ADVANTEST

ADVANTEST CORPORATION

INSTRUCTION MANUAL

D3185A

PULSE PATTERN GENERATOR

MANUAL NUMBER OEA00 9111

Before reselling to other corporations or re-exporting to other countries, you are required to obtain permission from both the Japanese Government under its Export Control Act and the U.S. Government under its Export Control Law.

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Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that Advantest bears absolutely no responsibility for the result of operations caused due to incorrect or inappropriate use of this instrument.

If the equipment is used in a manner not specified by Advantest, the protection provided by the equipment may be impaired.

- **Warning Labels**

  Warning labels are applied to Advantest products in locations where specific dangers exist. Pay careful attention to these labels during handling. Do not remove or tear these labels. If you have any questions regarding warning labels, please ask your nearest Advantest dealer. Our address and phone number are listed at the end of this manual.

  Symbols of those warning labels are shown below together with their meaning.

  DANGER: Indicates an imminently hazardous situation which will result in death or serious personal injury.

  WARNING: Indicates a potentially hazardous situation which will result in death or serious personal injury.

  CAUTION: Indicates a potentially hazardous situation which will result in personal injury or a damage to property including the product.

- **Basic Precautions**

  Please observe the following precautions to prevent fire, burn, electric shock, and personal injury.

  - Use a power cable rated for the voltage in question. Be sure however to use a power cable conforming to safety standards of your nation when using a product overseas.
  - When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.
  - When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
  - Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
  - Connect the power cable to a power outlet that is connected to a protected ground terminal. Grounding will be defeated if you use an extension cord which does not include a protected ground terminal.
  - Be sure to use fuses rated for the voltage in question.
  - Do not use this instrument with the case open.
  - Do not place anything on the product and do not apply excessive pressure to the product. Also, do not place flower pots or other containers containing liquid such as chemicals near this

product.

- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

- **Caution Symbols Used Within this Manual**

Symbols indicating items requiring caution which are used in this manual are shown below together with their meaning.

DANGER: Indicates an item where there is a danger of serious personal injury (death or serious injury).

WARNING: Indicates an item relating to personal safety or health.

CAUTION: Indicates an item relating to possible damage to the product or instrument or relating to a restriction on operation.

- **Safety Marks on the Product**

The following safety marks can be found on Advantest products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

The following parts used in the instrument are main parts with limited life.
Replace the parts listed below before their expected lifespan has expired to maintain the performance and function of the instrument.
Note that the estimated lifespan for the parts listed below may be shortened by factors such as the environment where the instrument is stored or used, and how often the instrument is used.
The parts inside are not user-replaceable. For a part replacement, please contact the Advantest sales office for servicing.

Each product may use parts with limited life.
For more information, refer to the section in this document where the parts with limited life are described.

Main Parts with Limited Life

Part name	Life
Unit power supply	5 years
Fan motor	5 years
Electrolytic capacitor	5 years
LCD display	6 years
LCD backlight	2.5 years
Floppy disk drive	5 years
Memory backup battery	5 years

- **Hard Disk Mounted Products**

The operational warnings are listed below.

- Do not move, shock and vibrate the product while the power is turned on.
  Reading or writing data in the hard disk unit is performed with the memory disk turning at a high speed. It is a very delicate process.

- Store and operate the products under the following environmental conditions.
  An area with no sudden temperature changes.
  An area away from shock or vibrations.
  An area free from moisture, dirt, or dust.
  An area away from magnets or an instrument which generates a magnetic field.

- Make back-ups of important data.
  The data stored in the disk may become damaged if the product is mishandled. The hard disc has a limited life span which depends on the operational conditions. Note that there is no guarantee for any loss of data.

- **Precautions when Disposing of this Instrument**

When disposing of harmful substances, be sure dispose of them properly with abiding by the state-provided law.

Harmful substances: (1) PCB (polycarbon biphenyl)
(2) Mercury
(3) Ni-Cd (nickel cadmium)
(4) Other
Items possessing cyan, organic phosphorous and hexadic chromium and items which may leak cadmium or arsenic (excluding lead in solder).

Example: fluorescent tubes, batteries

Environmental Conditions

This instrument should be only be used in an area which satisfies the following conditions:

- An area free from corrosive gas
- An area away from direct sunlight
- A dust-free area
- An area free from vibrations
- Altitude of up to 2000 m

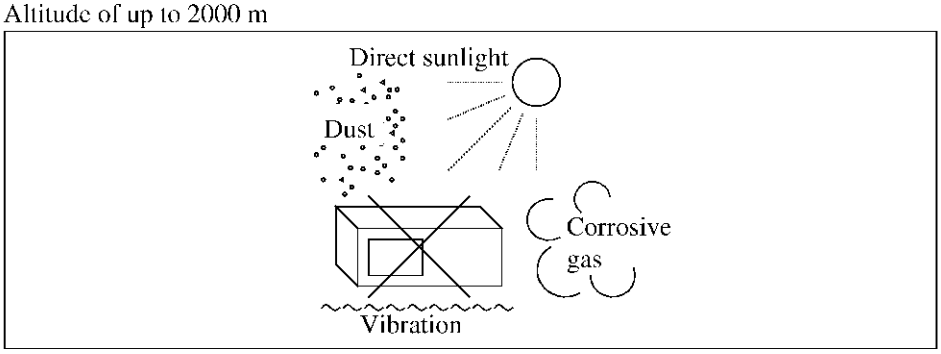


Figure-1 Environmental Conditions

- Operating position

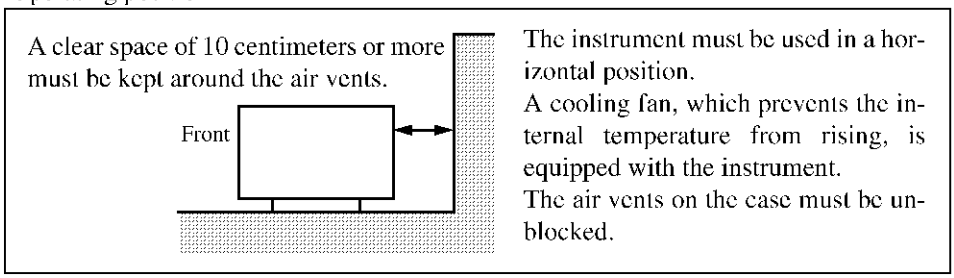


Figure-2 Operating Position

- Storage position

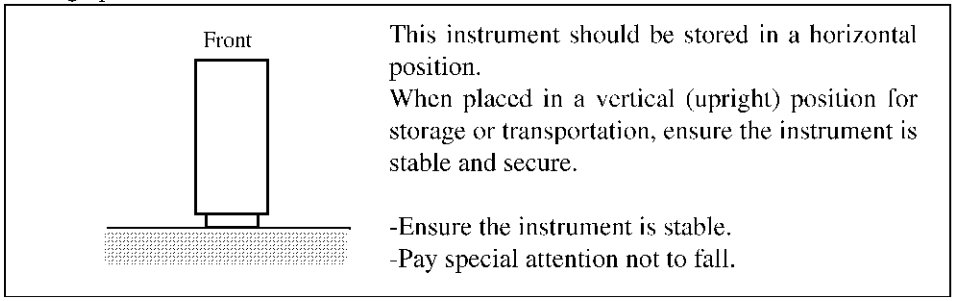


Figure-3 Storage Position

- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  Impulse withstand voltage (over-voltage) category II defined by IEC60364-4-443

  Pollution Degree 2

Types of Power Cable

Replace any references to the power cable type, according to the following table, with the appropriate power cable type for your country.

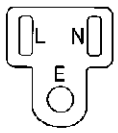
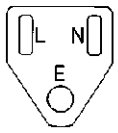
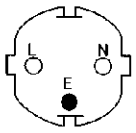
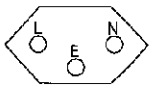
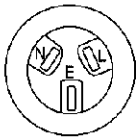
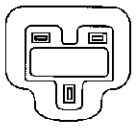
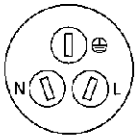
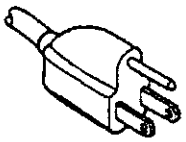
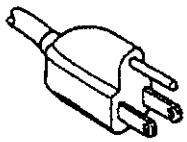
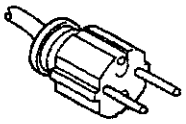
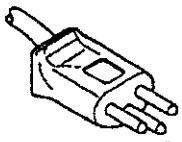
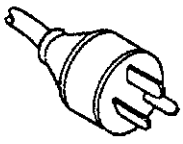
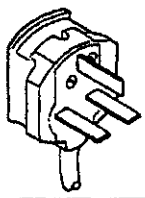
Plug configuration	Standards	Rating, color and length	Model number (Option number)
	PSE: Japan Electrical Appliance and Material Safety Law	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
	UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
	CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
	SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
	SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
	BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417
	CCC:China	250 V at 10 A Black 2 m (6 ft)	Straight: A114009 (Option 94) Angled: A114109

Table of Power Cable Options

There are six power cable options (refer to following table).

Order power cable options by Model number.

	Plug configuration	Standards	Rating, color and length	Model number (Option number)
1		JIS: Japan Law on Electrical Appliances	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
2		UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
3		CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
4		SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
5		SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
6		BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417

PREFACE

Related models are as follows:

- D3285 ERROR DETECTOR
- TR4515 SYNTHESIZED SWEEPER

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1. GENERAL INFORMATION

1.1 General

The D3185A high-performance pulse pattern generator generates (in combination with the TR4515 synthesized sweeper) nine stages of the pseudo random (PRBS) pattern from 2^7-1 to 2^{23}-1 and ten stages of the programmable pattern up to 2^{16} (65536)-bit length in the ultra-high frequency band from 1 to 10GHz.
For the PRBS pattern, a variety of marking rates can be set.

[FEATURES]

The D3185A pulse pattern generator:

- Provides a memory for storing 16 sets of frequency values for quicker setting of the frequency, in combination with TR4515.
- Has amplitude and offset selections knobs for each of the data and clock outputs.
- Has a motor-driven variable delay line of a maximum of ±400ps to the clock output and a resolution of 1ps.
- Provides a master slave function to coordinate the patterns with the D3285 error detector for determining the code error rate.

1.2 Before Using the Equipment

1.2.1 Check of Attachment

Upon receipt of the D3185A, run checks thereon as shown below.

① Run visual checks against any and all damages or imperffections.

② Check the quantity and rating of standard attachments to assure their conformance with Table 1-1.

Should there be any flaw, or damage, or missing or insufficient part, contact the nearest dealer or the sales and support offices.

Request to User: When ordering add-on attachments and the like, be good enough to stipulate the model (or stock No.) concerned.

Table 1-1 Standard Attachments

No.	Product name	Model	Stock No.	Q'ty	Remarks
1	Power cable	A01402	DCB-DD2428×01	1	
2	SMA-SMA cable	DGM224-00700A	DCB-FF1211×01	5	
3	GPIB cable	408JE-101	DCB-SS1076×02	1	
4	Double/triple-pole conversion adapter for power plug	A09034	JCD-AL003E×03	1	
5	K adapter	30-672-0000-890	JCF-BJ001E×02	5	
6	Instruction manual	—	JD3185A	1	Japanease
		—	ED3185A		English

1.2.2 Operating Environment

(1) Avoid using the D3185A where it may be exposed to a lot of dust, direct sunlight, or corrosive gases.

(2) Operate the D3185A at an ambient temperature from 0 to 40°C and a humidity of 40 to 85%.

(3) Be careful in handling the D3185A so as not to give it any severe machanical shock.

(4) Keep at least 10cm space between the back of the D3185A and an wall or other large object because the D3185A has a discharge-type cooling fan. Do not block the air intake holes on the top and sides of the unit.

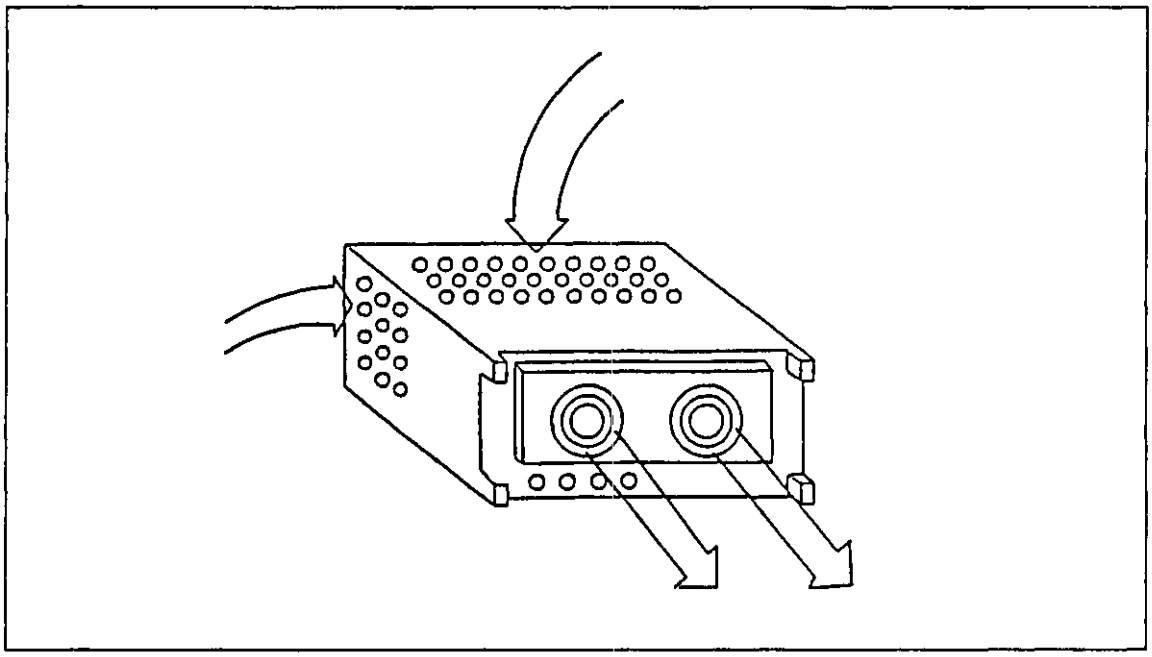


Figure 1-1 Ventilation with Cooling Fan

1.2.3 Setting Up

(1) Supply voltage

The AC supply voltage for the D3185A is factory set and its value is displayed near the power cable on the rear panel. This unit must be used within the range of the displayed value and at a frequency of 50Hz/60Hz.

(2) Power cable

The power cable has a three-pin plug whose round pin is to be grounded. Ground D3185A 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 D3185A.

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 D3185A using the power plug, use the ground terminal on the rear panel of the D3185A.

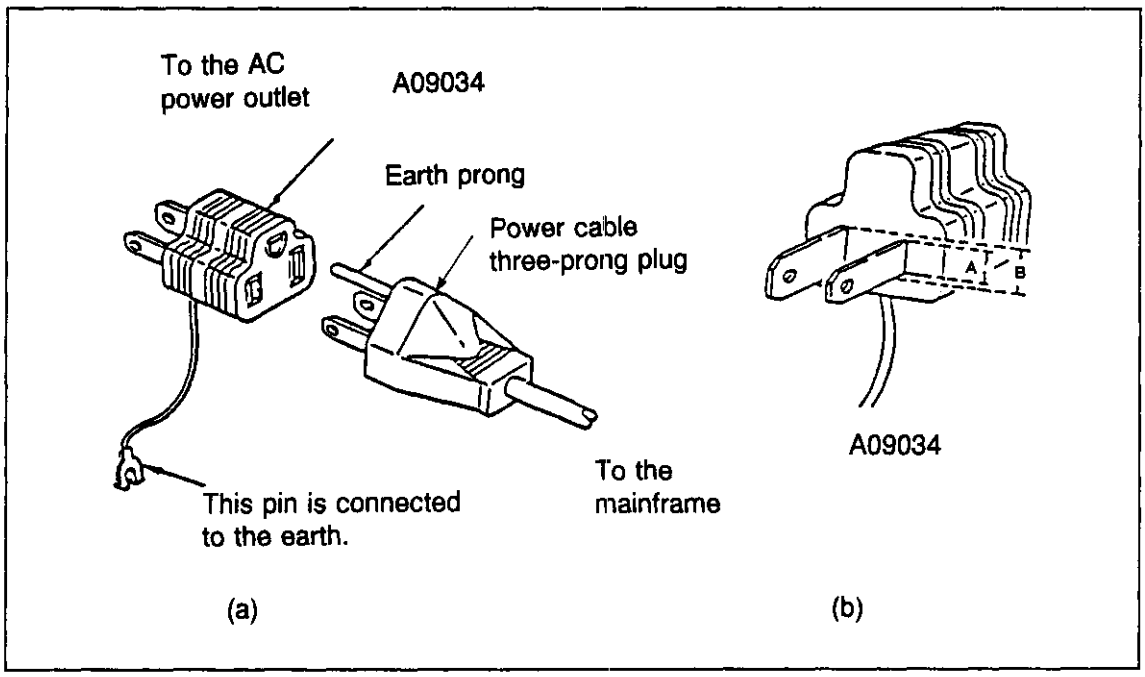


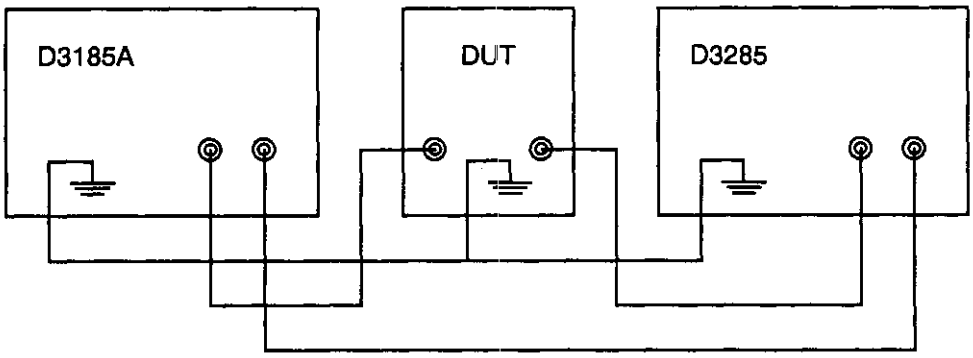
Figure 1-2 Power Cable Plug and Adapter

1.2.4 Notes on Use

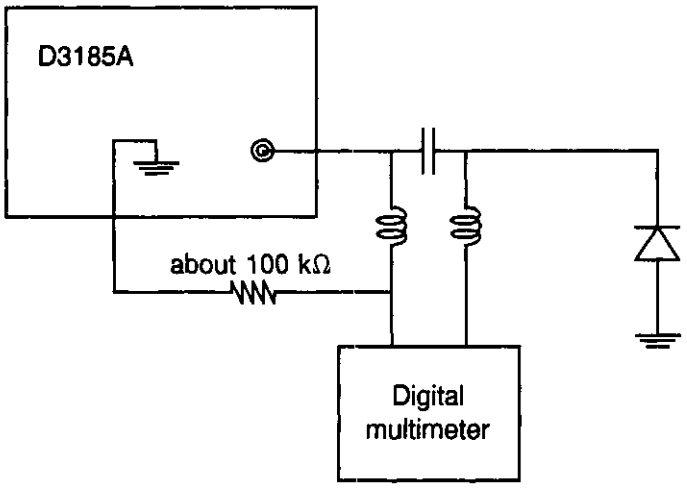
(1) Connect a 50-ohm resistor terminated by earth potential or −2V as a load to the output except when a DC blocking capacitor is connected to the output of the pulse pattern generator so that a voltage may not be applied there in the AC mode. (A voltage can be applied to the 50-ohm resistor.)

(2) Do not apply a voltage or feed a current to the output of the pulse pattern generator in a mode other than the ECL Level mode and when the output is terminated with a 50-ohm resistor.

(3) Since the part for high frequency is the internal circuit connected to the input/output terminal of this device, the static electricity is very weak and is sometimes damaged.



Be sure to ground the testing devices and the DUT before connecting inputs and outputs.



When floating equipment is connected, be sure to connect the resistor (about 100 kΩ) and the input/output terminal.

1.2.5 Storing, Transporting, and Cleaning

(1) Storage

When the D3185A is not used for a long period of time, the D3185A should be stored in a corrugated cardboard box in a place not exposed to direct sunlight which has low humidity.

The D3185A must be stored at an ambient temperature and humidity within the ranges from −20 to +60°C and 30 to 85% respectively.

(2) Transportation

When transporting D3185A, use its original packaging. If the packaging has been lost, observe the following instructions:

① Cover the D3185A with vinyl. (Put a desiccating agent under the vinyl cover to prevent the affects of moisture.)

② Put the D3185A in a corrugated cardboard box. Then put a cushioning material, 40mm or more thick, between the D3185A and the inner wall of the box so as to cover the D3185A with the cushion.

③ Put the accessories of the D3185A in the box, add a cushioning material and close the box. Lastly tie up the box with packing rope.

(3) Cleaning

When cleaning the D3185A, give attention to the following:

CAUTION

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

2. DESCRIPTION OF PANEL

This chapter describes the front and rear panels.

2.1 Front Panel

The front panel consists of the three blocks as shown in Figure 2-1.

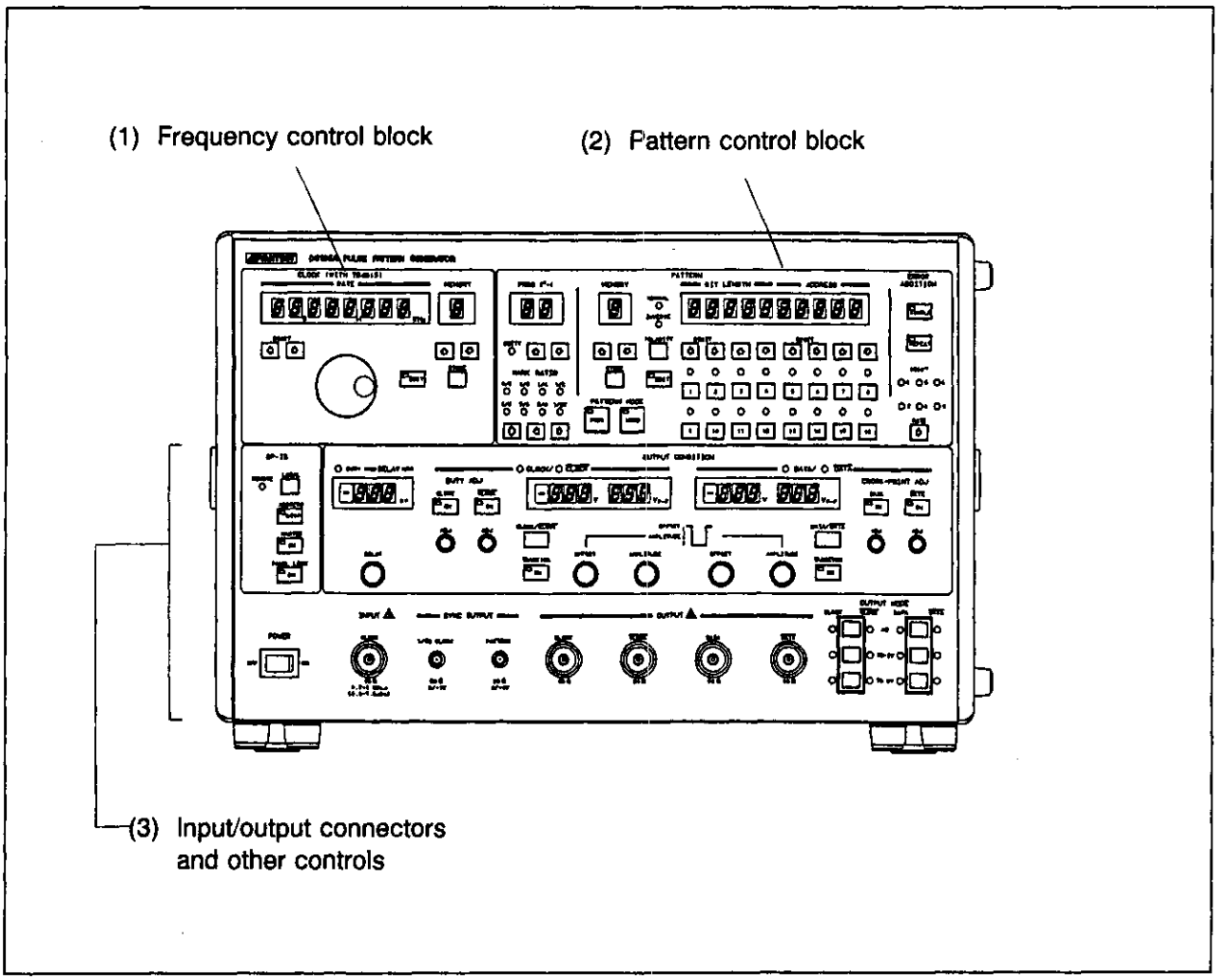


Figure 2-1 Front Panel

(1) Frequency control block (in combination with TR4515)

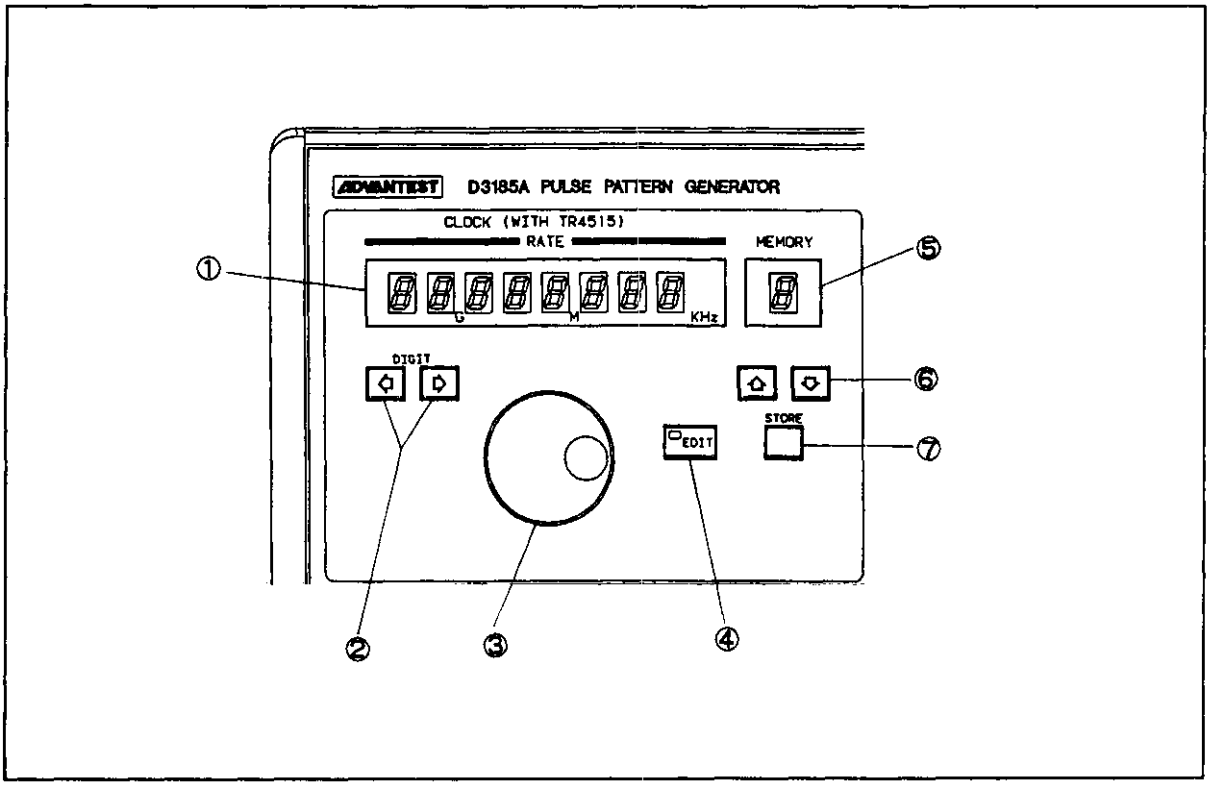


Figure 2-2 Frequency Control Block

① Frequency indicator (RATE)

Indicates the value of the currently set clock frequency in MHz.

② DIGIT key

Selects the digit in a frequency value to be set by the knob.
These keys can work only while the EDIT key is on.

③ Frequency setting knob

When this knob is turned counterclockwise and clockwise it increments and decrements the digit which has a lighting pointer on the frequency indicator.

④ EDIT key

Used to change the current frequency value in real time or to update stored values using the knob.

⑤ Memory operating section (for frequency value storage)

Stores up to sixteen frequency values set by the frequency setting knob.

⑥ STEP key

While the EDIT key ④ is off, the frequency registered for a selected file number is displayed in the RATE display ①. Step key [⇧] is used to increase the file number and step key [⇩] to decrease the file number.

⑦ STORE key

This key is valid while the EDIT key ④ is on. When this key is pressed, the frequency displayed in the RATE display is registered for the file number displayed in ⑤.

(2) PATTERN control block

(2-1) PRBS pattern setting block

⑧ PRBS key

Changes the output pattern setting to the pseudo-random mode.

⑨ PRBS stage count selector section

Selects one of nine types of PRBS pattern stages: 7, 9, 10, 11, 15, −15, 17, 20, and 23.

⑩ MARK RATIO selecting section

Selects any one of eight types of mark ratios.

⑪ CCITT LED

Lights up when a PRBS pattern which conforms to the standard specification is selected with the PRBS stage count selector section and the mark ratio selecting section.

(2-2) Word pattern setting block

⑫ WORD key

Changes the output pattern setting to the word mode.

⑬ Pattern polarity selector section

Determines the logic of a data pattern to be output from the DATA OUTPUT connector. (words only)

⑭ EDIT key

Turn off this key to use a stored pattern. Turn on this key to change the contents of stored patterns or output patterns created in real time.

⑮ Pattern indicators and pattern setting keys

Pattern setting keys from [1] to [16] are available only when the EDIT key is on.
When the PRBS key is on, the outputs of CLOCK DC and DATA can be changed to the AC mode with the [1] and [16] keys.

⑯ DIGIT key

Selects the digit to be set for a bit length.

⑰ BIT LENGTH indicator

Displays the bit length of a pattern which is being created when the EDIT key is on. The indicator displays the bit length of a stored pattern when the EDIT key is off. This indicator is cleared while the PRBS key is on.

⑱ Bit length setting key

Sets the digit with a lighting pointer on the BIT LENGTH indicator.

⑲ DIGIT key

Selects the digit to be set for an address number.

⑳ ADDRESS number indicator

Displays the address number of the 16-bit pattern which is being monitored with a pattern indicator.

㉑ Address number setting key

Used to set address numbers.

㉒ Memory operating section (for word pattern storage)

Stores up to ten word patterns which have been created.

㉓ Word memory setting keys

These keys are used to increase or decrease a file number displayed in the MEMORY display ㉒.
Step key [⇧] is used to increase the file number and step key [⇩] to decrease the file number.
When one of these keys is pressed while the EDIT key ⑭ is off, the word pattern registered for a selected file number is output.

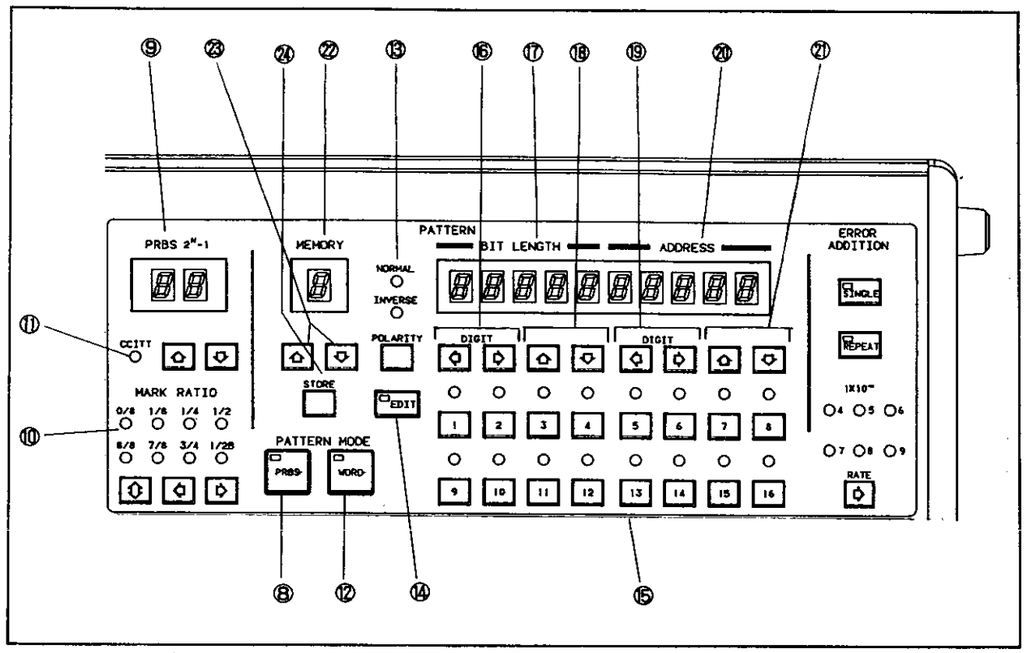


Figure 2-3 Pattern Control Block

㉔ Word pattern registration key

When this key is pressed wile the EDIT ⑭ is on, the currently-created word pattern is registered for a file number displayed in ㉒.

(3) Input/output connectors and other controls

㉕ POWER switch

Turns on or off the power supply of this unit.

㉖ CLOCK INPUT connector

Inputs external clock signals.

㉗ 1/32 CLOCK OUTPUT connector

Outputs a signal obtained by dividing the frequency of the input clock by 32.

㉘ PATTERN SYNC OUTPUT connector

Outputs a signal in synchronism with a pattern output from DATA OUTPUT.

㉙ CLOCK OUTPUT connector

Outputs a DC combination of the used clocks.

㉚ $\overline{\text{CLOCK}}$ OUTPUT connector

Outputs inverted CLOCK OUTPUT.

㉛ DATA OUTPUT connector

Outputs a preset pattern with NRZ.

㉜ $\overline{\text{DATA}}$ OUTPUT connector

Outputs inverted DATA OUTPUT.

㉝ Block to set terminating conditions of CLOCK or $\overline{\text{CLOCK}}$

Switches between CLOCK OUTPUT and $\overline{\text{CLOCK}}$ OUTPUT terminating conditions. The selected terminating condition is indicated by the indicator ㊷.

㉞ Block to set terminating conditions of DATA or $\overline{\text{DATA}}$

Switches between DATA OUTPUT and $\overline{\text{DATA}}$ OUTPUT terminating conditions. The selected terminating condition is indicated by the indicator ㊱.

㉟ DATA or $\overline{\text{DATA}}$ active channel selector switch

Enables switch knobs (amplitude, offset, and terminating condition) on the panel.

㊱ DATA or $\overline{\text{DATA}}$ active channel indicator

The indicator lights to indicate the selected channel of switch knobs (amplitude, offset, and terminating condition) on the panel.

㊲ DATA or $\overline{\text{DATA}}$ tracking/non-tracking selector switch

Switches to set DATA/$\overline{\text{DATA}}$ offsets and terminating conditions simultaneously or separately. The selected switch is indicated by the indicator.

㊳ Cross-point calibrating block

Calibrates the cross-point of the DATA or $\overline{\text{DATA}}$ output.

㊴ Block to set the amplitude of the DATA or $\overline{\text{DATA}}$ output

Equipped with a display to display the amplitude value of the DATA or $\overline{\text{DATA}}$ output and a control to set the amplitude value of the DATA or $\overline{\text{DATA}}$ output.

㊵ Block to set the offset of the DATA or $\overline{\text{DATA}}$ output

Equipped with a display to display the offset value of the DATA or $\overline{\text{DATA}}$ output and a control to set the offset value of the DATA or $\overline{\text{DATA}}$ output.

㊶ CLOCK or $\overline{\text{CLOCK}}$ active channel selector switch

Enables switch knobs (amplitude, offset, and terminating condition) on the panel.

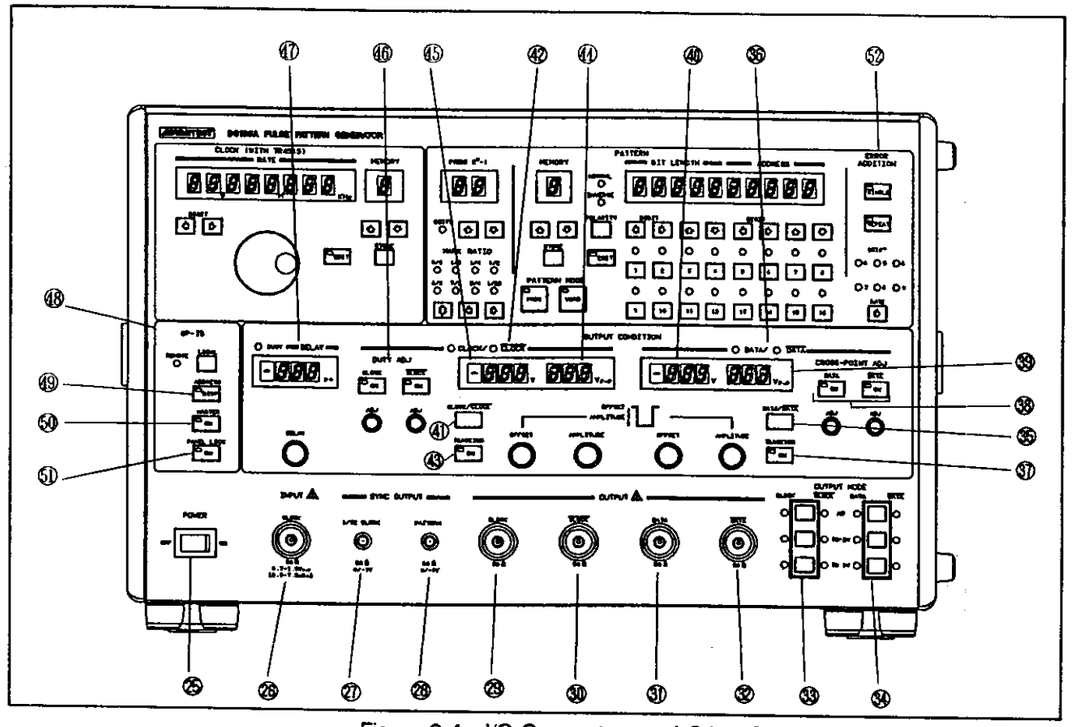


Figure 2-4 I/O Connectors and Other Controls

㊷ CLOCK or $\overline{\text{CLOCK}}$ active channel indicator

The indicator lights to indicate the selected channel of switch knobs (amplitude, offset, and terminating condition) on the panel.

㊸ CLOCK or $\overline{\text{CLOCK}}$ tracking/non-tracking selector switch

Switches to set CLOCK/$\overline{\text{CLOCK}}$ offsets and terminating conditions simultaneously or separately. The selected switch is indicated by the indicator.

㊹ Block to set the amplitude of the CLOCK or $\overline{\text{CLOCK}}$ output

Equipped with a display to display the amplitude value of the CLOCK or $\overline{\text{CLOCK}}$ output and a control to set the amplitude value of the CLOCK or $\overline{\text{CLOCK}}$ output.

㊺ Block to set the offset of the CLOCK or $\overline{\text{CLOCK}}$ output

Equipped with a display to display the offset value of the CLOCK or $\overline{\text{CLOCK}}$ output and a control to set the offset value of the CLOCK or $\overline{\text{CLOCK}}$ output.

㊻ Duty calibrating block

Calibrates the duty of the CLOCK or $\overline{\text{CLOCK}}$ output.

㊼ Delay setting block

Sets a time difference between the data (DATA/$\overline{\text{DATA}}$) output time and the clock (CLOCK/$\overline{\text{CLOCK}}$) output time.

㊽ GPIB setting block

The REMOTE indicator lights in the REMOTE status. You can return to the LOCAL status by pressing the LOCAL key.

㊾ Address display key

Enables the address number display to show a GPIB address.

㊿ Master control key

Used to cooperate the settings of the D3285 pattern setting block with those of the D3185A.

(51) Panel lock key

Locks all keys and controls.

(52) Error addition setting block

Enables addition of a single error and 1×10^{-4} to 1×10^{-9}.

2.2 Rear Panel

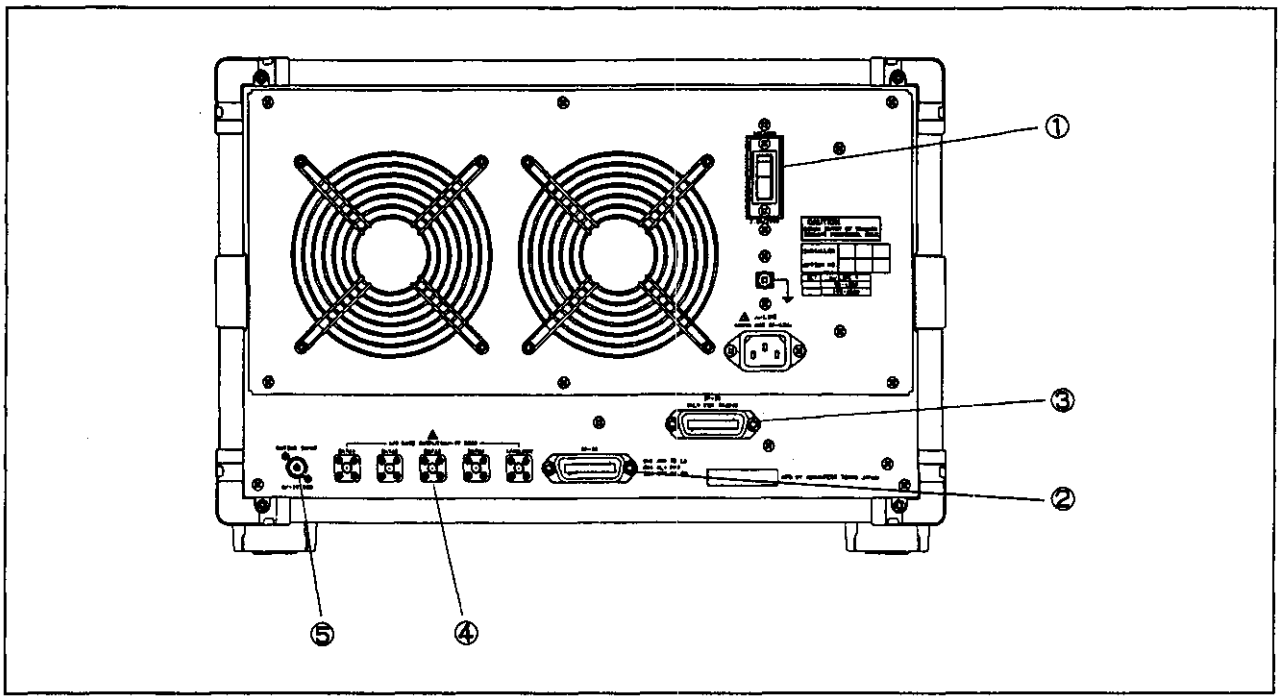


Figure 2-5 Rear Panel

① BREAKER

Turns off the power when an overcurrent flows through the AC line.

② GPIB connecter

Used for GPIB control ro master/slave control.

③ GPIB connector for TR4515

Transmits the clock frequency set for TR4515 by D3185A.

④ 1/4 RATE OUTPUT

1/4 RATE OUTPUT of the DATA output and the CLOCK output. Ground the unit with 50 Ω. The phase of each output is as follows at left side. (Figure 2-6)

⑤ GATING INPUT

Inhibits DATA output as follows at right side. The input impedance is about 50 Ω. (Figure 2-7)

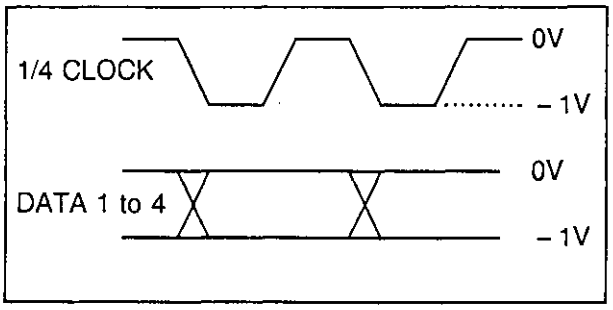


Figure 2-6 1/4 Rate Output

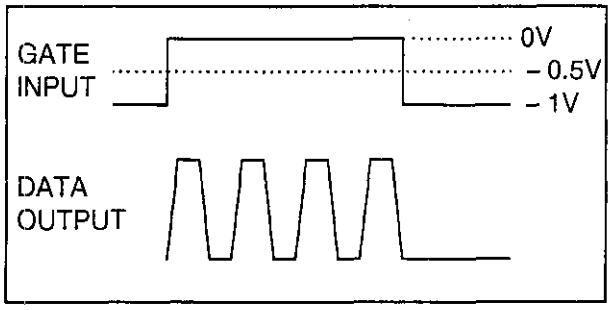


Figure 2-7 Gating Input

3. OPERATION METHOD

3.1 Turning on the Power

First check that the POWER switch on the front panel is off and the breaker on the rear panel is on (with the · side pressed). Then connect the power plug to the power receptacle. Avoid turning on and off the breaker frequently as a substitute for the POWER switch.

Lastly turn on the POWER switch to connect power to the D3185A.

3.2 Operation of Each Part

This section describes the operation method of each part of the front panel. See Figures 2-1, 2-2, 2-3, and 2-4 when required.

(1) Frequency control block

Note that D3185A must be connected to TR4515 with the GPIB cable.
The components are explained in the order of the numbering in Figure 2-2 as follows:

① Frequency indicator (RATE)

This indicator displays the frequency value of the TR4515 as it is currently set.
The value in MHz units is shown in eight digits with a decimal point fixed on the fourth digit. The resolution is 1kHz and the displayable frequency range is from 500000kHz to 10000000kHz.

This indicator may display the frequency value which is currently set on the knob in real time or it may display a store frequency value.

② DIGIT key

The DIGIT keys are used to select the digit of a frequency value to be set by the knob.

These keys work only while the EDIT key is on.

A selected digit to be set is accompanied by a left-superscript pointer on.
To move the pointer to the left by one digit, press the [◁] key once.
To move it to the right by one digit, press the [▷] key once.

③ Frequency setting knob

Turn this knob counterclockwise to increase the digit with the lighting pointer on the frequency indicator. At this time, a carry digit is transferred to the higher-order digit position. Turn this knob clockwise to decrease the numeral. Then a borrow digit is transferred to the higher-order digit.

This knob is of the constant-speed response type and has a limit in the speed at which a frequency value can be set or changed.

To set or change a frequency value, move the pointer to the higher digit position.

④ EDIT key

Turn on this key to change the current frequency value in real time or update stored values using the knob ③. This key must be off when a stored value is used.
This key is enabled when its indicator is on.

⑤ Memory operating section (for frequency value storage)

This section allows the storing of up to sixteen frequency values which are set with the frequency setting knob.
The MEMORY indicator displays an alphanumeric character from 0 to F which is handled as the file number (memory number) of a particular frequency value stored in memory. Keys [△] and [▽] cause the memory number, which is displayed on the MEMORY indicator, to increase and decrease respectively.

⑥ Step key

To set a higher memory number, press the [△] key once. Holding down the key increments the memory number in succession. To set a lower memory number, press the [▽] key once.

Press the [△] key or the [▽] key when the EDIT key (④ above) is off, the frequency indicator (① above) displays the stored frequency value corresponding to the displayed memory number.

⑦ Store key

To store a new frequency value, press the STORE key after checking that the EDIT key is turned on. Then the frequency value being displayed on the frequency indicator is stored in memory with the memory number which is being displayed on the MEMORY indicator.

(2) PATTERN control block

The components are explained in the order of the numbering in Figure 2-3 as follows:

⑧ PRBS key

This key is used to change the output pattern setting to the pseudo-random mode.

⑨ PRBS stage count selector section

The PRBS stage count is indicated with a two-digit and 7-segment LED display. The nine stages of PRBS are: 7, 9, 10, 11, 15, −15, 17, 20, and 23. Stage −15 is differ from 15 in the generating polynomial (refer to Table 3-1).
The [△] key increments the stage count, while the [▽] key decrements it.

⑩ MARK RATIO selecting section

This section is used to select any one of eight types of mark ratios: 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 in turn when the key is pressed. The [▷] key selects one of the horizontally arranged LEDs in a clockwise direction. The [◁] key selects it in a counterclockwise direction.

⑪ CCITT LED

This LED is on when the PRBS pattern selected with ⑧ and ⑩ conforms to the standard specification.
This indicator lights when the mark ratio is 1/2 in the above step 7, 9, 11, 15, 20, or 23.
(Note that the LED goes on for each of the 15 and 23 stages with a mark ratio of 1/2B.)
Table 3-1 shows the on/off state of the CCITT LED with the generating polynomial for each PRBS pattern stage.

⑫ WORD key

This key is used to change the output pattern setting to the word mode.

⑬ Pattern polarity selector section

This section is used to determine the logic of a data pattern to be output from the DATA OUTPUT connector ㉛. To select either of them, press the POLARITY key.

The NORMAL and INVERSE LEDs display the reverse of each other in their respective indicating logic.

The stored pattern is output in its original form when NORMAL polarity is selected. When INVERSE polarity is selected, on the other hand, the inverted pattern is output. Note that the contents of the pattern is monitored with the corresponding pattern indicator ⑮ at that time.

⑭ EDIT key

Turn off this key to use the stored pattern.
Turn on this key to change the contents of stored patterns or output created patterns in real time.

⑮ Pattern indicators and pattern setting keys

Pattern setting keys from [1] to [16] are available only when the EDIT key is on.
The set pattern is monitored using the LED (pattern indicator) above the corresponding key.
The lighting pattern indicator LED represents logic 1 (high level).

When the bit length is 17 or more, set the pattern after updating the address number.

When a stored pattern or a PRBS pattern is used, the contents of the pattern used is monitored with the corresponding LED.

⑯ DIGIT key

The DIGIT keys are used to select the digit to be set when setting a bit length.
The digit to be set is identified by its superscript pointer.
Pressing keys [▷] and [◁] cause the pointer to move to the right digits and left digits, respectively.

⑰ BIT LENGTH indicator

This indicator displays the bit length of a pattern being created. Press the ⇧ key or the ⇩ key when the EDIT key is on. The indicator displays the bit length of a stored pattern when the key is off.
This indicator is cleared while the PRBS key ⑧ is on.

The bit length is displayed with a maximum of five digits. The bit length is displayed in bits in the range of 1 bit to 1024 bits or with a multiple of 64 bits in the range of 1024 bits to 65536 bits.

⑱ Bit length setting key

The bit length setting keys are used to set the digit with a lighting pointer on the BIT LENGTH indicator ⑰.
When the ⇧ key is pressed, the numeral is incremented and a carry digit is transferred to the higher-order digit position. When the ⇩ key is pressed, the numeral is decremented and a borrow digit is transferred to the higher-order digit position.

⑲ DIGIT key

The DIGIT keys are used to select the digit to be set when setting an address number.
The digit to be set is identified with its superscript pointer.
Pressing keys ⇨ and ⇦ cause the pointer to move to the right digits and left digits, respectively.

⑳ ADDRESS number indicator

This indicator displays the address number of the 16-bit pattern which is being monitored with the pattern indicator ⑮. The address number indicator functions even with the PRBS key ⑧ on, allowing the contents of the PRBS pattern to be checked.

㉑ Address number setting key

The address number setting keys are used to set address numbers.
Pressing keys ⇧ and ⇩ cause the digit with a superscript pointer displayed in the address number indicator to be incremented and decremented, respectively. In each case, a carry or borrow digit is transferred to the higher digit position.

The setting range is step 1 from 0 to 4095. Note that this range does not apply to the case when the PRBS pattern is being monitored, and up to 524287 can be set.

㉒ Memory operating section (for word pattern storage)

This section is used to store up to ten word patterns which have been created. The MEMORY indicator displays numeric characters from 0 to 9 and alphabetic characters A and b. 0 to 9 can be both called and stored. The A and b are to be called only. The A stores 1023-bit length of the 10B1C-rule patterns. The b stores the all-zero pattern.

㉓ Word memory setting key

Press keys [△] and [▽] to increment and decrement respectively the number which is displayed on the MEMORY indicator.

To increment or decrement the currently displayed number by one, press the corresponding key once. Holding down the key increments or decrements the number in succession.

Press the [△] key or the [▽] key when the EDIT key ⑭ is off, the stored patterns are output according to the displayed memory numbers.

㉔ Word pattern registration key

To store a new pattern, press the STORE [□] key after checking that the EDIT key is on. Then the pattern being created is stored in memory with the memory number currently displayed on the MEMORY indicator.

(3) Input/output connectors and other controls

The components are explained in the order of the numbering in Figure 2-4 as follows:

㉕ POWER switch

This switch turns on and off the power supply of the D3185A.
If power isn't available to the D3185A when this switch is on, check if the breaker on the rear panel is off.

㉖ CLOCK INPUT connector

This connector inputs external clock signals to the D3185A.
The input impedance is approx. 50Ω (when connected directly to the GND). Enter the sine wave of 0.7 to 1.5$V_{p\text{-}p}$ amplitude.

㉗ 1/32 CLOCK OUTPUT connector

This connector outputs 1/32 divided signals from the clock being used.
This connector is used when measuring PRBS eye patterns with a sampling oscilloscope.
The output impedance is 50Ω with the level of 0V/ – 1V.

㉘ PATTERN SYNC OUTPUT connector

This connector outputs the signal synchronized with the pattern output from the DATA OUTPUT connector ㉛.
The signal changes its phase by 16 bits whenever the address number displayed on the address number indicator ⑳ changes.

㉙ CLOCK OUTPUT connector

This connector is the DC-coupled output of the clock in use.
The offset, amplitude and the duty factor can be varied by using their respective setting sections ㊹ , ㊺ , and ㊻ .

㉚ $\overline{\text{CLOCK}}$ OUTPUT connector

This connector is the DC-coupled output of the clock in use.
The offset, amplitude and the duty factor can be varied by using their respective setting sections ㊹ , ㊺ , and ㊻ . The output impedance is about 50Ω.
This is the inverted output of ㉙.

㉛ DATA OUTPUT connector

This connector outputs the set pattern in NRZ.
The offset, amplitude are variable by using ㊴ and ㊵, respectively. The output imped-ance is about 50Ω.

The change point of the data almost matches the last transition point of the CLOCK OUTPUT of ㉙.

㉜ $\overline{\text{DATA}}$ OUTPUT connector

Outputs the inversion of a preset pattern with NRZ. Its offset and amplitude can be changed by steps ㊴ and ㊵. The output impedance is about 50Ω.
The data transition point is approximately equal to the trailing edge of CLOCK OUTPUT (see ㉙).
This is the inverted output of ㉛.

㉝ Block to set terminating conditions of CLOCK or $\overline{\text{CLOCK}}$

Selects the output level of CLOCK or $\overline{\text{CLOCK}}$ (see ㉙and㉚) (selected by the active channel indicator ㊷).
When TRACKING ㊸ is selected, the terminating conditions of the active channel are set for both CLOCK and $\overline{\text{CLOCK}}$.

TO −2V : When the output is terminated with a 50Ω resistor to −2V, a waveform of the ECL level (high level: approx. −0.8V, low level: approx. −1.6V) is obtained. In this case, its offset and amplitude can be varied by ±200mV.

TO 0V : When the output is terminated with a 50Ω resistor to GND, the offset can be varies in the range of +2V to −2V and the amplitude can be varied in the range of 0.5 to $2V_{p\text{-}p}$.

TO AC : Used when the signal line is not connected to the 50Ω termination in a DC form. The amplitude can be varied in the range of 0.5 to $2V_{p\text{-}p}$.

㉞ Block to set terminating conditions of DATA or $\overline{\text{DATA}}$

Selects the output level of DATA or $\overline{\text{DATA}}$ (see ㉛ and ㉜) (selected by the active channel indicator ㊱).
When TRACKING ㊲ is selected, the terminating conditions of the active channel are set for both DATA and $\overline{\text{DATA}}$.

TO −2V : When the output is terminated with a 50Ω resistor to −2V, a waveform of the ECL level (high level: approx. −0.8V, low level: approx. −1.6V) is obtained. In this case, its offset and amplitude can be varied by ±200mV.

TO 0V : When the output is terminated with a 50Ω resistor to GND, the offset can be varies in the range of +2V to −2V and the amplitude can be varied in the range of 0.5 to $2V_{p\text{-}p}$.

TO AC : Used when the signal line is not connected to the 50Ω termination in a DC form. The amplitude can be varied in the range of 0.5 to $2V_{p\text{-}p}$.

㉟ DATA or $\overline{\text{DATA}}$ active channel selector switch

Switches between DATA or $\overline{\text{DATA}}$ channels for display of its amplitude and offset. The selected channel is indicated by indicator ㉟.
The offset and amplitude which are currently displayed can be changed by control knobs ㊴ and ㊵. Terminating conditions ㉞ are set for the selected channel.

㊱ DATA or $\overline{\text{DATA}}$ active channel indicator

The indicator lights to indicate a channel selected by ㉟.
When TRACKING ㊲ is selected, both DATA and $\overline{\text{DATA}}$ active indicators light.

㊲ DATA or $\overline{\text{DATA}}$ tracking/non-tracking selector switch

Switches to set DATA/$\overline{\text{DATA}}$ offset and amplitude simultaneously or separately. The selected switch is indicated by indicator ㊱.
When TRACKING is selected, terminating conditions ㉞ are set in the same manner.

㊳ Cross-point calibrating block

When the DATA key is on, you can calibrate the cross-point of the DATA output by the control knob.
When the $\overline{\text{DATA}}$ key is on, you can calibrate the cross-point of the $\overline{\text{DATA}}$ output by the control knob.

㊴ Block to set the amplitude of the DATA or $\overline{\text{DATA}}$ output

Equipped with a display to display the amplitude value of the DATA or $\overline{\text{DATA}}$ output and a control to set the amplitude value of the DATA or $\overline{\text{DATA}}$ output.
Turn the control knob clockwise to increase the amplitude value or counterclockwise to decrease it. The control range of the amplitude is 0.5 to $2V_{p\text{-}p}$ (0.6 to $1V_{p\text{-}p}$ in the ECL mode) at resolution of 10mV. This is valid for the selected channel (whose indicator is on).

㊵ Block to set the offset of the DATA or $\overline{\text{DATA}}$ output

Equipped with a display to display the offset value of the DATA or $\overline{\text{DATA}}$ output and a control to set the offset value of the DATA or $\overline{\text{DATA}}$ output.
Turn the control knob clockwise to increase the offset value or counterclockwise to decrease it. The control range of the offset is -2.00 to $+2V_{p\text{-}p}$ (-1.00 to $-0.60V_{p\text{-}p}$ in the ECL mode) at resolution of 10mV. The offset is applied to the high level of the output waveform. This is valid for the selected channel (whose indicator is on).

㊶ CLOCK or $\overline{\text{CLOCK}}$ active channel selector switch

Switches between CLOCK or $\overline{\text{CLOCK}}$ channels for display of its amplitude and offset. The selected channel is indicated by indicator ㊷.
The offset and amplitude which are currently displayed can be changed by control knobs ㊹ and ㊺. Terminating conditions ㉟ are set for the selected channel.

㊷ CLOCK or $\overline{\text{CLOCK}}$ active channel indicator

The indicator lights to indicate a channel selected by ㊶.

㊸ CLOCK or $\overline{\text{CLOCK}}$ tracking/non-tracking selector switch

Switches to set CLOCK/$\overline{\text{CLOCK}}$ offset and amplitude simultaneously or separately. The selected switch is indicated by indicator ㊷.
When TRACKING is selected, terminating conditions ㉝ are set in the same manner.

㊹ Block to set the amplitude of the CLOCK or $\overline{\text{CLOCK}}$ output

Equipped with a display to display the amplitude value of the CLOCK or $\overline{\text{CLOCK}}$ output and a control to set the amplitude value of the CLOCK or $\overline{\text{CLOCK}}$ output.
Turn the control knob clockwise to increase the amplitude value or counterclockwise to decrease it. The control range of the amplitude is 0.5 to $2V_{p\text{-}p}$ (0.6 to $1V_{p\text{-}p}$ in the ECL mode) at resolution of 10mV. This is valid for the selected channel (whose indicator ㊷ is on).

㊺ Block to set the offset of the CLOCK or $\overline{\text{CLOCK}}$ output

Equipped with a display to display the offset value of the CLOCK or $\overline{\text{CLOCK}}$ output and a control to set the offset value of the CLOCK or $\overline{\text{CLOCK}}$ output.
Turn the control knob clockwise to increase the offset value or counterclockwise to decrease it. The control range of the offset is -2.00 to $+2V_{p\text{-}p}$ (-1.00 to $-0.60V_{p\text{-}p}$ in the ECL mode) at resolution of 10mV. The offset is applied to the high level of the output waveform. This is valid for the selected channel (whose indicator ㊷ is on).

㊻ Duty ratio calibrating block

When the CLOCK key is on, the duty ratio of CLOCK OUTPUT can be calibrated by this control knob.
When the $\overline{\text{CLOCK}}$ key is on, the duty ratio of $\overline{\text{CLOCK}}$ OUTPUT can be calibrated by this control knob.

㊼ DELAY setting block

This section contains the knob to set the time difference between output and output. The D3185A uses the motor-driven delay line of the trombone type to provide the time difference. The setting range is from −400ps to +400ps (for the time difference of CLOCK output from DATA output) with a resolution 1ps. The motor starts driving about 0.2 seconds after turning the knob. The BUSY LED is on while the motor is on.

When the variation in the absolute value exceeds the tolerance, the unit enters the self-calibration routine and displays the word "CAL". This routine is terminated within 12 seconds. During the execution of this routine, any key setting on the panel is rejected.

㊽ GPIB setting block

When the GPIB is in the remote state, the REMOTE LED is on.
To release the GPIB from the remote state, press the LOCAL key.

㊾ ADDRESS display key

This key is used to display the address of the GPIB on the ADDRESS number indicator of ⑳. The setting range is from 0 to 30.

㊿ MASTER CONTROL key

This key interlocks the setting of the pattern control block of the error detector (D3285) with that of this unit (the D3185A).

Note: In this case, do not connect a device other than the D3285 to the GPIB connector.

(51) PANEL LOCK key

This key invalidates all the key settings and numerical settings.
Note that this does not apply to settings with the POWER switch, LOCAL key, DUTY ADJ knob, the CROSS-POINT ADJ knob and this PANEL LOCK key.

(52) ERROR ADDITION setting section

This section is used to set addition of 1×10^{-4} to 1×10^{-9} and a SINGLE error.

When the REPEAT key is ON, errors occur at the set error rate. When pressing the SINGLE key, the REPEAT key becomes OFF and an error occurs. After then, whenever pressing the SINGLE key, an error occurs.

If this key is pressed again when the REPEAT key is set to ON, the REPEAT key is set to OFF and occurrence of the error stops.

Table 3-1 PRBS Pattern Generating Polynomials

2^{N-1}	Generating polynomial	Governing specification	Applicable mark ratio	CCITT LED	
N = 7	$X^7 + X^6 + 1$	CCITT V.29	1/2	On	
9	$X^9 + X^5 + 1$	CCITT V.52	1/2	On	
10	$X^{10} + X^7 + 1$			Off	
11	$X^{11} + X^9 + 1$	CCITT O.152	1/2	On	
15	$X^{15} + X^{14} + 1$	CCITT O.151	1/2B	On	*
15	$X^{15} + X^1 + 1$			Off	*
17	$X^{17} + X^{14} + 1$			Off	
20	$X^{20} + X^3 + 1$	CCITT V.57	1/2	On	
23	$X^{23} + X^{18} + 1$	CCITT O.151 1	1/2B	On	

* : For $2^{15} - 1$, if the generating polynomial of $X^{15} + X^1 + 1$ is selected, the PRBS stage count selector section is " – 15" as described in item ⑨.

4. SYSTEM OPERATION

This chapter explains how to execute the error tests by connecting D3285, unit which has undergone test (UUT) or device which has undergone test (DUT) to the pulse pattern generator.

4.1 D3185A Setting

4.1.1 Setting the Clock Source and the Frequency

The D3185A requires an external clock source. Feed external clock of sinusoidal wave with amplitude of 0.7 to 1.5V_{p-p} to the Input Clock connector.

In case the TR4515 (when connected to the dedicated GPIB bus) is used as the clock source, you can set the frequency with the frequency setting dial on the D3185A panel or with the frequency memory operation.

CAUTION

When the clock frequency value has been modified, do not forget to switch the pattern mode WORD and PRBS. Unless this operation is done, correct pattern may not be obtained in the data output.

4.1.2 Setting the Data Output

Set the data output level in accordance with the UUT or DUT input conditions.

(1) If the UUT or DUT data input terminator voltage is 0V (See Fig. 4-1.)

Specify the output level by pressing the OUTPUT MODE key so that the TO 0V lamp on the front panel will light. Since the data output offset (high level) and the amplitude are variable in this case, specify the offset and amplitude values with the data OFFSET and AMPLITUDE knobs, respectively.

(2) If the UUT or DUT data input terminator voltage is −2V and at ECL level (See Fig. 4-2.)

Specify the output level by pressing the OUTPUT MODE key so that the TO −2V lamp on the front panel will light. In this case, the data output offset (high level) is set to about −0.8V and the amplitude is set to about 0.8V_{p-p} (variable).

(3) If the UUT or DUT data input is connected to AC (See Fig. 4-3.)

Press the OUTPUT MODE key so that the AC indicator on the front panel may light, then set the output level. In this case, the setting of a data output offset is ignored and only the amplitude can be set by the control.

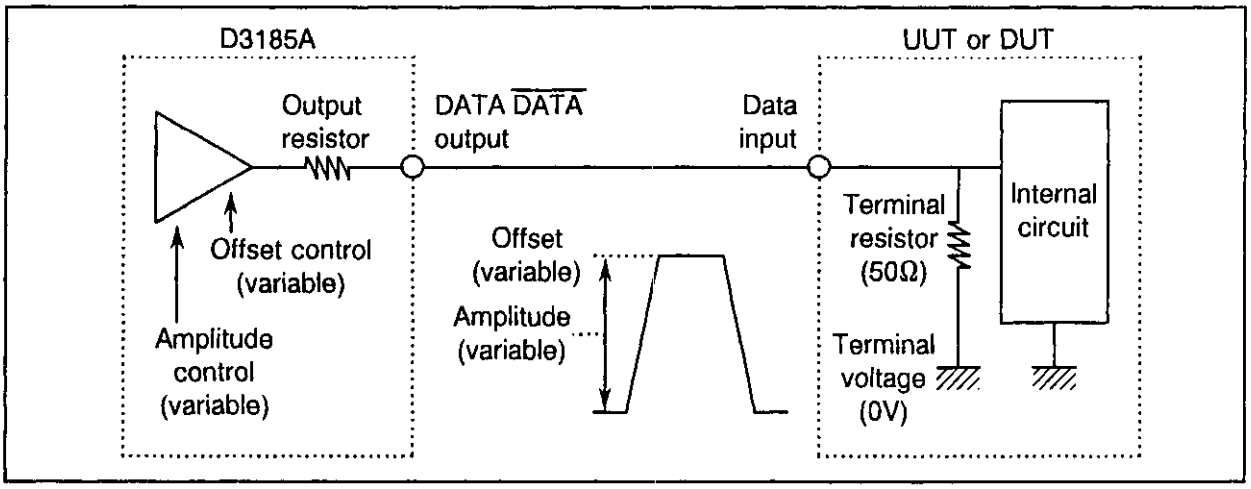


Figure 4-1 With DATA $\overline{\text{DATA}}$ Output Used and 0V Termination

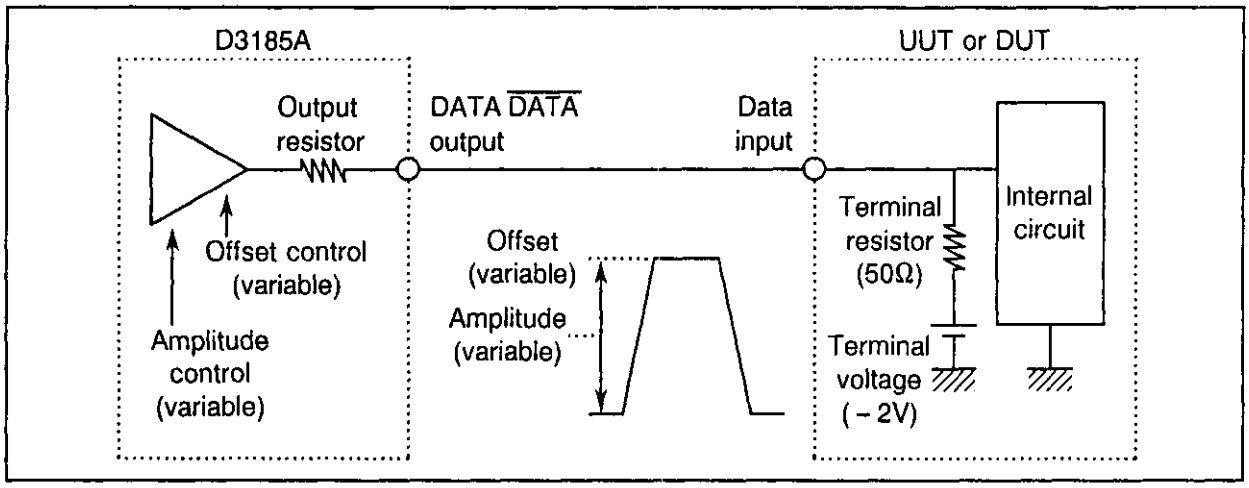


Figure 4-2 With DATA $\overline{\text{DATA}}$ Output Used, −2V Termination and ECL Level

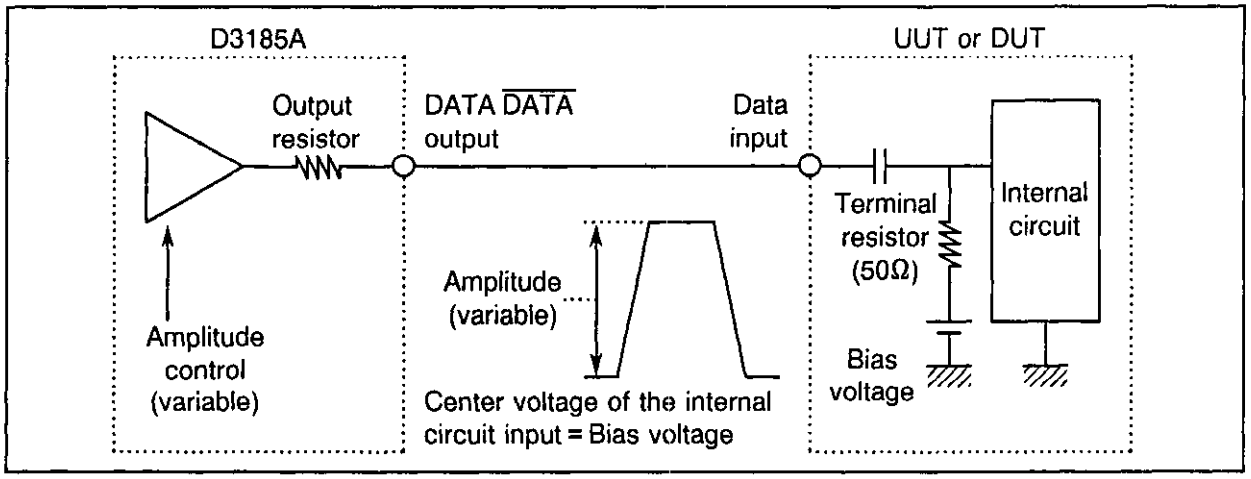


Figure 4-3 With DATA $\overline{\text{DATA}}$ Output Used in AC Mode and AC-connected Termination

4.1.3 Setting the Clock Output

In case the UUT or DUT requires clock, set the clock output level in accordance with the UUT or DUT input conditions.

(1) Setting the offset when the UUT or DUT clock input is DC-connected

(a) If the terminal voltage of the UUT or DUT clock input is 0V (See Fig. 4-4.)

Specify the output level by pressing the OUTPUT MODE key so that the TO 0V lamp on the front panel will light. Since the CLOCK output offset (high level) and the amplitude are variable in this case, set the offset and amplitude values with the CLOCK OFFSET and AMPLITUDE knobs, respectively.

(b) If the UUT or DUT clock input is with terminal voltage −2V and at the ECL level (See Fig. 4-5.)

Specify the output level by pressing the OUTPUT MODE key so that the TO −2V lamp on the front panel will light. In this case, the CLOCK output offset (high level) is set to about −0.8V and the amplitude is set to about $0.8V_{p\text{-}p}$ (variable).

(2) If the UUT or DUT clock Input is AC-connected (See Fig. 4-6.)

Press the OUTPUT MODE key so that the AC indicator on the front panel may light, then set the output level. In this case, the setting of a data output offset is ignored and only the amplitude can be set by the control.

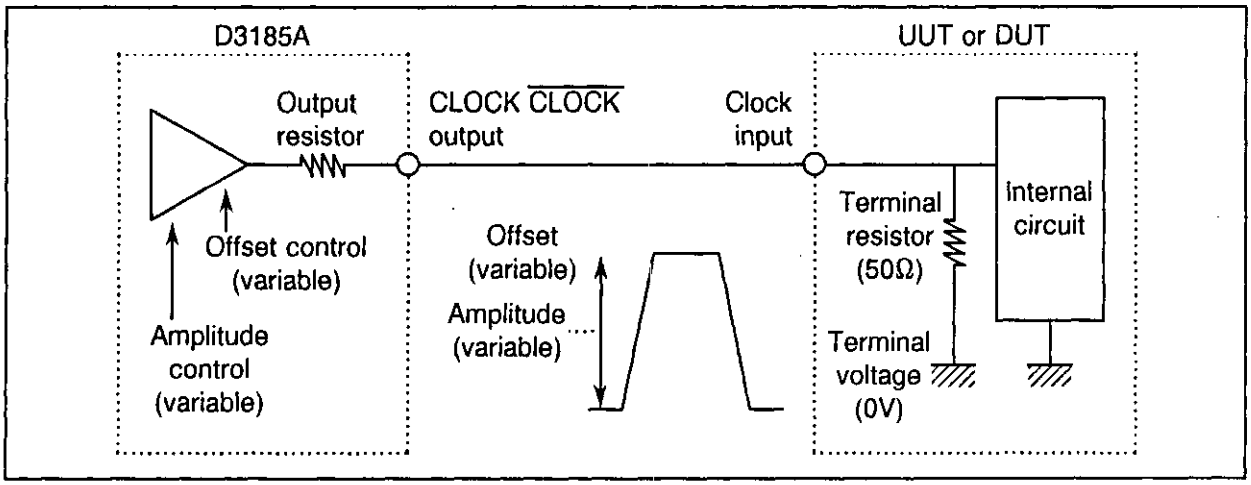


Figure 4-4 With CLOCK $\overline{\text{CLOCK}}$ Output Used and 0V Termination

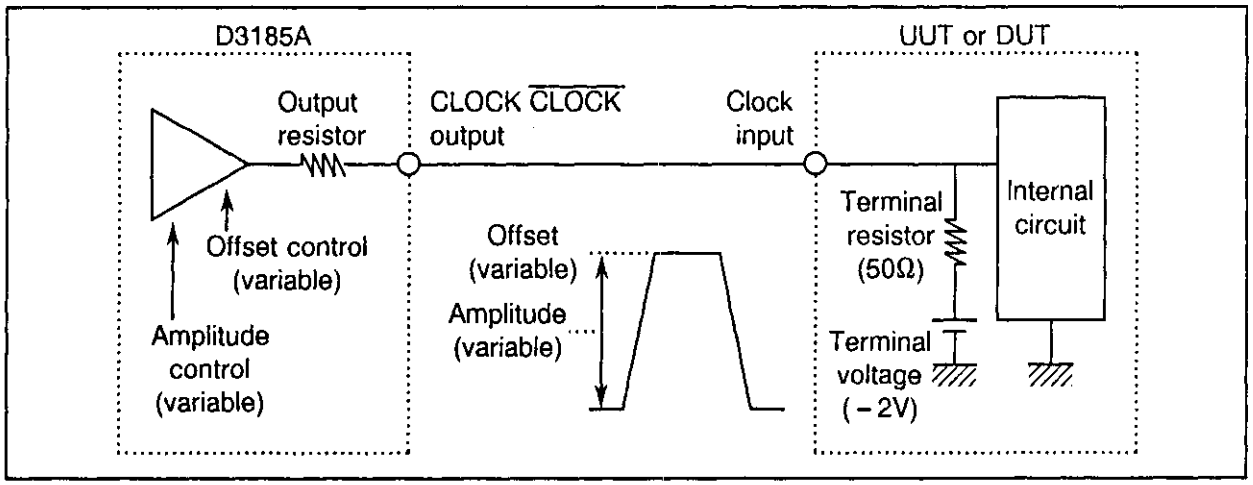


Figure 4-5 With CLOCK $\overline{\text{CLOCK}}$ Output Used, −2V Termination and ECL Level

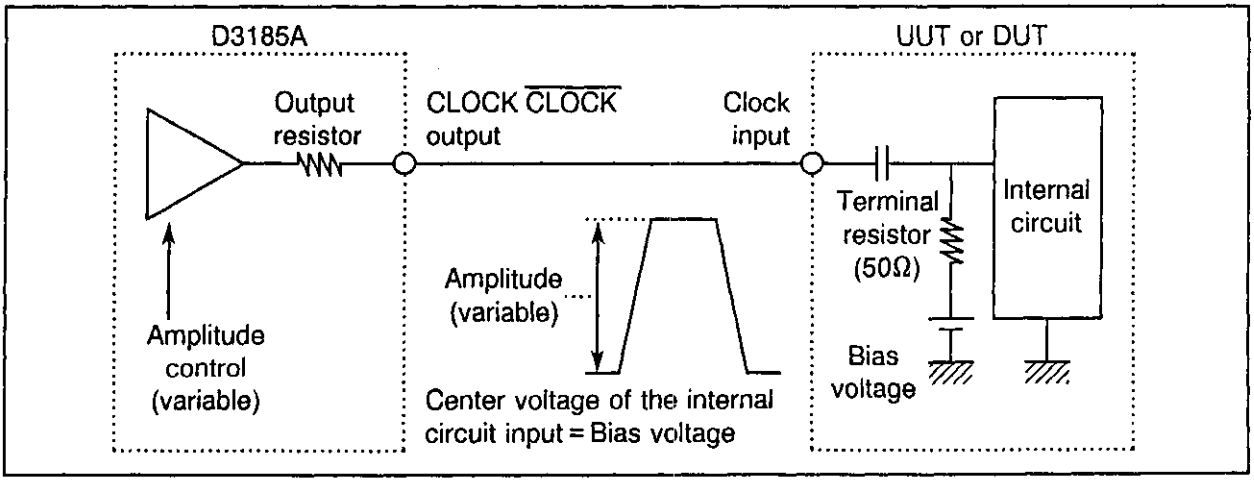


Figure 4-6 With CLOCK $\overline{\text{CLOCK}}$ Output Used in AC Mode and AC-connected Termination

4.1.4 Setting the Pattern

Set the pattern mode to WORD or PRBS.

If WORD is specified, call a pattern which has been created from the pattern memory or set the bit length and logic (0,1) for each bit.

If PRBS is specified, set the pattern length $2^N - 1$ and the mark factor.

In case of manual setting through panel key operation, it is recommended to use the Master-Slave function so that the pattern setting in the D3285 is interlocked with the D3185A. To use this function, connect the D3185A to the D3285 with the GPIB cable, and set the Master key on the D3185A front panel and the Slave key on the D3285 front panel to ON position.

CAUTION

1. When using the Master-Slave function, do not connect any other device to the GPIB connector between the D3185A and the D3285.
2. When performing remote control with the GPIB controller, do not forget to set the Master key and the Slave key to OFF position.

4.2 D3285 Setting

4.2.1 Setting the Data Input

(1) Set the data input terminal voltage in accordance with the UUT or DUT output conditions.

If the TO 0V lamp of the TERMINATOR DATA on the front panel is lit, the terminator is 0V. If the TO −2V lamp is lit, the terminator is −2V. This setting is switched alternately every time the DATA key is pressed.

(2) Set the data input threshold level in accordance with the UUT or DUT output voltage.

Set the THRESHOLD LEVEL voltage on the front panel approximately at the center value of the UUT or DUT output voltage by turning the knob. The range of setting varies depending on the data input terminal voltage.

4.2.2 Setting the Clock Input

Three types of clock input source are available. Set the clock input terminal voltage in accordance with the clock source output conditions.

(1) When using the UUT or DUT clock output

Set the clock input terminal voltage in accordance with the UUT or DUT output conditions.

If the TO 0V lamp of the TERMINATOR CLOCK on the front panel is lit, the terminator is 0V. If the TO −2V lamp is lit, the terminator is −2V. This setting is switched alternately every time the CLOCK key is pressed.

In case the UUT or DUT clock output is AC-connected, the D3285 clock input terminal voltage can be set either to 0V or −2V.

(2) When using the D3185A CLOCK output

If the D3185A output level is set to TO 0V, the D3285 clock input is to be eliminated at 0V; and if set to TO −2V, the D3285 clock input is to be terminated at −2V.

If the TO 0V lamp of the TERMINATOR CLOCK on the front panel is lit, the terminator is 0V; and if the TO −2V lamp is lit, the terminator is −2V. This setting is switched alternately every time the CLOCK key is pressed.

4.2.3 Setting the Pattern

The D3285 pattern setting is executed in the same way as the D3185A pattern setting.

To use the Master-Slave function so that the D3285 pattern setting is interlocked with the D3185A, connect the D3185A to the D3285 with the GPIB cable, and set the Master key on the D3185A front panel and the Slave key on the D3285 front panel to ON position.

CAUTION

When using the Master-Slave function, do not connect any other device to the GPIB cable between the D3185A and the D3285.
When performing remote control with the GPIB controller, do not forget to set the Master key and Slave key to OFF position.

4.2.4 Setting the Data Input Polarity

Set the INPUT POLARITY on the front panel depending whether the data polarity is reversed or not in the relationships between the input and the output of the UUT or DUT.

Press the INPUT POLARITY key so that the INVERS lamp will light if reversed; and the NORMAL lamp will light if not reversed.

4.3 Signal Line Connection

An example of signal line connection is given in Fig. 4-7.

When connecting the clock input and output signal lines, pay attention whether the UUT or DUT clock input/output is used and also on the voltage level as well as the terminator type.

CAUTION

To prevent device damage, make the following preparations before starting to connect signal lines.

1. Collect the ground terminals of all the devices at one place and connect them to the earth.
2. The operator must wear an earth band or the equivalent not to be charged with static electricity.
3. The static electricity between the conductors of the coaxial cables to be used for signal connection should be discharged beforehand.
4. The device output voltage levels and terminal voltages should be set strictly.

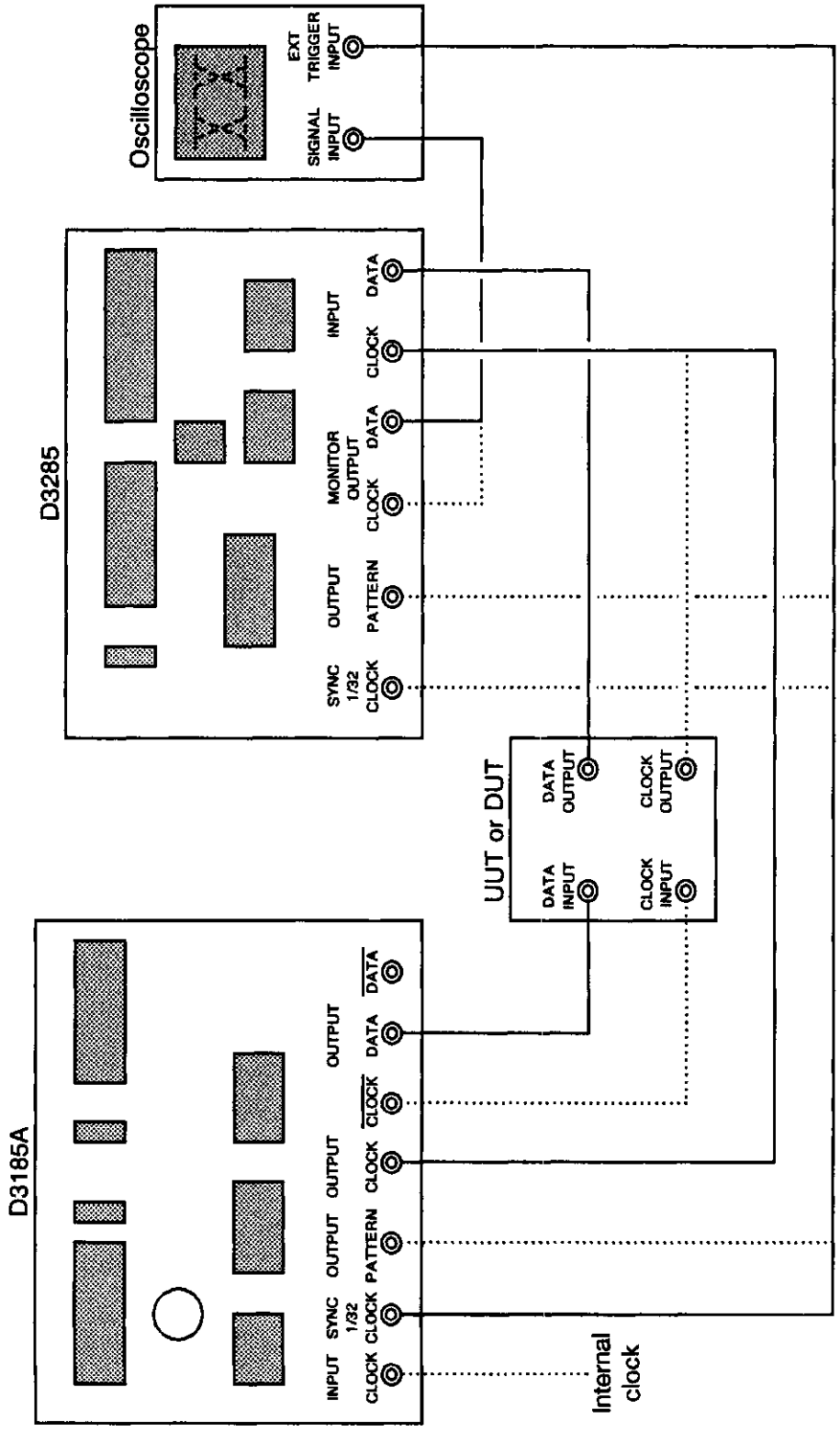


Figure 4-7 Signal Line Connection

5. GPIB

5.1 Introduction

The 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

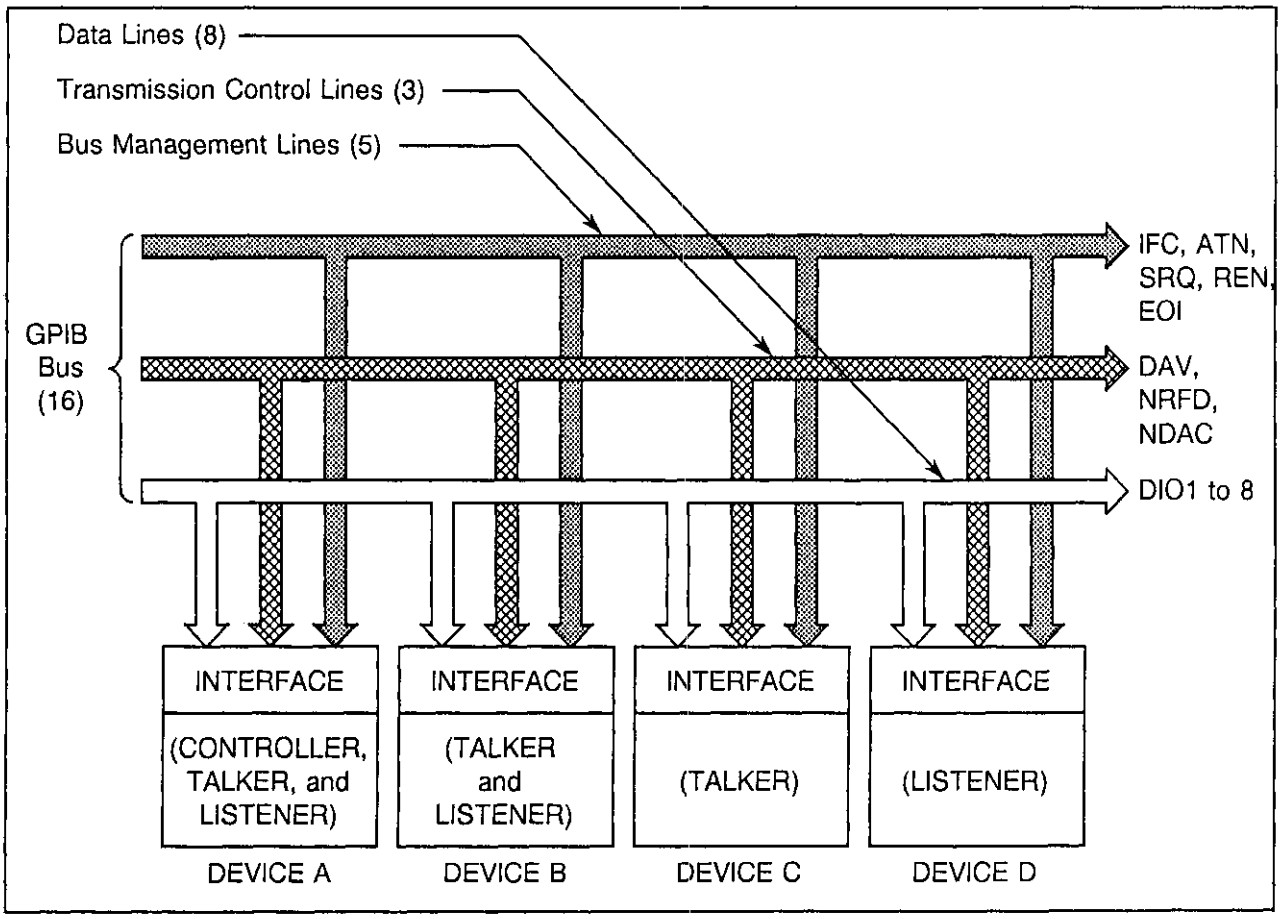


Figure 5-1 Outline of GPIB

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 +2.4V or more
"Low" state +0.4V or less

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

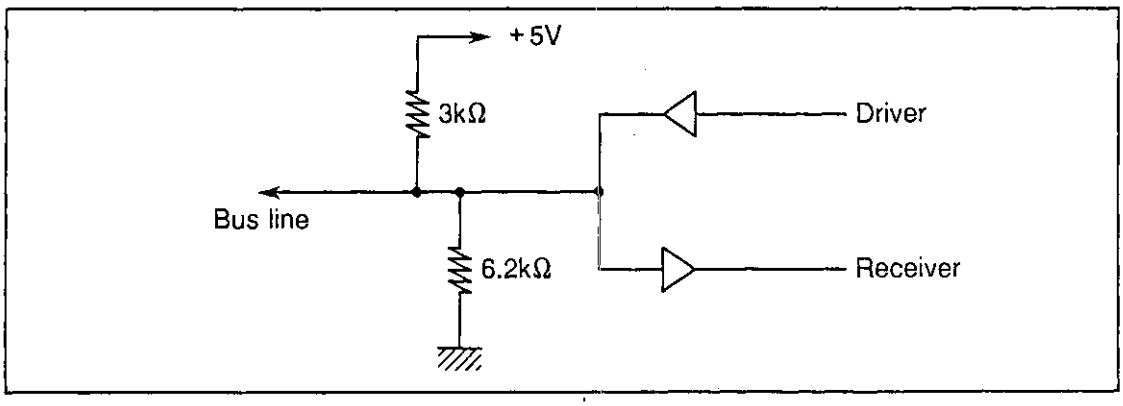


Figure 5-2 Termination of Signal Conductors

Driver specifications : Open collector system

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

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

Bus cable length : The length of each bus cable must not exceed: (the number of devices connected to the bus) × 2m or 20m 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
T5	Basic talker function, Serial poll function, Talk only mode, Listener-specified talker cancel function
L4	Basic listener function, Talker-specified listener cancel function
SR1	Service request function
RL1	Remote function n
PP0	No parallel poll function
DC1	Device clear function (SDC and DCL commands are available.)
DT0	No device trigger function
C0	No controller function
E2	Use of three-state bus driver

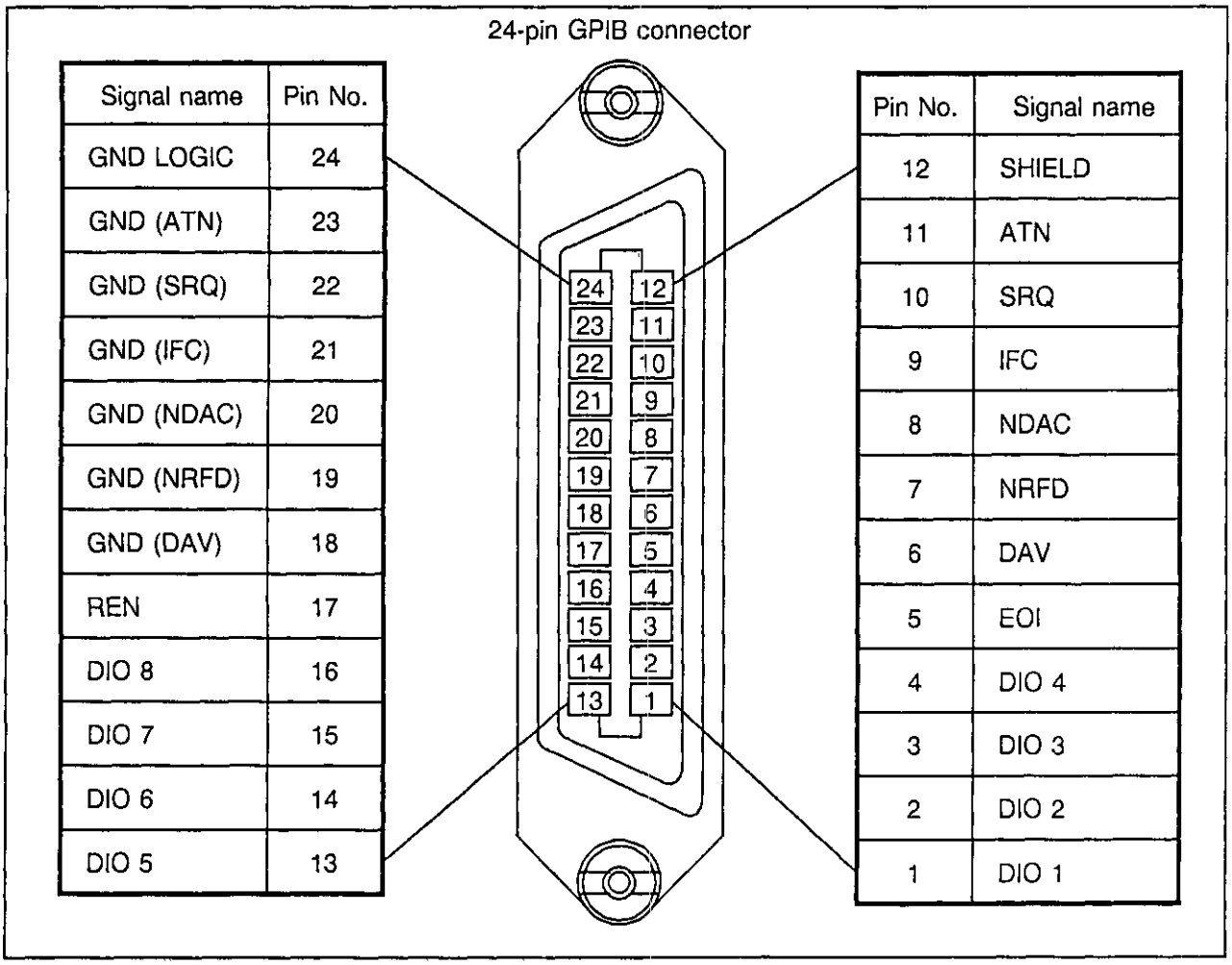


Figure 5-3 Pin Assignment of GPIB Connector

5.3 Notes on Using the GPIB

This section explains the notes on using the GPIB.

(1) Connecting or removing cables

Turn off all devices to which cables are to be connected or removed. In this case, all ground cables must be connected mutually (grounded). For D3185A, the GPIB address is set to 8 at the factory.

(2) GPIB connector for TR4515

D3185A provides a dedicated connector for the control of TR4515. Do not connect a device other than TR4515 to this connector.
For TR4515, the GPIB address should be set to 20.

(3) Master operation

If a device other than D3285 error detector is connected when the MASTER switch on the front panel is set to ON, the D3185A may operate abnormally and display an error message on the front panel. In such a case, set the MASTER key to OFF. If the MASTER switch is set to OFF via the GPIB, issue an instruction that sets the IFC line to the lower level.

(4) ATN interrupt caused during message transfer

If an ATN request is issued while transferring a message between devices, the ATN is given priority and the preceding state is canceled.

5.4 Setting a Device Address

The device address of the D3185A is displayed on the address number indicator in the pattern setting block. To change the device address, operate the ⌂ or ⌂ key under the indicator. The setting range is 0 to 30.

5.5 List Format (Program Code)

This section explains the program codes that the GPIB controller use for remote control.

5.5.1 Basic Format

Usually, ASCII codes are used. However, binary codes may be used for word pattern setting.

When ASCII codes are used, commas are used as string delimiters but they may be omitted unless specified otherwise.

Example: "WORD, CR1234.56" → "WORDCR1234.56"

When ASCII codes are used, the following record delimiters are used. EOI stands for "End Or Identify" (single wire signal). ASCII codes of CR and LF are 13 and 10 respectively.

a. CR, LF[+ EOI]
   EOI may be written together with LF.

b. LF[+ EOI]
   EOI may be written together.

c. CR + EOI
   EOI may be written together with CR.

d. EOI
   EOI is written together with the last byte of the program code.

When binary codes are used, only the single wire signal (EOI) may be used as a record delimiter.

The total length of program codes that the D3185A can receive at a time is 128 characters or less (string delimiters are included but record delimiters are not included) except when a word pattern is set.

If it is longer than 128 characters or any invalid code is included, a syntax error occurs. In this case, records are discarded up to the next record delimiter.

5.5.2 GPIB Function Code

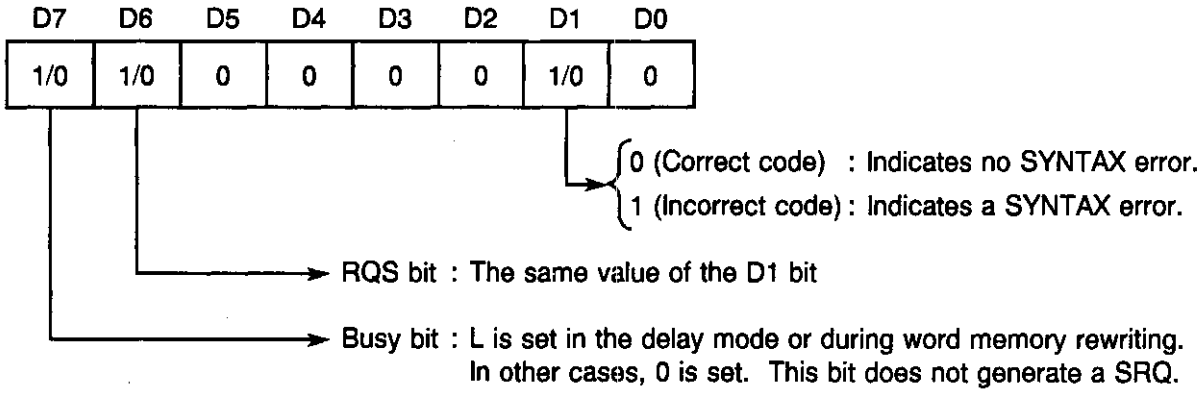
Code	Content
Z	Initialization of each parameter. (Initialization of the panel state)
C	Initialization for GPIB

5.5.3 Codes Related to Service Request (SRQ)

Code	Content
S0	Transmission of SRQ
S1	No transmission of SRQ

When the "S0" mode is specified, the service request is transmitted to the controller on the occurrence of a SYNTAX error. The state byte is transmitted when the SPE command is received at the time of serial polling from the controller.

5.5.4 Configuration of Status Byte



5.5.5 Remote Code

Table 5-2 shows the D3185A remote code below:

Table 5-2 Remote Code

Function name	Code	Contents
MEMORY (CLOCK)		(Clock rate memory number)
MEMORY STORE	"RMS x" x = 0 to F	Store the frequency in the memory number
MEMORY RECALL	"RMR x" x = 0 to F	Recall the frequency from the memory number
CLOCK RATE	"CR x" or "CR xE + 6" x = 500.000 to 10000.000	Set the frequency unit: MHz (former case) or Hz (later case)
PATTERN MODE		Set the pattern mode
PRBS	"PRBS"	PRBS
WORD	"WORD"	WORD
PRBS $2^N - 1$	"PBx, 0" x = 07 = 09 = 10 = 11 = 15 = 17 = 20 = 23 "PB – 15, 0", for the generating polynomial of $X^{15} + X^1 + 1$.	Selects the PRBS, $2^N - 1$ mode and the number of stages
MARK RATIO	"MR0/8" "MR1/8" "MR1/4" "MR1/2" "MR8/8" "MR7/8" "MR3/4" "MR1/2B"	Select the mark ratio

(cont'd)

Function name	Code	Contents
MEMORY (WORD)		(Word pattern memory number)
MEMORY STORE	"WMS x" x = 0 to 9	Store the word pattern in the memory number
MEMORY RECALL	"WMR x" x = 0 to 9, or A or B	Recall the word pattern from the memory number
POLARITY (WORD)		Set the word pattern polarity
NORMAL	"WPN"	Normal polarity
INVERSE	"WPI"	Inverse polarity
PATTERN BIT LENGTH	"BL x" x = 1 to 65536	Set the pattern bit length
PATTERN ADDRESS	"ADR x" x = 0 to 524287	Set the pattern address
PATTERN transfer Binary pattern data transfer	"BIN x, y" y: Byte count x: Address x = 0 to 4095 y = 1 to 8192	When this code is received once, binary pattern data transfer mode is set until the byte count is transferred or EOI is received the next time. A series of binary data to be transferred is stored from the address number specified on the left. The number of transfer patterns are determined by the byte count. The LSB of binary data is the first clock.
Hexadecimal pattern data transfer	"WP x, y, z" z: Arrangement of pattern data by size y: Size x: Address x = 0 to 4095 y = 1 to 128 z = Each character is 0 to 9 or A to F.	A series of pattern data has each character made up of four bits and the number of characters are specified. A series of pattern data is stored from the specified address number. The LSB of one-character data indicates the first clock.

(cont'd)

Function name	Code	Contents
ERROR ADDITION	"EAD x" x = 0 (SINGLE) = 4 = 5 = 6 = 7 = 8 = 9 = S (One error generation)	Select the error addition
OUTPUT MODE	"DAC" "DM2V" "DGND" "DBAC" "DBM2V" "DBGND" "CAC" "CM2V" "CGND" "CBAC" "CBM2V" "CBGND"	Set DATA output mode to AC. Set DATA output mode to TO −2V. Set DATA output mode to TO 0V. Set $\overline{\text{DATA}}$ output mode to AC. Set $\overline{\text{DATA}}$ output mode to TO −2V. Set $\overline{\text{DATA}}$ output mode to TO 0V. Set CLOCK output mode to AC. Set CLOCK output mode to TO −2V. Set CLOCK output mode to TO 0V. Set $\overline{\text{CLOCK}}$ output mode to AC. Set $\overline{\text{CLOCK}}$ output mode to TO −2V. Set $\overline{\text{CLOCK}}$ output mode to TO 0V.
DATA OUTPUT		Set the DATA output
AMPLITUDE	"DAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	DATA amplitude Unit : $V_{p\text{-}p}$
OFFSET	"DOFF△x" △ = + or − or ␣ ␣ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	DATA offset Unit : V

(cont'd)

Function name	Code	Contents
$\overline{\text{DATA}}$ OUTPUT		Set the $\overline{\text{DATA}}$ output
AMPLITUDE	"DBAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	$\overline{\text{DATA}}$ amplitude Unit : $V_{p\text{-}p}$
OFFSET	"DBOFF△x" △ = + or − or ␣ ␣ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	$\overline{\text{DATA}}$ offset Unit : V
DATA/$\overline{\text{DATA}}$ TRACKING		Set the DATA/$\overline{\text{DATA}}$ tracking function
ON	"DTRKON"	DATA/$\overline{\text{DATA}}$ tracking function on
OFF	"DTRKOF"	DATA/$\overline{\text{DATA}}$ tracking function off
DATA CROSS POINT ADJ		Set the DATA cross-point adjustment
ON	"DCPON	DATA cross-point adjustment on
OFF	"DCPOF"	DATA cross-point adjustment off
$\overline{\text{DATA}}$ CROSS POINT ADJ		Set the $\overline{\text{DATA}}$ cross-point adjustment
ON	"DBCPON	$\overline{\text{DATA}}$ cross-point adjustment on
OFF	"DBCPOF"	$\overline{\text{DATA}}$ cross-point adjustment off

(cont'd)

Function name	Code	Contents
CLOCK OUTPUT		Set the CLOCK output
AMPLITUDE	"CAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	CLOCK amplitude Unit : V_{p-p}
OFFSET	"COFF△x" △ = + or − or ␣ ␣ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	CLOCK offset Unit : V
$\overline{\text{CLOCK}}$ OUTPUT		Set the $\overline{\text{CLOCK}}$ output
AMPLITUDE	"CBAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	$\overline{\text{CLOCK}}$ amplitude Unit : V_{p-p}
OFFSET	"CBOFF△x" △ = + or − or ␣ ␣ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	$\overline{\text{CLOCK}}$ offset Unit : V
CLOCK/$\overline{\text{CLOCK}}$ TRACKING		Set the CLOCK/$\overline{\text{CLOCK}}$ tracking function
ON	"CTRKON"	CLOCK/$\overline{\text{CLOCK}}$ tracking function on
OFF	"CTRKOF"	CLOCK/$\overline{\text{CLOCK}}$ tracking function off
CLOCK DUTY ADJ		Set the CLOCK duty adjustment
ON	"CDTYON"	CLOCK duty adjustment on
OFF	"CDTYOF"	CLOCK duty adjustment off

(cont'd)

Function name	Code	Contents
$\overline{\text{CLOCK}}$ DUTY ADJ		Set the $\overline{\text{CLOCK}}$ duty adjustment
ON	"CBDTYON"	$\overline{\text{CLOCK}}$ duty adjustment on
OFF	"CBDTYOF"	$\overline{\text{CLOCK}}$ duty adjustment off
DELAY	"DLY△x" △ = + or − or ␣ ␣ is regarded as +. x = −400 to +400	Set the delay Unit: ps
PANEL LOCK		Set the panel lock
ON	"PLKON"	Panel lock on
OFF	"PLKOF"	Panel lock off
RECORD DELIMITER		Select the recode delimiter
RECORD DELIMITER at the time of TALKER output when using the OP command		
• CR, LF (+EOI)	"DL0"	CR, LF (+EOI)
• LF only	"DL1"	LF
• EOI only	"DL2"	EOI

* EOI : End or Identify

5.5.6 Canceling the Master Function

To cancel the D3185A master function from the controller, issue a command that set the GPIB connector's IFC pin (No. 9) at the lower level (e.g., "abort 7" of HP). Thus, the master control key is set off and the master function is canceled.

5.6 OP (Output Interrogated Parameter) Command

5.6.1 Outline of OP Command

The output interrogated parameter (OP) command allows the state of the parameter, function or mode which is specified from the D3185A to the GPIB to be output.

In programming, enter the code for the parameter to be output after entering the OP command. "OP" is unnecessary when using codes with "?".

Example: HP200 series

```
10 DIM A$ [20]
20 OUTPUT  708 ; "CR1234.56"
30 OUTPUT  708 ; "OPCR" (or "CR?")
40 ENTER   708 ; A$
50 DISP    A$
60 END
```

[Program description]

Line No.	Description
10	Reserves 20 bytes for character string variable A$.
20	Sets the clock rate 1234.56MHz for the D3185A.
30	Instructs to output the clock rate data.
40	Specifies the D3185A as a talker and reads data.
50	Displays input data A$.
60	Terminates the program.

5.6.2 Table of OP Code Output Data

Table 5-3 Table of OP Code Output Data

Function name (Function/mode)	Code	Output result and format	Contents
MEMORY (CLOCK)	"OPRM" (Rate memory) or "RM?"	"RM x" x = 0 to F	(Clock rate memory number) Read the memory number of frequency
CLOCK RATE	"OPCR" or "CR?"	"CR xE + 6" x = 00.500000E + 6 to 10000.000E + 6	Read the frequency setting Unit : Hz
PATTERN MODE			Read the setting value of the pattern mode
PRBS	"OPPM" or "PM?"	"PRBS"	PRBS
WORD	"OPPM" or "PM?"	"WORD"	WORD
PRBS $2^N - 1$	"OPPB" or "PB?"	"PB x, 0" x = 07 = 09 = 10 = 11 = 15 = 17 = 20 = 23 "PB – 15, 0", for the generating polynomial of $X^{15} + X^1 + 1$.	Read the setting value of PRBS, $2^N - 1$ mode and the number of stages
MARK RATIO	"OPMR" or "MR?"	"MR x" x = 0/8␣ = 1/8␣ = 1/4␣ = 1/2␣ = 8/8␣ = 7/8␣ = 3/4␣ = 1/2B	Read the setting value of the mark ratio (-STOP-RECALL-)

(cont'd)

Function name (Function/mode)	Code	Output result and format	Contents
MEMORY (WORD)	"OPWM" (Word memory) or "WM?"	"WM x" x = 0 to 9, A, or B	(Word pattern memory number) Read the word pattern memory number
POLARITY (WORD)			Read the word pattern polarity
NORMAL	"OPWP" or "WP?"	"WPN"	Normal polarity
INVERSE	"OPWP" or "WP?"	"WPI"	Inverse polarity
PATTERN BIT LENGTH	"OPBL" or "BL?"	"BL x" x = 00001 to 65536	Read the setting value of the pattern bit length
PATTERN ADDRESS	"OPADR" or "ADR?"	"ADR_ x" x = 000000 to 524287	Read the setting value of the pattern address
ERROR ADDITION	"OPEAD" or "EAD?"	"EAD x" x = 0 = 4 = 5 = 6 = 7 = 8 = 9	Read the setting value of the error addition SINGLE 1×10^{-4} 1×10^{-5} 1×10^{-6} 1×10^{-7} 1×10^{-8} 1×10^{-9}

(cont'd)

Function name (Function/mode)	Code	Output result and format	Contents
OUTPUT MODE			Read the setting value of the output mode
	"OPDOM" or "DOM?"	"DAC" "DM2V" "DGND"	DATA output AC TO −2V TO 0V
	"OPDBOM" or "DBOM?"	"DBAC" "DBM2V" "DBGND"	$\overline{\text{DATA}}$ output AC TO −2V TO 0V
	"OPCOM" or "COM?"	"CAC" "CM2V" "CGND"	CLOCK output AC TO −2V TO 0V
	"OPCBOM" or "CBOM?"	"CBAC" "CBM2V" "CBGND"	$\overline{\text{CLOCK}}$ output AC TO −2V TO 0V
DATA OUTPUT			Read the setting value of the data output
AMPLITUDE	"OPDAMP" or "DAMP?"	"DAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	Amplitude value Unit : $V_{p\text{-}p}$
OFFSET	"OPDOFF" or "DOFF?"	"DOFF△x" △ = + or − or ␣ ␣ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	Offset value Unit : V

(cont'd)

Function name (Function/mode)	Code	Output result and format	Contents
$\overline{\text{DATA}}$ OUTPUT			Read the setting value of the $\overline{\text{DATA}}$ output
AMPLITUDE	"OPDBAMP" or "DBAMP?"	"DBAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	Amplitude value Unit : V_{p-p}
OFFSET	"OPDBOFF" or "DBOFF?"	"DBOFF△x" △ = + or − or ⎵ ⎵ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	Offset value Unit : V
DATA/$\overline{\text{DATA}}$ TRACKING			Read the setting value of the DATA/$\overline{\text{DATA}}$ tracking function
ON	"OPDTRK" or "DTRK?"	"DTRKON"	On
OFF		"DTRKOF"	Off
DATA CROSS POINT ADJ			Read the setting value of the DATA cross point adjustment
ON	"OPDCP" or "DCP?"	"DCPON"	On
OFF		"DCPOF"	Off
$\overline{\text{DATA}}$ CROSS POINT ADJ			Read the setting value of the $\overline{\text{DATA}}$ cross point adjustment
ON	"OPDBCP" or "DBCP?"	"DBCPON"	On
OFF		"DBCPOF"	Off

(cont'd)

Function name (Function/mode)	Code	Output result and format	Contents
CLOCK OUTPUT			Read the setting value of the CLOCK output
AMPLITUDE	"OPCAMP" or "CAMP?"	"CAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	Amplitude value Unit : V_{p-p}
OFFSET	"OPCOFF" or "COFF?"	"COFF△x" △ = + or − or ␣ ␣ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	Offset value Unit : V
$\overline{\text{CLOCK}}$ OUTPUT			Read the setting value of the $\overline{\text{CLOCK}}$ output
AMPLITUDE	"OPCBAMP" or "CBAMP?"	"CBAMP x" x = 0.50 to 2.00 (TO 0V, AC) x = 0.60 to 1.00 (TO −2V)	Amplitude value Unit : V_{p-p}
OFFSET	"OPCBOFF" or "CBOFF?"	"CBOFF△x" △ = + or − or ␣ ␣ is regarded as +. x = −2.00 to +2.00 (TO 0V) x = −1.00 to −0.60 (TO −2V)	Offset value Unit : V
CLOCK/$\overline{\text{CLOCK}}$ TRACKING			Read the setting value of the CLOCK/$\overline{\text{CLOCK}}$ tracking function
ON	"OPCTRK" or "CTRK?"	"CTRKON"	On
OFF		"CTRKOF"	Off

(cont'd)

Function name (Function/mode)	Code	Output result and format	Contents
DELAY	"OPDLY" or "DLY?"	"DLY△x" △ = + or − or ⎵ ⎵ is regarded as +. x = −400 to +400	Read the setting value of the delay Unit: ps
CLOCK DUTY ADJ			Read the setting value of the CLOCK duty adjustment
ON	"OPCDTY" or "CDTY?"	"CDTYON"	On
OFF		"CDTYOF"	Off
$\overline{\text{CLOCK}}$ DUTY ADJ			Read the setting value of the $\overline{\text{CLOCK}}$ duty adjustment
ON	"OPCBDTY" or "CBDTY?"	"CBDTYON"	On
OFF		"CBDTYOF"	Off
PANEL LOCK			Read the setting value of the panel lock
ON	"OPPLK" or "PLK?"	"PLKON"	On
OFF		"PLKOF"	Off
Service request function			Read the setting value of the service request function
S0 (SRQ transmission)	"OPS" or "S?"	"S0"	SRQ transmission
S1 (No transmission of SRQ)		"S1"	No SRQ transmission

(cont'd)

Function name (Function/mode)	Code	Output result and format	Contents
Talker data delimiter function			Read the setting value of the talker data delimiter function
DL0 (CR, LF I (+EOI))	"OPDL" or "DL?"	"DL0"	CR, LF (+EOI)
DL1 (LF only)		"DL1"	LF
DL2 (EOI only)		"DL2"	EOI

* EOI : End or Identify

5.7 Setting a Word Pattern (Hexadecimal Mode)

There are two modes for setting a word pattern of the D3185A from the GPIB: (a) hexadecimal mode (ASCII code) and (b) binary mode. This section explains only the haxadecimal mode format. For the binary mode, see Section 5.8.

(1) Format of hexadecimal mode

"WPdddd, ddd , d....."
① ②

① First address of pattern setting (decimal)
0 to 4095

② Number of character in pattern character string (decimal)
1 to 128

(2) Pattern character string

A pattern character string is a combination of 0 to 9 and A to Z. Characters as many as the number specified in item ② above are set from the address specified in item ①.

A four-bit pattern is set for each character. When each code is represented by a binary code, the least significant bit (LSB) is assigned as the bit which is nearer to the beginning.

Example: Set code: "WP12,5,E4BA2"

Result:

Address \ Bit	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 fixed bit.

5.8 Setting a Word Pattern (Binary Mode)

This section explains the method of setting a word pattern in the binary mode. For the hexadecimal mode, see Section 5.7.

(1) Format of binary mode

"BINdddd, dddd"
① ②

① First address of pattern setting (decimal)
0 to 4095

② Setting pattern byte count (decimal)
1 to 8192

A delimiter (see 5.5.1 "Basic Format") is written after the byte count to complete step 1.

In the binary mode, two steps are used for word pattern setting.

(Step 1)
A binary mode, first address, and byte count are specified.

(Step 2)
Eight-bit binary codes equivalent to the number of bytes specified in item ② are written from the first bit (bit 1) of the first address specified in item ①.

An 8-bit pattern is set for each byte. The least significant bit (LSB) is assigned as the bit which is nearer to the beginning.

A single wire signal EOI (End Or Identify) must be assigned to the last byte.

If EOI is received or specified number of bytes are received, the D3185A stops pattern transmission and enters the usual ASCII code reception mode again.

Example: Set code: "BIN12,3"
Binary code (decimal notation): 78.171, 2

Result:

Address \ Bit	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 fixed bit.

5.9 Initial States

5.9.1 Initial State of Operation

When an SDC, DCL, or program code is received, the D3185A is initialized as follows:

(1) Status byte

All bits are set to 0s.

(2) Service request

The "S1" mode is set (an SRQ is not issued).

(3) OP mode

This mode is canceled.

(4) Word pattern setting mode

The binary mode is canceled.
It cannot be canceled with a program code "C".

5.9.2 Initialization of Parameters

All parameters are initialized by program code "Z".

(1) Clock section

Clock rate : 1000.000MHz (CR␣100.000E+6)
Memory number : 0 (RM0)
Edit : OFF

(2) Output section

DATA OUTPUT
Amplitude : 1.00 (DAMP␣1.00)
Offset : 0.00V (DOFF␣0.00)
Cross point control : OFF (DCPOF)
Termination : TO 0V (DGND)

$\overline{\text{DATA}}$ OUTPUT
Amplitude : 1.00 (DBAMP␣1.00)
Offset : 0.00V (DBOFF␣0.00)
Cross point control : OFF (DBCPOF)
Termination : TO 0V (DBGND)

CLOCK OUTPUT
- Amplitude : 1.00 (CAMP 1.00)
- Offset : 0.00V (COFF 0.00)
- Cross point control : OFF (CDTYOF)
- Termination : TO 0V (CGND)

$\overline{\text{CLOCK}}$ OUTPUT
- Amplitude : 1.00 (CBAMP 1.00)
- Offset : 0.00V (CBOFF 0.00)
- Cross point control : OFF (CBDTYOF)
- Termination : TO 0V (CBGND)

Data tracking : ON (DTRKON)

Clock tracking : ON (CTRKON)

Error addition : OFF (EADO)

(3) Pattern section

Pattern mode : WORD (WORD)

PRBS $2^N - 1$: N = 15 (PB15)

Mark ratio : 1/2 (MR1/2)

Memory number : 0 (WMR0)

Edit : OFF

Polarity : NORMAL (WPN)

Bit length : 16 (BL16)

Address : 0 (ADR0)

Word pattern : 0101010101010101 (WP0,4,AAAA)

Memory contents : Bit lengths of memory numbers 0 to 9 : 16 (BL16)
Even-number pattern : 0101010101010101 (WP0,4,AAAA)
Odd-number pattern : 1010101010101010 (WP0,4,5555)

(4) Control section

Panel lock : OFF (PLKOF)

(5) GPIB

Send record delimiter : CR,LF + EOI (DL0)

SRQ issue : Not issued (S1)

5.10 Program Example

This section gives an example of GPIB program.

The controller used is the Hewlette Packard HP9000 Series 300 and the language used is BASIC.

5.10.1 Setting a Word Pattern (Hexadecimal Mode)

This program converts a binary pattern (character string consisting of 0s and 1s) input from the keyboard into a hexadecimal character string, thus setting a word pattern.

(1) Program list

```
100   DIM P$[600],Q$[512],H$[128]
110   Ppg=708
120   OUTPUT Ppg;"WORD"
130   LOOP
140     INPUT "BIT LENGTH = ?",B1
150   EXIT IF B1>0 AND B1<1024
160   EXIT IF B1>=1024 AND B1<=65536 AND (B1 MOD 64)=0
170     BEEP
180   END LOOP
190   PRINT "BIT LENGTH :";B1
200   OUTPUT Ppg;"BL";B1
210   LOOP
220     LOOP
230       INPUT "TOP ADDRESS = ?",Adrs
240     EXIT IF Adrs>=0 AND Adrs<=4095
250       BEEP
260     END LOOP
270     PRINT "TOP ADDRESS :";Adrs
280     INPUT "PATTERN = ?",P$
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$&"0"
440       NEXT I
450       L=LEN(Q$)
```

(Cont'd)

```
460     END IF
470     !
480     PRINT "BINARY PATTERN :"
490     FOR I=1 TO L STEP 4
500       PRINT Q$[I,I+3];" ";
510     NEXT I
520     PRINT
530     !
540     H$=""
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$[I,I+3];" ";
710     NEXT I
720     PRINT
730     OUTPUT Ppg;"WP";Adrs;".";LEN(H$);".";H$
740   END LOOP
750   END
```

(2) Execution result

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

(3) Explanation of program

Line No.	Description
100	Character strings P$ (max. 600 characters), Q$ (max. 512 characters), and H$ (max. 128 characters) as defined arrays.
110	7 is defined as the select code of GPIB and 8 as the address of the D3185A.
120	WORD is specified as the pattern mode of the D3185A.
130 to 180	Input a bit length from the keyboard.
190 to 200	Print the bit length and set the bit length in the D3185A.
210 to 800	Input a pattern setting starting address and pattern. The input pattern is converted and set for the D3185A. This operation is repeated until " " (null character string) is input as a pattern.
220 to 260	Input the pattern setting starting address from the keyboard.
270	Print the starting address.
280	Input a pattern from the keyboard in binary notation (character string composed of 0s and 1s). Any character other than 0 and 1 may be inserted between characters as delimiters.
290	L is defined as the length of the input character string.
300	If the length of the character string is 0, control exits from the loop.
320 to 380	Only 0s and 1s are extracted from the input character string to make a new character string "Q$". L is defined as the length of character string Q$. If this length exceeds 128 characters, the excessive characters are discarded.
390	If the length of character string Q$ is 0, control exits from the loop.
410 to 460	0s are added after character string Q$ so that its length becomes a multiple of 4. Then, L is defined as the length of new character string.
480 to 520	Character string Q$ is printed. In this case, a space is printed per 4 characters for easier reading.
540 to 660	Character string Q$ is converted to decimal values in units of 4 characters from the beginning of this character string. Then, these values are converted to hexadecimal values to create a hexadecimal character string. Lh is defined as the length of this hexadecimal character string.
680 to 720	A hexadecimal character string is printed. In this case, a space is printed per 4 characters for easier reading.

(cont'd)

Line No.	Description
730	The starting address and pattern are set for the D3185A.
740	End of loop (Control returns to the beginning of the loop.)
750	Program end

5.10.2 Setting a Word Pattern (Binary Mode)

This program converts a binary pattern (character string consisting of 0s and 1s) input from the keyboard into a binary character string, thus setting a word pattern.

(1) Program list

```
100   DIM P$[600],Q$[512],B(64)
110   Ppg=708
120   OUTPUT Ppg;"WORD"
130   LOOP
140     INPUT "BIT LENGTH = ?",B1
150   EXIT IF B1>0 AND B1<1024
160   EXIT IF B1>=1024 AND B1<=65536 AND (B1 MOD 64)=0
170     BEEP
180   END LOOP
190   PRINT "BIT LENGTH :";B1
200   OUTPUT Ppg;"BL";B1
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$)
390   EXIT IF L=0
400     !
410     IF (L MOD 8)>0 THEN
420       FOR I=1 TO 8-(L MOD 8)
430         Q$=Q$&"0"
```

(Cont'd)

```
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$[I+J,I+J])*2^J
590       NEXT J
600       N=N+1
610     NEXT I
620     !
630     PRINT "BYTE PATTERN :"
640     FOR I=0 TO N-1
650       PRINT USING "#,4D";B(I)
660     NEXT I
670     PRINT
680     !
690     OUTPUT Ppg;"BIN";Adrs;",";N
700     FOR I=0 TO N
710       IF I<N THEN
720         OUTPUT Ppg;CHR$(B(I));
730       ELSE
740         SEND 7;DATA B(N) END
750       END IF
760     NEXT I
770   END LOOP
780   END
```

(2) Execution result

```
BIT LENGTH : 15
TOP ADDRESS : 0
BINARY PATTERN :
BYTE PATTERN :
 217 126
TOP ADDRESS : 0
```

(3) Explanation of Program

Line No.	Description
100	Character strings P$ (max. 600 characters), Q$ (max. 512 characters), and H$ (max. 128 characters) as defined arrays.
110	7 is defined as the select code of GPIB and 8 as the address of the D3185A.
120	WORD is specified as the pattern mode of the D3185A.
130 to 180	Input a bit length from the keyboard.
190 to 200	Print the bit length and set the bit length in the D3185A.
210 to 770	Input a pattern setting starting address and pattern. The input pattern is converted and set for the D3185A. This operation is repeated until " " (null character string) is input as a pattern.
220 to 260	Input the pattern setting starting address from the keyboard.
270	Print the starting address.
280	Input a pattern from the keyboard in binary notation (character string composed of 0s and 1s). Any character other than 0 and 1 may be inserted between characters as delimiters.
290	L is defined as the length of the input character string.
300	If the length of the character string is 0, control exits from the loop.
320 to 380	Only 0s and 1s are extracted from the input character string to make a new character string "Q$". L is defined as the length of character string Q$. If this length exceeds 128 characters, the excessive characters are discarded.
390	If the length of character string Q$ is 0, control exits from the loop.
410 to 460	0s are added after character string Q$ so that its length becomes a multiple of 8. Then, L is defined as the length of new character string.
480 to 520	Character string Q$ is printed. In this case, a space is printed per 4 characters for easier reading.
540 to 610	Character string Q$ is converted to decimal values (0 to 255) in units of 8 characters from the beginning of this character string. N is defined the number of decimal values.
630 to 670	Decimal values are printed sequentially.
690	The binary mode, string address, byte count N are set for the D3185A.

(cont'd)

Line No.	Description
700 to 760	Patterns are set for this unit byte by byte. EOI is sent together with the last byte.
770	Loop end (Control exits from the loop.)
780	Program end

5.11 Master/Slave Operation

If GPIB connectors are connected with a cable, the MASTER switch of the D3185A is set to ON, and the SLAVE switch of the D3285 is set to ON when the D3185A is used together with the D3285, the settings in the pattern setting block of the D3185A become the same as those of the D3285. In this case, keys and switches in the pattern setting block of the D3285 are ineffective.

During master/slave operation, any other GPIB device must not be connected to the D3185A and the D3285.

Setting the IFC (connector pin No.9) of the GPIB bus line at the lower level will cancel the master function of the D3185A and reset the MASTER key to OFF.

5.12 Error Indications and Trouble Indications

This section explains various error and trouble indications.

5.12.1 CPU Error Indication

When an error occurs in the CPU controlling the internal operations of the D3185A, an error message is displayed on the frequency indicator (① in Fig. 2-2) on the front panel. If such an error message is displayed, turn the D3185A off and turn it on again after waiting more than 5 seconds.

If the error is displayed again, the D3185A is defective. Contact the nearest dealer or the sales and support offices.

Addresses and telephone numbers are listed at the end of this manual.

Error indication format: Err x

Error code (4-digit number)

Error code	Contents
0001 to 1717	Memory error
8000 to 8008	Error in CPU's peripheral circuit

5.12.2 Low Battery Level Indication

When the D3185A is turned on, the following message may be displayed on the bit length indicator (⑰ in Fig. 2-3) or address number indicator (⑳ in Fig. 2-3) on the front panel:

LobAt

This message indicates that parameter settings saved in the memory have been cleared at power-off operation because the NiCd battery level was below the minimum level.

The low-battery indication lasts for about 3 seconds then the indicator starts displaying usual data. However, parameters have been initialized, that is, parameters are set to the initial values (see Section 5.9) as if they were initialized by GPIB program code "Z". The GPIB device address is initialized to 8.

To charge the NiCd battery from the lowest level up to the full level, the D3185A must be powered for at least 15 hours. If the low-battery message is displayed again even after charging the NiCd battery fully, the battery life has ended. Contact the nearest dealer or the sales and support offices.

Addresses and telephone numbers are listed at the end of this manual.

5.12.3 Delay Trouble Indication

If the absolute value of the delay indicated in the delay setting section (㊼ in Fig. 2-4) changes the tolerance or more, the automatic calibration routine starts and the following message is displayed for a maximum of 12 seconds:

CAL

In this case, the lower limit detection function and upper limit detection function are performed. If an error is detected, the following error indication will be made:

Err

When this is displayed, the system is undoubtedly defective, contact the nearest dealer or the sales and support offices.
Addresses and telephone numbers are listed at the end of this manual.

While this message is displayed, the delay setting control is ineffective. To make this knob effective, turn the D3185A off and turn it on again; the error indication will disappear but it will be displayed again after displaying CAL for several seconds unless the cause of the trouble is not remedied.

5.12.4 Initialization

To initialize the D3185A as specified in Section 5.9.2, hold down the pattern setting key [2], and turn the POWER switch on.

5.12.5 Pattern Data Initialization

The order of the pattern generation may sometimes go wrong when the clock frequency value is changed in wide range or the cable between the D3185A and the external clock generator is disconnected. In this case, press [PRBS] or [WORD] key once to initialize the pattern data.

6. SPECIFICATIONS

- Clock indicate

Frequency range	:	500MHz to 10GHz
Frequency setting resolution	:	1kHz (2kHz when 8.01GHz or more)
Frequency accuracy	:	±10ppm (in combination with TR4515)
Frequency memory	:	16 patterns

- External clock

Frequency range	:	500MHz to 10GHz
Input level	:	$0.7V_{p\text{-}p}$ to $1.5V_{p\text{-}p}$
Input waveform	:	Sine wave
Impedance	:	50 ohm (Nominal value)
Connector	:	K (plug)

- Pseudo-random pattern

$2^N - 1$	:	N = 7, 9, 10, 11, 15, 17, 20, 23 ($2^{15} - 1$ is true with either $X^{15} + X^{14} + 1$ or $X^{15} + X + 1$.)
Mark ratio	:	0/8, 1/8, 1/4, 1/2, 8/8, 7/8, 3/4, $\overline{1/2}$

- Word pattern

Bit length	:	1 bit to 65536 (2^{16}) bits
Bit length step	:	1 bit step for a length of up to 1024 bits 64 bit step for a length of over 1024 bits
Logic inversion	:	Possible
Pattern memory	:	Programmable 10 Types Fixed-pattern 2 Types

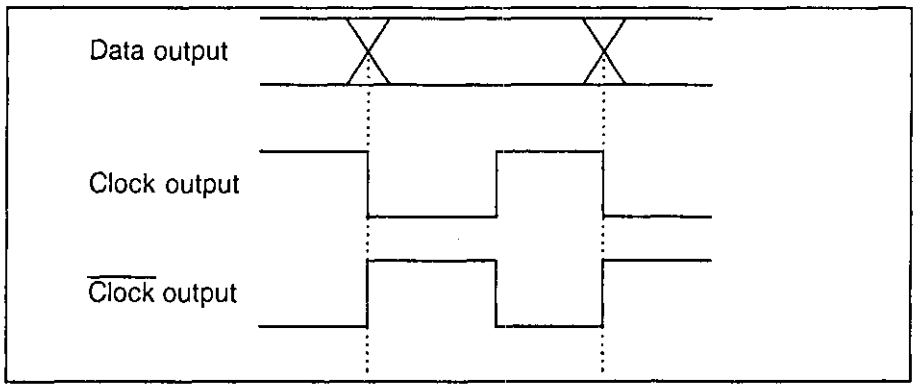
- Data output

Number of outputs	:	2 outputs (DATA and $\overline{\text{DATA}}$)
Amplitude range	:	0.5 to $2V_{p\text{-}p}$, 10mV step
Offset range	:	−2 to +2V, 10mV step, high-order level standard
Rise/fall time	:	30ps or less (20% to 80% for amplitude)
ECL level	:	Possible (Approx. −0.8V for high-order level and approx. −1.6V for low-order level at a 50 ohm load between coupled −2V, offset and amplitude can be variable at ±200mV)
Cross point ADJ	:	Can be changed manually
Load impedance	:	50 Ω
Connector	:	K (plug)

- Clock DC output

Number of outputs	:	2 outputs (CLOCK/$\overline{\text{CLOCK}}$)
Amplitude range	:	0.5 to $2V_{p\text{-}p}$, 10mV step
Offset range	:	−2 to +2V, 10mV step, high-order level standard
Rise/fall time	:	30ps or less (20% to 80% for amplitude) 6 to 10GHz 50ps or less (20% to 80% for amplitude) 2 to 6GHz 100ps or less (20% to 80% for amplitude) 0.5 to 2GHz
DUTY ADJ	:	Can be procedured the arrangement manually
Phase difference to DATA output	:	6 to 10GHz ± 40ps 2 to 6GHz ± 80ps 500MHz to 2GHz ± 150ps (with variable delay 0)
Phase difference to $\overline{\text{CLOCK}}$ output	:	6 to 10GHz ± 40ps 2 to 6GHz ± 80ps 500MHz to 2GHz ± 150ps
Variable delay	:	±400ps, 1ps step
ECL level	:	Possible (Approx. −0.8V for high-order level and approx. −1.6V for low-order level at 50 Ω load between coupled −2V, offset and amplitude can be variable at ±200mV)
Load impedance	:	50 Ω
Connector	:	K (plug)

- Output phase



- Error insertion

Error rate	:	1×10^{-N}, N = 4 to 9, or single

- Synchronous signal output

Clock synchronization	: 1/32 divided output of clock frequency
Pattern synchronization	: A synchronous signal at an arbitrary position can be selected in 16 bit units.
Output level	: 0V ±0.2V for high-order, −1V ±0.2V for low-order.
Load impedance	: 50 Ω
Connector	: SMA

- Auxiliary output

Output bit rate	: 1/4 of operation clock frequency
Number of pattern outputs	: 4-systems
Number of clock outputs	: 1-system
Skew between pattern outputs	: ±150ps or less (Referencing to falling edge of clock output)
Output level	: 0V/−1V
Load impedance	: 50 Ω
Connector	: SMA

- External gate input

Functions	: Inhibition of data output Inhibition at low-order level
Input level	: 0V/−1V
Input pulse width	: 20ns or more
Rise/fall time	: 10ns or less
Impedance	: Approx. 50 Ω
Connector	: BNC

- TR4515 control function

Purpose	: Controlling from D3185A, the output level and frequency level of TR4515 as used as an external clock source.
Connection	: The dedicated GPIB connector is used. For TR4515, the address should be "20".

- Master/slave function

Purpose	: Being used in combination with the D3285 unit, the pattern setting contents of the D3285 are automatically identical to that of the D3185A.
Connection method	: Connection of the D3185A with the D3285 via the GPIB cable between their respective GPIB connectors.

- Remote control

Interface	: GPIB IEEE 488-1978 (standard equipment)
Ability of the remote control	: All the settings on the fron panel are readable except suply on/off the power, the DUTY ADJ, cross point ADJ, and GPIB addressing.

- General specifications

Numeric indicator	: Green 7-segment LED
Storage of panel setting	: For 2 weeks or more after used for 12 hours in use
Working temperature range	: 0°C to +40°C
Working humidity range	: 40% to +85%RH
Storage temperature range	: −20 to +60°C
Storage humidity range	: 30% to 85%RH
Power supply	: 90 to 132V AC (standard) 198 to 250V AC (option 40) 48 to 63Hz, Sine wave
Power consumption	: 600VA or less
Weight	: 35kg or less
Dimensions	: Approx. 266 (height)×424 (width)×524.5 (depth) mm

ALPHABETICAL INDEX

[G]

[I]

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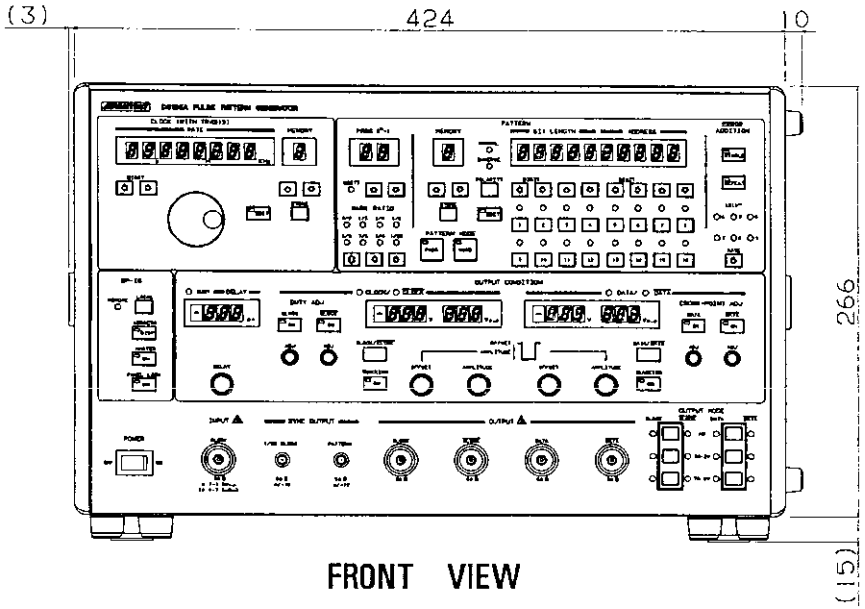
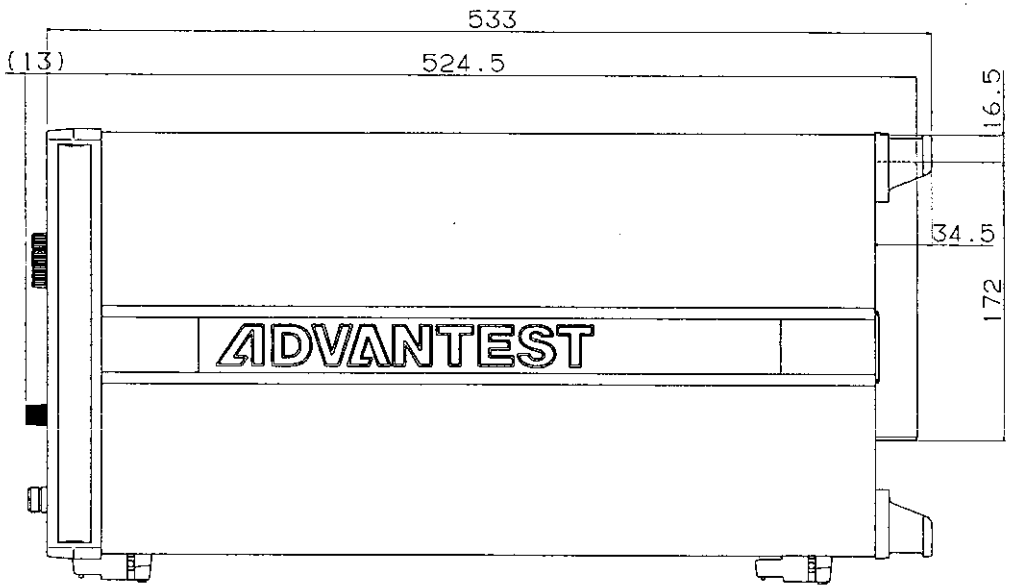
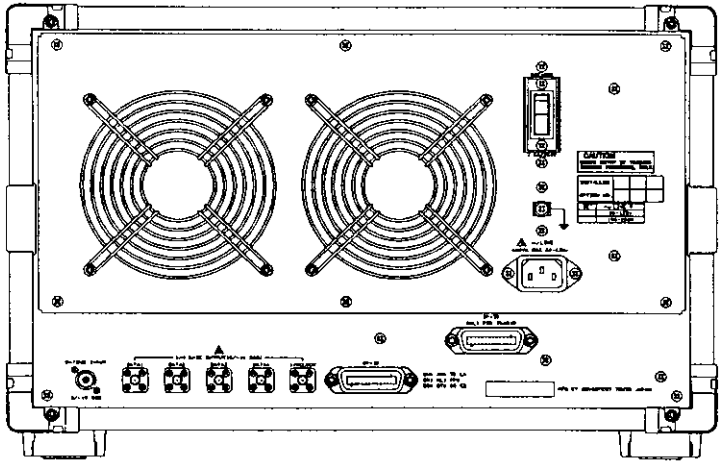
[W]



FRONT VIEW



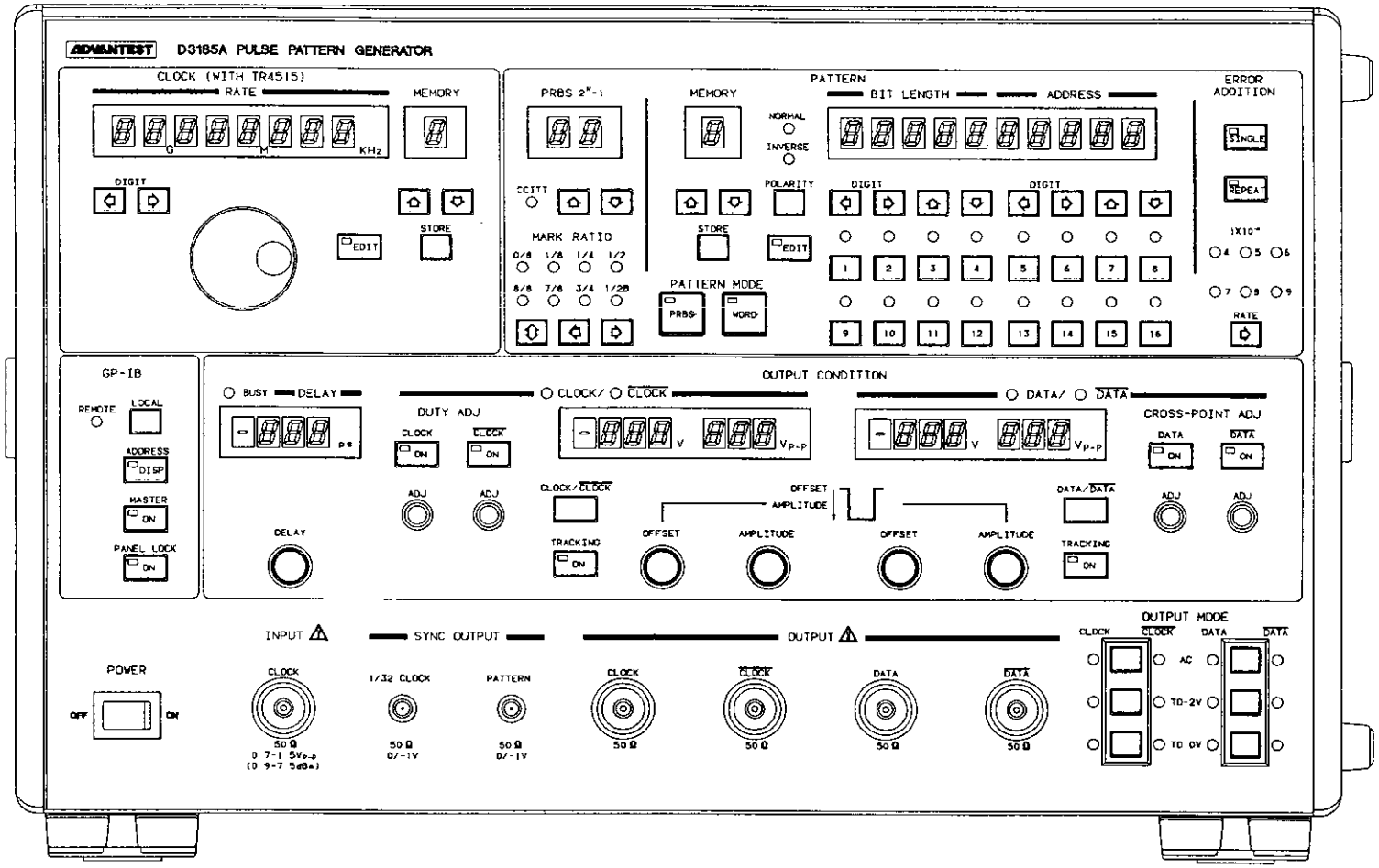
SIDE VIEW



REAR VIEW

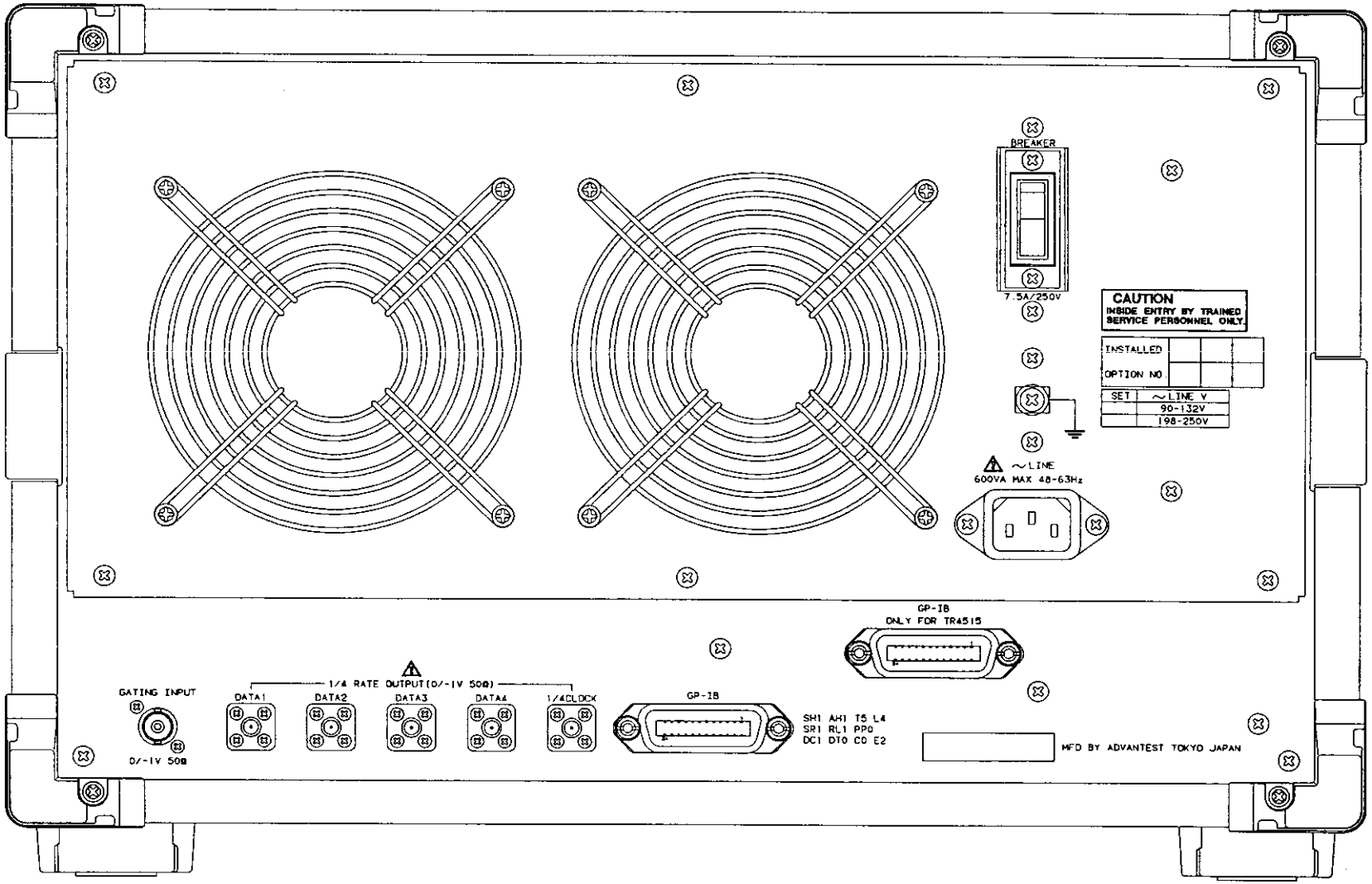
D3185A
EXTERNAL VIEW

EXT1-9111-A



D3185A FRONT VIEW

EXT2-9111-A



REAR VIEW

EXT3-9111-A

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").

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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.**

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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.

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