C Error Detector operation manuals are composed of the following two documents.
Use them properly according to the usage purpose.



Function and Operation Part: These outline the MP1764C, and describes the preparations before use, the panels, specifications, performances, functions, and operation procedures.

GPIB Programming: The MP1764C GPIB conforms to IEEE488.2. Remote control by GPIB is explained based on IEEE488.2. An application program example using the HP9000 series HP-BASIC and Quick Basic of Microsoft Corporation are also provided.

Title of Contents

SECTION 1
GENERAL

1.1 Features

The MP1764C is an error detector that operates over the 50 MHz to 12.5 GHz frequency range, and is used in conjunction with an MP1763B/C Pulse Pattern Generator to test high-speed digital communication systems and high-speed semiconductors.

The input threshold voltage (–3 V to +1.875 V) of MP1764C can be set in 1 mV steps and the input clock phase (–500 ps to +500 ps) can be set in 1 ps steps. The measurement patterns are pseudorandom (PRBS) pattern (1 period 2^N–1; N=7, 9, 11, 15, 20, 23, 31), programmable (PRGM) pattern (maximum 8M bits), alternate pattern, and zero substitution pattern. Since the 8M bits memory can program six STM-64 (OC192) frames, STM frame tests can be carried out by combining the MP1764C with an MP1763B/C Pulse Pattern Generator. The MP1764C has three error detection modes of total error, insertion error, and omission error. Its measurement items are error ratio, error count, error intervals (EI), error free intervals (EFI) and clock frequency. The measured result can be displayed on a display. A printer can printout the threshold EI/EFI data and performance data, as well as the measured result (error ratio, error count, EI/EFI, alarm time).

The MP1764C has an automatic search function that can automatically set the input data threshold voltage and input clock phase and a pattern tracking function that can send to and set the MP1764C pattern data to the MP1763B/C. The pattern tracking function can also send the MP1763B/C pattern data to the MP1764C. Data EYE Margin measurement is also possible. The MP1764C also has a memory function that can store the set patterns and pattern data to 3.5 inch floppy disk and read and set the stored data.

The MP1764C is equipped with an IEEE Std 488-1987 GPIB as standard so that it can be remotely controlled. It also has a DMA receive function that can receive pattern data transferred by DMA from the controller.

1.2 Functions

<table>
<tr><td colspan="2">Operating frequency</td><td></td><td>0.05 to 12.5 GHz</td></tr>
<tr><td rowspan="11">Measurement pattern</td><td rowspan="3">PRBS</td><td>Pattern length</td><td>2^N–1 (N=7, 9, 11, 15, 20, 23, 31)</td></tr>
<tr><td>Mark ratio</td><td>1/2, 1/4, 1/8, 0/8
($\overline{1/2}$, 3/4, 7/8, 8/8 possible by logic inversion)</td></tr>
<tr><td>Number of AND bit shifts at mark ratio</td><td>1 bit or 3 bits
(switchable by rear panel DIP switch)</td></tr>
<tr><td colspan="2">Zero substitution</td><td>Consecutive 0 pattern can be inserted up to pattern length–1.
Pattern at zero substitution: 2^N (N=7, 9, 11, 15)</td></tr>
<tr><td rowspan="2">DATA</td><td>DATA length</td><td>2 to 8388608 bits
2 to 65536 bits : step 1 bit
65536 to 131072 bits : step 2 bits
131072 to 262144 bits : step 4 bits
262144 to 524288 bits : step 8 bits
524288 to 1048576 bits : step 16 bits
1048576 to 2097152 bits : step 32 bits
2097152 to 4194304 bits : step 64 bits
4194304 to 8388608 bits : step 128 bits</td></tr>
<tr><td>Editing function</td><td>All 0 / all 1 / page 0 / page 1</td></tr>
<tr><td rowspan="3">Alternate pattern</td><td>DATA length</td><td>128 to 4194304 bits / Step 128 bits (A/B same length)</td></tr>
<tr><td>Number of loops</td><td>Controlled by external signal</td></tr>
<tr><td>Editing function</td><td>All 0 / all 1 / page 0 / page 1</td></tr>
<tr><td>Logic inversion</td><td colspan="2">Positive/Negative switching possible
[PRBS] Positive: H “0”, L “1” / Negative: H “1”, L “0”
[PRGM] Positive: H “1”, L “0” / Negative: H “0”, L “1”</td></tr>
</table>

Synchronization method	Normal		Enabled when the measurement pattern is a zero substitution, DATA, or alternate pattern.
	Frame		Enabled when the measurement pattern is a zero substitution or alternate pattern, and when it is a DATA pattern and the data length is 128 bits or longer. Frame bit length: 4 to 32 bits in 4 bit steps Pattern A only for the alternate pattern.
	Quick		Enabled when the measurement pattern is a zero substitution, or DATA.
Measurement	Measure-ment items	Error detection mode	Insertion / omission / total
		Error ratio	0.0000×10^{-16} to 1.0000×10^{-0}
		Error count	0 to 9999999 and 1.0000×10^{7} to 9.9999×10^{16}
		EI (asynchronous)	0 to 9999999 and 1.0000×10^{7} to 9.9999×10^{16} Interval:1 ms, 10 ms, 100 ms, 1 sec
		%EFI (asynchronous)	0.0000 to 100.0000 %
		Frequency	0.05 to 12.5 GHz (resolution 1 kHz/accuracy 10 ppm+1 kHz)
	Measure-ment time	Gating	Single, repeat, untimed
		Gate time	1 sec to 99 days 23 hours 59 minutes 59 seconds
	Sync threshold value		Internal, 10^{-n} (n=2, 3, 4, 5, 6, 7, 8)
	Auto Sync	Automatic pattern synchronization function	YES
	Error performance calculation function		YES (ES, EFS, SES, DM, UAS) (Output to an external printer or GPIB)
	Current data		Cycle time: 0.1 sec, 0.2 sec Display : Interval / cycle (ER and EC only at cycle.)
	Auto search function		YES
	EYE margin measurement		YES
	Bit Window		1 to 32ch Each channel can be set independently.
	Error peripheral analysis function		YES (OPTION 01). However, this function is ineffective when the measurement pattern is an alternate pattern and when the QUICK synchronization method is used.
	External mask function		YES
	Block window		YES (Effective only when the data length is a multiple of 32 and the QUICK synchronization method is not used.)

Input/output connector	Data input	Input waveform	NRZ
		Input amplitude	0.25 to 2.0 Vp-p
		Threshold voltage	–3.000 to 1.875 V (1mV steps)
		Termination voltage	GND / –2 V
		Input impedance	50 Ω
		Connector	APC-3.5
	Clock input	Input waveform	Up to 0.5 GHz: Square wave only (Duty 50 %) Others : Sine wave or square wave (Duty 50 %)
		Input amplitude	0.25 to 2.0 Vp-p
		Clock delay	±500 ps (1ps step)
		Polarity switching	CLOCK / $\overline{\text{CLOCK}}$
		Termination voltage	GND/–2 V
		Input impedance	50 Ω
		Connector	APC-3.5
	Sync signal output		1/32 Clock / Pattern sync (FIX) / Pattern sync (VARIABLE)
		Output level	V_{OH}: 0 ± 0.2 V Amplitude: 1 Vp-p ± 20 %
		Connector	SMA
	Error output (DIRECT)	Output level	0 / –1 V ± 0.2 V (LOW level at error)
		Connector	SMA

Input/output connector	Error output (STRETCHED)	Output level	TTL (LOW level at error)
		Pulse width	350 ns ± 100 ns
		Connector	BNC
	Alarm output	Output condition	Clock loss, sync loss
		Output level	TTL (LOW level at alarm)
		Connector	BNC
	Internal sync judgment output		HIGH level output when synchronization established.
		Output level	0 /–1 V ± 0.2 V
		Connector	SMA
	External mask input		Masked when LOW level.
		Input level	0 /–1 V ± 0.1 V
		Connector	SMA
	Resync input		Synchronization released when LOW level.
		Input level	0 /–1 V ± 0.1 V
		Connector	SMA
	Pattern switching input		Alternate pattern A/B switching signal (A when LOW level)
		Input level	ECL (H: –0.9 ± 0.2 V, L: –1.75 ± 0.2 V)
		Connector	SMA
Clock			Date and time display

Display	Measured result	7 segments, 8 digits display maximum
	Gating	12 segments bar graph
	Alarm	Error : Red LED Power failure history: Orange LED Clock loss: Orange LED Clock loss history : Orange LED Sync loss : Orange LED Sync loss history : Orange LED
Tracking function		YES
Audible alarm		YES (error sound, alarm sound)
Function switch		Functions conform to Table 1-1.
Parameter memory	Media	3.5 inch FDD 3 modes
	Format	See Table 1-2.
	Storage data	Programmable pattern / others
	Mode switching	Format, directory mode, recall, save, delete
Panel lock		Disables all keys other than POWER switch, LOCAL key, Printer and Alarm monitor.
External control		2 systems GPIB interface
	GPIB 1	Tracking and external controller connection port
	GPIB 2	External printer output port
Initialization		Initialization LOCAL key + POWER switch
Operating temperature range		0 to 50 ˚C
Power requirement		AC100 V system: AC85 V to AC132 V AC200 V system: AC170 V to 264 V 47.5 to 63 Hz 300 VA maximum
Dimensions and weight		221.5H, 426W, 451D (mm), 30 kg maximum
Options	Option 01	Error analysis function

Table 1-1 Rear Panel FUNCTION DIP Switch Settings

① FUNCTION SW 1

S W	Function	Setting	
		0	1
1	Number of mark ratio AND bit shifts	1 bit	3 bit
2	Clock loss processing	OFF	ON
3	Sync loss processing	OFF	ON
4	Error performance threshold selection	10^{-3}	10^{-4}
5	Burst measurement	OFF	ON
6	Intermediate data calculation	OFF	ON
7 8	Error detection mode selection	*1	*1
9 10	Measurement interval time selection	*2	*2

*1) SW7 SW8
0 0 : Total error
0 1 : Insertion error
1 0 : Omission error
1 1 : Total error

*2) SW9 SW10
0 0 : 1 msec
0 1 : 10 msec
1 0 : 100 msec
1 1 : 1 sec

② FUNCTION SW 2

S W	Function	Setting	
		0	1
1	Data printing format	Standard	Abbreviated
2	Threshold EI, EFI data printing function selection	OFF	ON
3	Error performance data printing selection	OFF	ON
4	Intermediate data printing selection	OFF	ON
5	1 second data printing selection	OFF	ON
6 7	1 second data printing threshold selection	*3	*3
8	Paper saving	OFF	ON
9	Current data interval	100 ms	200 ms
10	FD format switching	*4	*4

*3) SW6 SW7
0 0 : 0
0 1 : 10^{-6}
1 0 : 10^{-4}
1 1 : 10^{-3}

*4) Refer to table 1-2.

Table 1-2

① 2HD

Type	Sector length [bytes/sector]	Number of sectors [sectors/track]	Number of tracks [tracks/side]	Number of sides	SW2 BIT 10
1232KB	1024	8	77	2	1
1440KB	512	18	80	2	0

② 2DD

Type	Sector length [bytes/sector]	Number of sectors [sectors/track]	Number of tracks [tracks/side]	Number of sides	SW2 BIT 10
640KB	512	8	80	2	1
720KB	512	9	80	2	0

1.3 Composition

The standard composition of the MP1764C Error Detector is shown in Table 1-3.

Table 1-3 MP1764C Standard Composition

Item	No.	Name	Qty	Remarks
Main Unit	MP1764C	Error Detector	1	
Options	MP1764C-01		(1)	
Accessories	J0500A	Semi-rigid cable (50 cm)	2	SMA-P•SX-36•SMA-P
	J0776D	Coaxial cable (2 m)	2	BNC-P-3W•3D2W•BNC-P-3W
	J0693A	Coaxial cable (1 m)	3	HRM202B•Special 3D2W•HRM202B
	J0496	APC-3.5 J-J connector	2	
	J0008	GPIB cable	2	408JE-102 (2 m)
		Shield power cord	1	
	F0014	Fuse	1	T6.3A250V
	B0021	Front cover	1	
	Z0168	3.5-inch floppy disk • Formatted (PN23 layer-equivalent pattern is written) • Formatted	 1 1	2HD (1.44 MB)
	Z0306A	Wrist strap	1	
	W1850AE	Operation Manual	1	
	W1851AE	GPIB Operation Manual	1	
	Z0481	12.5G/3.2G BERTS application software demo	1	
Application Parts	MB24B	Caster	(1)	with 20 A power cord/plug
	J0500B	Semi-rigid cable (1 m)	(1)	SMA-P•SX-36•SMA-P
	J0322A	Coaxial cable (0.5 m)	(1)	11SMA•SUCOFLEX104•SMA
	J0322B	Coaxial cable (1 m)	(1)	11SMA•SUCOFLEX104•SMA
	J0498	Coaxial cable (0.5 m)	(1)	APC3.5-P•Double-shield coaxial cable•APC3.5-P
	J0499	Coaxial cable (1 m)	(1)	APC3.5-P•Double-shield coaxial cable•APC3.5-P
	J0007	GPIB connection cable	(1)	
	Z0054	3.5-inch floppy disk	(1)	2DD
	B0163	Portable carrying case	(1)	
	B0413A	Protective carrying case	(1)	
	B0044	Rack mount kit 1MW/5U	(1)	2 pcs/set
	Z0416	3.5-inch head-cleaning disk	(1)	For head-cleaning of 3.5-inch FDD
Peripheral Equipments *1	VP series	EPSON dot-impact printer	(1)	GPIB I/F option (PRIF6)
	2227B	HP QuietJet Printer	(1)	HP-IB I/F

*1: To use an external printer, use with GPIB interface, or prepare an interface adapter.

SECTION 2
PREPARATIONS

2.1 Installation Site Environment

Do not use the instrument in locations:

- Where vibrations are severe.
- Where it is damp or dusty.
- Where there is exposure to direct sunlight.
- Where there is exposure to active gases.

Long-term storage at high temperatures will shorten the life of the internal battery. Store the instrument at normal room temperature.

Operating temperature and humidity conditions	0 to 50 ˚C, Relative humidity ≤95 %.
Storage temperature and humidity conditions	– 20 to 60 ˚C, Relative humidity ≤95 %.

2.2 Safety Measures

- Use the power cord to connect the ac power supply. Ground the ground terminal of the power cord or the frame ground terminal on the rear panel of the instrument.
- When changing the fuse, always use a fuse of the same rating. (See the fuse replacement section.)
- If the instrument is operated at room temperature after being used or stored for a long time at low temperature, condensation may occur and cause short-circuiting. To prevent this, do not turn the power on until the instrument is completely dry.

2.3 Power Connection

This section describes the procedures for supplying power.

2.3.1 Power Requirements

For normal operation of the instrument, observe the power voltage range described below.

Voltage range	Frequency
85 to 132 V	47.5 to 63 Hz
170 to 264 V	47.5 to 63 Hz

Changeover between 100 and 200 V systems is made automatically.

CAUTION

Supplying power exceeding the above range may result in electrical shock, fire, failure, or malfunction.

2.3.2 Connecting the Power Cord

Check that the power switch on the front panel is turned off.

Insert the power plug into an outlet, and connect the other end to the power inlet on the rear panel. To ensure that the instrument is earthed, always use the supplied 3-pin power cord, and insert the plug into an outlet with a earth terminal.

WARNING

If the power cord is connected without the instrument earthed, there is a risk of receiving a fatal electric shock. In addition, the peripheral devices connected to the instrument may be damaged.

When connecting to the power supply, DO NOT connect to an outlet without a earth terminal. Also, avoid using electrical equipment such as an extension cord or a transformer.

CAUTION

If an emergency arises causing the instrument to fail or malfunction, disconnect the instrument from the power supply by either turning off the power switch on the front panel or by pulling out the power cord or the power inlet.

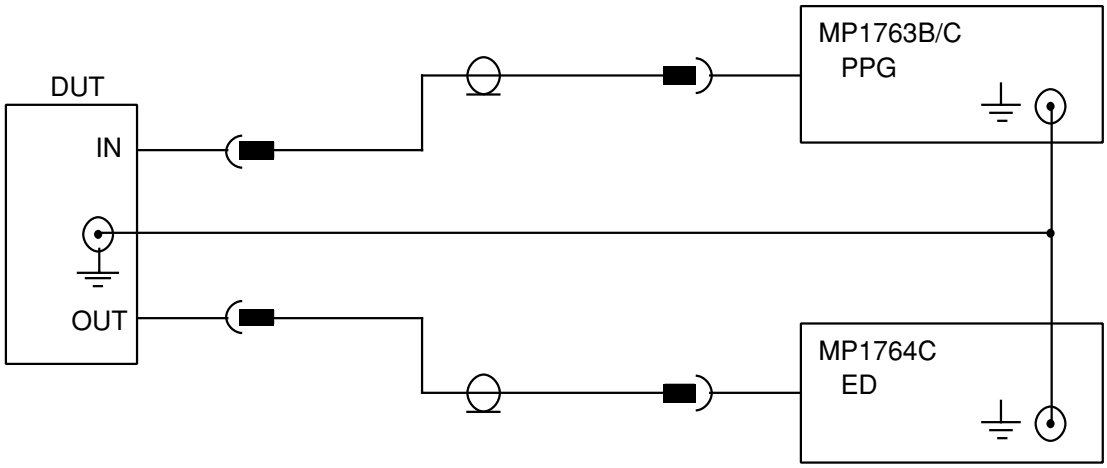
When installing the instrument, place the instrument so that an operator may easily operate the power switch.

If the instrument is mounted in a rack, a power switch for the rack or a circuit breaker may be used for power disconnection.

2.4 Destruction Prevention Measures

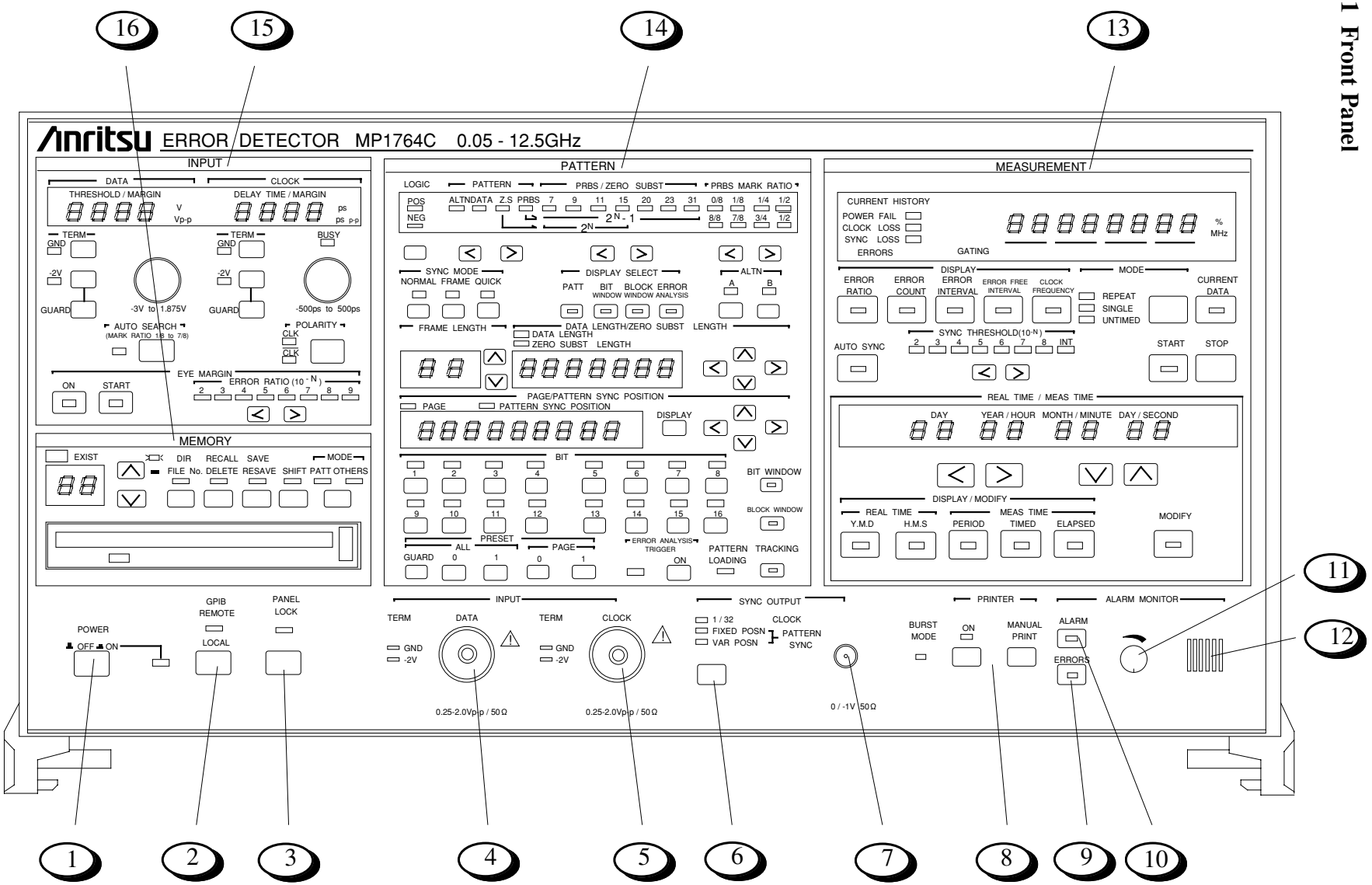
- Do not apply excessive voltage to the input of this instrument. The circuits may be destroyed.
- Terminate the output into 50 Ω. Do not feed current to the output. The load must be a 50 Ω pure resistance termination at ground potential.
- Before connecting the input and output terminals, ground the other equipment (including test circuits) with a ground wire. (Static electric countermeasure)
- The outer and inner conductors of coaxial cable may be charged as a capacitor. Therefore, discharge them with a piece of metal, etc. before using the cable.
- This instrument contains hybrid ICs and other important circuits and parts. These parts are extremely vulnerable to static electricity. Never remove the bottom cover.
- The hybrid ICs inside this instrument are hermetically sealed. Never break this seal. If the hybrid ICs are unsealed and the instrument fails to perform as specified, maintenance may be refused.
- Ventilation holes are drilled into the bottom cover. Be careful not to block the ventilation.
- This instrument backs up, in internal memory, the setup conditions immediately before the power is turned on , but several seconds are necessary after setup is changed.

  Note that if the power is turned off while internal memory is being updated, the setup state will be cleared (initialized).



SECTION 3
DESCRIPTION OF PANELS AND CONNECTORS

3.1 Front Panel



1 POWER switch

When  the power is turned on and the LED lights.
When  the power is turned off.

2 LOCAL key

Switches from GPIB REMOTE state (LED lit) to LOCAL key enabled state.
In the GPIB REMOTE state, all the keys other than the POWER switch and LOCAL key are disabled.

3 Panel lock key

At panel lock (LED lit), all the keys other than the following keys are disabled.
POWER, PANEL LOCK, PRINTER, ALARM MONITOR

4 DATA INPUT

DATA signal input connector. Impedance 50 Ω, GND or –2 V termination can be selected.

5 CLOCK INPUT

CLOCK signal input connector. Impedance 50 Ω, GND or –2 V can be termination can be selected.

6 Sync output selector key

Selects the type of sync output.

1/32 CLOCK:	Output CLOCK divided by 32.
FIXED POSITION:	Output sync pulse at fixed position relative to output pattern.
VARIABLE POSITION:	Shift sync output pulse output position in 16-bit units.

7 Sync output connector

Impedance 50Ω, output level 0/–1 V

8 Printer output

Turns the printer output on and off. When the switch is on, the lamp blinks at end of paper and when on-line.

Press when printing intermediate measurement data. Enabled only when the printer switch is on.

9 ERROR key

When the audible alarm sounds at error detection, the key is turned on. When the key is on, the LED inside the key lights.

10 ALARM key

When the audible alarm sounds at alarm detection, the key is turned on. When the key is on, the LED inside the key lights.

11 Variable resistor

Adjust the volume of the audible alarm.

12 Speaker

Audible alarm speaker.

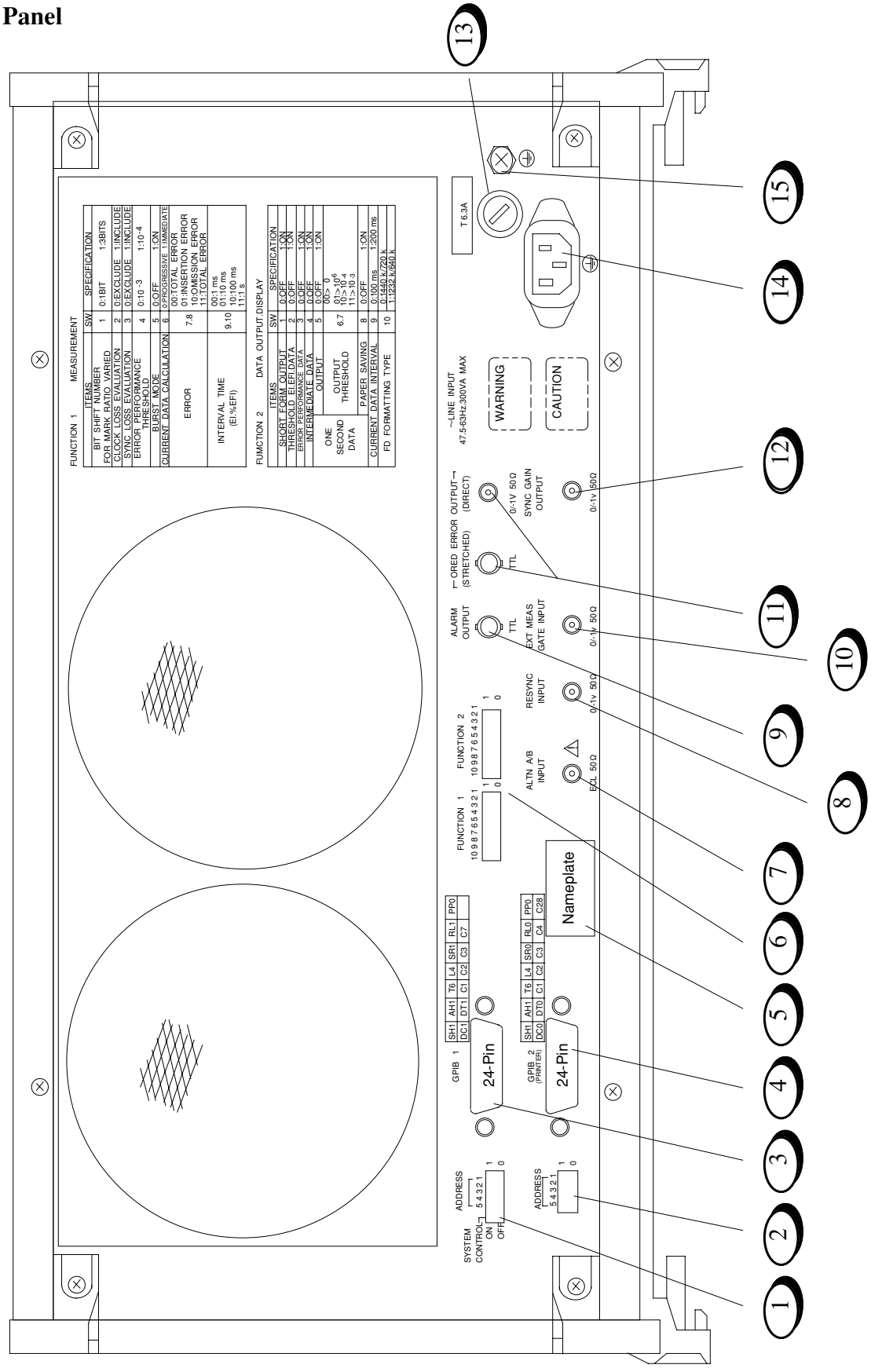
13 Measurement unit

14 Pattern setting unit

15 Input setting unit

16 Floppy disk drive

3.2 Rear Panel

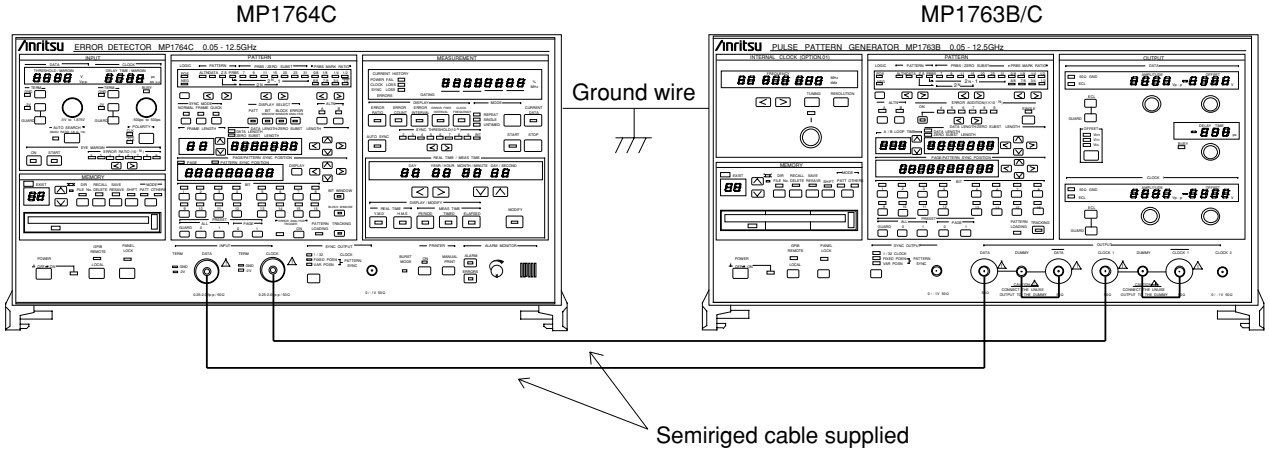


1	DIP switch	Sets system control ON/OFF and the GPIB 1 address.
2	DIP SWITCH	Sets the GPIB 2 address.
3	GPIB 1	GPIB 1 connector.
4	GPIB 2	GPIB 2 connector. (for printer)
5	Nameplate	Displays the serial number and oiption.
6	DIP SWITCH	FUNCTION 1/FUNCTION 2 setting DIP SWITCH.
7	ALT A/B INPUT	ECL level. Inputs the pattern A/pattern B switching timing in the ALTN mode.
8	RESYNC INPUT	0/–1 V 50 Ω. When LOW level is input, sync loss is generated.
9	ALARM OUTPUT	TTL level. Outputs LOW level when an alarm is generated.
10	EXT MEAS GATE INPUT	0/–1 V 50 Ω. Mask when LOW level.
11	ORED ERROR OUTPUT	STRETCHED: TTL level. Outputs low level when an error is generated. DIRECT: 0/–1 V 50 Ω
12	SYNC. GAIN OUTPUT	0/–1 V 50 Ω. Synchronization established when HIGH level.
13	FUSE holder	
14	Power inlet	
15	Function earth terminal	Connects to the earth terminal of the instrument connected to this instrument.

SECTION 4
OPERATION

4.1 Setup

Be careful of static electricity when handling the MP1764C. Connection to an MP1763B/C Pulse Pattern Generator is described here as an example. Refer to the following figure and make the connections in the following order.



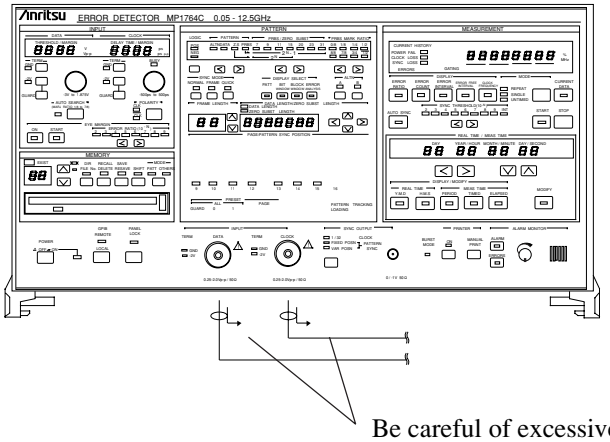
1. Connect the MP1764C and MP1763B/C ground terminals with ground wire.

2. Connect the power cord to an ac outlet. At this time, use a 3-prong plug with ground. If a 2-prong plug must be used, connect the MP1764C and MP1763B/C ground terminals before connecting the plug to the socket.

3. While pressing the LOCAL key, turn on the power and initialize the MP1764C and MP1763B/C. When initialization is performed, all the settings are set to the factory settings. (See Table 4-1.) When setting a pattern, etc. that you do not want to clear, save it to FD. (See 4.6.1.) Initialization makes the MP1764C and MP1763B/C settings the same. Turn off the power.

NOTE

If a high voltage is applied to the input connector, the protection circuit may be damaged. Never apply an input exceeding the rating. If the rating may be exceeded, check the input signal before making any connections.

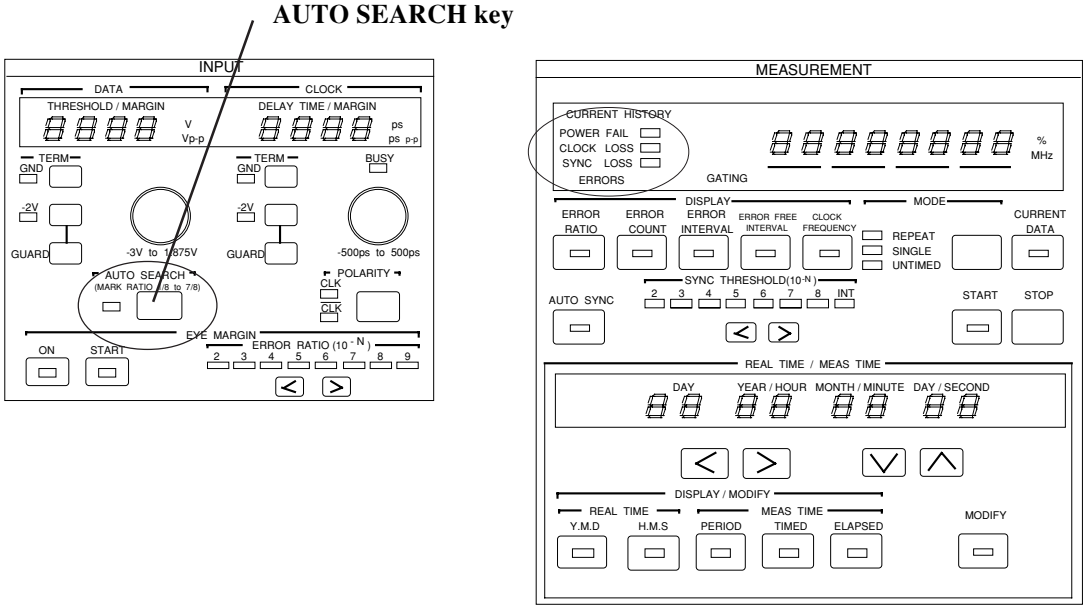


4.1.2 Measurement

1. Check that the MP1764C Error Detector and MP1763B/C Pulse Pattern Generator settings are the same. Since the instruments were initialized in Paragraph 4.1, the settings should be the same. If the settings are different, initialize the instruments again. Then, set the MP1763B/C OUTPUT and the MP1764C AUTO SYNC to ON.

2. Press the MP1764C AUTO SEARCH key. The input data threshold voltage and input clock delay time are automatically set.

   After the AUTO SEARCH lamp goes off, check that the CLOCK LOSS, SYNC LOSS, and ERRORS real time lamps are not lit. If the lamps are lit, check that signaling cables are connected correctly.



3. Change the DISPLAY display item and check if the following measured result is obtained:
   - ERROR RATIO : Error ratio displayed
   - ERROR COUNT : Error count displayed
   - ERROR INTERVAL : Number of error intervals (See 4.8.1.)
   - ERROR FREE INTERVAL: Number of error free intervals ratio (See 4.8.1.)

4. Add an error and check if it is correctly detected.
   Set MP1763B/C ERROR ADDITION to ON and select 1×10^{-6}.

   Select ERROR RATIO at MP1764C DISPLAY and check if 1×10^{-6} is displayed at DISPLAY.

4.2 Internal Memory Initialization

To set the MP1764C to the initial state (factory setting state), set the POWER switch to ON while pressing the LOCAL key. When the MP1764C is set to the initial state, the previously set contents are all cleared and are preset as shown in Table 4-1. Verify which patterns, etc. must not be cleared with the user.

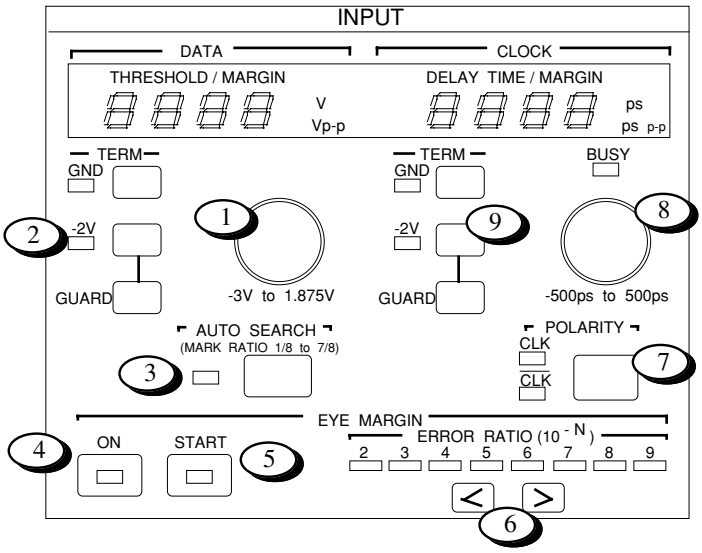
Table 4-1 Panel and Internal Circuits Initial State

Item			Panel	Internal circuit
INPUT	DATA	TERM	GND	
		THRESHOLD value	–0.500	
	CLOCK	TERM	GND	
		DELAY TIME value	0	
		BUSY	OFF	
		POLARITY	CLK	
	AUTO SEARCH		OFF	
PATTERN	LOGIC		POS	
	PATTERN mode		PRBS 2^{15}–1	
	MARK RATIO		1/2	
	TRACKING		OFF	
	SYNC MODE		NORMAL	
	ALTN	Pattern	All 0	
		A/B selection	A	
		DATA LENGTH	128	
		PAGE	1	
	DATA	Pattern	All 0	
		DATA LENGTH	2	
		PAGE	1	
	Z.S.	Pattern	Pseudo PRBS 2^{7}	
		ZERO SUB LENGTH	1	
		PAGE	1	
MEASURE-MENT	DISPLAY		ERROR RATIO (All digits "-" displayed on display)	
	CURRENT DATA		OFF	
	MODE		REPEAT	
	START		OFF	
	AUTO SYNC		ON	
SYNC OUTPUT			1/32 CLOCK	
REAL TIME / MEAS TIME	Display		Measurement period is displayed.	(1) REAL TIME • Y. M. D : Current date (year, month, day) • H. M. S : Current time (hour, minute, second) (2) MEAS TIME • PERIOD : 00 day 00 hour 00 minute 00 second • TIMED : All digits '-' • ELAPSED : All digits '-'
	DISPLAY/MODIFY		PERIOD (MEAS TIME)	
	MODIFY		OFF	

Table 4-1 Panel and Internal Circuits Initial State

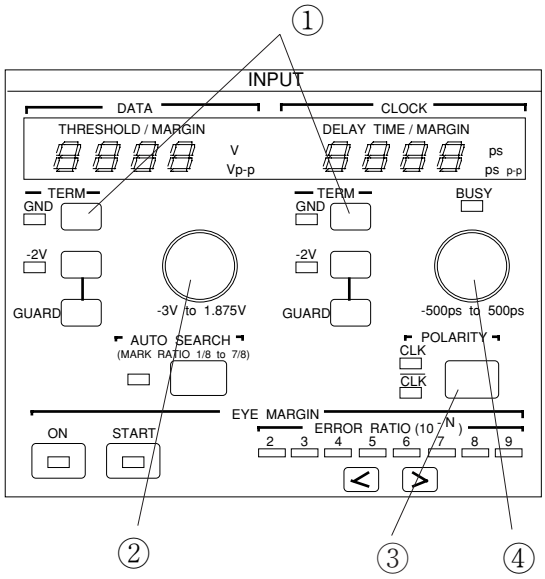
Item		Panel	Internal circuits
GPIB REMOTE		OFF	
PANEL LOCK		OFF	
MEASURE CH MASK		Displayed according to the state at that time.	
PRINTER ON		OFF	
ALARM MONITOR	ALARM	OFF	
	ERRORS	OFF	
GPIB 1	ADDRESS 1 to 5	In accordance with the initial state of the switches.	
	SYSTEM CONTROL		
GPIB 2	ADDRESS 1 to 5		
FUNCTION 1			
FUNCTION 2			

4.3 Input Conditions Setting



1	Rotary encoder (DATA)	Sets the DATA THRESHOLD.
2	TERM key	Selects the DATA termination condition. To select –2 V termination, press this key while pressing the GUARD key.
3	AUTO SEARCH key	Performs AUTO SEARCH. To repeat AUTO SEARCH, press this key again.
4	EYE MARGIN ON	Sets the EYE margin measurement mode.
5	EYE MARGIN START	Starts EYE margin measurement.
6	EYE MARGIN < > keys	Select the EYE margin threshold value.
7	POLARITY	Inverts the CLOCK polarity.
8	Rotary encoder (CLOCK)	Adjusts the CLOCK input phase within a ± 500 ps range.
9	TERM key	Selects the CLOCK termination conditions. To select –2 V termination, press this key while pressing the GUARD key.

4.3.1 When both DATA and CLOCK are GND termination



① Press the GND key. The GND LED lights.

② Turn the DATA rotary encoder and set the DATA threshold value. (See Fig. 4-1-1 to 4-1-3.)

③ Change the CLOCK polarity according to the DATA and clock input phase. (By synchronization relationship. See Fig. 4-2.)

④ Adjust the clock delay time.
Turn the rotary encoder and search for the error-free point. Set the delay time to midway between the two points that generate an error.

Example: When an error was generated at –210 ps and –130 ps, set the delay time to –170 ps.

• When amplitude and offset voltage known

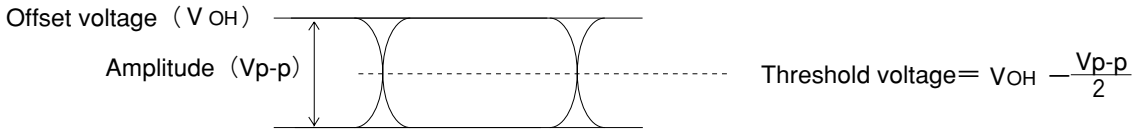


Fig. 4-1-1

• When high level and low level known

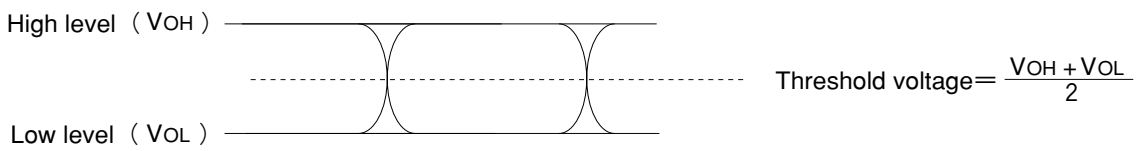


Fig. 4-1-2

Setting the optimum value

In the error free state, lower the DATA threshold voltage and measure the voltage that generates an error (V_1). Then raise the threshold voltage and measure the voltage that generates an error (V_2). Set the threshold voltage to midway between these two voltages. $\left(\frac{V_1 + V_2}{2}\right)$

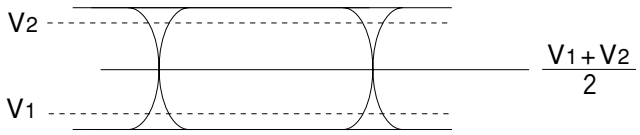


Fig. 4-1-3

Next, move CLOCK Delay in the minus direction and measure the phase (D_1) that generates an error. Then move CLOCK Delay in the plus direction and measure the phase (D_2) that generates an error. Set the CLOCK Delay to midway between these two values. $\left(\frac{D_1 + D_2}{2}\right)$

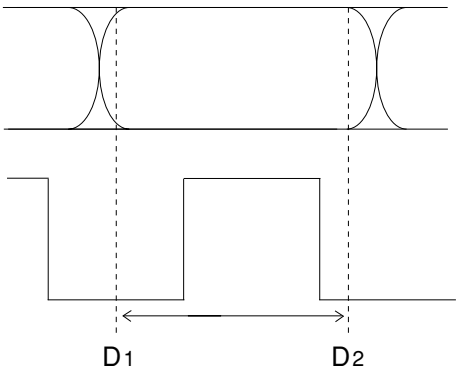
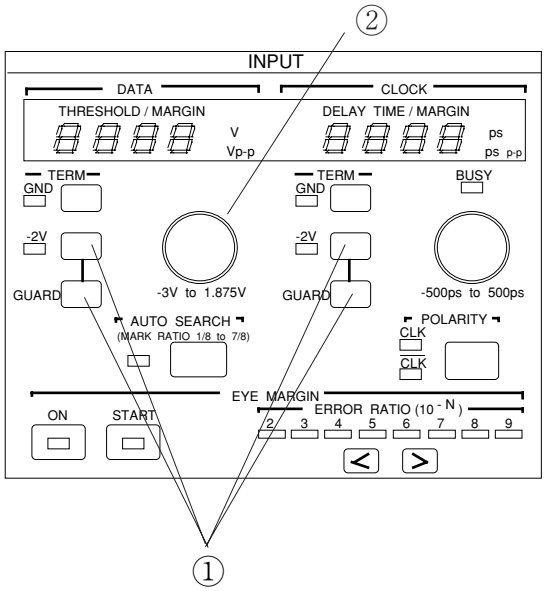


Fig. 4-2

4.3.2 When DATA and CLOCK are both ECL termination



① While pressing the GUARD key, press the –2 V key. The –2 V LED lights.

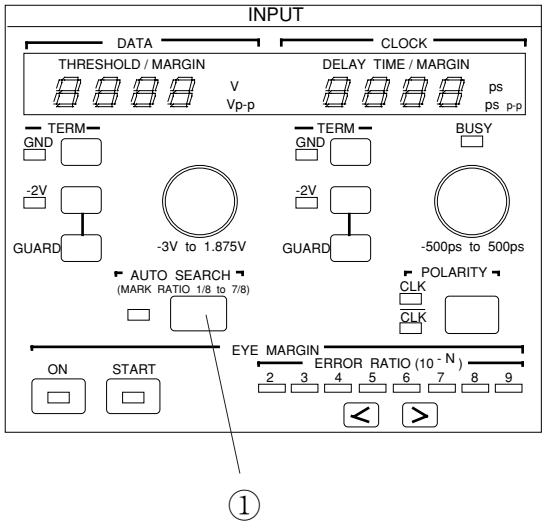
② Set the DATA threshold voltage to –1.3 V (ECL standard voltage).

③ Set the CLOCK phase, etc. as described in Paragraph 4.3.1.

NOTE

Incorrect setting of the termination voltage may damage the device under test. Be very careful when changing the setting.

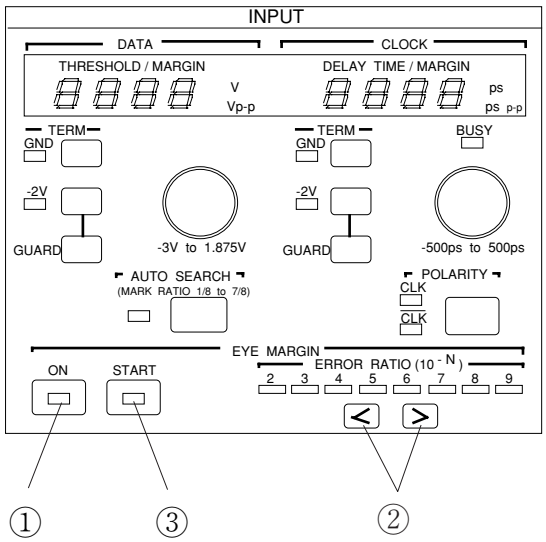
4.3.3 Auto search



① When the AUTO SEARCH key is pressed, the DATA threshold voltage and CLOCK Delay are automatically set. If AUTO SEARCH does not end within three seconds, AUTO SEARCH stops and the AUTO SEARCH lamp begins to blink. At this time, return the data threshold voltage and CLOCK delay time to the set value before AUTO SEARCH.

If AUTO SEARCH does not end normally, check the cable connections and termination conditions. It they are normal, check the input waveform with a sampling oscilloscope.

4.3.4 EYE MARGIN Measurement



① Press the ON key. The LED inside the key lights. At this time,

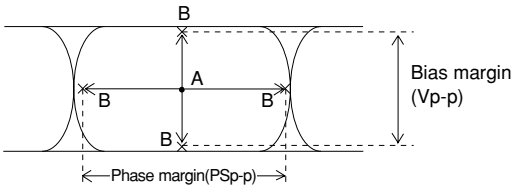
Vp-p ps p-p

is displayed.

② Set the threshold value error rate.

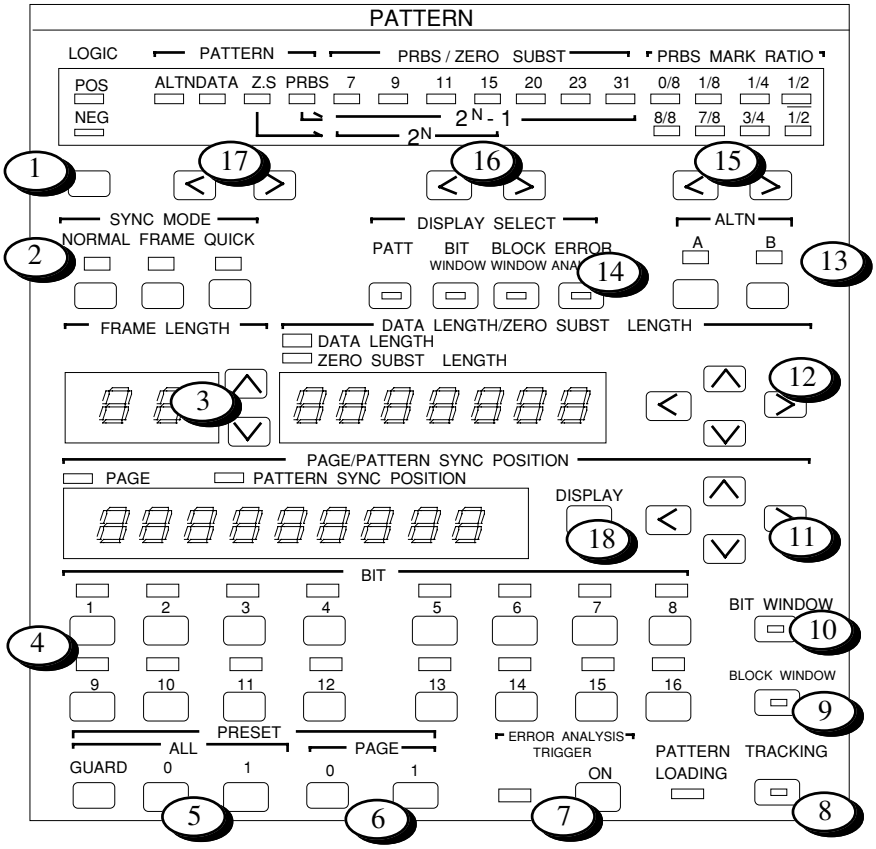
③ Start measurement by pressing the START key. At the end of measurement, the measured result is displayed on the display.

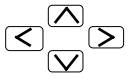
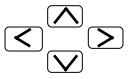
EYE MARGIN starts measurement from the point (point A) obtained by AUTO SEARCH. Therefore, measurements are made within the range shown below.



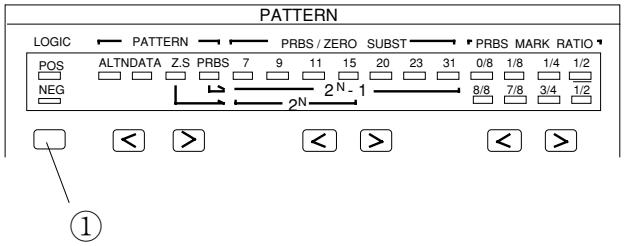
Point B is the position (10^{-2} to 10^{-9}) delayed by the threshold value set ERROR RATIO.

4.4 Pattern Setting



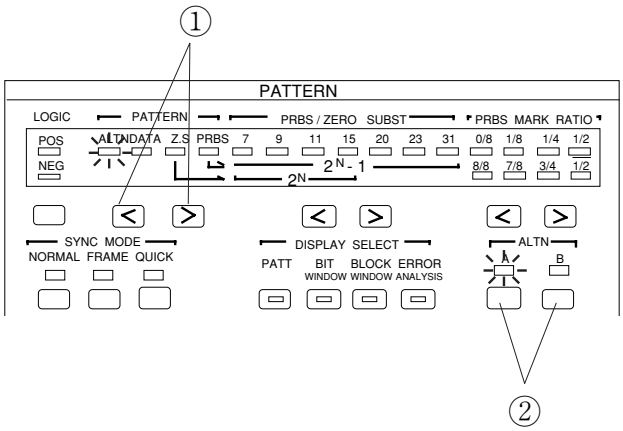
1	LOGIC	Inverts the DATA/$\overline{\text{DATA}}$ output logic. The DATA output logic is shown by lighting of the POS or NEG lamp.
2	SYNC MODE	Selects the sync pull-in mode. One of the following three modes can be selected: NORMAL : Turn on normal sync pull-in. FRAME : Turn on the frame sync function. QUICK : Turn on the quick sync function.
3	FRAME LENGTH	Sets the frame pattern bit length at FRAME SYNC .
4	BIT setting keys	Set the logic of each bit for each Page. When LOGIC is POS, lighting of the lamp above each key indicates logic '1'.
5	ALL edit keys	Set all the bits of the selected pattern to logic '0' or '1'. Press the 0 or 1 key while pressing the GUARD key.
6	PAGE edit keys	Set all bits of the displayed page to logic '0' or '1'.
7	ERROR ANALYSIS (OPTION 01)	Turns the error analysis function on and off. Lighting of the lamp shows that the error analysis function is 'ON'. This function is enabled only when OPTION 01 is built-in.
8	TRACKING	Turns the tracking function on and off. Lighting of the lamp inside the key shows that the tracking function is 'ON'.
9	BLOCK WINDOW	Turned on when error measurement in block units (32 bits) is masked.
10	BIT WINDOW	Turned on when error measurement in channel units (1 bit) is masked. (All 32 channels)
11	 keys	Set the page and the pattern sync output position.
12	 keys	Set the data length and number of consecutive zeros in Z.S.
13	ALTN keys	Select the A/B pattern at ALTN pattern setting.
14	DISPLAY SELECT	Select the item displayed on the display. When PATT, BIT WINDOW, and BLOCK WINDOW are set, that item is selected and is set at the panel. (It is possible to select ERROR ANALYSIS, When OPTION 01 is built-in.)
15	MARK ratio selection keys	Set the receive pattern mark ratio for PRBS.
16	PRBS/ZERO SUBST keys	Set the PRBS or pseudo PRBS period.
17	PATTERN selection keys	Select the type of receive pattern.
18	DISPLAY key	Toggles the display between PAGE and PATTERN SYNC POSITION. Selected display mode is displayed by the indicator.

4.4.1 Logic



① Each time the LOGIC key is pressed, the logic of the set pattern changes in positive → negative → positive order. (The set logic is shown by lighting of the lamps.)

4.4.2 Alternate pattern setting

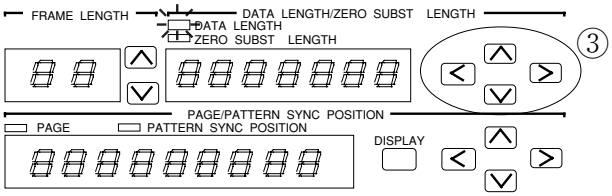


① Select ALTN with the ◁ ▷ keys.

DATA, Z.S., and PRBS are selected with these keys.

ALTN → DATA → Z.S. → PRBS
ALTN ← DATA ← Z.S. ← PRBS

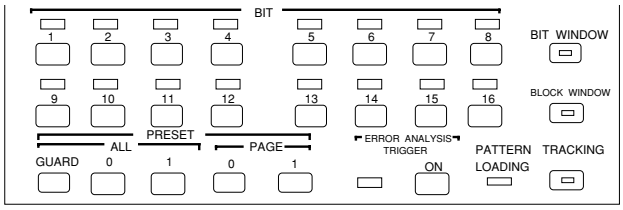
② Pattern A or B is selected with this key. First, pattern A is set and A lights. (Either pattern A or pattern B can be set first.)



③ Set DATA LENGTH with the ◁ ▷ and △ ▽ keys. This value is common to both patterns A and B.

Select the digit to be set with the ◁ ▷ keys.

Set DATA LENGTH with the △ ▽ keys.
Set value: 128 to 4194304 bits (128 bit steps)



Change the BIT value with the button below the LED. When LOGIC is positive, lighting of the LED indicates High Level.

When you want to change all the DATA at once, use PRESET ALL or PAGE.

PAGE 0 or 1: All BIT of the displayed PAGE become 0 or 1.

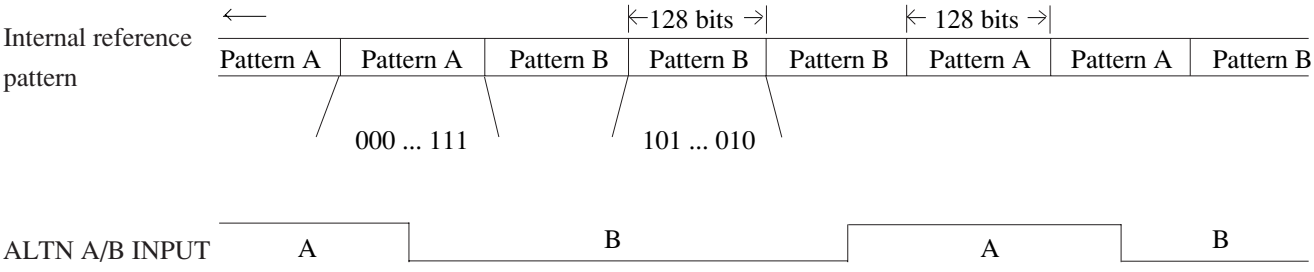
ALL 0 or 1: Each time the 0 or 1 key is pressed while pressing the GUARD key, all BIT specified by DATA LENGTH become '0' or '1'.

Next, set ② to pattern B (B LED lights) and set pattern B the same as pattern A.

However, since DATA LENGTH is common to patterns A and B, do not change it here. If it is changed, the pattern A DATA LENGTH changes also.

Two patterns (pattern A and pattern B) can be set. The number of repetitions of each pattern is controlled by ALTN A/B INPUT (rear panel). (Connected to the MP1763B)

An example when DATA LENGTH was made 128 bits is shown below.
If pattern A 0 0 0 ... 1 1 1
pattern B 1 0 1 ... 0 1 0

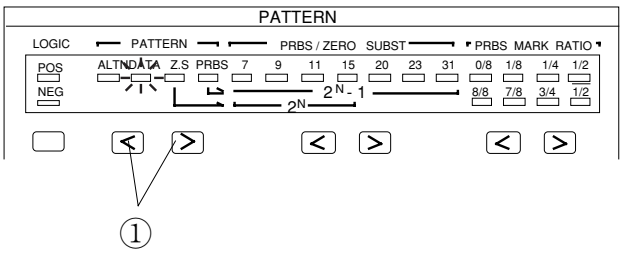


Bit 1 of Page 1 is the top of reference pattern.

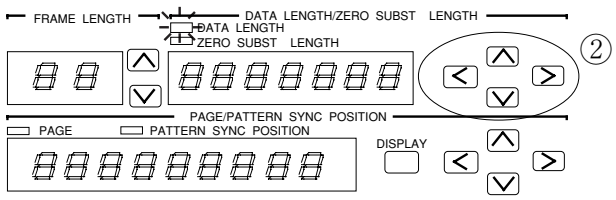
Internal reference data change from pattern A to pattern B at the end of pattern A when ALTN A/B INPUT change from A to B. It is same to change from pattern B to pattern A.

Do not set pattern A and pattern B to same pattern.

4.4.3 Data pattern setting



① Select DATA with the ◁ ▷ keys.



② Set DATA LENGTH with the ◁ ▷ and △ ▽ keys.

Select the digit to be set with the ◁ ▷ keys.

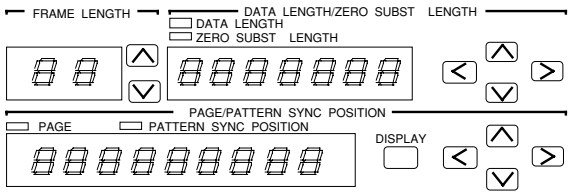
Set DATA LENGTH with the △ ▽ keys.

DATA LENGTH setting step

2 to 655364 : STEP 1 bit

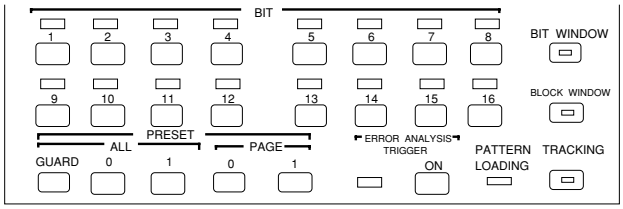
65536 to 131012 : STEP 2 bits

Thereafter see Paragraph 1.2 Functions.



First set the page displayed at the bottom BIT display, with the set DATA LENGTH as 16 bits/page. BIT of the displayed page can be changed.

Set value: 1 to (DATA LENGTH/16)
(LENGTH is multiple of 16)
1 to INT (DATA LENGTH/16) +1
(LENGTH is not multiple of 16)



Change the BIT value with the button below the LED. When LOGIC is positive, lighting of the LED indicates High level.

When you want to change all the DATA at once, use PRESET ALL or PAGE.

PAGE 0 or 1: All BIT of the displayed PAGE become 0 or 1.

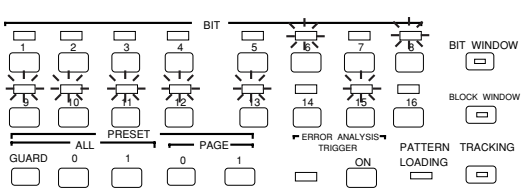
ALL 0 or 1 : All BIT specified by DATA LENGTH become '0' or '1' each time the '0' or '1' key is pressed while pressing the GUARD KEY.

An arbitrary pattern is repeated as reference pattern.

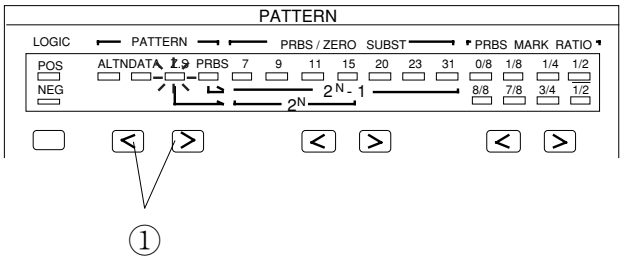
When a 16 bits pattern was set:

Set pattern "0000 0101 1111 1010"

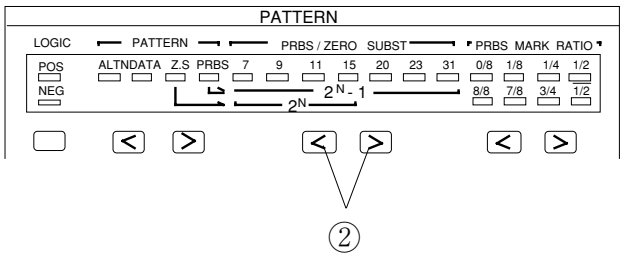
←	←	
111010	0000 0101 1111 1010	0000 0101



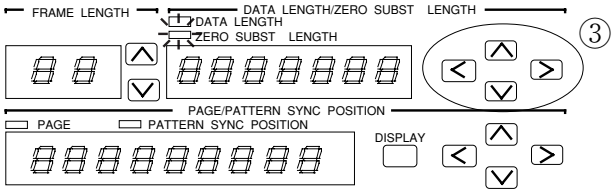
4.4.4 Zero substitution pattern setting



① Select Z.S. with the ◁ ▷ keys.



② Set 2^N pattern with the ◁ ▷ keys. (This pattern is pseudo PRBS with a 2^N period.)



③ Set ZERO SUBSTITUTION BIT LENGTH.

Here, the pattern is substituted by a set number of bits logic '0' pattern. For a description of the substitution method, see the following.

Setting: 1 to 2^N (N=7, 9, 11, 15)

Pattern with the number of set bits substituted by a logic '0' pattern immediately after the maximum length of consecutive 0 bits of a pseudo PRBS (period 2^N bits: N=7, 9, 11, 15) with a one bit pattern of logic '1' at the end of PRBS stages 7 ,9, 11, and 15. However, when the bit directly after substitution by '0' is '0', it is inverted and made '1'.

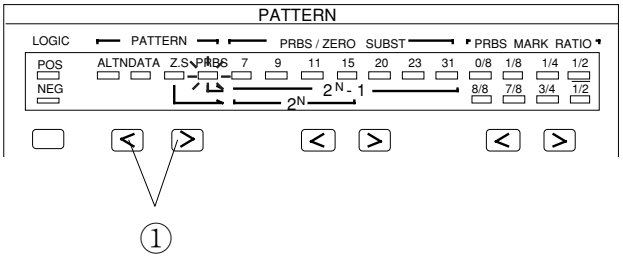
Example: Pseudo PRBS frame 7

Since the maximum length of consecutive 0 is 7–1 = 6 bits, 0 substitution begins from the position shown below.

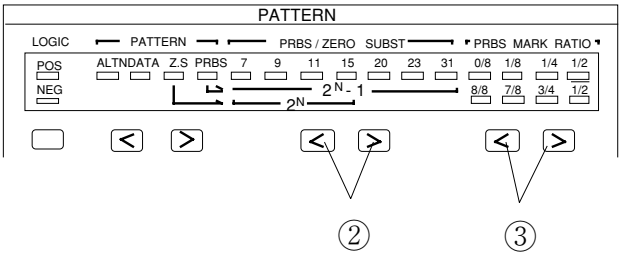
```
                ←
                1 0 0 0 0 0 0 | 1 0 0 0 0 0 1 1 0 0 0 0 1 0 1 0 .....  ← Pseudo PRBS frame 7
                              |
                              |
1 bit   1 0 0 0 0 0 0 | 0 1 0
5 bits  1 0 0 0 0 0 0 | 0 0 0 0 0 1 1
7 bits  1 0 0 0 0 0 0 | 0 0 0 0 0 0 0 1 0
```

Since the bit immediately after '0' substitution is '0', it is inverted and made '1'.

4.4.5 Pseudo random pattern setting



① Select PRBS with the ◁ ▷ keys.



② Set the number of PRBS frames with the ◁ ▷ keys.

③ Set the PRBS mark ratio with the ◁ ▷ keys.

When LOGIC is positive, make your selection from the top row (0/8, 1/8, 1/4, 1/2).

When LOGIC is negative, make your selection from the bottom row (8/8, 7/8, 3/4, $\overline{1/2}$).

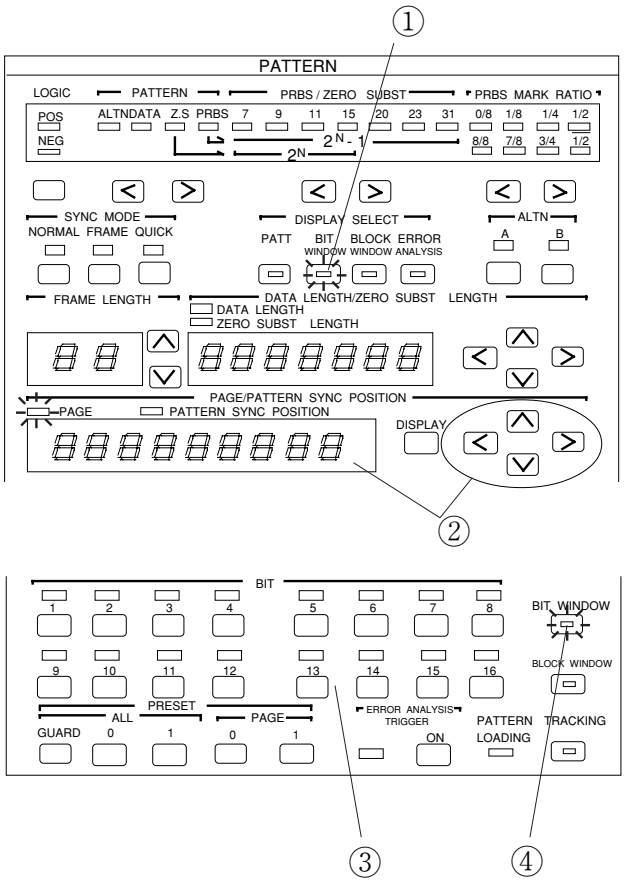
When LOGIC is changed from positive to negative when mark ratio is 1/4, the mark ratio changes to 3/4.

Pattern generated by the principle described in Paragraph 5.1 Pseudo random Pattern. When arbitrary consecutive N bits was selected in the bit array of a PRBS pattern having a period of 2^N–1, the same bit array does not exist in one period. That is, all bit arrays can be considered other than '0' in one period.

Note: When setting pseudo random pattern, the BIT LEDs light according to the set pattern.

4.4.6 Bit window setting

This setting masks the 32 error counters in the MP1764C.



① Press the BIT WINDOW key of DISPLAY SELECT to light the LED inside the key.

② PAGE is displayed. The PAGE number is 1 to 2.

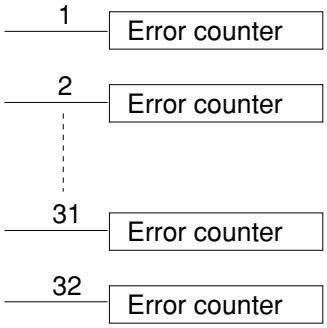
③ Select the channel for which the error counter is to be masked.

④ To actually execute the BIT WINDOW function, press the BIT WINDOW key to light the LED inside the key.

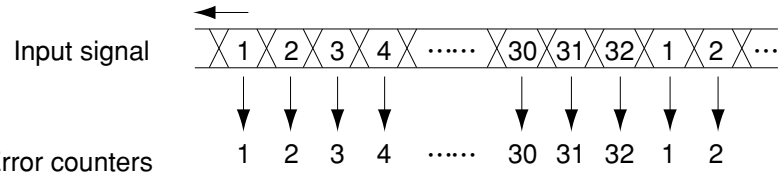
The relationship between the bits selected in ③ and the 32 error counters is as follows:

PAGE 1, BIT 1 → Error counter number 1
PAGE 1, BIT 2 → Error counter number 2
⋮ ⋮ ⋮
PAGE 1, BIT 16 → Error counter number 16
PAGE 2, BIT 1 → Error counter number 17
PAGE 2, BIT 2 → Error counter number 18
⋮ ⋮
PAGE 2, BIT 16 → Error counter number 32

The bit window function masks the error counters in the MP1764C.



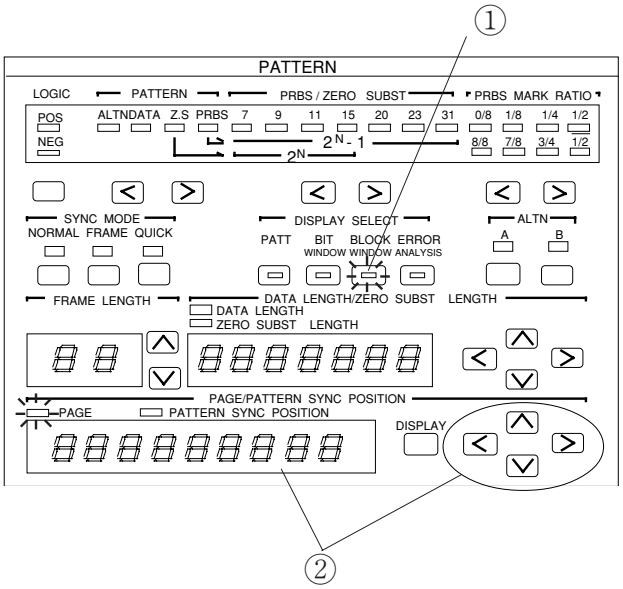
The 32 error counters detect errors in the order of set pattern bits for programmable patterns (zero substitution, DATA, and alternate). For example, for 32 bit long DATA patterns:

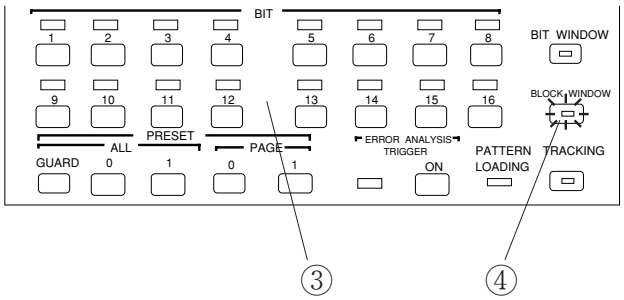


This bit window can be combined with the block window (4.4.7) to measure a 1 bit error in the measurement pattern.

4.4.7 Block window setting

This setting masks the bits for 32 bit based pattern error measurement.





① Press the BLOCK WINDOW key of DISPLAY SELECT to light the LED inside the key.

The block window is enabled for programmable patterns (zero substitution, DATA, and alternate). For DATA, the DATA length must be a multiple of 32 and the synchronization mode must not be QUICK.

② Move PAGE to the pattern position where measurement masking is to be performed. The PAGE operation is the same as when PATT is selected for DISPLAY SELECT. (See Paragraphs 4.4.2 to 4.4.4)

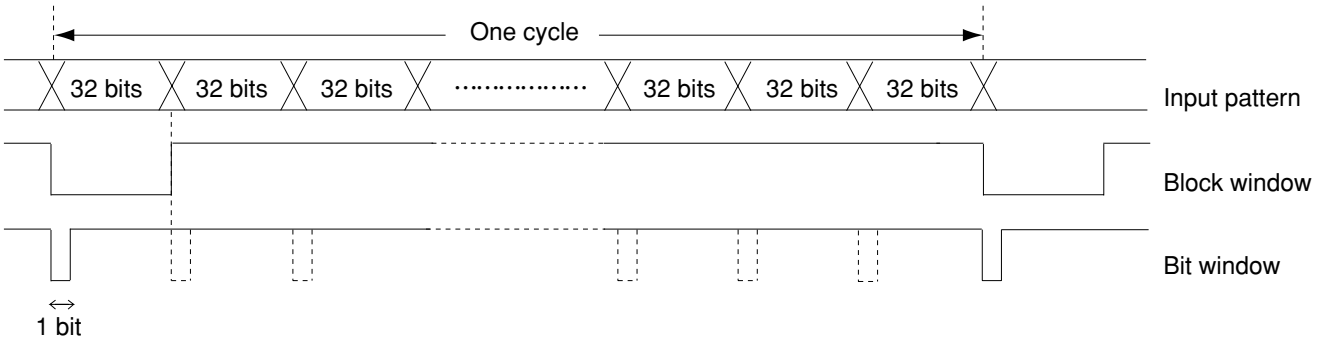
③ Select a pattern mask on the BIT indicator.

When a LED is on, the bit is masked.

One LED of the BIT indicator indicates one bit in the pattern setting. When one key of the BIT indicator is pressed, the LEDs for all 32 bits go on or off together because the block window is turned on or off for each of the 32 bits.

④ To actually execute the block window function, press the BLOCK WINDOW key to light the LED inside the key.

The block window function can be used with the bit window function to measure errors on one-bit basis. Measurement can be masked by OR operation of the bit and block windows.



Only the high-order bit of a pattern can be measured as shown above.

4.4.8 Sync detection mode

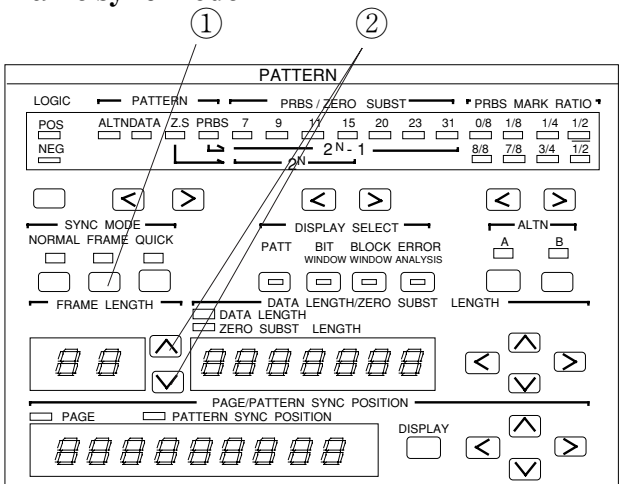
The transmitter generated pattern and receiver pattern synchronization method is selected.
Three synchronization methods are available: NORMAL, FRAME, and QUICK. However, the following restrictions apply:

Table 4-2 Synchronization Selection Restrictions

PATTERN	SYNC MODE		
	NORMAL	FRAME	QUICK
ALTN	○	○	×
DATA	○	△*1	○
Z.S.	○	○	○
PRBS	Automatic (Internal Synchronization circuit)		

*1 When DATA LENGTH≧128 bits

Frame sync mode



① Select FRAME from SYNC MODE.

② Set FRAME LENGTH with the ▲ ▼ keys.

Set the frame bit from the top of page 1. The set bit which represents logic '1' by orange color.

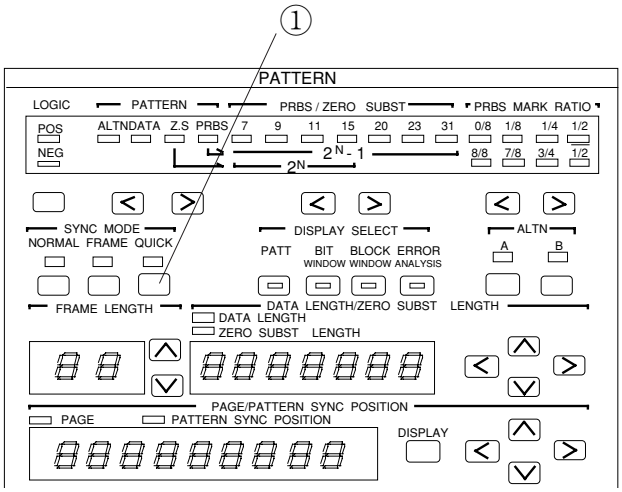
- The set value is maximum 32 bits/4 bits STEP.
- For ALTN, set the frame bit from the top of pattern A. (Pattern B is not a frame bit objective.)

Frame sync mode: Since synchronization is established by frame bit (maximum 32 bits) specified at FRAME LENGTH, when the same pattern string as frame bit exists, synchronization may take some time. The use of a special pattern at frame bit is desirable. (All '1', 'AA' repetition, etc.)

When testing with data having a long bit length, synchronization can be detected quickly by the following procedure:

(1) Set the data.
(2) Select the frame sync mode and make the frame length 32 bits.
(3) Make the contents of the 32 bits a special pattern (All '1', 'AA' repetition, etc.)
(4) Establish synchronization by automatic synchronization. (AUTO SYNC ON)
(5) Release automatic synchronization. (AUTO SYNC OFF)
(6) Return the changed 32-bit data to its original state.

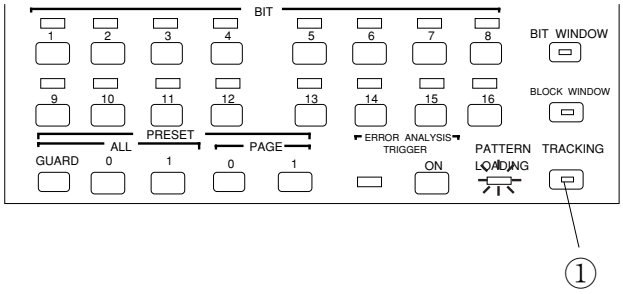
QUICK sync mode



① Select QUICK from SYNC MODE.

QUICK sync mode: Method that makes error measurements by fetching data of the bit length set by DATA LENGTH to internal memory and uses the fetched pattern as the standard pattern. In this case, the pattern BIT setting is invalid.

4.4.9 Tracking



① Press the TRACKING key. The LED inside the key lights and the MP1764C enters the tracking mode.

* When tracking is performed, the MP1763B/C must be connected by GPIB.

When the PATTERN LOADING lamp lights, data is being read and the keys cannot be operated.

Tracking can be performed from both the receiver and the transmitter. However, one of them must be set as the master. Therefore, tracking cannot be performed simultaneously from both the receiver and the transmitter.

When performing tracking, set 'SYSTEM CONTROL' of the DIP switch on the rear panel of the master unit to 'ON'. (Set 'SYSTEM CONTROL' of the controlled unit to 'OFF'.)

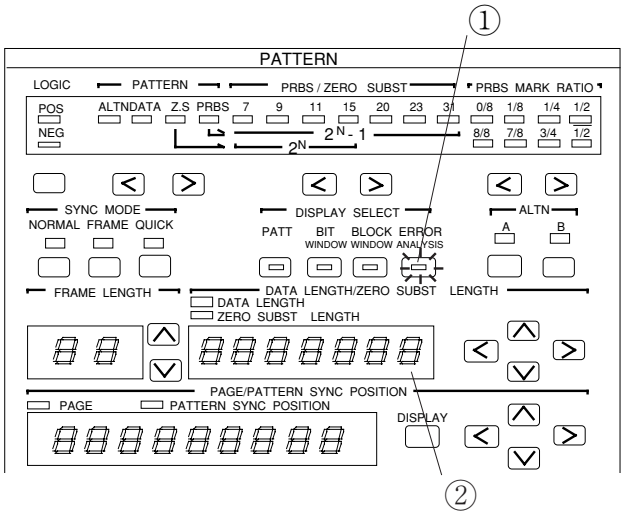
Set GPIB ADDRESS of the controlled unit to master unit GPIB ADDRESS + 2.

Note: The Dip switch on the rear panel for setting GPIB address is covered with the panel and fasten with screws to decrease the radio active radiation.
To change the address, remove the panel for the setting.

Each time the settings of the master unit (receiver or transmitter) are changed in the tracking ON state, the settings of the transmitter (or receiver) are changed. Therefore, each time a master key is operated, an unavailable state is generated. (Especially, when the program bit length is long, an unavailable state of several tens of seconds is generated.) To prevent this, when changing the master unit settings, set tracking to OFF.

4.4.10 Error analysis (Option 01)

At error detection, 256 bits of data are memorized and the error and the data before and after it can be checked.

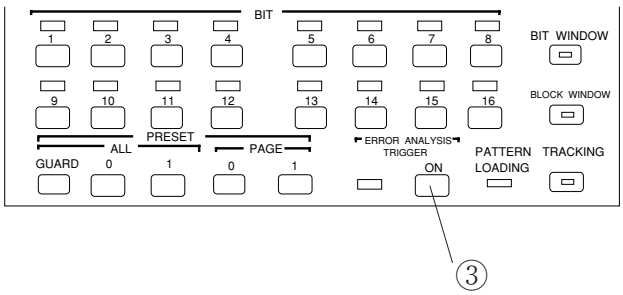


① Press the ERROR ANALYSIS key. The LED inside the key lights.

② Change the display page for the ERROR ANALYSIS DATA.

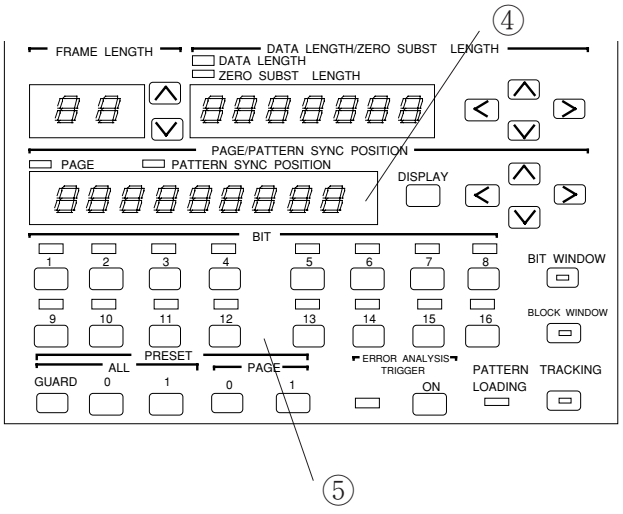
Sixteen pages, including the pattern that generated an error, can be set.

Pages 9 and 10 display the BIT that generated an error and became the trigger.



③ Set ERROR ANALYSIS TRIGGER to ON.

Result Display



④ The display page is shown.

Page position shows the pattern setting and display page position.

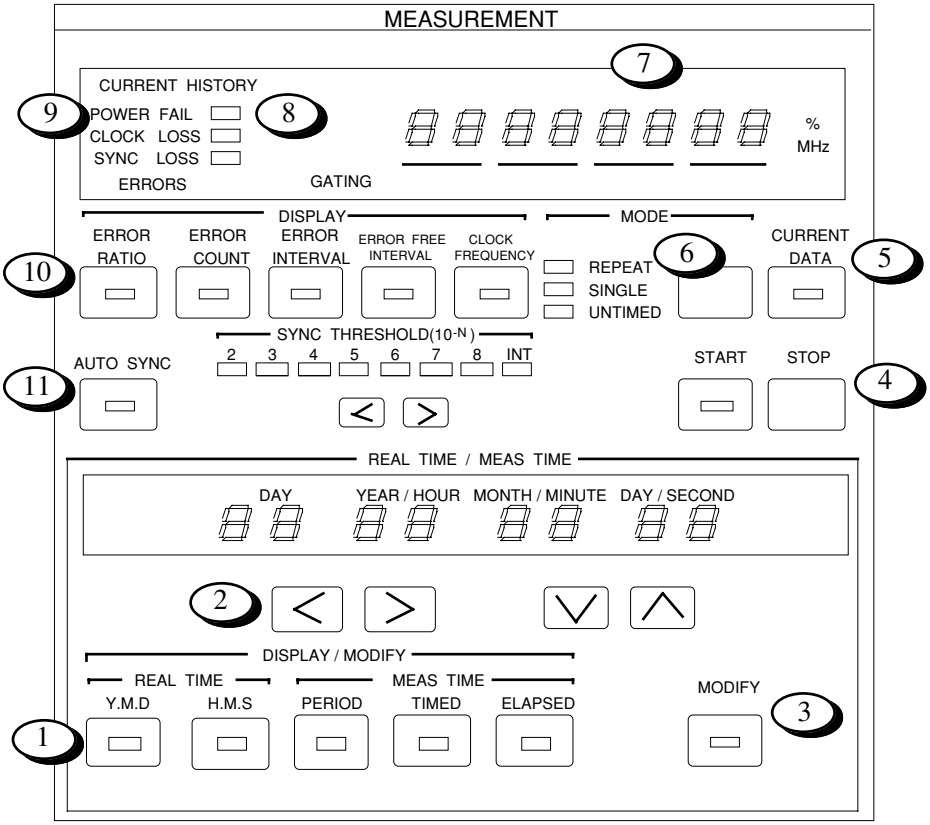
⑤ The error is indicated by a red or orange LED. (See Table 4-3.)

Table 4-3

Receive data	Reference	LED	
0	0	OFF	Normal
1	1	Green	Normal
0	1	Red	Insertion error
1	0	Orange	Omission error

* When performing error analysis using the PRBS 2^{31}-1 pattern, a few seconds after synchronization is established before starting analysis.

4.5 Error Measurement



1 DISPLAY/MODIFY key

REAL TIME

Y.H.D. Press to set or display the date. When the lamp inside the key lights, the date is displayed on the display.

H.M.S. Press to set or display the time., When the lamp inside the key lights, the time is displayed on the display.

MEAS TIME

PERIOD Press to set or display the measurement time (gating time). When the LED inside the key lights, the measurement time (gating time) is displayed on the display.

TIME Press to display the remaining measurement time. When the LED inside the key lights, the remaining time is displayed on the display. Cannot be selected when the measurement mode is UNTIMED.

ELAPSED Press to display the elapsed measurement time. When the LED inside the key lights, the elapsed time is displayed on the display.

(2) ◁ ▷ △ ▽ keys

◁ ▷ keys Select the item to be set when setting REAL TIME. The selected item blinks.
△ ▽ keys Used when raising and lowering the set value.

(3) MODIFY key

Pressed when changing the REAL TIME or MEAS TIME setting. When the LED inside the key lights, the set value can be changed.

(4) START / STOP keys

Start and stop measurement. During measurement, the LED inside the START key remains lit.

(5) CURRENT DATA key

Turns the data display on and off during measurement. When the LED inside the key is lit, the current measurement data is displayed.

(6) Measurement mode selection keys

Select the measurement mode from among REPEAT, SINGLE, and UNTIMED.

REPEAT : Repeated measurement
SINGLE : One measurement
UNTIMED : Manual measurement (accumulative measurement)

(7) Display

Displays the measured result. The display contents are selected with (10).

(8) HISTORY key

Displays the past state. (Displays the result of the last measurement.)

POWER FAIL : Lamp that shows that the power dipped or failed. (History lamp only)
CLOCK LOSS : Display and lamp that show that the clock pulses were lost.
SYNC LOSS : Display and lamp that show that synchronization was lost.

(9) CURRENT lamp

Displays the current measurement state.

(10) DISPLAY display switching keys

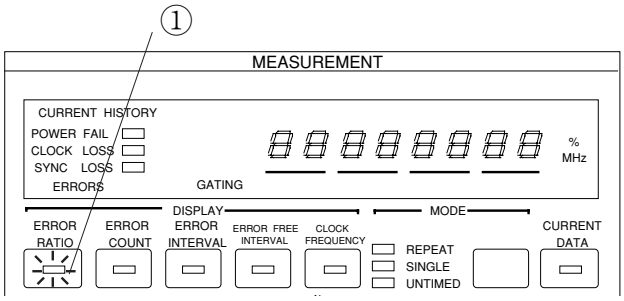
Select the item displayed on the display. The item at which the internal LED is lit is displayed.

ERROR RATIO : Displays the error ratio.
ERROR COUNT : Displays the number of errors.
ERROR INTERVAL : Displays the number of error intervals (EI).
ERROR FREE INTERVAL : Displays the number of error free intervals ratio(EFI).
CLOCK FREQUENCY : Displays the clock frequency.

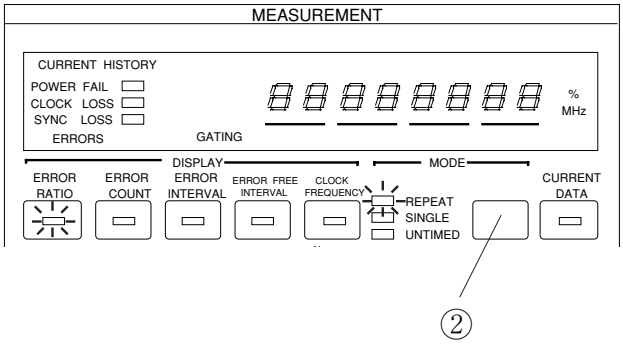
(11) AUTO SYNC key

Turns the pattern automatic synchronization function on and off.

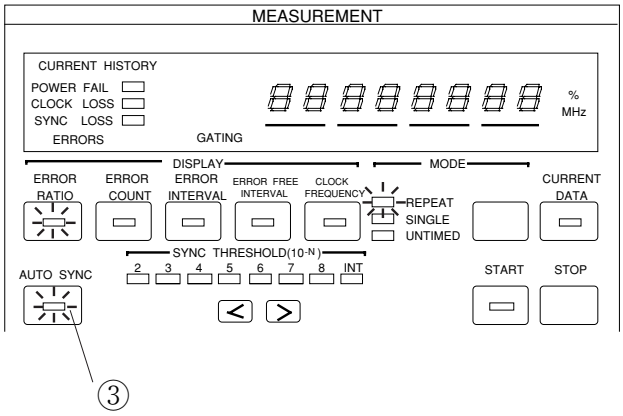
4.5.1 ERROR RATIO measurement



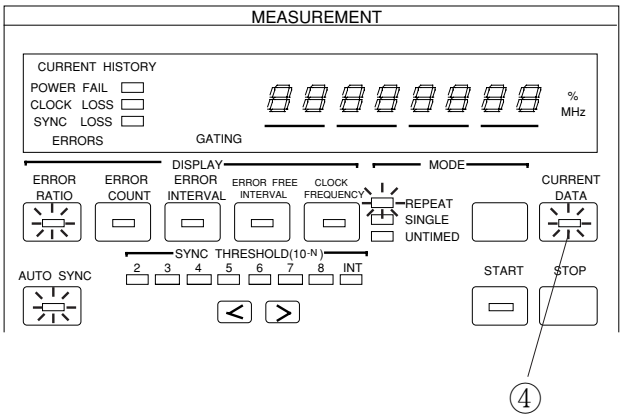
① Press the ERROR RATIO key. The LED inside the key lights and the ERROR RATIO measured result is displayed at DISPLAY.



② Press the MODE key and select REPEAT. (See 4.5.7.) When REPEAT is selected, the DISPLAY display value is updated at each MEAS TIME set value.

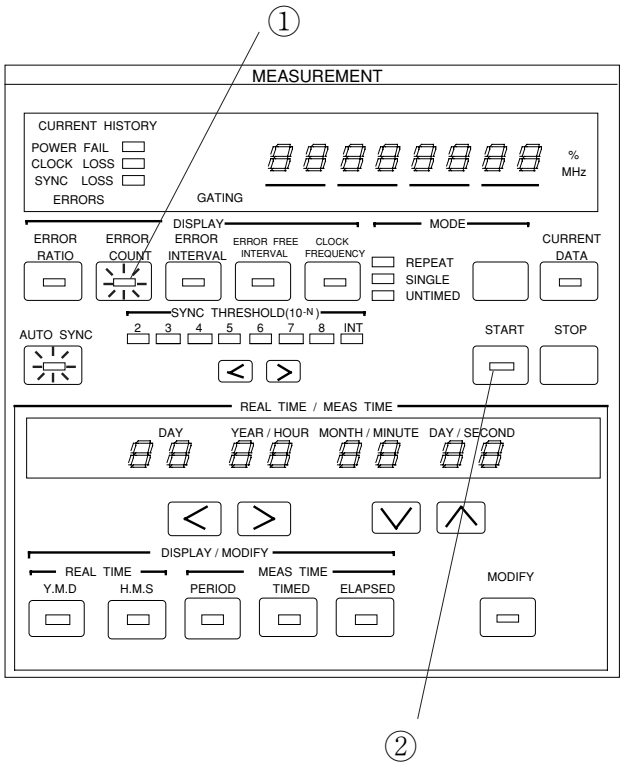


③ Set AUTO SYNC to ON. (Internal LED lights) During normalmeasurement, the AUTO SYNC key is usually left in the ON position. (See 4.5.10.).



④ When you want to display the result during measurement, press the CURRENT DATA key. The LED inside the key lights. When CURRENT DATA is ON, the current measured result is displayed at eachmeasurement time. (See 4.5.11.)

4.5.2 ERROR COUNT

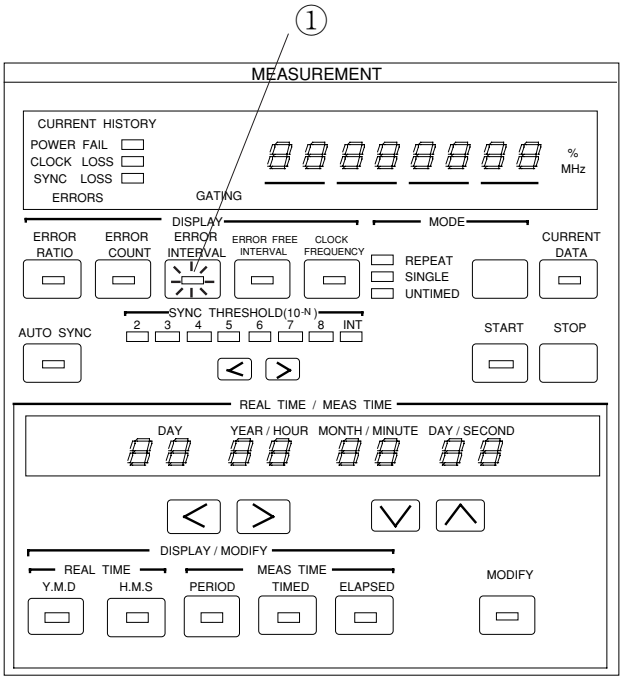


① Press the ERROR COUNT key. The LED inside the key lights and the ERROR COUNT measured result is displayed at DISPLAY.

② Set MODE (Paragraph 4.5.2) and MEAS TIME (Paragraph 4.5.11) and start measurement by pressing the START key.

In the AUTO SYNC OFF state, synchronization is not established. Therefore, always leave the AUTO SYNC key in the ON position.

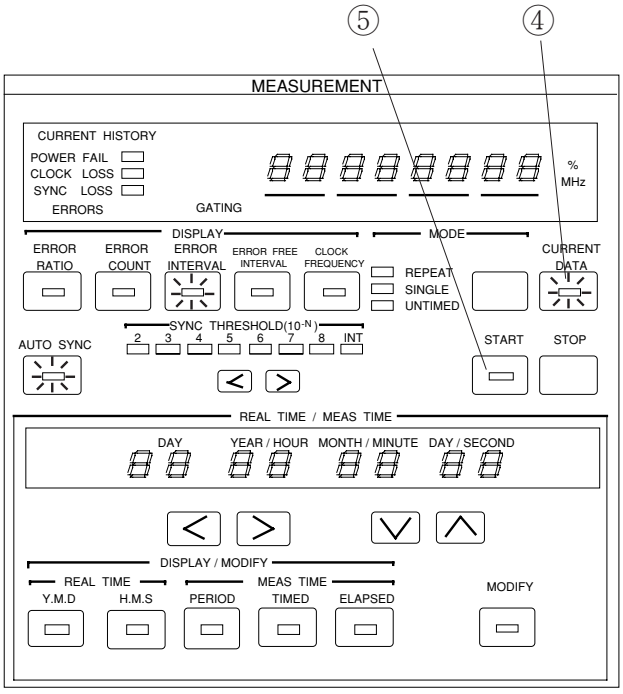
4.5.3 ERROR INTERVAL



① Press the ERROR INTERVAL key. The LED inside the key lights.

② Select the measurement mode. (See 4.5.1.)

③ Set MEAS TIME. (See 4.5.11.)

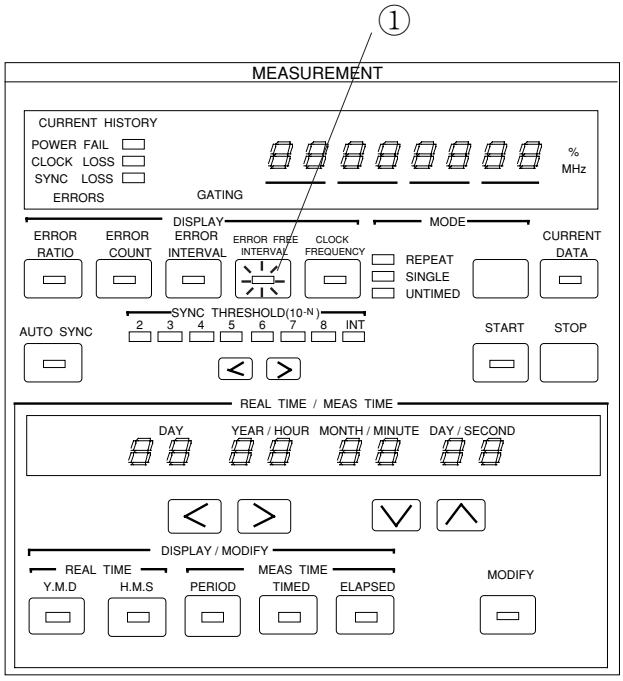


④ When an intermediate measured result is necessary, press the CURRENT DATA key. The LED inside the key lights. (See 4.5.9.)

⑤ Start measurement by pressing the START key.

* During measurement, always leave the AUTO SYNC key in the ON position. (See 4.5.10.)

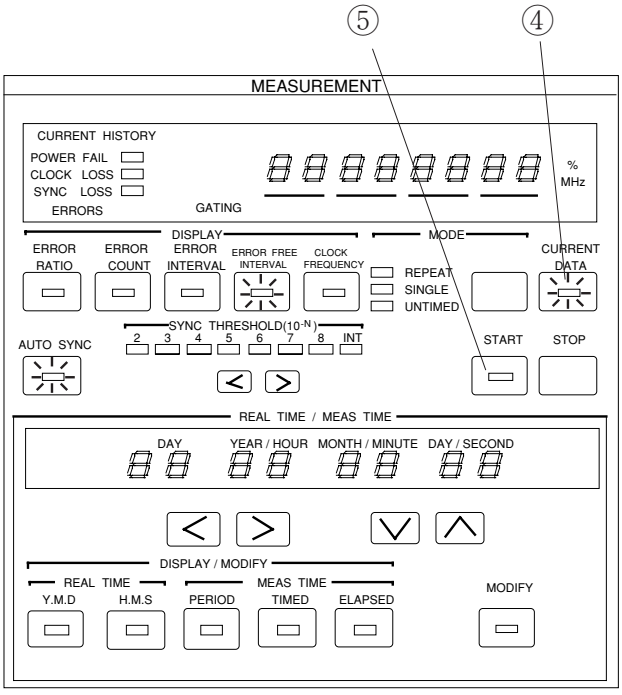
4.5.4 ERROR FREE INTERVAL



① Press the ERROR FREE INTERVAL key. The LED inside the key lights.

② Select the measurement mode. (See 4.5.1.)

③ Set MEAS TIME. (See 4.5.11.)

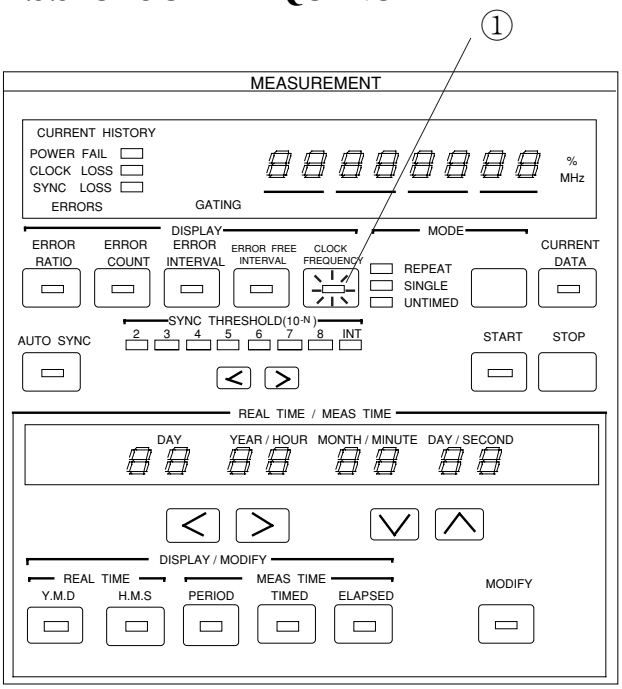


④ When an intermediate measured result is necessary, press the CURRENT DATA key. The LED inside the key lights. (See 4.5.9.)

⑤ Start measurement by pressing the START key.

* During measurement, always leave the AUTO SYNC key in the ON position. (See 4.5.10.)

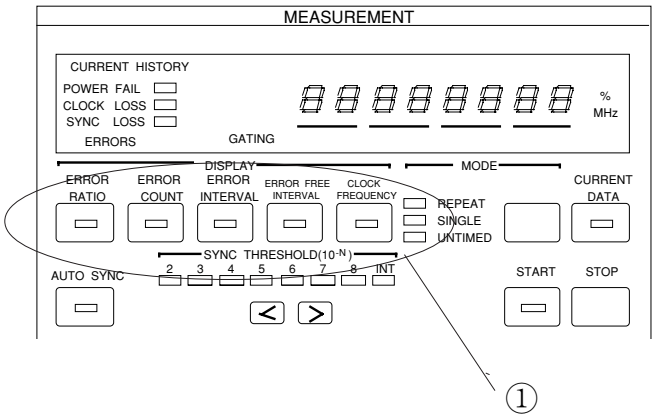
4.5.5 CLOCK FREQUENCY



① Press the CLOCK FREQUENCY key. The LED inside the key lights.

② For SYNC LOSS, CLOCK FREQUENCY is not displayed. In this case, make measurements with the AUTO SYNC key set to OFF. If the clock pulse is input normally, CLOCK FREQ. is correctly displayed.

4.5.6 DISPLAY display



① Select the item to be displayed at DISPLAY from among error ratio, error count, error intervals, error free intervals, and clock frequency.

Press the key of the item you want to display. The LED inside the key lights.

DISPLAY display of each item is shown below.

(1) Error ratio

0.0000–16 to 1.0000E–0

(2) Error count

△△△△△△△0 to △9999999

1.0000E07 to 9.9999E–16

(3) Error intervals (EI) count

△△△△△△△0 to △9999999

(4) Error free intervals (EFI) ratio

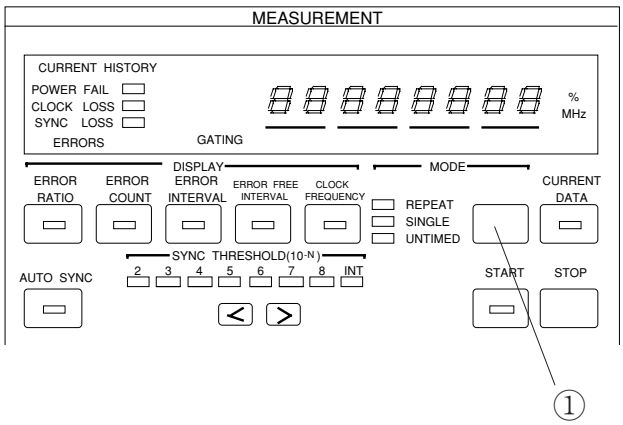
△△△0.0000 to △100.000 (% units display lights)

(5) Clock frequency

△△△50.000 to 12500.000 (MHz units display lights)

Note: During sync loss, '–' is displayed at all digits. If the AUTO SYNC key is set to OFF at this time, the clock frequency is displayed.

4.5.7 Measurement mode selection



① Press the MODE key and select the measurement mode. The measurement mode changes in REPEAT → SINGLE → UNTIMED → REPEAT... order and the LED of the selected item lights.

When selecting REPEAT or SINGLE, set the measurement time in accordance with Paragraph 4.5.11.

The measurement modes are defined below.

(1) REPEAT mode

Unit measurement is repeated continuously during the set measurement time.

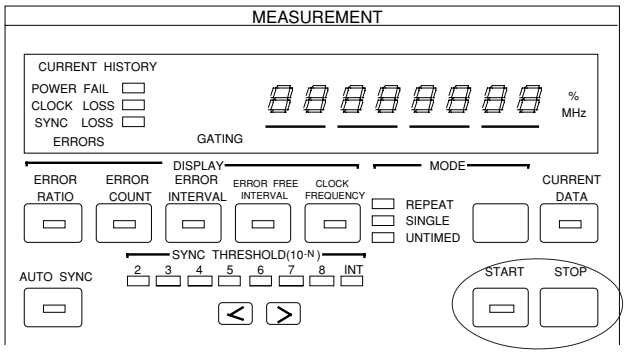
(2) SINGLE mode

Unit measurement is performed once during the set measuring time.

(3) UNTIMED mode

After the START key is pressed, measurement is performed continuously until the STOP key is pressed.

4.5.8 Measurement start/stop



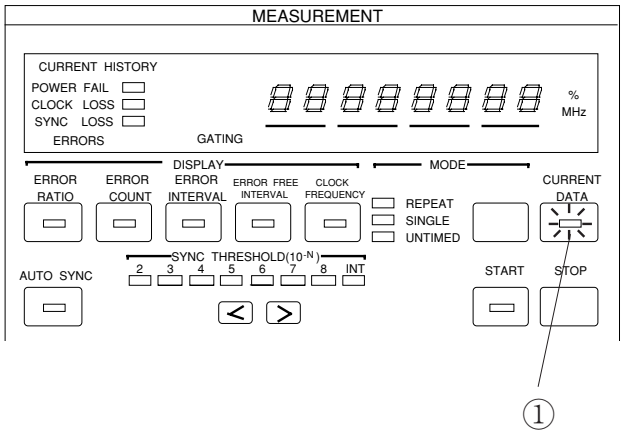
When the START key is pressed, the start lamp lights and measurement starts in accordance with the measurement mode.

When the STOP key is pressed, the START lamp goes off and measurement stops. When the START key is pressed during measurement, measurement is restarted.

In the SINGLE mode, when the measurement time ends before the STOP key is pressed, the START lamp goes off automatically and measurement stops.

4.5.9 Current data function

The current data function can display intermediate measured results at the specified cycle time (0.1, 0.2 secs). There are two intermediate measured result calculation modes: PROGRESSIVE mode and IMMEDIATE mode. In the PROGRESSIVE mode, the result accumulated from the start of measurement is displayed. In the IMMEDIATE mode, the instantaneous result of each cycle time is displayed. An example of display of the measured result for 2 seconds measurement time and 0.2 second cycle time is shown in Fig. 4-3.



① Press the CURRENT DATA key. The LED inside the key lights.

② Set rear panel FUNCTION1 SW6. (Calculation mode setting)

SW6
- 0: PROGRESSIVE mode
- 1: IMMEDIATE mode

③ Set rear panel FUNCTION2 SW9. (Cycle time setting)

SW9	Cycle time
0	0.1 sec
1	0.2 sec

The measurement time and calculation mode have the following relationship:

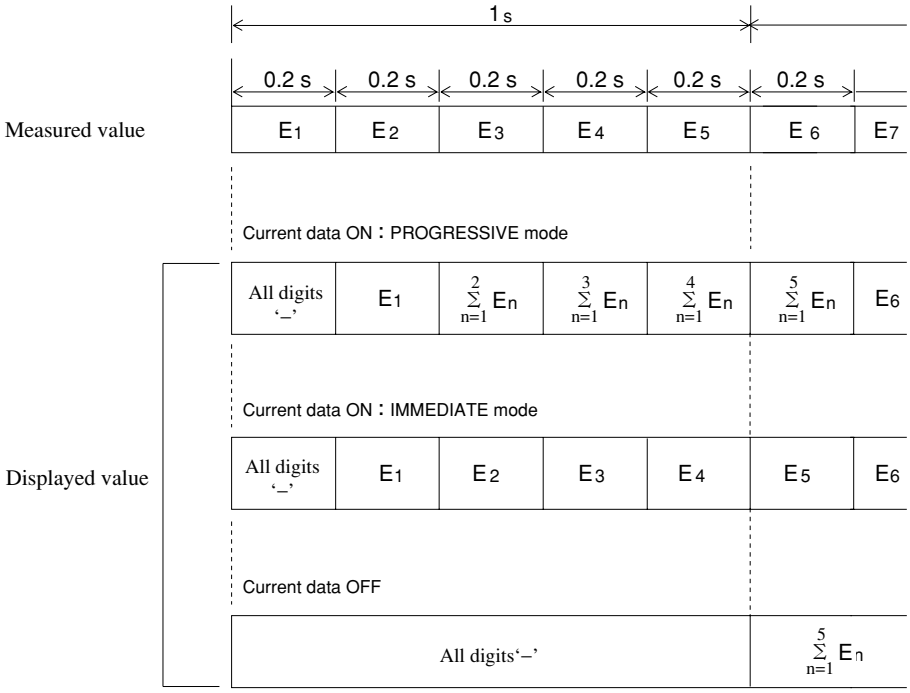
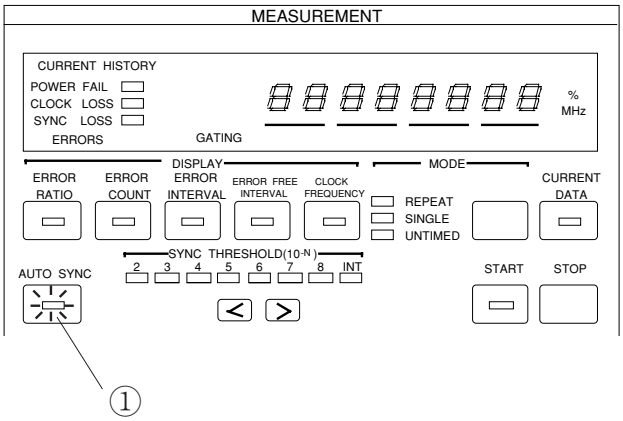


Fig. 4-3

4.5.10 AUTO SYNC function



① In normal measurement, the AUTO SYNC function is turned on and input pattern and comparison pattern synchronization is established automatically. To turn on the AUTO SYNC function, press the AUTO SYNC key. The lamp inside the key lights.

The AUTO SYNC function has a normal mode, a frame mode and a quick mode. The monitor pattern during sync loss is different in the normal mode and the frame mode. Whereas the monitor pattern in the normal mode is all patterns, the monitor pattern in the frame mode is only a specific pattern of from 4 to 32 bits (hereinafter referred to as "frame bits").

The frame mode can be set only when one period is a programmable pattern of at least 128 bits. The synchronization pull-in time can be made shorter than the normal pattern by monitoring only the frame bits.

② To set the AUTO SYNC function to the frame mode, select frame at SYNC MODE. The lamp lights and the frame sync function is turned on. For a description of frame bit length and frame bit setting, see 5.2.4 Frame sync function setting.

When number of errors is large

Ordinary, the AUTO SYNC function is left on during measurement. However, when the number of errors extremely large (larger than the sync pull-in value) and synchronization cannot be established, the pull-in value can be set manually. Moreover, once synchronization has been established by AUTO SYNC function, error measurements can be made, even if the number of errors is extremely large, by tuning off the AUTO SYNC function. However, when the frequency is changed, measurement may become impossible.

When SYNC THRESHOLD is INT

Sync pull-in state or sync loss state judgment is performed by sync threshold value. In the sync pull-in state, when the error ratio exceeds the sync loss threshold value, the sync loss state is judged. In the sync loss state, when the error ratio drops below the sync recovery threshold value, the sync pull-in state is judged. When the error ratio always exceeds the sync loss threshold value, pattern synchronization is not established and measurements cannot be made. However, when the error ratio is smaller than the sync loss threshold value, pattern synchronization is established by setting the AUTO SYNC to ON. Thereafter, if the AUTO SYNC key is set to OFF and the pattern sync circuit is locked, measurements can be made even if the error ratio exceeds the sync loss threshold value.

As SYNC THRESHOLD, INT or either of 10^{-2} to 10^{-8} can be selected. Refer to Fig. 4-4-1 for INT, and refer to Fig. 4-4-2 for either of 10^{-2} to 10^{-8}.

Example: PRBS threshold value when SYNC THRESHOLD made 10^{-5} (See Table 4-4-2.)

Sync pull-in threshold value

1.56×10^{-5}

Sync loss threshold value

5×10^{-5}

Table 4-4-1 Sync Threshold Values (At INT)

Mode	Pattern	Data length	Sync threshold value Error ratio = (Error count / Clock count)	
			Sync pull-in state→sync loss state When normal	Sync loss state→sync pull-in state (When abnormal)
Normal	PRBS	2^{N-1} (N=7, 9, 11, 15, 20, 23, 31)	$\frac{(128)\times 2{,}000}{(2{,}048)\times 2{,}500} = \frac{1}{20} = 5\times 10^{-2}$	$\frac{(64)}{(2{,}048)\times 2} = \frac{1}{64} = 1.56\times 10^{-2}$
	ALTN/DATA /Z.S.	2～16	$\frac{(128)\times 2{,}000}{(2{,}048)\times 2{,}500} = \frac{1}{20} = 5\times 10^{-2}$	$\frac{(64)}{(2{,}048)\times 2} = \frac{1}{64} = 1.56\times 10^{-2}$
		17～160	$\frac{(128)\times 200}{(2{,}048)\times 2{,}500} = \frac{1}{200} = 5\times 10^{-3}$	$\frac{(64)}{(2{,}048)\times 20} = \frac{1}{640} = 1.56\times 10^{-3}$
		161～1,600	$\frac{(128)\times 20}{(2{,}048)\times 2{,}500} = \frac{1}{2{,}000} = 5\times 10^{-4}$	$\frac{(64)}{(2{,}048)\times 200} = \frac{1}{6400} = 1.56\times 10^{-4}$
		1,601～16,000	$\frac{(128)\times 2}{(2{,}048)\times 2{,}500} = \frac{1}{20{,}000} = 5\times 10^{-5}$	$\frac{(64)}{(2{,}048)\times 2{,}000} = \frac{1}{64{,}000} = 1.56\times 10^{-5}$
		16,001～80,000	$\frac{(128)\times 2}{(2{,}048)\times 12{,}500} = \frac{1}{100{,}000} = 1\times 10^{-5}$	$\frac{(64)}{(2{,}048)\times 5{,}000} = \frac{1}{160{,}000} = 6.25\times 10^{-6}$
		20,001～160,000	$\frac{(128)\times 2}{(2{,}048)\times 25{,}000} = \frac{1}{200{,}000} = 5\times 10^{-6}$	$\frac{(64)}{(2{,}048)\times 10{,}000} = \frac{1}{320{,}000} = 3.13\times 10^{-6}$
		160,001～320,000	$\frac{(128)\times 2}{(2{,}048)\times 500{,}000} = \frac{1}{400{,}000} = 2.5\times 10^{-6}$	$\frac{(64)}{(2{,}048)\times 20{,}000} = \frac{1}{640{,}000} = 1.56\times 10^{-6}$
		320,001～524,288	$\frac{(128)\times 2}{(2{,}048)\times 2^{16}} = \frac{1}{524{,}288} = 1.9\times 10^{-6}$	$\frac{(64)}{(2{,}048)\times 40{,}000} = \frac{1}{1{,}280{,}000} = 7.81\times 10^{-7}$
		524,289～1,048,576	$\frac{(128)\times 2}{(2{,}048)\times 2^{17}} = \frac{1}{1{,}048{,}576} = 9.54\times 10^{-7}$	$\frac{(64)}{(2{,}048)\times 80{,}000} = \frac{1}{2{,}560{,}000} = 3.91\times 10^{-7}$
		1,648,577～2,097,152	$\frac{(128)\times 2}{(2{,}048)\times 2^{18}} = \frac{1}{2{,}097{,}152} = 4.77\times 10^{-7}$	$\frac{(64)}{(2{,}048)\times 160{,}000} = \frac{1}{5{,}120{,}000} = 1.96\times 10^{-7}$
		2,097,153～4,194,304	$\frac{(128)\times 2}{(2{,}048)\times 2^{19}} = \frac{1}{4{,}194{,}304} = 2.38\times 10^{-7}$	$\frac{(64)}{(2{,}048)\times 320{,}000} = \frac{1}{10{,}240{,}000} = 9.80\times 10^{-8}$
		4,194,305～8,388,608	$\frac{(128)\times 2}{(2{,}048)\times 2^{20}} = \frac{1}{8{,}388{,}608} = 1.19\times 10^{-7}$	$\frac{(64)}{(2{,}048)\times 640{,}000} = \frac{1}{20{,}480{,}000} = 4.90\times 10^{-8}$
Frame /quick	ALTN/DATA /Z.S.	128～5,120	$\frac{(128)\times 100}{(2{,}048)\times 37.500} = \frac{1}{6{,}000} = 1.7\times 10^{-4}$	$\frac{256}{256\times N} = \frac{1}{N}$ (N: Length That is, 128 to 8,388,608)
		5,121～10,240	$\frac{(128)\times 100}{(2{,}048)\times 68{,}750} = \frac{1}{11{,}000} = 9.1\times 10^{-5}$	
		10,241～51,200	$\frac{(128)\times 100}{(2{,}048)\times 10\times 32{,}500} = \frac{1}{52{,}000} = 1.9\times 10^{-5}$	
		51,201～102,400	$\frac{(128)\times 100}{(2{,}048)\times 20\times 34{,}375} = \frac{1}{110{,}000} = 9.1\times 10^{-6}$	
		102,401～204,800	$\frac{(128)\times 100}{(2{,}048)\times 50\times 26{,}250} = \frac{1}{210{,}000} = 4.8\times 10^{-6}$	
		204,801～307,200	$\frac{(128)\times 100}{(2{,}048)\times 50\times 38{,}750} = \frac{1}{310{,}000} = 3.2\times 10^{-6}$	
		307,201～409,600	$\frac{(128)\times 100}{(2{,}048)\times 50\times 51{,}250} = \frac{1}{410{,}000} = 2.4\times 10^{-6}$	
		409,601～524,288	$\frac{(128)\times 100}{(2{,}048)\times 50\times 32{,}768} = \frac{1}{530{,}000} = 1.9\times 10^{-6}$	
		524,289～1,048,576	$\frac{(128)\times 100}{(2{,}048)\times 687{,}500} = \frac{1}{1{,}100{,}000} = 9.1\times 10^{-7}$	
		1,048,577～2,097,152	$\frac{(128)\times 100}{(2{,}048)\times 13.125.000} = \frac{1}{2.100.000} = 4.8\times 10^{-7}$	
		2,097,153～4,194,304	$\frac{(128)\times 100}{(2{,}048)\times 26{,}250{,}000} = \frac{1}{4{,}200{,}000} = 2.4\times 10^{-7}$	
		4,194,305～8,388,608	$\frac{(128)\times 100}{(2{,}048)\times 52{,}500{,}000} = \frac{1}{8{,}400{,}000} = 1.2\times 10^{-7}$	

Note: For ALTN pattern, the maximum length is 4194304 bits and the Z.S. pattern data length is 2^N (N=7, 9, 11, 15) bits and the threshold value becomes the threshold value of the corresponding data length.

Example) For 2^7, the data length is 2^7=128 and corresponds to a value of 17 to 160.

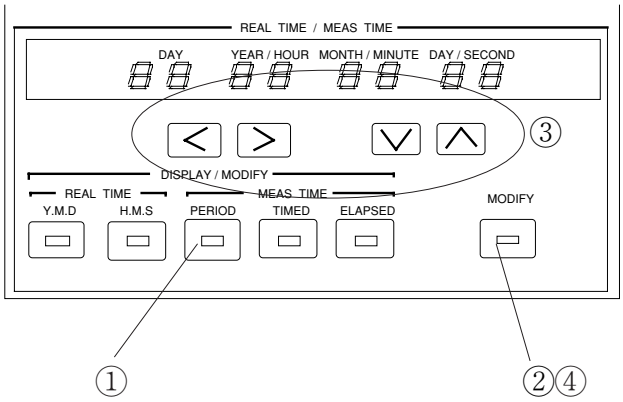
Table 4-4-2 Sync Threshold Values (At 10^{-2} to 10^{-8})

The Sync Threshold values are independent from the Pattern and Data Length.

SYNC THRESHOLD	Sync threshold value Error ratio $= \left(\frac{\text{Error count}}{\text{Clock count}}\right)$	
	Sync pull-in state→sync loss state When normal	Sync loss state→sync pull-in state (When abnormal)
10^{-2}	$\frac{(128)\times 2{,}000}{(2{,}048)\times 2{,}500} = 5\times 10^{-2}$	$\frac{(64)}{(2{,}048)\times 2} = 1.56\times 10^{-2}$
10^{-3}	$\frac{(128)\times 2{,}000}{(2{,}048)\times 25{,}000} = 5\times 10^{-3}$	$\frac{(64)}{(2{,}048)\times 20} = 1.56\times 10^{-3}$
10^{-4}	$\frac{(128)\times 2{,}000}{(2{,}048)\times 250{,}000} = 5\times 10^{-4}$	$\frac{(64)}{(2{,}048)\times 200} = 1.56\times 10^{-4}$
10^{-5}	$\frac{(128)\times 2{,}000}{(2{,}048)\times 2{,}500{,}000} = 5\times 10^{-5}$	$\frac{(64)}{(2{,}048)\times 2{,}000} = 1.56\times 10^{-5}$
10^{-6}	$\frac{(128)\times 2{,}000}{(2{,}048)\times 25{,}000{,}000} = 5\times 10^{-6}$	$\frac{(64)}{(2{,}048)\times 20{,}000} = 1.56\times 10^{-6}$
10^{-7}	$\frac{(128)\times 200}{(2{,}048)\times 25{,}000{,}000} = 5\times 10^{-7}$	$\frac{(64)}{(2{,}048)\times 200{,}000} = 1.56\times 10^{-7}$
10^{-8}	$\frac{(128)\times 20}{(2{,}048)\times 25{,}000{,}000} = 5\times 10^{-8}$	$\frac{(64)}{(2{,}048)\times 2{,}000{,}000} = 1.56\times 10^{-8}$

4.5.11 Measurement time setting

This setting sets the measurement time in the REPEAT and SINGLE measurement modes.



① Press the PERIOD key. The currently set measurement time is displayed at DISPLAY.

② Press the MODIFY key. The figures on DISPLAY that can be changed begin to blink.

③ Set the DAY, HOUR, MINUTE, and SECOND values with the ◁ ▷ and △ ▽ keys.

④ Press the MODIFY key again. The DISPLAY stops blinking and the measurement time is set. Check if the LED inside the MODIFY key is off.

* When the set value is 00 day 00 hour 00 minute 00 second, the MODIFY key is not turned off.

Measurements are made at the initially set time even if a power failure, clock loss, or sync loss alarm is generated during measurement.

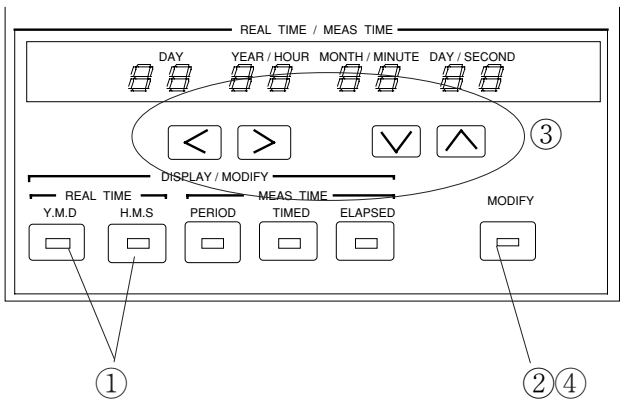
The measurement time and minimum measurable error ratio have the following relationship:

$$\text{Minimum error ratio} = \frac{1}{\text{Measurement time (sec)} \times \text{frequency (Hz)}}$$

Example: When the measurement time is 10 seconds and the frequency is 10 GHz, the minimum error ratio is 1×10^{-11}.

4.5.12 Real time setting

This setting sets the internal calendar clock.



① Press the Y.M.D or H.M.S key. The date or time is displayed at DISPLAY. Display the item to be changed.

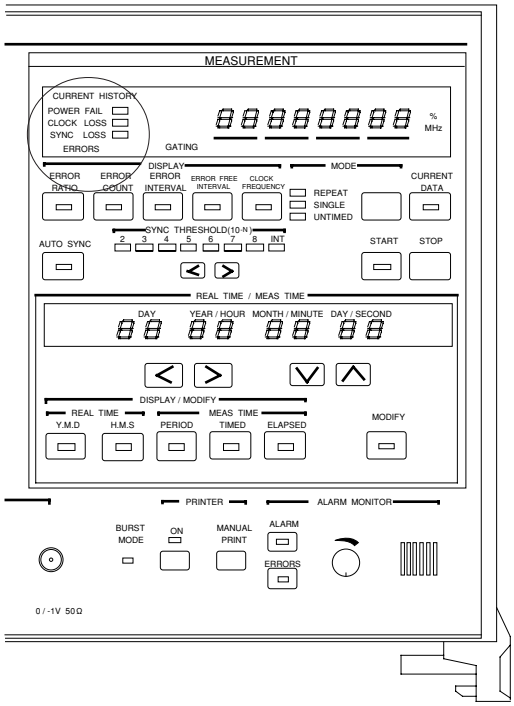
② Press the MODIFY key. The figures on DISPLAY that can be changed begin to blink.

③ Change the date or time with the ◁ ▷ and △ ▽ keys.

④ Press the MODIFY key again. The DISPLAY stops blinking and setting is complete.

* When the set value is an impossible value, the MODIFY key is not turned off.

4.5.13 Error lamp and alarm lamps



(1) Error lamp

This lamp indicates that an error was generated.

- ON condition: When error generated
- OFF condition: When there are no errors and at clock loss and sync loss

(2) Alarm lamps

The alarm lamps are made up of a HISTORY lamp (orange, small) that displays the past state and a realtime lamp (orange, large) that displays the current state.

(a) POWER FAIL lamp (HISTORY lamp only)

This lamp indicates generation of a power dip or power failure alarm.

- ON condition HISTORY lamp: After power is recovered when a power dip or power failure occurred during measurement.
- OFF condition HISTORY lamp: At the start of measurement.

(b) CLOCK LOSS lamps

These lamps indicate that a clock loss alarm was generated.

- ON condition HISTORY lamp: When clock loss alarm generated during measurement.
  Realtime lamp : When clock loss alarm generated.
- OFF condition HISTORY lamp: At start of measurement.
  Realtime lamp : When clock signal recovered.

(c) SYNC LOSS lamps

These lamps indicate that a sync loss alarm was generated.

- ON condition HISTORY lamp: When sync loss alarm generatedduring measurement.
  Realtime lamp : When sync loss alarm generated.
- OFF condition HISTORY lamp: At start of measurement.
  Realtime lamp : When synchronization recovered and when clock loss alarm generated and when the AUTO SYNC key is OFF.

4.5.14 Error detection mode setting

Errors are detected by comparing each bit of the input pattern to an internally generated pattern. The error detection mode has three kinds of errors: total error, insertion error, and omission error. The kind of error is selected by rear panel FUNCTION1 SW7 and SW8 as shown below.

SW7	SW8	Error
0	0	Total error
0	1	Insertion error
1	0	Omission error
1	1	Total error

In the insertion error mode, the pattern is detected only as an error of BIT that changed from “0” to “1”. In the omission error mode, the pattern is detected as an error of only BIT that changed from “1” to “0”. In the total error mode, all errors are detected.

In Fig. 4-4, the pattern logic was set to positive logic. When the pattern logic was set to negative logic, (d) becomes an omission error and (e) becomes an insertion error.

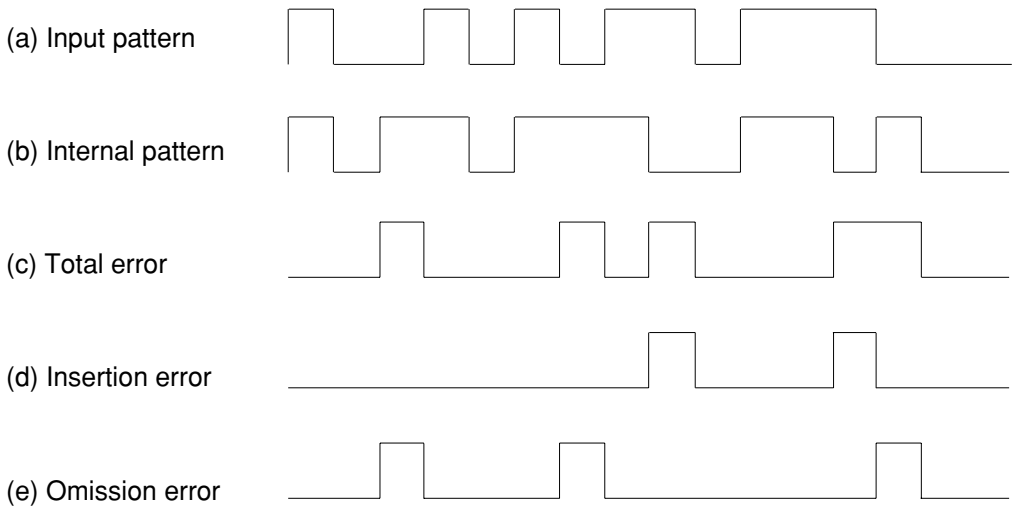
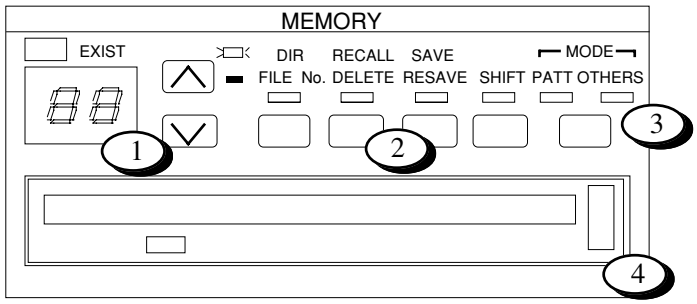


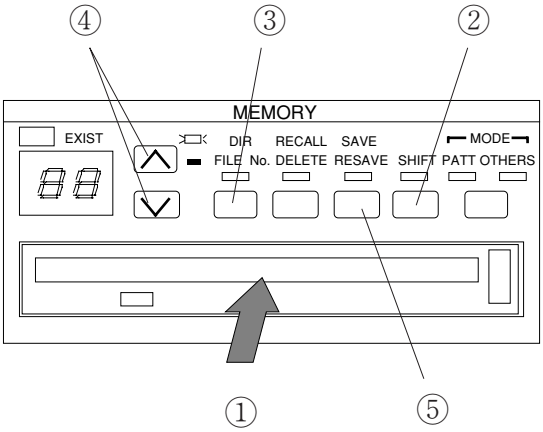
Fig. 4-4 Error Detection Mode

4.6 Memory (Floppy Disk)



1. File No. selection
2. File control
3. Mode selection
4. Eject

4.6.1 File save



① Insert a formatted disk (2HD, 2DD) into the floppy disk drive. (For a description of the formatting method, see Paragraph 4.6.3 Disk formatting.)

② Select the PATT mode or OTHERS mode.
PATT mode : Stores the contents set at Paragraph 4.4.
OTHERS mode : Stores the contents other than PATT.

③ Press the DIR/File No. key. The File No. LED lights.

④ Set the file name (00 to 99) with the ⌃ ⌄ keys.

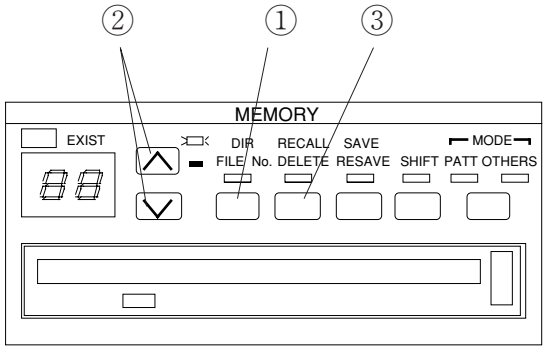
⑤ Press the SAVE key and save the file.

* If another file was previously saved under the same file name, the current file cannot be saved with the SAVE key. If the old file is unnecessary, a new file can be saved by pressing the SHIFT key, then pressing the SAVE key. If the old file is necessary, save the new file by changing its file name.

Note: When there is not enough vacant space on the FD to resave files, files cannot be resaved. In this case, to try to resave files, "DELETE" files from the FD.

Files larger than 720 k cannot be resaved to an FD formatted at 1.44 M.

4.6.2 File recall

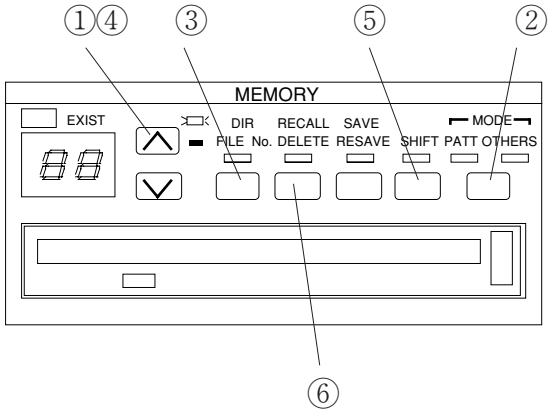


① Insert the disk into the floppy disk drive and select the DIR mode. When the FD was changed, always execute the DIR command.

② Press the [∧][∨] keys and check if the file exists. If the file exists, only its file name is displayed. However, if the file is not on the inserted floppy, "– –" is displayed.

③ Press the RECALL key and call the contents of the file.

4.6.3 Disk formatting



① Insert an unformatted floppy disk into the floppy disk drive.

② Select the PATT mode or OTHERS mode.

③ Select the FILE No. mode.

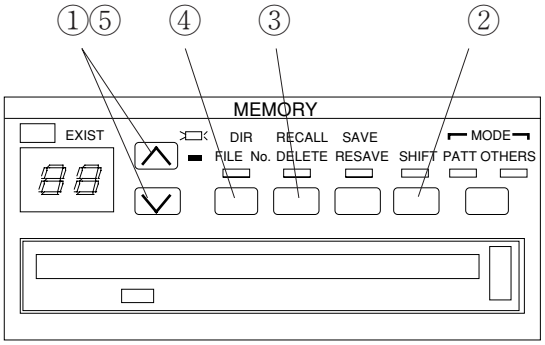
④ Hold down the [∧] key. "Fr" is displayed. (Fr is displayed after 99.)

⑤ Select the SHIFT mode.

⑥ When the DELETE key is pressed, formatting starts.

Note: The formatting format can be switched between 1440 KB/720 KB or 1232 KB/640 KB by rear panel FUNCTION switch. However, if the format was changed, turn the power off, then turn it back on.

4.6.4 File delete



① Insert the floppy disk into the floppy disk drive and select the name of the file you want to delete.

② Press the SHIFT key.

③ Press the DELETE key. The file with the displayed file name is deleted.

④ (Confirmation)
Execute the DIR command.

⑤ Press the [^][v] keys and check that the deleted file name is not displayed.

4.6.5 Error messages

When a floppy disk error was generated, an error code of from E0 to E9 is displayed on the file name display. For the error display, see Table 4-5 Error Messages. The error messages are cleared each time the [^][v] keys are pressed.

Table 4-5 Error Messages

Error item	Error contents
E0	Media error (Formatting, media error)
E1	Write protection error (Protection error when writing)
E2	File full (Write area too small)
E3	File not found (Specified file could not be found when reading.)
E4	File exists error (An attempt was made to save the same file)
E5	Write error (Write obstruction error)
E6	Read error (Read obstruction error)
E7	File type, File error (File type or file contents error)
E8	FD error (Other error)
E9	Hardware error (Hardware trouble error)

4.6.6 Floppy disk

(a) Disk type

Floppy disks are formatted in the standard MS-DOS format provided by the MS-DOS handler. The type of formatted floppy disk is data disk. This is because the MS-DOS file handler does not copy the MS-DOS system. A system disk containing the MS-DOS system can also be used to store data.

(b) Volume label

A volume label is added when the floppy disk is formatted.

Volume label: MP1764A

This volume label is provided to identify the floppy disk.

(c) File structure

• Directory structure

Route directory only.

• File name, extension

The file name and extension have the following format:

File name RR××

00 to 99 (file name)

Extension PTN: Pattern file

OTH: Parameter file other than pattern

Examples: RR99. PTN

RR01. OTH

(d) Data format

The format of the data stored on floppy disk is, as a rule, not made public. Therefore, when data creation, updating, etc. are performed using a personal computer that runs under MS-DOS, operation is not guaranteed. However, there is no problem in checking the file directory or copying files.

(e) Compatibility

The MP1764C Error Detector 'PTN' file mode can be used with the MP1763B/C Pulse Pattern Generator. The 'OTH' file cannot be used with the MP1763B/C Pulse Pattern Generator.

The MP1764C cannot read the files of the old MP1702A, MP1609A, and MP1653A Error Detectors.

4.6.7 Floppy disk precautions

• Do not remove a floppy disk from the floppy disk drive while it is being accessed.
• Observe the specified environmental conditions, and do not use the floppy disk in dusty places.
• Clean head of floppy disk drive with 3.5 inch head cleaning disk set regularly.
• Do not place a magnetized object near the floppy disk and do not bend the floppy disk.

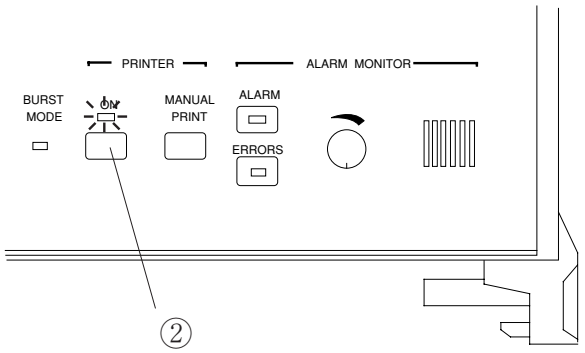
4.7 Printer output

The MP1764C has an GPIB connector for local printer. It is easy to print measurement data.

Five kinds of data are printed: measurement start data, measurement end data, intermediate measurement data, 1 second data, and alarm data.

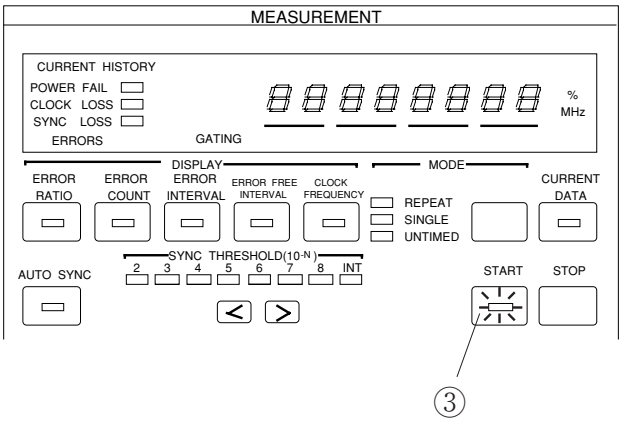
Not only the measured results, but also threshold EI/EFI and performance data can be printed at the measurement end data and intermediate measurement data.

Printout procedure



① Select the desired print data from Table 4-6 and set the FUNCTION2 switch.

② Set the PRINTER key to ON. When the key is ON, the LED lights.



③ Press the START key.

* To print intermediate measurement data, press the MANUAL PRINTER key each time.

The print data contents are shown below.

Table 4-6 Print Data Contents

	Print data contents	Print timing	Printing restriction
Measurement start data	・Measurement start time	・At the start of measurement.	None
Measurement end data	・Measurement start time ・Measurement end time ・Measurement elapsed time ・Measured result Measurement value — Error ratio / Error count / EI count / EFI ratio Alarm intervals — Power failure / Clock loss / Sync loss ・Threshold EI and EFI data ・Error performance data	・At the end of measurement	・The following can be selected with FUNCTION2 SW1, SW2, and SW3. SW1 0 : Print all measured result 1 : Print only error ratio and error count of measured result SW2 0 : Do not print threshold EI and EFI data. 1 : Print threshold EI and EFI data. SW3 0 : Do not print error performance data. 1 : Print error performance data.
Intermediate measurement data	・Same as measurement end data. However, the measurement end time is replaced by the intermediate measurement time.	・When MANUAL PRINT key pressed. ・When intermediate data printing is selected: 1. When measurement time is less than 2 days, every 2 hours. 2. when measurement time is 2 days or more, every day. 3. In UNTIMED mode, every day.	・The following can be selected with FUNCTION2 SW4. 0 : Do not print intermediate data. 1 : Print intermediate data. ・Except for the above, the same as measurement end data.

Table 4-6 Print Data Contents (Continued)

<table>
<tr><th></th><th>Print data contents</th><th>Print timing</th><th>Printing restrictions</th></tr>
<tr><td>1 second data</td><td>・Generation time
・1 second average error ratio
・1 second error count</td><td>・Every second</td><td>・The following can be selected with FUNCTION2 SW5, SW6, and SW7:

SW5
0 : Do not print 1 second data.
1 : Print 1 second data.

SW6 and SW7
<table><tr><th>SW6</th><th>SW7</th><th>Function</th></tr><tr><td>0</td><td>0</td><td>When error > 0, print 1 second data.</td></tr><tr><td>0</td><td>1</td><td>When error > 10^{-6}, print 1 second data.</td></tr><tr><td>1</td><td>0</td><td>When error > 10^{-4}, print 1 second data.</td></tr><tr><td>1</td><td>1</td><td>When error > 10^{-3}, print 1 second data.</td></tr></table>
SW8
0 : Paper save function off
1 : Paper save function on</td></tr>
<tr><td>Alarm data</td><td>・Power failure generation time
・Power failure recovery time
・Clock loss generation time
・Clock loss recovery time
・ Sync loss generation time
・ Sync loss recovery time
・ Unavailable seconds</td><td>・Time alarm generated and when alarm recovered. However, the power failure generation time is when the power is recovered.</td><td>None</td></tr>
</table>

4.7.1 Printing Format

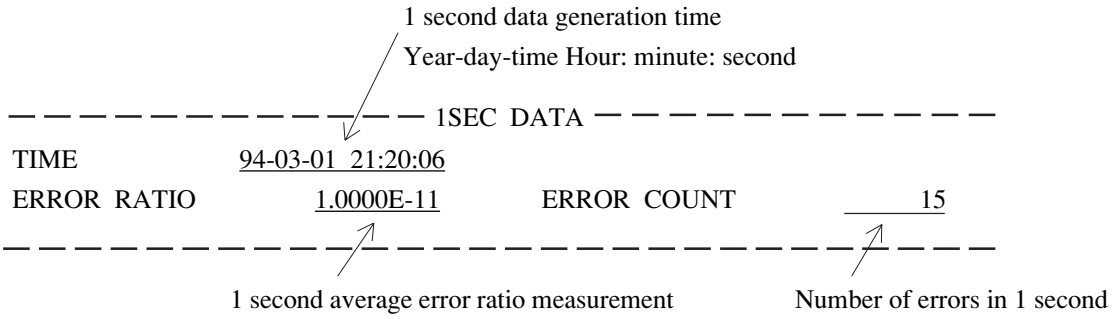
Note: ——— Print data (Differs with the setting state and measurement state)

(1) Measurement start data

<<START 94-03-01 21: 20: 05 REPEAT 99-01: 59: 59 >>

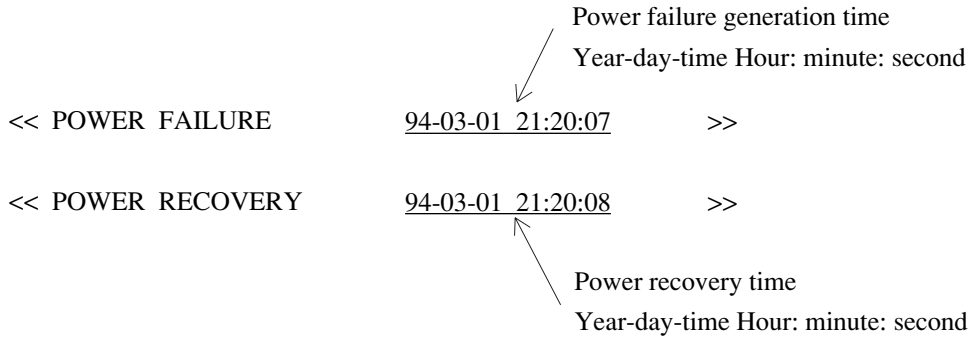
94-03-01 21: 20: 05	REPEAT	99-01: 59: 59 >>
Measurement start time Year-day-time Hour:minute:second	Measurement mode REPEAT SINGLE UNTIMED	Measurement time Day-hour:minute:second (Not printed for UNTIMED.)

(2) 1 second data

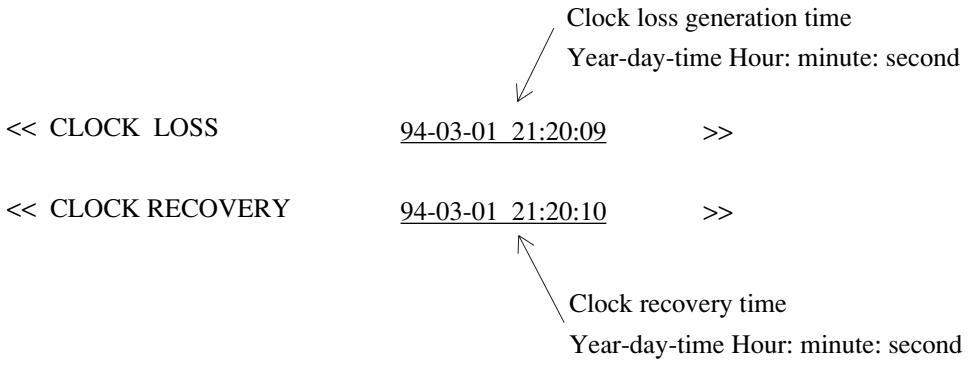


(3) Alarm data

- Power failure/power recovery



- Clock loss/clock recovery



- Sync loss/sync recovery

Sync loss generation time
Year-day-time Hour: minute: second

<< PATTERN SYNC LOSS 94-03-01 21: 20:11 >>

<< PATTERN SYNC RECOVERY 94-03-01 21: 20:12 >>

Sync recovery time
Year-day-time Hour: minute: second

(4) Measurement end data and intermediate measurement data

There are two output formats, standard format and abbreviated format. These formats are described below in the order: (a) Standard format and (b) abbreviated format.

(a) Standard format

Line 1 **********

Line 2 START 94-03-01 21: 20:13 END 94-03-01 21: 20:14

Measurement start time Year-day-time Hour: minute: second

Measurement end data INT for intermediate measurement data

Measurement end time or intermediate measurement time

Line 3 — — — — — — — — — — ERROR MEASUREMENT — — — — — — — — — —

Line 4 ERROR RATIO 1.0000E-11 ERROR COUNT 25

Average error ratio

Number of errors

Line 5 ERROR INTVL 1 %ERROR FREE INTVL 0

Number of error intervals

Error free intervals ratio

Line 6 POWER FAIL INTVL 0 CLOCK LOSS INTVL 0

Number of power fail intervals

Number of clock loss intervals

Line 7 SYNC LOSS INTVL 0

Number of sync loss intervals

Line 8 —

Line 9 **********

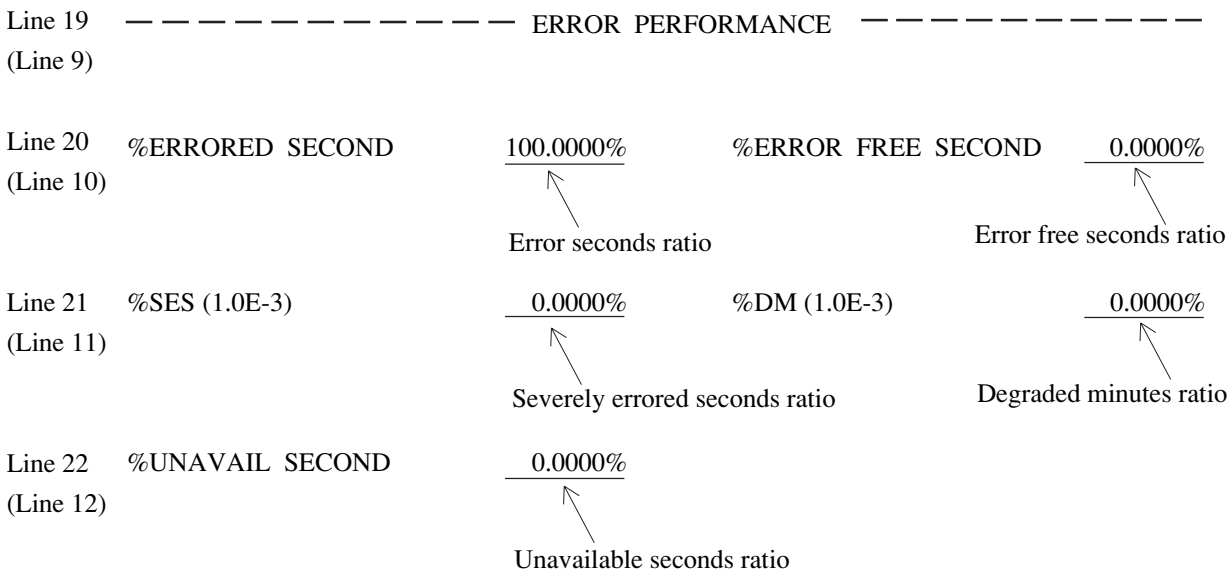
When there is threshold EI/EFI data to be printed, the following data is printed between lines 8 and 9.

Line 9 — — — — — — — — — THRESHOLD EI. EFI — — — — — — — — —

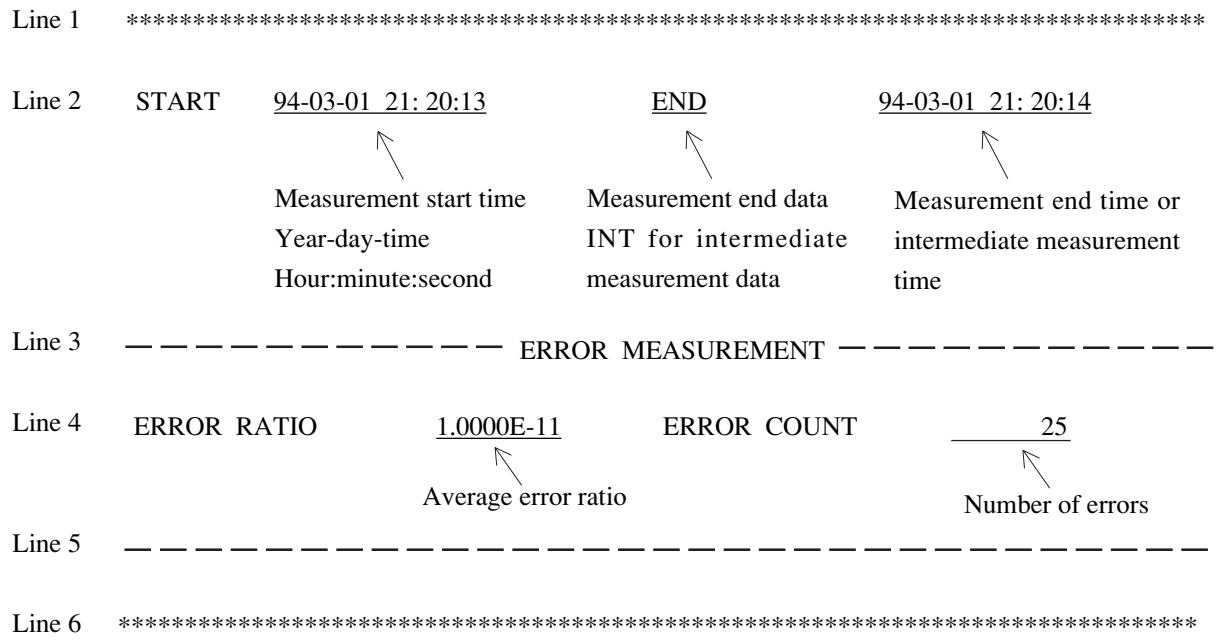
Line 10	ERROR RATIO	ERROR INTVL	%ERROR FREE INTVL
Line 11	>1.0E-3	0	100.0000%
		Number of threshold EI	Threshold EFI ratio
Line 12	>1.0E-4	0	100.0000%
		Number of threshold EI	Threshold EFI ratio
Line 13	>1.0E-5	0	100.0000%
		Number of threshold EI	Threshold EFI ratio
Line 14	>1.0E-6	0	100.0000%
		Number of threshold EI	Threshold EFI ratio
Line 15	>1.0E-7	0	100.0000%
		Number of threshold EI	Threshold EFI ratio
Line 16	>1.0E-8	0	100.0000%
		Number of threshold EI	Threshold EFI ratio
Line 17	=<1.0E-8	1	0.0000%
		Number of threshold EI	Threshold EFI ratio

Line 18 —

When there is error performance data to be printed, the following data is printed after line 19 (between lines 8 and 9 when threshold EI/EFI data is not printed).



(b) Abbreviated format



Note: The threshold EI/EFI data and error performance data printing format is the same as the standard output format. The data is printed from line 4.

4.8 Definition of Terms

4.8.1 Measurement items

(1) Error ratio

$$\frac{\text{Number of error pulses in measurement time}}{\text{Number of clock pulses in measurement time}}$$

(2) Error count

Number of error pulses in measurement time.

(3) Error intervals (EI) count

Number of intervals (1 second) containing one or more error pulses in measurement time.

(4) Error free intervals (EFI) ratio

Ratio of total number of intervals with number of intervals (1 second) containing one or more error pulses to total number of intervals in measurement time. It is calculated from EI with the following equation:

$$\text{EFI} = \left(\frac{\text{number of measurement intervals} - \text{EI}}{\text{Number of measurement intervals}} \right) \times 100\ \%$$

(5) Clock frequency

One second clock frequency.

4.8.2 Alarm intervals

(1) Power failure alarm intervals

Number of intervals (1 second) at which a power failure occurred.

(2) Clock loss intervals

Number of intervals (1 second) at which a clock loss alarm was generated.

(3) Sync loss intervals

Number of intervals (1 second) at which a sync loss alarm was generated.

4.8.3 Threshold EI and EFI data

(1) Threshold EI

Number of intervals (1 second) that the 1 second average error ratio satisfies each of the following thresholds in the measurement time.

1 second average error ratio > 10^{-3}, >10^{-4}, >10^{-5}, >10^{-6}, >10^{-7}, >10^{-8}, ≤10^{-8}

(2) Threshold EFI

Ratio of the number of intervals at which the 1 second average error ratio does not satisfy each threshold condition of item (1) to the total number of intervals.

The threshold EFI is calculated from EI with the following equation:

$$\text{Threshold EFI} = \left(\frac{\text{Number of measurement intervals} - \text{threshold EI}}{\text{Number of measurement intervals}} \right) \times 100\ \%$$

4.8.4 Error performance data

The interval from the start of measurement to the end of measurements is divided into available periods and unavailable periods, with 1 second interval as the unit. Each item is calculated for the available periods.

(1) Definition of unavailable period and available period

When an interval at which the 1 second average error ratio exceeds the unavailable threshold (unavailable period) continues for 10 seconds, the unavailable period starts and this 10 seconds is included in the unavailable seconds.

When an interval at which the 1 second average error ratio does not exceed the unavailable threshold (available interval) continues for 10 seconds in an unavailable period, the unavailable period ends and this 10 seconds is included in the available seconds.

Each is subdivided into two states, with the periods that are not unavailable periods as available periods.

- Unavailable period (after confirmation)
  This is the state after the last interval was calculated in the unavailable seconds. When an interval is an unavailable interval, it is calculated in the unavailable seconds and the state does not change.

  When an interval is an available interval, the unavailable seconds and available seconds do not change and the state changes to unavailable seconds (during judgment).

- Unavailable period (during judgment)
  This is the state during which whether the last interval was included in unavailable seconds or available seconds during an unavailable interval is judged.

  When the interval is an unavailable interval, the continuation seconds of this state is calculated in the unavailable seconds and the state changes to unavailable period (after confirmation).

  When the interval is an available interval, and the number of consecutive available intervals reached 10, the continuation time of this state (=10 seconds) is calculated in the available seconds and the state changes to available period (after confirmation). When the number of consecutive available intervals is less than 10, the unavailable seconds and available seconds do not change and this state continues.

- Available period (after confirmation)
  This is the state after the last interval was calculated in the available seconds.

  When the interval is an available interval, it is calculated in the available seconds and the state does not change.

  When the interval is an unavailable interval, the available seconds and unavailable seconds do not change and the state changes to available seconds (during judgment).

- Available seconds (during judgment)
  This is the state during which whether the last interval is included in the available seconds in an available period.

  When the interval is an available interval, the continuation time of that state is calculated in the available seconds and the state changes to available period (after confirmation).

  When the interval is an unavailable interval, and the number of consecutive unavailable intervals reached 10, the continuation time (=10 seconds) of this state is calculated in the unavailable seconds and the state changes to unavailable period (after confirmation). When the number of consecutive unavailable intervals is less than 10, the available seconds and unavailable seconds do not change and this state is continued.

  The initial state is available period (after confirmation).

(2) Unavailable threshold, DM threshold
The following can be selected with FUNCTION1 SW4:

0: Unavailable threshold = 10^{-3}, DM threshold = 10^{-6}
1: Unavailable threshold = 10^{-4}, DM threshold = 10^{-8}

(3) Measurement items
- Unavailable Seconds
  Ratio of unavailable seconds to measurement time.

- Error Seconds
  Ratio of error intervals calculated in available seconds to all intervals calculated in available seconds.

- Error Free Seconds
  Ratio of error free intervals calculated in available seconds to all intervals calculated in available seconds.

- Severely Errored Seconds (SES)
  Ratio of unavailable intervals calculated in available seconds to all intervals calculated in available seconds.

- Degraded Minutes
  The error ratio is calculated for every 60 packets, excluding the SES above at the available interval calculated in the available seconds. The error ratio is the ratio of the number of packets exceeding the DM threshold to the total number of packets.

4.9 Processing of Measurement Data At Alarm Generation

(1) Power failure

When a power failure alarm is generated during measurement, the measurement data up to the interval before the interval that generated the power failure alarm is saved during the power failure.

If the measurement data was correctly saved, measurement is continued after the power recovers.

(a) Error measurement

The number of error pulses and the number of clock pulses counted in the interval that generated the power failure alarm are removed from calculation.

(b) Interval measurement, threshold interval measurement

The interval that generated the power failure alarm and the interval during continuation of the power failure are included only in the power failure intervals calculation and are included in other calculations.

(c) Error performance

The interval being judged when a power failure alarm was generated is not included in neither unavailable seconds nor available seconds calculation.

After the power recovers, measurement restarts from the initial state.

(2) Clock loss

When a clock loss alarm is generated during measurement, one of the following two processings can be selected:

(a) Removal of clock loss processing from calculation (FUNCTION1 SW2 set to 0.)

(i) Error measurement

The number of error pulses and number of clock pulses counted in the interval that generated the clock loss alarm are removed from calculation.

(ii) Interval measurement, threshold interval measurement

Intervals whose interval status is clock loss are included in clock loss intervals calculation only. They are not included in other calculations.

(iii) Error performance

Intervals whose interval status is clock loss are not included in neither unavailable seconds or available seconds calculation. The interval being judged is not included in unavailable seconds or available seconds calculation either.

When the interval status is no longer clock off, measurement is continued from the initial state.

(b) Inclusion of clock loss processing in calculation (FUNCTION1 SW2 set to 1.)

(i) Error measurement
The number of error pulses and number of clock pulses counted in the interval that generated the clock loss alarm are removed from calculation.

(ii) Interval measurement, threshold interval measurement
Intervals whose interval status is clock loss are included in clock loss intervals and total intervals calculation, but are not included in threshold EI calculation.

(iii) Error performance
Intervals whose interval status is clock loss become unavailable intervals and when they were included in available seconds calculation, they are also included in error seconds calculation.

(3) Sync loss
When a sync loss alarm is generated during measurement, one of the following two processings can be selected:

(a) Removal of sync loss processing from calculation (FUNCTION1 SW3 set to 0)

(i) Error measurement
The number of error pulses and number of clock pulses counted in the interval that generated the sync loss alarm are removed from calculation.

(ii) Interval measurement, threshold interval measurement
Intervals whose interval status is sync loss are included only in sync loss intervals calculation. They are not included in other calculations.

(iii) Error performance
Intervals whose interval status is sync loss are not included in neither unavailable seconds nor available seconds calculation. The interval being judged is not included in unavailable seconds and available seconds calculations either.

When the interval status is not longer sync loss, measurement is continued from the initial state.

(b) Inclusion of sync loss processing in calculations (FUNCTION1 SW3 set to 1.)

(i) Error measurement
The number of error pulses and the number of clock pulses counted in the interval that generated the sync loss alarm are removed from all calculations.

(ii) Interval measurement, threshold interval measurement
Intervals whose interval status is sync loss are included in sync loss intervals and total intervals calculations, but are not included in threshold EI calculation.

(iii) Error performance
Intervals whose interval status is sync loss become unavailable intervals and when they were included in available seconds calculation, they are also included in error seconds calculation.

4.10 FUNCTION Switch Setting

The setting contents of the FUNCTION1 and 2 switches on the rear panel of the mainframe show below.

When the FUNCTION2 SW10 setting was changed, turn on the mainframe power again.

* When the setting of the other FUNCTION switches was changed, the power does not have to be turned on again.

Note: When the system control setting was changed, turn on the power again.

Note: The FUNCTION switch on the rear panel is covered with the panel and fasten with screws to decrease the radio active radiation.
To change the FUNCTION switch, remove the panel for the setting.

FUNCTION 1

<table>
<tr><th></th><th>Marking</th><th>Function</th></tr>
<tr><td>1</td><td>BIT SHIFT
NUMBER FOR
MARK RATIO
VARIED</td><td>Number of AND shift bits at mark ratio setting switch
0 : 1 bit
1 : 3 bits</td></tr>
<tr><td>2</td><td>CLOCK LOSS
EVALUATION</td><td>Clock loss processing function selector switch
0 : Do not measure and evaluate clock loss
1 : Measure and evaluate clock loss</td></tr>
<tr><td>3</td><td>SYNC LOSS
EVALUATION</td><td>Sync loss processing function selector switch
0 : Do not measure and evaluate sync loss
1 : Measure and evaluate sync loss</td></tr>
<tr><td>4</td><td>ERROR
PERFORMANCE
THRESHOLD</td><td>Error performance threshold selector switch
0 : 10^{-3}
1 : 10^{-4}</td></tr>
<tr><td>5</td><td>BURST MODE</td><td>Burst mode switch
0 : OFF
1 : ON</td></tr>
<tr><td>6</td><td>CURRENT
DATA
CALCULATION</td><td>Calculation mode of intermediate measurement data displayed when CURRENT DATA key ON selector switch
0 : Progressive mode
1 : Immediate mode</td></tr>
<tr><td>7 , 8</td><td>ERROR</td><td>Error detection mode selector switch
<table><tr><th>SW7</th><th>SW8</th><th>Error mode</th></tr><tr><td>0</td><td>0</td><td>Total error</td></tr><tr><td>0</td><td>1</td><td>Insertion error</td></tr><tr><td>1</td><td>0</td><td>Omission error</td></tr><tr><td>1</td><td>1</td><td>Total error</td></tr></table></td></tr>
<tr><td>9 ,10</td><td>INTERVAL TIME</td><td>INTERVAL TIME selector switch
(at the EI or %EFI measurement)
<table><tr><th>SW9</th><th>SW10</th><th>Cycle time</th></tr><tr><td>0</td><td>0</td><td>1 ms</td></tr><tr><td>0</td><td>1</td><td>10 ms</td></tr><tr><td>1</td><td>0</td><td>100 ms</td></tr><tr><td>1</td><td>1</td><td>1 s</td></tr></table></td></tr>
</table>

FUNCTION 2

	Marking		Function
1	SHORT FORM OUTPUT		Measurement data printing format selector switch 0 : Standard format 1 : Abbreviated format
2	THRESHOLD EI, EFI DATA		Switch that selects whether or not threshold EI and EFI data are printed. 0 : Do not print 1 : Print
3	ERROR PERFORMANCE DATA		Switch that selects whether or not error performance data is printed. 0 : Do not print 1 : Print
4	INTERMEDIATE DATA		Switch that selects whether or not intermediate data is printed. 0 : Do not print 1 : Print
5	ONE SECOND DATA	OUTPUT	Switch that selects whether or not 1 second data is printed. 0 : Do not print 1 : Print
6 , 7		OUTPUT THRESHOLD	1 second data printing threshold selector switch SW6 SW7 Error threshold 0 0 > 0 0 1 > 10^{-6} 1 0 > 10^{-4} 1 1 > 10^{-3}
8		PAPER SAVING	Switch that selects whether or not printer paper is saved. 0 : Do not save 1 : Save
9	CURRENT DATA INTERVAL		Switch that selects the current data measurement time. 0 : 100 ms 1 : 200 ms
1 0	FD FORMATTING TYPE		Switch that selects the floppy disk format. 0 : 1440 K / 720 KB 1 : 1232 K / 640 KB

SECTION 5
PRINCIPLE OF OPERATION

5.1 Pseudorandom Pattern (PRBS Pattern)

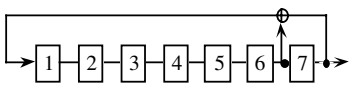
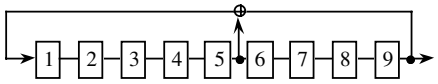
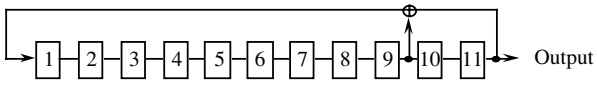
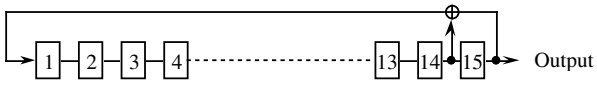
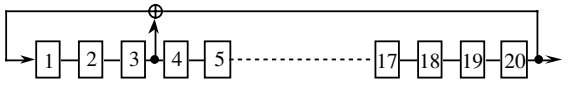
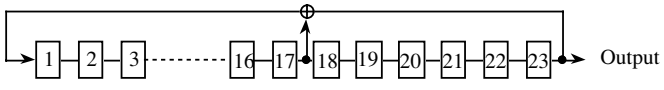
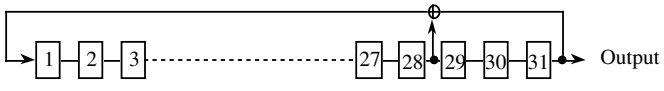
The principle of pseudorandom pattern generation is shown in Table 5-1. The pseudorandom pattern is represented by the N-order generation polynomial shown in Table 5-1. One period is 2^N–1. A PRBS pattern with a 2^N–1 period produces an N bits continuous "1" pattern per period.

When LOGIC is set to POS (positive logic), PRBS pattern output level "1" corresponds to low level and "0" corresponds to high level.

The PRBS pattern mark ratio is generated by the block shown in Fig. 5-1. There are four mark ratios of 1/2, 1/4, 1/8, and 0/8 (all 0). For 1/4 and 1/8, 2 bit shift or 3 bit shift can be selected by rear panel DIP switch. (See Paragraph 4.10 FUNCTION Switch Setting.)

When the rear panel 1/8 SPEED output is PRBS pattern, a pattern like that shown in Fig. 5-2 is produced.

Table 5-1 Principle of Pseudorandom Pattern Generation

Period	Generation polynomial	Pattern generation block diagram
2^7-1	$1+X^6+X^7$	
2^9-1	$1+X^5+X^9$	
$2^{11}-1$	$1+X^9+X^{11}$	
$2^{15}-1$	$1+X^{14}+X^{15}$	
$2^{20}-1$	$1+X^3+X^{20}$	
$2^{23}-1$	$1+X^{18}+X^{23}$	
$2^{31}-1$	$1+X^{28}+X^{31}$	

N : Shift register

⊕ : Exclusive-OR

SECTION 5 PRINCIPLE OF OPERATION

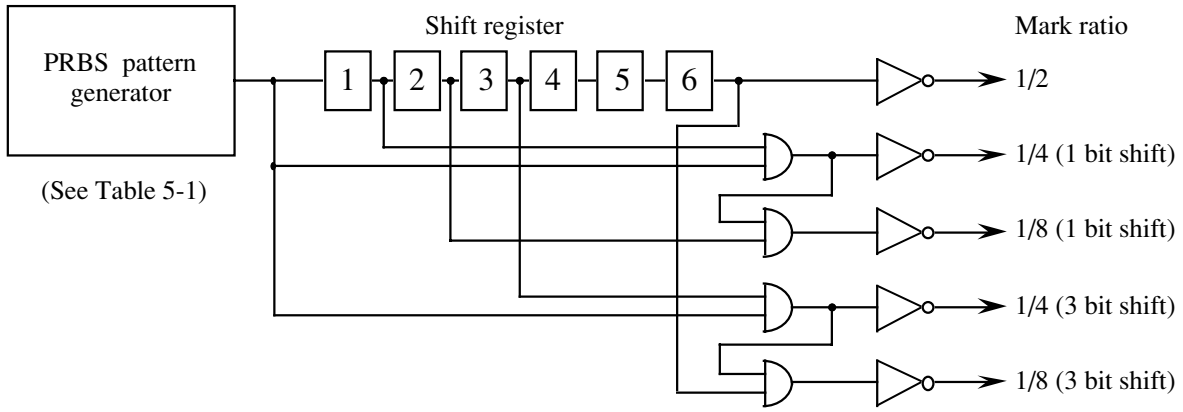


Fig. 5-1 Mark Ratio 1/4, 1/8 Pattern Generation Circuit

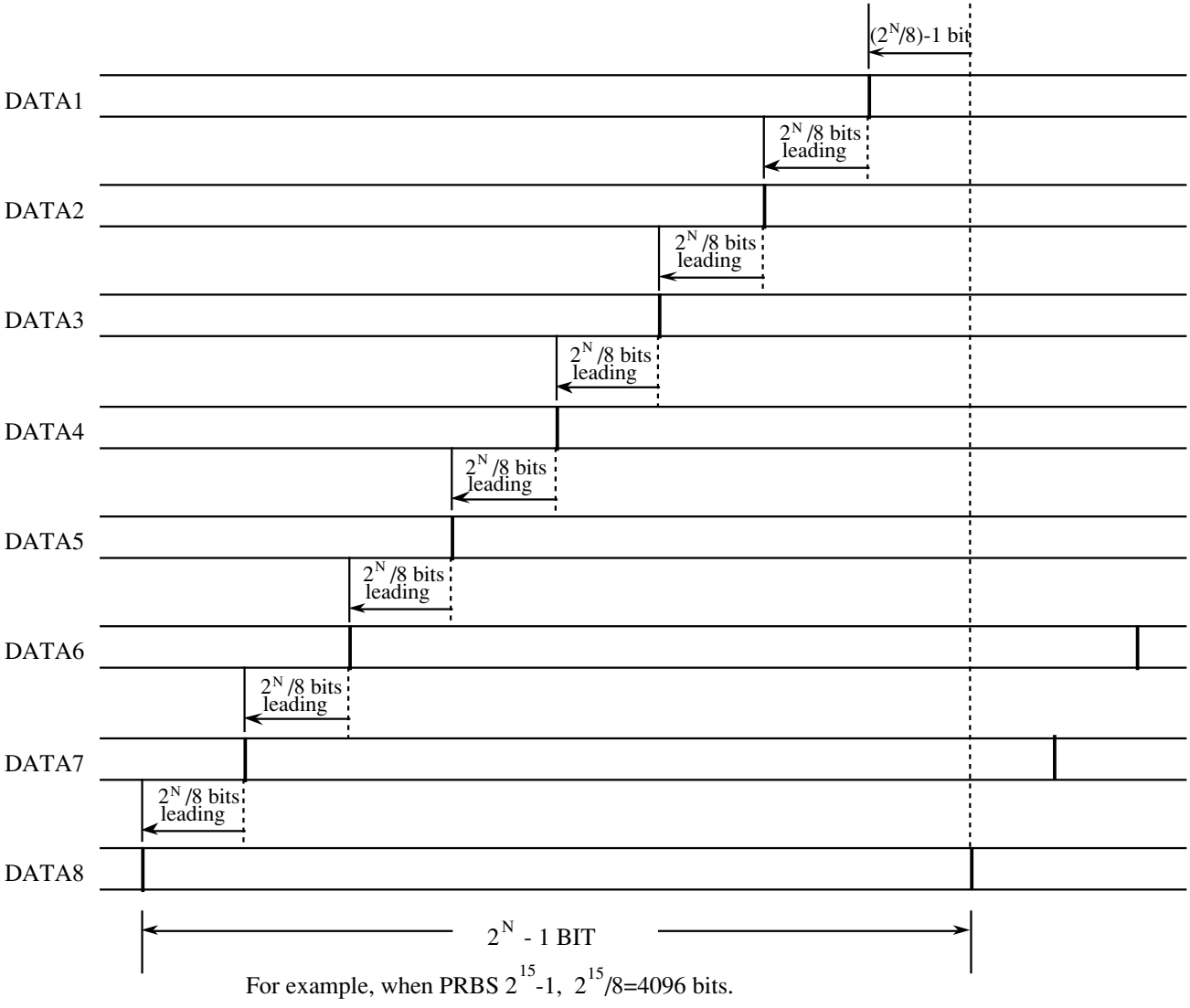


Fig. 5-2 Example of Pseudorandom Pattern

5.2 Pattern Synchronized Output Synchronization

5.2.1 Pseudorandom pattern

$$\text{Period} = \frac{1}{(\text{Set frequency})} \times (2^N - 1) \times 128$$

N=7, 9, 11, 15, 20, 23, 31

$$\text{(Where pulse width} = \frac{1}{(\text{Set frequency})} \times 64 \text{ plus pulses)}$$

5.2.2 Programmable pattern

(1) Data pattern, alternate pattern

(a) Data length = 65536 or less

$$\text{Period} = \frac{1}{(\text{Set frequency})} \times (128 \text{ and lowest common denominator of data length})$$

(Example 1) Data = 8

$$\text{Period} = \frac{1}{(\text{Set frequency})} \times 128$$

(Example 2) Data = 10

$$\text{Period} = \frac{1}{(\text{Set frequency})} \times 640$$

(b) Data length > 65536

$$\text{Period} = \frac{1}{(\text{Set frequency})} \times (\text{data length})$$

(2) Zero Sub pattern

$$\text{Period} = \frac{1}{(\text{Set frequency})} \times 2^N \qquad N=7, 9, 11, 15$$

(3) Pulse width

For any of the programmable patterns above, the pulse width is pulse width = $\frac{1}{(\text{Set frequency})} \times 64$. The output signal polarity is plus pulse.

Note: For alternate pattern, the sync pulse is output in basic data length units. When the data output is observed with a sampling oscilloscope, pattern A and pattern B appear to be superimposed.

When you want to observe the data output pattern A or pattern C without being superimposed, input the rear panel A/B TIMING OUTPUT of MP1763B/C to a sampling oscilloscope trigger via an ECL terminator.

5.3 Error Output

The error output can be of two types, direct error and stretched error. The error detection block diagram is shown in Fig. 5-3 and the error output pulse is illustrated in Fig. 5-4.

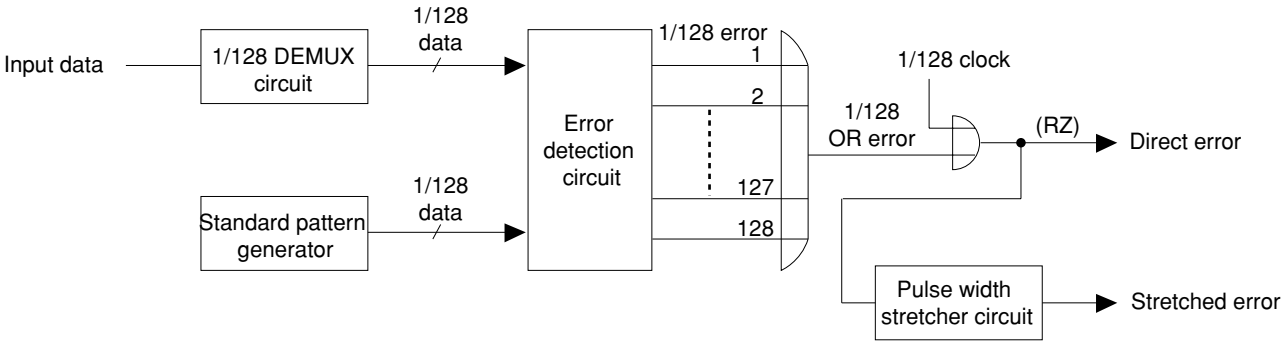


Fig. 5-3 Error Output Block Diagram

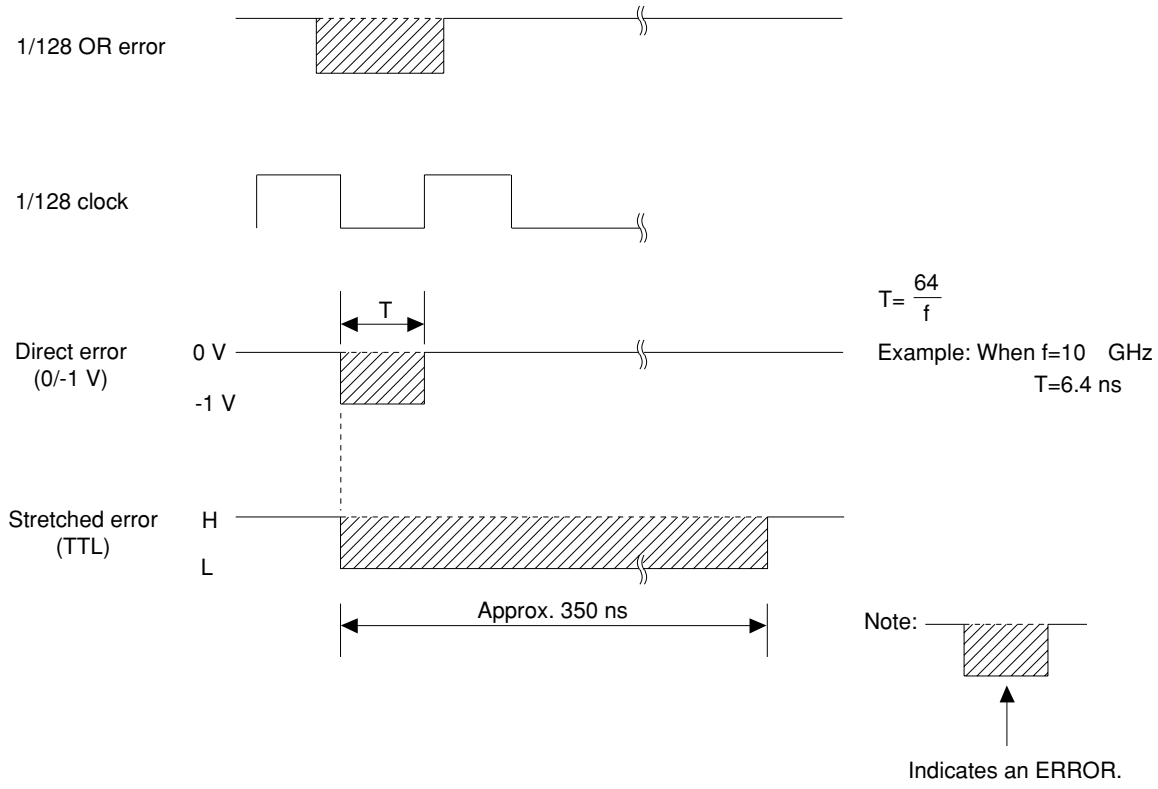
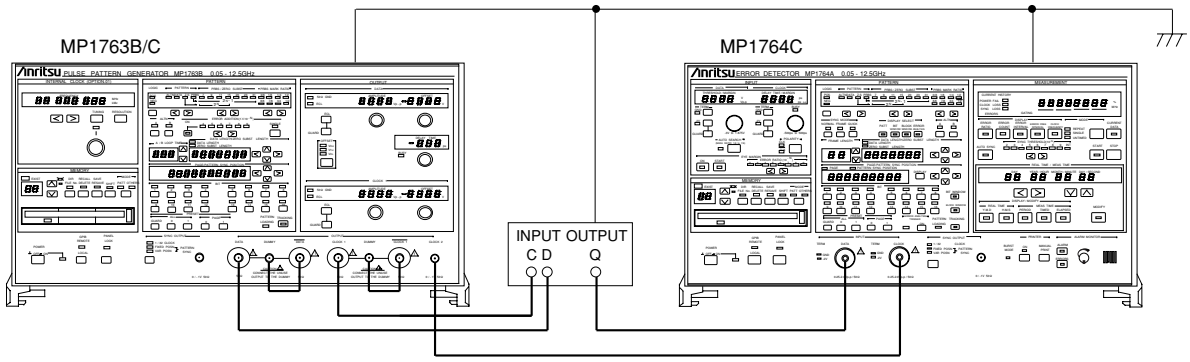


Fig. 5-4 Error Output Pulse

SECTION 6
MEASUREMENT

This section describes an example of DFF IC evaluation using the MP1764C Error Detector and MP1763B/C Pulse Pattern Generator.

6.1 Set-up



(1) Ground the system by connecting GND of the measuring instruments and the device under test.

(2) Connect the power cord.

(3) Connect the input/output signals using the accessory semirigid cable or an equivalent coaxial cable. At this time, short the center conductor of the cable with tweezers, etc. before use.

6.2 Measurement

(1) Initialize the MP1763B/C and MP1764C. Set the POWER switch to ON while pressing the LOCAL key.

(2) Set the MP1763B/C DATA and CLOCK1 outputs to ECL level (offset: 0.8V_{OH}, level: 0.9Vp-p). Set the DUMMY termination to –2 V.

(3) Set the MP1764C termination condition to –2 V.

(4) Turn on the power of the device under test.

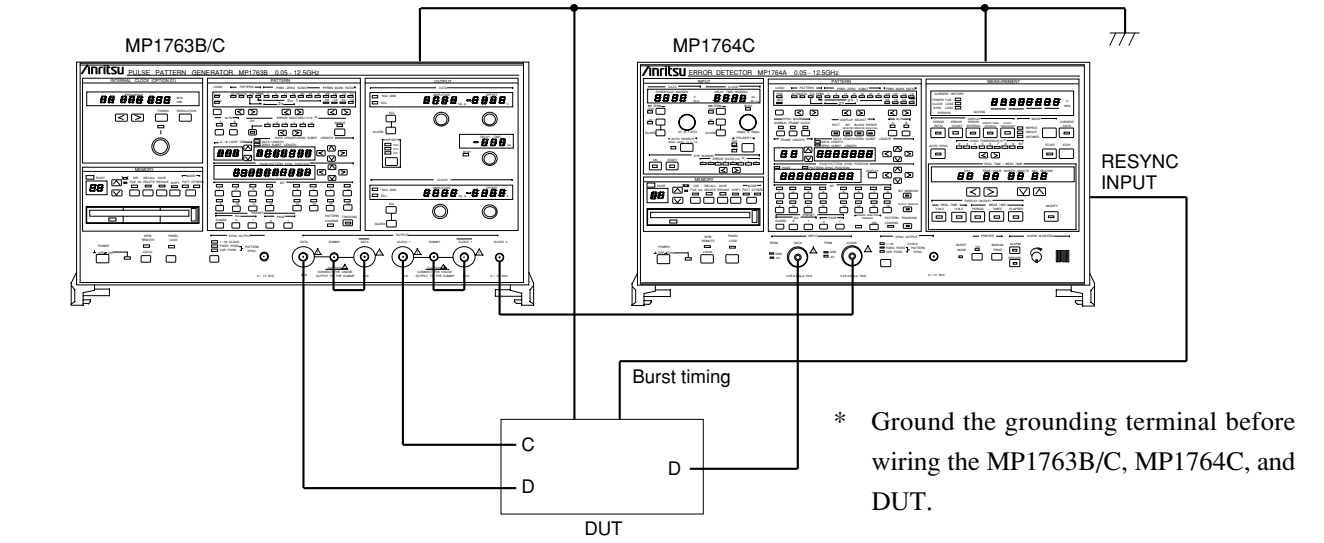
(5) Set the MP1763B/C frequency to the measurement frequency, and the OUTPUT to ON.

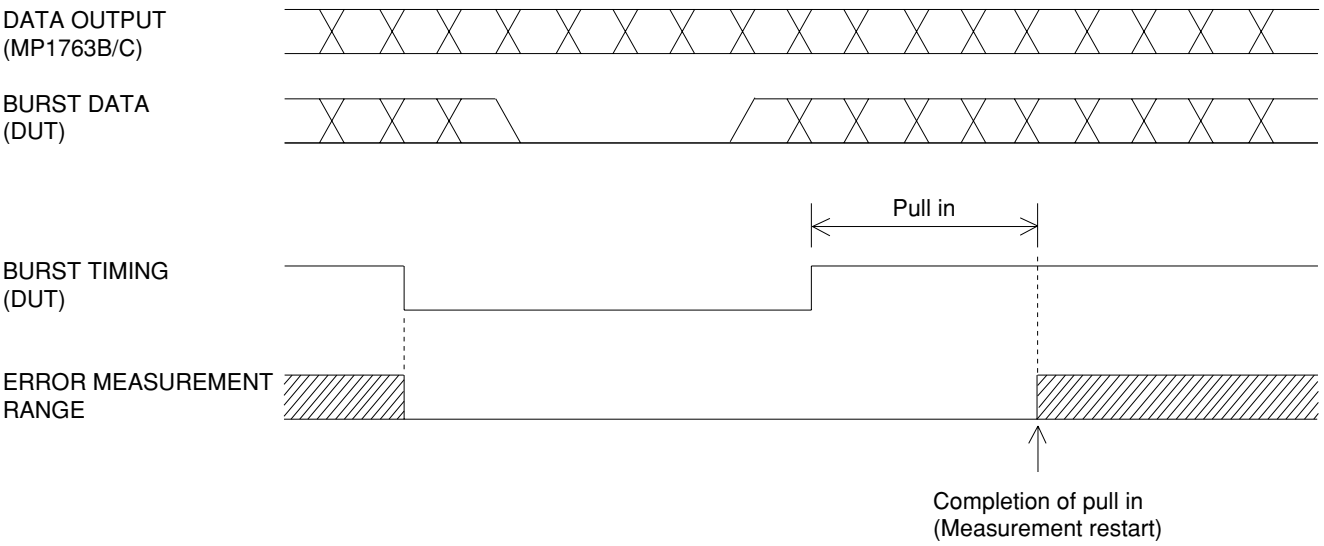
(6) Press the MP1764C AUTO SYNC key, then press the AUTO SEARCH key. After the end of AUTO SEARCH, check that all the error and alarm lamps are off. If an error lamp is lit, change the MP1763B/C CLOCK phase.

(7) While watching the MP1764C ERRORS lamp, change the MP1763B/C offset voltage and amplitude and measure the input level margin of the IC under test.

6.3 Burst Measurement

To perform the burst measurement, set the function sw5 (BURST MODE) on the MP1764C rear panel to ON and connect the MP1764C to the MP1763B/C and DUT as shown below:





Burst measurement

Restart the burst measurement after termination of the burst timing and completion of pull in. In other words, the measurement inhibiting time is the time of burst timing added by the pull-in time.

SECTION 7
PERFORMANCE CHECK

7.1 When Performance Check Necessary

Performance checks are performed to check that the main performances of the MP1764C satisfy the ratings. Carry out the performance checks during receiving inspection, operation confirmation after repair, and periodic inspection (every six months).

The performance check items are shown below.

7.2 Test Equipment

The test equipment needed for performance check are shown in Table 7-1.

Table 7-1 Performance Check Test Equipment

Test equipment name (Anritsu)	**Required performance**	**Measurement item**
Pulse pattern generator (MP1763B/C)	Operating frequency: 50 MHz to 12.5 GHz Other performances: Equivalent to MP1763B/C	• Operating frequency • Input level • Pattern • Measurement items
Sampling oscilloscope	Bandwidth: 50 GHz minimum	

7.3 Check Method

Before starting performance checks, allow the MP1764C and the other test equipment to warm up for at least 30 minutes.

7.3.1 Operating frequency

(1) Rating

50 MHz to 12.5 GHz

(2) Setup

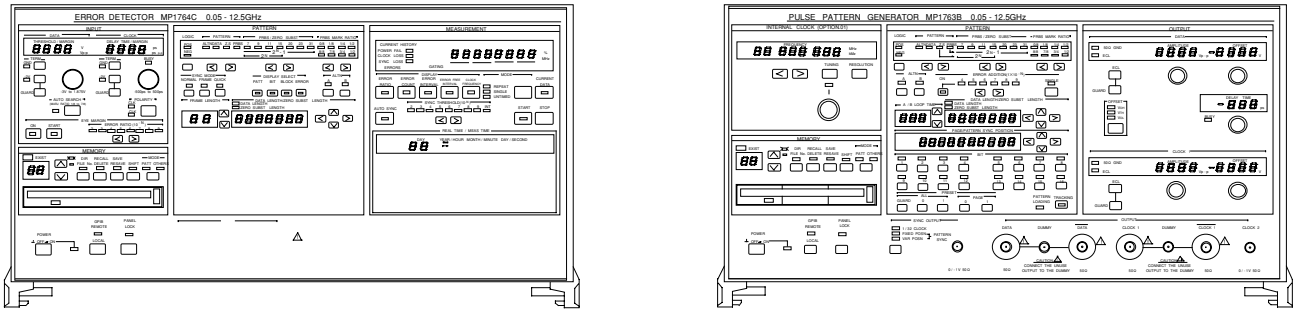


Fig. 7-1 MP1763B/C and MP1764C Setup

(3) Procedure

(a) Set up the equipment as shown in Fig. 7-1.

(b) While pressing the MP1763B/C and MP1764C LOCAL key, set the POWER switch to ON and place the instruments into the initialize state. Then, set the MP1763B/C OUTPUT to ON, and press the MP1764C AUTO SYNC key.

(c) Set the MP1763B/C FREQUENCY to an arbitrary value with the frequency setting knob.

(d) Press the MP1764C AUTO SEARCH key. At this time, check that the ERRORS lamp at the MP1764C display is not lit.

(e) Repeat steps (c), (d) and confirm that the MP1764C operates normally.

7.3.2 Input data level

(1) Rating

Amplitude : 0.25 to 2 Vp-p
Offset (V_{OH}) : –2 to +2 V
Threshold voltage : –3 to +1.875 V

(2) Setup

The setup method is the same as Paragraph 7.3.1(2) and is shown in Fig. 7-1.

(3) Procedure

(a) Set up the equipment as shown in Fig. 7-1.

(b) While pressing the MP1763B/C and MP1764C LOCAL key, set the POWER switch to ON and set the instruments to the initialize state. Then, set the MP1763B/C OUTPUT and the MP1764C AUTO SYNC to ON.

(c) When the following was effected, check that the ERRORS lamp is not lit. However, set the input clock and input data phase suitably with the DELAY TIME value setting knob.

Note: Since the MP1764C THRESHOLD value shown below is the logic value, measure the MP1763B/C data output level in advance with a calibrated sampling oscilloscope, then set the MP1764C THRESHOLD value to the correct value.

Item / Setting order	MP1763B/C		MP1764C	
	DATA		DATA	
	AMPLITUDE	OFFSET (V_{OH})	TERM	THRESHOLD
①	2.000 Vp-p	–2.000 V	GND	–3.000 V
②	0.250 Vp-p	–2.000 V	GND	–2.125 V
③	2.000 Vp-p	2.000 V	GND	1.000 V
④	0.250 Vp-p	2.000 V	GND	1.875 V
⑤	0.800 Vp-p	–0.900 V	–2 V	–1.300 V

7.3.3 Input clock level

(1) Rating

Amplitude : 0.25 to 2 Vp-p

Offset (V_{OH}) : –2 to +2 V

(2) Setup

The setup method is the same as Paragraph 7.3.1(2) and is shown in Fig. 7-1.

(3) Procedure

(a) Set up the equipment as shown in Fig. 7-1.

(b) While pressing the MP1763B/C and MP1764C LOCAL key, set the POWER switch to ON and set the instruments to the initialize state. Then, set the MP1763B/C OUTPUT and the MP1764C AUTO SYNC to ON.

(c) When the following was effected, confirm that the ERRORS lamp did not light. However set the input clock and input data phases suitably with the DELAY TIME setting knob.

Note: Since the MP1764C THRESHOLD value below is the logic value, measure the MP1763B/C data output level in advance with a calibrated sampling oscilloscope, then set the MP1764C THRESHOLD value to the correct value.

Item / Setting order	MP1763B/C		MP1764C
	CLOCK 1		CLOCK TERM
	AMPLITUDE	OFFSET (V_{OH})	
①	2.000 Vp-p	–2.000 V	GND
②	0.250 Vp-p	–2.000 V	GND
③	2.000 Vp-p	2.000 V	GND
④	0.250 Vp-p	2.000 V	GND
⑤	0.800 Vp-p	–0.900 V	–2 V

7.3.4 Pattern

(1) Rating

Pseudorandom (PRBS) pattern

Programmable (PRGM) pattern

Data mode Data length: 2 to 8388608 bits

(2) Setup

The setup method is the same as Paragraph 7.3.1(2) and is shown in Fig. 7-1.

(3) Procedure

(a) Set up the equipment as shown in Fig. 7-1.

(b) While pressing the MP1763B/C and MP1764C LOCAL key, set the POWER switch to ON and set the instruments to the initialize state. Then, set the MP1763B/C OUTPUT and the MP1764C AUTO SYNC to ON.

(c) Press the MP1764C AUTO SEARCH key.

(d) Set the MP1763B/C and MP1764C pattern mode to programmable data pattern and make the settings shown below. At this time, confirm that the ERRORS lamp does not light.

Setting order	Item		Setting
①	DATA LENGTH value		8
②	BIT key	1	ON (LED lit)
		2 to 8	OFF (LED off)

(e) Change the MP1763B/C and MP1764C pattern mode to PRBS 2^7–1, PRBS 2^9–1, PRBS 2^{11}–1, PRBS 2^{15}–1, PRBS 2^{20}–1, PRBS 2^{23}–1, and PRBS 2^{31}–1 and check that the ERRORS lamp does not light at each mode.

(f) Fix the MP1763B/C and MP1764C pattern mode at PRBS 2^{31}–1 and change the mark ratio 0/8, 1/8, 1/4, 1/2, 8/8, 7/8, 3/2, and $\overline{1/2}$ and check that the ERRORS lamp does not light at each mark ratio.

7.3.5 Measurement items

(1) Rating

Error rate	: 0.0000×10^{-16} to 1.0000×10^{-0}
Error count	: 0 to 9.9999×10^{16}
Error intervals I(EI)	: 0 to 9999999
Error free intervals (EFI)	: 0.0000 to 100.0000%
Clock frequency	: 50 MHz to 12.5 GHz
	Accuracy: ±(10 ppm+1 kHz)

(2) Setup

The setup method is the same as Paragraph 7.3.1(2) and is shown in Fig. 7-1.

(3) Procedure

(a) Set up the equipment as shown in Fig. 7-1.

(b) While pressing the MP1763B/C and MP1764C LOCAL key, set the POWER switch to ON and set the instruments to the initialize state. Set the MP1763B/C OUTPUT to ON, and the frequency to 10 GHz.

(c) Set the MP1764C AUTO SYNC to ON, and press the AUTO SEARCH key.

(d) Turn on the MP1763B/C error addition function. (Error addition: Single)

(e) Set the MP1764C measurement mode to SINGLE and set the measurement time to 10 seconds.

(f) Press the MP1764C START key. After the GATING lamp lights, press the MP1763B/C ERROR ADDITION SINGLE key once.

After the end of measurement (after 10 seconds), switch the DISPLAY key and check if each value shown below is displayed.

Error ratio	: 1.0000E–11
Error count	: 1
Error intervals	: 1
Error free intervals	: 99.9900 %
Clock frequency	: 9999.899 to 10000.101 MHz

SECTION 8
MAINTENANCE

8.1 Daily Maintenance

- Wipe external dirt with a cloth soaked in a diluted neutral detergent.
- Remove dust or specks by using a vacuum cleaner.
- Periodically clean the FDD head by using a 3.5-inch head-cleaning disk.
- If any loosened screws for attached parts are found, secure by using the specified tool.

8.2 Storage Precautions

(1) Store the unit after removing any dirt or dust.

(2) Do not store the unit in a place with a temperature of over +60 ˚C, under –20 ˚C, or with humidity of over 85 %.

(3) Do not store the unit in a place where it may be exposed to direct sunlight or dust.

(4) Do not store the unit in a place where it may be exposed to dew and active gas.

(5) Do not store the unit in a place where it may be oxidized or exposed to strong vibrations.

- **Recommended storage conditions**

When the unit is stored for a long period, we recommend observing the following conditions in addition to those discussed above:

1. Temperature :5 to 30 ˚C
2. Humidity :40 to 75 %
3. Place where the temperature and humidity are stable throughout the day.

8.3 Transportation

When transporting the unit, use the original packing material, if available. If not available, follow the packing procedures shown below. Wear clean gloves and handle equipment gently so as not to scratch or dent them.

(1) Wipe off dirt or dust on the unit surface with a dry cloth.

(2) Check for loosened or missing screws.

(3) Protect structural projections or any parts that can be easily damaged and cover the equipment with a polyethylene sheet. Cover with moisture-proof material.

(4) Put the covered equipment into a cardboard box and close with adhesive tape. Place into a wood box, or other, according to the distance or method of transportation.

(5) During transportation, keep the unit in the environmental conditions specified in “8.2 Storage Precautions”.

8.4 Calibration

Calibration of this unit should not be performed by other than Anritsu Corporation. We recommend periodic calibration to maintain performance.

8.5 Disposal

This unit contains a lithium battery. Be sure to follow the rules on disposal for each country and/or local government.

SECTION 9
TROUBLESHOOTING AND REPAIR

9.1 Before Considering Trouble

If the instrument is not operating properly for some reason, check it as follows:

- **Power is not turned on**

  Is the power cord loose? → Plug in firmly.
  ↓
  Is the fuse blown? → Replace the fuse.

- **Synchronization is not established.**

  Are the transmit and receive interfaces the same? → Check the set values and set them to the correct values.
  (Termination conditions, output level, offset, etc.)
  ↓
  Is the connection cable normal? → Change the cable.
  ↓
  Initialize the instrument. (Transmitter and receiver)
  Set the receiver the same as the transmitter.

- **Error added**

  Is the cable loose? → Retighten the connector.
  ↓
  Is Error addition OFF? → Set Error addition to OFF.
  ↓
  Are the phase margin and bias margin sufficient? → Adjust so that the phase and offset are suitably cut.

- **Floppy disk drive is not used.**

  Is the floppy disk normal ? → Use the normal floppy disk.
  ↓
  Is the head of floppy disk drive dusty ? → Clean head of floppy disk drive with 3.5 inch head cleaning disk set.

If the problem cannot be found from the above check items, contact the service section of Anritsu.

9.2 Fuse Replacement

Turn off the power switch, then disconnect the power cable plugged into the AC power inlet. Next, open the AC power fuse holder cover and replace the fuse with a spare.

APPENDIX A
PERFORMANCE TEST REPORT SHEET

Name : MP1764C Error Detector
Serial No. : _____
Ambient Temperature : _____˚C
Relative humidity : _____%

• Operating Frequency Test

Conditions	Criteria	Results
50 MHz	ERRORS lamp does not light up.	
1 GHz	Same as above	
3 GHz	Same as above	
5 GHz	Same as above	
12.5 GHz	Same as above	

• Input Data Level Test

Setting Order	Criteria	Results
<1>	ERRORS lamp does not light up.	
<2>	Same as above	
<3>	Same as above	
<4>	Same as above	
<5>	Same as above	

• Input Clock Level Test

Setting Order	Criteria	Results
<1>	ERRORS lamp does not light up.	
<2>	Same as above	
<3>	Same as above	
<4>	Same as above	
<5>	Same as above	

APPENDIX A PERFORMANCE TEST REPORT SHEET

• Pattern Test

Setting Order	Criteria	Result
<1>	ERRORS lamp does not lit.	
<2>	Same as above	
PRBS2^7-1	Same as above	
PRBS2^9-1	Same as above	
PRBS2^{11}-1	Same as above	
PRBS2^{15}-1	Same as above	
PRBS2^{20}-1	Same as above	
PRBS2^{23}-1	Same as above	
PRBS2^{31}-1	Same as above	
0/8	Same as above	
1/8	Same as above	
1/4	Same as above	
1/2	Same as above	
8/8	Same as above	
7/8	Same as above	
3/4	Same as above	
1/2	Same as above	

• Measurement Item Test

Condition	Criteria	Result
Error rate	1.0000E-11	
Number of Errors	1	
Error Interval	1	
Error-free Interval	99.9900 %	
Clock Frequency	9999.899 to 10000.101 MHz	

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