OPERATION MANUAL
ERROR DETECTOR
MP1702A

1990.07 Ver. I

ANRITSU CORPORATION

CERTIFICATION

ANRITSU CORPORATION certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All parts of this product are warranted by Anritsu Corporation of Japan against defects in material or workmanship for a period of one year from the date of delivery.
In the event of a defect occurring during the warranty period, Anritsu Corporation will repair or replace this product within a reasonable period of time after notification, free-of-charge, provided that: it is returned to Anritsu; has not been misused; has not been damaged by an act of God; and that the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and is not transferable if it is resold.

ALL OTHER EXPRESSED WARRANTIES ARE DISCLAIMED AND ALL IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY. IN NO EVENT SHALL ANRITSU CORPORATION BE LIABLE TO THE CUSTOMER FOR ANY DAMAGES, INCLUDING LOST PROFITS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, ARISING OUT OF THE USE OR INABILITY TO USE THIS PRODUCT.

All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to Anritsu Corporation or its representative in your area.

WARNING

NO OPERATOR SERVICEABLE PARTS INSIDE.
REFER SERVICING TO QUALIFIED PERSONNEL.

CAUTION

FOR CONTINUED FIRE PROTECTION REPLACE
ONLY WITH SPECIFIED TYPE AND RATED FUSE.

Note 1:

1. The instrument is operable on a nominal voltage of 100 to 127 Vac (AC 100 V system) or 200 to 250 Vac (AC 200 V system) by setting the AC 100 V/AC 200 V switch under the left side cover.

   The voltage and current ratings are indicated on the rear panel when the instrument is shipped from the factory.

   To operate on the other voltage system, change the AC 100 V/AC 200 V switch setting. The plate on the rear panel indicating the voltage and current ratings should be changed to the appropriate one. Order the plate from ANRITSU CORPORATION if needed.

2. In this manual, the power supply voltage and current ratings are represented by **Vac and ***A, respectively.

3. The relationship between power supply voltage and current ratings is shown below.

**Vac	***A
100 to 127 V (AC 100 V system)	8 A
200 to 250 V (AC 200 V system)	6.3 A

Note 2:

WARNINGs, ***CAUTION***s, ***Note***s, and Explanatory footnotes are used in this manual. Their meanings are given below:

WARNING:	***WARNING is used when there is a personal injury hazard.***
CAUTION:	***CAUTION is used when the equipment may be damaged.***
Note:	Note is used to provide information about exceptions, corrections, and restrictions.
Explanatory footnote:	Explanatory footnotes provide comments on the same page as the text, figure or table. They are referenced by either an asterisk (*) or by combination of an asterisk and numeral.

Note 3:

STORAGE MEDIUM

This equipment stores data and programs using floppy disk.

Data and programs may be lost due to improper use or failure.

ANRITSU therefore recommends that you back-up the memory.

ANRITSU CANNOT COMPENSATE FOR ANY MEMORY LOSS.

Please pay careful attention to the following points. Do not remove the floppy disk while it is being accessed.

For details refer to the relevant operation manual.

(Floppy disk)

- Observe the specified environmental conditions. Also, do not use the equipment in a dusty place.
- Keep magnetic objects away from the disk. Do not bend the disk.
- Insert the head protection sheet into the disk slot when moving the equipment.
- Operate the disk in a temperature range of 5° to 45°C.

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SECTION 1
GENERAL

1.1 General Description of Equipment

The MP1702A Error Detector operates at frequencies of 50 MHz to 10 GHz. It is used with the MP1701A to test high-speed telecommunications systems and high-speed semiconductors.

The MP1702A input data threshold voltage (-3 to $+1.75$ V) can be set in 2 mV steps, and the input clock phase (-500 to $+500$ ps) can be set in 1 ps steps.

There are two measurement patterns: pseudorandom (1 period 2^N-1: where N = 7, 9, 11, 15, 20, 23 and 31), and programmable (maximum length 512 Kbits). The MP1702A has three error detection modes: total error, insertion error and omission error.

The measurement items are error ratio, number of errors (error count), number of error intervals (EI), error-free interval (EFI) ratio as well as clock frequency; the results of these error measurements are displayed on a digital display.

In addition, the measurement results (error ratio, error count, EI, EFI, alarm time) can be printed-out via the built-in printer along with the threshold EI/EFI data and error performance data.

The MP1702A input data threshold voltage and input clock phase can be set automatically with the auto search function. The MP1702A also has functions for transferring its pattern setting data to the MP1701A and for tracking the pattern setting.

Furthermore, the MP1702A can store data about the set patterns and each setting parameter on a 3.5-inch floppy disk; these stored data can be recalled and used for setting. The MP1702A has a GP-IB interface conforming to IEEE Std.488.2 by which it can be controlled remotely. It also has a DMA receiver function for transferring pattern data from a controller by DMA.

1.2 Manual Composition

This manual and the separate GP-IB Operation Manual apply to the MP1702A. When controlling the MP1702A remotely via the GP-IB, refer to the MP1702A/MP1609A/MP1651A GP-IB Operation Manual.

This operation manual is composed of eight sections. The contents of which are outlined below.

SECTION 1 describes the outline of the equipment, the manual composition, the equipment composition, the application parts and peripheral devices, the selection guide, and the specifications.

SECTION 2 describes the environmental conditions at the installation location, the safety precautions, the power supply voltage, the internal battery life, and countermeasures to prevent damage.

SECTION 3 describes the front and rear panels.

SECTION 4 describes the basic setup, power-on and initial operation settings.

SECTION 5 describes the operation of the front and rear panels in detail.

SECTION 6 describes a device measurement example.

SECTION 7 describes the performance test.

SECTION 8 describes regular care, maintenance, and transportation procedures.

1.3 Composition

Table 1-1 shows the standard composition of the MP1702A.

Table 1-1 Standard Composition

Item	Model No./ Order No.	Name	Qty.	Remarks
Instrument		MP1702A error detector	1	
Accessories supplied	F0071 or F0014	Fuse	2	8A (MF51NR8A, for 100 Vac system) or 6.3A (T6.3A 250 V, for 200 Vac system)
	J0500A	Semirigid cable	2	SMA-P — *1 SX-36, 50 cm — SMA-P
	J0500B	Semirigid cable	2	SMA-P — *1 SX-36, 1m — SMA-P
	J0515	Coaxial cable	2	HRM 202B — RG58A/U, 1m — HRM 202B
	J0127B	Coaxial cable	2	BNC-P — RG58A/U, 2m — BNC-P
	J0496	Adaptor	6	APC3.5 J-J connector
	Z0168	3.5 inch floppy disk	2	MF 2HD – 3.5 MF *2
	J0008	GP-IB cable	1	2 m, 408JE-102
	J0491	Power cord	1	2.6 m, shielded, 13 A
	Z0169	Thermal printer paper	2	
	W0577AE	Operation manual	1	
	W0576AE	GP-IB operation manual	1	

*1 UT-141AA equivalent semirigid cable

*2 3.5-inch floppy disks are formatted.
Stores the PRBS 2^{10}-1 equivalent (mark ratio 1/2, 1/4, 1/8) patterns that can be generated by the Anritsu MP1601A and MP1604A Pulse Pattern Generators in one disk.
Another disk is empty.

1.4 Optional Accessories and Peripheral Devices

Table 1-2 lists the optional accessories and peripheral devices (sold separately) for the MP1702A.

Table 1-2 Optional Accessories and Peripheral Devices

Item	Model No./ Order No.	Name	Remarks
Optional accessories	J0500A	Semirigid cable, 0.5 m	SMA-P·SX-36·SMA-P
	J0500B	Semirigid cable, 1 m	SMA-P·SX-36·SMA-P
	J0322A	Coaxial cable, 0.5 m	SUCOFLEX 104, 11SMA-11SMA
	J0322B	Coaxial cable, 1 m	SUCOFLEX 104, 11SMA-11SMA
	J0498	Coaxial cable, 0.5 m	APC 3.5-P·double-shielded coaxial cable·APC 3.5-P
	J0499	Coaxial cable, 1 m	APC 3.5-P·double-shielded coaxial cable·APC 3.5-P
	J0515	Coaxial cable, 1 m	HRM202B·RG58A/U·HRM202B
	J0127B	Coaxial cable, 2 m	BNC-P·RG58A/U·BNC-P
	J0007	GP-IB cable , 1 m	408 JE-101
	J0008	GP-IB cable, 2 m	408 JE-102
	J0496	APC3.5 J-J	
	Z0168	3.5-inch floppy disk	MF 2HD-3.5MF
	Z0169	Thermal printer paper	
	MB24B	Portable Test Rack	20 A power cord with plug
	B0163	Soft Carrying Case	
	B0171	Protective carring case	
	B0044	Rack mount kit (Cabinet width: 1MW, Screw: 5U)	2 pieces/1 unit
Peripheral devices		PACKET V Personal Technical Computer	Controller for automatic measurement system

1.5 Specifications

Table 1-3 Specifications

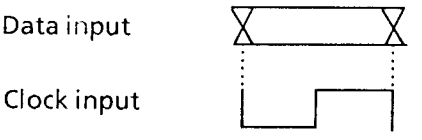
Operation frequency		0.05 to 10 GHz
Data input	Input waveform	NRZ
	Input voltage	0.5 to 2.0 Vp-p
	Offset voltage	−2 to +2 V (V_{IH})
	Threshold voltage variable range	−3.00 to +1.75 V (2 mV step)
	Termination	50 Ω, connected to GND (other than ECL) or to −2 V (ECL)
	Connector	APC-3.5
Clock input	Input waveform	RZ (duty factor: 50%)
	Input voltage	0.5 to 2.0 Vp-p
	Offset voltage	−2 to +2 V (V_{IH})
	Input delay variable range	−500 to +500 ps (1 ps steps)
	Polarity inversion	CLOCK/$\overline{\text{CLOCK}}$ inversion possible
	Termination	50 Ω, connected to GND (other than ECL) or to −2 V (ECL)
	Connector	APC-3.5
Optimum phase relationship between data and clock		Optimum when data conversion delay time is 0 ps and CLOCK polarity is normal. 
Automatic input data threshold/clock delay search function		Provided, Voltage/delay (vertical/horizontal axis)

Table 1-3 Specifications (Continued)

Receive pattern	Pseudo-random binary sequence pattern (PRBS)	Pattern	2^n-1 (n: 7, 9, 11, 15, 20, 23, 31)
		Mark ratio	1/2, 1/4, 1/8, 0/8 (1/2, 3/4, 7/8, 8/8 are possible with logic inversion)
		Number of AND bits shifted when setting the mark ratio	1, 3 bits (Selectable by using DIP switch on rear panel)
	Data pattern	Data length	2 to 524288 bits (See Table 1-4 for restrictions.)
		Pattern reset/preset	ALL/PAGE
	Word pattern	Word length	2 to 16 bits
		Number of words	1 to 32768 (See Table 1-5 for restrictions.)
		Pattern reset/preset	ALL/PAGE
	Logic polarity		Positive or negative
	Tracking		Information about pattern set by the Error Detector is sent to the Pulse Pattern Generator via GP-IB
Sync. mode	Normal		Valid for PRBS and programmable pattern, pattern sync bits for all patterns
	Frame		Valid for programmable pattern of more than 1024 bits, pattern sync bits for only frame bits
	Frame bit length		4 to 32 bits (4-bit steps)
Error detection mode			Omission, insertion, total (selectable with DIP switch on rear panel)
Measurement channel mask function			8 or 16 error count output channels are selectable, any channel can be selected via the DIP switches on rear panel.
Measure-ment item	Error rate		0.0000×10^{-16} to 1.0000×10^{-0}
	Number of errors		0 to 9.9999×10^{16}
	Error interval (EI)		0 to 9999999 (1 second interval, asynchronous)
	Error free interval (EFI)		0.0000% to 100.0000%
	Clock frequency		0.05 to 10 GHz Resolution: 1 kHz Error: ± (10 ppm + 1 kHz)

Table 1-3 Specifications (Continued)

Error performance data calculation function				Provided (Results are output to built-in printer or external instruments via GP-IB)
Current data	Display cycle			01, 0.2, 0.5 s (selectable with rear panel DIP switch)
	Display mode			INTERVAL/CYCLE (selectable with rear panel DIP switch)
Measurement mode				Repeat, single, manual
Measurement time				1 s to 99 days 23 hours 59 minutes 59 seconds (1 second steps)
Timer				Year, month, day, hour, minute, second
Auxiliary output	DEMUX output	Number of outputs		2 (1/2 DEMUX output)
		Output level		V_{OH}: −0.2 to +0.1 V, V_{OL}: −0.5 ±0.15 V
		Connector		SMA-type
	Sync. signal output	Number of outputs	Pattern	1
			Clock	1 (1/32 clock)
		Level		V_{OH}: 0 V ±0.1 V, V_{OL}: −1 ±0.1 V
		Connector		BNC-type
	1/8 SPEED output	Number of outputs		CLOCK: 1, DATA: 8
		Level		ECL
		Rise/fall time		≦500 ps (20% to 80% of amplitude)
		Skew		≦ ±200 ps referred to 1/8 clock fall edge
		Connector		SMA-type
	ORED ERROR output (DIRECT)	Logic		−1 V/50 Ω at error
		Level		V_{OH}: 0 ±0.1 V, V_{OL}: −1 ±0.1 V
		Connector		SMA-type
	ORED ERROR output (STRETCHED)	Logic		Low level at error (typical pulse width: 250 ns)
		Level		TTL
		Connector		BNC-type

Table 1-3 Specifications (Continued)

Auxiliary output (cont'd)	Alarm output	Output condition/ logic	Low level at power recovery, clock loss, and sync loss
		Level	TTL
		Connector	BNC-type
	Frame sync. output	Level	V_{OH}: 0 ±0.1 V, V_{OL}: −1 ±0.1 V
		Connector	SMA-type
External mask input		Level	V_{OH}: 0 ±0.1 V, V_{OL}: −1 ±0.1 V
		Connector	SMA-type
Display	Measurement results		7 segments, 7 digit
	Gate time		12-segment bar graph
	Alarm	Error occurence	Red lamp comes on.
		Clock loss	Orange lamp comes on.
		Sync. loss	Orange lamp comes on.
Built-in printer	Font		9 × 8 dot matrix
	Number of characters		24 characters/line
	Printing method		Thermal
Audible alarm			Provided (error/alarm indicator)
External control			GP-IB IEEE 488.2
Ambient temperature, rated range of use			0° to 50°C (However, 5° to 45°C for parameter memory floppy disk)
Para-meter memory	Media		3.5 inch floppy disk (2HD or 2DD)
	Format		MS-DOS, Rev. 3.1
	Memory capacity		1.6 Mbytes (when unformatted for 2HD-type) 1.0 Mbytes (when unformatted for 2DD-type) Note: This instrument can format only 2HD-type floppy disks. To format 2DD-type floppy disks, use a personal computer with 9 sectors/track MS-DOS disk formatting option.
	Data that can be stored		Programmable pattern and parameters

Table 1-3 Specifications (Continued)

Power	**Vac ±10%,50/60 Hz, ≦700 VA
Dimensions and weight	221 H × 426 W × 450 mm, ≦35 kg

Table 1-4 Data Length and the Step Width

Data length	Step width
2 to 4096	1 step
4224 to 524288	128 step

Table 1-5 Word Length and Number of Words

Word length N	Number of words M			
	Range	Step width	Range	Step width
2	1 to 2048	1 step	2112 to 32768	64 step
3	1 to 1365	1 step	1408 to 32768	128 step
4	1 to 1024	1 step	1056 to 32768	32 step
5	1 to 819	1 step	896 to 32768	128 step
6	1 to 682	1 step	704 to 32768	64 step
7	1 to 585	1 step	640 to 32768	128 step
8	1 to 512	1 step	528 to 32768	16 step
9	1 to 455	1 step	512 to 32768	128 step
10	1 to 409	1 step	448 to 32768	64 step
11	1 to 372	1 step	384 to 32768	128 step
12	1 to 341	1 step	352 to 32768	32 step
13	1 to 315	1 step	384 to 32768	128 step
14	1 to 292	1 step	320 to 32768	64 step

Table 1-5 Word Length and Number of Words (Continued)

Word length N	Number of words M			
	Range	Step width	Range	Step width
15	1 to 273	1 step	384 to 32768	128 step
16	1 to 256	1 step	264 to 32768	8 step

SECTION 2
PREPARATIONS

2.1 Installation Conditions

The operating temperature range of the MP1702A is 0° to 50°C (memory floppy disk: 5° to 45°C). Its storage temperature range is −40° to 70°C.

Use and store the MP1702A within these ranges.

Do not use or store 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 reactive gases.

Long-term storage at high temperature will increase the discharge rate of the internal battery. Store the instrument below room temperature.

2.2 Safety Measures

- Use the supplied power cord accessory to connect the instrument to the ac power supply.

  Ground either the ground terminal of the power cord or the frame ground terminal on the rear panel.

- Turn off the POWER switch and disconnect the power cord from the socket before changing the fuse.

  Use a fuse of the same rating.

- If the MP1702A 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 Supply Voltage

The power supply voltage rating for the MP1702A is shown on the rear panel. Always use a voltage within the rated voltage range. Excessive voltage may damage the circuits.

2.4 Internal Battery Life

The MP1702A uses lithium primary cells as the timer and memory back-up power supply. The life of the cells depends on the temperatures at which the instrument is stored. It is more than 10 years for storage at room temperature.

Storage at high temperature for long periods will shorten the battery life.

Replace discharge cells: they cannot be recharged.

2.5 Damage Prevention Measures

- When applying signals to the MP1702A, never apply an excessive voltage because the circuits may be damaged.
- The output is terminated at 50 Ω. Do not feed a reverse current into the output terminal. The load must have an effective resistance of 50 Ω, and should be terminated to ground.
- Always ground the equipment to be connected (including the device under test) to a common earth ground before connecting the input and output terminals.
- Since the outer shielding and center conductors of a coaxial cable act like a capacitor, discharge the shield and center conductors by shorting them together with a piece of metal.

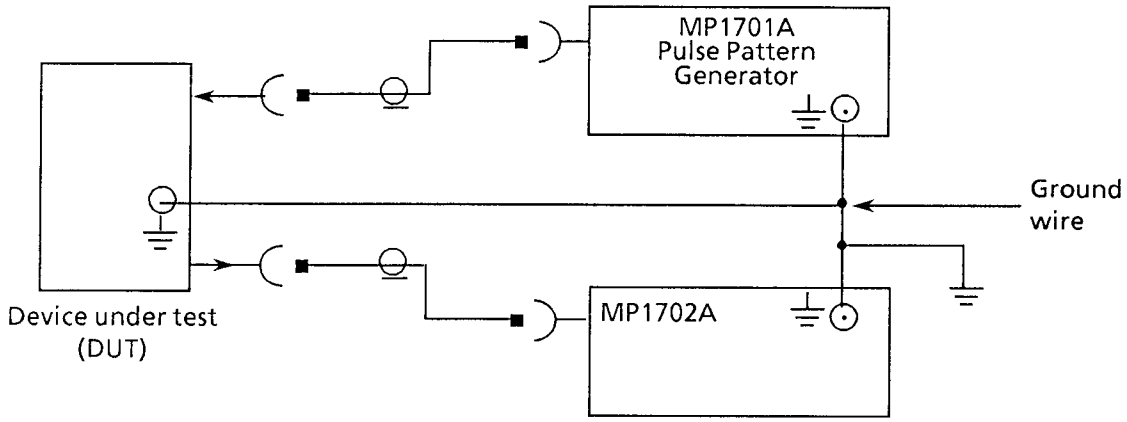


Fig. 2-1 Grounding and Cable Discharging

- The bottom section of the MP1702A includes hybrid ICs and important circuits and parts which are susceptible to static electricity. Do not open it.
- The hybrid ICs used in the MP1702A are air-tight. Do not open them. If they are opened and then do not perform satisfactorily, maintenance service may be refused.

SECTION 3
FRONT AND REAR PANELS

Table 3-1 describes the front and rear panels.

Figure 3-1 shows the front panel. Refer to Fig. 3-2 for the INPUT section, Fig. 3-3 for the MEMORY section, Fig. 3-4 for the PATTERN section, and Fig. 3-5 for the MEASUREMENT section.

Figure 3-6 shows the rear panel.

Table 3-1 Panel Explanation (1/13)

No.	Label		Function
①	POWER	OFF ON	Power switch and LED
②	GP-IB	REMOTE	LED lit in GP-IB remote control state
		LOCAL	Key for manually switching from GP-IB remote state to local state. When POWER switch ① is set to ON while [LOCAL] is pressed, the MP1702A is set to the initial settings (refer to paragraph 4.2.) rather than recalling the most recent settings.
③	PANEL LOCK		The [PANEL LOCK] LED is lit when [PANEL LOCK] is in the locked state. In the panel-lock state, all the front-panel keys except those listed below are disabled. • POWER switch ① • [LOCAL] ② • [PANEL LOCK] ③ • [PRINTER ON] ⑧ • [MANUAL PRINT] ⑧ • [ALARM] ⑨ • [ERRORS] ⑨ • [GUARD] ㉑, ㉟, ㊳

Table 3-1 Panel Explanation (2/13)

No.	Label		Function
④	INPUT	DATA ⚠ 0.5 – 2.0 Vp-p/50 Ω	Data input connector
		TERM	LED for input-data termination voltage (GND or – 2 V)
		GND – 2 V	Select with [TERM] ㉟
		CLOCK ⚠ 0.5 – 2.0 Vp-p/50 Ω	Clock input connector
		TERM	LED for input-clock termination voltage (GND or – 2 V)
		GND – 2 V	Select with [TERM] ㊳
⑤	DEMUX OUTPUT DEMUX A 0/– 0.5 V 50 Ω DEMUX B 0/– 0.5 V 50 Ω		1/2 DEMUX data output connector (Refer to paragraph 5.9.)
⑥	SYNC OUTPUT	1/32 CLOCK 0/– 1 V 50 Ω	1/32 CLOCK output connector
		PATTERN 0/– 1 V 50 Ω	PATTERN SYNC output connector (Refer to paragraph 5.10.)
⑦	MEASURE CH MASK ON		LED lit when MEASURE CH MASK SELECT switch ㊸ is set to ON for 1 or more channels (Refer to paragraph 5.3.2.)
⑧	PRINTER (Refer to paragraph 5.6)	ON	When the PRINTER [ON] key is pressed, the built-in printer is set to ON and the LED lights. The LED flashes when the end of paper is reached or when the printer goes offline.
		MANUAL PRINT	Intermediate data can be printed by pressing this key. However, this function is only enabled when PRINTER [ON] is set to ON.

Table 3-1 Panel Explanation (3/13)

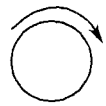
No.	Label			Function
⑨	ALARM MONITOR (Refer to paragraph 5.3.8)	ALARM ERRORS		Key to select audible alarm condition (below) and LEDs • At alarm detection • At error detection • At both alarm and error detection (Alarm: Generated on sync loss, clock loss, power recovery, or when end paper is reached at built-in printer)
		 (Knob)		Audible-alarm volume adjustment
⑩	DISPLAY/ MODIFY	REAL TIME	Y.M.D	Key to set or display year, month and day; and LED
			H.M.S	Key to set or display hour, minute and second; and LED
		MEAS TIME	PERIOD	Key to set or display measurement time; and LED
			TIMED	Key to display remaining measurement time; and LED
			ELAPSED	Key to display elapsed measurement time; and LED
⑪	MODIFY			Key to modify and set calendar time or measurement time; and LED (Refer to paragraph 5.4.)
⑫				Key to decrease/increase calendar time or measurement time settings
⑬	START STOP			Key to start/stop measurements; and LED (Refer to paragraph 5.3.4.)
⑭	AUTO SYNC			Key to switch pattern AUTO SYNC function ON/OFF, and LED (refer to paragraph 5.3.7.)

Table 3-1 Panel Explanation (4/13)

No.	Label		Function
⑮	CURRENT DATA		Key to enable/disable (intermediate) data display, and LED (Refer to paragraph 5.3.6.)
⑯	(7-segment display) % MHz		Display for results of measurements and for % or MHz units, selected via [DISPLAY] keys ⑰ (Refer to paragraph 5.3.5.)
	HISTORY		HISTORY LED: displays past error conditions Real time LED: displays current conditions
	POWER FAIL		This LED indicates the occurrence of momentary power loss or power failure (History LED only)
	CLOCK LOSS		This LED indicates the occurence of clock-loss
	SYNC LOSS		This LED indicates the occurrence of sync-loss (Refer to paragraph 5.3.9 (2).)
	ERRORS		This LED indicates occurrence of errors (Refer to paragraph 5.3.9 (1).)
	GATING		12-segment LED bar graph indicating elapsed measurement time One segment of the LED bar graph lights when 1/12th of the measurement time has elapsed. However, in the UNTIMED mode, at the start of measurement, the left 6 LEDs light and remain lit until measurement is completed.
⑰	DISPLAY (Refer to paragraph 5.3.5.)	ERROR RATIO	Key to display error ratio, and LED
		ERROR COUNT	Key to display number of errors, and LED
		ERROR INTERVAL	Key to display number of error intervals (EI), and LED
		ERROR FREE INTERVAL	Key to display error-free interval (EFI) ratio, and LED
		CLOCK FREQUENCY	Key to display clock frequency, and LED

Table 3-1 Panel Explanation (5/13)

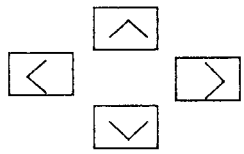
No.	Label			Function
⑱	MODE (Refer to paragraph 5.3.3.)	REPEAT		Key to select REPEAT measurement mode, and LED
		SINGLE		Key to select SINGLE measurement mode, and LED
		UNTIMED		Key to select MANUAL measurement mode, and LED
⑲	(7-segment display) DAY YEAR/HOUR MONTH/MINUTE DAY/SECOND			Display for real time or measurement time, as selected by [DISPLAY/MODIFY] ⑩
⑳				Keys to select setting position for real time or measurement time displayed on ⑲
㉑	PRESET (Refer to paragraph 5.2.3.)	ALL	GUARD	Guard switch for ALL 0 or ALL 1 setting To use these pattern, press [ALL 0] or [ALL 1] while holding the [GUARD] key down.
			ALL 0	Key to set all programmable-pattern bits to 0
			ALL 1	Key to set all programmable-pattern bits to 1
		PAGE	0	Key to set all bits on one page of programmable-pattern to 0
			1	Key to set all bits on one page of programmable-pattern to 1
㉒	BIT			Programmable-pattern setting keys and LEDs (Refer to paragraph 5.2.1 (4).)
㉓				Key to specify page of pattern to be set with [BIT] ㉒

Table 3-1 Panel Explanation (6/13)

No.	Label	Function
㉔	PATTERN LOADING	LED lit during pattern loading
㉕	TRACKING ON	Key to enable/disable pattern tracking function, and LED (Refer to paragraph 5.2.7.)
㉖	MARK RATIO < >	Key to switch pseudorandom (PRBS)-pattern mark ratio (Refer to paragraph 5.2.5.)
㉗	LOGIC POS, NEG	LEDs indicating pattern logic selection with [LOGIC] ㉘.
	PROG WORD, DATA PRBS 7, 9, 11, 15, 20, 23, 31 2^N-1	LEDs indicating pattern selected with pattern selection keys ㉙.
	MARK RATIO 0/8 1/8 1/4 1/2 8/8 7/8 3/4 1/2	LEDs indicating PRBS-pattern mark ratio selected with mark ratio selection keys ㉖ or [LOGIC] ㉘.
㉘	LOGIC	Key to switch porality of pattern output logic (refer to paragraph 5.2.6.)
㉙	< >	Pattern selection keys (Refer to paragraph 5.2.1 (1), 5.2.2 (1) and 5.2.5 (1).)
㉚	FRAME SYNC	Key to enable/disable frame pattern sync function, and LED (refer to paragraph 5.2.4.)
㉛	FRAME/WORD LENGTH	Key to switch frame or word length display
㉜	DATA LENGTH NUMBER OF WORD (7-segment display, 6 digits)	7-segment display and LEDs indicating programmable-pattern data length or number of words, as set by the keys in ㉞.
	FRAME WORD (7-segment display, 2 digits)	7-segment display and LED indicating the frame length or word length as set by the keys in ㉝.
	PAGE (7-Segment display, 5 digits)	Display for number of pages Set with page No. specfication key ㉓.

Table 3-1 Panel Explanation (7/13)

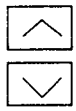
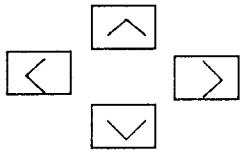
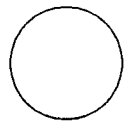
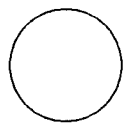
No.	Label	Function
㉝		Frame length or word length setting keys
㉞		Data length or number of words setting keys
㉟	TERM GND −2 V GUARD	Key to select input-data termination voltage (GND or −2 V), and LEDs (Refer to paragraph 5.1.1.)
㊱	 −3 V to 1.75 V	Input-data threshold-voltage setting knob (Refer to paragraph 5.1.1.)
㊲	AUTO SEARCH (MARK RATIO 1/8 to 7/8)	Key to enable/disable AUTO SEARCH function (Refer to paragraph 5.1.5.)
㊳	TERM GND −2 V GUARD	Key to select input-clock termination voltage (GND or −2 V), and LEDs (Refer to paragraph 5.1.2.)
㊴	POLARITY CLK $\overline{\text{CLK}}$	Key to reverse input-clock polarity, and LEDs (Refer to paragraph 5.1.3.)
㊵	 −500 ps to 500 ps	Delay-time setting knob for iput clock (Refer to paragraph 5.1.4.)
㊶	BUSY	LED lit when input-clock delay-time setting circuit is unlocked
㊷	DELAY TIME ps	7-segment display indicating input-clock delay time
㊸	DATA THRESHOLD V	7-segment display indicating input-data threshold voltage
㊹		Floppy disk drive

Table 3-1 Panel Explanation (8/13)

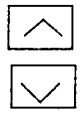
No.	Label	Function
㊺	DIR FILE No.	Key to change display mode of file or directory, and LED (Refer to paragraph 5.5.5.)
㊻	RECALL DELETE	Key to recall or delete (in SHIFT mode) memory contents, and LED (Refer to paragraphs 5.5.4, 5.5.7, and 5.5.8.)
㊼	SAVE RESAVE	Key to save or resave (in SHIFT mode) file, and LED (Refer to paragraphs 5.5.3 and 5.5.6.)
㊽	SHIFT	Key to enable SHIFT mode, and LED (Refer to paragraphs 5.5.6 and 5.5.7.)
㊾	MODE PTN OTHERS	Key to switch from MEMORY mode to PATTERN mode or to OTHERS mode, and LEDs (Refer to paragraph 5.5.2.)
㊿		File number setting keys
(51)	EXIST	LED indicating presence of saved file (Refer to paragraph 5.5.5.)
(52)	(7-segment display: 2 digits)	Display for file number or error code
(53)	EXT MASK INPUT 0/−1 V 50 Ω	External mask-signal input connector Detected errors are masked while input level is low (− 1 V).
(54)	FRAME SYNC OUTPUT 0/−1 V 50 Ω	Frame sync signal output connector (Refer to paragraph 5.12.)

Table 3-1 Panel Explanation (9/13)

No.	Label			Function
(55)	FUNCTION 1	1	BIT SHIFT NUMBER FOR MARK RATIO VARIED	Selection switch for number of AND bits to be shifted for mark ratio setting (Refer to paragraph 5.2.5 (3).) 0: 1 bit 1: 3 bits
		2	CLOCK LOSS EVALUATION	Selection switch for clock-loss processing function (Refer to paragraph 5.8 (2).) 0: Clock-loss not evaluated 1: Clock-loss evaluated
		3	SYNC LOSS EVALUATION	Selection switch for sync-loss processing function (Refer to paragraph 5.8 (3).) 0: Sync-loss not evaluated 1: Sync-loss evaluated
		4	ERROR PERFORMANCE THRESHOLD	Error-performance-threshold selection switch (Refer to paragraph 5.7.4.) 0: 10^{-3} 1: 10^{-4}
		5	ERROR RATIO DISPLAY	Selection switch for setting the number of digits on the measurement result display (16). (Refer to paragraph 5.3.5 (1) and (2).) 0: 5-digit display 1: 2-digit display
		6	CURRENT DATA CALCULATION	Selection switch for displaying the calculation mode for intermediate measurement data when [CURRENT DATA] (15) is set to ON. (Refer to paragraph 5.3.6.) 0: Interval mode 1: Cycle mode

Table 3-1 Panel Explanation (10/13)

<table>
<tr><th>No.</th><th colspan="3">Label</th><th>Function</th></tr>
<tr><td rowspan="2">⑤⑤</td><td rowspan="2">FUNCTION 1
(continued)</td><td>7,8</td><td>ERROR</td><td>Error-detection-mode selection switch (Refer to paragraph 5.3.1.)
<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>CURRENT
DATA
INTERVAL</td><td>Selection switch for displaying the cycle time of intermediate measurement data when [CURRENT DATA] ⑮ is set to ON (Refer to paragraph 5.3.6.)
<table><tr><th>SW9</th><th>SW10</th><th>Cycle time</th></tr><tr><td>0</td><td>0</td><td>100 ms</td></tr><tr><td>0</td><td>1</td><td>200 ms</td></tr><tr><td>1</td><td>0</td><td>500 ms</td></tr><tr><td>1</td><td>1</td><td>100 ms</td></tr></table></td></tr>
<tr><td>⑤⑥</td><td colspan="2">ALARM
OUTPUT

TTL</td><td>Alarm output connector
Low-level pulse is output at power recovery, clock loss, and sync loss.</td></tr>
<tr><td rowspan="2">⑤⑦</td><td rowspan="2">ORED
ERROR
OUTPUT
(Refer to paragraph 5.13.)</td><td>(STRETCHED)

TTL</td><td>Stretched error output connector
Low at ERROR (Pulse width is 250 ns typ.)</td></tr>
<tr><td>(DIRECT)

0/−1 V 50 Ω</td><td>Director error output connector
Low at ERROR (−1 V (50Ω) at ERROR)</td></tr>
</table>

Table 3-1 Panel Explanation (11/13)

<table>
<tr><th>No.</th><th colspan="3">Label</th><th>Function</th></tr>
<tr><td rowspan="8">⑤⑧</td><td rowspan="8">FUNCTION 2
(Refer to
paragraph 5.6)</td><td>1</td><td>SHORT FORM OUTPUT</td><td>Switch to change measurement data print format.
0: Standard format
1: Short (abridged) format</td></tr>
<tr><td>2</td><td>THRESHOLD EI, EFI DATA</td><td>Selection switch to print or not print threshold EI and EFI data
0: Not printed
1: Printed</td></tr>
<tr><td>3</td><td>ERROR PERFORMANCE DATA</td><td>Selection switch to print or not print error performance data
0: Not printed
1: Printed</td></tr>
<tr><td>4</td><td>INTERMEDIATE DATA</td><td>Selection switch to print or not print intermediate data
0: Not printed
1: Printed</td></tr>
<tr><td>5</td><td rowspan="3">ONE SEC-OND DATA</td><td>OUTPUT</td><td>Switch to print or not print one-second data
0: Not printed
1: Printed</td></tr>
<tr><td>6,7</td><td>OUTPUT THRES-HOLD</td><td>Switch to select threshold for printing one-second data
<table>
<tr><th>SW6</th><th>SW7</th><th>Error threshold</th></tr>
<tr><td>0</td><td>0</td><td>>0</td></tr>
<tr><td>0</td><td>1</td><td>$>10^{-6}$</td></tr>
<tr><td>1</td><td>0</td><td>$>10^{-4}$</td></tr>
<tr><td>1</td><td>1</td><td>$>10^{-3}$</td></tr>
</table></td></tr>
<tr><td>8</td><td>PAPER SAVING</td><td>Selection switch for printer-paper saving
0: Paper not saved
1: Paper saved</td></tr>
</table>

Table 3-1 Panel Explanation (12/13)

No.	Label			Function
⑱	FUNCTION 2 (continued)	9	MEASURE-MENT RESULT DATA REQUEST	Selection switch for requesting or not requesting measurement-result data 0: Data not requested 1: Data requested
		10	DMA PATTERN TRACKING	Selection switch for transmitting or not transmitting pattern-data from pattern tracking by DMA 0: Transmitted by DMA 1: Not transmitted by DMA
⑲	AC ** V			Power inlet
⑳	*** A			Fuse holder (*** A, 2 fuses)
㉑				Frame ground terminal
㉒	1/8 SPEED OUTPUT (ECL to −2 V) ⚠	CLOCK 50Ω		1/8-speed clock-signal output connector
		DATA 1 2 3 4 50Ω 50Ω 50Ω 50Ω 5 6 7 8 50Ω 50Ω 50Ω 50Ω		1/8-speed data-signal output connector (Refer to paragraph 5.11.)

Table 3-1 Panel Explanation (13/13)

No.	Label		Function
⑥③	MEASURE CH MASK SELECT		ON/OFF switch for error-counter mask function (Refer to paragraph 5.3.2.)
		LENGTH 16 8	Switch to change error-counter mask routing to 8 or 16 routes
		SET 9 – 16 1 – 8	Switch to change error-counter mask switches shown below for 1 to 8 routes or 9 to 16 routes
		1 2 3 4 ON OFF	Error-counter mask switches
		5 6 7 8 ON OFF	
		1 2 3 4 (9) (10) (11) (12)	LEDs indicating error-counter mask routes
		5 6 7 8 (13) (14) (15) (16)	
⑥④	GP-IB	(Connector)	GP-IB connector
		ADDRESS 5 4 3 2 1	GP-IB address switches
		SYSTEM CONTROL ON OFF	System control switch Set the address of the MP1701A on the GP-IB to 2 greater than the address set on the MP1702A GP-IB address switches.

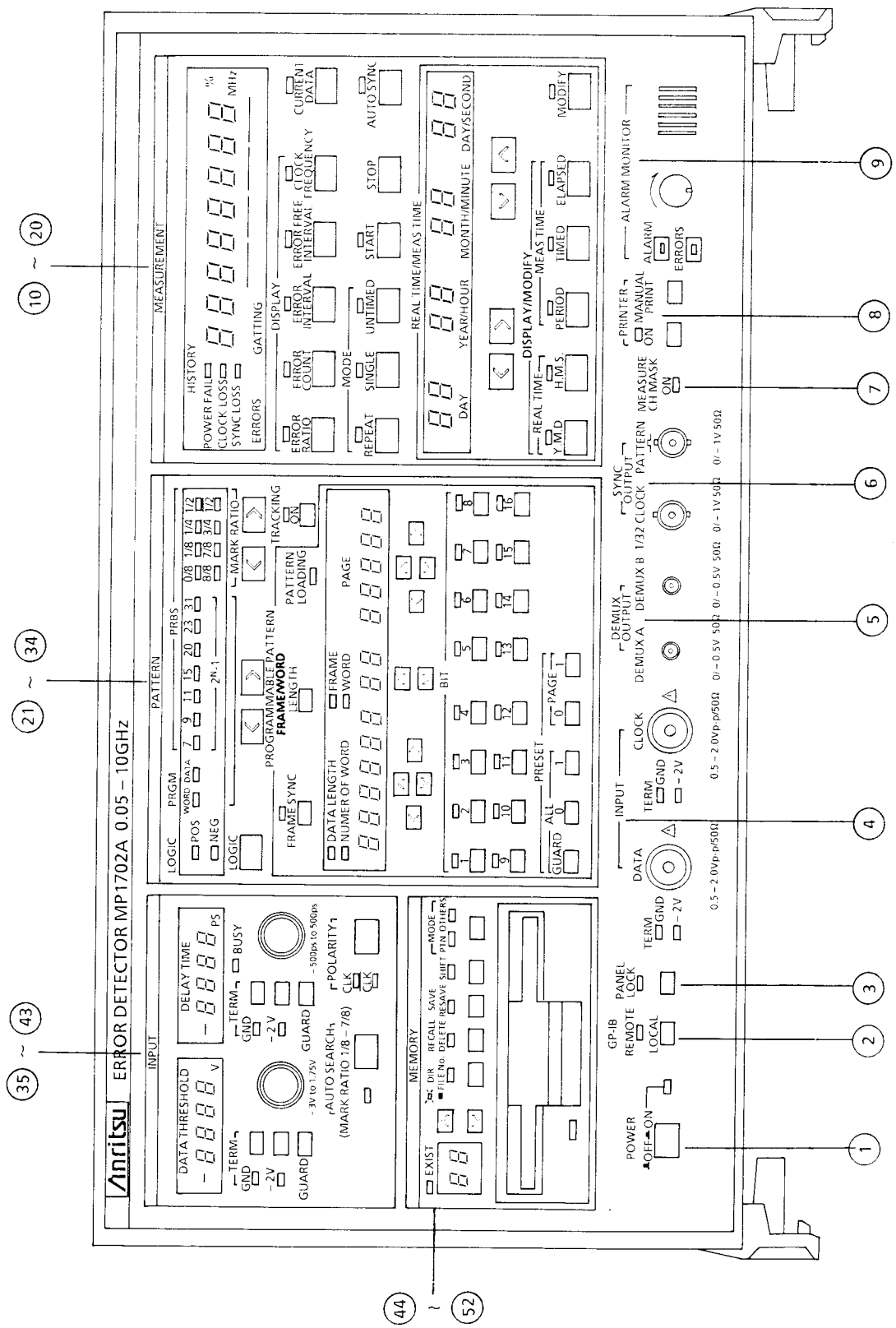


Fig. 3-1 Front Panel

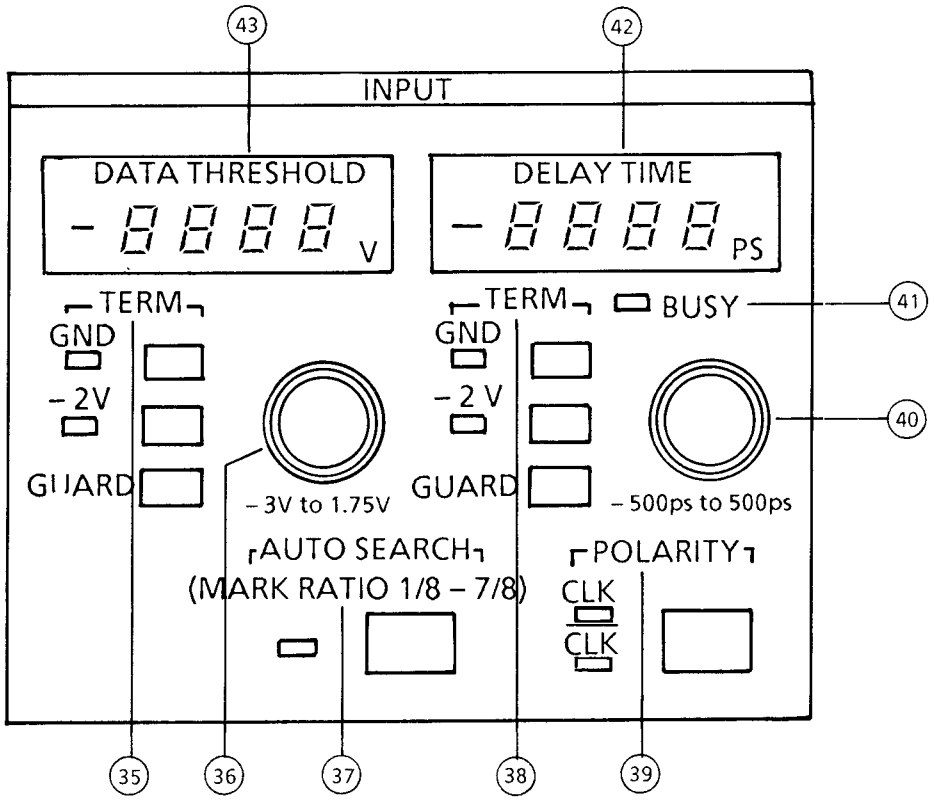


Fig. 3-2 INPUT Section Panel (35) to (43)

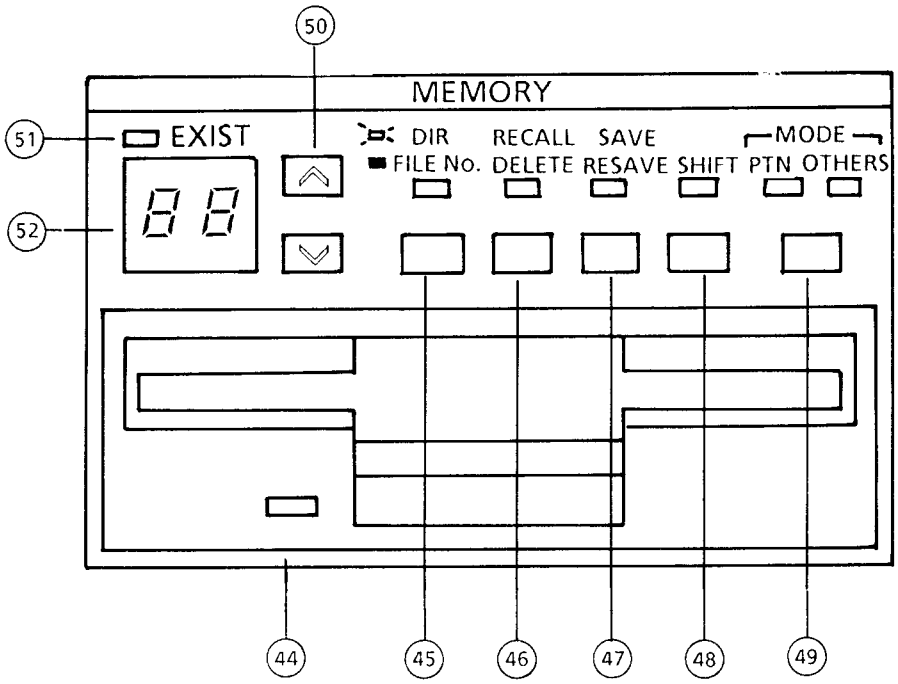


Fig. 3-3 MEMORY Section Panel (44) to (52)

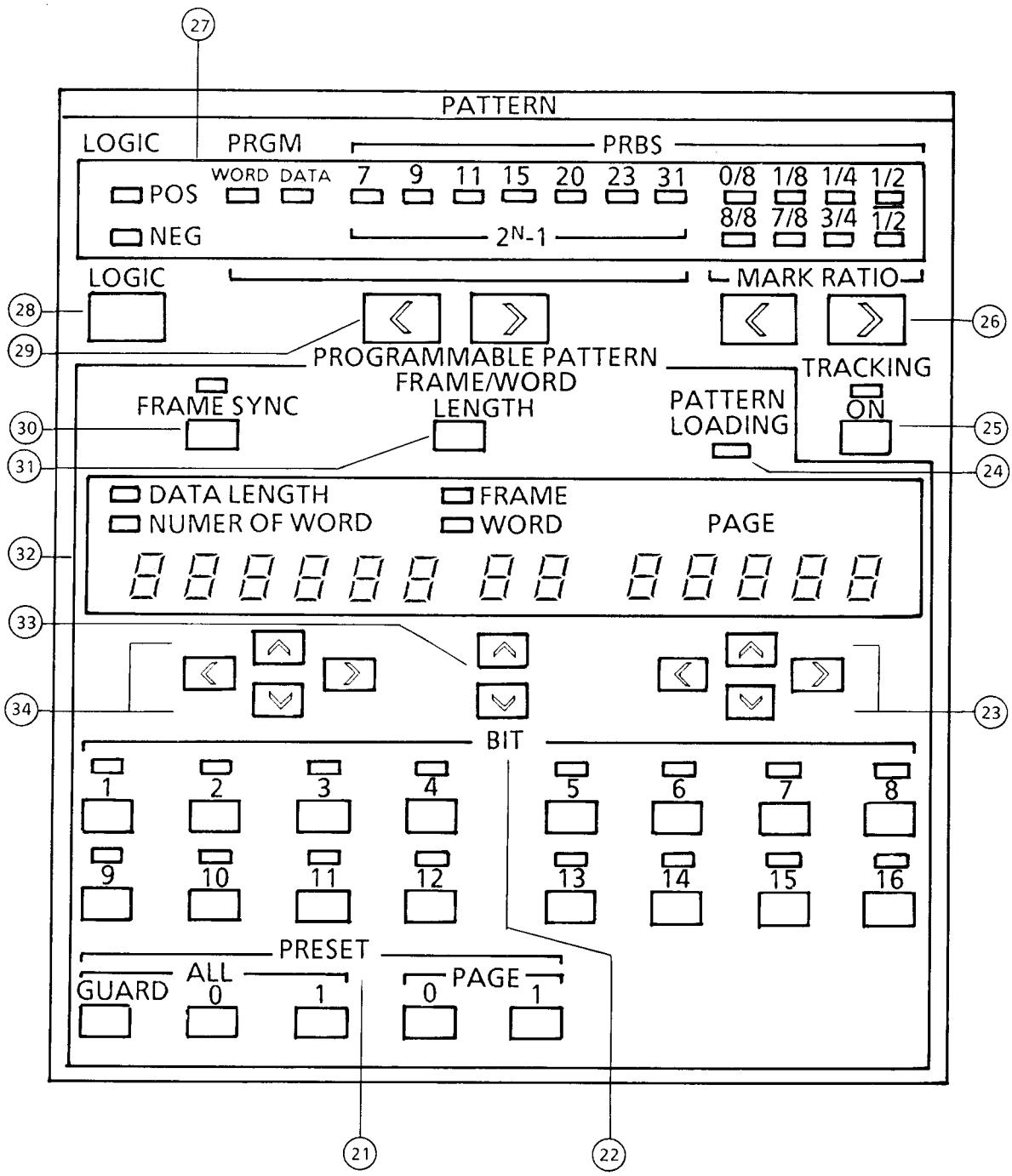


Fig. 3-4 PATTERN Section Panel (21) to (34)

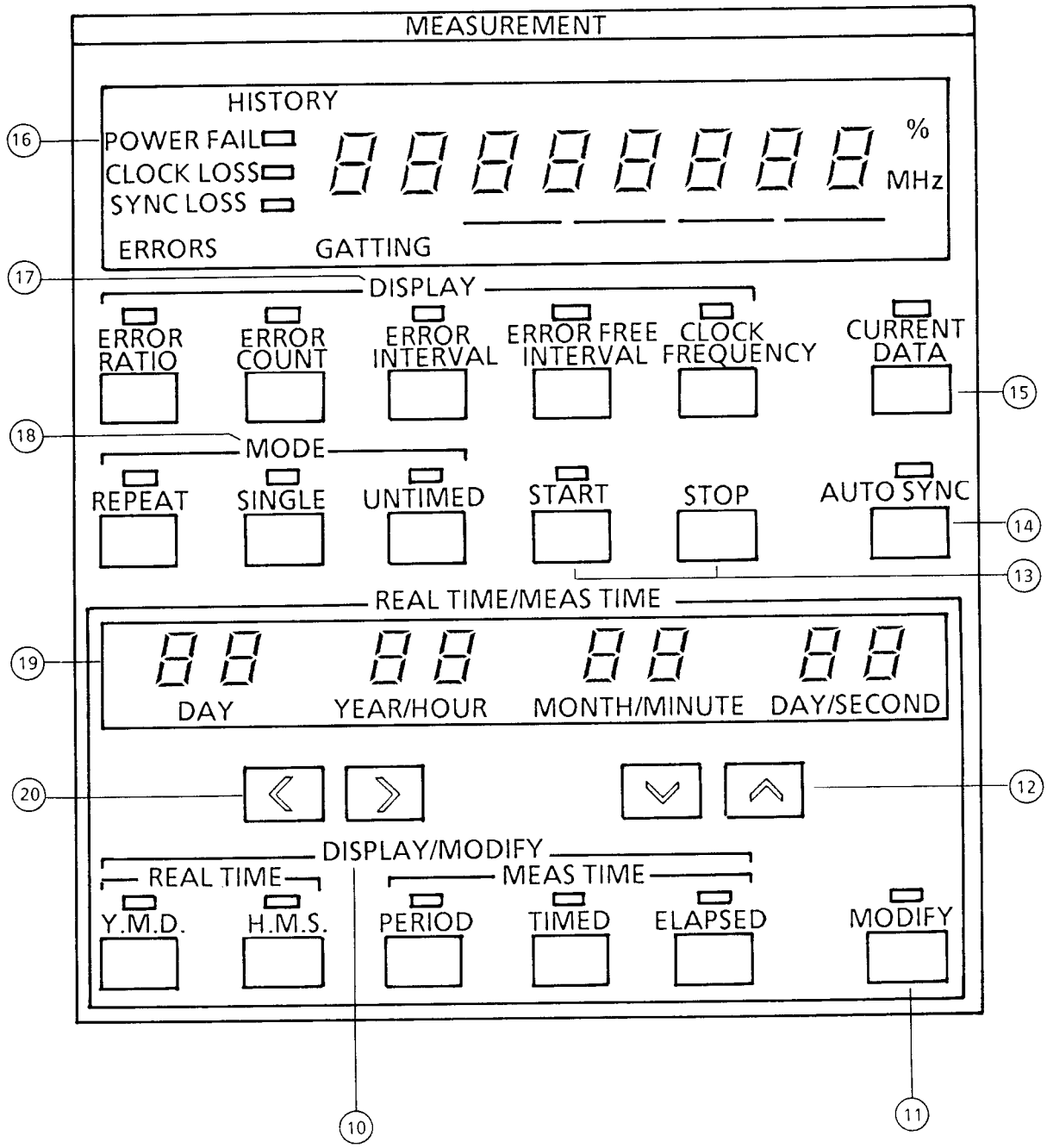


Fig. 3-5 MEASUREMENT Section Panel ⑩ to ⑳

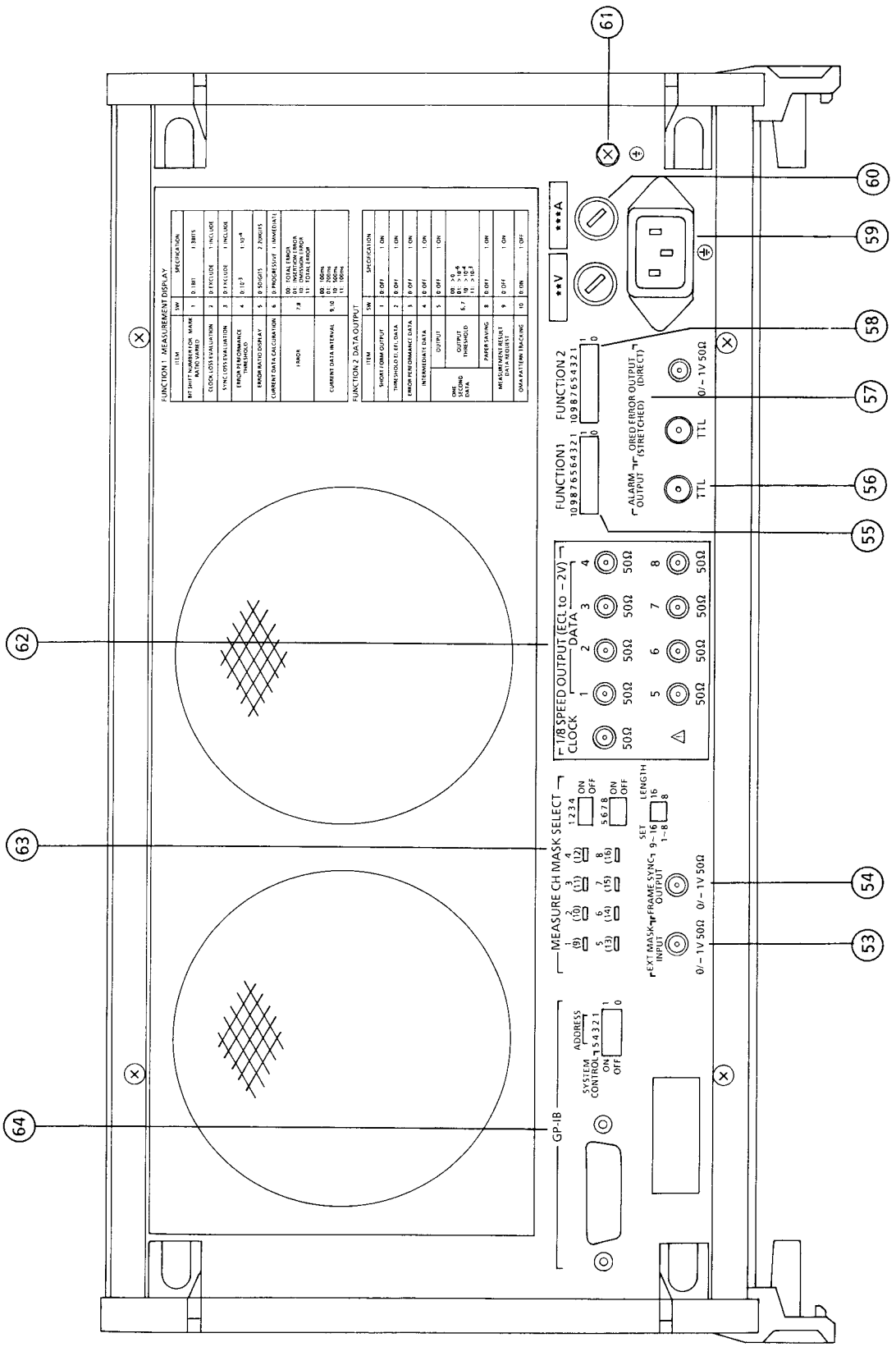


Fig. 3-6 Rear Panel

SECTION 4
BASIC OPERATION

This section describes the basic operating method and basic functions of the MP1702A. For those who are using the MP1702A for the first time, please read the detailed operation instructions in SECTION 5. Those who have used the MP1602A or MP1605A Error Detector, may skip this section.

Paragraph 4.1 describes the setup, power-on and operations while paragraph 4.2 describes the initial condition settings.

Number such as (4), (2) and (1) which appear in the text, correspond to the labels on the controls in Figs. 3-1 to 3-6.

4.1 Setup, Power-on and Operation

To understand the basic operations of MP1702A, a measurement example is given in which the MP1701A is directly connected to the MP1702A.

(1) Setup

Set-up the equipment as shown in Fig. 4-1.

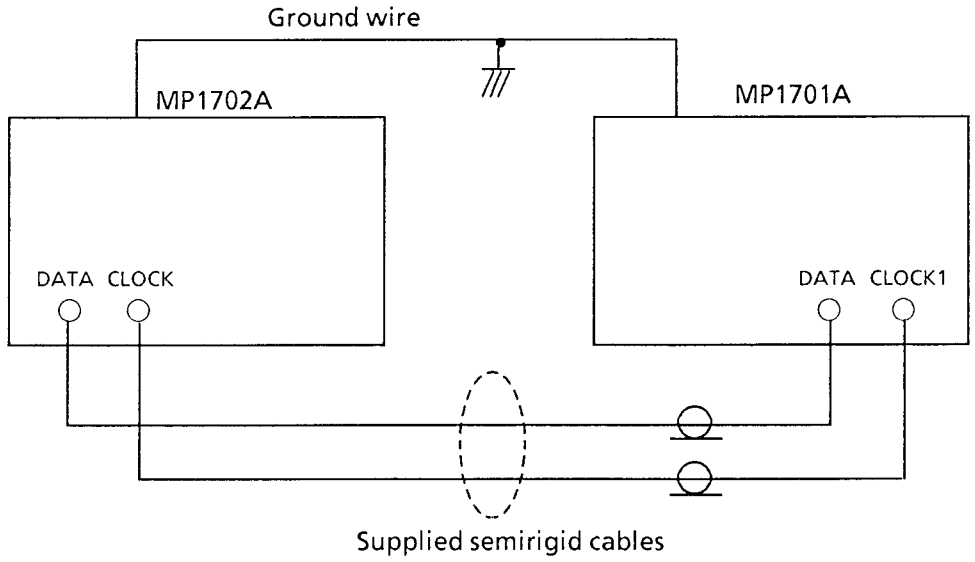


Fig. 4-1 Setup

Step	Procedure
1	Connect the MP1702A and the MP1701A frame ground terminals to the ground wire. Then, connect the semirigid cables and power cords.
2	Connect the plugs of the MP1701A and MP1702A power cords to a suitable AC power supply. If the power plug is a 3-pole plug with a ground pin, verify that the power supply is connected to earth ground. When using a 2-pole plug, ground the frame ground terminals of the MP1701A and MP1702A before connecting the power cords to the power supply.
3	Short the external and center conductors of the supplied semirigid cables together with tweezers, then connect the MP1701A DATA and CLOCK1 output connectors to the MP1702A DATA and CLOCK input connectors (4), respectively.

(2) Power-on and operation

Note: When the following operations are performed, the set memory contents are cleared and returned to the factory presettings. (Refer to paragraph 4.2 Initial Settings.)

Check with the previous user the ensure that all settings may be cleared.

Step	Procedure
1	While pressing [LOCAL] (2) of the MP1701A or MP1702A, set the POWER switch to ON. (This operation recalls the preset factory settings.)
2	Press the MP1702A [AUTO SEARCH] (37). (When this key is pressed, the input data threshold voltage and input clock delay time are searched for and set automatically.) Confirm that the MP1702A CLOCK LOSS, SYNC LOSS and ERRORS real time LEDs in the display section (16) are not lit.
3	If the ERRORS LED is lit, use the MP1702A input-data threshold-voltage setting knob (36), to search for the threshold voltage (43) range in which the ERRORS LED is not light. (The center value of this range is the most appropriate threshold voltage.)
4	If the ERRORS LED remains lit, use the MP1702A input-clock delay-time setting knob (40) to search for the delay time (42) range where the ERRORS LED is not lit. (The center value of this range is the most appropriate delay time.)
5	Press the MP1701A ERROR ADDITION [ON] key to set it to ON.
6	Press [SINGLE] of the MP1702A MEASUREMENT MODE (18) to set it to ON.

(Continued)

Step	Procedure
7	Press [PERIOD] of the MP1702A DISPLAY/MODIFY key (10) and [MODIFY] (11) to set them to ON; use [MEAS TIME] (12) to set the SECOND value on the display (19) to 10. Finally, press [MODIFY] (11) to set it to OFF. (This sets the measurement time to 10 seconds.)
8	Press [START] (13) of the MP1702A. When the GATING LED on the display (16) lights, press [SINGLE] of the MP1701A ERROR ADDITION key once. At the end of measurement (after 10 seconds), confirm that the display items and values shown below are displayed sequentially as [DISPLAY] (17) is pressed. ERROR RATIO: 1.0000E-11 ERROR COUNT: 1 ERROR INTERVAL: 1 ERROR FREE INTERVAL: 90.0000% CLOCK FREQUENCY: 9999.899 to 10000.101 MHz

4.2 Initial Settings

Table 4-1 lists the initial settings.

To restore the initial settings, turn on the POWER switch (1) while pressing [LOCAL] (2) ; the factory presettings are returned and all previous settings are cleared. When using this function, please check with the previous user that there are no previous settings that must be saved.

Table 4-1 Panel and Internal-Circuit Initial Settings (1/3)

Item			Panel	Internal circuit
INPUT	DATA	TERM	GND	
		THRESHOLD value	−0.500	
	CLOCK	TERM	GND	
		DELAY TIME value	0.000	
		BUSY	OFF	
		POLARITY	CLK	
	AUTO SEARCH		OFF	
PATTERN	LOGIC		POS	
	PATTERN mode		PRBS 2^{15}-1	
	MARK RATIO		1/2	
	TRACKING		OFF	
	PROGRAM-MABLE PATTERN	FRAME SYNC	OFF	
		DATA LENGTH NUMBER OF WORD	Blanking	(1)WORD pattern • NUMBER OF WORD value: 1 • WORD value: 2 • FRAME value: 4 • PAGE value: 1 • Pattern contents: 524 288 bits are all 0s
		FRAME WORD		

Table 4-1 Panel and Internal-Circuit Initial Settings (2/3)

Item			Panel	Internal circuit
PATTERN (cont'd)	PROGRAM-MABLE PATTERN (cont'd)	PAGE	Blanking (cont'd)	(2) DATA pattern • DATA LENGTH value: 2 • FRAME LENGTH value: 4 • PAGE value: 1 • Pattern contents: 524 288 bits are all 0s
		BIT 1 to 16		
MEASURE-MENT	DISPLAY		ERROR RATIO (All display digits are "—")	
	CURRENT DATA		OFF	
	MODE		REPEAT	
	START		OFF	
	AUTO		ON	
REAL TIME/ MEAS TIME	DISPLAY		Displays current time	(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 01 second • TIMED: All digits "—" • ELAPSED: All digits "—"
	DISPLAY/MODIFY		H.M.S (REAL TIME)	
	MODIFY		OFF	

Table 4-1 Panel and Internal-Circuit Initial Settings (3/3)

Item		Panel	Internal circuit
GP-IB REMOTE		OFF	
PANEL LOCK		OFF	
MEASURE CH MASK		Displayed in accordance with current conditions	
PRINTER ON		OFF	
ALARM MONITOR	ALARM	ON	
	ERRORS	OFF	
GP-IB	ADDRESS 1 to 5	According to switch settings	
	SYSTEM CONTROL		
MEASURE CH MASK SELECT	LENGTH 8 16		
	SET 1-8 9-16		
	ON OFF 1 to 8		
FUNCTION 1			
FUNCTION 2			

SECTION 5
DETAILED OPERATING INSTRUCTIONS

This section explains the panel and panel operation method in detail. Refer to SECTION 4 for the basic functions and operation methods. Items are explained in the following sequence.

- INPUT section (paragraph 5.1)
- PATTERN section (paragraph 5.2)
- MEASUREMENT section (paragraph 5.3)
- MEAS TIME/REAL TIME sections (paragraph 5.4)
- MEMORY section (paragraph 5.5)
- Built-in printer (paragraph 5.6)
- Definition of errors and alarms (paragraph 5.7)
- Measurement data processing (paragraph 5.8)
- DEMUX OUTPUT (paragraph 5.9)
- PATTERN SYNC OUTPUT (paragraph 5.10)
- 1/8 SPEED DATA OUTPUT (paragraph 5.11)
- FRAME SYNC OUTPUT (paragraph 5.12)
- ERROR OUTPUT (paragraph 5.13)

Numbers such a (4), (35), and (36) which appear in the text correspond with the labels in Figs. 3-1 to 3-6.

5.1 INPUT Section

This paragraph describes the methods for handling the data and clock inputs to the MP1702A. They are explained in the sequence listed below.

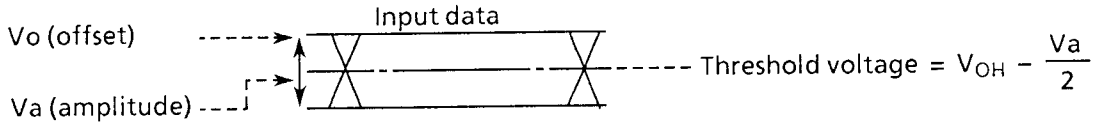
- Setting input-data termination voltage and threshold voltage (paragraph 5.1.1)
- Setting input-clock termination voltage (paragraph 5.1.2)
- Setting input-clock polarity (5.1.3)
- Setting input-clock delay times (paragraph 5.1.4)
- AUTO SEARCH function (paragraph 5.1.5)
- Setting optimum input conditions with DEMUX OUTPUT (paragraph 5.1.6)

5.1.1 Input data termination voltage and threshold voltage settings

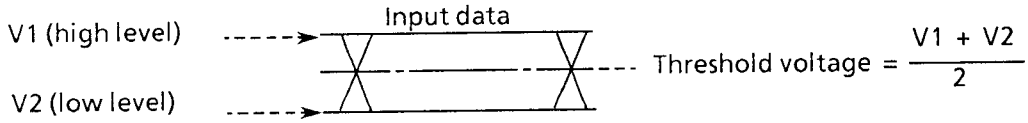
(1) If the signal input to the INPUT DATA connector (4) is terminated to ground through 50 Ω

Step	Procedure
1	Press [GND] (35) to light the GND LED.
2	Use the THRESHOLD knob (36) to set the DATA THRESHOLD value (43) to the input data threshold voltage as shown below.

1. When amplitude and offset are known



2. When high and low levels are known



(2) When an ECL signal is input to INPUT DATA connector (4)

Step	Procedure
1	While holding down [GUARD] (35), press [−2 V] (35) to light the −2V LED.
2	Use the THRESHOLD knob (36) to set the DATA THRESHOLD value (43) to −1.3 V.

Note: The device under test (DUT) may be damaged if the voltage is set incorrectly (e.g. ECL to −2 V), therefore, the voltage must be carefully set.

(3) Relationship between displayed DATA THRESHOLD value (43) and input data threshold voltage setting

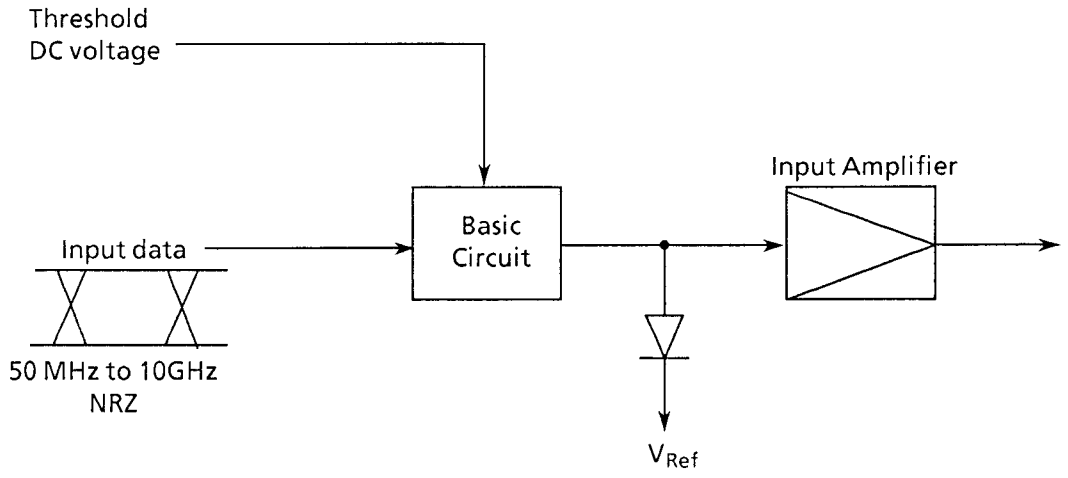


Fig. 5-1 Data Input Section Block Diagram

The data input section has a protection diode to protect the input amplifier as shown in Fig. 5-1. If a diode were not provided, the threshold margin would be as indicated by the broken lines in Fig. 5-2.

The protection diode clamps the input level which is then used to determine the displayed threshold voltage in accordance with the solid lines in Fig. 5-2. Note that the input vs. displayed voltage margin for negative voltages is large.

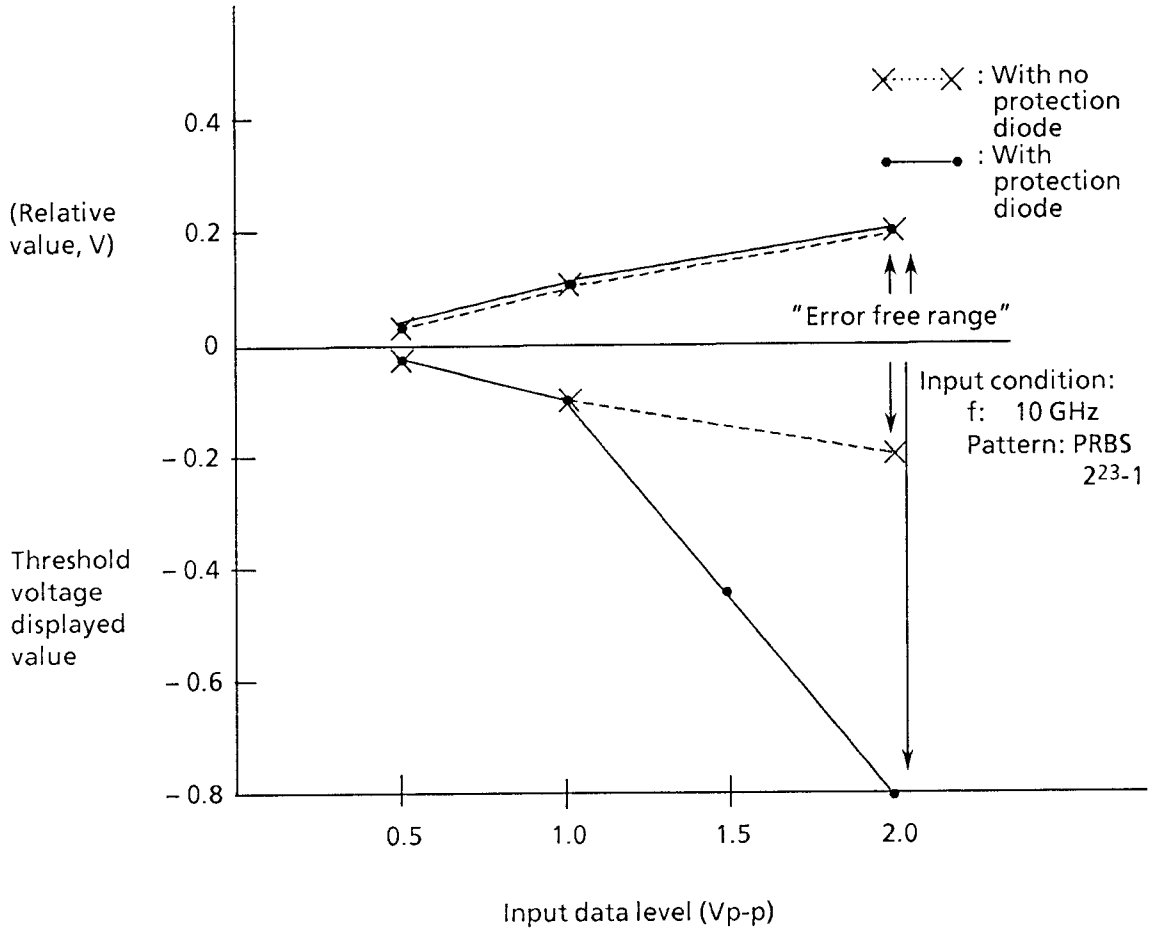


Fig. 5-2 Threshold Margin

5.1.2 Input clock termination voltage settting

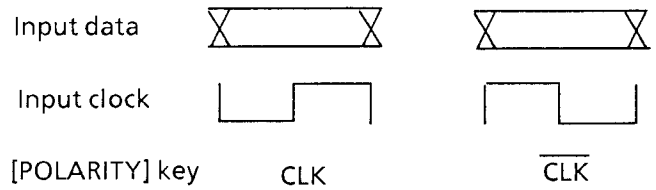
(1) If the signal input to the INPUT CLOCK connector (4) is terminated to ground through 50 Ω, press [GND] (38) to light the GND LED.

(2) If an ECL signal is input to the INPUT CLOCK connector (4), press [−2 V] (38) while holding down GUARD (38) to light the −2 V LED.

Note: The device under test (DUT) may be damaged if the voltage is set incorrectly (e.g. ECL to −2 V); therefore, set the voltage carefully.

5.1.3 Input clock polarity setting

Press [POLARITY] (39) to select either CLK or $\overline{\text{CLK}}$, in accordance with the following phase relationships between the input data and input clock.



5.1.4 Input clock delay time (phase) setting

To set the optimum input clock and data phase, use the delay time setting knob (40) to find the phase range (without error), then set the DELAY TIME (42) to the value at the center of that range.

5.1.5 AUTO SEARCH function

When [AUTO SEARCH] (37) is set to ON, the input-data threshold voltage and the input-clock delay time that corresponds to the input data are automatically sought and set.

However, if the AUTO SEARCH is not completed within 3 seconds, the search is aborted and the AUTO SEARCH LED starts flashing. At this time, the values used for the DATA THRESHOLD voltage and DELAY TIME prior to AUTO SEARCH are recalled.

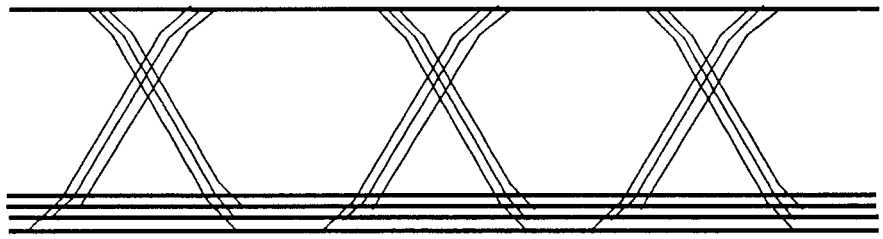
5.1.6 Setting optimum input conditions with the DEMUX OUTPUT

Sometimes the AUTO SEARCH function is unusable due to the waveform conditions (jitter, level etc.) of the input DATA signal. In this case, the values of the threshold voltage and delay time can be set more accurately if they are manually adjusted while monitoring the DEMUX OUTPUT signal with a sampling oscilloscope as described below.

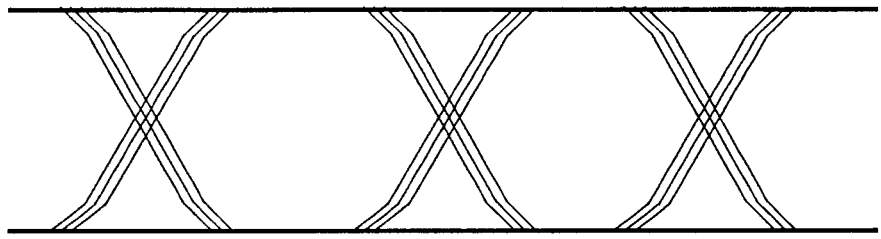
When the DATA signal and CLOCK signal are input while the threshold voltage is varied, the monitored DEMUX OUTPUT signal waveform changes as shown in Fig. 5-3 (a) to (c). When adjusting the threshold voltage manually, set it to a stable mid-point value such that the waveform appears as shown in Fig. 5-3 (b).

Next, adjust the delay-time value up or down so that the waveform on the monitor changes from that shown in Fig. 5-4 (a) to (b) and then back to (a) periodically. Set the delay time to a stable mid-point value such that the waveform appears as shown in Fig. 5-4 (b).

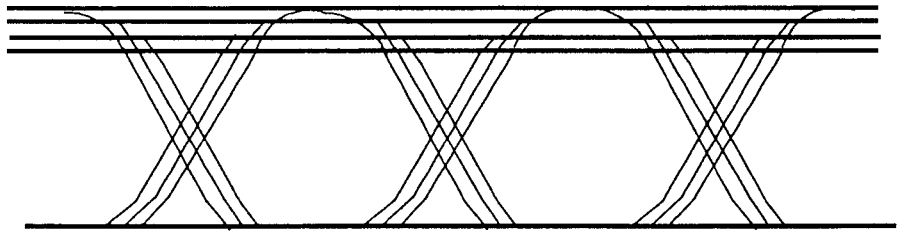
Continue to adjust the threshold-voltage and delay-time values until the error is minimized. This procedure sets the optimum input conditions.



(a) Threshold setting too low

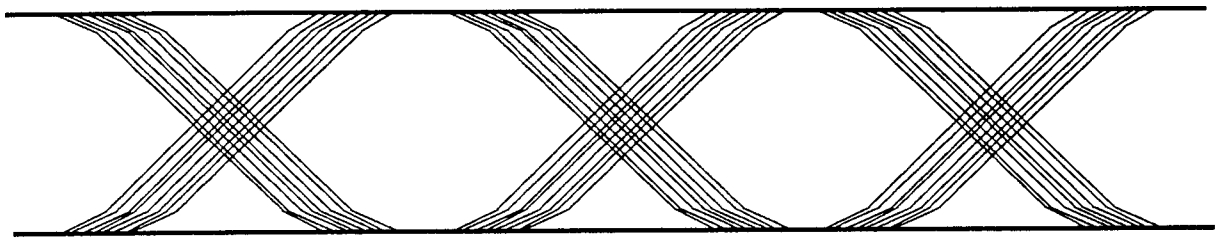


(b) Optimum threshold setting

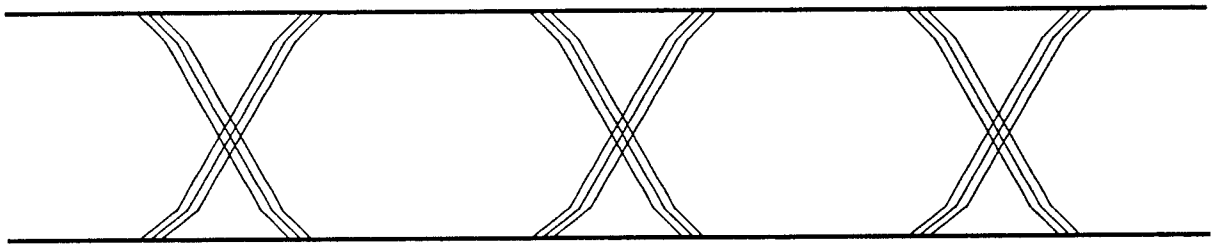


(c) Threshold setting too high

Fig. 5-3 Setting Threshold



(a) Phase adjustment is too small or too large



(b) Phase adjustment is optimal

Fig. 5-4 Phase (Delay Time) Adjustment

5.2 PATTERN Section

This paragraph explains the measurement pattern setting methods in the following sequence.

- Setting word pattern (paragraph 5.2.1)
- Setting data pattern (paragraph 5.2.2)
- Presetting programmable pattern (paragraph 5.2.3)
- Setting FRAME SYNC function (paragraph 5.2.4)
- Setting pseudorandom (PRBS) pattern (paragraph 5.2.5)
- Setting pattern logic (paragraph 5.2.6)
- Pattern tracking function (paragraph 5.2.7)

5.2.1 Word pattern setting

(1) Pattern selection

Press [<] and [>] (29) so that the PRGM-WORD LED (27) lights.

(2) Number of words and word length

If the number of bits making up one word is represented by word length N, and the number of words making up one period is represented by M, the pattern shown in Fig. 5-3 is obtained.

The number of words M setting keys are labelled (34) and the display is labelled NUMBER OF WORD (32).

The word length N setting keys are labelled (33) and the display is labelled WORD LENGTH (32).

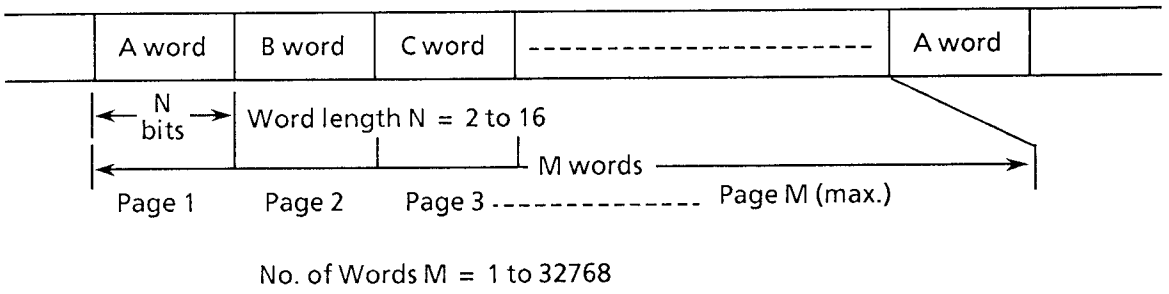


Fig. 5-3 Word-Mode Programmable Pattern

(3) Number of words setting

Press [<] or [>] (34) to move the blinking cursor to the digit of the number which is to be set. Press [∨] and [∧] (34) to set the number within the range specified in Table 1-5.

Note: When the blinking cursor is moved past the left or right end with [<] or [>] (34), the LED stops blinking and numbers cannot be set. Numbers can only be set when the cursor is within range.

(4) Page and pattern setting (Fig. 5-3)

The display (32) and keys (23) of PAGE identify, and enable modification of each word in an M-word pattern.

When the page is specified as 1, the contents of the A word in Fig. 5-3 are displayed at BIT (22) and can be modified with the BIT key (22).

When the page is specified as 2, the contents of the B word are displayed and can be modified in the same manner. Perform the same operation for the C word, etc.

Up to M pages may be specified.

When the word length is 15 bits, the (22) up to 15 BIT keys and LED are enabled.

(5) Pattern setting state after number of words and word length changed

A number of different pattern setting states are illustrated in Fig. 5-4 for patterns of various word lengths and numbers of words.

Initially, the number of words, M, is 4 and the word length N, is also 4 (Fig. 5-4 (a)). When the number of words is changed from 4 to 3 (Fig. 5-4 (b)), the D word is lost and only words A, B, and C are repeated.

When the number of words is reset back to 4 (Fig. 5-4 (c)), the D word is recovered and A, B, C, and D are repeatedly output again.

In state 4 (Fig. 5-4 (d)), the word length is changed from 4 to 3 which causes bit 4 of each word to be cleared. Once again, when word length is reset back to 4 (Fig. 5-4 (e)), bit 4 of each word is recovered.

Generally, when the number of words is decreased, the leading data are retained while the final data words are lost. As regards word length, leading bits are retained while the final data bits are lost.

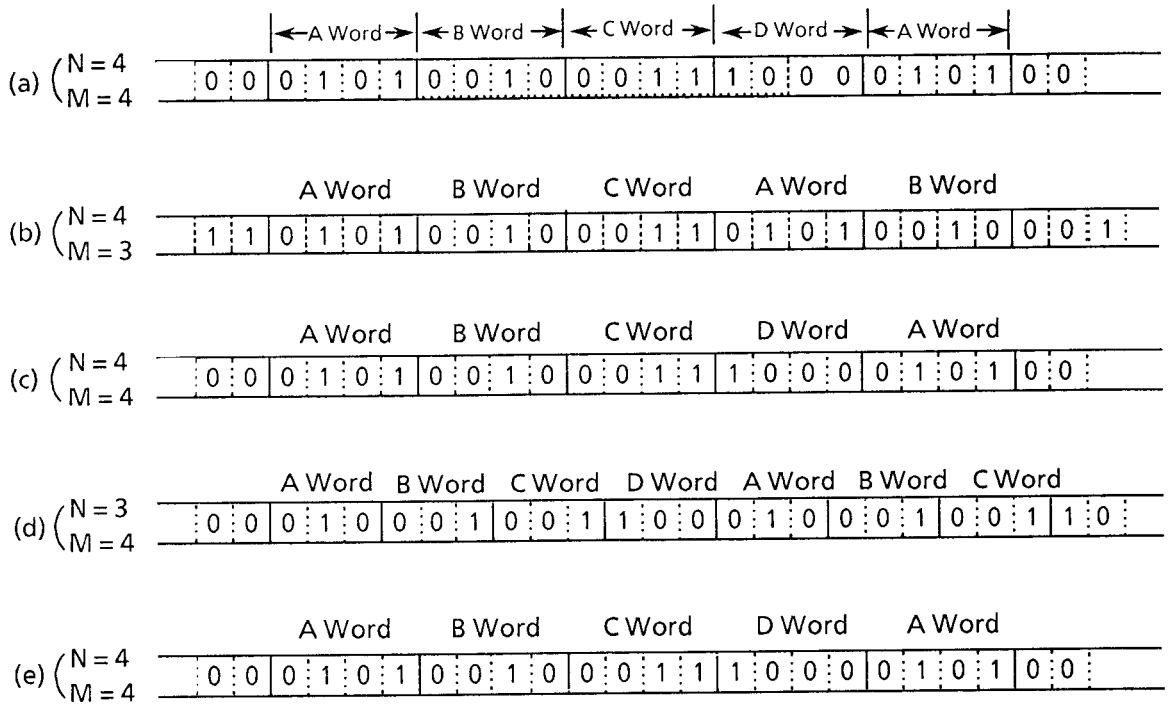


Fig. 5-4 Patterns after the Number of Words and Word Length have been Changed

5.2.2 Data pattern setting

(1) Pattern selection

Press [<] and [>] (29) to select output data and light PRGM-DATA LED (27).

(2) Data length setting

If the data length in the data mode is made N, the period of the repeated pattern will also be N bits. Set the data length with the PROGRAMMABLE-PATTERN DATA LENGTH display (32) and keys (34). The data length can be set from 2 to 524 288 bits. However, when the data length exceeds 4096 bits, setting in 128-bit steps only is possible.

Thus, numbers that are indivisible by 128 cannot be set (Table 1-2).

The setting method is the same as that described in paragraph 5.2.1 (3) "Number of words setting".

(3) Patten setting

Select page 1 with the PAGE key keys (23).

This allows patterns of up to 16 bits to be set with the BIT with the BIT keys (22).

When N is smaller than 16, the keys from N + 1 to 16 are disabled and the corresponding lamps remain off.

If N is larger than 16, select page 2 to enter the pattern from bit 17 to bit 32. Word positions greater than 32 bits can also be set in 16-bit units by specifying page number with the PAGE keys (23).

(4) Output pattern when the data length is changed

When the data length is reduced from P to Q and then increased back to P again, the original pattern is restored.

5.2.3 Programmable pattern setting

(1) All bits "0" setting

Set all bits to "0" by pressing PRESET (21) [All 0] while holding [GUARD].

Note: "All bits" denotes all setting bits for the current output pattern and the entire (used and unused) buffer memory contents (512k bits) connected to it.

(2) All bits "1" setting

Set all bits to "1" by pressing PRESET (21) [ALL 1] while holding [GUARD].

(3) One page "0" setting

Set all the bits of the currently displayed page to "0" by pressing the PRESET (21) [PAGE 0].

Only settable bits are set to "0". (For instance, if the number of words is 15, only bit 1 to bit 15 are set to "0".)

(4) One page "1" setting

Set all the bits of the currently displayed page to "1" by pressing the PRESET (21) [PAGE 1].

Only settable bits are set to "1".

5.2.4 Setting FRAME SYNC function

The AUTO SYNC function mode can be set from normal to frame by setting the FRAME SYNC function to ON. Refer to paragraph 5.3.7 for the AUTO SYNC function. However, the FRAME SYNC function can only be set to ON when the programmable pattern length is of 1024 or more bits.

The frame bit length and frame bit setting procedure are explained below.

(1) Setting the frame bit length

Press [FRAME SYNC] (30) to set FRAME SYNC function to ON (lamp lit.)

Next, press [FRAME/WORK LENGTH] (31) so that the FRAME lamp (32) lights.

Finally, use the setting keys (33) to set any frame bit length.

The frame bit length can be set in 4-bit steps from 4 to 32 bits.

(2) Setting frame bit

Select page 1 with the number of page specification keys (23).

Bits 1 to 16 of the page 1 frame bit can be set with [BIT] (22). The LED is orange. However, if the number of frame bits is less than 16, excess bits are not handled as frames but as ordinary bit settings. In this case, the LED becomes green.

Also,when the number of frame bits is larger than 16, use the page specification key (23) to call page 2 so that the 17th to 32nd frame bits can be set.

5.2.5 Pseudorandom (PRBS) pattern setting

(1) Pseudorandom (PRBS) pattern length selection

Press [<] and [>] (29) to select the PRBS pattern type.

The bit length of one PRBS pattern period can be selected from among seven bit-lengths, 2^7-1 to 2^{31}-1 bits [2^N-1: N = 7, 9, 11, 15, 20, 23, 31, Table 5-1).

(2) Mark ratio selection

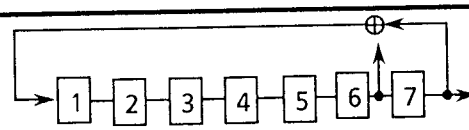
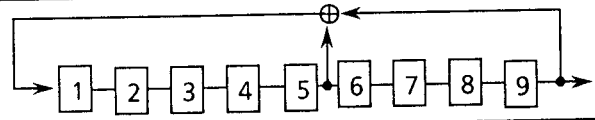
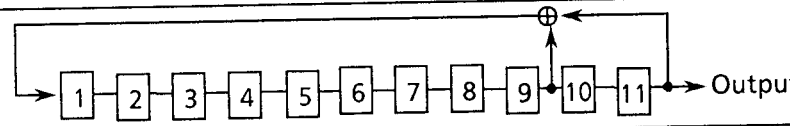
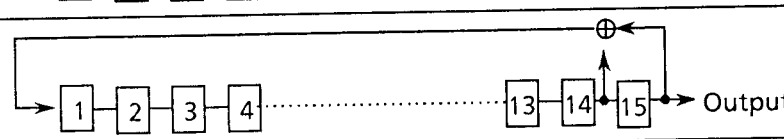
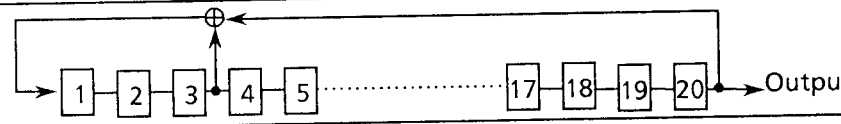
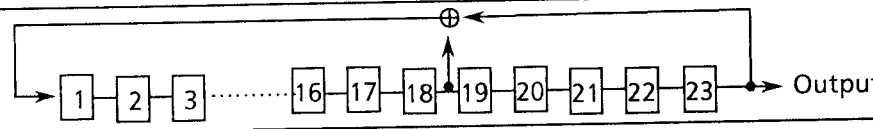
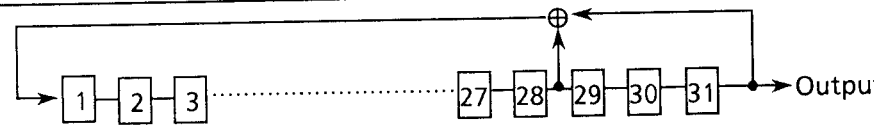
Press [<] and [>] (26) to select a PRBS mark ratio of 0/8, 1/8, 1/4, or 1/2,

Select a mark ratio of 8/8, 7/8, 3/4, or $\overline{1/2}$ by inverting the logic with the [LOGIC] (28) key.

(3) Select the number of AND bits shifted for mark ratios of 1/8. 1/4, 7/8, and 3/4

Select the number of AND bits shifted at mark ratios of 1/8, 1/4, 7/8, and 3/4. 1 bit or 3 bits can be selected via the rear panel FUNCTION switch 1 (55). (For details, see Fig. 5-5.)

Table 5-1 Pseudorandom Pattern Generation Principle

Period	Generation polynominal	Pattern Generation Block Diagram
2^7-1	$1+X^6+X^7$	
2^9-1	$1+X^5+X^9$	
$2^{11}-1$	$1+X^9+X^{11}$	
$2^{15}-1$	$1+X^{14}+X^{15}$	
$2^{20}-1$	$1+X^3+X^{20}$	
$2^{23}-1$	$1+X^{18}+X^{23}$	
$2^{23}-1$	$1+X^{25}+X^{31}$	

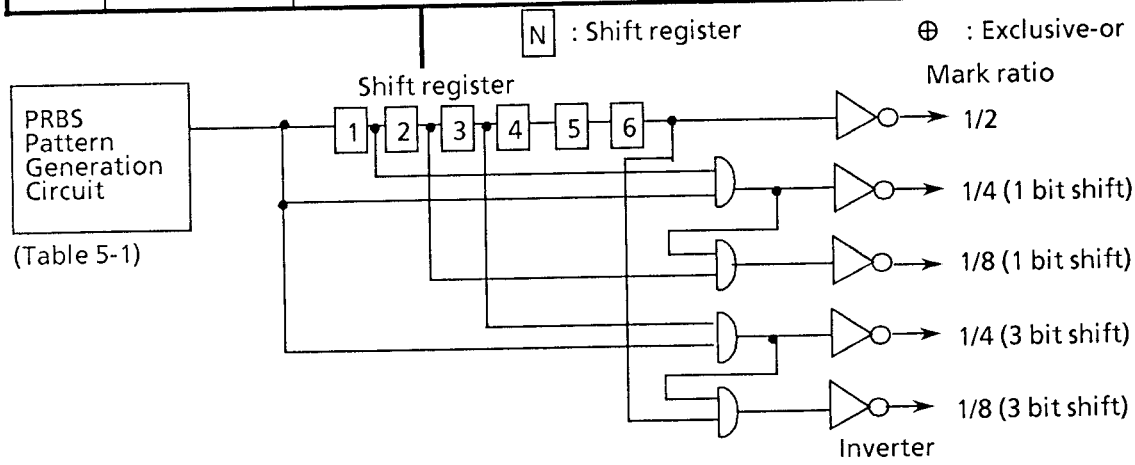


Fig. 5-5 Mark Ratio 1/4, 1/8 Pattern Generator

5.2.6 Logic setting

Select the logic polarity with the [LOGIC] key according to the logic state of the pattern input to the INPUT DATA connector (4) :

Positive logic (1 is high level) : POS

Negative logic (1 is low level): NEG

The PRBS pattern logic is defined by using a PRBS 2^7-1 pattern as an example. A pattern of seven consecutive "0" bits is low level, it is defined as positive logic.

5.2.7 Tracking function

The MP1702A pattern setting information (except the MEMORY section) can be set to the MP1701A Pulse Pattern Generator and set by turning on the tracking function.

This function is useful when a programmable pattern with a long repetition period is set, and prevents pattern repetition and setting mistakes.

The tracking function operating instructions are given below.

Step	Procedure
1	Connect the MP1702A to the MP1701A as shown in Fig. 5-6.

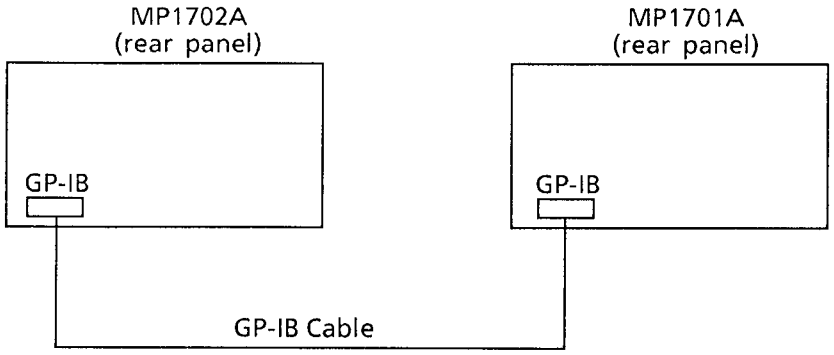


Fig. 5-6 Setup

2	Set the MP1702A GP-IB ADDRESS value to 0 and the MP1701A GP-IB ADDRESS value to 2 (MP1702A address value + 2).
3	Set the MP1702A SYSTEM CONTROL switch to ON.

(Continued)

Step	Procedure
4	Set the MP1702A FUNCTION-2 SW-10 to 0 (DMA ON).
5	Set the MP1701A POWER switch to ON.
6	Set the MP1702A POWER switch to ON.
7	Press the TRACKING [ON] key (25) to turn the tracking function ON. (This places the MP1702A and MP1701A in the same pattern setting state. When the tracking function is on, and the MP1702A pattern setting changes, the MP1701A pattern setting also changes.)

Note: The state of the SYSTEM CONTROL switch is only determined immediately after the POWER switch is set to ON.

5.3 MEASUREMENT Section

This paragraph describes the settings required to measure errors. The setting methods are described in the following order.

- Setting error detection mode (paragraph 5.3.1)
- Setting measurement channel mask route (paragraph 5.3.2)
- Setting measurement mode (paragraph 5.3.3)
- Measurement start/stop (paragraph 5.3.4)
- Measurement results display (paragraph 5.3.5)
- CURRENT DATA function (paragraph 5.3.6)
- AUTO SYNC function (paragraph 5.3.7)
- ALARM MONITOR function (paragraph 5.3.8)
- Error and alarm LEDs (paragraph 5.3.9)

5.3.1 Error detection mode setting

Errors are detected by comparing the input pattern to the internal reference pattern one bit by bit.

There are three error detection modes: TOTAL ERROR, INSERTION ERROR, and OMISSION ERROR. The mode is selected with FUNCTION 1, switches 7 and 8.

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

In the INSERTION ERROR mode, only a pattern change from "0" to "1" is detected as an error. In the OMISSION ERROR mode, only a pattern change from "1" to "0" is detected as an error. In the TOTAL ERROR mode, all errors are detected.

Figure 5-7 shows an example using positive logic. Conversely, for negative logic, (d) becomes the OMISSION ERROR and (e) becomes the INSERTION ERROR.

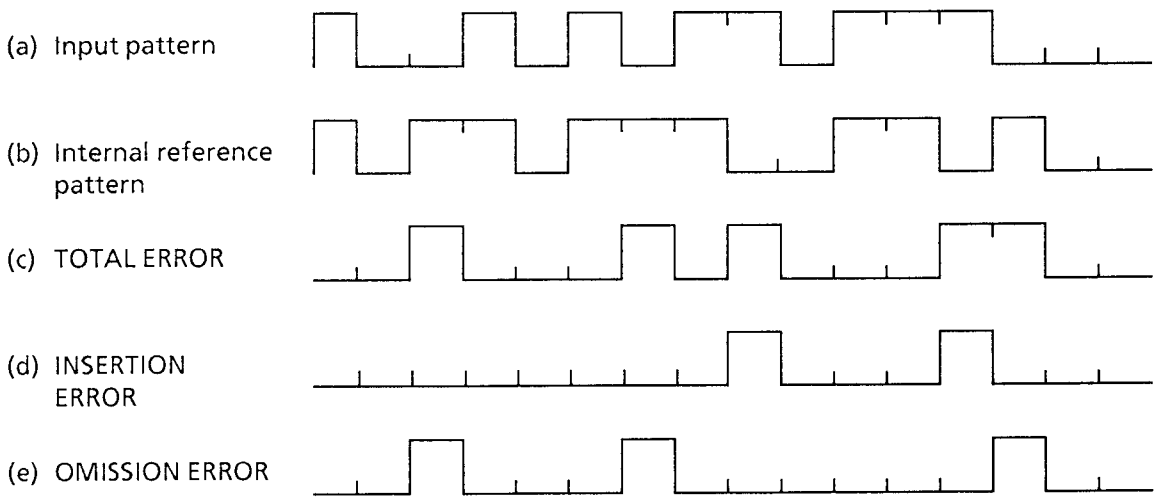


Fig. 5-7 Error Detection Mode

5.3.2 Setting MEAS CH MASK SELECT

The MP1702A has a MEAS CH MASK SELECT function that allows arbitrary masking of the error-counter gate in 8-bit or 16-bit units.

If the mask bit length is 8-bits long and the 4th channel bit is masked, bit (4 + 8N) will always be masked (N = 0, 1, 2...).

If the mask bit length is 16-bits long and the 4th channel bit is masked, bit (4 + 16N) will always be maked (N = 0, 1, 2...).

More than one channel bit can be set for masking.

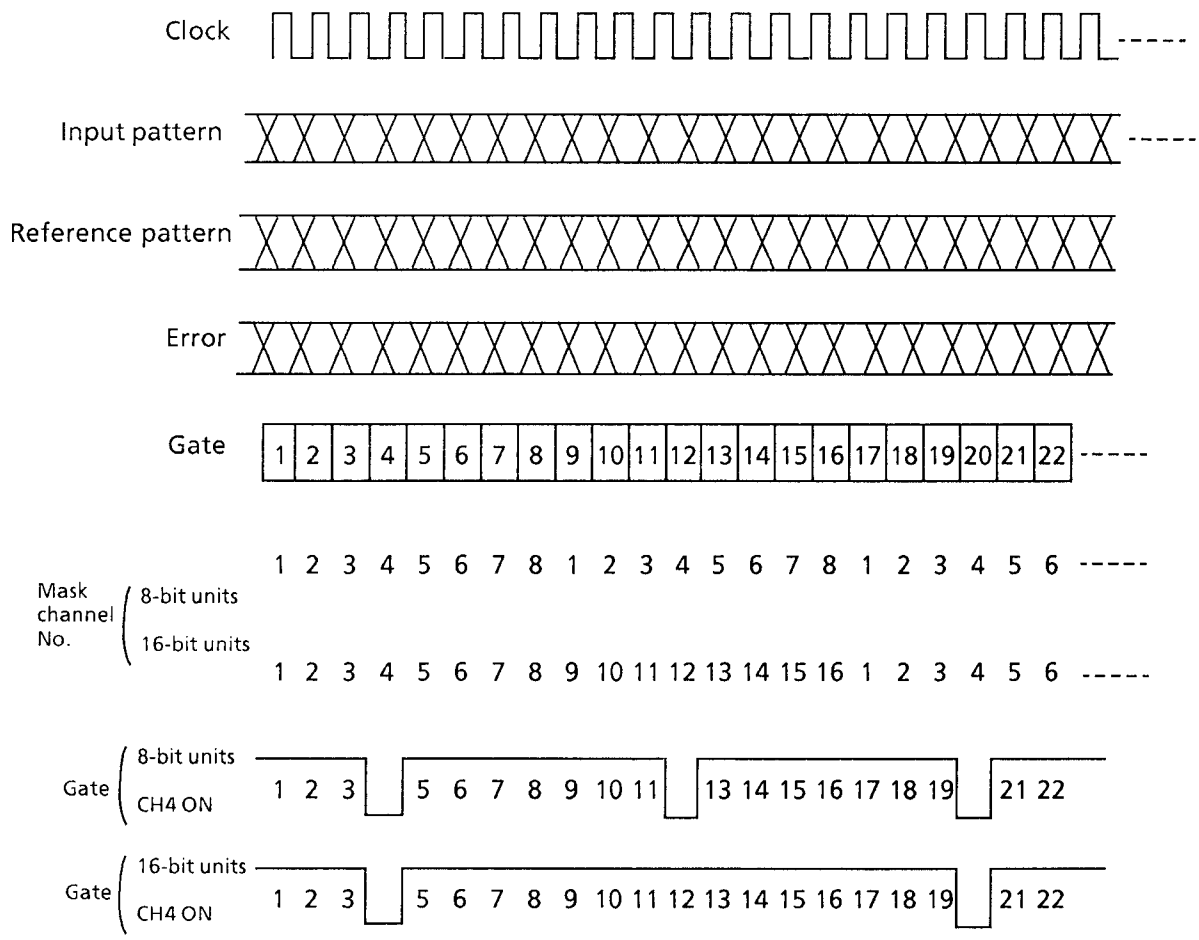


Fig. 5-8 Error and Mask Channel

The operating procedure for setting the MEAS CH MASK SELECT switches (63) is given below.

(1) Masking in 8-bit units

Step	Procedure
1	Set the LENGTH switch to the 8 position.
2	Set the SET switch to the (1 to 8) position.
3	Set bits 1 to 8 of the channel to be masked with the mask channel ON/OFF switches. (The LEDs of the masked channels come on. When one or more channel is masked, the MEASURE CH MASK ON LED (7) on the front panel comes on.)

(2) Masking in 16-bit units

Step	Procedure
1	Set the LENGTH switch to the 16 position.
2	Set the SET switch to the (1 to 8) position.
3	Set bits 1 to 8 of the channel to be masked with the mask channel ON/OFF switches.
4	Set the SET switch to the (9 to 16) position.
5	Set bits 9 to 16 of the channel to be masked with the mask channel ON/OFF switches. (When one or more channel is masked, the MEASURE CH MASK ON LED (7) on the front panel comes on.)

5.3.3 Setting measurement mode

The MP1702A has three measurement modes: REPEAT, SINGLE, and UNTIMED. The measurement mode is set with [MODE] (18).

If either the REPEAT or SINGLE mode is selected, the required measurement time must be set first.

Refer to paragraph 5.4.1 for a description of this procedure.

The measurement modes are defined below.

- REPEAT mode

  Measurement is repeated continuously during the set measurement time period.

- SINGLE mode

  Measurement is performed only once during the set measurement time period.

- UNTIMED mode

  Measurement is repeated from the moment [START] is pressed to the moment [STOP] is pressed.

5.3.4 Measurement start/stop

When [START] is pressed, the START LED lights and measurement starts in accordance with the measurement mode.

When [STOP] is pressed, the START LED goes off and measurement stops.

When [START] is pressed during measurement, measurement is restarted.

In the SINGLE mode, if the measurement time elapses before [STOP] is pressed, the START LED goes off and measurement stops automatically.

5.3.5 Measured result display

There are five measurement items: ERROR RATIO, ERROR COUNT, ERROR INTERVAL (EI, number), ERROR-FREE INTERVAL (EFI, ratio), and CLOCK FREQUENCY. These items are measured simultaneously, and the measured data are displayed sequentially with [DISPLAY] (17). The measurement range and display format (△: space) for each measurement item are shown below.

For the definition of each measurement item, see paragraph 5.7.

(1) ERROR RATIO

- 5-digit display (FUNCTION 1 SW5: 0)

  0.0000E-16 to 1.0000E-0

- 2-digit display (FUNCTION 1 SW5: 1)

  △ △ △ 0.E-16 to △ △ △ 1.0E-0

(2) ERROR COUNT

- 5-digit display (FUNCTION 1 SW5: 0)

  △ △ △ △ △ △△ 0 to △ 9999999 for $<10^7$

  1.0000E07 to 9.9999E16 for $\geqq 10^7$

- 2-digit display (FUNCTION 1 SW5: 1)

  △ △ △ △ △ △△ 0 to △9999999 for $<10^7$

  △ △ △ 1.0E07 to △ △ △9.9E16 for $\geqq 10^7$

(3) Number of ERROR INTERVALs (EI)

△ △ △ △ △ △ △0 to △ 9999999

(4) ERROR-FREE INTERVAL (EFI) ratio

△ △ △ 0.0000 to △100.0000 (%-units LED lights)

(5) CLOCK FREQUENCY

△ △ △50.000 to 10000.000 (MHz-units LED lights)

Note: During sync loss, "–" is displayed for all digits.

In this case, the normal clock frequency can be displayed by turning off [AUTO SYNC] (14).

5.3.6 CURRENT DATA function

The MP1702A has a CURRENT DATA function that can display intermediate data at a specified cycle time (0.1, 0.2, or 0.5 seconds). There are two intermediate-data calculation modes: interval mode and cycle mode.

In the interval mode, data that have been accumulated from the start of measurement are displayed.

In the cycle mode, only the instantaneous data for that cycle are displayed. Figure 5-9 shows a display example of measured data over a 2-second measurement time period and 0.5-second cycle time.

The operation procedure is described below.

Step	Procedure
1	Set [CURRENT DATA] (15) to ON.
2	Set the calculation mode by setting rear-panel FUNCTION 1 switch 6 as follows:

SW6	Mode
0	Interval mode
1	Cycle mode

3 Set the cycle time by setting rear-panel FUNCTION 1 switches 9 and 10 as follows:

SW9	SW10	Cycle time
0	0	0.1 s
0	1	0.2 s
1	0	0.5 s
1	1	0.1 s (Note: not 1 s)

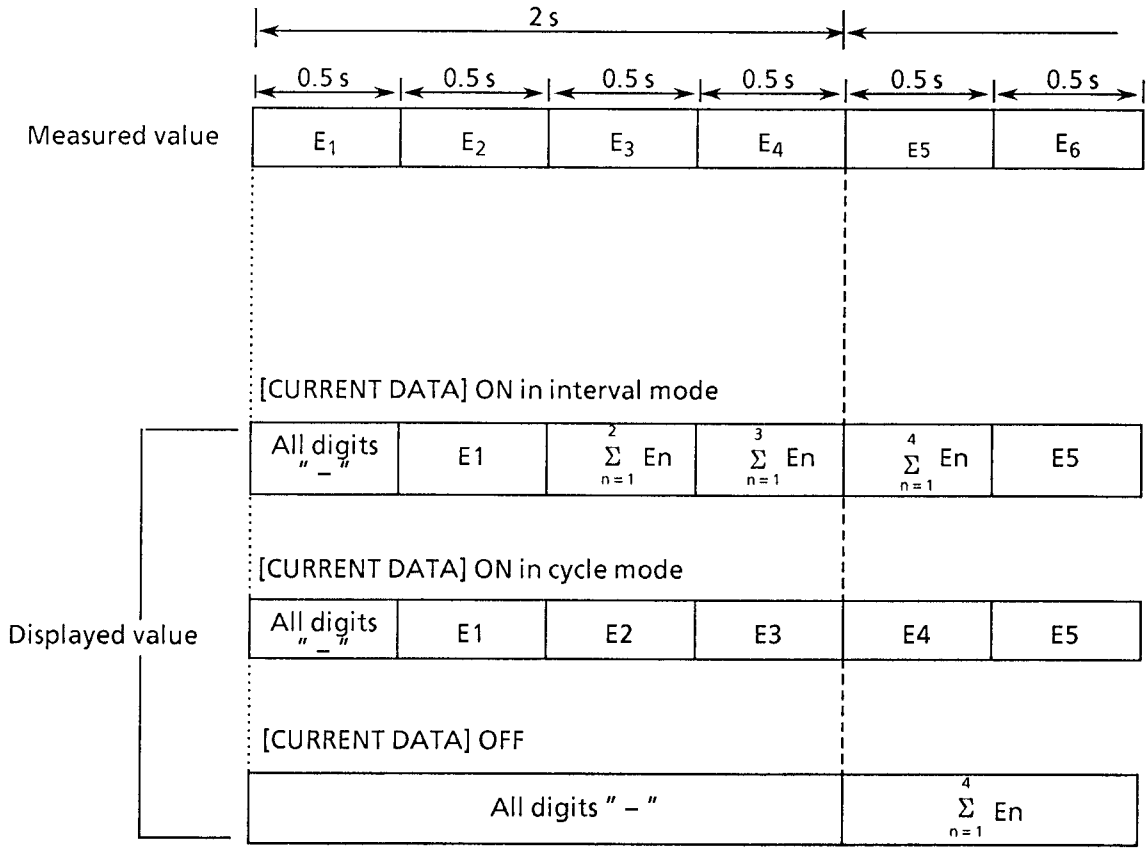


Fig. 5-9 Measured Value and Displayed Value

5.3.7 AUTO SYNC function

During normal measurements, when AUTO SYNC function is on, the input pattern and reference pattern are synchronized automaticelly. Press [AUTO SYNC] (14) to turn on the AUTO SYNC function and light the LED.

The AUTO SYNC function has two modes: normal mode and frame mode. Pattern monitoring during sync loss is different in the normal mode and frame mode.

In the normal mode, all patterns are monitored, whereas in the frame mode, only the specified patterns, from the 4th to the 32nd bits (hereafter called "frame bits") are monitored.

The frame mode can be set only when a single cycle has a programmable pattern length of 1024 bits or more. In this case, the sync recovery (pull-in) time can be made shorter than that in the normal mode by monitoring only the frame bits.

When [FRAME SYNC] (30) is pressed; the AUTO SYNC function is set to the frame mode, the LED lights, and the FRAME SYNC function is set to ON.

For a description of frame-bit length and frame bit setting, refer to paragraph 5.2.4.

Whether the input signal is in the SYNC GAIN state or the SYNC LOSS state is determined by the sync threshold values shown in Table 5-2.

In the SYNC GAIN state, when the error ratio exceeds the sync-loss threshold value, the state is determined to be the SYNC LOSS state.

In the SYNC LOSS state, when the error ratio is below the sync-gain threshold value, the state is determined to be the SYNC GAIN state.

If the error rate always exceeds the sync-loss threshold values of Table 5-2, pattern synchronization is not established and measurements cannot be made. However, when the error ratio is smaller than the sync-loss threshold value, set [AUTO SYNC] to ON to establish pattern synchronization, and then lock the pattern synchronization by setting [AUTO SYNC] to OFF so that even error ratios which exceed the sync loss threshold value can be measured.

Table 5-2 Sync Threshold Values (1/2)

Mode	Pattern	Pattern length *	Sync threshold value (error ratio = number of errors/number of clocks)	
			Sync-loss threshold value (SYNC GAIN state → SYNC LOSS state)	Sync-gain threshold value (SYNC LOSS state → SYNC GAIN state)
Normal	PRBS	2^N-1 (N=7,9,11, 15,20,23,31)	$\frac{(128)\times 2{,}000}{(2{,}048)\times 2{,}500} = \frac{1}{20} = 5\times 10^{-2}$	$\frac{64}{2{,}048\times 2} = \frac{1}{64} = 1.56\times 10^{-2}$
	Program-mable	2 to 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 to 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 to 1,600	$\frac{(128)\times 20}{(2{,}048)\times 2{,}500} = \frac{1}{2{,}000} = 5\times 10^{-4}$	$\frac{64}{2{,}048\times 200} = \frac{1}{6{,}400} = 1.56\times 10^{-4}$
		1,601 to 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 to 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 to 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 to 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 to 524,288	$\frac{(128)\times 2}{(2{,}048)\times 2^{16}} = \frac{1}{524{,}288} = 1.9\times 10^{-6}$	$\frac{64}{2{,}048\times 40{,}000} = \frac{1}{1280{,}000} = 7.81\times 10^{-7}$

* The programmable pattern length is shown below.
WORD mode: (Number of words) × (Word length)
DATA mode: Data length

Table 5-2 Sync Threshold Values (Cont.) (2/2)

Mode	Pattern	Pattern length *	Sync threshold value (error ratio = number of errors/ number of clocks)	
			Sync-loss threshold value (SYNC GAIN state → SYNC LOSS state)	Sync-gain threshold value (SYNC LOSS state → SYNC GAIN state)
Frame	Progam-mable	1,024 to 5,120	$\frac{(128) \times 100}{(4{,}096) \times 18{,}750} = \frac{1}{6{,}000} = 1.7 \times 10^{-4}$	$\frac{256}{256 \times N} = \frac{1}{N}$ (N: length, 1,024 to 524,288)
		5,248 to 10,240	$\frac{(128) \times 100}{(4{,}096) \times 34{,}375} = \frac{1}{11{,}000} = 9.1 \times 10^{-5}$	
		10,368 to 51,200	$\frac{(128) \times 100}{(2{,}048) \times 10 \times 32{,}500} = \frac{1}{52{,}000} = 1.9 \times 10^{-5}$	
		51,328 to 102,400	$\frac{(128) \times 100}{(2{,}048) \times 20 \times 34{,}375} = \frac{1}{110{,}000} = 9.1 \times 10^{-6}$	
		102,528 to 204,800	$\frac{(128) \times 100}{(2{,}048) \times 50 \times 26{,}250} = \frac{1}{210{,}000} = 4.8 \times 10^{-6}$	
		204,928 to 307,200	$\frac{(128) \times 100}{(2{,}048) \times 50 \times 38{,}750} = \frac{1}{310{,}000} = 3.2 \times 10^{-6}$	
		307,328 to 409,600	$\frac{(128) \times 100}{(2{,}048) \times 50 \times 51{,}250} = \frac{1}{410{,}000} = 2.4 \times 10^{-6}$	
		409,728 to 524,288	$\frac{(128) \times 100}{(2{,}048) \times 100 \times 32{,}768} = \frac{1}{530{,}000} = 1.9 \times 10^{-6}$	

* The programmable pattern length is shown below.
WORD mode: (Number of words) × (Word length)
DATA mode: Data length

5.3.8 Audible alarm

There are two audible indicators: one for errors and one for alarms. The error indicator is heard on error generation, and the alarm indicator is heard on clock loss, sync loss, and power recovery.

To enable the error indicator, press [ERRORS] of the ALARM MONITOR (9); the ERRORS LED will light.

To enable the alarm indicator, press [ALARM]; the ALARM LED will light. [ERRORS] and [ALARM] operate independently.

Adjust the audible alarm volume with the ALARM MONITOR knob. Turn the knob clockwise to increase the volume; turn it counterclockwise to decrease the volume.

5.3.9 ERRORS and alarm LEDs

(1) ERRORS LED

This LED (16) indicates that an error has occurred.

- ON condition

  Error has occurred

- OFF condition

  Clock loss, sync loss, and when no errors

(2) Alarm LED

The alarm LEDs consist of both HISTORY LEDs (small-sized orange LEDs), which display past events, and real time LEDs (large-sized orange), which display the current operational status.

(a) POWER FAIL LED (HISTORY LED only)

This LED indicates that momentary power failure occurred or that the power was interrupted.

- ON condition

  HISTORY LED:

  After power recovery from momentary power failure or the power interruption during measurement, this LED is lit.

- OFF condition

  HISTORY LED:

  At start of measurement or when power supply is uninterrupted.

(b) CLOCK LOSS LED

This LED indicates that the clock signal is or has been lost.

- ON condition

  HISTORY LED:

  LED is lit if clock has been lost during measurement

  Real time LED:

  LED lights at the moment that clock loss occurs

- OFF condition

  HISTORY LED:

  At start of measurement or no clock loss

  Real time LED:

  At clock recovery

(c) SYNC LOSS LED

This LED indicates that sync is or has been lost.

- ON condition

  HISTORY LED:

  LED lights if sync has been lost during measurement

  Real time LED:

  LED lights at the moment sync loss occurs

- OFF condition

  HISTORY LED:

  At start of measurement or no sync loss

  Real time LED:

  At recovery of sync, at clock loss, or when [AUTO SYNC] key is set OFF

5.4 REAL TIME/MEAS TIME Section

Both the real time (calendar time) and measurement time can be set with the [MODIFY] key (11).

5.4.1 Measurement time

In the REPEAT and SINGLE measurement modes, the measurement time (i.e. duration of measurement) must be set in advance.

Measurement is performed only during this period even if power failure, clock loss, or sync loss occurs during measurement.

The relationship between measurement time and the minimum measurable error ratio is:

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

Example: When the measurement time is 10 seconds and the frequency is 10 GHz, the minimum error ratio is approximately 3.3×10^{-11}.

The method for setting measurement times is described below:

Step	Procedure
1	Set the MEAS TIME (10) [PERIOD] key to ON. (At this time, the measurement time currently set is shown on the display (19).)
2	Set the [MODIFY] key (11) to ON. (At this time, those display items which can be modified (19), will blink.)
3	Press the [<][>] (20) and [∨][∧] (12) keys to set the DAY, HOUR, MINUTE, and SECOND values.
4	Set the [MODIFY] key (11) to OFF to accept the measurement time. (However, a measurement time of 00 day 00 hour 00 minute 00 second will not be accepted.)

5.4.2 Real time

The MP1702A contains a clock with a calendar. Measurements are performed in accordance with this clock.

The method for setting the real time (calendar clock) is described below:

Step	Procedure
1	Set the REAL TIME (10)[Y.M.D] key or [H.M.S] key to ON to display the current year/month/day or hour/minute/second.
2	Set the [MODIFY] key (11) to ON. (At this time, those display items which can be modified (19) will blink. While the [H.M.S] key is ON, 00 is displayed at the SECOND value.)
3	Press the [Y.M.D] key to set the YEAR, MONTH, and DAY values. While [H.M.S] is ON, the HOUR, and MINUTE values can be set by pressing the [<] [>] (20) and [∨] [∧] (12) keys.
4	Set the [MODIFY] key (11) to OFF. (The year/month/day or hour/minute/second are accepted at this time. However, when a time which can never occur [00 year, 04 month 31 day, for example] is set, the [MODIFY] key cannot be used to accept that data.)

5.5 MEMORY Section

5.5.1 Floppy disk insertion

Insert a formattted 3.5-inch 2HD or 2DD-type floppy disk into the floppy disk drive (44). (The accessory floppy disk is formatted. For the formatting method, see paragraph 5.5.8.)

5.5.2 Mode setting

Set the PTN (pattern) mode or OTHERS mode by pressing MEMORY [MODE] (49). In the PTN mode, the pattern set contents are stored; in the OTHERS mode, other set conditions (frequency, amplitude, offset voltage, etc.) are stored.

For each mode, file names from 00 to 99 can be selected.

5.5.3 File save

Select the FILE No. display mode by pressing [DIR/FILE No.] (45). Select the desired file name (00 to 99) by pressing [∧] or [∨] (50) and then press [SAVE] (47). In the PTN mode, the pattern set contents are saved; in the OTHERS mode, the other set conditions are saved. (In the PTN mode, if the data length is too long, the number of files that can be saved is restricted. See paragraph 5.5.11.)

5.5.4 File recall

Select the PTN mode or OTHES mode by pressing MEMORY [MODE] (49), then select the desired file name with [∧] or [∨] (50).

Press [RECALL] to recall the contents of the file.

5.5.5 Directory

Select the DIR mode with [DIR/FILE No.] (45) to access the floppy disk and check the saved file. Press [∧] or [∨] (50) to display the names of those files on the inserted floppy disk. When there are no files on the inserted floppy disk, "– –" is displayed.

In the DIR mode, recall, resave, and delete operations can be performed, but the save operation cannot be performed.

When returning to the FILE No. mode from the DIR mode, if the file is selected with [∧] or [∨] (50) exists, the EXIST will be lit.

Note: When the floppy disk is changed after the DIR mode has been set, set the DIR mode again.

Directory information is read and stored in the MP1702A, therefore, even if the floppy disk is removed, the displayed directory information will not represent the directory information for the floppy disk which has just been inserted.

5.5.6 File resave

After setting the shift mode by pressing [SHIFT], press [RESAVE] to resave an existing file.

However, resave may be impossible, depending on the remaining storage capacity of the floppy disk. Read the resave operation described in paragraph 5.5.12.

5.5.7 File delete

After setting the shift mode by pressing [SHIFT] , press [DELETE] (46) to delete an existing file.

5.5.8 Floppy disk formatting

Sst the OTHERS mode and FILE No. mode, then press [∧] (50) to select Fr (Fr follows 99).

After pressing [SHIFT], press [DELETE] (46) to format the floppy disk.

It takes about two minutes to format a floppy disk

Note: This instrument can format only 2HD-type flopy disks.

To format 2DD-type floppy disks, use a personal computer with 9 sectors/track MS-DOS disk formatting option.

5.5.9 Error message

When a floppy disk error occurs, an error code, E0 to E9, is displayed on the display for that file name.

Error messages are listed in Table 5-3.

All the keys in the MEMORY section, other than [∨] and [∧] (50),are disabled as long as an error message is being displayed. To reset the error display, press [∨] and [∧] once each.

Table 5-3 Error Messages

Error item	Error contents
E0	Media error (formatting or media error)
E1	Write protection error
E2	File full (insufficient write area)
E3	File not found (specified file not found at read)
E4	File already exists error (duplicate file name)
E5	Write error
E6	Read error
E7	File type, file error (file type or file contents error)
E8	FD error (other error)
E9	Hardware error (hardware trouble error)

5.5.10 Memory capacity

Usually, 200 files can be stored on one floppy disk; 100 files in the OTHERS mode and 100 files in the PTN mode. However, when large data files or full-length word patterns are stored, the number of files that can be stored may be reduced.

For example, only eighteen (for 2HD-type, or eleven for 2DD-type) 512 kbits pattern files can be stored (paragraph 5.5.11 (5)).

5.5.11 Floppy disk

(1) Disk type

When the floppy disk is formatted in standard MS-DOS format provided by the MS-DOS file handler, it becomes data type disk. This is because the MS-DOS handler does not copy the MS-DOS system.

The system disk containing the MS-DOS system can also be used to store data.

(2) Volume label

The volume label is assigned when the floppy disk is formatted.

Volume label: MP1702A_DAT

This volume label is used to identify the floppy disk.

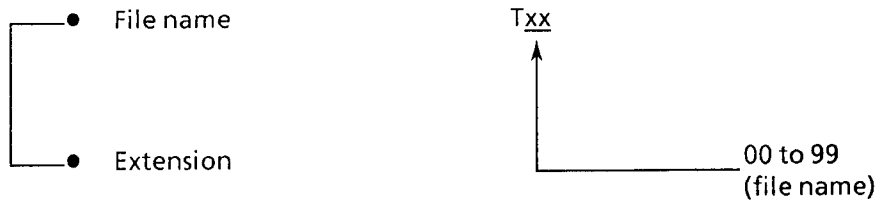
(3) File configuration

- Directory configuration

  Only a root directory is configured.

- File name, extension

  The file name and extension have the format shown below:



PTN: Pattern file
OTH: Parameter file for other than pattern data

Examples: T99.PTN
T01.OTH

(4) Data format

Since the format of data stored on floppy disk is not, as a rule, accessible to the user; opeation is not guaranteed when data is generated, modified, etc. with a personal computer that operates under MS-DOS.

However, file directory checking and file copying are no problem.

(5) 512k bits pattern data and floppy disk capacity

As mentioned previously in paragraph 5.5.10, only eighteen 512-kbit files can be stored as shown below:

T99	PTN	65640	89-11-14	13:13
T98	PTN	65640	89-11-14	13:13
T97	PTN	65640	89-11-14	13:14
T96	PTN	65640	89-11-14	13:14
T95	PTN	65640	89-11-14	13:15
T94	PTN	65640	89-11-14	13:15
T93	PTN	65640	89-11-14	13:16
T92	PTN	65640	89-11-14	13:16
T91	PTN	65640	89-11-14	13:17
T90	PTN	65640	89-11-14	13:17
T89	PTN	65640	89-11-14	13:18
T88	PTN	65640	89-11-14	13:19
T87	PTN	65640	89-11-14	13:19
T86	PTN	65640	89-11-14	13:20
T85	PTN	65640	89-11-14	13:20
T84	PTN	65640	89-11-14	13:21
T83	PTN	65640	89-11-14	13:22
T82	PTN	65640	89-11-14	13:22

Note: Refer to paragraph 5.5.12.

(6) Actual data

A dump of data stored on a floppy disk is shown below. This data is for DATA pattern, data length = 512.

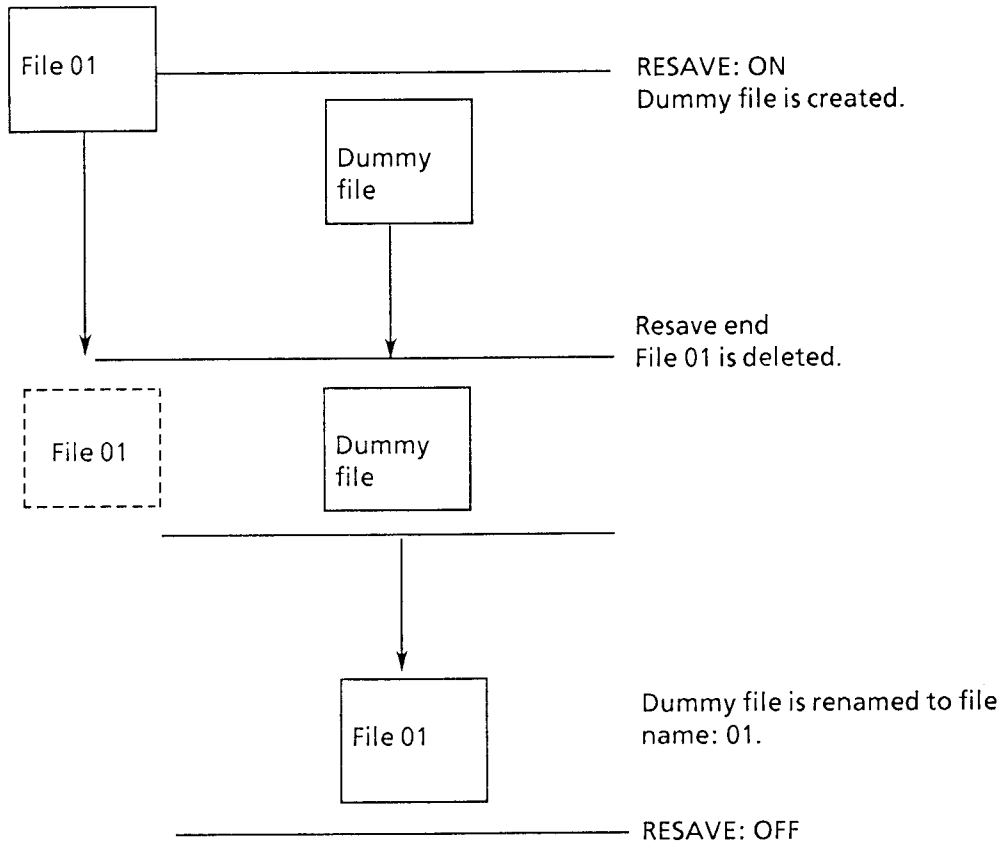
Dump Version 2.1.

```
00000000   00 00 00 00 31 2E 30 20-00 00 00 00 00 00 00 01
00000010   00 00 00 01 00 00 00 00-00 00 00 05 00 00 80 00
00000020   00 00 00 06 00 01 86 A0-00 00 00 10 00 00 00 02
00000030   00 00 00 01 00 00 00 06-00 00 00 01 00 00 80 01
00000040   00 00 00 01 00 00 02 00-00 00 00 01 00 00 00 01
00000050   00 00 00 20 00 00 00 01-00 00 00 03 00 00 00 01
00000060   00 00 00 20 00 00 00 01-00 01 00 02 00 04 00 08
00000070   00 10 00 20 00 40 00 80-01 00 02 00 04 00 08 01
00000080   10 00 20 00 40 00 7F FF-80 00 C0 00 E0 00 F0 01
00000090   F8 00 F0 00 FE 00 FF 00-FF 80 FF C0 FF E0 FF F0
000000A0   FF F8 FF FC FF FE FF FF-00 00 00 00 00 00 00 00
```

5.5.12 Resave operation

The resave function performed by the MP1702A is shown below:

When a file named 01 is resaved, the following operation sequence is performed.



The resave operation cannot be performed if the free space on the floppy disk is not equal to, or greater than, the size of the file to be resaved.

That is, for paragraph 5.5.11 (5), since the free space on the floppy disk is only 52 224 bytes, a 65 640 -byte file cannot be resaved.

5.5.13 Key operations during floppy disk accessing

While the floppy disk is being accessed in the following operations,

- SAVE
- RESAVE
- RECALL
- DELETE
- FORMATTING
- DIRECTORY SEARCH

Keys and knobs are essentially locked and remain in this state until access is completed.

5.5.14 Notes on floppy-disk handling

Please pay careful attention to the following points.

- Do not remove the floppy disk while it is being accessed.
- Observe the specified environmental conditions. Also, do not use the equipment in a dusty place.
- Keep magnetic objects away from the disk. Do not bend the disk.
- Insert the head protection sheet into the disk slot when moving the equipment.

5.6 Description of Built-in Printer

The MP1702A has a built-in printer upon which five types of data can be printed: measurement start data, measurement end data, intermediate data, one-second data, and alarm data.

During printing of measurement-end data and intermediate data, both the threshold EI/EFI and error performance data can also be printed in addition to the measured results. Print commands are described in paragraph 5.6.1; print contents in paragraph 5.6.2 and print formats are described in paragraph 5.6.3.

5.6.1 Printing measurement data

To print the measurement data, proceed as follows:

Step	Procedure
1	Select the data to be printed from the printout data in Table 5-4 and set the rear-panel FUNCTION 2 switches (58), appropriately.
2	Set [PRINTER] (8) to ON.
3	Press [START] (13).

Note: To print intermediate data, press [MANUAL PRINT] (8) at the desired time.

5.6.2 Print data contents

The print data contents are shown in Table 5-4.

Table 5-4 Print Data Contents (1/3)

Print data type	Print data contents	Print timing	Print selection
Measurement start data	· Measurement start time	· At measurement start	None
Measurement end data	· Measurement start time · Measurement end time · Measurement elapsed time · Measred results Measured value - Error ratio - Error count - EI - EFI Alarm intervals - Power fail - Clock loss - Sync loss · Threshold EI and EFI data · Error performance data	· At measurement end	· The following can be selected with FUNCTION 2 switches 1, 2, and 3: (i) Switch 1 0: Prints all measured results 1: Prints only error ratio and error count of measured results (ii) Switch 2 0: Does not print threshold EI and EFI data 1: Prints threshold EI and EFI data (iii) Switch 3 0: Does not print error performance data 1: Prints error performance data
Measurement intermediate data	· Same as measurement end data items. However, measurement end time is replaced by measurement intermediate time.	· When [MANUAL PRINT] key ⑧ is pressed · When intermediate data print is selected, the data is printed as follows:	· The following can be selected with the FUNCTION 2 switch 4: 0: Does not print intermediate data 1: Prints intermediate data

Table 5-4 Print Data Contents (2/3)

Print data type	Print data contents	Print timing	Print selection
Measurement start data (cont.)		(i) Every 2 hours when measurement time is less than 2 days (ii) Every day when measurement time is more than 2 days (iii) Every day in UNTIMED mode	· Data items printed by the FUNCTION 2 switches 1, 2, and 3 are the same as for measurement end data
One second data	· Generation time · One second average error ratio · One second error count	· Every second	· The following can be selected with FUNCTION 2 switches 5, 6, 7, and 8: (i) Switch 5 0: Does not print one second data 1: Prints one second data (ii) Switches 6 and 7 SW6 SW7 Output threshold 0 0: Prints one second data when error > 0 0 1: Prints one second data when error $> 10^{-6}$ 1 0: Prints one second data when error 10^{-4} 1 1: Prints one second data when error $> 10^{-3}$ (iii) Switch 8 0: Paper saving function disabled 1: Paper saving function enabled

Table 5-4 Print Data Contents (3/3)

Print data type	Print data contents	Print timing	Print selection
Alarm data	· Power failure time · Power failure recovery time · Clock loss time · Clock loss recovery time · Sync loss time · Sync loss recovery time · Measurement abort generation time	· On occurrence of error or at error recovery. Power failure time is printed at time of power recovery.	None

5.6.3 Printing format

Note:

0: a single numerical digit, △: a single space

(1) Measurement start data

(Year) (Month) (Day) (Hour) (Minute) (Second)

○ ○ – ○ ○ – ○ ○ / ○ ○ : ○ ○ : ○ ○ △ S T A R T △

(2) 1-second data

(Minute) (Second) ⌐ 1-second average error ratio ¬ ⌐ 1-second error count ¬

○ ○ : ○ ○ △ ○ . ○ ○ E – ○ ○ △ ○ ○ ○ ○ ○ ○ ○ ○ △

(3) Alarm data

- Power failure/power recovery

(Year) (Month) (Day) (Hour)

○ ○ – ○ ○ – ○ ○ / ○ ○ : △ △ △ △ △ △ △ △ △ △ △ △

(Minute) (Second)

○ ○ : ○ ○ △ P O W E R △ F A I L U R E △ △ △ △ △

(Year) (Month) (Day) (Hour)

○ ○ – ○ ○ – ○ ○ / ○ ○ : △ △ △ △ △ △ △ △ △ △ △ △

(Minute) (Second)

○ ○ : ○ ○ △ P O W E R △ R E C O V E R Y △ △ △ △

- Clock loss/clock recovery

(Minute) (Second)

○ ○ : ○ ○ △ C L O C K △ L O S S △ △ △ △ △ △ △ △

(Minute) (Second)

○ ○ : ○ ○ △ C L O C K △ R E C O V E R Y △ △ △ △

- Sync loss/sync recovery

(Minute) (Second)

○ ○ : ○ ○ △ P T N △ S Y N C △ L O S S △ △ △ △ △

(Minute) (Second)

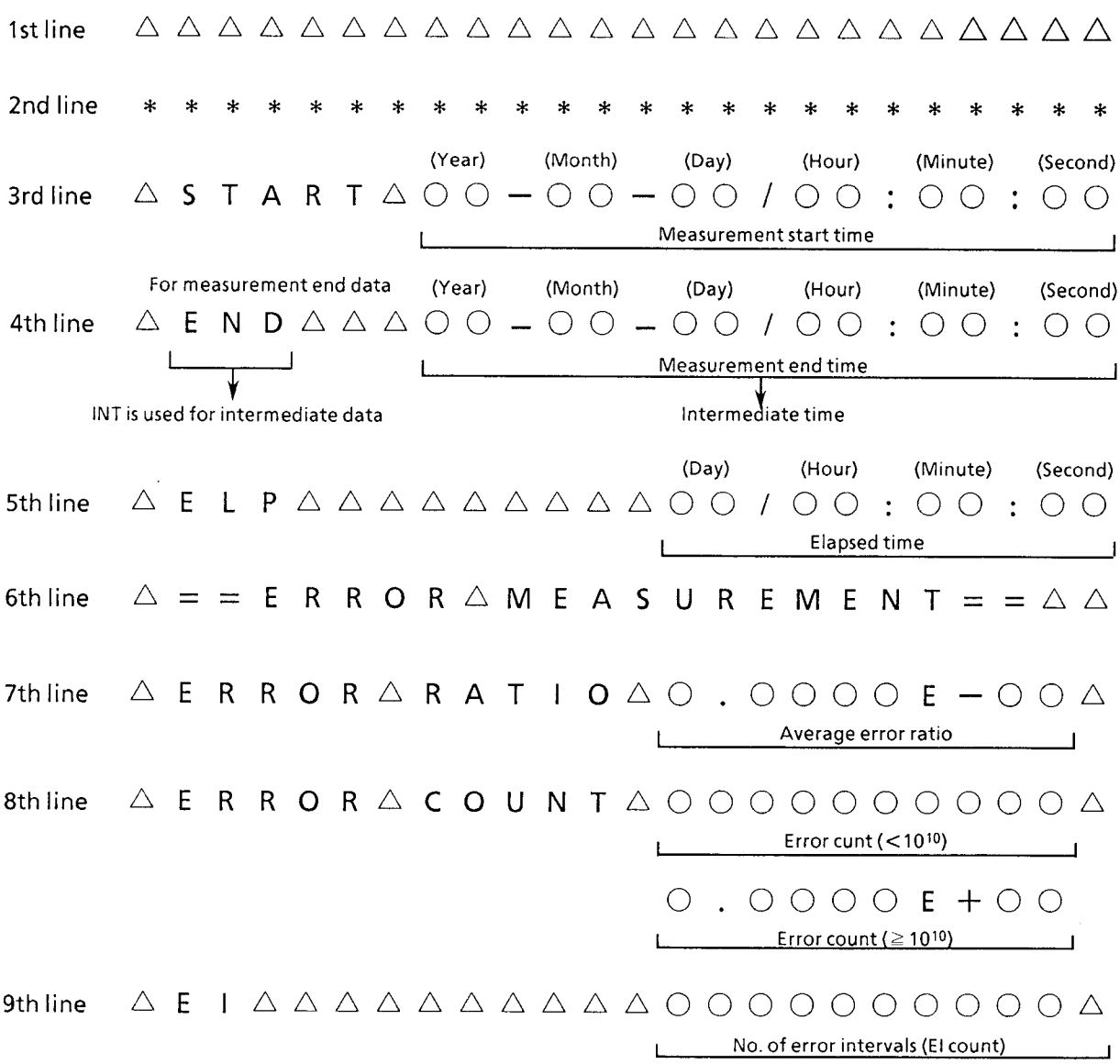
○ ○ : ○ ○ △ P T N △ S Y N C △ R E C O V E R Y △

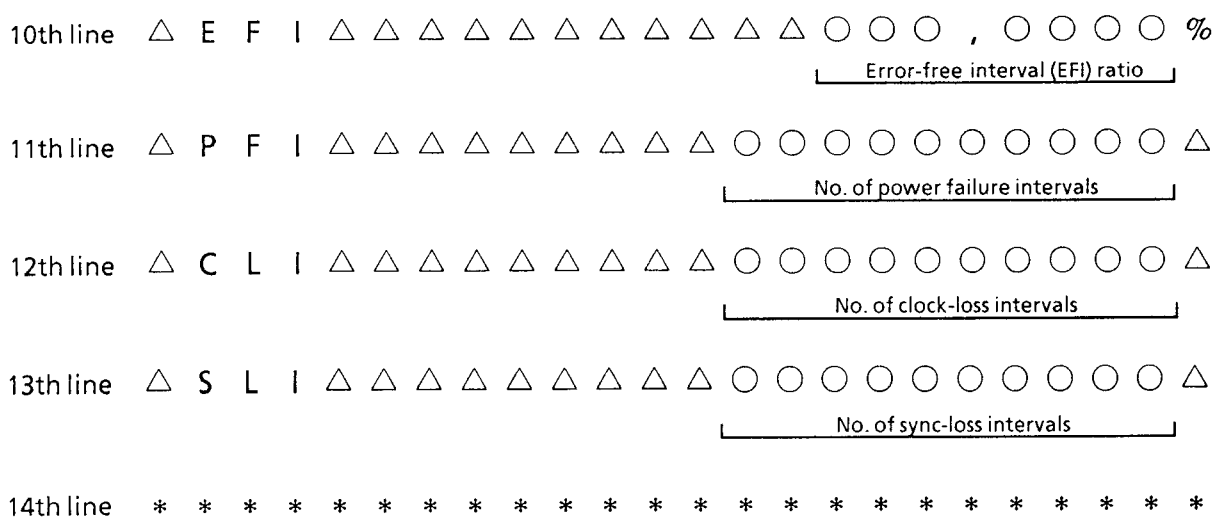
(4) Measurement end data and intermediate data

There are two output formats: standard format and short (abridged) format.

These formats are described below in (a) Standard format and (b) Short (abridged) format.

(a) Standard format




10th line △ E F I △△△△△△△△△△△△ ○○○ , ○○○○ %
Error-free interval (EFI) ratio
11th line △ P F I △△△△△△△△△△△ ○○○○○○○○○○ △
No. of power failure intervals
12th line △ C L I △△△△△△△△△△△ ○○○○○○○○○○ △
No. of clock-loss intervals
13th line △ S L I △△△△△△△△△△△ ○○○○○○○○○○ △
No. of sync-loss intervals
14th line *

Note 1: When threshold EI/EFI data are printed, the 1st to 9th lines, below, are printed between the 13th and 14th lines, above.

1st line △ = = △ T H R E S H O L D △ E I , E F 1 △ = = △

2nd line △ E R △ △ △ E I △ △ △ △ △ △ △ E F I △ △ △ △ △ △

3rd line △ > − 3 △ △ ○ ○ ○ ○ ○ ○ ○ ○ △ ○ ○ ○ , ○ ○ ○ ○ %
Threshold EI count | Threshold EFI ratio

4th line △ > − 4 △ △ ○ ○ ○ ○ ○ ○ ○ ○ △ ○ ○ ○ , ○ ○ ○ ○ %
Threshold EI count | Threshold EFI ratio

5th line △ > − 5 △ △ ○ ○ ○ ○ ○ ○ ○ ○ △ ○ ○ ○ , ○ ○ ○ ○ %
Threshold EI count | Threshold EFI ratio

6th line △ > − 6 △ △ ○ ○ ○ ○ ○ ○ ○ ○ △ ○ ○ ○ , ○ ○ ○ ○ %
Threshold EI count | Threshold EFI ratio

7th line △ > − 7 △ △ ○ ○ ○ ○ ○ ○ ○ ○ △ ○ ○ ○ , ○ ○ ○ ○ %
Threshold EI count | Threshold EFI ratio

8th line △ > − 8 △ △ ○ ○ ○ ○ ○ ○ ○ ○ △ ○ ○ ○ , ○ ○ ○ ○ %
Threshold EI count | Threshold EFI ratio

9th line △ = < − 8 △ △ ○ ○ ○ ○ ○ ○ ○ ○ △ ○ ○ ○ , ○ ○ ○ ○ %
Threshold EI count | Threshold EFI ratio

Note 2: When error performance data are printed, the 1st to 6th lines, below, are also printed between the 13th and 14th lines, above.

1st line △ = = E R R O R △ P E R F O R M A N C E = = △ △

2nd line △ E R R O R E D △ S E C △ △ △ ○ ○ ○ , ○ ○ ○ ○ %
Error seconds ratio

3rd line △ E R △ F R E E △ S E C △ △ △ ○ ○ ○ , ○ ○ ○ ○ %
Error-free seconds ratio

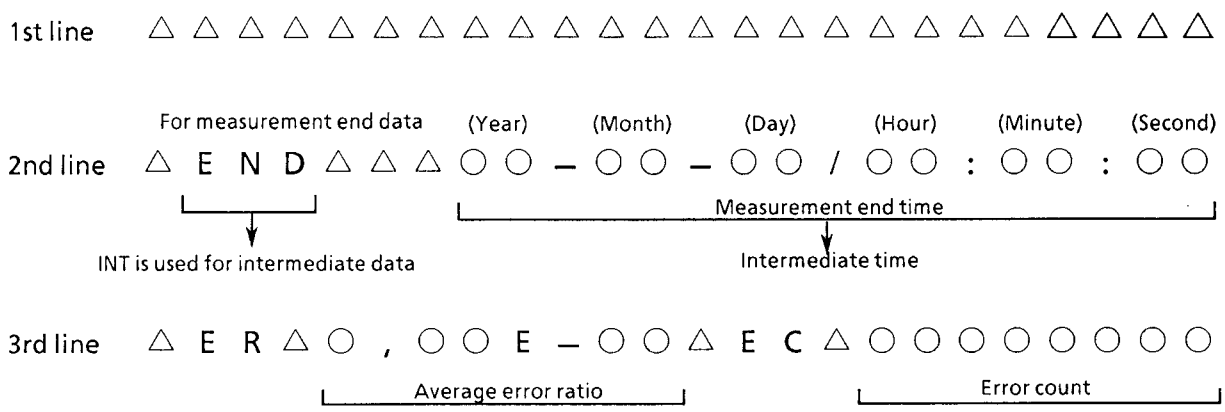
4th line △ S E S △ (E − ○) △ △ △ △ △ ○ ○ ○ , ○ ○ ○ ○ %
Severely-errored seconds ratio
Error performance threshold

5th line △ D M △ △ (E − ○) △ △ △ △ △ ○ ○ ○ , ○ ○ ○ ○ %
Degraded minutes ratio
DM threshold

6th line △ U N A V A I L △ S E C △ △ △ ○ ○ ○ , ○ ○ ○ ○ %
Unavailable seconds ratio

Note 3: When both threshold EI/EFI data and performance data are printed, the threshold EI/EFI data are printed first.

(b) Short (abridged) format



Note: The threshold EI/EFI and error performance printing formats are the same as the standard output format. The data are printed after the 4th line.

5.7 Definition of Terms

5.7.1 Measurement items

(1) ERROR RATIO

$$\frac{\text{Number of error pulses during measurement time}}{\text{Number of clocks during measurement time}}$$

(2) ERROR COUNT

Number of error pulses during measurement time

(3) ERROR INTERVAL (EI)

Number of intervals of one-second duration containing one or more error pulses for the duration of the measurement time.

(4) ERROR FREE INTERVAL (EFI)

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

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

(5) CLOCK FREQUENCY

Number of clocks in one second

5.7.2 Alarm intervals

(1) POWER FAILURE INTERVALS

Number of one-second intervals during which power failure occurred.

(2) CLOCK LOSS INTERVALS

Number of one-second intervals during which clock loss occurred.

(3) SYNC LOSS INTERVALS

Number of one-second intervals during which sync loss occurred.

5.7.3 THRESHOLD EI and EFI data

(1) THRESHOLD EI

Number of one-second intervals during which the one-second average error ratio satisfied the following threshold conditions in the measurement time.

One-second average error ratio

$>10^{-3}$, $>10^{-4}$, $>10^{-5}$, $>10^{-6}$, $<10^{-7}$, $>10^{-8}$, $\leqq 10^{-8}$

(2) THRESHOLD FEI

Ratio of the number of one-second intervals (during which the one-second average error ratio did not satisfy the error ratio conditions of item (1)) to the total number of one-second intervals for the duration of the measurement times.

It is calculated from the threshold EI from the following equation:

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

5.7.4 Error performance data

The time from the start of measurement to the end of measurement is divided in one-second intervals into an available state and an unavailable state. Various items are calculated, mainly for intervals occuring during the available state.

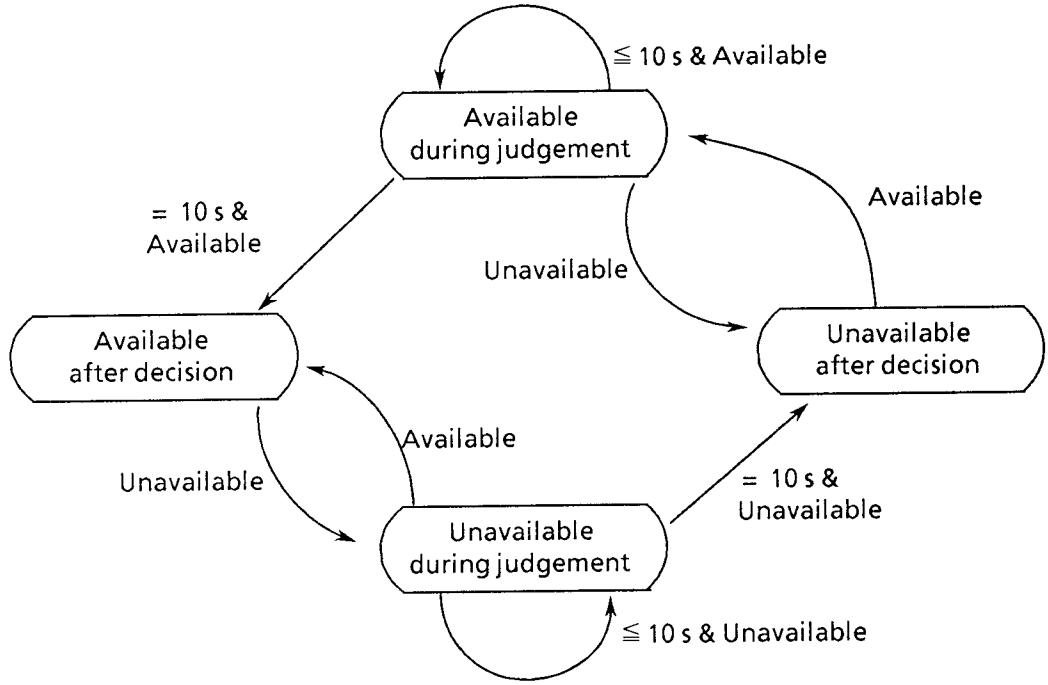
(1) Definition of unavailable state and available state

The unavailable state begins when the average error ratio exceeds the unavailable threshold for 10 consecutive 1-second intervals. These 10 seconds are included as part of the unavailable state calculations.

The unavailable state ends when the average error ratio does not exceed the unavailable threshold for 10 consecutive 1-second intervals. These 10 seconds are included as part of the available state calculations.

An available state is defined as the state during which the unavailable state does not exist.

Each interval is further divided into two states as described below:



- Unavailable state (after decision):

  The state is entered from the UNAVAILABLE (during judgement) state after the UNAVAILABLE state criteria have been fulfilled for ten consecutive 1-second intervals.

  When a newly calculated error ratio fulfills the UNAVAILABLE state criteria, its data are included as part of the UNAVAILABLE state calculations.

  When it does not fulfill these criteria, its data are not included in either AVAILABLE or UNAVAILABLE state calculations, instead the AVAILABLE (during judgement) state is entered.

- Unavailable state (during judgement):

  This state is entered from the AVAILABLE (after judgement) state when the error ratio for a 1-second interval does not fulfill the AVAILABLE state requirements. After this state has been entered, the UNAVAILABLE state criteria continue to be monitored for the next ten consecutive 1-second intervals.

  If, within that 10-second period, the UNAVAILABLE state criteria are fulfilled, then the state changes to the UNAVAILABLE (after decision) state and the data accumulated up until that time are included as part of the UNAVAILABLE (after decision) state calculations.

  Conversely, if the UNAVAILABLE state criteria are not fulfilled for ten consecutive 1-second intervals, the state returns to AVAILABLE (after decision) and the data accumulated up until that time are included as part of the AVAILABLE (after decision) state calculations.

- Available state (after decision):

  This state is entered from the AVAILABLE (during judgement) state when the UNAVAILABLE state criteria have not been fulfilled for ten consecutive 1-second intervals.

After entry, if the state criteria for a 1-second interval still do not fulfill the UNAVAILABLE state criteria, then the data for that 1-second interval will be included in calculations for the AVAILABLE state.

However, if the state criteria for a 1-second interval do fulfill UNAVAILABLE state criteria, then the data for that interval will not be included in either AVAILABLE or UNAVAILABLE state calculations, instead the UNAVAILABLE (during judgement) state will be entered.

- Available state (during judgement):

  This state is entered from the UNAVAILABLE (after decision) state when the error ratio for a 1-second interval does not fulfill the UNAVAILABLE state requirements. After this state has been entered, the UNAVAILABLE state criteria continue to be monitored for the next ten consecutive 1-second intervals.

  If, within that 10-second period, the UNAVAILABLE state criteria are not fulfilled, then the state changes to the AVAILABLE (after decision) state and the data accumulated up until that time are included as part of the AVAILABLE (after decision) state calculations.

  Conversely, if the UNAVAILABLE state criteria are fulfilled for ten consecutive 1-second intervals, the state returns to UNAVAILABLE (after decision) and the data accumulated up until that time are included as part of the UNAVAILABLE (after decision) state calculations.

(2) Unavailable threshold and DM threshold

The following can be selected with FUNCTION 1 switch 4:

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 (total intervals calculated in available seconds)

- Error-free seconds

  Ratio of (error-free intervals calculated in available seconds) to (total intervals calculated in available seconds).

- Severely errored seconds (SES)

  Ratio of (unavailable intervals calculated in available seconds) to (total intervals calculated in available seconds).

- Degraded minutes

  Ratio of (number of packets whose error ratio exceeds the DM threshold) to (total number of packets). The ratio is calculated for every 60 intervals (one packet) provided that those intervals are calculated in the AVAILABLE state. Intervals which are in an errored seconds state are not used in calculating degraded minutes.

5.8 Processing of Measurement Data at an Alarm

(1) Power failure

When the power fails during measurement, the measurement data from the interval immediately prior to power failure is saved.

After the power recovery, measurement data are retrieved correctly and measurement is continued.

(a) Error measurement

The number of error pulses and number of clock pulses (that occur during power failure) are not used in calculations.

(b) Interval measurement and threshold interval measurement

The interval (at which power failure occurred) and the intervals (over which power failure continued) are used only to calculate the number of power fail intervals. They are not used to calculate other items.

(c) Error performance

The interval (at which power failure occurs) is not included either as unavailable seconds or available seconds.

After power recovery, measurement is restarted from the initial state.

(2) Clock-loss

When the clock signal is lost during measurement, the following two processes can be selected:

(a) Exclude clock-loss processing from calculation (FUNCTION 1 switch 2 = 0)

(i) Error measurement

The number of error pulses and number of clock pulses (which occured during clock-loss) are excluded from calculations.

(ii) Interval measurement and threshold interval measurement

Intervals during which clock-loss exists are used only in the number of clock-loss intervals calculation.

They are not used in the calculation of other items.

(iii) Error performance

Intervals during which clock-loss exists are not counted as either unavailable seconds or available seconds. The interval (at which clock-loss occurs) is also not counted as either unavailable seconds or available seconds.

When the clock-loss is recovered, measurement is continued from the initial state.

(b) Include clock-loss processing in calculation (FUNCTION 1 switch 2 = 1)

(i) Error measurement

The number of error pulses and clock pulses which occur during clock-loss are excluded from calculation.

(ii) Interval measurement and threshold interval measurement

Intervals during clock-loss are included in the number of clock-loss intervals and total number of intervals calculation, but are not included in the number of threshold EI calculation.

(iii) Error performance

Intervals in which clock-loss occurs, are considered to be unavailable intervals. If these intervals occur during the available state, then they are counted as errored second intervals. If they occur during the unavailable state, then they are only counted as unavailable intervals.

(3) Sync-loss

When synchronization is lost during measurement, the following two processes can be selected:

(a) Exclude sync-loss processing from calculation (FUNCTION 1 SWITCH 3 = 0)

(i) Error measurement

The number of error pulses and clock pulses (during sync-loss) are excluded from the calculation.

(ii) Interval measurement and threshold interval measurement

Intervals which occur during sync-loss are only included in the number of sync-loss intervals calculation. They are not used when calculating other items.

(iii) Error performance

Intervals which occur during sync-loss are not included in unavailable seconds or available seconds calculation. The interval (at which synchronization is lost) is not included in the unavailable seconds or available seconds calculation.

When synchronization is recovered, measurement is continued from the initial state.

(b) Include sync-loss processing in calculation (FUNCTION 1 switch 3 = 1)

(i) Error measurement

The number of error pulses and clock pulses (which occur during sync-loss) are excluded from calculation.

(ii) Interval measurement and threshold interval measurement

Intervals which occur during sync-loss are included in the calculation of the number of sync-loss intervals and the total number of intervals, but are not included in the calculation of the number of threshold EIs.

(iii) Error performance

Intervals which occur during sync-loss are considered to be unavailable intervals. When they are included in available seconds calculation, they are also used in the errored seconds calculation.

5.9 DEMUX OUTPUT

The input data, demultiplexed by 1/2, are output from the DEMUX A and B output connectors. Whether or not the input data were fetched normally by the MP1702A internal circuitry can be checked by observing these signals with a sampling oscilloscope. Observation is especially effective for checking the phase relationship between the input data and input clock. The block diagram of the INPUT section is shown in Fig. 5-10.

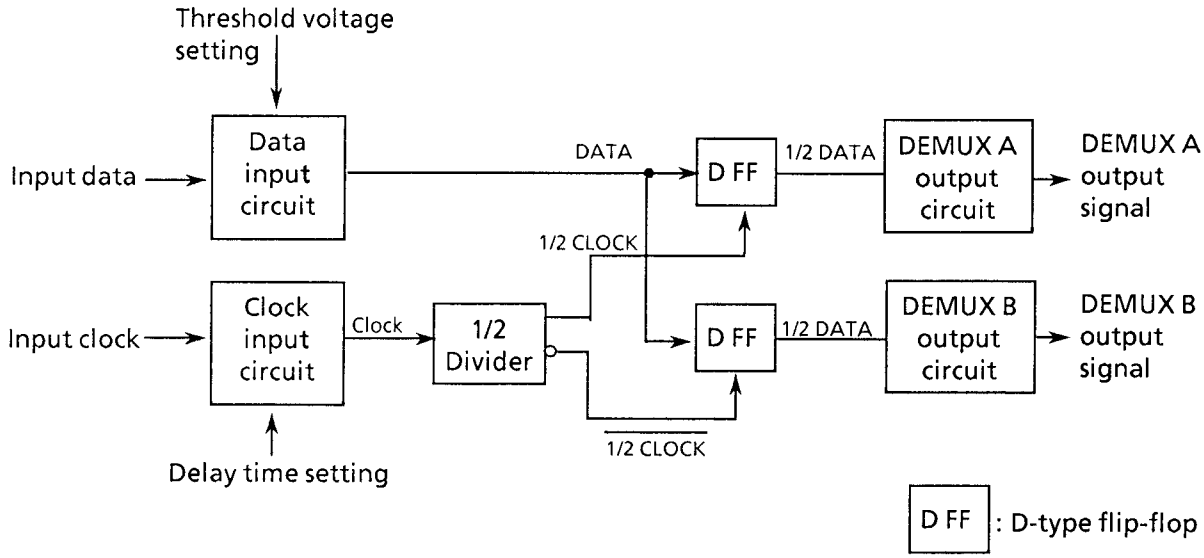


Fig. 5-10 INPUT Section Block Diagram

5.10 Pattern Sync Output

5.10.1 Pseudorandom pattern

Period = [1/(set frequency)] × (2^N-1) × 32

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

where, plus pulse with pulse width = [1/(set frequency)] × 32

5.10.2 Programmable pattern

(1) Period in data mode

(a) When data length is 4096 or less

Period = [1/(set frequency)] × (least common multiple of 128 and data length)

(Examples)

1. When data length is 8.

   Period = [1/(set frequency)] × 128

2. When data length is 10.

   Period = [1/(set frequency)] × 640

(b) When data length exceeds 4096

Period = [1/(set frequency)] × (data length)

(2) Period in word mode

Because (word length) × (number of words) = data length, the pattern sync output period is the same as that described in paragraph (1) Data mode.

(3) Pulse width

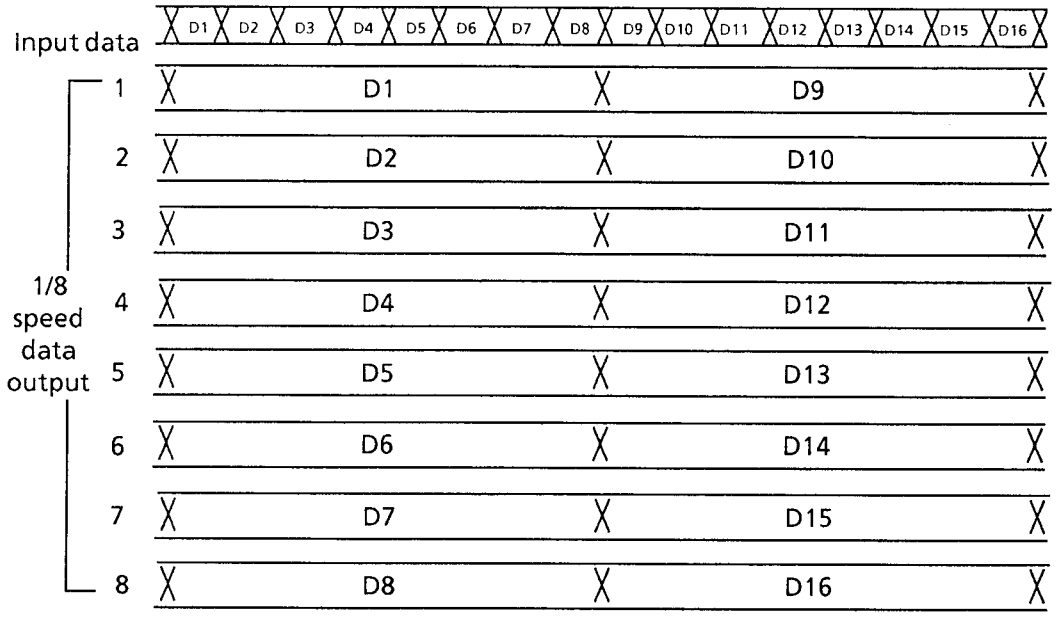
For all programmable patterns, the pulse width = [1/(set frequency)] × 64.

The output signal polarity is plus pulse.

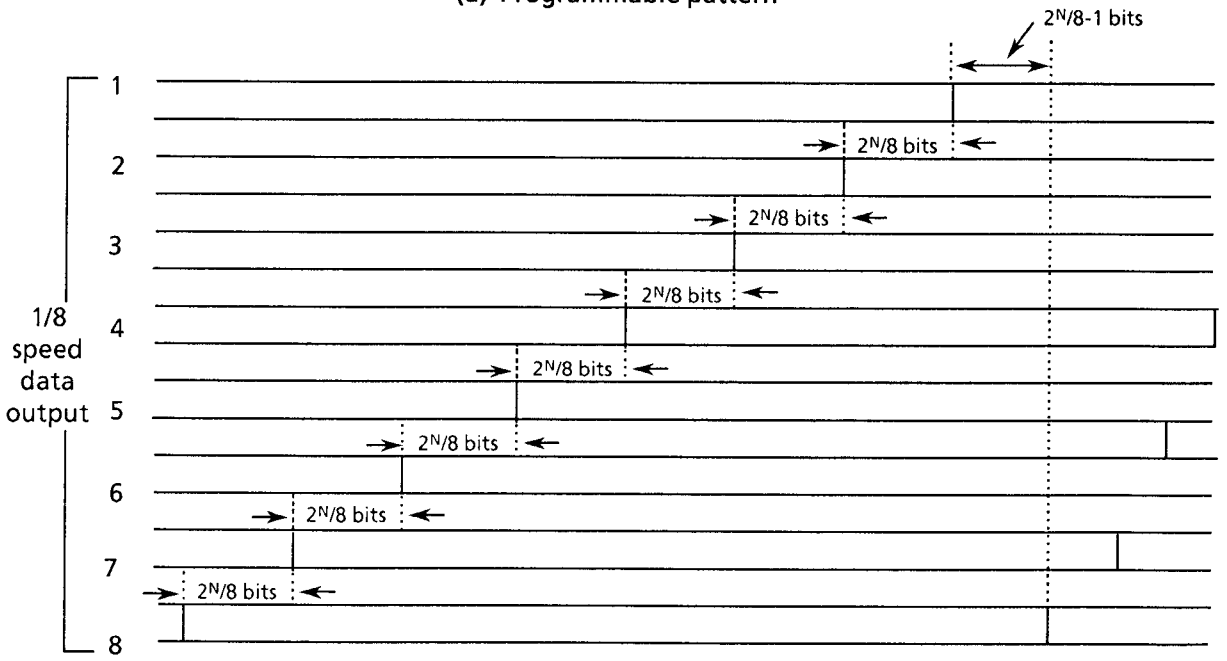
5.11 1/8 SPEED OUTPUT: DATA

This output is the input data demultiplexed by 1/8.

The relationship between the input data and 1/8 speed data output is shown in Fig. 5-11.



(a) Programmable pattern

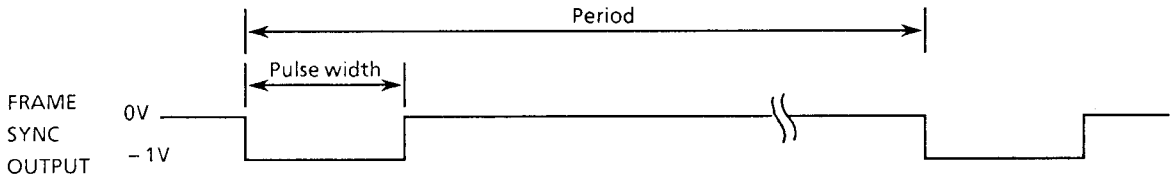


(b) PRBS pattern

Fig. 5-11 Input Data and 1/8 Speed Data Output

5.12 FRAME SYNC OUTPUT

This signal is output when the FRAME SYNC function is ON. The period and pulse width are shown in Fig. 5-12.



- Pulse width = (1/set frequency) × 32
- The period is the same as that of the SYNC OUTPUT PATTERN.

  Refer to paragraph 5.10.2.

Fig. 5-12 FRAME SYNC OUTPUT

5.13 ORED ERROR OUTPUT

There are two types of ORED ERROR OUTPUTs: direct error and stretched error. The error detection block diagram is shown in Fig. 5-13, and the error output pulse is described in Fig. 5-14.

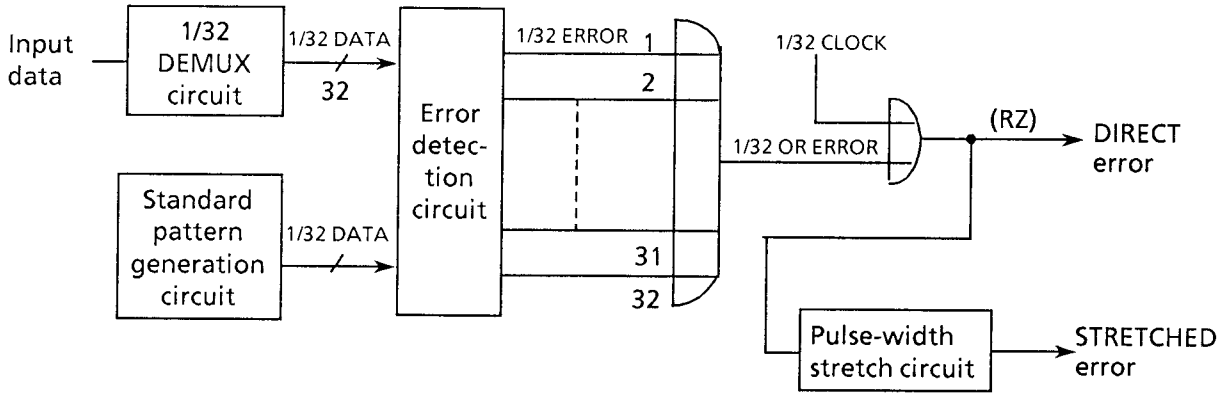


Fig. 5-13 Error Detection Block Diagram

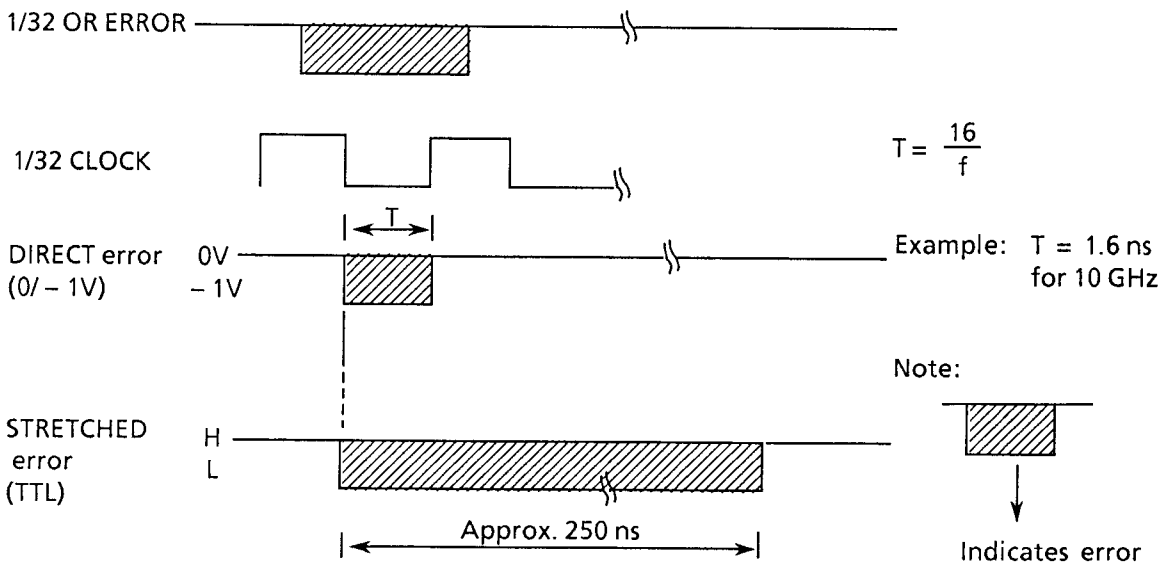
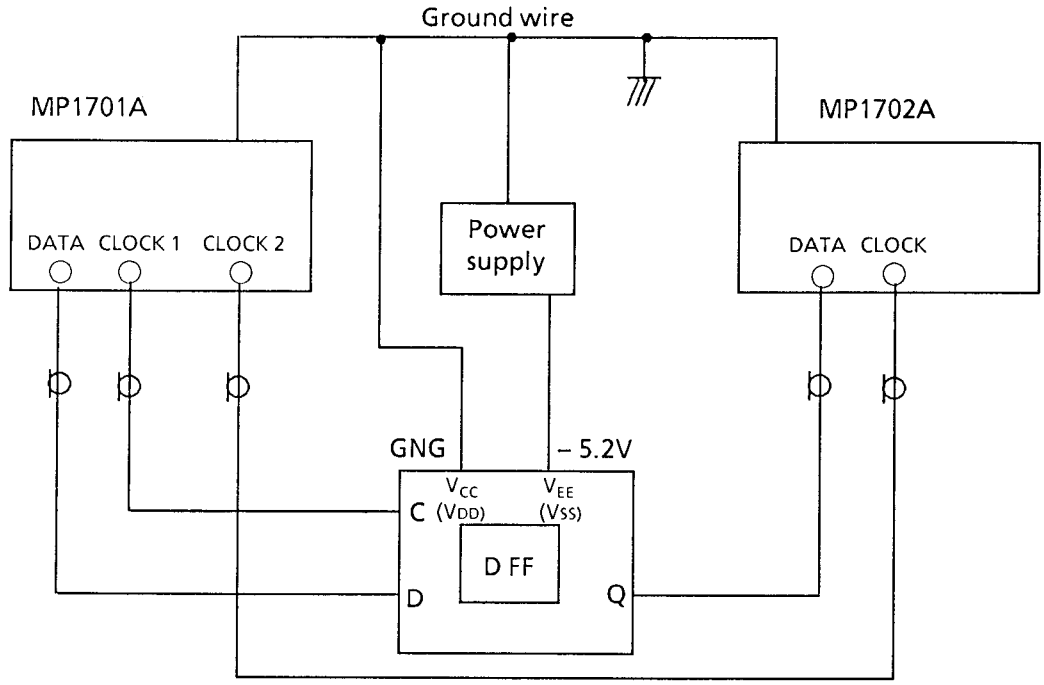


Fig. 5-14 Error Output Pulse

SECTION 6
MEASUREMENT

This section describes the equipment setup and operating procedure when using the MP1702A and MP1701A Pulse Pattern Generator to test a D-type flip-flop IC.

6.1 Setup



Note: Use the supplied semirigid cables or equivalent 50 Ω coaxial cables as the input/output signal connection cables.

Fig. 6-1 Setup

6.2 Procedure

Step	Procedure
1	Set-up the equipment as shown in Fig. 6-1 except the input/output signal connection cables.
2	While pressing [LOCAL] of both the MP1701A and MP1702A, turn ON the POWER switches to set the equipment to its initial state.
3	Set the MP1701A DATA and CLOCK1 offset voltage to -0.8 V (V_{OH}) and the amplitude to 0.9 Vp-p.
4	Set the MP1702A INPUT DATA TERM to -2 V and DATA THRESHOLD voltage to -1.3 V.
5	Connect the input/output signal connection cables as shown in Fig. 6-1.
6	Turn ON the power supply to the IC under test (DFF).
7	Set the MP1701A frequency to the test frequency.
8	Set the MP1702A [AUTO SEARCH] to ON. Then, confirm that the MP1702A ERRORS LED and CLOCK LOSS and SYNC LOSS real-time LEDs are OFF. Optimize the phase relationship between the data and clock being input to the IC under test.
9	While observing the MP1702A ERRORS LED, measure the input level margin of the IC under test by changing the MP1701A offset voltage and amplitude.

SECTION 7
PERFORMANCE TESTS

7.1 Introduction

Performance tests are used to check the main functions of the MP1702A and verify that it meets specifications.

Conduct performance tests on delivery, after repair, and during routine testing (every 6 months).

7.2 Equipment Required for Performance Tests

The equipment required for performance tests is listed in Table 8-1.

Table 8-1 Equipment Required for Performance Tests

Equipment (Anritsu)	Major performance characteristics	Test items
Pulse pattern generator (MP1701A)	Operating frequency range: 50 MHz to 10 GHz Other performance: Same as MP1701A	• Operation frequency • Input level • Pattern • Measurement item • Built-in printer
Sampling oscilloscope	Operating frequency range: DC to 20 GHz	(Used to monitor waveform.)

7.3 Performance Tests

Before starting the performance tests, warm-up the MP1702A and measuring instruments for at least 30 minutes.

7.3.1 Operation frequency

(1) Specifications

50 MHz to 10 GHz

(2) Setup

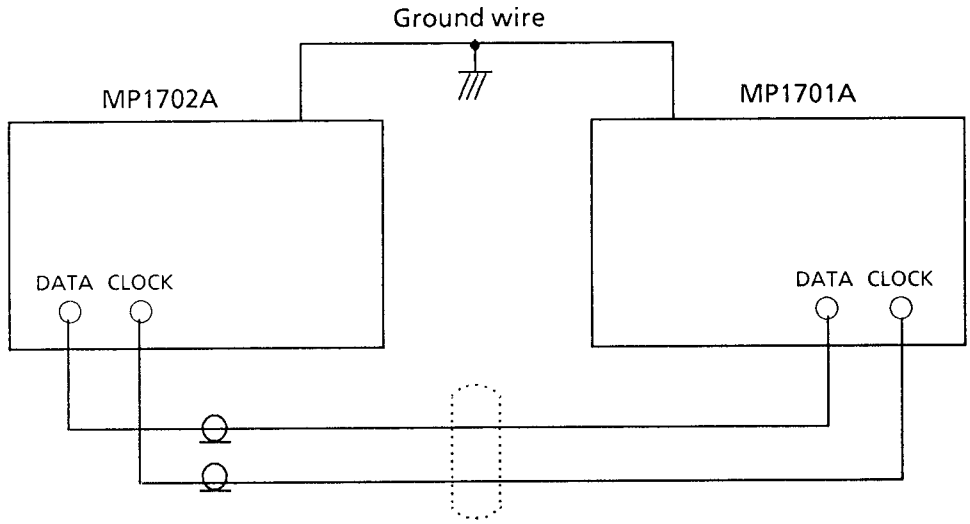


Fig. 7-1 MP1701A and MP1702A Setup

(3) Procedure

Step	Procedure
1	Set-up the equipment as shown in Fig. 7-1.
2	While pressing [LOCAL] (2) of both the MP1701A and MP1702A, set the POWER switches (1) to ON to initialize the equipment.
3	Set the MP1701A FREQUENCY value (23) with the frequency setting knob (26).
4	Press [AUTO SEARCH] (37) of the MP1702A. At this time, confirm that the MP1702A display (16) ERRORS LED is OFF.
5	Repeat steps 3 and 4, and confirm that the MP1702A is operating normally.

7.3.2 Input data level

(1) Specifications

Amplitude : 0.5 to 2 Vp-p

Offset (V_{OH}) : −2 to +2 V

Threshold voltage : −3 to +1.75 V

(2) Setup

The setup is the same as that shown in Fig. 7-1.

(3) Procedure

Step	Procedure
1	Set-up the equipment as shown in Fig. 7-1.
2	While pressing [LOCAL] (2) of both the MP1701A and MP1702A, set the POWER switches (1) to ON to initialize the equipment.
3	Cofirm thant the ERRORS LED does not light when optimizing the phase relationship between the input clock and input data with the DELAY TIME value (42) setting knob (40).
	Note: The MP1702A THRESHOLD values, shown below, are theoretical values. Therefore, performs step 3 only after measuring the MP1701A data output level with a calibrated sampling oscilloscope and only after setting the MP1702A THRESHOLD value to the correct value.

Item / Execution sequence	MP1701A		MP1702A	
	DATA		DATA	
	AMPLITUDE	OFFSET (V_{OH})	TERM	THRESHOLD
(1)	2.000 Vp-p	−2.000 V	GND	−3.000 V
(2)	0.500 Vp-p	−2.000 V	GND	−2.250 V
(3)	2.000 Vp-p	2.000 V	GND	1.000 V
(4)	0.500 Vp-p	2.000 V	GND	1.750 V
(5)	0.800 Vp-p	−0.900 V	−2 V	−1.300 V

7.3.3 Input clock level

(1) Specifications

Amplitude : 0.5 to 2 Vp-p

Offset (V_{OH}) : −2 to +2 V

(2) Setup

The setup is the same as that shown in Fig. 7-1.

(3) Procedure

Step	Procedure
1	Set-up the equipment as shown in Fig. 7-1.
2	While pressing [LOCAL] (2) of both the MP1701A and MP1702A, set the POWER switches (1) to ON to initialize the equipment.
3	Cofirm thant the ERRORS LED does not light when optimizing the phase relationship between the input clock and input data with the DELAY TIME value (42) setting knob (40) .

Note: The MP1702A THRESHOLD values, shown below, are theoretical values. Therefore, perform step 3 only after measuring the MP1701A data output level with a calibrated sampling oscilloscope and only after setting the MP1702A THRESHOLD value to the correct value.

Item / Execution sequence	MP1701A		MP1702A
	CLOCK 1		CLOCK TERM
	AMPLITUDE	OFFSET (V_{OH})	
(1)	2.000 Vp-p	−2.000 V	GND
(2)	0.500 Vp-p	−2.000 V	GND
(3)	2.000 Vp-p	2.000 V	GND
(4)	0.500 Vp-p	2.000 V	GND
(5)	0.800 Vp-p	−0.900 V	−2 V

7.3.4 PATTERN

(1) Specifications

Pseudorandom (PRBS) pattern

Programmable (PRGM) pattern

DATA mode:

Data length: 2 to 524288 bits

WORD mode:

Word length: 2 to 16 bits

No. of words: 1 to 32768

(2) Setup

The setup is the same as that shown in Fig. 7-1.

(3) Procedure

Step	Procedure

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

2 While pressing [LOCAL] (2) of both the MP1701A and MP1702A, set the POWER switches (1) to ON to initialize the equipment.

3 Press [AUTO SEARCH] (37) of the MP1702A.

4 Set the MP1701A and MP1702A pattern modes to programmable word pattern mode, and enter the settings shown below. Confirm that the MP1702A ERRORS LED does not light at this time.

Execution sequence	Item		Setting
(1)	NUMBER OF WORD value		1
(2)	WORD LENGTH value		8
(3)	[BIT] key	1	ON (LED on)
		2 to 8	OFF (LED off)

5 Set the MP1701A and MP1702A pattern modes to programmable data pattern mode, and enter the settings shown below. Confirm that the ERRORS LED does not light at this time.

Execution sequence	Item		Setting
(1)	WORD LENGTH value		8
(2)	[BIT] key	1	ON (LED on)
		2 to 8	OFF (LED off)

6 Confirm that the MP1702A ERRORS LED does not light when the MP1701A and MP1702A pattern modes are switched to the PRBS 2^7-1, PRBS 2^9-1, PRBS 2^{11}-1, PRBS 2^{15}-1, PRBS 2^{20}-1, PRBS 2^{23}-1, or PRBS 2^{31}-1 modes.

7 Confirm that the MP1702A ERRORS LED does not light when the MP1701A and MP1702A pattern modes are fixed at PRBS 2^{31}-1 mode and MARK RATIO is switched to 0/8, 1/8, 1/4, 1/2, 8/8, 7/8, 3/4, and $\overline{1/2}$.

7.3.5 Measurement items

(1) Specifications

Error ratio	:	0.0000×10^{-16} to 1.0000×10^{-0}
Error count	:	0 to 9.9999×10^{16}
Error interval (EI)	:	0 to 999 9999
Error-free interval (EFI)	:	0.0000 to 100.0000%
Clock frequency	:	50 MHz to 10 GHz
		Accuracy: ±(10 ppm + 1 kHz)

(2) Setup

The setup is the same as that shown in Fig. 7-1.

(3) Procedure

Step	Procedure
1	Set-up the equipment as shown in Fig. 7-1.
2	While pressing [LOCAL] (2) of both the MP1701A and MP1702A, set the POWER switches (1) to ON to initialize the equipment.
3	Press [AUTO SEARCH] (37) of the MP1702A.
4	Set the MP1701A ERROR ADDITION function to ON.
5	Set the MP1702A measurement mode to SINGLE, and set the measurement time to 10 s.
6	Press [START] of the MP1702A. After the GATING LED goes on, press ERROR ADDITION [SINGLE] of the MP1701A once. At the end of measurement (after about 10 s), press [DISPLAY] to confirm that the following values are sequentially displayed. ERROR RATIO : 1.0000E-11 ERROR COUNT : 1 ERROR INTERVAL : 1 ERROR FREE INTERVAL : 90.0000% CLOCK FREQUENCY : 9999.899 to 10000.101 MHz

7.3.6 Built-in printer

(1) Specifications

The following data are printed on the built-in printer:

- Measurement data : Error ratio, error count, EI, EFI
- Alarm interval : Power failure, clock-loss, sync-loss
- Threshold EI and EFI data
- Error performance data

(2) Setup

This setup is the same as that shown in Fig. 7-1.

(3) Procedure

Step	Procedure
1	Set-up the equipment as shown in Fig. 7-1.
2	While pressing [LOCAL] (2) of both the MP1701A and MP1702A, set the POWER switches (1) to ON to initialize the equipment.
3	Press [AUTO SEARCH] (37) of the MP1702A.
4	Set the MP1701A ERROR ADDITION function to ON.
5	Set the MP1702A as follows: MEASUREMENT MODE : SINGLE MEAS TIME : 60 s FUNCTION 1 : All 0 FUNCTION 2 : SW2 and SW3 = 1 Others = 0
6	Press [START] of the MP1702A. After the GATING LED of the MP1702A comes on, press ERROR ADDITION [SINGLE] of the MP1701A once. Confirm that the data at the end of measurement (after about 60 s) is:

Step	Procedure

```
**************************
 START  90-02-26/11:55:08
 END    90-02-26/11:56:08
 ELP             0/00:01:00
 ==ERROR MEASUREMENT==
 ERROR RATIO 1.6666E-12
 ERROR COUNT              1
 EI                       1
 EFI                98.3333%
 PFI                      0
 CLI                      0
 SLI                      0
 == THRESHOLD EI,EFI   ==
 ER    EI          EFI
 >-3            0 100.0000%
 >-4            0 100.0000%
 >-5            0 100.0000%
 >-6            0 100.0000%
 >-7            0 100.0000%
 >-8            0 100.0000%
 =<-8           1  98.3333%
 ==ERROR PERFORMANCE==
 ERRORED SEC       1.6667%
 ER FREE SEC      98.3333%
 SES (E-3)         0.0000%
 DM  (E-6)         0.0000%
 UNAVAIL SEC       0.0000%
**************************
```

7 Set the MP1702A as follows:

MEASUREMENT MODE : UNTIMED

FUNCTION 1 : SW5 = 1

8 Press [START] of the MP1702A. After the GATING LED of the MP1702A comes on, press ERROR ADDITION [SINGLE] of the MP1701A once.

Confirm that the one-second data at this time is:

```
53:04 1.00E-10              1
```

SECTION 8
STORAGE AND TRANSPORTATION

8.1 Regular Care and Preventive Maintenance

Table 8-1 lists the procedures and regularity with which regular maintenance should be performed.

Table 8-1 Regular Care and Maintenance

Period		Care and maintenance
Soiling	• Before long-term storage • When dust has entered housing • When noticeable dust and dirt have accumulated inside cabinet	Wipe off dust with soapy water or cleaning solvent* Ensure that proper ventilation is provided
Dust and dirt		Open housing and blow out dust with compressed air; Take care to shield face from dust or loose particles
Lubrication	Not necessary	
Loose screws	When found	Retighten with screwdriver

* Do not use thinner or benzene since they will damage the coating.

8.2 Recommended Storage Conditions

In addition to meeting the conditions listed in paragraph 2.1, the MP1702A should preferably be stored where:

1. Temperature is 0° to 30°C
2. Humidity is 40% to 80%
3. Temperature and humidity are stable

Before using the MP1702A after storage, check the performance and functions as described in SECTION 7.

8.3 Repacking and Transportation

When transporting the MP1702A over long distances, observe the following precautions.

8.3.1 Repacking

Use the original packing materials. If the original packing materials were thrown away or destroyed, repack the analyzer as follows:

1. Install protective covers over the front and rear panels, and insert the head protection sheet into the disk slot.
2. Wrap the MP1702A in plastic or similar material.
3. Obtain a cardboard, wood, or aluminum box 10 to 15 cm larger than the MP1702A on all sides.
4. Put the MP1702A in the center of the box and fill the surrounding space with shock absorbent material.
5. Secure the box with twine, tape, or bands.

Note: It is easy to repack the MP1702A when the original packing materials are saved.

8.3.2 Transportation

Transport the MP1702A under the storage conditions described in paragraph 8.2.