ADVANTEST®
ADVANTEST CORPORATION

INSTRUCTION MANUAL

D3273

ERROR DETECTOR

MANUAL NUMBER OEI00 9203

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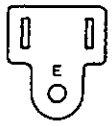
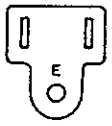
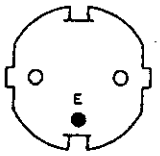
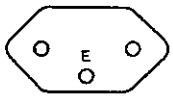
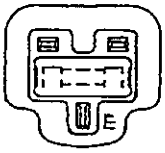
NOTICE

ADVANTEST provides the following power cables for each country. If there was any inconvenience on your use, please contact our subsidiaries or ADVANTEST representatives.

	Plugs	Standards/Countries	Ratings/Color/ Length	Accessory Codes
1		JIS : JAPAN	Rating :125V 7A Color :Black Length :2m	A01402 A01412
2		UL : USA CSA : CANADA	Rating :125V 7A Color :Black Length :2m	A01403 (Opt.95) A01413
3		CEE : EUROPE VDE : FRG OVE : AUSTRIA SEMKO : SWEDEN DEMKO : DENMARK KEMA : NETHERLANDS FIMKO : FINLAND NEMKO : NORWAY CEBEC : BELGIUM	Rating :250V 6A Color :Gray Length :2m	A01404 (Opt.96) A01414
4		SEV : SWITZERLAND	Rating :250V 6A Color :Gray Length :2m	A01405 (Opt.97) A01415
5		SAA : AUSTRALIA NEWZELAND	Rating :250V 6A Color :Gray Length :2m	A01406 (Opt.98)
6		BS : UK	Rating :250V 6A Color :Black Length :2m	A01407 (Opt.99) A01417

Note : "E" shows earth (ground).

PREFACE

1. This manual explains how to use the D3273 Error Detector.

2. The D3173/D3173A Pulse Pattern Generator can be connected with this error detector.

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1. GENERAL INFORMATION

1.1 General

The D3273 error detector measures the bit error rate, error count, error second (ES), error-free second (EFS), and frequencies within a wide range from 50 MHz to 3 GHz.

When used in combination with the D3173/D3173A pulse pattern generator, the D3273 evaluates the bit error rate of high-speed digital communication transmission systems and super high-speed devices by using pseudo random bit sequence (PRBS) patterns from $2^7 - 1$ to $2^{23} - 1$ and programmable patterns up to 2^{16} (65536) bits.

In addition, the D3273 provides the following features:

(1) Displays results of measurement clearly using a large LED

(2) Detects INSERT (0⟶1) and OMIT (1⟶0) errors separately.

(3) Incorporates a program pattern memory to set ten kinds of word patterns quickly.

(4) PRBS pattern allows a mark ratio to vary within the range from 1/8 to 7/8, and 0/8 and 8/8.

(5) Provided with a motor drive delay line of 10 ps resolution, variable up to ±1 ns to clock input

(6) Master-slave function available to use the same pattern as generated by the combined D3273

(7) Equipped with the AUTO SEARCH function to search the optimum value threshold level and phase delay (phase between for data input and clock input).

(8) Supplied with a GPIB

(9) Provided with monitor output, synchronous output, error output, and alarm output

1.2 Checking the Accessories Supplied

Upon arrival, check this unit for external damage caused during transportation.

Then check the quantity and specification of each accessory supplied according to Table 1-1 below:

Table 1-1 List of Accessories Supplied

No.	Accessory name	Specification	Code	Q'ty
1	BNC-BNC cable	MI-02	DCB-FF0386	2
2	SMA-SMA cable	DGM224-00700A	DCB-FF1211x01	2
3	N-SMA adaptor	HRM-554S	JCF-AA001Jx36	4
4	GPIB cable	408JE-101	DCB-SS1076x02	1
5	Power cable	A01402	DCB-DD2428x01	1
6	Double/triple-pole conversion adapter for power plug	A09034	JCD-AL003Ex03	1
7	Instruction manual	-	JD3273	1
		-	ED3273	

If any damage is found or if any accessory is found to be missing, contact your local ADVANTEST agent.

1.3 Installation Locations and Notes

(1) Installation locations

Avoid using the D3273 in the following places:

- Excessive dusts
- Corrosive gas
- Direct sun light
- Excessive noise
- Excessive mechanical shock
- Continuous vibration

(2) Operation conditions

- Use the D3273 in the ambient temperature of 0 to 40°C and relative humidity of 40% to 85%.
- Plug the D3273 power cord into the socket having the ground lead.
- The D3273 has ventilation holes at its top and side panels. Do not place anything on it or at the side of it, or the cooling air flow may be affected.
- Keep the D3273 rear panel at least 10 cm away from the wall.
- When handling the D3273 and its devices, the operator should take an appropriate action to prevent electromagnetic interference (EMI) (by using the ground wrist strip).

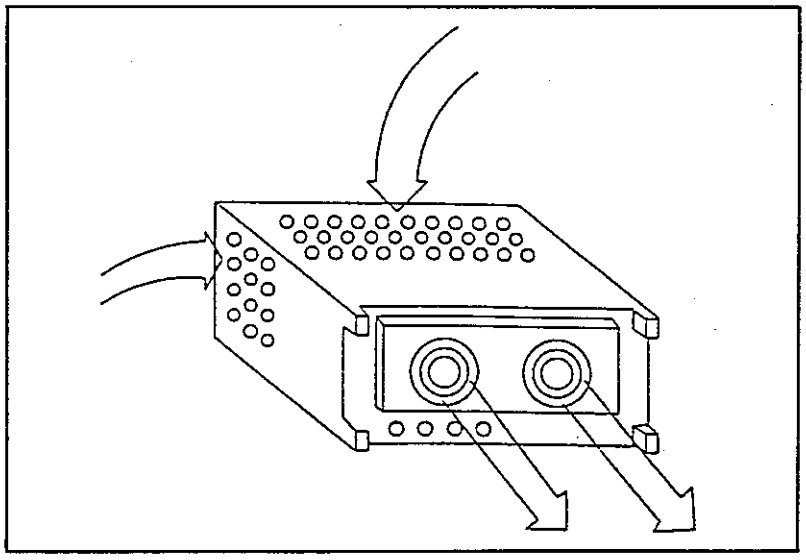


Figure 1-1 Ventilation with Cooling Fan

(3) Notes on Storage

When the D3273 is not used for a long period of time, the unit should be stored in a corrugated cardboard box in a place not exposed to direct sunlight which has low humidity.

The D3273 must be stored at an ambient temperature and humidity within the ranges from -20 to +60°C and 30 to 85% respectively.

(4) Notes on Cleaning

CAUTION

Do not use solvents harmful to plastic or other resins (e.g., organic solvents such as benzene and acetone) during maintenance and cleaning.

(5) Notes on Transportation

When transporting the D3273, use its original packaging. If the packaging was lost, observe the following instructions:

① Cover the D3273 with vinyl. (Put a desiccating agent under the vinyl cover to prevent the affects of moisture.)

② Put the D3273 in a corrugated cardboard box. Then put a cushioning material, 40 mm or more thick, between the D3273 and the inner wall of the box so as to cover the D3273 with the cushion.

③ Put the accessories of the D3273 in the box, add a cushioning material and close the box. Lastly tie up the box with packing rope.

1.4 Setting Up

(1) Supply Voltage

The AC supply voltage for the D3273 is factory set and its value is displayed near the power connector on the rear panel. The D3273 must be used within the range of the displayed value and at a frequency of 48 Hz to 63 Hz.

(2) Power Cable

The power cable has a three-pin plug whose round pin is to be grounded. Ground the D3273 before use according to one of the following methods:

① When using a three-pin/two-pin conversion adapter (A09034) attached to the power plug, use the green ground wire out of the conversion adapter to ground the D3273.

② When using the power plug without the conversion adapter, simply insert the three pin plug in a three pin receptacle.

③ If it is not possible to ground the D3273 using the power plug, use the ground terminal on the rear panel.

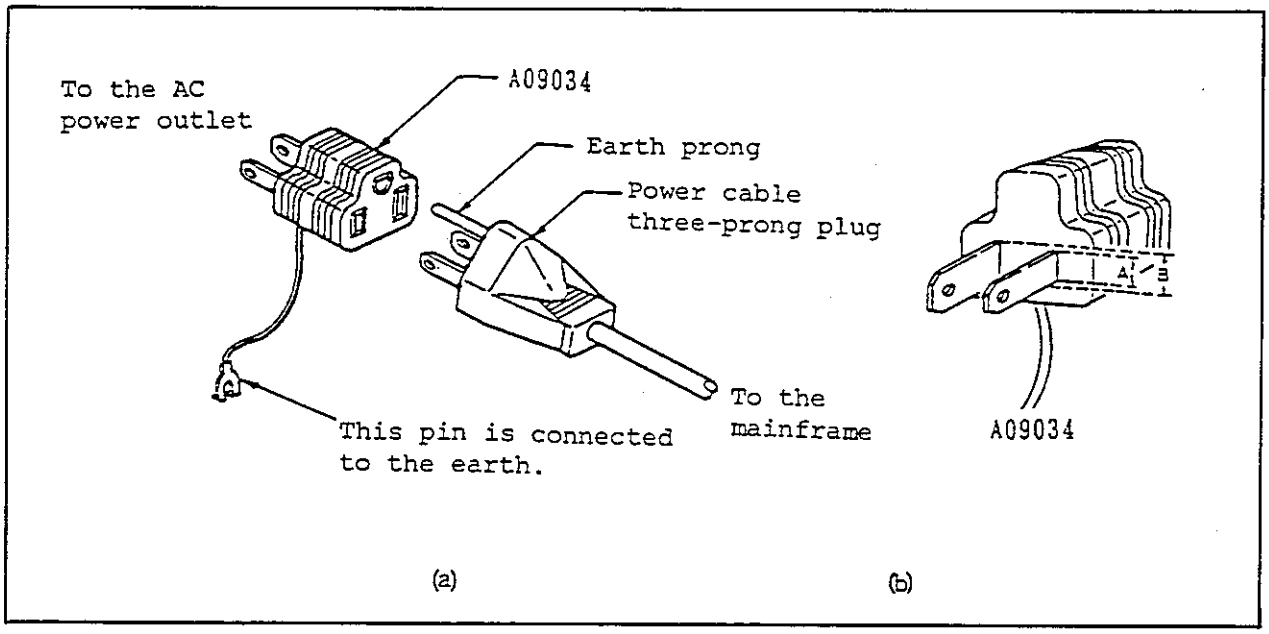


Figure 1-2 Power Cable Plug and Adapter

1.5 Notes on I/O Signal Line Connection

CAUTION

The D3273 has the RF electronic components and parts in its internal circuit. They are very sensitive and may be damaged by the statistics. Use the following notes during application.

(1) The D3273 has the allowable input voltage of each input terminal as defined on Table 1-2. Never apply the voltage exceeding the limit to their terminals.

Table 1-2 Allowable input voltage of each terminal

Input terminal	Allowable input voltage
DATA INPUT	-4.5 V - +2.5 V
CLOCK INPUT	-2.5 V - +2.5 V (If terminating voltage is 0 V) -4.5 V - +0.5 V (If terminating voltage is -2 V)

(2) The output terminals (MONITOR OUTPUT, SYNC OUTPUT, and ERROR OUTPUT) must be terminated with the ground potential of 50-ohm resistor. Do not apply any voltage to them.

(3) Connect the ground leads to the GND terminal of the D3273 rear panel. Also, connect the ground leads to the GND pin of the power plug.

(4) Fully discharge the statistics of the cables and equipment before connecting them to I/O terminals of the D3273. The operator should be discharged by using the ground wrist strap.

2. IDENTIFICATION OF EACH PART

2.1 Front Panel

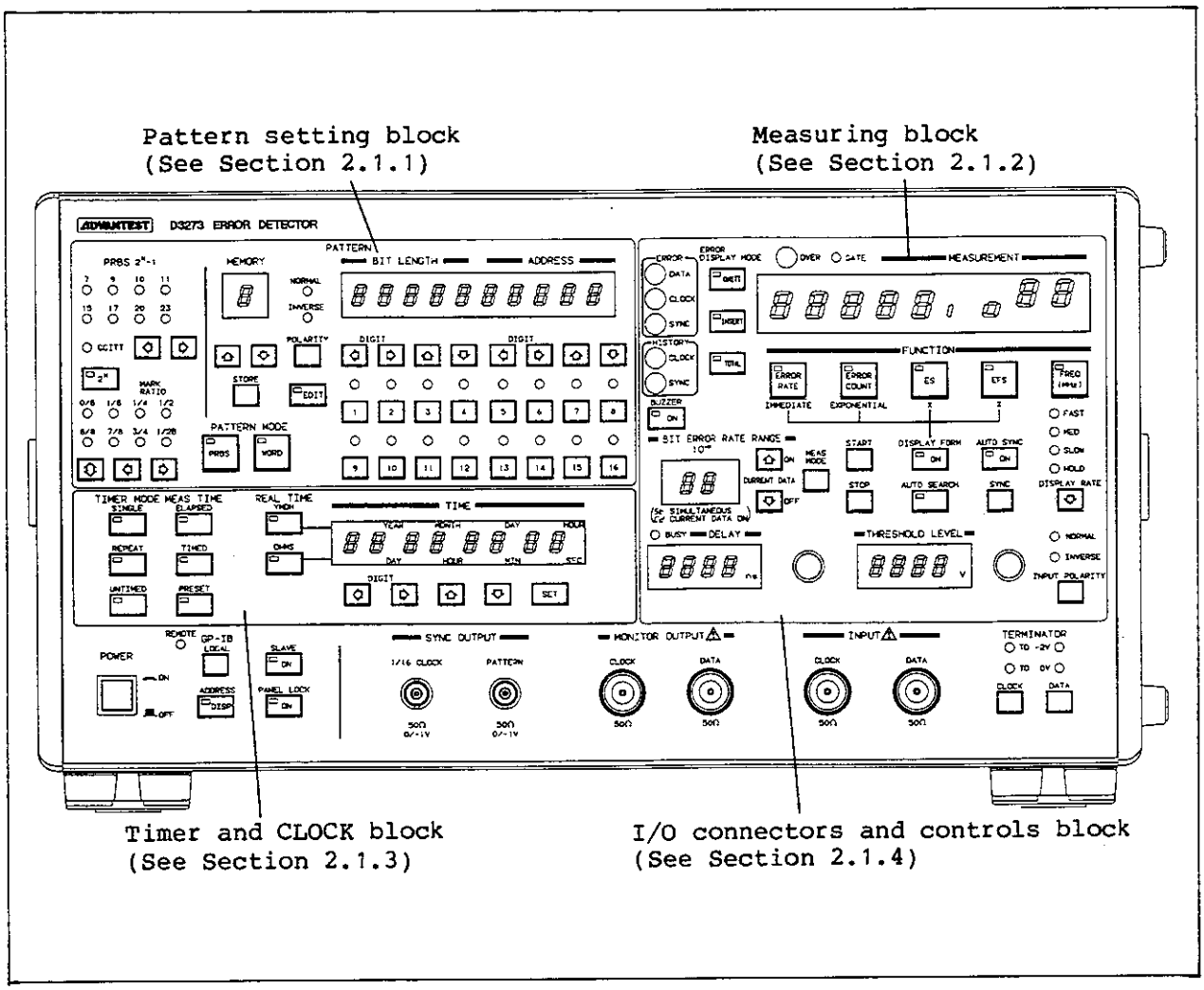


Figure 2-1 Front Panel

2.1.1 Pattern Setting Block

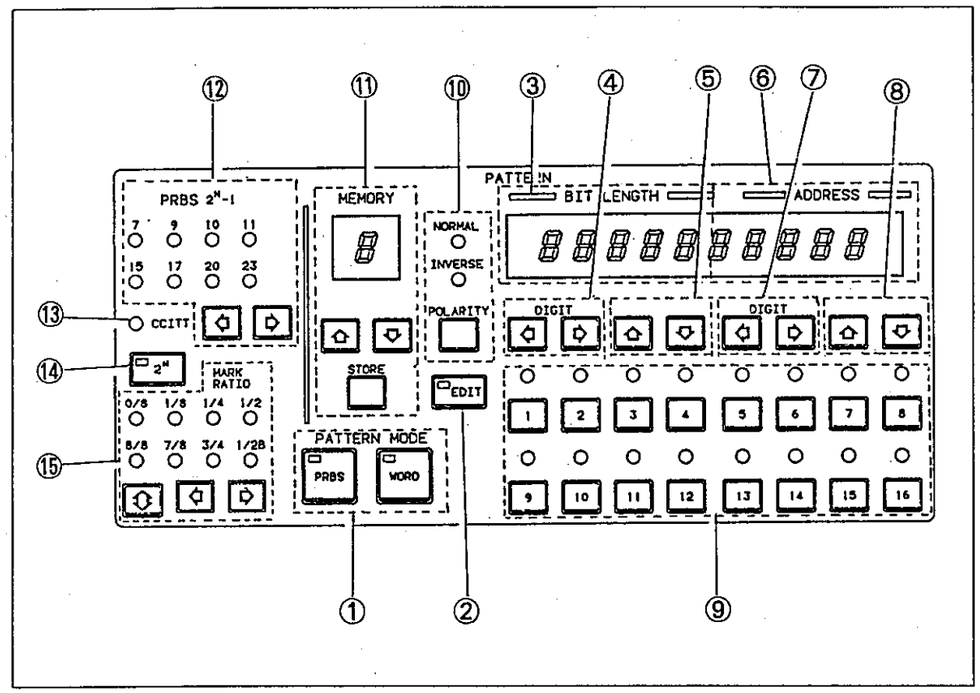


Figure 2-2 Pattern Control Block

① PATTERN MODE keys
Switche the internal reference pattern mode between PRBS (Pseudo Random) and WORD (Programmable Word) modes.

② EDIT key
Turn off the EDIT key to call the stored word data, and turn it on to change the pattern contents.

③ BIT LENGTH indicator
Indicates the bit length of the word pattern. It is cleared in the PRBS pattern mode.

④ DIGIT keys
Select the digit to be set for the bit length.

⑤ BIT LENGTH keys
Increase or decrease the digit value indicated by the BIT LENGTH pointer.

⑥ ADDRESS number indicator
Indicates the address number of 16-bit pattern that is monitored with the pattern indicator.

⑦ DIGIT keys
Select the digit to be set for the address number.

⑧ Address number set keys
Increase or decrease the digit value indicated by the ADDRESS number indicator pointer.

⑨ Pattern set keys and indicator LEDs
Set the word pattern for each bit, and the set value is shown by the indicator.

⑩ POLARITY key and NORMAL/INVERSE LEDS
Selects the word pattern logic (polarity), and the selection is shown by the indicator.

⑪ MEMORY number set keys and indicator, and STORE key
Store the created word patterns numbered by 0 to 9 and call any of them from memory. Also, this key can be used to call the fixed patterns of 10B1C rules and all bit zeros.

⑫ PRBS stage number set keys and indicator LEDs
Select one of eight types of PRBS pattern stages: 7, 9, 10, 11, 15, 17, 20, and 23. The selected key is identified by the indicator lamp.

⑬ CCITT LED
Lights when a PRBS pattern satisfying the CCITT Recommendations is selected with the PRBS stage number selector and the mark ratio selecting section.

⑭ 2^N key
When this key is turned on, the ordinary "2^N-1" bit is added by 1 bit and the PRBS pattern has an even bit length.

⑮ MARK RATIO set keys and indicator LEDs
Select any one of eight types of mark ratios (0/8 to 8/8) of the PRBS pattern. The selected mark ratio is shown by the indicator LED.

2.1.2 Measuring Block

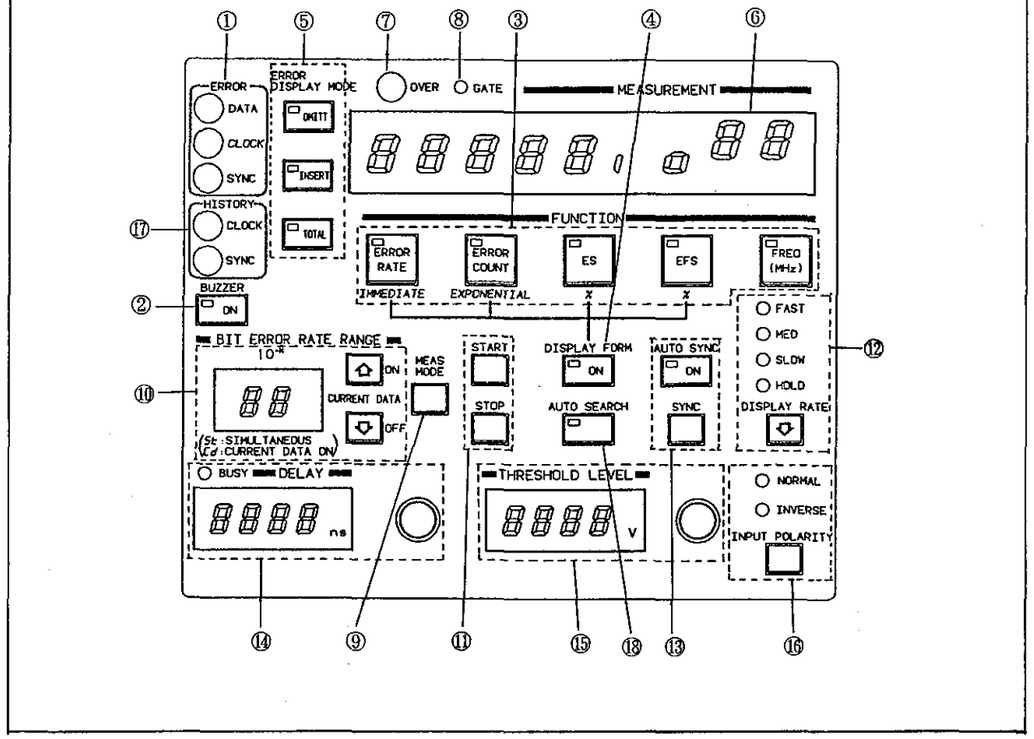


Figure 2-3 Measuring Block

① ERROR lamp
Lights when an error is detected.

② BUZZER key
Turns the alarm buzzer on or off.

③ FUNCTION key
Selects the measuring function.

④ DISPLAY FORM key
Switches the display format of the error rate measurement in the Error Count, Error Second, Error-Free Second Measurement, or Simultaneous Measurement mode.

⑤ ERROR DISPLAY MODE keys
Select the type of error to be displayed during error measurement.

⑥ Measuring result indicator
Indicates the results of measurement or error. The display format depends on the measuring function being used.

⑦ OVER lamp
Indicates that the result of measurement has exceeded the limit.

⑧ GATE lamp
Indicates that the measurement is being made.

⑨ MEAS MODE key
Switches the measuring mode between the individual measurement and simultaneous measurement.

⑩ BIT ERROR RATE RANGE indicator and set keys
Set and indicate the error rate measuring range in the Individual Measurement mode. While in the Simultaneous Measurement mode, these keys can turn on or off the current data display. When turned on, "Cd" is displayed. When turned off, "St" is displayed.

⑪ START and STOP keys
The START key starts measurement and the STOP key stops measurement.

⑫ DISPLAY RATE key and FAST, MED, SLOW and HOLD lamps
The key sets the measuring time interval for error rate and frequency measurement in the Individual Measurement mode. One of the lamps lights to indicate its selected time interval.

⑬ AUTO SYNC and SYNC keys
The AUTO SYNC key turns on or off the automatic pattern synchronizing function, while the SYNC key resets the synchronization.

⑭ DELAY indicator, control knob, and BUSY lamp
The control knob sets the amount of CLOCK input phase delays, and the indicator shows the set value. The BUSY lamp lights when the motor is operating.

⑮ THRESHOLD LEVEL indicator and control knob
The control knob sets the threshold level of data input, and the indicator shows the set level.

⑯ INPUT POLARITY key and NORMAL and INVERSE lamps
The key switches the polarity of data input. The selected polarity is indicated by the respective lamp.

⑰ HISTORY lamp
Indicates existence of errors which occurred in the past.

⑱ AUTO SEARCH key
The key to perform the execution/release for the AUTO SEARCH function.

2.1.3 Timer and CLOCK Block

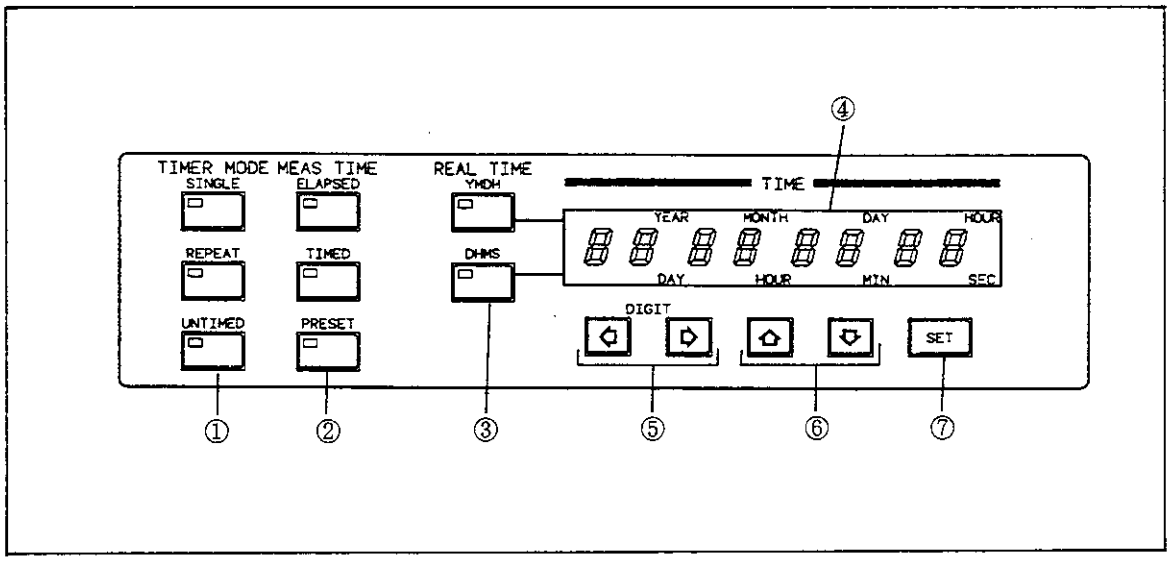


Figure 2-4 Timer and CLOCK Block

① TIMER MODE keys
Set their respective timer/clock display modes for error count, error second (ES), and error free second (EFS) measurement in the Individual Measurement mode. Also, they are used to select the timer operation in the Simultaneous Measurement mode.

② MEAS TIME key
Switches the display mode of timer/clock indicator ④ to the measurement time display mode.

③ REALTIME key
Switches the display mode of timer/clock indicator ④ to the realtime display mode.

④ Timer/clock indicator
Indicates the timer or clock time.

⑤ DIGIT keys
Shifts the timer/clock time setting digits to the left or right.

⑥ Timer/clock change keys
Increments or decrements the set value of the digit selected by the DIGIT key ⑤ by 1.

⑦ SET key
Starts or terminates the timer/clock setup.

2.1.4 I/O Connectors and Other Controls Block

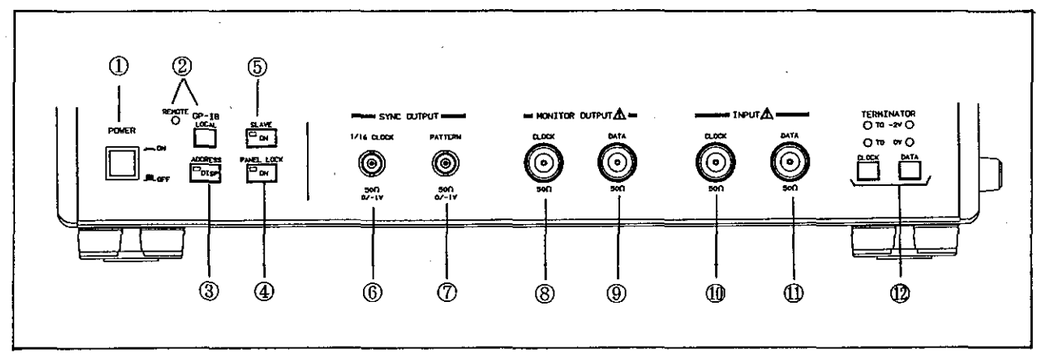


Figure 2-5 I/O Connectors and Other Controls

① POWER switch
Turns the power on and off.

② REMOTE lamp and LOCAL key
The lamp indicates that this equipment is under remote control of the GPIB controller. The key releases the equipment from the remote control.

③ ADDRESS DISP key
Sets and displays the GPIB device address of this equipment. The device address is displayed in the pattern setting block.

④ PANEL LOCK key
Locks and unlocks the keys and knobs on the front panel.

⑤ SLAVE key
Makes the pattern setting block of this equipment interlock with that of the D3173/D3173A.

⑥ SYNC OUTPUT 1/16 CLOCK connector
1/16 divided output of the INPUT CLOCK ⑩.

⑦ SYNC OUTPUT PATTER connector
Synchronous output of comparative patterns.

⑧ MONITOR OUTPUT CLOCK connector
Monitor output of CLOCK input.

⑨ MONITOR OUTPUT DATA connector
Monitor output of data input.

⑩ INPUT CLOCK connector
CLOCK input connector.

⑪ INPUT DATA connector
Data input connector.

⑫ TERMINATOR keys and TO -2V and TO 0V lamps
The keys specify the terminator voltage of data and CLOCK input.

2.2 Rear Panel

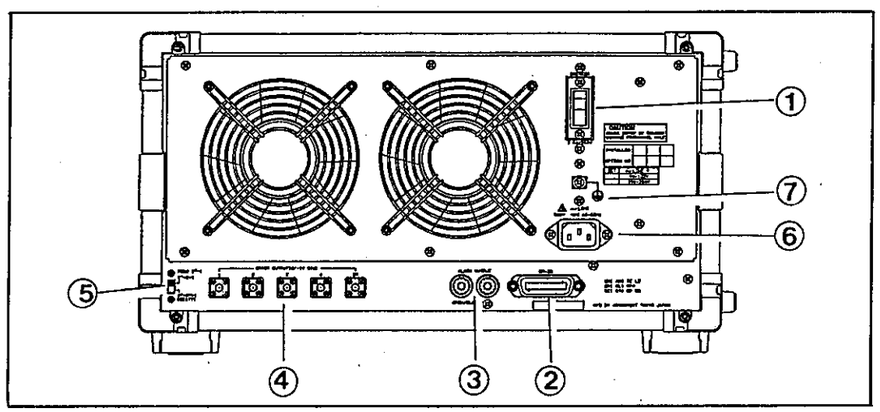


Figure 2-6 Rear Panel

① BREAKER
This swtich is used to protect the AC line from overcurrent. It can be turned ON/OFF manually, too.

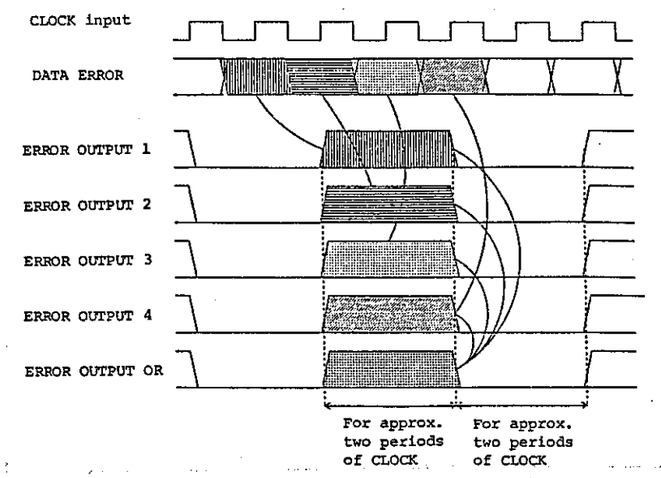
② Connector for GPIB bus
Connector to which GPIB cable is connected for remote control from a controller or using SLAVE function.

③ ALARM OUTPUT
This is a relay contact output which operates when a clock error or syne error is detected.

errors	Relay contact inside of the D3273	
detected	ON	ALARM
not detected	OFF	OUTPUT

Rating is 20Vdc, 0.4A (max).

④ ERROR OUTPUT
Each phase of the 1/4 of data error and their logical sum (OR) are output.



⑤ PRBS Switch
Switch used to switch a generator polynominal of PRBS $2^{15}-1$.

⑥ POWER connector
Connects AC power supply to the detector. Use the supplied power cable (A01402) for AC power connection.

3. OPERATION METHOD

3.1 Turning on the Power

Operation Instructions:

(1) Turn off the POWER switch on the front panel.

(2) Turn on the breaker (by pressing its . marked position) on the rear panel.

(3) Plug the power cord into receptacle and turn on the POWER switch, and the power will turn on.

CAUTION

Avoid frequently turning on and off the BREAKER switch instead of the POWER switch.

3.2 Operation of Each Part

This section describes the function and operation of each part of the front panel.

3.2.1 Pattern Setting Block

(See figure 2-2)

CAUTION

All keys of the pattern setting block are invalid when the SLAVE key (key ⑤ for I/O connectors and other controls Block) is turned on.

① PATTERN MODE (PRBS, WORD) keys
Switches the internal reference pattern mode between PRBS (Pseudo Random) and WORD (Programmable Word) modes.

When the PRBS key is pressed, the pseudo random mode is selected. When the WORD key is pressed, the word mode is selected. The selected mode is indicated by the respective lamp.

② EDIT key
Turn off the EDIT key to call the stored word data, and turn it on to change the pattern contents.

③ BIT LENGTH indicator
Indicates the bit length of the word pattern.

The bit length is shown in up to 5 digits. When EDIT key ② is on, the pointer lights at the left shoulder of the digit that can be set.

When the PRBS pattern mode is selected, this indicator is cleared.

When the ADDRESS DISP key (key ③ for I/O connectors and other controls block) is turned on, characters ⊏ P - ; ⊔ are shown on the display.

④ DIGITs keys
Select the digit to be set for the word pattern bit length.

The digit to be set is identified by the pointer which appears at the left shoulder of BIT LENGTH indicator ③.

The pointer shifts to the left when the ⇦ key is pressed, and it shifts to the right when the ⇨ key is pressed.

When EDIT key ② is turned off, these keys are made invalid.

⑤ BIT LENGTH set keys

Set the bit length of the word pattern.

When the ⇧ key is pressed, the digit value identified by the pointer of BIT LENGTH indicator ③ is increased. When the ⇩ key is pressed, it is decreased. In either case, the carry or borrow is transferred to the next higher-order digit position.

When the EDIT key is turned off, these keys are made invalid.

The bit length can be set and indicated in units of 1 bit in the range of 1 to 1,024 bits. It can be set and indicated in units of 64 bits in the range of 1,024 to 65,536 bits.

When creating a pattern exceeding 1,024 bits in a smaller steps, it may be possible to set the desired pattern through repeated pattern setup. In such case, the total bit length of repeated patterns must be 65,536 bits or less and it must be an integer multiplied by 64 bits.

To minimize the total bit length of repeated patterns, the following must be satisfied:

Total bit length of repeated patterns = Least common multiple of the desired bit length and 64 bits

If this value exceeds 65,536 bits, it cannot be set.

For example, if the desired bit length is 1,025 bits, the least common multiple of 1,025 bits and 64 bits is equal to 65,600 bits. It is greater than 65,536 bits and, therefore, it cannot be set.

If the desired bit length is 1,026 bits, the least common multiple of 1,026 bits and 64 bits is equal to 32,832 bits. It can be set. In this case, the pattern can repeat 32 times (32,832 bits divided by 1,026 bits).

Table 3-1 summarizes the bit length range and step of patterns that can be actually created.

Table 3-1 Available Bit Length Range and Step

Range of bit length	Step of bit length	Iteration time
1 to 1024	1 bit	1 time
1026 to 2048	2 bits	1 to 32 times
2052 to 4096	4 bits	1 to 16 times
4104 to 8192	8 bits	1 to 8 times
8208 to 16384	16 bits	1 to 4 times
16416 to 32768	32 bits	1 to 2 times
32832 to 65536	64 bits	1 time

⑥ ADDRESS number indicator

Indicates the address number of 16-bit pattern that is monitored with pattern indicator ⑨.

The address number is the number of each 16-bit divided area of pattern from its beginning. It begins with zero (0).

When the ADDRESS DISP key (key ③ for I/O connectors and other controls block) is on, the GPIB device address is shown on this indicator.

⑦ DIGIT keys

Select the digit to be set for the address number of pattern.

The set digit is indicated by the pointer which lights at the left shoulder of ADDRESS number indicator. The pointer shifts to the left when the ⇦ key is pressed, and it shifts to the right when the ⇨ key is pressed.

⑧ Address number set keys

Sets the address number of the pattern.

When the ⇧ key is pressed, the digit indicated by the pointer of ADDRESS number indicator ⑥ is increased. When the ⇩ key is pressed, it is decreased. In either case, the carry or borrow is transferred to the next higher-order digit position. The set range is as follows:

WORD pattern: 0 to (Bit length set value-1) ÷ 16
PRBS pattern: 0 to (2^N-1) ÷ 16

The phase relationship between the pattern sync signals output to the SYNC OUTPUT PATTERN connector and the data input signals entered into the INPUT DATA connector varies in every 16-bit steps according to the address number setup.

⑨ Pattern set keys and indicator LEDs

Set and indicate the 16-bits logics of the internal reference pattern address shown on ADDRESS number indicator ⑥.

When one of 1 to 16 pattern set keys is pressed, the logic of its bit is inverted. When logic 1 (the signal is logical high when the INPUT POLARITY ⑯ is NORMAL), the upper lamp lights.

These keys are valid only when the WORD pattern mode is selected and EDIT key ② is turned on. When the PRBS pattern mode is selected or when the EDIT key is turned off, only the indicator lamps are valid.

⑩ POLARITY key and NORMAL/INVERSE LEDS

Selects the word pattern logic (polarity), and the selection is shown by the indicator.

The NORMAL (positive polarity) and INVERSE (negative polarity) modes are switched whenever the POLARITY key is pressed.

The pattern stored in memory is displayed as it is in the NORMAL mode.

Pattern indicator lamp ⑨ is also switched according to the pattern logic switching by the POLARITY key.

⑪ MEMORY number set keys and indicator, and STORE key

The generated word patterns can be stored in up to 10 ways.

The memory indicator shows the memory number using numeric characters of 0 to 9 and alphabetic characters of A, b, and C.

The displayed memory number is incremented or decremented by 1 when the respective ⇧ or ⇩ key is pressed.
Created word patterns can be stored in memories numbered from 0 to 9, and they can be recalled from them when necessary.

Memories A and C store the 1,023-bit 10B1C rule pattern. This 10B1C rule pattern is based on the pattern of PRBS 2^{10} -1 and the mark ratio of 1/2. The 1,023 bits of PRBS -1 pattern is divided into 11-bits blocks. And the bit 11 (last bit) of each block is replaced with the logical inverse of the preceding specific bit. The specific bit locates at bit 9 from the beginning of each block in memory number A. In memory number C, it locates at bit 10 of each block.

Memory number b stores the 16-bit pattern of all zeros (or all ones if the bit pattern has the INVERSE logic).

When EDIT key ② is turned off and when the ⇧ or ⇩ key is pressed, the stored pattern is called from the specified memory number.

To store a new pattern in memory, turn the EDIT key on, specify the desired memory number (0 to 9) using the ⇧ or ⇩ key, and press the STORE key.

Memories A, "b", and C are read only and no pattern can be stored into them. However, you can read a pattern from them, modify the bit length and pattern data, and store the edited data in memory numbers 0 to 9.

⑫ PRBS stage number set keys and indicator LEDs

The front panel has eight lamps indicating PRBS pattern stages: 7, 9, 10, 11, 15, 17, 20, and 23.

When the PRBS pattern mode is selected, one of these types is selected and its stage lamp lights.

When 2^N key ⑭ is turned on, you can select one of four types of 7, 9, 10 and 11 stages.

When the 2^N key is turned off, the original 2^N-1 bit length PRBS mode is selected and you can select one of eight types of 7, 9, 10, 11, 15, 17, 20, and 23 stages.

There are two types of 15-stage PRBS mode, and you can select one of them by using the PRBS switch on the D3273 rear panel.
When you press the ⇦ key, the number of stages decreases. When you press the ⇨ key, it increases.

Table 3-2 PRBS Pattern Generating Polynomials

2^N-1	Generating polynomial	Reference standards	Applicable mark ratio
N=7	X^7+X^6+1	CCITT V.29	1/2
9	X^9+X^5+1	CCITT V.52	1/2
10	$X^{10}+X^7+1$	-	-
11	$X^{11}+X^9+1$	CCITT 0.152	1/2
15	$X^{15}+X^{14}+1$	CCITT 0.151	1/2B
15	$X^{15}+X^1+1$	-	-
17	$X^{17}+X^{14}+1$	-	-
20	$X^{20}+X^3+1$	CCITT V.57	1/2
23	$X^{23}+X^{18}+1$	CCITT 0.151	1/2B

The PRBS pattern of 2^N is equal to the pattern of 2^N-1 at the same stage added by 1 bit.

⑬ CCITT LED

Lights when a PRBS pattern satisfying the CCITT Recommendations is selected with PRBS stage number set key ⑫, 2^N key ⑭ and MARK RATIO set key ⑮ (see Table 3-2).

⑭ 2N key

When this key is turned on, the PRBS pattern becomes an even number (2^N) bit length. (A single bit of zero (0) is added to the maximum continuous zero section of the original pattern if the mark ratio is 1/2.)

The number of selectable stages are 7, 9, 10 and 11. You can select the PRBS of 7 stages during the time immediately after the 2^N key has been turned on or off.

⑮ MARK RATIO set keys and indicator LEDs

Selects any one of eight types of mark ratios of the PRBS pattern: 0/8, 1/8, 1/4, 1/2, 8/8, 7/8, 3/4, and 1/2B.

The ⇕ key selects one of vertically paired LEDs of mark ratio alternatively (in reverse relationship to each other). The ⇑ key selects a mark rate indicated by a lamp of the transverse direction counterclockwise. The ⇓ selects clockwise.

For the pattern having the mark ratio of 1/2 of PRBS 2^N-1, the maximum continuous section of logical 1 bits is N bits long, and the maximum continuous section of logical 0 bits is N-1 bits long.

For the pattern having the mark ratio of 1/2 and 1/2B of PRBS 2^N, the maximum continuous section of logical 1 bits and that of logical 0 bits are both N bits long.

A pattern of mark ratio 1/4 is created by two continuous bits of the pattern of mark ratio 1/2. A pattern of mark ratio 1/8 is created by ANDed (logical product) of three continuous bits of pattern of mark ratio 1/8.

A pattern of mark ratio 0/8 is equal to the pattern having all logical bits of zero (0).

3.2.2 Measuring Block

(See figure 2-3)

The D3273 error detector has two primary measuring modes: individual measuring mode and simultaneous measuring mode.

Each of these modes support five measuring functions: error rate, error count, error second (ES), error free second (EFS), and frequency measurement.

If the measuring function is switched in the individual measuring mode, the already measured values are lost. In the simultaneous measuring mode, however, five measuring functions are measured simultaneously in the detector. You can switch the measuring functions without terminating each measurement.

Various display formats can be selected for these measuring modes and functions.
Table 3-3 summarizes the available measuring modes and functions.

The error display modes (OMIT, INSERT, and TOTAL) can be switched any time by using four display functions except for frequency measurement.

Table 3-3 Measuring Modes and Measuring Functions

Measuring mode	Measuring function	Display format	Current data display	Use of timer	Display rate
In-dividual measure-ment	Error rate	—	None	Impossible	FAST, MED, SLOW, HOLD
	Error count	- Exponential format - Integer format	Yes	Possible	Fixed to approx. 0.1 sec
	Error second	- Percent (%) format - Seconds format	Yes	Possible	Fixed to 1 sec
	Error free second	- Percent (%) format - Seconds format	Yes	Possible	Fixed to 1 sec
	Frequency	In MHz unit	-	Impossible	FAST, MED, SLOW, HOLD

Table 3-3 Measuring Modes and Measuring Functions (cont'd)

Measuring mode	Measuring function	Display format	Current data display	Use of timer	Display rate
Simultaneous measurement	Error rate	- Progressive mode - Immediate mode	Can be turned on or off.	Possible	Fixed to approx. 0.2 sec
	Error count	- Exponential format - Integer format	Can be turned on or off.	Possible	Fixed to approx. 0.2 sec
	Error second	- Percent (%) format - Seconds format	Can be turned on or off.	Possible	Fixed to 1 sec
	Error free second	- Percent (%) format - Seconds format	Can be turned on or off.	Possible	Fixed to 1 sec
	Frequency	In MHz unit	Can be turned on or off.	Possible	Fixed to approx. 0.2 sec

Note: In the simultaneous measuring mode, you can select the immediate mode of error rate only when the Current Data Display is on.

① ERROR lamp

The lamp indicating present existence of errors.

(a) DATA lamp

Lights if an bit error (data error) is detected in the input data. The DATA lamp goes out when the bit error is corrected.

In the individual measuring mode, this lamp does not light for frequency measurement.

(b) CLOCK lamp

Lights if the clock input is lost or if the input clock frequency is too low (clock error). This lamp has the history log function and once it lights, it continues to light even when the error is recovered.

(c) SYNC lamp

Lights when an out-of-sync pattern is detected.

In the individual measuring mode, the SYNC lamp does not light for frequency measurement.

Note: The measurement function is provided with error rate, error count, error second(ES) and error free second(EFS), during CLOCK or SYNC errors are occuring, the funcntion can not be used. The measurement function is provided with the frequency (FREQ) measurement for the individual measurement mode, during CLOCK errors are occurring, the function can not be used.

② BUZZER key

Turns the alarm buzzer on or off.

The alarm buzzer turns on or off whenever this key is pressed.

When it is turned on, the key lamp lights. If a data, clock, or sync error is detected, the buzzer continues to sound. If a data error is detected, the buzzer tone changes according to the error bit amount in units of time.

If the frequency measuring function is selected in the individual measuring mode, the alarm buzzer sounds only when a clock error is detected.

③ FUNCTION (ERROR RATE, ERROR COUNT, ES, EFS, FREQ (MHz)) keys

Select the specifies measuring function.

When one of these five keys is pressed once, its function is selected and its key lamp lights. The lamp of another switch go out.

If you switch the measuring function or measuring mode in the individual measuring mode, the already measured data is lost.

(a) ERROR RATE key

Measures and displays the error rate.

The error rate is indicated as the number of errored bits divided by the number of input bits. The number of input bits is equal to the number of input clocks.

The actual measurement depends on the selected measuring mode as follows. In either mode, no measurement starts if a clock error or sync error has occurred. When the error is recovered, the measurement restarts from its beginning automatically.

(i) Individual measuring mode

The number of input bits is set at 10-time steps in the range of 10^5 to 10^{14} as the reciprocal number of BIT ERROR RATE RANGE.

Therefore, the time period required for measurement increases when a small value (10^{-N}) is set for the BIT ERROR RATE RANGE or when the input clock frequency is low.

The minimum resolution is equal to the set value of the BIT ERROR RATE RANGE, and the upper limit of the measuring range depends on the BIT ERROR RATE RANGE (see Table 3-4).

The measurement is repeated automatically if the DISPLAY RATE is set to FAST, MED, or SLOW. If set to HOLD, the measurement is made only once when the START key is pressed.

(ii) Simultaneous measuring mode

When you set the measurement time on the timer and press the START key, the measurement starts.

The measurement stops when the timer value has expired or when you press the STOP key.

In the simultaneous measuring mode, the number of input bits is equal to measuring frequency of input clock multiplied by the elapsed time (in seconds) from the beginning of measurement. When the elapsed time increases, the resolution increases.

In this mode, you can turn on or off the display of the CURRENT DATA during measurement.

The CURRENT DATA contents are updated approximately every 0.2 second.

The CURRENT DATA can be displayed in either the PROGRESSIVE mode or IMMEDIATE mode, and they can be switched by the DISPLAY FORM key.

In the PROGRESSIVE mode, the error rate is calculated based on the accumulation of the number of errored bits from the start of measurement and the number of input bits. In the IMMEDIATE mode, the error rate is displayed as the value in a specific period (approximately 0.2 second) between the previous display and current display.

(b) ERROR COUNT key

Measures and displays the error count.
It displays the number of errored bits detected during measurement.

The error count can be displayed in either the EXPONENTIAL display format or INTEGRAL display format, and they can be switched by the DISPLAY FORM key.

In the EXPONENTIAL display format, the error count is displayed within the range of 0 to 9.9999×10^{18}. In the INTEGRAL display format, it is displayed within the range of 0 to 9999999.

The measurement starts when the START key is pressed, and it stops when the timer value has expired or when the STOP key is pressed.

No measurement starts if a clock error or sync error has occurred. When the error is recovered, the measurement restarts from its beginning automatically.

The results of measurement are displayed in different ways depending on the selected measuring mode as follows:

(i) Individual measuring mode

The current data is displayed during measurement and it is updated approximately every 0.1 second.

(ii) Simultaneous measuring mode

You can turn on or off the current data display during measurement. The current data is updated approximately every 0.2 second.

(c) ES

Measures and displays the error seconds (ES).
The ES can be displayed in the percent (%) format or in seconds, and they can be switched by the DISPLAY FORM key.

In the second mode, the number of seconds at which an error exceeding one bit has occurred is displayed in seconds. In the percent (%) display format, the number of seconds at which an error exceeding one bit has occurred within one second is divided by the elapsed time (in seconds) from the start of measurement, and it is multiplied by 100 and displayed in percent.

The measurement starts when the START key is pressed, and it stops when the timer value has expired or when the STOP key is pressed.

No measurement starts if a clock error or sync error has occurred. When the error is recovered, the measurement restarts from its beginning automatically.

The results of measurement are displayed in different ways depending on the selected measuring mode as follows:

(i) Individual measuring mode

The current data is displayed during measurement and it is updated approximately every 1 second.

(ii) Simultaneous measuring mode

You can turn on or off the current data display during measurement. The current data is updated approximately every 1 second.

(d) EFS key

Measures and displays the error free second.
It can also be display in two formats: percent display and second display which can be switched by the DISPLAY FORM key.

In the second mode, the number of seconds at which no error exceeding one bit has occurred is displayed in seconds. In the percent (%) display format, the number of seconds at which no error exceeding one bit has occurred within one second is divided by the elapsed time (in seconds) from the start of measurement, and it is multiplied by 100 and displayed in percent.

The measurement starts when the START key is pressed, and it stops when the timer value has expired or when the STOP key is pressed.

No measurement starts if a clock error or sync error has occurred. When the error is recovered, the measurement restarts from its beginning automatically.

The results of measurement are displayed in different ways depending on the selected measuring mode as follows:

(i) Individual measuring mode

The current data is displayed during measurement and it is updated approximately every 1 second.

(ii) Simultaneous measuring mode

You can turn on or off the current data display during measurement. The current data is updated approximately every 1 second.

(e) FREQ (MHz) key

Measures and displays the input clock frequency in megahertz within the range of 40.000 MHz to 3200.000 MHz.

The measurement varies depending on the selected measuring mode as follows:

(i) Individual measuring mode

The input clock frequency is measured with the 10-ms gate time.

The measurement is repeated automatically if the DISPLAY RATE is set to FAST, MED, or SLOW. If set to HOLD, the measurement is made only once when the START key is pressed.

The measurement does not start if a clock error has occurred. When the error is recovered, the measurement restarts automatically.

(ii) Simultaneous measuring mode

When you set the measurement time on the timer and press the START key, the measurement starts.

The measurement stops when the timer value has expired or when you press the STOP key.

The results of measurement are updated approximately every 0.2 second.

The measurement does not start if a clock error has occurred. When the error is recovered, the measurement restarts automatically.

④ DISPLAY FORM key

Switches the display format of Error Count, Error Second, Error-Free Second Measurement, or the Error Rate Measurement in the Simultaneous Measurement mode.

The operation of each measuring function and the actions you take are as follows:

(a) Display in Error Rate measurement

If the CURRENT DATA display is turned on in the simultaneous measuring mode, you can switch the PROGRESSIVE and IMMEDIATE modes. The mode is switched whenever you press the DISPLAY FORM key. When the IMMEDIATE mode is selected, the lamp lights on this key.

If the CURRENT DATA display is turned off or if the individual measuring mode is selected, this key is made invalid. The key lamp goes out.

(b) Display in Error Count measurement

You can switch the EXPONENTIAL and INTEGRAL display formats regardless of measuring mode selection or CURRENT DATA display on/off switching.

The display format is switched whenever you press the DISPLAY FORM key. When the EXPONENTIAL display mode is selected, the lamp lights on this key.

(c) Display in ES or EFS measurement

You can switch the percent and seconds display formats regardless of measuring mode selection or CURRENT DATA display on/off switching.

The display format is switched whenever you press the DISPLAY FORM key. When the percent (%) display mode is selected, the lamp lights on this key.

The common display format is set for ES measurement and EFS measurement.

(d) Display in frequency measurement

The DISPLAY FORM key is invalid for frequency measurement. The key lamp does not light.

⑤ ERROR DISPLAY MODE (OMIT, INSERT, and TOTAL) keys

Select the type of error to be displayed during error measurement in the Error Rate, Error Count, Error Second, or Error-Free Second Measurement mode.

When you press one of OMIT, INSERT, or TOTAL keys, its display mode is selected and its lamp lights. The lamps of other keys go out.

This switch setup is invalid for frequency measurement. All lamps of these keys go out.

(a) OMITT key

This mode indicates the measuring result for an error in which the data of "0" (low level) is input when the data of "1" (high level) must be input.

(b) INSERT key

This mode indicates the measuring result for an error in which the data of "1" (high level) is input when the data of "0" (low level) must be input.

(c) TOTAL key

This mode indicates the results of measurement for the total sum of both errors of OMIT and INSERT.

In ES measurement, this mode results the number of seconds at which an error has occurred in the OMIT or INSERT mode or both of them. Also, in EFS measurement this mode results the number of seconds at which no error has occurred in both modes.

⑥ Measuring result indicator

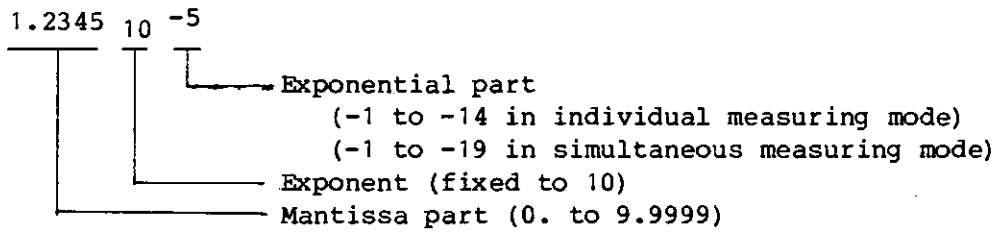
Displays the results of measurement, measuring status, or error status. The following explains the display format of each measuring function.

(a) Error rate

The error rate is displayed in the following format:

5 digits maximum of mantissa part (with decimal point) + Exponent (10) + 2 digits maximum of exponential part (integer with negative sign)

Example:



This example shows that the error rate is 1.2345×10^{-5}.

If the measuring result exceeds the limit, OVER lamp ⑦ lights and "␣␣␣␣␣10^{0}" is displayed.

(b) Error count

The EXPONENTIAL and INTEGRAL display formats can be switched by DISPLAY FORM key ④.

(i) In the EXPONENTIAL display format, the number of errors is displayed in the following format:

5 digits maximum of mantissa part (with decimal point) + Exponent (10) + 2 digits maximum of exponential part

Example: $4.2836\ 10^{6}$ (4.2836×10^{6})

If the measuring result exceeds the limit, OVER lamp 7 lights and "␣␣␣␣␣10^{19}" is displayed.

(ii) In the INTEGRAL display format, the number of errors is displayed in up to 7 digits of integer. If it exceeds 9999999, OVER lamp ⑦ lights and the low-order 7 digits of the measured value are displayed.

Example: 4283643

(c) ES or EFS

The second display format and percent display format can be switched by DISPLAY FORM key ④ .

(i) In the percent (%) display format, the ES or EFS is displayed in the following format:

3 digits maximum of integer + Decimal point + 4 digits of decimal part

Example: 0.7451 (0.7451%)

If the measuring result exceeds the limit, OVER lamp ⑦ lights and "␣␣␣.␣␣␣␣" is displayed.

(ii) In the second display format, the number of seconds is displayed in the following format:

5 digits maximum of mantissa part (with decimal point) + Exponent (10) + 1 digit of exponential part

Example: $3.26\ 10^{2}$ (3.26×10^{2} seconds)

If the measuring result exceeds the limit, OVER lamp ⑦ lights and "uuuuuu$\times 10^9$" is displayed.

(d) Input clock frequency

The input clock frequency (in MHz) is shown in the following format:

4 digits maximum of integer + Decimal point + 3 digits of decimal part

Example: 3120.523 (3120.523 MHz)

If the measuring result exceeds the limit, OVER lamp ⑦ lights and "uuuu.uuu" is displayed.

(e) Clock error

If no clock is entered or if the input clock is below the limit, the measurement is stopped and the "ClocErr" message is displayed.

(f) Sync error

If the pattern is out of synchronization, the measurement is stopped and the "SyncErr" message is displayed.

(g) Status before starting measurement (HALT)

The "HALt" message continues on the display during time when the measuring mode or measuring function is switched and when the measurement is started.

(h) Status immediately after start of measurement (BUSY)

The "buSy" message continues on the display during time when the measurement has started and when the result of first measurement is displayed.

⑦ OVER lamp

Indicates that the result of measurement has exceeded the limit.

Table 3-4 lists the upper limit of measurement of each measuring function.

Table 3-4 Upper limit of measurement

Measuring function	Measuring mode	Display format	Bit error rate range	Upper limit of measurement
Error rate	Individual	-	10^{-5} - $1-^{-9}$	9.9999×10^{-1}
			10^{-10}	1.0737×10^{-1}
			10^{-11}	1.0737×10^{-2}
			10^{-12}	1.0737×10^{-3}
			10^{-13}	1.0737×10^{-4}
			10^{-14}	1.0737×10^{-5}
	Simultaneous	Progressive or Immediate	-	9.9999×10^{-1}
Error count	- Individual - Simultaneous	EXPONENTIAL format	-	9.9999×10^{18}
		INTEGRAL format	-	9999999
ES, EFS	- Individual - Simultaneous	Percent(%) format	-	100.0000
		Second format		4.2949×10^{9}
Frequency	- Individual - Simultaneous	in MHz unit	-	3200.000

Note: If the bit error rate range is 10^{-10} to 10^{-14} during error rate measurement in individual measuring mode, the error rate exceeding the limit may be measured.

⑧ GATE lamp

This lamp indicates that the measuring is going on.

⑨ MEAS MODE key

Switches the measuring mode between the individual measurement and simultaneous measurement.

These two measuring modes are switched whenever you press the MEAS MODE key.

When the individual measuring mode is selected, the error rate measuring range of 5 to 14 is displayed on BIT ERROR RATE RANGE display ⑩. When the simultaneous measuring mode is selected, the "Cd" message indicating the CURRENT DATA display or the "5t" message indicating CURRENT DATA non-display is shown.

⑩ BIT ERROR RATE RANGE indicator and set keys

This indicator and keys have different functions as follows:

(a) Individual measuring mode

The BIT ERROR RATE RANGE key sets and displays the error rate measuring range.

You can specify the measuring range within the range of 10^{-5} to 10^{-14}. The absolute value of this exponent part is shown in the window.

The absolute value of the exponent part is incremented by 1 whenever you press the ⇧ key, but it is decremented by 1 when you press the ⇩ key.

The measuring range indicates the reciprocal number of the number of input bits (equal to the number of input clocks) for each time of error rate measurement. If you have set the error rate of 10^{-8}, for example, the number of error bits for each number of input bits of 10^{8} (equal to 100 million) is measured.

The time required for a single error rate measurement is:

$$\frac{1}{(\text{Measuring range } (10^{-N})) \times (\text{Input clock frequency (Hz)})} \text{ (Seconds)}$$

For example, if the measuring range is 10^{-12} and the input clock frequency is 2G (that is, 2×10^{9}) Hz, the error rate is 500 seconds.

This indicator is cleared for measurement other than error rate.

(b) Simultaneous measuring mode

Turns the CURRENT DATA display on or off.

When you press the ⇧ key, the CURRENT DATA display is turned on and the "Cd" message is displayed in the window. When you press the ⇩ key, the CURRENT DATA display is turned off and the "5t" message is displayed.

ｶﾚﾝﾄ indicates the CURRENT DATA, and ｼｭｳﾘｮｳ indicates the simultaneous measuring mode.

(11) START and STOP keys

The START key starts measurement and the STOP key stops measurement.

(a) START key

Starts measurement of Error Count, Error Second (ES), or Error Free Second (EFS) in the individual measuring mode. Also, this key starts measurement of all functions in the simultaneous measuring mode. If the DISPLAY RATE is set to HOLD for ERROR RATE or FREQuency measurement in the individual measuring mode, this key can start its measurement.

If a clock error or frequency error has occurred and when you press the START key, the measurement starts only after the error has been recovered.

If you press the START key, the current measurement stops and another measurement starts. If the timer is used, the ELAPSED time is reset to zero (0) and the remaining time (TIMED) is returned to the PRESET time.

When you press the START key, the history of the clock error and sync error is reset.

(b) STOP key

Stops measurement of Error Count, Error Second (ES), or Error Free Second (EFS) in the individual measuring mode. Also, this key stops measurement of all functions in the simultaneous measuring mode.

This STOP key is also valid if the automatic measurement stop function of the timer is used.

This key is invalid for error rate or frequency measurement in the individual measuring mode.

(12) DISPLAY RATE key and FAST, MED, SLOW and HOLD lamps

The key sets the error rate in the individual measuring mode and the display rate for frequency measurement. One of the lamps lights to indicate its selected time interval.

When you repeat pressing this key, the display rate is changed in the sequence of FAST, MED, SLOW, and HOLD. After HOLD, it is changed to FAST and repeated in this sequence.

The display rate means the measuring time interval from the end of one measurement to the start of the next measurement. Its time is approximately 0.1 second for FAST, approximately 0.3 second for MED, or approximately 1 second for SLOW. If you select HOLD, the measurement is held until you press the START key again.

This key is made invalid and all these lamps are off during measurement of Error Count, ES, and EFS and in the simultaneous measuring mode.

⑬ AUTO SYNC, SYNC Key

This key is used to turn ON/OFF the automatic pattern synchronizing function and to reset the synchronism.

Each time the AUTO SYNC key is pressed, the ON/OFF of the automatic pattern synchronizing function is changed over alternately. When the key is set to ON, the lamp in this key lights.

If the error rate rises when this key is set to ON, the system automatically goes to the status of out of synchronism (SYNC error) and searches for the pattern where the input pattern matches the reference pattern. When matched, the system goes to the status of synchronism establishment.

When this key is set to OFF, however, the system does not make a transition to the status of out of synchronism automatically, even if the error rate rises, but it holds the status of synchronism establishment until the SYNC key is pressed.

When the SYNC key is pressed, the status of synchronism establishment is released once even if the AUTO SYNC is set to either ON or OFF, and then the system makes a status transition to the out of synchronism status, and searches for the pattern until the pattern match is taken.

The threshold value of the error rate between the establishment of synchronism and out of synchronism is set as shown in the table below:

PATTERN MODE	BIT LENGTH	Threshold value of error rate	
		Out of synchronism → establishment of synchronism	Establishment of synchronism → out of synchronism
WORD	1 to 64	Approx. 3.9×10^{-3}	Approx. 1.6×10^{-2}
	65 to 256	Approx. 9.8×10^{-4}	Approx. 1.6×10^{-2}
	257 to 1024	Approx. 2.4×10^{-4}	Approx. 1.6×10^{-2}
	1088 to 4096	Approx. 6.1×10^{-5}	Approx. 1.6×10^{-2}
	4160 to 16384	Approx. 1.5×10^{-5}	Approx. 1.6×10^{-2}
	16448 to 32768	Approx. 7.6×10^{-6}	Approx. 1.6×10^{-2}
	32832 to 65536	Approx. 3.8×10^{-6}	Approx. 1.6×10^{-2}
PRBS	----------	Approx. 3.9×10^{-3}	Approx. 1.6×10^{-2}

When the pattern synchronism cannot be established even if the input is normal, press the SYNC key.

⑭ DELAY Indicator, Knob, and BUSY Lamp

Used to set and display the amount of phase delay in the CLOCK input.

The delay amount can be varied with a step of 0.01 ns by turning the knob.

The variable range is -1.00 ns to +1.00 ns.

Since the range is varied mechanically using a motor and variable delay line, it takes some time from the turning of the knob to the end of its setting. The BUSY lamp lights during this operation.

Incidentally, CAL is displayed during automatic calibrating of the amount of phase delay.

When a malfunction occurs in this operation, "----" is displayed and the delay line operation is stopped.

⑮ THRESHOLD LEVEL indicator and knob

Set and display the threshold level of data input.

You can change the threshold in every 0.001 Vdc step by rotating the knob. The variable range depends on the setting of the TERMINATOR (TO 0V or TO -2V) keys at the right lower end of the front panel as follows:

TERMINATOR	Variable range
TO 0 V	-1.999V to +1.999V
TO -2 V	-1.850V to -0.750V

⑯ Input POLARITY key and NORMAL, INVERSE Lamp

This key is used to change over the polarity of data input, and the lamp to display it.

Each time this key is pressed, the polarity changes over from NORMAL to INVERSE and vice versa alternately.

(a) NORMAL

Compares data input with the internal reference pattern set in the pattern setting block as it is to detect and measure any error.

(b) INVERSE

Compares data input by inverting the pattern with the internal reference pattern set in the pattern setting block to detect and measure any error.

⑰ HISTORY lamp

(a) CLOCK lamp

After pressing the START key, when a condition of no clock input or a condition of too low frequency on the input clock (clock error) occurs, the clock lamp lights ON.

(b) SYNC lamp

After pressing the START key, when a condition of disordered pattern synchronization (synchronous error) occurs, the SYNC lamp lights ON.

⑱ AUTO SEARCH key

The AUTO SEARCH function automatically searches the optimum threshold level of data input in the D3273 (ERD) or the optimum phase (DELAY) between input data and clock.
(It also searches the optimum mark rate in the PRBS pattern mode and the optimum W.PORARITY in the WORD pattern mode. Therefore, the number of PN stages in the PRBS pattern mode and the programmable pattern in the WORD pattern mode must be set in common to the PPG and the ERD.)

Conditions for executing the AUTO SEARCH function:
●Input data level range: High level ... +2.00 or less
Low level ... -2.00 or more
●Input data mark rate range
: 1/8 to 7/8 (WORD pattern mode) display LED.

AUTO SEARCH is executed once every time the AUTO SEARCH key is pressed. The lamp in the key lights during execution. " SEArCh " is displayed on the measurement display LED, and "- - - -" is displayed on the TLVL (threshold level) display LED.

Upon completion of AUTO SEARCH operation, the lamp in the key and the measurement dislpay LED go out. When the optimum DELAY or TLVL value is found, the value is displayed, and the measurement mode becomes the one that has been effective prior to execution.

If the optimum value is unavailabe, " not found " is displayed on the measurement display LED, and the DELAY or TLVL value returns to the one that has been effective prior to execution.
AUTO SEARCH can be cancelled by pressing the AUTO SEARCH key during operation. Measurement setting conditions return to the ones that have been effective prior to execution.

3.2.3 Timer and Clock Block (Figure 2-4)

① TIMER MODE (SINGLE, REPEAT, and UNTIMED) keys

Set their respective timer/clock display modes for error count, error second (ES), and error free second (EFS) measurement in the individual measurement mode. Also, they are used to select the timer operation in the simultaneous measurement mode.

When you press one of these three keys, its mode is selected and the key lamp lights. The lamps of the other two keys do not light.

You cannot change the TIMER MODE during measurement of the error count, ES or EFS in the individual measuring mode or during measurement in the simultaneous measuring mode.

(a) SINGLE mode key

Performs measurement only once.

When you press the START key, the measurement starts. This measurement ends when the time set by the timer PRESET key is expired or when you press the STOP key.

(b) REPEAT mode key

Repeats measurement.

When you press the START key, the measurement starts. When the time set by the timer PRESET is expired, the last measuring data is displayed and the next measurement starts. This measurement repeats until you press the STOP key.

(c) UNTIMED mode key

Repeats measurement regardless of the time set by the timer PRESET key.

When you press the START key, the measurement starts and it continues until you press the STOP key.

This measurement mode is the same as when you have set the timer PRESET value to "00_{DAY} 00_{HOUR} 00_{MIN} 00_{SEC}". You can change the mode without changing the PRESET value.

② MEAS TIME (ELAPSED, TIMED, and PRESET) keys

Switche the display mode of timer/clock indicator ③ to the measurement time display mode (elapsed time, remaining time, or measuring period).

When you press one of these three keys, its mode is selected and the key lamp lights. The lamps of the other two keys and the REALTIME keys do not light.

(a) ELAPSED time key

Displays the elapsed time (DAY, HOUR, MIN, SEC) from the start of measurement in the individual measuring mode for error count, ES or EFS or in the simultaneous measuring mode.

The maximum display range is 99_{DAY} 23_{HOUR} 59_{MIN} 59_{SEC}. If the elapsed time exceeds this limit, the left upper pointers of all digits are displayed.

When the error rate or input clock frequency is measured in the individual measuring mode, a hyphen (-) is displayed in all digits.

(b) TIMED (remaining time) key

Displays the remaining time (DAY, HOUR, MIN, SEC) until the measurement is stopped at the time set by the timer PRESET key in the individual measuring mode for error count, ES or EFS or in the simultaneous measuring mode.

When the remaining time reaches zero (0), the measurement stops automatically.

When the measurement is not started yet, when the automatic stop function of the timer is not used, or when the error rate and input clock frequency (FREQ) are measured in the individual measuring mode, a hyphen (-) is displayed in all digits.

(c) PRESET (measuring period setup) key

Sets and displays the measuring time from the start of measurement to the automatic stop of it by the timer in the individual measuring mode for error count, ES or EFS measurement or in the simultaneous measuring mode.

The maximum range of this setup and display is 99_{DAY} 23_{HOUR} 59_{MIN} 59_{SEC}. You can set it in every 1 second.

If you set 00_{DAY} 00_{HOUR} 00_{MIN} 00_{SEC}, the automatic stop function by the timer is not used (that is, the measurement can be stopped by the STOP key only).

To change the setup, use SET key ⑦, DIGIT key ⑤ and TIMER/CLOCK change key ⑥.

When you set the TIMER MODE to UNTIMED, the PRESET key displays 00_{DAY} 00_{HOUR} 00_{MIN} 00_{SEC}. However, when you press SET key ⑦ to select the timer setup mode, the set value is displayed and you can change it. When you press the SET key again to complete timer setup, the display returns to 00_{DAY} 00_{HOUR} 00_{MIN} 00_{SEC}.

You cannot change the setup during measurement of error count, ES or EFS in the individual measuring mode or during measurement in the simultaneous measuring mode.

③ REALTIME (YMDH and DHMS) keys

Switche the display mode of timer/clock indicator to the realtime ("YMDH" or "DHMS") display mode.

When you press one of these keys, its display mode is selected and its key lamp lights. The other key lamp and the MEAS TIME key lamp do not light.

To change the realtime setup, press the desired display key and use SET key ⑦, DIGIT key ⑤ and TIMER/CLOCK change key ⑥.

When you set the day (DAY) and hours (HOUR) for either "YMDH" or "DHMS", the same value is set for the other value.

(a) YMDH (year, month, day, hours) key

Sets and displays the year (YEAR), month (MONTH), day (DAY) and hours (HOUR).

(b) DHMS (day, hours, minutes, seconds) key

Sets and displays the day (DAY), hours (HOUR), minutes (MINUTE), and seconds (SECOND).

④ Timer/clock Indicator

This indicator indicates the time/hour of the timer and clock.

A pointer is displayed on the upper left of digits to which the time/hour can be set.

⑤ DIGIT Keys

These key are used to shift the digit (a pointer is displayed on its upper left) to which the timer/clock can be set to the left (⇦) or right (⇨).

⑥ Timer/Clock Change Keys

These key are used to increment the set value of the digit selected by the DIGIT key by 1 (⇧) or decrement it by 1 (⇩).

⑦ SET key

Selects the timer/clock setup mode. The pointer is turned on or off at the digit where you can set the value of timer/clock indicator ④ whenever you press the SET key. To set the timer/clock value, press the SET key to turn on the pointer. Set the value using DIGIT key ⑤ and Timer/Clock change key ⑥, and press the SET key again to turn off the pointer and terminate the setup.

When you set the realtime, the digits below 1 second are set to zero when you press the SET key at the end of time setup.

If you press the SET key to turn on the pointer during realtime setup and if you press the SET key again without setting any time, the realtime setup is canceled. The internal clock is not set.

3.2.4 I/O Connectors and other Controls Block

(See Figure 2-5)

① POWER switch

This is the POWER switch. It is arranged in series with the breaker on the rear panel.

② REMOTE lamp and LOCAL key

The REMOTE lamp lights when the error detector is under remote control by the GPIB controller.

When you press the LOCAL key, the remote control is released. However, when the error detector is set to LOCAL LOCKOUT by the GPIB controller, you cannot release it.

③ ADDRESS DISP switch

Sets and displays the GPIB device address of the error detector.

The device address is displayed on the ADDRESS number indicator of the pattern setting block.

The device address setup/display mode and the ordinary pattern address setup/display mode are switched to each other whenever this key is pressed.

When you select the device address set/display mode, the switch lamp lights and GP-IB is displayed on the BIT LENGTH indicator of the pattern setting block.

④ PANEL LOCK key

This key is used to set/release the locking of the key and knob on the front panel.

Each time this switch is pressed, the lock setting and releasing are changed over alternately.

When the locking is set, the lamp in this key lights and keys and knobs other than this key and POWER key, LOCAL key and PRBS Switch on the rear panel are disabled.

⑤ SLAVE key

Links the pattern setting block of the error detector to the pattern setting block of the D3173/D3173A pulse pattern generator.

The linkage function is switched on and off whenever you press the SLAVE key. When turned on, the key lamp lights.

For the detailed functions and their use, see Section 5.12 "Master and Slave Operations."

⑥ SYNC OUTPUT 1/16 CLOCK connector

This is an output of 1/16 of INPUT CLOCK ⑩.

⑦ SYNC OUTPUT PATTERN connector

This is the sync output connector of compared patterns. When patterns are synchronized, the pulse synchronized with the input data pattern is output. The output bit position can be changed in every 16-bit step according to the address number of the pattern setting block.

⑧ MONITOR OUTPUT CLOCK connector

This is a monitor output of INPUT CLOCK ⑩.

⑨ MONITOR OUTPUT DATA connector

This is a monitor output of INPUT DATA ⑪.

⑩ INPUT CLOCK connector

This is a clock output of the UUT, DUT or D3173/D3173A.

CAUTION

The INPUT CLOCK connector has the following allowable input voltage.
Never input the voltage exceeding the limit.
-2.5 to +2.5 Vdc (for 0 Vdc terminating voltage)
-4.5 to +0.5 Vdc (for -2 Vdc terminating voltage)

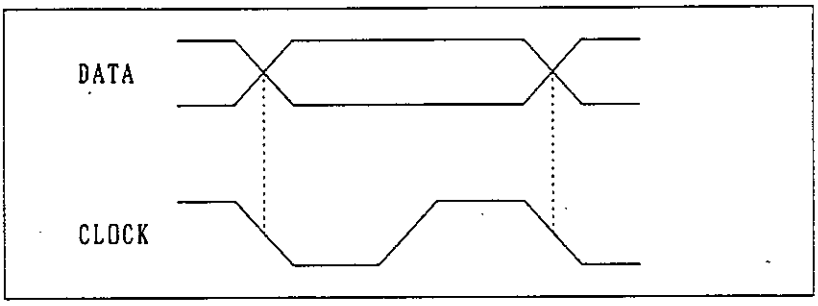
⑪ INPUT DATA connector

This is a input to connect data output of the UUT or DUT.

CAUTION

The INPUT DATA connector has the following allowable input voltage. Never input the voltage exceeding the limit.
-4.5 to +2.5 Vdc

Set the phase relation with INPUT CLOCK ⑩ as follows. This phase relation can be monitored at MONITOR OUTPUT connectors ⑧ and ⑨.



⑫ TERMINATOR (DATA, CLOCK) keys and TO 0V/TO -2V lamps

This key is used to specify the terminating voltage of the INPUT CLOCK ⑩ and INPUT DATA ⑪.

Resistance of the internal terminator is approx 50 ohm. Terminator is connected to 0V in TO 0V or -2V in to -2V.

4. SYSTEM OPERATIONS

This chapter explains how to perform the error test by connecting the D3273 Error Detector, the unit under test (UUT) or device under test (DUT) to the D3173/D3173A pulse pattern generator.

4.1 Setup on the D3173/D3173A Pulse Pattern Generator

4.1.1 Setting the Clock Source and Frequency

When using the internal synthesized oscillator as the clock source of the D3173/D3173A pulse pattern generator, press the INT key on the front panel and set the frequency by using the frequency setup dial or by frequency memory specification.

To use an external clock source, press the EXT key and input the external sine wave clocks having the 0.7 to 2 Vp-p amplitude into the EXT CLOCK INPUT connector.

CAUTION

If you have switched the clock source (or if you select the external clock input mode and input an external clock), switch the pattern mode between WORD and PRBS. If you skip this operation, invalid patterns may be output.

4.1.2 Setting the Data Output

Set the data output level according to the input conditions of the UUT or DUT as follows:

(1) If the terminating voltage of the UUT or DUT data input is zero (0) volt

Press the LEVEL key and set the output level so that the VARIABLE TO 0V lamp lights on the front panel. In this case, the data output offset (high level) and the amplitude can be changed. Set them by using the OFFSET and AMPLITUDE controls of the DATA section. The CLOCK (DC) output is also terminated with zero volt, and its offset and amplitude can be changed.

(2) If the terminating voltage of the UUT or DUT data input is -2 Vdc at ECL level

Press the LEVEL key and set the output level so that the ECL TO -2V lamp lights on the front panel. In this case, the data output offset (high level) is fixed to approximately -0.8 Vdc and the amplitude is fixed to approximately 0.8 Vp-p. Also, the CLOCK (DC) output is terminated with -2 Vdc, and the offset and amplitude are the same as those of data output.

4.1.3 Setting the Clock Output

If the UUT or DUT requires a clock, set the generator clock output according to the UUT or DUT input conditions.

(1) If the clock input of the UUT or DUT is DC coupled and if you want to set the offset:

Use the CLOCK (DC) output. It cannot be used if the clock input of the UUT or DUT terminates with the voltage different from the terminating voltage of the data input.

(a) If the terminating voltage of the UUT or DUT clock input is zero (0) volt (Figure 4-1)

Press the LEVEL key and set the output level so that the VARIABLE TO 0V lamp lights on the front panel. In this case, the CLOCK (DC) output offset (high level) and the amplitude can be changed. Set them by using the OFFSET and AMPLITUDE controls of the CLOCK section. The data output is also terminated with zero volt, and its offset and amplitude can be changed.

(b) If the terminating voltage of the UUT or DUT data input is -2 Vdc at ECL level (Figure 4-2)

Press the LEVEL key and set the output level so that the ECL TO -2V lamp lights on the front panel. In this case, the CLOCK (DC) output offset (high level) is fixed to approximately -0.8 Vdc and the amplitude is fixed to approximately 0.8 Vp-p. Also, the data output is terminated with -2 Vdc, and the offset is fixed to approximately -0.8 Vdc and the amplitude is fixed to approximately 0.8 Vp-p.

(2) If the clock input of the UUT or DUT is AC coupled (Figure 4-3) or DC coupled and if you want to set the center voltage of the amplitude equal to the terminating voltage (Figure 4-4)

Use the CLOCK (AC) output. It is not affected by the output level, offset, and amplitude setup.

The CLOCK (AC) output is AC coupled and its amplitude is approximately 2 Vp-p. If you need an output having a smaller amplitude, use an external attenuator.

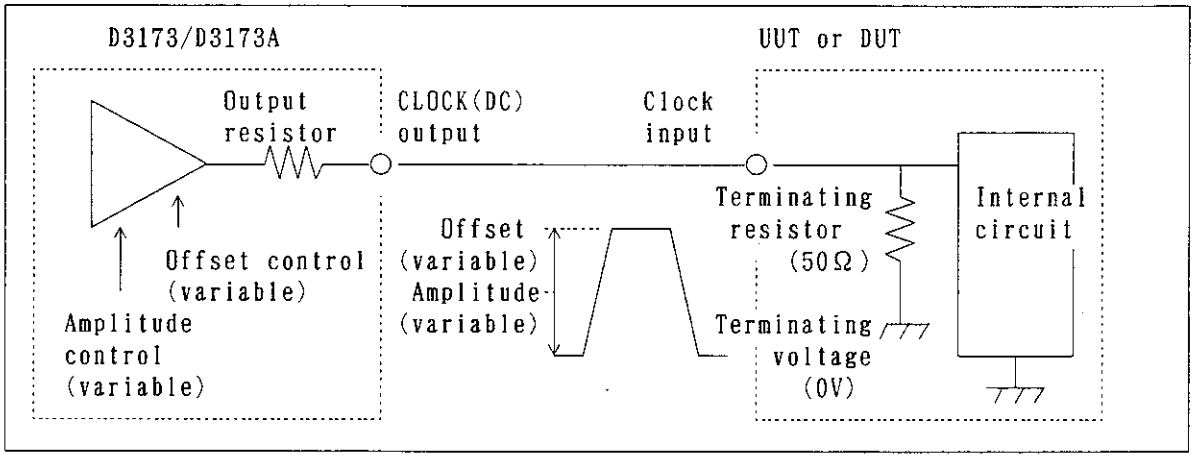


Figure 4 - 1 If CLOCK (DC) is used and the terminating voltage is 0 V

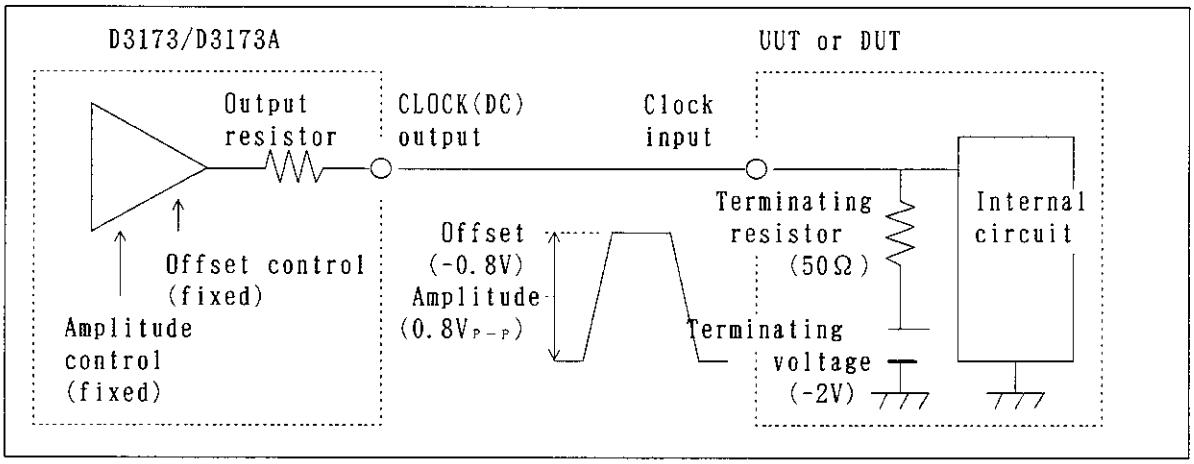


Figure 4 - 2 If CLOCK (DC) is used and the terminating voltage is -2 Vdc at ECL level

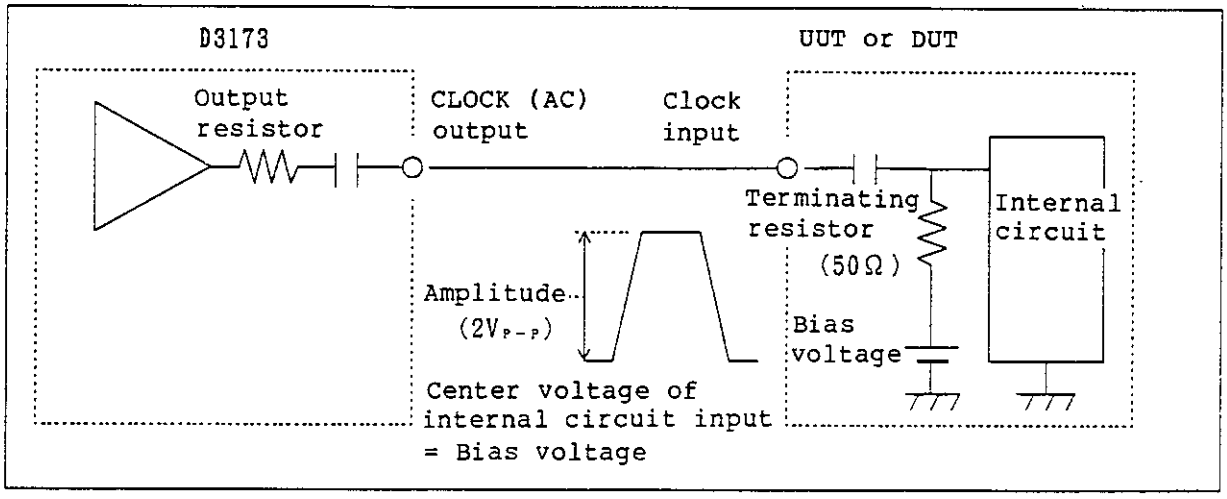


Figure 4 - 3 If CLOCK (AC) is used for AC coupled termination

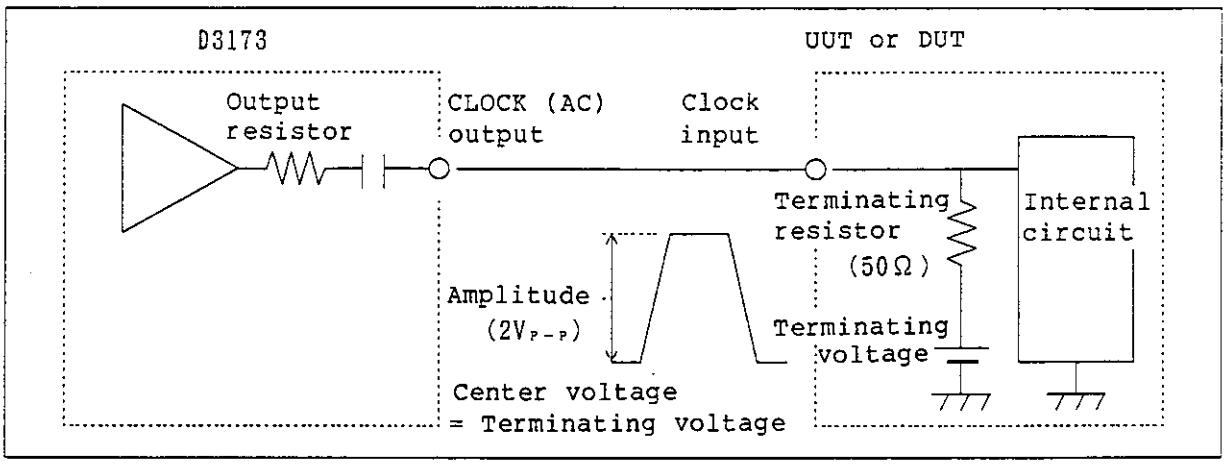


Figure 4 - 4 If CLOCK (AC) is used for DC coupled termination

4.1.4 Setting the Pattern

Select the WORD or PRBS pattern mode. In the WORD mode, set the bit length and the logic (0 or 1) of each bit to use an already created pattern from the pattern memory. In the PRBS mode, set the pattern length of $2^{N}-1$ or 2^{N}, step level N, and mark ratio.

When you set a pattern manually by using the keys on the generator panel, it is convenient to use the master/slave function to establish the linkage between the pattern on the D3273 error detector and that on the D3173/D3173A pulse pattern generator. To use this function, connect the GPIB cable between the D3273 and D3173/D3173A, turn on the SLAVE key on the D3273 front panel, and turn on the MASTER key on the D3173/D3173A front panel.

CAUTION

When using the master/slave function, do not connect any other device to the GPIB cable that is connected between the D3173/D3173A and D3273.

Also, when selecting the remote control mode on the GPIB controller, turn off both the MASTER and SLAVE keys on the generator and detector.

4.2 Setup on the D3273 Error Detector

4.2.1 Setting the Data Input

(1) Set the terminating voltage of data input according to the output conditions of the UUT or DUT.

When the TO 0V lamp for DATA lights in the TERMINATOR section, the data input is terminated with 0 V. When the TO -2V lamp for DATA lights, it is terminated with -2 Vdc. This setup is switched whenever the DATA key is pressed.

(2) Set the threshold of data input according to the output voltage of the UUT or DUT.

Adjust the THRESHOLD LEVEL voltage on the front panel so that it comes to the roughly center position of the output voltage of the UUT or DUT. Rotate the control knob for adjustment. The adjusting range depends on the terminating voltage of the data input.

4.2.2 Setting the Clock Input

There are three sources of clock input. You must set the terminating voltage of their clock input according to the output conditions of the source.

(1) If the clock output of the UUT or DUT is used

Set the terminating voltage of the clock input according to the output conditions of the UUT or DUT.

When the TO 0V lamp for CLOCK lights in the TERMINATOR section of the front panel, the clock input is terminated with 0 V. When the TO -2V lamp for CLOCk lights, it is terminated with -2 Vdc. This setup is switched whenever the CLOCK key is pressed.

When the UUT or DUT provides AC coupled clock output, the terminating voltage of the D3273 clock input may be either 0V or -2 Vdc.

(2) If the CLOCK (DC) output of the D3173/D3173A generator is used

When the D3173/D3173A output level has been set to VARIABLE TO 0V on the front panel, the D3273 clock input is terminated with 0 V. When the D3173/D3173A output level has been set to ECL TO -2V, it is terminated with -2 Vdc.

When the TO 0V lamp for CLOCK lights in the TERMINATOR section of the D3273 front panel, the line is terminated with 0 V. When the TO -2V lamp for CLOCK lights on the D3273, it is terminated with -2 Vdc. This setup is switched whenever the CLOCK key is pressed.

(3) If the CLOCK (AC) output of the D3173 generator is used

In this case, the terminating voltage of the D3273 clock input may be 0 V or -2 Vdc.

4.2.3 Setting the Pattern

Set the patterns in the same was as for D3173/D3173A pattern setup (see Section 4.1.4).

To use the master/slave function to establish the linkage between the pattern on the D3273 error detector and that on the D3173/D3173A generator, connect the GPIB cable between the D3273 and D3173/D3173A. Then, turn on the SLAVE key on the D3273 front panel, and turn on the MASTER key on the D3173/D3173A front panel.

CAUTION

When using the master/slave function, do not connect any other device to the GPIB cable that is connected between the D3173/D3173A and D3273.

Also, when selecting the remote control mode on the GPIB controller, turn off both the MASTER and SLAVE keys on the generator and detector.

4.2.4 Setting the Data Input Polarity

Set the INPUT POLARITY on the front panel according to the normal or inverted polarity of data during I/O to/from the UUT or DUT.

Press and set the INPUT POLARITY key so that the INVERSE lamp lights if the data is inverted or the NORMAL lamp lights if not.

4.3 Connection of Signal Lines

Figure 4-5 and Figure 4-6 gives an example of signal line connection.

Connect the clock I/O signal lines by considering the use or no use of clock I/O, voltage level, and line termination of the UUT or DUT.

CAUTION

To prevent possible damage of system equipment and devices, prepare the following before connecting the signal lines:

(1) Connect ground leads of all equipment and devices to a single ground (GND) terminal, and ground this terminal.

(2) The operators should use the ground wrist strip to discharge statistics.

(3) The conductors of coaxial cables should be fully discharged before being connected to the system signal lines.

(4) Set the correct output voltage and terminating voltage of each equipment.

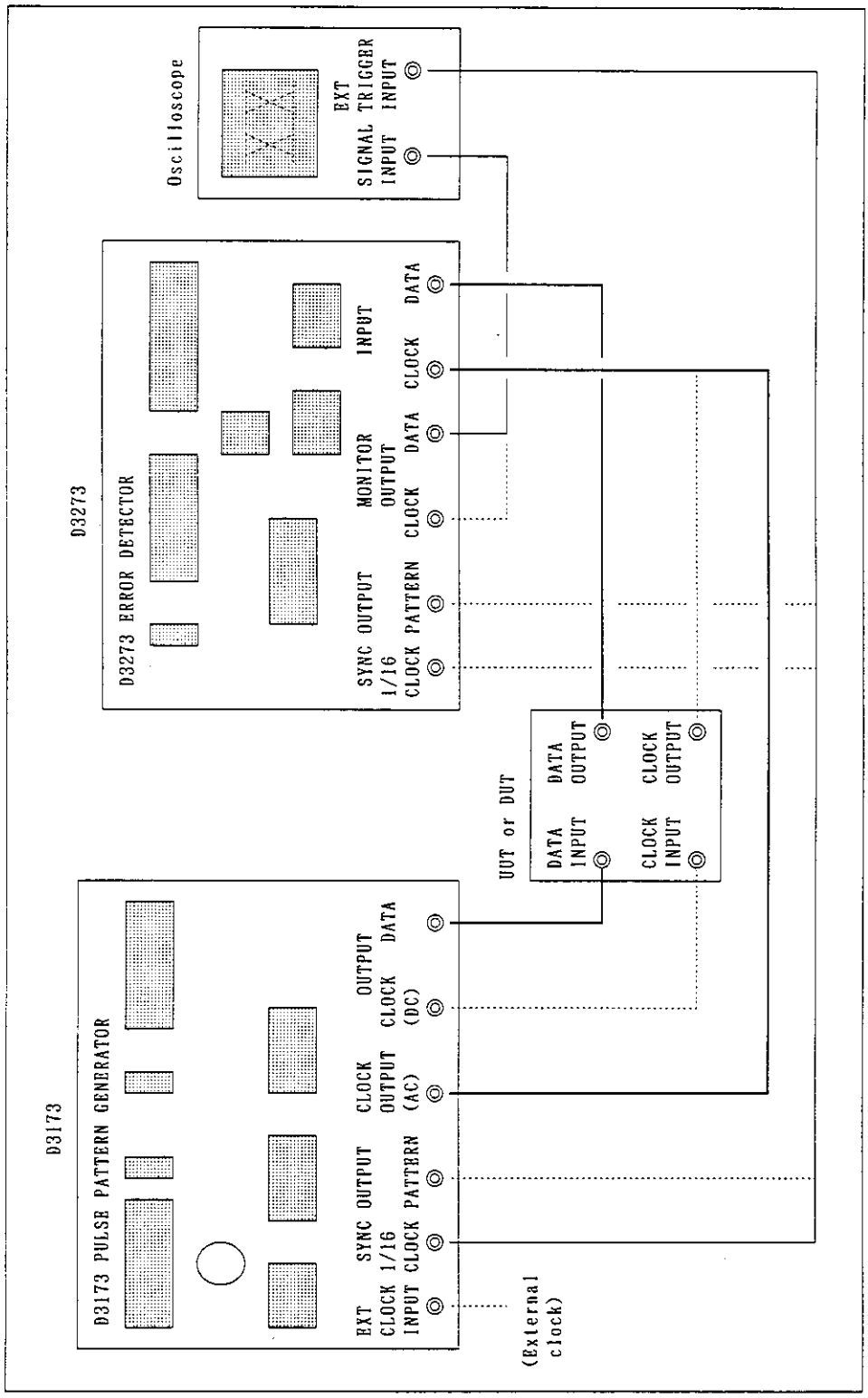


Figure 4-5 Signal Line Connection (D3173)

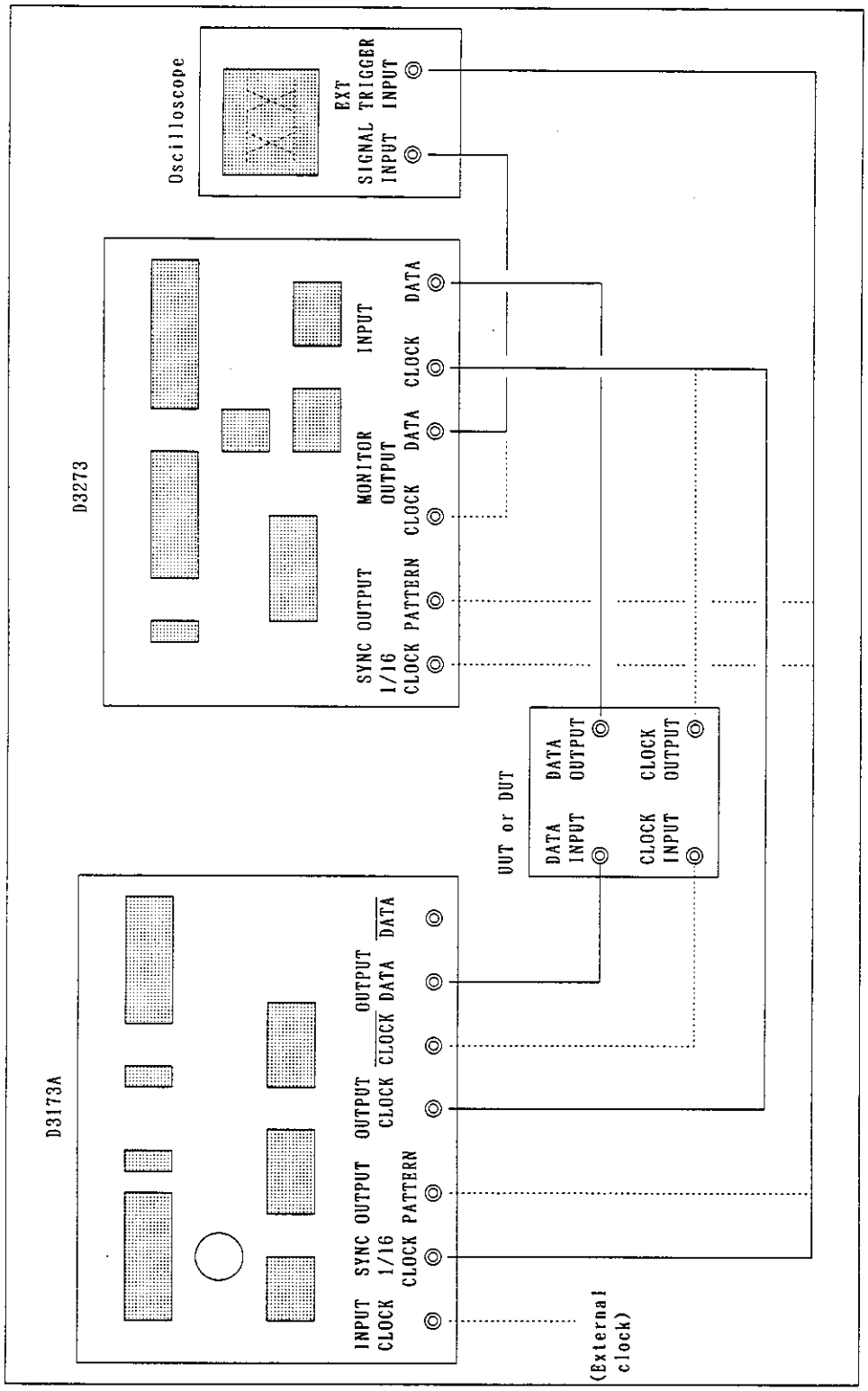


Figure 4-6 Signal Line Connection (D3173A)

MEMO

5. GENERAL-PURPOSE INTERFACE BUS (GPIB)

5.1 Introduction

The general-purpose interface bus (GPIB) is the interface system which connects the tester to the controller and/or the peripheral devices using a simple cable (bus line).

The GPIB is an easy-to-use interface system with higher expandability compared to other systems. In addition, it provides electrical, mechanical and functional compatibility with other manufacturers' products. Therefore, the GPIB can make up not only a simple system but an automatic instrumentation system using the single bus cable.

In the GPIB system, it is necessary to set the address of each component connected to the bus line. Each component may play one or more roles of the controller, talker and listener.

During operation of the system, only one talker can transmit data on the bus line while the listeners receive the data.

The controller specifies the addresses of the talker and the listeners. It transfers data from the talker to the listeners and sets the measuring conditions from itself (or the talker) to the listeners.

For data transfer among components of the system, eight data lines of the parallel/serial bit type are used for asynchronous two-way transmission. The asynchronous system allows high-speed and low-speed compound devices to be connected arbitrarily.

A collection of data (messages) sent and received among devices includes measurement data, measuring conditions (programs) and commands. The ASCII code is mainly used.

Beside the above mentioned eight data lines, the system includes three handshaking lines to control asynchronous data transfer among devices and five control lines to control the information flow on the bus.

- The following signals are used for the handshaking lines.

DAV (Data Valid)	:	Signal to indicate the data valid state
NRFD (Not Ready For Data)	:	Signal to indicate the data reception enabled state
NDAC (Not Data Accepted)	:	Signal to indicate the reception completion state

- The following signals are used for the control lines:

ATN (Attention) : This signal identifies whether the signal on the data line is an address, command or other information.

IFC (Interface Clear): Signal to clear the interface

EOI (End or Identify): Signal to be used on the termination of information transfer

SRQ (Service Request): Signal to cause an arbitrary device to present a request for services from the controller

REN (Remote Enable) : Signal to be used for remote control of a remote-programmable device

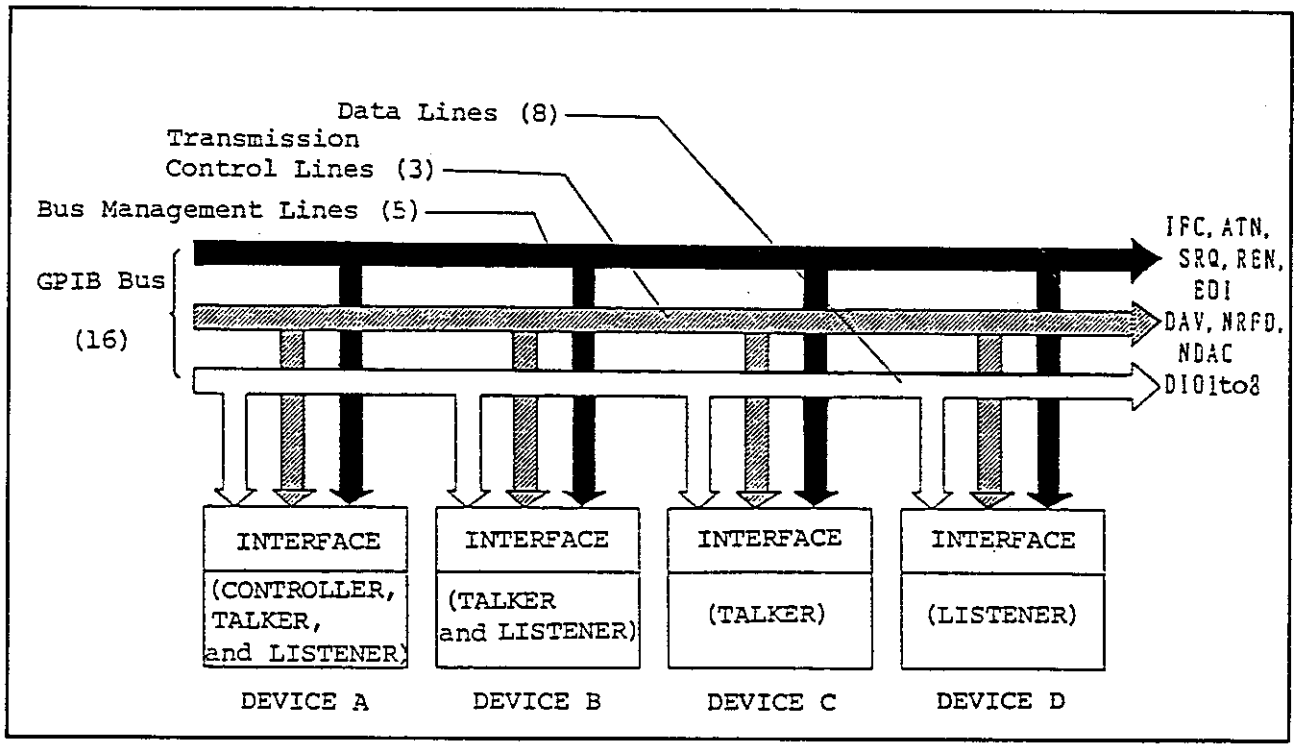


Figure 5-1 Outline of GPIB

5.2 Performance

5.2.1 GPIB Specifications

Governing specification: IEEE standard 488-1978

Available code : ASCII code and binary codes

Signal level : "High" state + 2.4 V or more
"Low" state + 0.4 V or less

Termination of signal conductors
: 16 bus lines are terminated as follows:

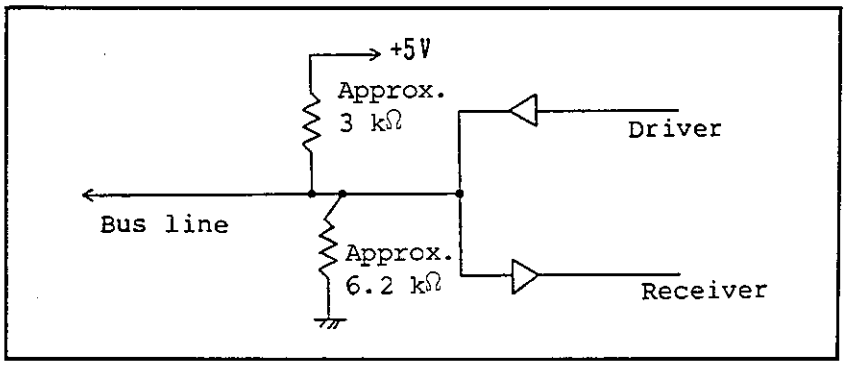


Figure 5-2 Termination of Signal Conductors

Driver specifications : Open collector system

"Low" state output voltage : +0.4 V or less, 48 mA
"High" state output voltage: +2.4 V or more, -5.2 mA

Receiver specifications: "Low" state at +0.6 V or less
"High" state at +2.0 V or more

Bus cable length : The length of each bus cable must not exceed: (the number of devices connected to the bus x 2 m) or 20 m in total.

Addressing : The address selection switch on the front panel allows
32 types of talk/listen addresses to be selected.

Connector : 24-pin GPIB connector, 57-20240-D35
(Equivalent to the product manufactured by Anphenol)

5.2.2 Interface Functions

Table 5-1 shows interface functions below:

Table 5-1 Interface Functions

Code	Functions and description
SH1	Source handshake function
AH1	Accepter handshake function
T6	Basic talker function, Serial poll function, Listener-specified talker cancel function
L3	Basic listener function, Talker-specified listener cancel function, Listen-only mode function
SR1	Service request function
RL1	Remote function
PP0	No parallel poll function
DC1	Device clear function (SDC and DCL commands are available.)
DT1	Device trigger function (GET command is available.)
C0	No controller function
E2	Use of three-state bus driver

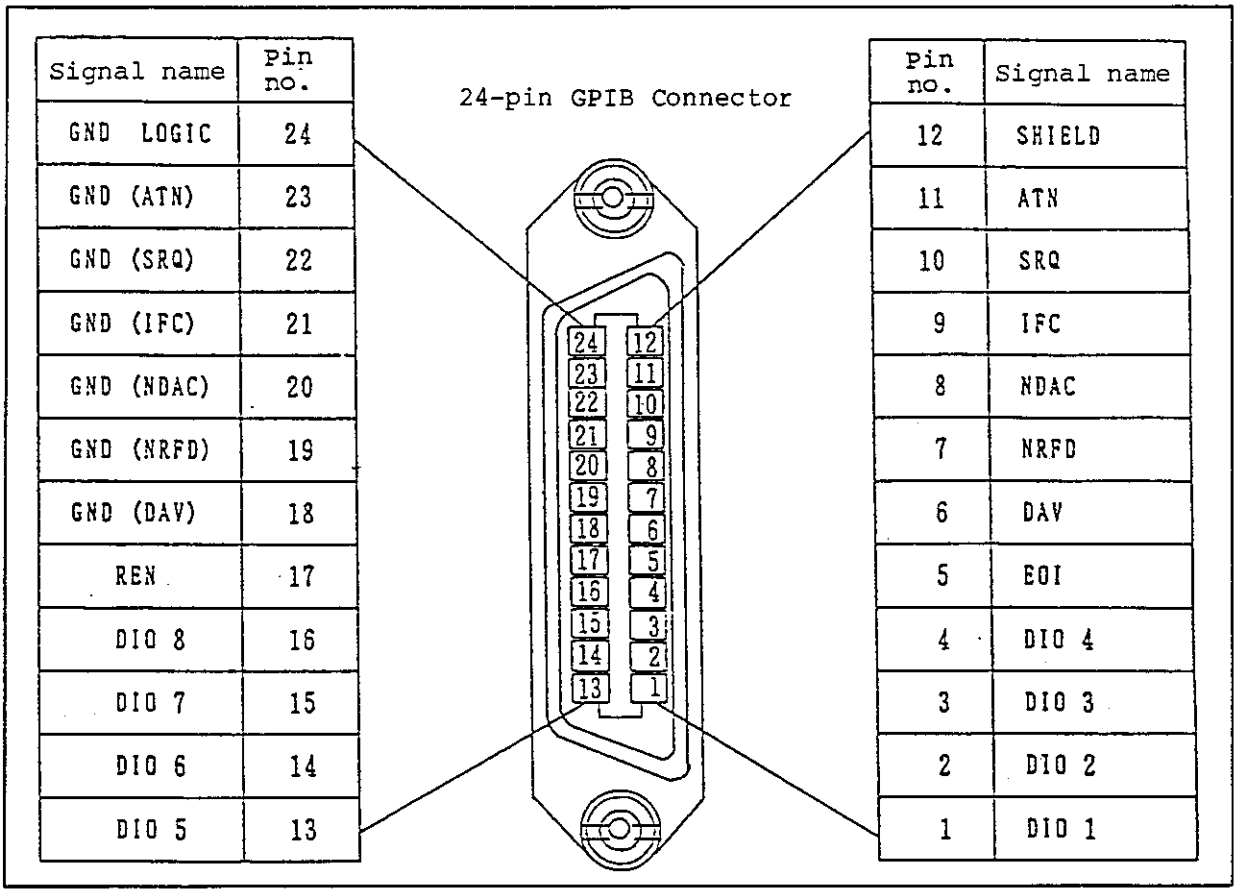


Figure 5-3 GPIB Connector Pin Assignment

5.3 Notes on Use of GPIB

This section explains the use of the GPIB.

(1) Connecting and Disconnecting the Cable

Before connecting or disconnecting the GPIB cable, turn off the power supply of every device connected to the cable. At the same time, check that the frames of the devices have been properly grounded with each another.

(2) Slave Operation

If any device except D3173 serves as a talker when the SLAVE switch on the front panel of the D3273 is on, the D3273 may malfunction and display an error message on the measuring result indicator in the front panel. When this happens, turn the power supply of the D3273 off to disconnect the talker from it or stop operation of the talker.

Note that if the IFC line of the bus goes low with no error message displayed and the SLAVE switch on, the SLAVE switch will be turned off to stop slave operation.

(3) ATN Interrupt During Message Transfer

If an ATN request interrupts a transfer of messages between devices, the ATN takes priority and the previous state is cleared.

5.4 Device Address Setting Procedure

Set the device address of the D3273 error detector by using the ADDRESS DISP key at the left lower end of the front panel and the ◁ , ▷ , △ , and ▽ keys at the bottom of the ADDRESS number indicator of the pattern setting block.

The pattern address and device address are switched to each other on the ADDRESS number indicator whenever you press the ADDRESS DISP key.

When the device address is displayed, the lamp lights on the ADDRESS DISP key and C P - ; b is displayed on the BIT LENGTH indicator of the pattern setting block.

To set the device address, select the digit to change by using the ◁ and ▷ keys at the bottom of the ADDRESS number indicator, and change the digit value by using the △ and ▽ keys.

You can set the device address within the range of 0 to 30. Take care not to overlap the device address of the error detector and another device on the same bus.

5.5 Listener Format (Program Code)

This section describes the program code when this equipment is remote controlled using the GPIB controller.

5.5.1 Basic Format

The ASCII code is used generally in the program code for the remote control, but the binary code can also be used to set the work pattern.

Although comma (,) is used as a string delimiter when the ASCII code is used, the string delimiter can be omitted unless otherwise specified especially.

(Example): "ERC, STT"⟶"ERCSTT"

When the ASCII code is used, the following codes and uni line signal EOI (END OR IDENTIFY) can be used as the record delimiter:

(a) CR, LF [+EOI]
Key in CR (ASCII code: 13) and then LF (ASCII code: 10). EOI can be added simultaneously with LF.

(b) LF [+EOI]
Key in LF (ASCII code: 10).
EOI can be added simultaneously with LF.

(c) CR+EOI
Add EOI simultaneously with CR (ASCII code: 13).

(d) EOI
Add EOI simultaneously with the last byte of the program code.

The uni line signal EOI only can be used as the record delimiter when the binary code is used.

The length of program code which can be received by this equipment at one time is 128 characters max. except when the word pattern is set. (This includes the string delimiters, but not record delimiters.)

When the program code is longer than this, and when any invalid code is included in the program code, it becomes a SYNTAX error.

When the SYNTAX error occurs, the subsequent codes up to a record delimiter are ignored.

5.5.2 Parameter Setting Format

Parameter	Code	Contents	Initial value
(1) Pattern setting block			
PATTERN MODE	WORD	Word pattern (WORD)	WORD
	PRBS	Pseudo random pattern (PRBS)	
BIT LENGTH	BLddddd	ddddd = Bit length (1 to 65,536 bits)	BL16 (except memory numbers A and C)
ADDRESS number	ADRdddddd	dddddd = Address number (0 to 524,287)	ADR0
WORD PATTERN (in hexa-decimal)	WPaaaa,nnn, dd...	aaaa = First address of pattern string (0 to 4,095) nnn = No. of characters of pattern string (1 to 128) dd... = Hexadecimal pattern string (consisting of 0 to 9 and A to F characters)	WP0, 4, AAAA (Output pattern and odd numbered memory contents) WP0, 4, 5555 (Even numbered memory contents)
WORD PATTERN (in binary mode)	BINaaaa,nnnn dl bb...	aaaa = First address of pattern string (0 to 4,095) nnn = No. of bytes of pattern string (1 to 8,192) dl = Record delimiter (CR+LF(+EOI), LF(+EOI), CR(+EOI), (EOI)) bb... = Binary data of certain bytes	WP0, 4, AAAA (Output pattern and odd numbered memory contents) WP0, 4, 5555 (Even numbered memory contents)
WORD POLARITY	WPN	Normal polarity (NORMAL)	WPN
	WPI	Inverse polarity (INVERSE)	
MEMORY STORE	WMSd	d = Memory number (0 to 9)	None
MEMORY RECALL	WMRd	d = Memory number (0 to 9 and A to C)	None

(cont'd)

Parameter	Code	Contents	Initial value
PRBS 2^N -1	PBdd, 0	dd = No. of stages (N): 7, 9, 10, 11, 15, 17, 20, 23 Note: ",0" may be omitted.	PB15
PRBS 2^N	PBdd, 1	dd = No. of stages (N); 7, 9, 10, 11	None
MARK RATIO	MR0/8	Mark ratio 0/8	MR1/2
	MR1/8	Mark ratio 1/8	
	MR1/4	Mark ratio 1/4	
	MR1/2	Mark ratio 1/2	
	MR1/2B	Mark ratio 1/2B	
	MR3/4	Mark ratio 3/4	
	MR7/8	Mark ratio 7/8	
	MR8/8	Mark ratio 8/8	
(2) Measuring block			
MEASUREMENT FUNCTION	ERR	Error rate	ERR
	ERC	Error count	
	ES	Error second (ES)	
	EFS	Error free second (EFS)	
	FRQ	Frequency (FREQ in MHz)	

(cont'd)

Parameter	Code	Contents		Initial value
DISPLAY FORM	PRG	PROGRESSIVE value	During error rate measurement	PRG
	IMD	IMMEDIATE value		
	EXP	EX-PONENTIAL	During error count measurement	EXP
	INT	INTEGRAL		
	PTON	%	During ES or EFS measurement	PTON
	PCT			
	PTOF	Seconds		
	SEC			
ERROR DISPLAY MODE	OMI	OMIT error		TOT
	INS	INSERT error		
	TOT	TOTAL error		
MEASUREMENT MODE	IND	Individual measuring mode		IND
	SIM	Simultaneous measuring mode		
CURRENT DATA	CDON	CURRENT DATA display on		CDON
	CDOF	CURRENT DATA display off		
BIT ERROR RATE RANGE	RNG-dd	dd = Absolute value of range exponent (5 to 14)		RNG-8
	RNGdd			
DISPLAY RATE	FST	FAST		FST
	MED	MED		
	SLW	SLOW		
	HLD	HOLD		

(cont'd)

Parameter	Code	Contents	Initial value
MEASUREMENT CONTROL	STT	Start of measurement. Equivalent to the GET command. The current measurement is stopped and another measurement starts. The history is also reset.	None
	E		
	RST	Restart of measurement. Equivalent to the STT code during measurement. If the measurement is stopped, only the history is reset.	
	STP	Stop of measurement	
AUTO SYNC	ASON	AUTO SYNC on	ASON
	ASOF	AUTO SYNC off	
SYNC	SYN	Restart of synchronization	None
BUZZER	BZON	The buzzer sounds.	BZON
	BZOF	The buzzer stops.	
DELAY	DLYsd.dd	sd.dd = Delay (in nanoseconds) between -1.00 and +1.00. Note: The positive sign (+) of polarity may be a space or omitted.	DLY0
	DLYsdddd	sdddd = Delay (in picoseconds) between -1000 and +1000. Note: The positive sign (+) of polarity may be a space or omitted. The 1 ps digit is truncated.	

(cont'd)

Parameter	Code	Contents	Initial value
DELAY UNIT	DLYNS	In nanoseconds unit	DLYNS
	DLYPS	In picoseconds unit	
THRESHOLD LEVEL	TLVLsd. ddd	sd.ddd = Threshold level -1.999 to +1.999 (Vdc) for 0V termination -0.750 to -1.850 (Vdc) for -2V termination Note: The positive sign (+) of polarity may be a space or omitted.	TLVL-0.5 (for DGND) TLVL-1.3 (for DM2V)
INPUT POLARITY	MPN	Positive logic (NORMAL)	MPN
	MPI	Negative logic (INVERSE)	
AUTO SEARCH	SRHGO	Operation start (START)	
	SRHST	Operation stop (STOP(CANCEL))	
(3) Input block			
TERMINATOR DATA	DGND	0 Vdc termination (TO 0V)	DGND
	DM2V	-2 Vdc termination (TO -2V)	
TERMINATOR CLOCK	CGND	0 Vdc termination (TO 0V)	CGND
	CM2V	-2 Vdc termination (TO -2V)	
(4) Timer/clock block			
TIME DISPLAY	RTU	Realtime upper digit display (YEAR:MONTH:DAY:HOUR)	RTL
	YMDH		
	RTL	Realtime lower digit display (DAY:HOUR:MINUTE:SECOND)	
	DHMS		
	ELP	ELAPSED time	
	TMD	TIMED remaining time	
	PRS	PRESET measuring period	

(cont'd)

Parameter	Code	Contents	Initial value
REALTIME SET	RTS␣yy:mm:dd:hh:nn:ss YMDHMS␣yy:mm:dd:hh:nn:ss	yy = Year (0 to 99) mm = Month (1 to 12) dd = Day (1 to 31) hh = Hours (0 to 23) nn = Minutes (0 to 59) ss = Seconds (0 to 59) Note: "␣" is a space and it may be omitted.	None
	RTU␣yy:mm:dd:hh YMDH␣yy:mm:dd:hh	yy = Year (0 to 99) mm = Month (1 to 12) dd = Day (1 to 31) hh = Hours (0 to 23) Note: "␣" is a space and it may be omitted.	None
	RTL␣dd:hh:nn:ss DHMS␣dd:hh:nn:ss	dd = Day (1 to 31) hh = Hours (0 to 23) nn = Minutes (0 to 59) ss = Seconds (0 to 59) Note: "␣" is a space and it may be omitted.	None
MEASUREMENT TIME PRESET	PRS␣dd:hh:nn:ss	dd = Day (0 to 99) hh = Hours (0 to 23) nn = Minutes (0 to 59) ss = Seconds (0 to 59) Note: "␣" is a space and it may be omitted.	PRS␣00:00:00:00
TIMER MODE	SIN	SINGLE timer mode	SIN
	REP	REPEAT timer mode	
	UTM	UNTIMED timer not used	
(5) Control block			
PANEL LOCK	PLKON	PANEL LOCK on	PLKOF
	PLKOF	PANEL LOCK off	

(cont'd)

Parameter	Code	Contents	Initial value
INITIALI-ZATION	C	Initializes the operation. (CLEAR) Equivalent to the SDC or DCL command.	Z
	Z	Initializes each parameter and executes the same processing as C code.	
(6) GPIB parameters			
OUTPUT DATA	MES	Measurement data	MES
	TIM	Time data	
HEADER	HDON	Turns on the HEADER.	HDON
	HDOF	Turns off the HEADER.	
RECORD DELIMITER	DL0	Outputs two-byte CR and LF, and EOI uni line signal.	DL0
	DL1	Outputs one-byte LF only.	
	DL2	Outputs the last byte of send data and EOI uni line signal simultaneously.	
SRQ TRANSMISSION	S0	Allows to transmit an SRQ.	S1
	S1	Does not transmit an SRQ.	
STATUS BYTE MASK	MSdd	dd = Mask bit pattern (0 to 63) Note: When a decimal "dd" is converted into binary data, bits 0 of the status byte are masked and they are fixed to zeros.	MS63

5.5.3 Reading the Setup Parameters

The output interrogated parameter (OP) code and the "?" code are used to read any parameter set for the D3273 error detector and to send it to the GPIB controller. Usually, such codes are called queries. The D3273 can use both types.

If the D3273 error detector is specified to be the talker after it has received a query, the detector sends the current set value of the parameter specified by the query.

After the detector has sent the set value, it returns to the normal measuring data or time data send mode until it receives the next query. The set value of the send parameter has the same "format of the parameter as explained" in Section 5.5.2.

The queries allow to read the history clock error, sync error status, and product ID.

When receiving an "OP" only, the D3273 sends the set value of the same parameter as specified by the previous query if it is specified as the talker.

Parameter	Query	Send code	Contents
(1) Pattern setting block			
PATTERN MODE	"PM?" or "OPPM"	WORD	Word pattern (WORD)
		PRBS	Pseudo random pattern (PRBS)
BIT LENGTH	"BL?" or "OPBL"	BLddddd	ddddd = Bit length (00001 to 65,536 bits)
ADDRESS number	"ADR?" or "OPADR"	ADRdddddd	dddddd = Address number (000000 to 524,287)
WORD PATTERN (in hexa-decimal)	"WPaaaa,nnn?" or "OPWPaaaa,nnn"	WPaaaa,nnn,dd...	aaaa = First address of pattern string (0000 to 4,095) nnn = No. of characters of pattern string (001 to 128) dd... = Hexadecimal pattern string (consisting of 0 to 9 and A to F characters)
WORD PATTERN	"WP?" or "OPWP"	WPN	Normal polarity (NORMAL)
		WPI	Inverse polarity (INVERSE)

(cont'd)

Parameter	Query	Send code	Contents	
MEMORY STORE	"WM?" or "OPWM"	WMd	d = Memory number (0 to 9, A to C)	
PRBS	"PB?" or "OPPB"	PBdd,m	dd = No. of stages (N): 7, 9, 10, 11, 15, 17, 20, 23 m = Bit length 2^{N-1} (N=7 to 23): 0 2^{N} (N=7 to 11): 1	
GENERATE POLYNOMIAL PRBS $2^{15}-1$	"PN?" or "OPPN"	PN0	$X^{15}+X^{14}+1$ (CCITT Rec. 0.151)	
		PN1	$X^{15}+X^{1}+1$	
MARK RATIO	"MR? or "OPMR"	MR0/8␣	Mark ratio 0/8	"␣" is a space.
		MR1/8␣	Mark ratio 1/8	
		MR1/4␣	Mark ratio 1/4	
		MR1/2␣	Mark ratio 1/2	
		MR1/2B	Mark ratio 1/2bar	
		MR3/4␣	Mark ratio 3/4	
		MR7/8␣	Mark ratio 7/8	
		MR8/8␣	Mark ratio 8/8	
(2) Measuring block				
MEASUREMENT FUNCTION	"MF?" or "OPMF"	ERR	Error rate	
		ERC	Error count	
		ES␣	Error second (ES) ("␣" is a space.)	
		EFS	Error free second (EFS)	
		FRQ	Frequency (FREQ in MHz)	

(cont'd)

Parameter	Query	Send code	Contents	
DISPLAY FORM	"DF?" or "OPDF"	PRG	PROGRESSIVE value	During error rate measurement
		IMD	IMMEDIATE value	
	"FMT?" or "OPFMT"	EXP	EXPONENTIAL	During error count measurement
		INT	INTEGRAL	
	"PT?" or "OPPT"	PTON	%	During ES or EFS measurement
		PTOF	Seconds	
ERROR DISPLAY MODE	"DM?" or "OPDM"	OMI	OMIT error	
		INS	INSERT error	
		TOT	TOTAL error	
MEASUREMENT MODE	"MM?" or "OPMM"	IND	Individual measuring mode	
		SIM	Simultaneous measuring mode	
CURRENT DATA	"CD?" or "OPCD"	CDON	CURRENT DATA display on	
		CDOF	CURRENT DATA display off	
BIT ERROR RATE RANGE	"RNG?" or "OPRNG"	RNG-dd	dd = Absolute value of range exponent (05 to 14)	
DISPLAY RATE	"DR?" or "OPDR"	FST	FAST	
		MED	MED	
		SLW	SLOW	
		HLD	HOLD	
AUTO SYNC	"AS?" or "OPAS"	ASON	Turns on AUTO SYNC mode.	
		ASOF	Turns off AUTO SYNC mode.	

(cont'd)

Parameter	Query	Send code	Contents
BUZZER	"BZ?" or "OPBZ"	BZON	The buzzer sounds.
		BZOF	The buzzer stops.
DELAY	"DLY?" or "OPDLY"	DLYsd.dd	sd.dd = Delay (in nanoseconds) between -1.00 to ␣1.00. ("␣" is a space.)
		DLYsdddd	sdddd = Delay (in picoseconds) between -1000 to ␣1000 ("␣" is a space. The delay in every 10 ps steps.)
DELAY UNIT	"DLYU?" or "OPDLYU"	DLYNS	In nanoseconds
		DLYPS	In picoseconds
THRESHOLD LEVEL	"TLVL?" or "OPTLVL"	TLVLsd.ddd	sd.ddd = Threshold level -1.999 to ␣1.999 (Vdc) for 0V termination -0.750 to -1.850 (Vdc) for -2V termination
INPUT POLARITY	"MP?" or "OPMP"	MPN	Positive logic (NORMAL)
		MPI	Negative logic (INVERSE)
(3) Input block			
TERMINATOR DATA	"TD?" or "OPTD"	DGND	0 Vdc termination (TO 0V)
		DM2V	-2 Vdc termination (TO -2V)
TERMINATOR CLOCK	"TC?" or "OPTC"	CGND	0 Vdc termination (TO 0V)
		CM2V	-2 Vdc termination (TO -2V)

(cont'd)

Parameter	Query	Send code	Contents
(4) Timer/clock block			
TIME DISPLAY	"TM?" or "OPTM"	RTU	Realtime upper digit display (DAY:MONTH:DAY:HOUR)
		RTL	Realtime lower digit display (YEAR:HOUR:MINUTE:SECOND)
		ELP	ELAPSED time
		TMD	TIMED remaining time
		PRS	PRESET measuring period
TIMER MODE	"TR?" or "OPTR"	SIN	SINGLE timer mode
		REP	REPEAT timer mode
		UTM	UNTIMED timer not used
(5) Control block			
PANEL LOCK	"PLK?" or "OPPLK"	PLKON	Turns on PANEL LOCK.
		PLKOF	Turns off PANEL LOCK.
(6) GPIB parameters			
OUTPUT DATA	"OD?" or "OPOD"	MES	Measurement data
		TIM	Time data
HEADER	"HD?" or "OPHD"	HDON	Turns on the HEADER.
		HDOF	Turns off the HEADER.
RECORD DELIMITER	"DL?" or "OPDL"	DL0	Outputs two-byte CR and LF, and EOI uni line signal.
		DL1	Outputs one-byte LF only.
		DL2	Outputs the last byte of send data and EOI uni line signal simultaneously.

(cont'd)

Parameter	Query	Send code	Contents
SRQ TRANSMISSION	"S?" or "OPS"	S0	Allows to transmit an SRQ.
		S1	Does not transmit an SRQ.
STATUS BYTE MASK	"MS?" or "OPMS"	MSdd	dd = Mask bit pattern (00 to 63) Note: When a decimal "dd" is converted into binary data, bits 0 of the status byte are masked and they are fixed to zeros.

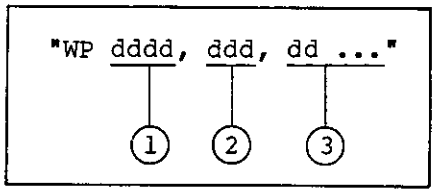
(7) Other states

			Sync error	Clock error	Data error
HISTORY	"HST?" or "OPHST"	HST0	None	None	None
		HST1	None	None	Exist
		HST2	None	Exist	None
		HST3	None	Exist	Exist
		HST4	Exist	None	None
		HST5	Exist	None	Exist
		HST6	Exist	Exist	None
		HST7	Exist	Exist	Exist

IDENTIFI-CATION	"IDN?" or "OPIDN"	ADVANTEST,D3273, REV␣add	add = Product version No. (A00 to Z99)

5.5.4 Word Pattern Setting (Hexadecimal Mode)

There are two ways available in setting the work pattern from the GPIB to this equipment, one being the hexadecimal mode (ASCII code) and the other, the binary mode. This subsection describes the format of the hexadecimal mode.



① Head address to which the pattern is set (decimal)

0 to 4095

② Number of characters of the set pattern character string (decimal)

1 to 128

③ Pattern character string (hexadecimal)

Transmit as many characters as specified by ② in combination of characters 0 to 9 and A to F in order of the leading bit (bit 1) of the head address specified by ①.

A 4-bit pattern is set per character, and when each character is expressed with the binary code, the LSB (the least significant bit) is assigned as the closer bit to the leading bit.

(Example) Code : "WP 12, 5, E4BA2"

Result:

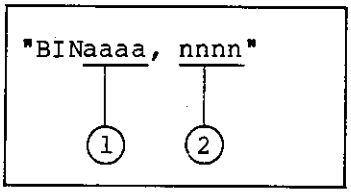
Bit / Address	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
12	0	1	1	1	0	0	1	0	1	1	0	1	0	1	0	1
13	0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	X

X indicates a bit with no change.

5.5.5 Word Pattern Setting (Binary Mode)

This subsection describes how to set the word pattern in the binary mode. It is set in the binary mode in two steps as follows:

(Step 1)
The binary mode specify at ASCII code, head address, and the number of bytes.



(1) Head address to which the pattern is set (decimal)

0 to 4095

(2) Number of bytes of the pattern to be set (decimal)

1 to 8192

A delimiter (see Section 5.5.1, "Basic Format") is allocated after this to end the processing once.

(Step 2)
Transmit the 8-bit binary code character string after step 1 for as many bytes as specified by (2) in order from the leading bit (bit 1) of the head address specified by (1) in step 1. An 8-bit pattern is set per byte and the LSB (the least significant bit) of these eight bits is assigned as the closer bit to the leading bit.

Add the uni line signal EOI (END OR IDENTIFY) to the last byte.

Upon receipt of the EOI or the number of bytes specified in (2), the pattern transfer ends, to return to the routine ASCII code reception mode.

(Example) Code: "BIN 12, 3"

Binary code (in decimal notation): 78, 171, and 2

Result:

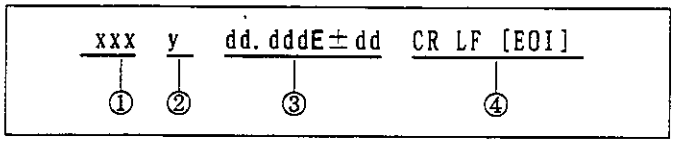
Bit / Address	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
12	0	1	1	1	0	0	1	0	1	1	0	1	0	1	0	1
13	0	1	0	0	0	0	0	0	X	X	X	X	X	X	X	X

X indicates a bit with no change.

5.6 Talker Format

5.6.1 Format of Measuring Data

This section explains the measuring result output format. When the "MES" send data code is sent to the D3273 error detector, it transmits the measuring results.



① Main header (3-digit alphabetic character or omitted)

The measuring functions are listed below. They are not transmitted when the header is turned off.

Main header	Measuring function
ERR	Error rate
ERC	Error count
ES_	Error second (ES)
EFS	Error free second (EFS)
FRQ	Frequency

② Subheader (1-digit alphabetic symbol or omitted)

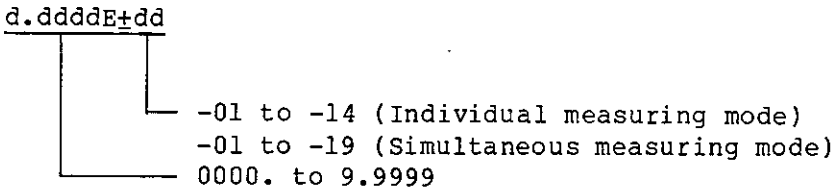
The subheader indicates whether the overflow of measured value is detected or not. It is not transmitted if the subheader is turned off.

Subheader	Overflow
_	Exist
*	None

③ Measured Value

Although a measured value can be divided into the mantissa part (dd.ddd) and exponential part (E±dd), the number of digits and the existence or absence of decimal point position and exponential part vary according to the measurement function selected and display format.

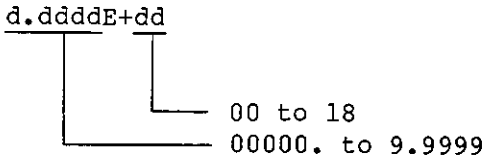
(a) ERROR RATE (main header: ERR)



If the measurement is overflowed, "9.9999E+00" is set.

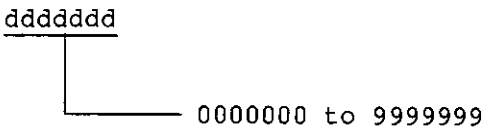
(b) ERROR COUNT (main header: ERC)

(i) Exponential format



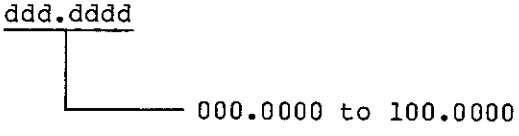
If the measurement is overflowed, "9.9999E+19" is set.

(ii) Integer format



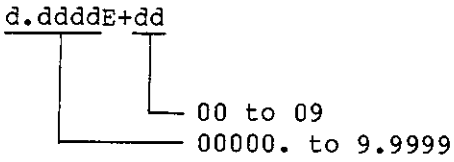
(c) ES and EFS (main header: "ES_" or "EFS")

(i) Percent display



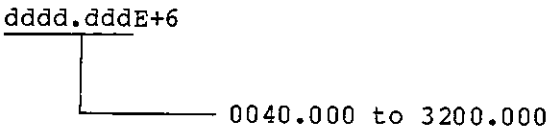
If the measurement is overflowed, "999.9999" is set.

(ii) Second display



If the measurement is overflowed, "9.9999E+19" is set.

(d) FREQ frequency (main header: FRQ)



If the measurement is overflowed, "9999.999E+6" is set.

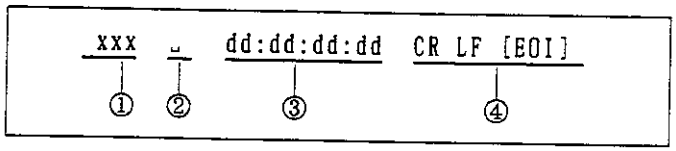
④ Record delimiter

Indicates the end of data. The code which has been set as the send record delimiter (DL0, DL1, or DL2) is sent.

5.6.2 Time Data Format

This section explains the time data send format of the D3273 error detector.

When the "TIM" send data set code is sent to the D3273, it transmits the time data.



① Main Header (3-digit alphabetic character or omitted)

This header indicates the type of data.
This is not transmitted when the header is set to OFF.

Main header	Type of data
RTU	REAL TIME YEAR:MONTH:DAY:HOUR
RTL	REAL TIME DAY:HOUR:MIN:SEC
ELP	MEASUREMENT TIME ELAPSED
TMD	MEASUREMENT TIME TIMED
PRS	MEASUREMENT TIME PRESET

② Sub-Header (1-digit symbol or omitted)

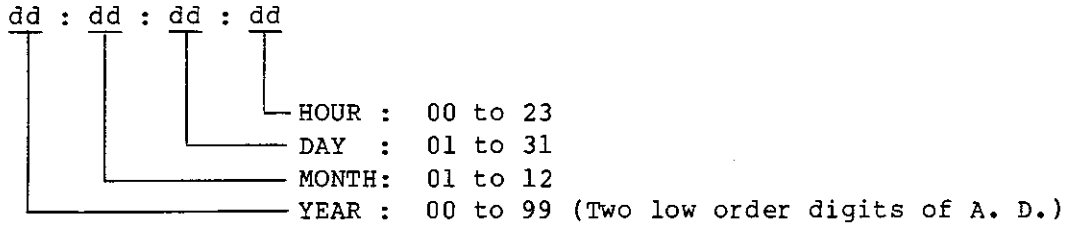
This header indicates whether the data overflow is detected or not.
It always becomes no overflow when the type of data is not ELP.
This data is not transmitted when the header is set to OFF.

Sub-header	Overflow detected or not
␣ (space)	No overflow detected
*	Overflow detected

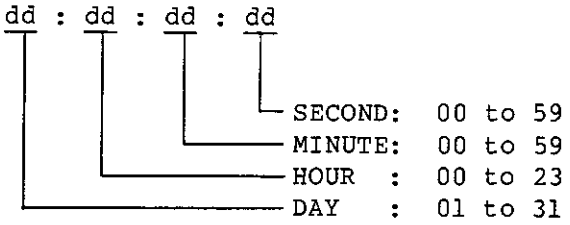
③ Time Data

The time data is transmitted with alphanumeric characters delimited every two digits with colon (:).

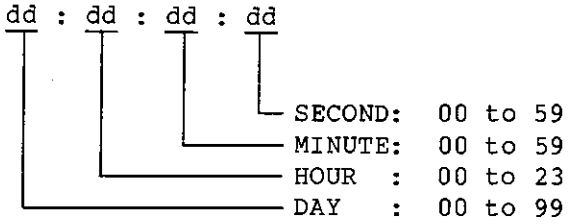
(a) REAL TIME YEAR:MONTH:DAY:HOUR (main header: RTU)



(b) REAL TIME DAY:HOUR:MIN:SEC (main header: RTL)



(c) MEASUREMENT TIME of ELAPSED, TIMED or PRESET
(main header: ELP,TMD,or PRS)



The ELAPSED and TIMED data when the measurement function is error rate or frequency in the individual measuring mode, and the TIMED data when the measurement is not started yet or when the automatic measurement stop function of the timer is not used are as follows:

--:--:--:--

If the ELP data is overflowed, the ELP data becomes "99:99:99:99".

④ Record delimiter

Indicates the end of data. The code which has been set as the send record delimiter (DL0, DL1, or DL2) is sent.

5.6.3 Format of Parameter Read by Query

The transmission format of parameters transmitted by the OP code or ? code (query) is the same as that of the parameter setting in Section 5.5.2. The leading 0 in the parameter set value is not omitted, but 0 is always transmitted.
For further details, see "Parameter Setting Format" in Section 5.5.2 and "Set Parameter Reading (Using OP and ? Codes)" in Section 5.5.3.

5.7 Service Request and Status Byte

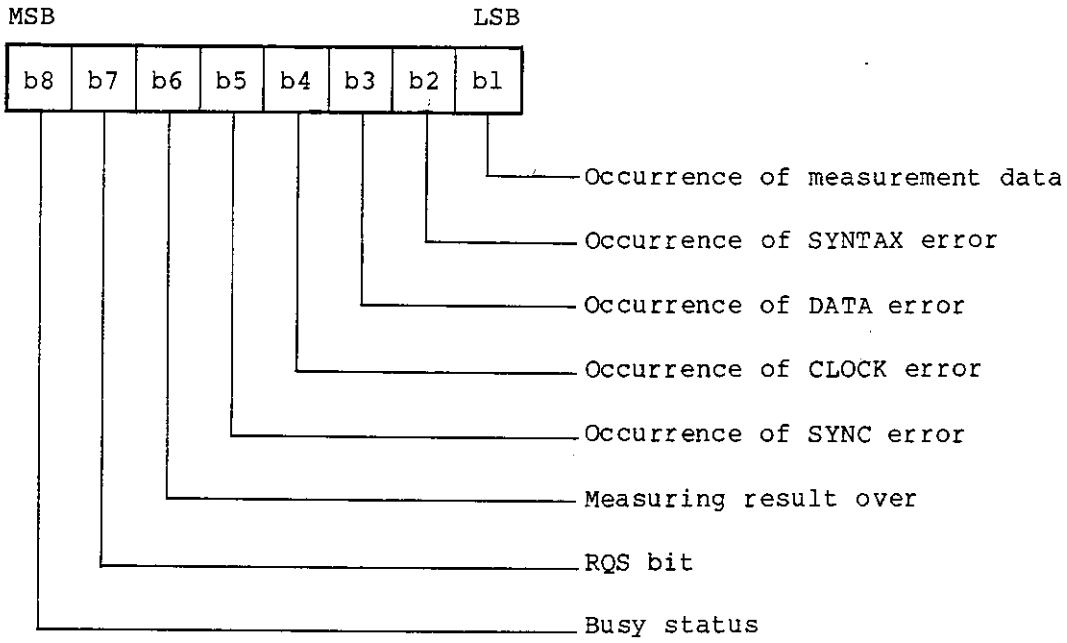
This equipment indicates the status like the end of measurement, out of synchronism (SYNC error) etc. with the status byte.

In addition, it can transmit the service request signal (SRQ) for the GPIB controller when these factors occur.

5.7.1 Status Byte

The status byte is composed of eight bits as shown below:

Upon receipt of the SPE command from the controller through the execution of the serial polling, this equipment transmits this status byte when specified as the talker.



(1) Bit b_1 (Generation of measured data)

This bit is set to "1" when the measured data to be transmitted at the end of a measurement is generated.

It is cleared to "0" when the transmission of the measured data ends.

(2) Bit b_2 (Occurrence of SYNTAX error)

This bit is set to "1" when an undefined program code is received, when a parameter value in the program code is out of the tolerable range, and when the program code is too long.

It is cleared to "0" when the valid program code is received.

(3) Bit b_3 (Occurrence of DATA error)

This bit is set to "1" when a bit error is detected in the input data, and is reset to "0" when no bit error is detected any more.

(4) Bit b_4 (Occurrence of CLOCK error)

This bit is set to "1" when there is no CLOCK input, or when the frequency of the CLOCK input is too low. This bit is cleared to "0" when CLOCK returns to normal status.

(5) Bit b_5 (Occurrence of SYNC error)

This bit is set to "1" when the pattern goes out of synchronism, and is cleared to "0" when pattern synchronism is established.

(6) Bit b_6 (measuring result over)

This bit is set to "1" when the measuring result is over. This bit is cleared to "0" when the measuring result is normal or at the end of measuring data output.

(7) Bit b_7 (RQS bit)

This bit is set to "1" when one of bits b1 to b6 becomes 1. It is cleared to zero when all of them become "0".

(8) Bit b_8 (BUSY status)

This bit is set to "1" while the delay of CLOCK input is being set or some setting is being changed on the pattern setting block. On completion of the setting or changing, it is cleared to "0". This bit does not cause service request to be generated.

5.7.2 Service Request (SRQ)

When the bit RQS of the status byte is set to "1" and this equipment is set to the "S0" mode, this equipment transmits the uni line signal SRQ (SERVICE REQUEST) to report it to the GPIB controller.

The SRQ is cleared when a serial polling is executed.

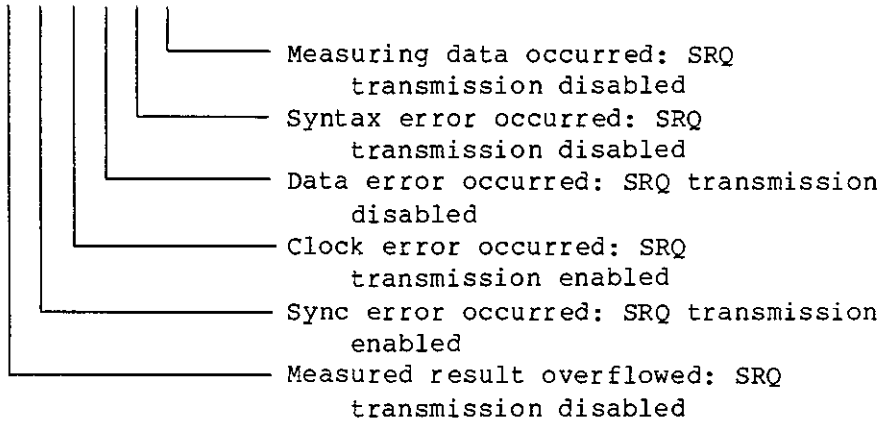
5.7.3 Mask of Status Byte

The D3273 can mask unnecessary bits of bits b1 to b6 of the status byte. This allows to transmit an SRQ due to the required cause only.

To mask the status byte, use the "MSdd" program code. "dd" is a decimal value of 0 to 63. When it is converted into 6-digit binary data, certain bits correspond to it. The status byte of these bits are fixed to zero (0).

Example: MS24

Binary value: 0 1 1 0 0 0



In this example, the RQS bit (b6) is set only when a clock error or sync error has occurred, and a service request can be issued.

5.8 Device Trigger (GET Command)

If the measuring function is in the individual measuring mode for Error Count, ES or EFS or in the simultaneous measuring mode, you can start the measurement by using the GET command. The GET command functions the same as the program code "STT" or "E".

5.9 Device Clear (SDC/DCL Command)

Upon receipt of the SDC or DCL command, this equipment initializes the operation. The SDC or DCL command functions the same as the program code "C".

5.10 Initial Status

5.10.1 Initial Status Setup

When receiving the SDC command or DLC command, or when receiving program code "C" or "Z", the D3273 initializes its operations as follows:

(1) Measuring status

In the Error Rate or Frequency measurement in the individual measuring mode, the measurement is terminated and another measurement starts.

The measurement is stopped in the individual measuring mode for Error Count, ES, or EFS or in the simultaneous measuring mode. However, no measured data is generated.

(2) Status byte

All bits are cleared to zero (0).

(3) Service request

The D3273 is set to the "S1" mode, and the SRQ is cleared.

(4) Query

Canceled.

(5) Word pattern setting mode

The binary mode is released.

However, the mode cannot canceled by the "C" or "Z" program code.

(6) History

The history of clock error, sync error and data error is reset.

5.10.2 Parameter Initial Value

The "Z" program code initializes each parameter to those listed on the table (see the parameter setting format of Section 5.5.2).

5.11 Sample Programs

This section describes sample programs for reference to GPIB program generation. They are assumed to be written in BASIC on an HP9000 series 300 manufactured by Hewlett-Packard Co., as a controller.

5.11.1 Parameter Setting

This program measures an error rate after optimizing the phase to data input by varying the delay of CLOCK input.

Note that the threshold level must be set to the optimum point in advance.

Program list

```
1000   Erd=703
1010   OUTPUT Erd;"ASON ERR TOT'
1020   !
1030 Begin: !
1040   Dly=0
1050   GOSUB Dly
1060   IF Se=0 THEN GOTO Se0
1070   !
1080 Sel: !
1090   LOOP
1100     Dly=PROUND(Dly+.01,-2)  ! INCREMENT AND ROUND TO d.dd
1110   EXIT IF Dly>1
1120     GOSUB Dly
1130   EXIT IF Se=0
1140   END LOOP
1150   IF Dly>1 THEN GOTO Sel1
1160   Dly1=Dly
1170   !
1180   LOOP
1190   EXIT IF Dly=1
1200     Dly=PROUND(Dly+.01,-2)  ! INCREMENT AND ROUND TO d.dd
1210     GOSUB Dly
1220   EXIT IF Se=1
1230   END LOOP
1240   Dly2=Dly
1250   GOTO Fin
1260   !
1270 Sel1: !
1280   Dly=0
1290   LOOP
1300     Dly=PROUND(Dly-.01,-2)  ! DECREMENT AND ROUND TO d.dd
1310   EXIT IF Dly<-1
1320     GOSUB Dly
1330   EXIT IF Se=0
1340   END LOOP
```

(cont'd)

```
1350   IF Dly<-1 THEN GOTO Error
1360   Dly2=Dly
1370   !
1380   LOOP
1390   EXIT IF Dly=-1
1400     Dly=PROUND(Dly-.01,-2)  ! DECREMENT AND ROUND TO d.dd
1410     GOSUB Dly
1420   EXIT IF Se=1
1430   END LOOP
1440   Dly1=Dly
1450   GOTO Fin
1460   !
1470 Se0: !
1480   LOOP
1490   EXIT IF Dly=1
1500     Dly=PROUND(Dly+.01,-2)  ! INCREMENT AND ROUND TO d.dd
1510     GOSUB Dly
1520   EXIT IF Se=1
1530   END LOOP
1540   Dly2=Dly
1550   !
1560   Dly=0
1570   LOOP
1580   EXIT IF Dly=-1
1590     Dly=PROUND(Dly-.01,-2)  ! DECREMENT AND ROUND TO d.dd
1600     GOSUB Dly
1610   EXIT IF Se=1
1620   END LOOP
1630   Dly1=Dly
1640   GOTO Fin
1650   !
1660 Fin: !
1670   Dly=PROUND(Dly1+Dly2)/2,-2)  ! GET CENTER POSITION
1680   GOSUB Dly
1690   IF Se=1 THEN GOTO Re_try
1700   ENTER Erd;Err
1710   PRINT USING "15A,MD.2D,X,K";"DELAY WIDTH  :",Dly2-Dly1,"ns"
1720   PRINT USING "15A,MD.2D,X,K";"DELAY CENTER :",Dly,"ns"
1730   PRINT USING "15A,2D.4DE";"ERROR RATE   :";Err
1740   PRINT "Completed"
1750   STOP
1760   !
1770 Re_try: !
1780   PRINT "Re_try"
1790   GOTO Begin
1800   !
1810 Error: !
1820   BEEP
1830   PRINT "Syncronization Error !"
1840   STOP
```

(cont'd)

```
1850   !
1860 Dly: !
1870   OUTPUT Erd;"DLY";Dly
1880   WAIT .01
1890   LOOP
1900     S=SPOLL(Erd)
1910   EXIT IF BIT(S,7)=0
1920   END LOOP
1930   Se=BIT(S,4)
1940   RETURN
1950   END
```

Execution result

```
DELAY WIDTH  :   .48 ns
DELAY CENTER :   .10 ns
ERROR RATE   : 00.0000E+00
Completed
```

Program description

Line No.	Function
1000	Sets the GPIB select code to 7 and the device address of the D3273 to 3.
1010	Sets AUTO SYNC to ON, selects the error rate measuring function, and sets the error display mode to TOTAL.
1030	Label Begin (Start of automatic adjustment)
1040 to 1050	Sets DELAY to 0.00 ns.
1060	Branches to label Se0 if no SYNC error occurs.
1080	Label Sel (Occurrence of SYNC error at DELAY of 0.00 ns)
1090 to 1140	Increments DELAY by 0.01 ns until a SYNC error is eliminated.
1150	Branches to label Sel1 if the SYNC error still remains when DELAY becomes +1.00 ns.
1160	Sets DELAY when the SYNC error is removed to Dly1.
1180 to 1230	Increments DELAY by 0.01 ns until the next SYNC error occurs.
1240	Sets DELAY when a SYNC error occurs to Dly2.
1250	Branches to label Fin (termination).
1270	Label Sel1

(cont'd)

Line No.	Function
1280 to 1340	Decrements DELAY by 0.01 ns from -0.01 ns until the SYNC error is removed.
1350	Branches to label Error if the SYNC error still remains when DELAY becomes -1.00 ns.
1360	Sets DELAY when the SYNC error is removed to Dly2.
1380 to 1430	Decrements DELAY by 0.01 ns until the next SYNC error occurs.
1440	Sets DELAY when a SYNC error occurs to Dly1.
1450	Branches to label Fin (termination).
1470	Label St0 (No SYNC error at DELAY of 0.00 ns)
1480 to 1530	Increments DELAY by 0.01 ns from 0.01 ns until a SYNC error occurs.
1540	Sets DELAY when a SYNC error occurs to Dly2.
1560 to 1620	Decrements DELAY by 0.01 ns from -0.01 ns until a SYNC error occurs.
1630	Sets DELAY when a SYNC error occurs to Dly1.
1640	Branches to label Fin (termination).
1660	Label Fin (termination)
1670 to 1680	Sets DELAY to the central value within the range of DELAY where no SYNC error occurs: $\frac{Dly1 + Dly2}{2}$
1690	Branches to label Re_try if a SYNC error occurs.
1700	Obtains the measured value of error rate.
1710 to 1740	Prints the width and central value of the DELAY range having no SYNC error, and the measured value of the error rate at the central value.
1750	Stops the program.
1770	Label Re_try (retry)
1780 to 1790	Prints Re_try and returns to label Begin.
1810	Label Error (No range in which SYNC error does not occur)
1820 to 1830	Causes the buzzer to sound and prints the error message.
1840	Stops the program.
1860	Label Dly (DELAY setting subroutine)

(cont'd)

Line No.	Function
1880	Waits until the controller of the D3273 terminates processing.
1890 to 1920	Executes serial polling and waits until the status byte b8 (BUSY) becomes 0.
1930	Sets the status byte b5 (SYNC error) to Se.
1940	Returns from the subroutine.
1950	Terminates the program.

5.11.2 Parameter Reading

This program reads the states of currently set parameters using the queries (? codes).

Program list

```
100  DATA MF,DM
110  DATA DLY,TLVL
120  DATA PM,BL
130  DATA "WP0,4"
140  DATA ""
150  Erd=703
160  LOOP
170    READ A$
180  EXIT IF A$=""
190    OUTPUT Erd;A$;"?"
200    ENTER Erd;B$
210    PRINT B$
220  END LOOP
230  END
```

Execution result

```
ERR
TOT
DLY 0.00
TLVL-1.30
WORD
BL 00016
WP0000,004,AAAA
```

Program description

Line No.	Function
100 to 140	DATA statements for the codes corresponding to parameters to be read. Place "" (NULL character string) to specify the end of a series of the codes.
150	Sets the GPIB select code to 7 and the device address of the D3273 to 3.
160	Declares the start of a repeat loop.
170	Reads one code corresponding to the parameter to be read from DATA statements.
180	Exits from the loop if the read code is "".
190	Sends the read code added with ? to the D3273.
200	Reads the parameter from the D3273.
210	Prints the read parameter.
220	Terminates the loop (returning to the start of the loop).
230	terminates the program.

5.11.3 Error Second Measurement Using SRQ

This program presets the timer to 10 seconds, reads and prints the measured values including the process of error second (ES) measurement.

The program obtains measured values using interruptions by SRQ.

For each element of the status byte other than occurrence of measurement data, the program prints the corresponding message as required.
The program prints measured values with the lapse of time in the order of OMITT, INSERT, and TOTAL.

Program list

```
100     Erd=703
110     ON INTR 7 GOSUB Srq
120     ENABLE INTR 7;2
130     OUTPUT Erd;"S0 ES PTON HDON"
140     OUTPUT Erd;"PRS 00:00:00:10 ELP"
150     PRINT "ELAPSED TIME","OMITTING ERROR","INSERTING ERROR",
        "TOTAL ERROR"
160     I=0
170     TRIGGER Erd
180 Loop: !
190     ! *** Other Transactions Here ***
200     IF I<10 THEN GOTO Loop
210     STOP
220     !
230 Srq: !
240     S=SPOLL(Erd)
250     IF BIT(S,0)=1 THEN
260       OUTPUT Erd;"TIM"
270       ENTER Erd;T$
280       OUTPUT Erd;"MES OMI"
290       ENTER Erd;A$
300       OUTPUT Erd;"INS"
310       ENTER Erd;B$
320       OUTPUT Erd;"TOT"
330       ENTER Erd;C$
340       PRINT T$,A$,B$,C$
350       I=I+1
360     END IF
370     IF BIT(S,1)=1 THEN PRINT "SYNTAX ERROR"
380     IF BIT(S,2)=1 THEN PRINT "DATA ERROR"
390     IF BIT(S,3)=1 THEN PRINT "CLOCK ERROR"
400     IF BIT(S,4)=1 THEN PRINT "SYNC ERROR"
410     IF BIT(S,5)=1 THEN PRINT "OVER"
420     IF BIT(S,7)=1 THEN PRINT "BUSY"
430     ENABLE INTR 7;2
440     RETURN
450     END
```

Execution result

```
ELAPSED TIME       OMITTING ERROR     INSERTING ERROR     TOTAL ERROR
ELP 00:00:00:01    ES  000.0000       ES  000.0000        ES  000.0000
ELP 00:00:00:02    ES  000.0000       ES  000.0000        ES  000.0000
ELP 00:00:00:03    ES  000.0000       ES  000.0000        ES  000.0000
DATA ERROR
ELP 00:00:00:04    ES  000.0000       ES  025.0000        ES  025.0000
ELP 00:00:00:05    ES  000.0000       ES  020.0000        ES  020.0000
ELP 00:00:00:06    ES  000.0000       ES  016.6666        ES  016.6666
ELP 00:00:00:07    ES  000.0000       ES  014.2857        ES  014.2857
ELP 00:00:00:08    ES  000.0000       ES  012.5000        ES  012.5000
ELP 00:00:00:09    ES  000.0000       ES  011.1111        ES  011.1111
ELP 00:00:00:10    ES  000.0000       ES  010.0000        ES  010.0000
```

Program description

Line No.	Function
100	Sets the GPIB select code to 7 and the device address of the D3273 to 3.
110	Defines a branch to the subroutine with label Srq when an interruption occurs from the GPIB.
120	Enables interruptions by SQR from the GPIB.
130	Sets the D3273 into the S0 mode (allowing SRQ transmission), error second measurement, % display mode, and turns the header on.
140	Sets the timer to 10 seconds and the timer/CLOCK display mode to ELAPSED TIME.
150	Prints the title.
160	Clears the measurement counter to zero.
170	Sends the measurement start instruction (GET) to this equipment.
180	Label Loop (Start of SRQ waiting loop)
190	Allows other transactions to be done here.
200	Returns to label Loop if the number of measurement times is less than 10 on the measurement counter.
210	Stops the program on completion of the tenth measurement.
230	Label Srq (SRQ interrupt subroutine)
240	Executes serial polling and reads the value of the status byte into variable S.

(cont'd)

Line No.		Function
250 to 360		Executes the following series of processings if bit 0 (LSB) in variable S is 1 (occurrence of measurement data):
	260	Sets data output of the D3273 to time data (ELAPSED TIME).
	270	Reads time data.
	280	Sets data output of the D3273 to measurement data, OMITT.
	290	Reads measurement data (OMITT)
	300	Sets data output of the D3273 to INSERT.
	310	Reads measurement data (INSERT).
	320	Sets data output of the D3273 to TOTAL.
	330	Reads measurement data (TOTAL)
	340	Prints measurement data: time data, OMITT, INSERT, and TOTAL.
	350	Increments the measurement counter by one.
370		Prints the SYNTAX error message if bit 1 in variable S (status byte) is 1.
380		Prints the DATA error message if bit 2 in variable S (status byte) is 1.
390		Prints the CLOCK error message if bit 3 in variable S (status byte) is 1.
400		Prints the SYNC error message if bit 4 in variable S (status byte) is 1.
410		Prints the OVER message if bit 5 in variable S (status byte) is 1.
420		Prints the BUSY message if bit 7 (MSB) in variable S (status byte) is 1.
430		Enables the interruption by the next SRQ.
440		Returns from the subroutine.
450		Terminates the program.

5.11.4 Word Pattern Setting (Hexadecimal Mode)

This program converts the binary pattern (0 and 1 character string) entered from the keyboard of the GPIB controller into the hexadecimal character string and sets it as a word pattern.

Program list

```
100     DIM P$[600],Q$[512],H$[128]
110     Erd=703
120     OUTPUT Erd;"WORD"
130     LOOP
140       INPUT "BIT LENGTH = ?",Bl
158     EXIT IF Bl>0 AND Bl<1024
160     EXIT IF Bl>=1024 AND Bl<=65536 AND (Bl MOD 64)=0
170       BEEP
180     END LOOP
190     PRINT "BIT LENGTH :";Bl
200     OUTPUT Erd;"BL";Bl
210     LOOP
220       LOOP
230         INPUT "TOP ADDRESS = ?",Adrs
240       EXIT IF Adrs>=0 AND Adrs<=4095
250         BEEP
260       END LOOP
270       PRINT "TOP ADDRESS :";Adrs
280       INPUT "PATTERN = ?",P$
290       L=LEN(P$)
300     EXIT IF L=0
310       !
320       Q$=""
330       FOR I=1 TO L
340         IF P$[I,I]="0" OR P$[I,I]="1" THEN
350            IF LEN(Q$)<128 THEN Q$=Q$&P$[I,I]
360         END IF
370       NEXT I
380       L=LEN(Q$)
390     EXIT IF L=0
400       !
410       IF (L MOD 4)>0 THEN
420         FOR I=1 TO 4-(L MOD 4)
430           Q$=Q$&"0"
440         NEXT I
450         L=LEN(Q$)
460       END IF
470       !
480       PRINT "BINARY PATTERN :"
490       FOR I=1 TO L STEP 4
500         PRINT Q$[I,I+3];" ";
510       NEXT I
520       PRINT
```

(cont'd)

```
530       !
540       H$=""
550       FOR I=1 TO L STEP 4
560         H=0
570         FOR J=0 TO 3
580           H=H+VAL(Q$[I+J,I+J])*2^J
590         NEXT J
600         IF H<10 THEN
610           H$=H$&VAL$(H)
620         ELSE
630           H$=H$&CHR$(NUM("A")-10+H)
640         END IF
650       NEXT I
660       Lh=LEN(H$)
670       !
680       PRINT "HEXADECIMAL PATTERN :"
690       FOR I=1 TO INT(Lh/4)*4+1 STEP 4
700         PRINT H$[I,I+3];" ";
710       NEXT I
720       PRINT
730       OUTPUT Erd;"WP";Adrs;",";LEN(H$);",";H$
740     END LOOP
750     END
```

Execution result

```
BIT LENGTH : 15
TOP ADDRESS : 0
BINARY PATTERN :
1001 1011 0111 1110
HEXADECIMAL PATTERN :
9DE7
TOP ADDRESS : 0
```

Program description

Line No.	Function
100	Declares arrays: P$ (up to 600 characters), Q$ (up to 512 characters), H$ (up to 128 characters).
110	Set the GPIB select code to 7 and the device address of the D3273 to 3.
120	Sets the pattern mode of the D3273 to WORD.
130 to 180	Prompts the user to enter a bit length from the keyboard.
190 to 200	Prints the bit length and sets it into the D3273.
210 to 740	Prompts the user to enter the top address of a pattern and the pattern itself, converts it and sets it into the D3273. Repeats this operation until "" (Null character string) is input as a pattern.
220 to 260	Prompts the user to enter the head address to set a pattern from the keyboard.
270	Prints the head address.
280	Prompts the user to enter the pattern in binary (0 and 1 character string) from the keyboard. Any character except 0 and 1 can be inserted as a delimiter in the character string.
290	Sets the length of the input character string to L.
300	Exits from the loop if the character string length is 0.
320 to 380	Fetches only 0 and 1 from the input character string to form a new character string and sets the length of Q$ to L. If the Q$ exceeds 128 characters in length, the excessive characters are discarded.
390	Exits from the loop if the length of the character string Q$ is 0.
410 to 460	Adds 0 to Q$ so that the length of the character string Q$ is an integral multiple of the number 4 and sets the length of the new character string to L.
480 to 520	Prints the character string Q$ with a space between every pair of four characters so that it is easy to read.
540 to 660	Sequentially converts every set of four characters in the character string Q$, starting from the first, into the decimal equivalent. Converts the decimal value further into hexadecimal characters to form a hexadecimal character string and sets its character string length to Lh.

(cont'd)

Line No.		Function
	680 to 720	Prints the hexadecimal character string with a space between every pair of four characters so that it is easy to read.
	730	Sets the head address and pattern into the D3273.
	740	Terminates the loop (returning to the start of the loop).
750		Terminates the program.

5.11.5 Word Pattern Setting (Binary Mode)

This program converts the binary pattern (0 and 1 character string) entered from the keyboard of the GPIB controller into the numeric in bytes and sets it as a word pattern.

Program list

```
100     DIM P$[600],Q$[512],B(64)
110     Erd=703
120     OUTPUT Erd;"WORD"
130     LOOP
140       INPUT "BIT LENGTH = ?",Bl
158     EXIT IF Bl>0 AND Bl<1024
160     EXIT IF Bl>=1024 AND<Bl =65536 AND (Bl MOD 64)=0
170       BEEP
180     END LOOP
190     PRINT "BIT LENGTH :";Bl
200     OUTPUT Erd;"BL";Bl
210     LOOP
220       LOOP
230         INPUT "TOP ADDRESS = ?",Adrs
240       EXIT IF Adrs>=0 AND Adrs<=4095
250         BEEP
260       END LOOP
270       PRINT "TOP ADDRESS :";Adrs
280       INPUT "PATTERN = ?",P$
290       L=LEN(P$)
300     EXIT IF L=0
310       !
320       Q$=""
330       FOR I=1 TO L
340         IF P$[I,I]="0" OR P$[I,I]="1" THEN
350           IF LEN(Q$)<128 THEN Q$=Q$&P$[I,I]
360         END IF
370       NEXT I
380       L=LEN(Q$)
```

(cont'd)

```
390     EXIT IF L=0
400       !
410       IF (L MOD 8)>0 THEN
420         FOR I=1 TO 8-(L MOD 8)
430           Q$=Q$&"0"
440         NEXT I
450         L=LEN(Q$)
460       END IF
470       !
480       PRINT "BINARY PATTERN :"
490       FOR I=1 TO L STEP 4
500         PRINT Q$[I,I+3];" ";
510       NEXT I
520       PRINT
530       !
540       N=0
550       FOR I=1 TO L STEP 8
560         B(N)=0
570         FOR J=0 TO 7
580           B(N)=B(N)+VAL(Q$[I+J,I+J])*2^J
590         NEXT J
600         N=N+1
610       NEXT I
620       !
630       PRINT "BYTE PATTERN :"
640       FOR I=0 TO N-1
650         PRINT USING "#,4D";B(I)
660       NEXT I
670       PRINT
680       !
690       OUTPUT Erd;"BIN";Adrs;",";N
700       FOR I=0 TO N
710         IF I<N THEN
720           OUTPUT Erd;CHR$(B(I));
730         ELSE
740           SEND 7;DATA B(N) END
750         END IF
760       NEXT I
770     END LOOP
780     END
```

Execution result

```
BIT LENGTH : 15
TOP ADDRESS : 0
BINARY PATTERN :
1001 1011 0111 1110
BYTE PATTERN
 217 126
TOP ADDRESS : 0
```

Program description

Line No.	Function
100	Declares arrays: P$ (up to 600 characters), Q$ (up to 512 characters), H$ (up to 128 characters).
110	Set the GPIB select code to 7 and the device address of the D3273 to 3.
120	Sets the pattern mode of the D3273 to WORD.
130 to 180	Prompts the user to enter a bit length from the keyboard.
190 to 200	Prints the bit length and sets it into the D3273.
210 to 770	Prompts the user to enter the top address of a pattern and the pattern itself, converts it and sets it into the D3273. Repeats this operation until ""(Null character string) is input as a pattern.
220 to 260	Prompts the user to enter the head address to set a pattern from the keyboard.
270	Prints the head address.
280	Prompts the user to enter the pattern in binary (0 and 1 character string) from the keyboard. Any character other than 0 and 1 can be inserted as a delimiter in the character string.
290	Sets the length of the input character string to L.
300	Exits from the loop if the character string length is 0.
320 to 380	Fetches only 0 and 1 from the input character string to form a new character string and sets the length of Q$ to L. If the Q$ exceeds 128 characters in length, the excessive characters are discarded.
390	Exits from the loop if the length of the character string Q$ is 0.
410 to 460	Adds 0 to Q$ so that the length of the character string Q$ is an integral multiple of the number 8 and sets the length of the new character string to L.
480 to 520	Prints the character string Q$ with a space between every pair of four characters so that it is easy to read.
540 to 610	Sequentially converts every set of eight characters in the character string Q$, starting from the first, into its decimal equivalent (0 to 255). Set the number of such decimals to N.
630 to 670	Prints the hexadecimal characters in sequence.

(cont'd)

Line No.		Function
	690	Sets the binary mode, head address, and the number of bytes N into the D3273.
	700 to 760	Sets the word pattern into this equipment byte to byte. EOI is transmitted the moment the last byte is set.
	770	Terminates the loop (returning to the start of the loop).
780		Terminates the program.

5.12 Master-Slave Operation

When this equipment is used in combination with the D3173/D3173A connect both sides of GPIB with a cable and set the SLAVE switch of the unit to ON and the MASTER CONTROL switch of the D3173/D3173A to ON; then the setting of the pattern setting block of the unit becomes the same as that of D3173/D3173A.

During master-slave operation, the other GPIB equipments cannot be connected to the D3273. Also, the key-switch in the pattern setting block on the panel of the D3273 is disabled at this time.

When the IFC (connector pin No. 9) of the GPIB bus line goes low, the slave function of the D3273 is released and the SLAVE switch is turned off.

MEMO

6. DISPLAY MESSAGES

6.1 Messages Concerning Measurement

This section describes special messages concerning measurement. The following messages are displayed on the measuring result indicator (⑥ in Figure 2-3) in the front panel:

Message	Meaning
CLocErr	CLOCK error. This message appears when no clock pulse is input or the input clock frequency is too low.
SYncErr	SYNC error. This message appears while the pattern is out of synchronism.
buSY	BUSY. This message appears from the start of measurement until the result of the measurement is first displayed.
HALt	HALT. This message continues on the display between the time when the measuring mode or function is switched and when the measurement is started.
SEArCh	SEARCH. Display during the AUTO SEARCH function is executing.
not Found	not Found. Display when the AUTO SEARCH function can't search the optimum value.

6.2 CPU Error Messages

This section explains the error display if the CPU, which controls D3273 internal circuits, has failed.

The message is displayed on the measured result indicator (⑥ in Figure 2-3) on the front panel.

If one of these errors is displayed, turn the D3273 power supply off, wait for more than five seconds, hold down the PATTERN setting key (2) (⑨ in Figure 2-2) and turn the D3273 power supply on again.

Hold down key (2) several seconds until a message is displayed on the BIT LENGTH indicator (③ in Figure 2-2) or on the ADDRESS number indicator (⑥ in Figure 2-2).

If such errors are displayed frequently, the CPU or its peripheral circuit may be faulty. Contact your local ADVANTEST office or agency. ADVANTEST offices and agencies are listed at the end of this manual.

Display format: E-1-1- OOOO
└ Error code (4-digit numeric characters)

Error code	Meaning
0001 to 1717	Memory error
8000 to 8008	Error in CPU peripheral circuit

6.3 LOW Voltage Message

When the power supply of the D3273 is turned on, the following message may appear on the bit length indicator (③ in Figure 2-2) and address number indicator (⑥ in Figure 2-2) in the front panel:

This message indicates that the voltage of the Nicd battery has been lowered and set parameters have been lost because the battery backs up the memory storing them while the power supply is off.

This low battery message is displayed for about three seconds. After that the equipment operates normally, though all of the previously set parameters in the memory have been initialized. The initial value of each parameter is the same as the value initialized by the GPIB program code "Z" (See Section 5.10.2). When this message appears, the device address of the GPIB is initialized to 1 and the clock is reset to 92 (year), 01 (month), 01 (day), 00 (hour), 00 (minute), and 00 (second).

To fully charge the battery in the low battery state, leave the power supply of the D3273 connected with power continuously for 15 hours or more.

If the low battery message still appears after the battery is fully charged, the battery may have exhausted its life span. In this case, contact the nearest dealer or the sales and support offices. The address and telephone numbers are listed at the end of this manual.

6.4 Self-Calibration of Variable Delay Line and Error Display

If the set value shown on the DELAY indicator ((14) in Figure 2-3) on the front panel does not match the mechanical position of the actual variable delay line, self-calibration starts automatically. The self-calibration is shown on the DELAY indicator.

The following appears (up to 20 seconds):

CAL

You cannot set any parameter during this time. The set value is cleared to approximately 0.00 ns at the end of self-calibration.

If the difference cannot be removed through self-calibration, the Err error message is displayed.

Err

The variable delay line operation stops. In such case, the variable delay line may fail. Call the service (by referring to the service representative list at the end of this manual).

If this error message continues on the display, you cannot set the delay. In such case, if you turn the D3273 power supply off, wait for several seconds, and turn it on again then you can set the delay but as the positional difference is not corrected, the self-calibration may start again by certain set value and an error message may be displayed.

7. PERFORMANCE DATA

- Measuring function and measuring range

Error rate
$0.x10^{-14}$ to $9.9999x10^{-1}$ (Individual measuring mode)
(By bit error rate range setup)
$0.x10^{-16}$ to $9.9999x10^{-1}$ (Simultaneous measuring mode)
(The measuring capacity is $0.x10^{-19}$ to $9.9999x10^{-1}$.)

Error count
$0.x10^{0}$ to $9.9999x10^{18}$ (Exponential display mode)
(The measuring capacity is $0.x10^{0}$ to $9.9999x10^{18}$.)
0 to 9999999 (Integer display mode)

Error second (ES)
0.0000% to 100.0000% (Percent display mode)
$0.x10^{0}$ to $3.9999x10^{6}$ (Second display mode)
(The measuring capacity is $0.x10^{0}$ to $4.2949x10^{9}$.)

Error free second (EFS)
0.0000% to 100.0000% (Percent display mode)
$0.x10^{0}$ to $3.9999x10^{6}$ (Second display mode)
(The measuring capacity is $0.x10^{0}$ to $4.2949x10^{9}$.)

Frequency (FREQ)
50.000 MHz to 3000.000 MHz
(The measuring capacity is approx. 10.000 MHz to 3200.000 MHz)

The above five functions can be measured separately or simultaneously.

- Operating frequency range

50 MHz to 3 GHz

- Error measuring display mode

OMITT : Displays the measured value of an error in which the data of "0" is input against the expected value of logical "1".
INSERT: Displays the measured value of an error in which the data of "1" in input against the expected value of logical "0".
TOTAL : Displays the measured value of both errors OMITT and INSERT.

- Display rate (Valid in the error rate measurement in individual measuring mode and in the frequency measurement.)

FAST : Approx. 0.1 sec
MED : Approx. 0.3 sec
SLOW : Approx. 1 sec
HOLD : Perform a single measurement and stops it.

- Bit error rate range (valid in individual measuring mode only)

  10^{-N}, N=5, 6, 7, 8, 9, 10, 11, 12, 13, 14

- Measuring control

  START command

  Starts measuring the error count, error second (ES), and error free second (EFS) in the individual measuring mode or all measuring functions in the simultaneous measuring mode. Also, this command can stop measurement and restart measurement.

  If the error rate or frequency is measured in the individual measuring mode and if the DISPLAY RATE is set to HOLD, this command starts a single time measurement. Also, it can reset the history function.

  STOP command

  Stops measuring the error count, error second (ES), and error free second (EFS) in the individual measuring mode or all measuring functions in the simultaneous measuring mode.

- Pattern synchronism

  AUTO SYNC ON ; Automatic synchronism
  AUTO SYNC OFF; Manual synchronism
  SYNC ; Start of resynchronism

- Error display lamp

  DATA ERROR

  Lights when an error exceeding one bit is detected. It goes out when the error is recovered.

  CLOCK ERROR

  When either input clock breaking or too low frequency is occurred, the CLOCK error lamp linghts ON.
  The lamp lights OFF when input the clock more than some fixed quantity (50MHz).

  SYNC ERROR

  The lamp lights ON beyond the pattern synchronization. The lamp lights OFF at the pattern synchronization.

- History display lamps

  CLOCK ERROR

  Lights if the input clock fails or if the clock frequency is below the limit. This lamp continues to light even when the error is recovered. It goes out when the START key is pressed.

  SYNC ERROR

  Lights if a pattern is out of synchronization. This lamp continues to light even when the error is recovered. It goes out when the START key is pressed.

- Measuring status display lamp

  GATE: This lamp lights during measurement.
  OVER: This lamp lights when the result of a measurement is overflowed.

- Buzzer

  This buzzer sounds when a DATA error, CLOCK error, or SYNC error occurs. This buzzer can be specified to be set to ON/OFF.

- Error rate measurement

  Bit error rate range and measuring range in individual measuring mode:

Bit error rate range	Measuring range
10^{-5}	0×10^{-5} to 9.9999×10^{-1}
10^{-6}	0×10^{-6} to 9.9999×10^{-1}
10^{-7}	0×10^{-7} to 9.9999×10^{-1}
10^{-8}	0×10^{-8} to 9.9999×10^{-1}
10^{-9}	0×10^{-9} to 9.9999×10^{-1}
10^{-10}	0×10^{-10} to 1.0737×10^{-1} or more
10^{-11}	0×10^{-11} to 1.0737×10^{-2} or more
10^{-12}	0×10^{-12} to 1.0737×10^{-3} or more
10^{-13}	0×10^{-13} to 1.0737×10^{-4} or more
10^{-14}	0×10^{-14} to 1.0737×10^{-5} or more

Measuring time in individual measuring mode:
1/(Input clock frequency (Hz))x(Bit error rate range)) (sec)

Measuring range in simultaneous measuring mode:
0×10^{-R} to 9.9999×10^{-1}

where, $R=\log_{10}$((Input clock frequency (Hz))x(Measuring time (sec)))
The maximum value of R is 19.

- Error count measurement

Measuring range:
0 to 9.9999×10^{18} (Exponential display mode)
0 to 9999999 (Integer display mode)

Measuring time:
From the START command to the STOP command, or until the timer preset time

- Error second (ES) measurement

Measuring range:
0.0000% to 100.0000% (Percent display mode)
0 to 4.2949×10^{9} (Second display mode)

Measuring time:
From the START command to the STOP command, or until the timer preset time

- Error free second (EFS) measurement

Measuring range:
0.0000% to 100.0000% (Percent display mode)
0 to 4.2949×10^{9} (Second display mode)

Measuring time:
From the START command to the STOP command, or until the timer preset time

- Frequency measurement

Measuring range:
50.000 MHz to 3000.000 MHz

Gate time:
10 msec (Individual measuring mode)
0.2 sec (Simultaneous measuring mode)

Standard clock accuracy:
$\pm$10 ppm

- Data input

Input format: DC terminated, DC coupled
Code: NRZ
Polarity: Logical inversion allowed
Input amplitude: 0.5 V_{p-p} to 2 V_{p-p}
Threshold level:
-1.999 Vdc to +1.999 Vdc at 0.001 Vdc step (for 0 Vdc termination)
-1.850 Vdc to -0.750 Vdc at 0.001 Vdc step (for -2 Vdc termination)
Allowable input voltage: -4.5 Vdc / +2.5 Vdc
Terminating voltage: -2 Vdc/0 Vdc$\pm$0.1 Vdc
Input impedance: Approximately 50 ohms
Connector: Type N

- Clock input

Input format: DC terminated, AC coupled
Duty: 50% $\pm$5%
Polarity: Identified at rising edge
Input amplitude: 0.5 V_{p-p} to 2 V_{p-p}
Allowable input voltage:
$\pm$2.5 Vdc (for 0 Vdc terminating voltage)
-4.5 Vdc / +0.5 Vdc (for -2 Vdc terminating voltage)
Terminating voltage:
-2 Vdc / 0 Vdc$\pm$0.1 Vdc
(Can be set separately from that of data input)
Input impedance: Approximately 50 ohms
Connector: Type N

- AUTO SEARCH function

AUTO SEARCH function search automatically the optimum value for threshold level and delay quantity (phase between data input and clock input).

- Reference Pattern:
  PRBS $2^N - 1$:

Number of stages N	Generator polynomial	Conformed standard
7	$x^7 + x^6 + 1$	CCITT Recommendations V.29
9	$x^9 + x^5 + 1$	CCITT Recommendations V.52
10	$x^{10} + x^7 + 1$	-
11	$x^{11} + x^9 + 1$	CCITT Recommendations O.152
15	$x^{15} + x^{14} + 1$	CCITT Recommendations O.151
15	$x^{15} + x^1 + 1$	-
17	$x^{17} + x^{14} + 1$	-
20	$x^{20} + x^3 + 1$	CCITT Recmmendations V.57
23	$x^{23} + x^{18} + 1$	CCITT Recommendations O.151

PRBS 2^N : Number of stages N = 7, 9, 10, and 11
The 2^N pattern is added with "0" of one bit next to the largest "0" continued part (N - 1 bit continuation) of the $2^N - 1$ pattern when the mark rate is assumed to be 1/2.

Mark ratio : 1/2, 1/4, 1/8, 0/8, 1/2B, 3/4, 7/8, and 8/8
The 1/2B pattern is the 1/2 pattern with its polarity inverted.

Standard display lamp : This lamp lights when the setting of the number of stages of PRBS and mark ratio conforms to the CCITT Recommendations

Word bit length : 1 to 65536 bits/1 bit step. However, it becomes 64-bit step above 1024 bits.

Word address : 16 bits are displayed as one address.

Word polarity : Logical inversion possible

Word memory : Programmable ... 10 types
Fixed pattern ... 3 types

- Timer/clock display

REALTIME

The realtime is display in the format of "YEAR:MONTH:DAY:HOURS" or "DAY:HOUR:MINUTE:SECOND"

ELAPSED

The elapsed time from the start of measurement is displayed during measurement of error count, error second (ES) and error free second (EFS) in the individual measuring mode or during measurement in the simultaneous measuring mode.
The maximum elapsed time is 99 days 23 hours 59 minutes 59 seconds.

TIMED

The remaining time to the end of measurement is displayed during measurement of error count, error second (ES) and error free second (EFS) in the individual measuring mode or during measurement in the simultaneous measuring mode.
This command is valid only when the PRESET key has been set to 00 day 00 hour 00 minute 00 second and when the timer has been set to a mode other than UNTIMED.
The maximum elapsed time is 99 days 23 hours 59 minutes 59 seconds.

PRESET

The time from the start to the end of measurement is displayed during measurement of error count, error second (ES) and error free second (EFS) in the individual measuring mode or during measurement in the simultaneous measuring mode.
The maximum elapsed time is 99 days 23 hours 59 minutes 59 seconds.
If 00 day 00 hour 00 minute 00 second is set, the measuring time is made unlimited.

- Timer mode

SINGLE

The measurement stops when the time set by the PRESET key has expired.

REPEAT

When the time set by the PRESET key has expired, the current measurement is stopped and its results are displayed. Then, the next measurement starts automatically. The measurement continues until the STOP key is pressed.

UNTIMED

The measurement continues regardless of the time set by the PRESET key. The measurement stops when the STOP key is pressed.

- GPIB:

Conformed standard:		IEEE 488-1978
Interface function:		SH1, AH1, T6, L3, SR1, RL1, PP0, DC1, DT1, C0, and E2
Remote control	:	Remote control possible for all operations excluding the power ON/OFF, GPIB address setting, and slave function ON/OFF, generator polynomial selection in the PRBS 15^N, and also to read the set status.
Data output	:	Possible to output the measured result and timer data.

- Slave Function:
  Possible to interlock the setting of the pattern block of the D3173/D3173A to that of this equipment. This applies only to the case where no other GPIB device is connected to the D3273.

- Panel Lock:
  This can disable the operation of all keys and knobs excepting the power ON/OFF, panel lock ON/OFF, generator polynomial selection in the PRBS $2^{15}-1$, and LOCAL key of GPIB.

- Monitor Output:
  DATA : This monitor outputs the data input through an amplifier.
  Impedance 50 ohms
  Connector N type
  CLOCK: This monitor outputs the CLOCK input through an amplifier.
  Impedance 50 ohms
  Connector N type

- Synchronous Output:
  1/16 CLOCK: The CLOCK input is output by dividing it into 1/16.
  Output voltage High level 0 ±0.2 V
  Low level -1 ±0.2 V
  (When a load of 50 ohms is connected to the 0V(GND))
  Connector used BNC type
  Pattern : Pulses are output at the bit position set by the address in the internal reference pattern.
  Output voltage High level 0 ±0.2 V
  Low level -1 ±0.2 V
  (When a load of 50 ohms is connected to the 0V(GND))
  Connector used BNC type

- Error Output:
  Rate : 1/4 of the CLOCK input
  Number of phases: 4 phases
  Signal type : 4-phase individual and logical sum of 4 phases
  Code : RZ
  Output voltage : High level -0.15 ±0.2 V
  Low level -1 ±0.2 V
  (When a load of 50 ohms is connected to the 0V (GND))

- Alarm output: The alarm is activated when a CLOCK error, or SYNC error occurs.

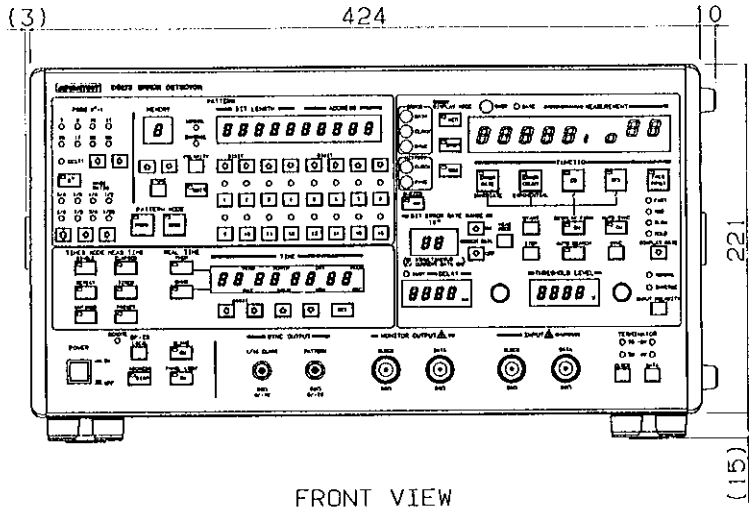
Relay contact output	NORMAL/OPEN
Contact ratings	20 VDC, 0.4 A
Operating time	Approx. 100 mS

- General Specifications:

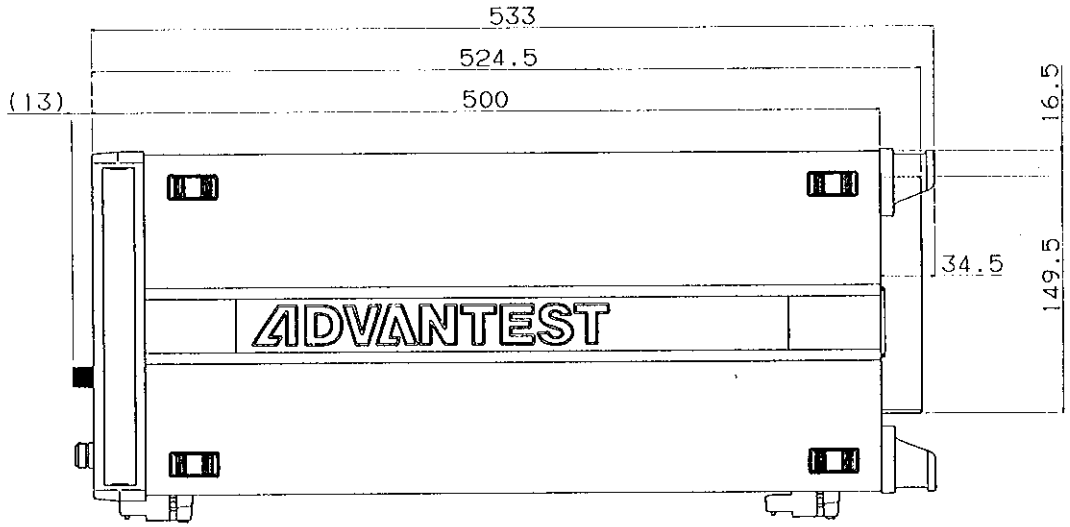
Numerical display	:	7-segment green LED
Panel setting storage	:	Two weeks or longer if the D3273 has been operated 15 hours or more
Working temperature range	:	0°C to +40°C
Working humidity range	:	40% to 85% RH
Storage temperature range	:	-20°C to +60°C
Storage humidity range	:	30% to 85% RH
Power supply	:	90 to 132 VAC (Standard) 198 to 250 VAC (Option 40) 48 Hz to 63 Hz, sine wave
Power consumption	:	520 VA or less
Weight	:	28 kg or less
External dimensions	:	Approx. 221 (H) x 424 (W) x 525 (D) mm

MEMO

ALPHABETICAL INDEX

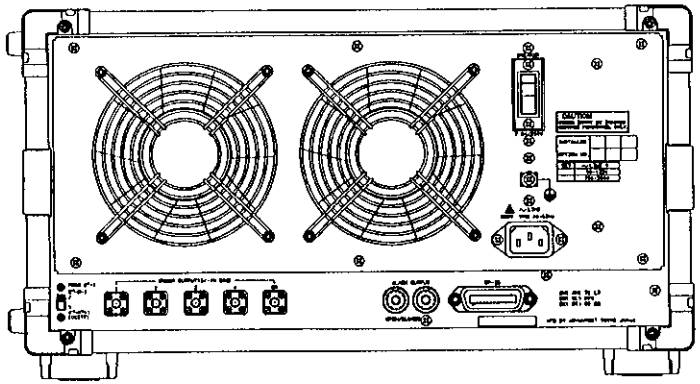


FRONT VIEW



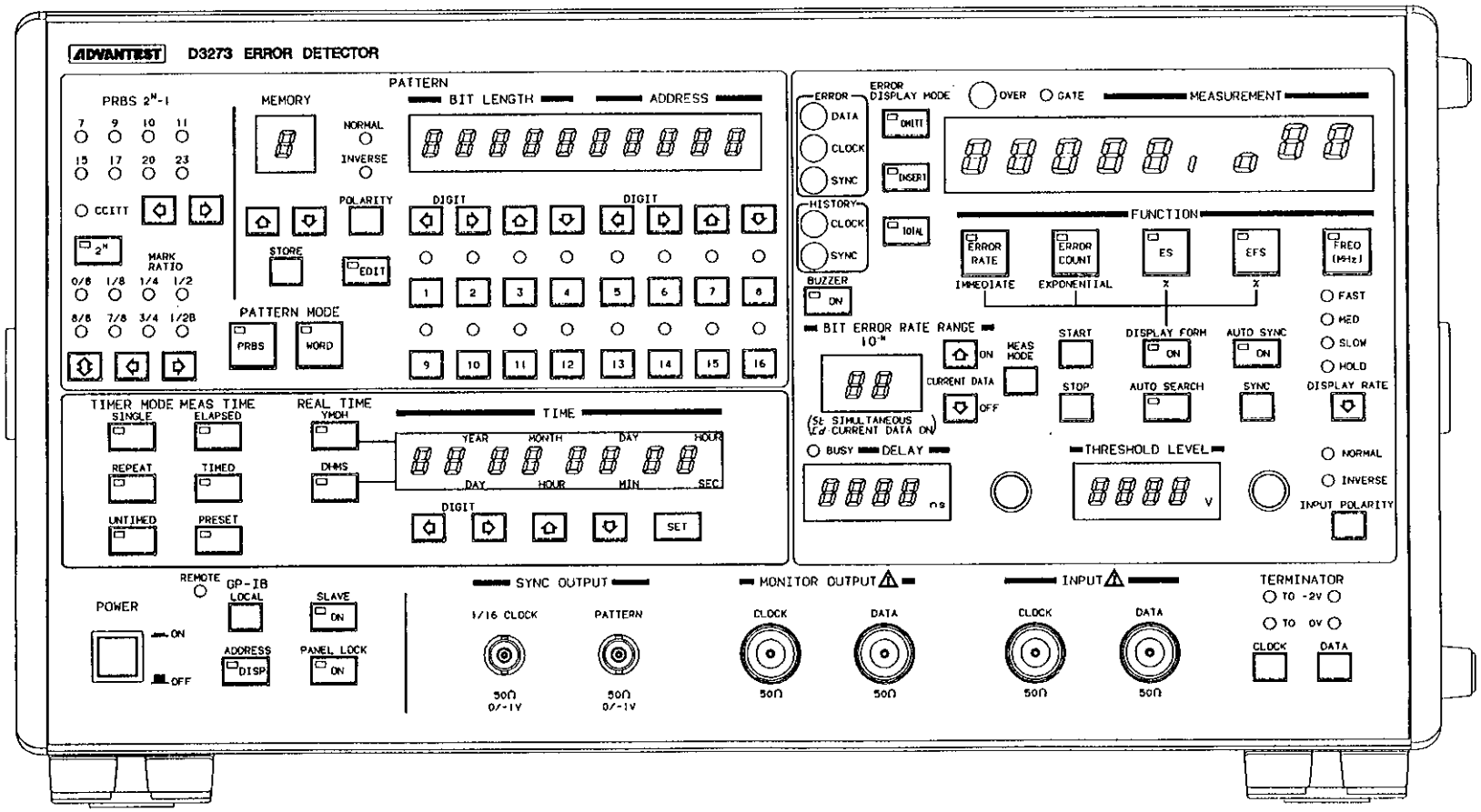
SIDE VIEW

Unit : mm



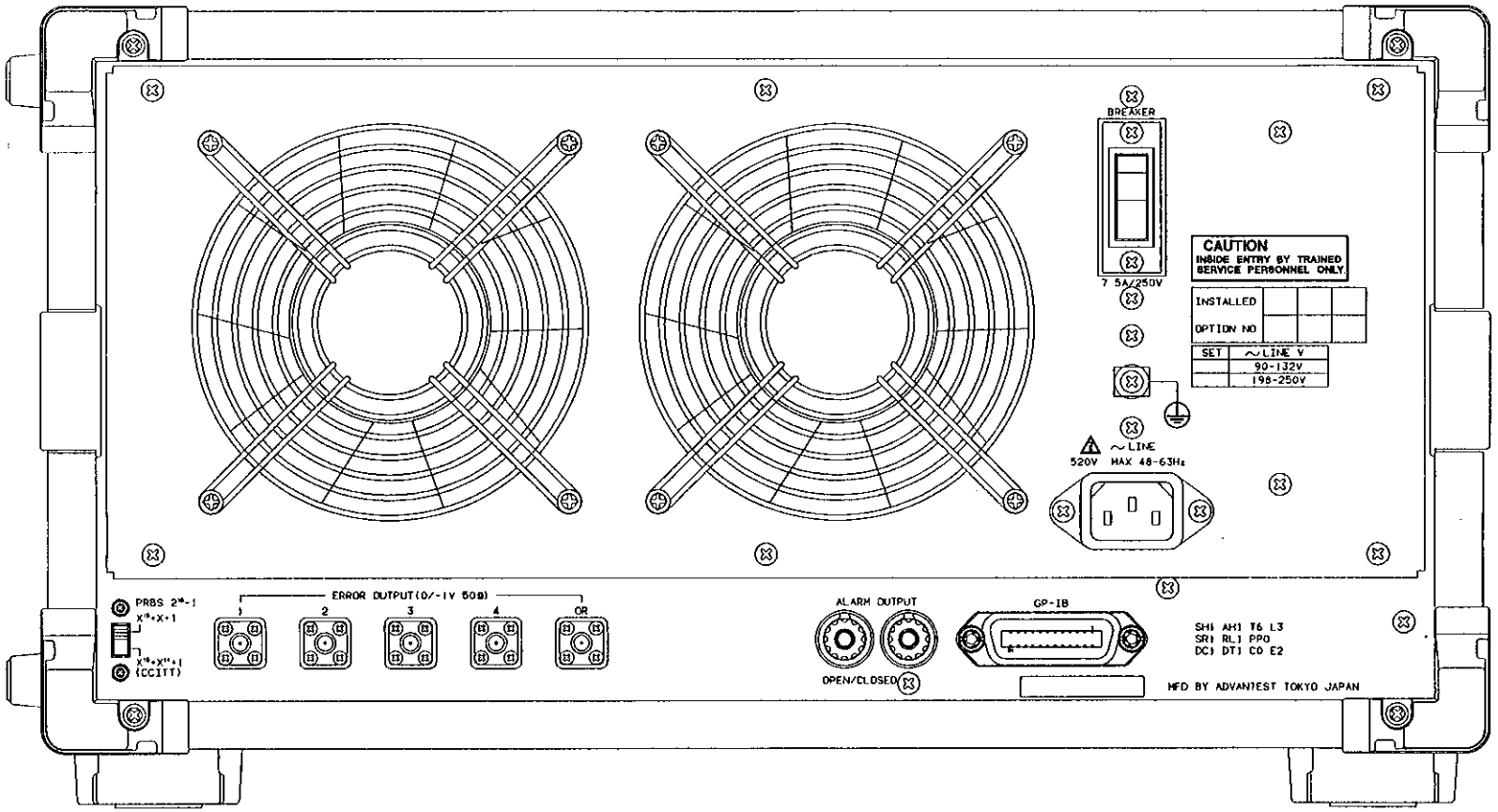
EXT1-9202-G REAR VIEW

D3273
EXTERNAL VIEW



D3273
FRONT VIEW

EXT2-9202-E



EXT3-9202-F

D3273

REAR VIEW

IMPORTANT INFORMATION FOR ADVANTEST SOFTWARE

PLEASE READ CAREFULLY: This is an important notice for the software defined herein. Computer programs including any additions, modifications and updates thereof, operation manuals, and related materials provided by Advantest (hereafter referred to as "SOFTWARE"), included in or used with hardware produced by Advantest (hereafter referred to as "PRODUCTS").

SOFTWARE License

All rights in and to the SOFTWARE (including, but not limited to, copyright) shall be and remain vested in Advantest. Advantest hereby grants you a license to use the SOFTWARE only on or with Advantest PRODUCTS.

Restrictions

(1) You may not use the SOFTWARE for any purpose other than for the use of the PRODUCTS.
(2) You may not copy, modify, or change, all or any part of, the SOFTWARE without permission from Advantest.
(3) You may not reverse engineer, de-compile, or disassemble, all or any part of, the SOFTWARE.

Liability

Advantest shall have no liability (1) for any PRODUCT failures, which may arise out of any misuse (misuse is deemed to be use of the SOFTWARE for purposes other than it's intended use) of the SOFTWARE. (2) For any dispute between you and any third party for any reason whatsoever including, but not limited to, infringement of intellectual property rights.

LIMITED WARRANTY

1. Unless otherwise specifically agreed by Seller and Purchaser in writing, Advantest will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by Advantest or (ii) specifically recommended or authorized by Advantest and performed in accordance with Advantest 's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than Advantest or its agents);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;

   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

5. **EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADVANTEST HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.**

6. **THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.**

7. **ADVANTEST WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADVANTEST HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE. TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

8. **OTHER THAN THE REMEDY FOR THE BREACH OF WARRANTY SET FORTH HEREIN, ADVANTEST SHALL NOT BE LIABLE FOR, AND HEREBY DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY LIABILITY FOR, DAMAGES FOR PRODUCT FAILURE OR DEFECT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLEGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

CUSTOMER SERVICE DESCRIPTION

In order to maintain safe and trouble-free operation of the Product and to prevent the incurrence of unnecessary costs and expenses, Advantest recommends a regular preventive maintenance program under its maintenance agreement.

Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest 's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

SALES & SUPPORT OFFICES

Advantest Korea Co., Ltd.
22BF, Kyobo KangNam Tower,
1303-22, Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071
Fax: +82-2-532-7132

Advantest (Suzhou) Co., Ltd.
Shanghai Branch Office:
Bldg. 6D, NO.1188 Gumei Road, Shanghai, China 201102 P.R.C.
Phone: +86-21-6485-2725
Fax: +86-21-6485-2726

Shanghai Branch Office:
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing,
China 100083
Phone: +86-10-8235-3377
Fax: +86-10-8235-6717

Advantest (Singapore) Pte. Ltd.
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

Advantest America, Inc.
3201 Scott Boulevard, Suite, Santa Clara, CA 95054, U.S.A
Phone: +1-408-988-7700
Fax: +1-408-987-0691

ROHDE & SCHWARZ Europe GmbH
Mühldorfstraße 15 D-81671 München, Germany
(P.O.B. 80 14 60 D-81614 München, Germany)
Phone: +49-89-4129-13711
Fax: +49-89-4129-13723

ADVANTEST®

http://www.advantest.co.jp

ADVANTEST CORPORATION
Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Phone: +81-3-3214-7500