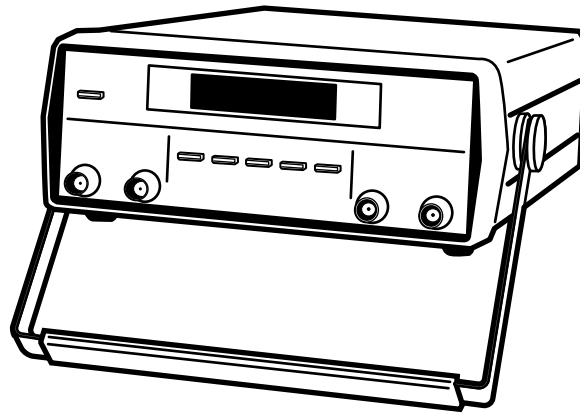
Part No. Z1-001-912, IA001384
Jun. 2009

OPERATION MANUAL

BIT ERROR RATE METER

KBM6010



KIKUSUI

Use of Operation Manual

Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.
If you find any incorrectly arranged or missing pages in this manual, they will be replaced. If the manual gets lost or soiled, a new copy can be provided for a fee. In either case, please contact Kikusui distributor/agent, and provide the "Kikusui Part No." given on the cover.
This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly. (Revision should be applied to items indicated by a check mark ☑.)

☐ **Input voltage**

The input voltage of this product is _____ VAC, and the voltage range is _____ to _____ VAC.
Use the product within this range only.

☐ **Input fuse**

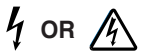
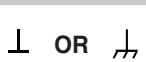
The rating of this product's input fuse is
_____ A, _____ VAC, and _____ .

⚠WARNING

- To avoid electrical shock, always disconnect the AC power cord or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

⚠Safety Symbols

For the safe use and safe maintenance of this product, the following symbols are used throughout this manual and on the product. Understand the meanings of the symbols and observe the instructions they indicate (the choice of symbols used depends on the products).

	Indicates that a high voltage (over 1,000 V) is used here. Touching the part causes a possibly fatal electric shock. If physical contact is required by your work, start work only after you make sure that no voltage is output here.
DANGER	Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury.
⚠WARNING	Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.
⚠CAUTION	Indicates a potentially hazardous situation which, if ignored, may result in damage to the product and other property.
	Shows that the act indicated is prohibited.
	Is placed before the sign “DANGER,” “WARNING,” or “CAUTION” to emphasize these. When this symbol is marked on the product, see the relevant sections in this manual.
	Indicates an earth ground terminal.
	Indicates a chassis ground terminal.

⚠Safety Precautions

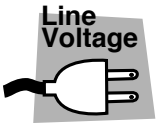
The following safety precautions must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly.

Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)

Purposes of use

- Do not use the product for purposes other than those described in the operation manual.



Input power

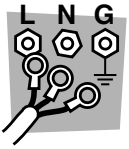
- Use the product with the specified input power voltage.
- For applying power, use the AC power cord provided. Note that the provided power cord is not use with some products that can switch among different input power voltages or use 100 V and 200 V without switching between them. In such a case, use an appropriate power cord. For details, see the relevant page of this operation manual.

Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.

Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover.



Installation

- When installing products be sure to observe "Precautions for Installation" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When applying power to the products from a switchboard, be sure work is performed by a qualified and licensed electrician or is conducted under the direction of such a person.
- When installing products with casters, be sure to lock the casters.

Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.

Operation

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the AC power cord. Be sure to unplug the AC power cord or stop applying power before checking.
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the AC power cord or disconnect the AC power cord from the switchboard. Be careful not to allow the product to be used before it is completely repaired.
- For output wiring or load cables, use connection cables with larger current capacity.
- Do not disassemble or modify the product. If it must be modified, contact Kikusui distributor/agent.

Maintenance and checking

- To avoid electrical shock, be absolutely sure to unplug the AC power cord or stop applying power before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

Service

- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact Kikusui distributor/agent.

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Preface

General description

The Bit Error Rate Meter KBM6010 includes a pattern generation section that generates pseudo-random noise (PN) patterns (*1) and the error rate measurement section that measures bit error rates (*2).

The pattern generation section operates at clock frequencies from 100 Hz to 10 MHz (internal) and from DC to 10 MHz (external). The error rate measurement section operates at clock frequencies from DC to 10 MHz.

A single piece of the Meter permits both test pattern generation and error rate measurement. Thus, the Meter can be applied to bit error rate measurement in digital transmission circuits and to the measurement of the receiving sensitivity of digital communication equipment and of digital broadcasting equipment.

Features

- The PLL, incorporated at the pattern generation section for clock output, covers a wide frequency range from 100 Hz to 10 MHz.
- Eight output patterns are available, namely ALL 0, ALL 1, PN9, PN11, PN15, PN20, PN20 (no zero suppress), and PN23.
- Error insertion possible
- I/O polarity reversible
- GPIB interface provided

DESCRIPTION *1: Test patterns are used to measure the transmission quality of a digital transmission circuit.

*2: The disappearance of pulses, or the generation of undesired pulses at the receiving end because of deteriorated transmission quality in a digital transmission circuit, is called a bit error. The bit error rate refers to a ratio of the number of bit errors at the receiving end over the number of bits sent. The error rate is expressed by the following equation:

Bit error rate = no. of bit errors/no. of bits sent

About this manual

This manual only covers products incorporating the ROM of version 1.0x.

When making an inquiry about your product, please include in your communication the ROM version number and the manufacturing number attached to the rear panel.

For the ROM version number, see “2.4 ROM version number display” of this manual.

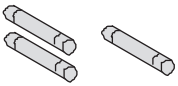
Chapter 1 Setup

This chapter presents procedures for setup, ranging from unpacking to starting the Meter.

1.1 Checking at unpacking

Upon receiving this product, make sure the package contains the necessary accessories and has not been damaged during transportation. If any part is damaged or missing, contact Kikusui distributor/agent.

We recommend that all packing materials be saved, in case the product needs to be transported at a later date.



0.5A(T): [99-00-0028]
1A(T): [99-00-0029]

☐ Fuse (3 pcs.)

Three fuses are included with the product. At the time of delivery, different types of fuses are provided in accordance with the settings of the line voltage range, as follows:

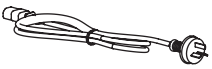
Line voltage range				
90V-110V	1A(T)	1 pc.	0.5A(T)	2 pcs.
104V-126V	1A(T)	1 pc.	0.5A(T)	2 pcs.
194V-236V	0.5A(T)	1 pc.	1A(T)	2 pcs.
207V-250V	0.5A(T)	1 pc.	1A(T)	2 pcs.

Rating: 125 V, 10 A
PLUG: NEMA5-15
[85-AA-0003]

or

Rating: 250 V, 10 A
PLUG: CEE7/7
[85-AA-0005]

or



Rating: 250 V, 10 A
PLUG: GB1002
[85-10-0790]

☐ AC power cord (1 pc.)

The power cord that is provided varies depending on the destination for the product at the factory-shipment.

[Z1-001-912]

☐ Operation Manual (1 copy)

Fig. 1-1 Accessories

1.2 Precautions for installation

Be sure to observe the following precautions when installing the Meter.

■ Do not use the Meter in a flammable atmosphere.

To prevent explosion or fire, do not use the Meter near alcohol, thinner, or other combustible materials, or in an atmosphere containing such vapors.

■ Avoid locations where the Meter is exposed to high temperatures or direct sunlight.

Do not locate the Meter near a heater or in areas subject to drastic temperature changes.

Operating temperature range: 0 °C to 40 °C (32 °F to 104 °F)

Storage temperature range: -25 °C to 70 °C (-13 °F to 158 °F)

■ Avoid humid environments.

Do not locate the Meter in a high-humidity environment—near a boiler, humidifier, or water supply.

Operating humidity range: 20 % to 85 % R.H
(no dew condensation is allowed)

Storage humidity range: 20 % to 90 % R.H
(no dew condensation is allowed)

Condensation may occur even within the operating humidity range. In that case, do not start using the Meter until the location is completely dry.

■ Do not place the Meter in a corrosive atmosphere.

Do not install the Meter in a corrosive atmosphere or one containing sulfuric acid mist or the like. This may cause corrosion of various conductors and imperfect contact with connectors, leading to malfunction and failure, or in the worst case, a fire.

■ Do not locate the Meter in a dusty environment.

Dirt and dust in the Meter may cause electrical shock or fire.

■ Do not use the Meter where ventilation is poor.

Provide sufficient space around the Meter. Otherwise, heat may accumulate in the Meter, resulting in fire.

■ **Do not place any object on the Meter.**

Particularly a heavy one, as doing so could result in a malfunction.

■ **Do not place the Meter on a tilted surface or in a location subject to vibrations.**

If placed on a non-level surface or in a location subject to vibration, the Meter may fall, resulting in damage and injury.

■ **Do not use the Meter in locations affected by strong magnetic or electric fields.**

Operation in a location subject to magnetic or electric fields may cause the Meter to malfunction, resulting in electrical shock or fire.

1.3 Precautions on moving

When moving or transporting the Meter to an installation site, observe the following precautions.

■ **Turn the POWER switch off.**

Moving the Meter with the power on may result in electrical shock or damage.

■ **Remove all wirings connected.**

Moving the Meter with cables connected may break the cables or cause the Meter to fall, resulting in injury.

■ **Free the handle.**

When carrying the Meter with the handle, free the handle. In the locked condition, the Meter is difficult to hold, and the lock may disengage suddenly.

■ **For transportation, use the special packing material for the Meter.**

Transport the Meter in its original package to prevent vibration and falls, which may damage the Meter.

1.4 Checking input power and the fuse

As shown in Table 1-1, four line voltage ranges are available for the Meter. Check the default settings to determine whether the voltage is suitable for your Meter. Use a input power fuse appropriate for your line voltage range.

⚠WARNING • To prevent electric shock, be sure to unplug the AC power cord or turn the switch on the switchboard off before checking or replacing the fuse.

⚠CAUTION • Make sure that the fuse used conforms to the Meter specifications, including shape, rating, and characteristics. Using a fuse with different rating or short-circuiting, the fuse holder will damage the Meter.

When checking or changing the line voltage range, or when checking or replacing the power fuse, observe the following instructions:

1. – Turn the POWER switch off and unplug the AC power cord.
2. – Remove the fuse holder cover (Fig. 1-2).
3. – Referring to Table 1-1, check that the rating and fusing characteristics of the fuse installed conform to the line voltage. If not, replace the fuse.
4. – Insert the fuse holder cover, adjusting its position to the line voltage to be applied.

Table 1-1 Line Voltage Range

LINE VOLTAGE		FUSE
100	90V–110V	1A(T) AC250V
120	104V–126V	
220	194V–236V	0.5A(T) AC250V
240	207V–250V	

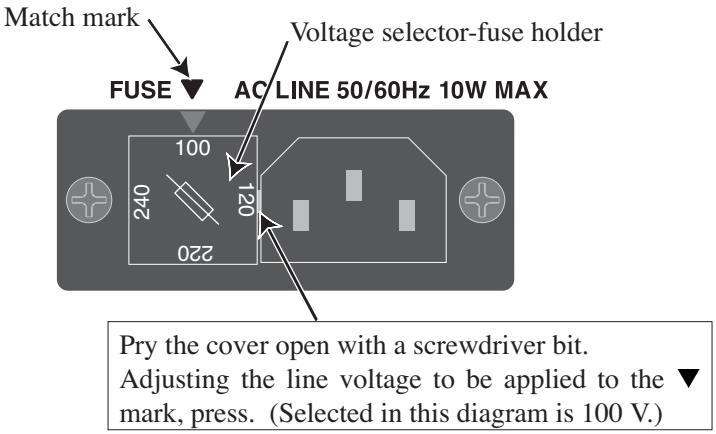


Fig. 1-2 Removing the Fuse Holder

1.5 AC Power Cord Connection

The power cord that is provided varies depending on the destination for the product at the factory-shipment.

⚠WARNING • The AC power cord for 100 V system shown in Fig.1-3 has a rated voltage of 125 V AC. If this AC power cord is used at the line voltage of a 200 V system, replace the power cord with that satisfying that line voltage.

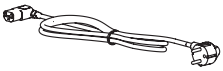
Appropriate power code must be selected by qualified personel (those who have electrical knowledge).

If such a power cord cannot be obtained, contact your Kikusui distributor/agent.

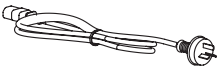
Do not use the power code attached to this product for the power code of other instruments.

[85-AA-0003]
PLUG:NEMA5-15

Power cord for 100 V system
Rated voltage: 125 VAC
Rated current: 10 A



[85-AA-0005]
PLUG:CEE7/7



[85-10-0790]
PLUG:GB1002

Power cord for 200 V system
Rated voltage: 250 VAC
Rated current: 10 A

Fig. 1-3 AC power cord

Make connections as follows:

1. – Turn off the power.
2. – Connect the AC power cord to the AC LINE connector on the rear panel.
3. – Plug the power cord into the receptacle.

■ To directly connect to the switchboard:

If the AC power cord is to be connected directly to the switchboard without using a plug, install crimp terminals on the power cord.

⚠WARNING

- An AC power cord cannot be used for over rated voltage, even if its plug is cut off to be replaced with crimp terminals.
- To prevent electrical shock, turn off the switchboard before connecting the power cord.
- Connections to the switchboard must be made by qualified personnel.

1.6 Grounding

⚠WARNING • Not grounding the Meter creates danger of electric shock.

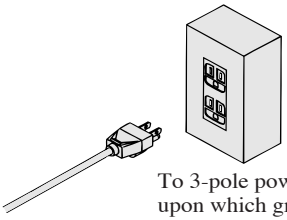
• Connect the ground terminal to an electrical ground (safety ground).

⚠CAUTION • Not performing adequate grounding work on the Meter results in malfunction or the production of large noises from the Meter.

To ensure safety, provide secure grounding.

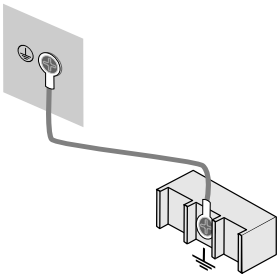
The Meter can be grounded by one of the two methods specified below. Select one, and ground the Meter securely.

a. Plug the AC power cord into a 3-pole power outlet upon which grounding construction has been performed.



To 3-pole power outlet upon which grounding construction has been performed

b. Connect terminal ⏚ on the Meter rear panel to the ground terminal (GND).



To the ground terminal (GND) on switchboards

Chapter 2 Basic Operation

This chapter describes precautions to take before starting the description of the Meter and procedures to turn the power on, among other operations.

2.1 Before starting

Before turning the power on, the user should be fully familiar with safety precautions. Be sure to study the following.

TX CLOCK terminal

This serves as the external clock input terminal depending on panel settings. When “EXT IN LED” is lit on the terminal, the terminal is set for input. When inputting a clock signal from outside into the Meter, check beforehand that “EXT IN LED” is lit. Then make connections.

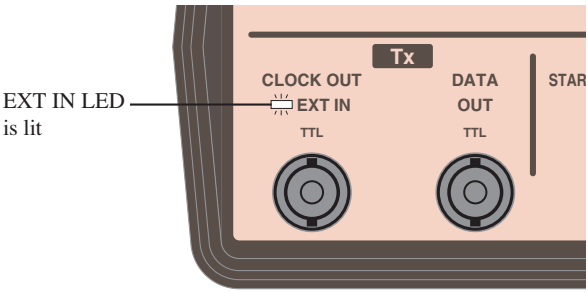


Fig. 2-1 TX CLOCK EXT IN LED

2.2 Turning power on

1. – Check that the POWER switch is off.
2. – Referring to the LINE VOLTAGE table on the rear panel, check that the voltage selector position is set to the voltage to be supplied to the Meter.
3. – Connect the accompanying AC power cord to AC LINE on the rear panel.
4. – Connect the plug to the specified power line.

⚠ CAUTION • If the voltage selector position is not set at the voltage to be supplied, the fuse will be damaged.

---

5. – Turn the POWER switch on.

After all LEDs light, the front panel indication shows the error rate measurement mode.

If nothing is connected to the Rx CLOCK IN or the Rx DATA IN terminal, the BER LED lights, and the display becomes as shown in Fig. 2-2.

Fig. 2-2 Example of Error Rate Display

SYNC and ERROR LEDs

The measurement section of the Meter is guaranteed to operate from DC.

The SYNC and ERROR LEDs may light in the following cases, but they do not indicate errors.

- When the clock is cut off during the measurement operation, and the Meter enters a clock input wait state.
- When the power is turned on without the clock being applied.

When the clock is applied, the display is updated to indicate the appropriate state.

2.3 Initialization

Turning the POWER switch on while pressing the SHIFT key initializes the Meter. Once it is initialized, all panel settings return to those at shipment from the factory.

NOTE • Keep pressing the SHIFT key until all LEDs light once, followed by error rate display. Releasing the key midway aborts initialization.

Table 2-1 Settings at Shipment from the Factory

7-segment LED	Error rate display
Output frequency	10.000 MHz
Measurement range	10^4
Data pattern	PN9
Error insertion	0
Synchronous mode	1: AUTO RESYNC on
Tx clock	1: INT (internal)
Tx clock polarity	1: rising edge
Tx data polarity	1: non-inversion
Rx clock polarity	1: rising edge
Rx data polarity	1: non-inversion
GPIB address	02

2.4 ROM version number display

If you press the SYNC key while pressing the SHIFT key, the ROM version number appears after the date on which the data was written in the ROM.

Fig. 2-3 ROM Version Number Display

This case shows that the version number is "1.00".

2.5 Panel settings

For the Meter to operate, the Meter operation modes, including the output frequency, measurement range, and data patterns, must be preset.

The Meter provides the following five setting menus.

1. Setting output frequency
2. Setting measurement range
3. Setting data patterns
4. Setting error insertion
5. Setting clock/data/synchronous modes

To open a setting menu, press the MODE key. Each time you press the MODE key, the next menu appears.

To exit a setting menu, press the START/STOP key. From GPIB, send the STA or SIN ON command message.

2.5.1 Setting the output frequency

To set the Tx clock frequency:

1. – Press the MODE key once while the error rate is on display. This produces the output frequency setting mode (Fig. 2-4).

   You can set the frequency between 100 Hz and 10 MHz.

2. – Using the ◀ or ▶ key while pressing the SHIFT key, specify a desired digit. The digit specified blinks.

3. – Using the ▲ or ▼ key, choose a desired frequency.

   Keeping the ▲ key pressed produces the auto increment mode. Keeping the ▼ key pressed produces the auto decrement mode.

Fig. 2-4 Output Frequency Setting Mode Display

This case shows settings up to 10.000 MHz.

2.5.2 Setting the measurement range

To set the measurement range of bit error rate:

1. – Press the MODE key twice while the error rate is on display. This produces the measurement range setting mode (Fig. 2-5).

   You can set the measurement range between 10^4 and 10^8.

2. – Using the ▲ or ▼ key, choose a desired range.

Fig. 2-5 Measurement Range Setting Mode Display

This case shows settings to 10^4.

2.5.3 Setting the data patterns

This allows to set patterns for Tx and Rx data.

It is not possible to set different patterns for Tx and Rx data.

1. – Press the MODE key three times while the error rate is on display. This produces the data pattern setting mode (Fig. 2-6).

   Data patterns can be set to ALL0, ALL1, PN9, PN11, PN15, PN20, PN20 (no zero suppress), and PN23.

2. – Using the ▲ or ▼ key, choose a desired pattern.

   When PN20 (no zero suppress) is specified, the display becomes as shown in Fig. 2-7.

Fig. 2-6 Data Pattern Setting Mode Display 1

This case shows settings to PN9.

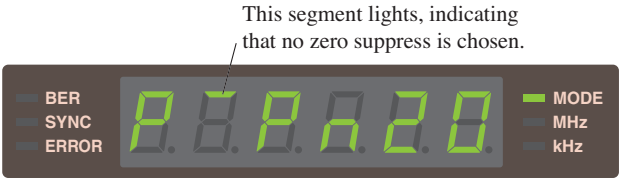


Fig. 2-7 Data Pattern Setting Mode Display 2

This case shows settings to PN20 (no zero suppress).

2.5.4 Setting the error insertion

This allows an error to be inserted in Tx data.

1. – Press the MODE key four times while the error rate is on display. This produces the error insertion setting mode (Fig. 2-8).

   You can set the error insertion to 0 or a value between 10^{-7} and 10^{-1}.

2. – Using the ▲ or ▼ key, choose a desired error insertion.

   When this is set to 0, the display becomes as shown in Fig. 2-9.

Fig. 2-8 Error Insertion Setting Mode Display 1

This case shows settings to 10^{-7}.

Fig. 2-9 Error Insertion Setting Mode Display 2

This case shows settings to 0.

2.5.5 Setting the clock/data/synchronous modes

These instructions are for setting the Tx clock and data polarities and Rx clock and data polarities, the Tx clock to be used, and the synchronous mode.

Make each setting, inputting "1" or "0" in each segment, assuming the 7-segment LED in six digits to be a 6-bit register.

1. – Press the MODE key five times while the error rate is being displayed. This produces the clock/data/synchronous mode setting mode (Fig. 2-10).

   For information on setting the synchronous mode, see the next page.

2. – Pressing the ◀ or ▶ key while pressing the SHIFT key, specify a desired bit. The specified bit blinks.

3. – Using the ▲ or ▼ key, choose "1" or "0".

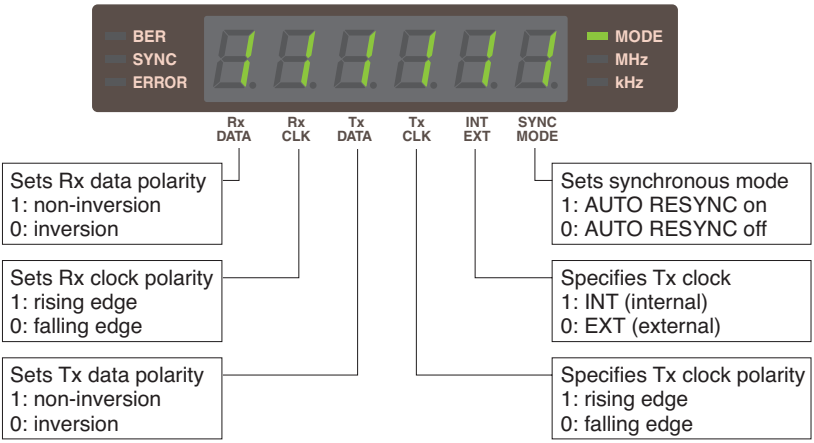


Fig. 2-10 Clock/Data/Synchronous Mode Setting Mode Display

This section gives instructions on setting all bits to "1".

■ Setting the synchronous mode

"Automatic" or "manual" must be set to establish synchronization.

1: AUTO RESYNC on

When the input data coincides with the Meter internal reference pattern for continuous 32 bits after the start of measurement, synchronization is established (SYNC LED on the display lights).

If an error occurs during measurement for six or more bits out of the 64, synchronization is deemed to fail. When this happens, the Meter automatically prepares to execute resynchronization establishment.

0: AUTO RESYNC off

When AUTO RESYNC is turned off, it is necessary to press the SYNC key to establish synchronization. After the key is pressed, if the input data coincides with the Meter internal reference pattern for continuous 32 bits, synchronization is established (SYNC LED on the display lights).

If an error occurs during measurement for six or more bits out of the 64, synchronization is deemed to fail. If this happens, the Meter continues error measurement without preparing to execute resynchronization establishment.

NOTE When AUTO RESYNC is off:

- Remember to press the SYNC key to start measurement.
- If you change the Meter mode during measurement or input a signal through the Rx DATA IN terminal after starting measurement with no signal input through the Rx DATA IN terminal, SYNC LED may light. However, in this case, operation is not actually synchronized.

2.6 Starting and stopping measurement

To start or stop error rate measurement, press the START/STOP key. This key functions as follows.

■ When the current display does not show the error rate measurement mode

Pressing the START/STOP key starts measurement, displaying the error rate reading. At the initial measurement, however, the display remains as shown in Fig. 2-11 until the measurement is completed.

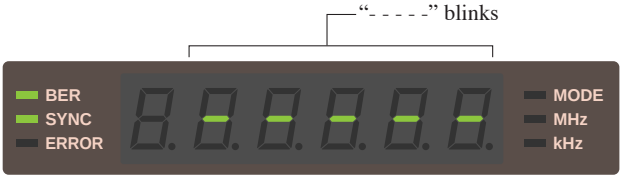


Fig. 2-11 Display during Error Rate Measurement

■ When the current display shows the error rate measurement mode

Pressing the START/STOP key halts refreshing of the error rate display holds the measured value. The display at this time is as shown in Fig. 2-12.

To resume measurement, press the same key once again.

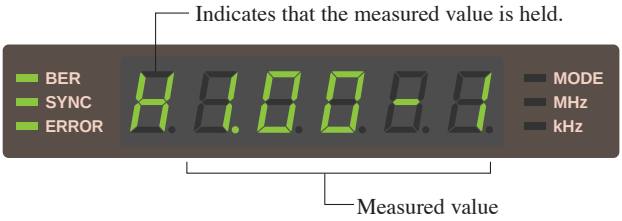


Fig. 2-12 Held Measurement Display

In this case, an erroneous measurement of 1.00×10^{-1} was taken.

2.7 Single measurement mode

Pressing the START/STOP key while pressing the SHIFT key starts measurement in the single measurement mode. Thereafter, each time the same key is pressed, the Meter measures the error rate for the bits corresponding to the preset measurement range, displaying the reading. In this mode, the display during measurement is as shown in Fig. 2-13.

The display will be as shown in Fig. 2-14 when the measurement is completed.

To cancel the single mode, press the START/STOP key while pressing the SHIFT key once again.

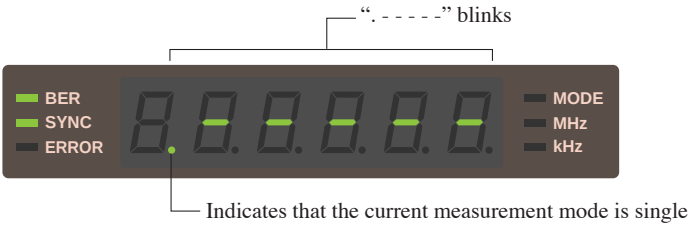


Fig. 2-13 Display during Measurement in the Single Measurement Mode

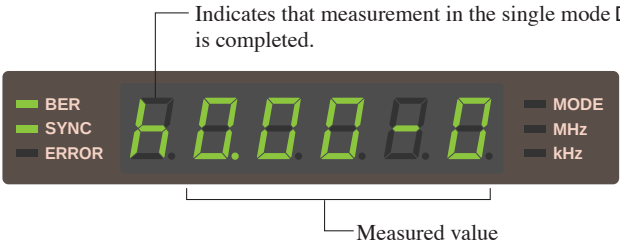


Fig. 2-14 Display Showing the End of Measurement in the Single Measurement Mode

This figure indicates that there is no error.

2.8 SYNC key

Use this key to manually execute synchronization establishment.

When the synchronization mode is set to AUTO RESYNC off, pressing the SYNC key executes synchronization establishment.

For synchronous mode setting, see Section 2.5.5, “Setting the clock/data/synchronous modes.”

NOTE

- When AUTO RESYNC is turned on, the SYNC key is invalid.

Chapter 3 Operating Procedures

This chapter describes procedures for operating the Meter, taking for instance the error bit measurement of a digital receiver and a digital mobile phone as the subjects of EUT (Equipment Under Test).

Taken up here are the following three cases:

Case 1: Measurements using the error rate measurement section only

Case 2: Measurements using data and the clock from the pattern generation section

Case 3: Measurements using data from the pattern generation section and an external clock

Case 1: Measurements using the error rate measurement section only

In this case study we will measure error rates using data stored in the digital modulation signal generator. The pattern generation section of the Meter is not used.

■ Setting the Meter panel

Proceed as follows.

For the details of each setting, see Section 2.5, “Panel settings.”

- Measurement range
  Set a range corresponding to the error rate to be measured.
  [Ex.] For a target error rate of 1×10^{4}.
  Set the measurement range to above 1×10^{4}.
- Data pattern
  Set to a pattern to be sent from the digital modulation signal generator.
- Rx clock polarity
  Set to the EUT clock output.
- Rx data polarity
  Set to the EUT data output.

■ Connections

Connect the EUT clock and data output to the Meter Rx CLOCK IN and Rx DATA IN, respectively.

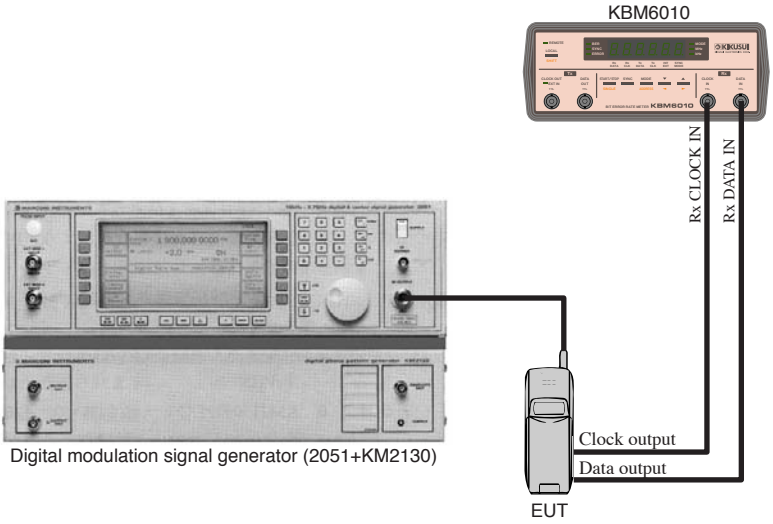


Fig. 3-1 Connections for Measurement Using the Error Rate Measurement Section Only

■ Starting measurement

Pressing the START/STOP key starts measurement.

For measurement in the single measurement mode, see Section 2.7, “Single measurement mode.” For measurement with AUTO RESYNC off, see Section 2.8, “SYNC key.”

Case 2: Measurements using data and the clock from the pattern generation section

In this case study we will measure error rates using data and the clock from the pattern generation section.

■ Setting the Meter panel

Proceed as follows.

For the details of each setting, see Section 2.5, “Panel settings.”

- Output frequency
  Set a bit rate to be measured.
- Measurement range
  Set a range corresponding to the error rate to be measured.
- Data pattern
  Choose a pattern to be used for measurement.
- Tx clock
  Choose “1: INT” (internal).
- Tx clock polarity
  Set to the specification of the digital modulation signal generator.
- Rx clock polarity
  Set to the EUT clock output.
- Rx data polarity
  Set to the EUT data output.

■ Connections

Connect Tx CLOCK OUT and Tx DATA OUT to the clock input and data input of the digital modulation signal generator, respectively. Connect the EUT clock and data output to the Meter Rx CLOCK IN and Rx DATA IN, respectively.

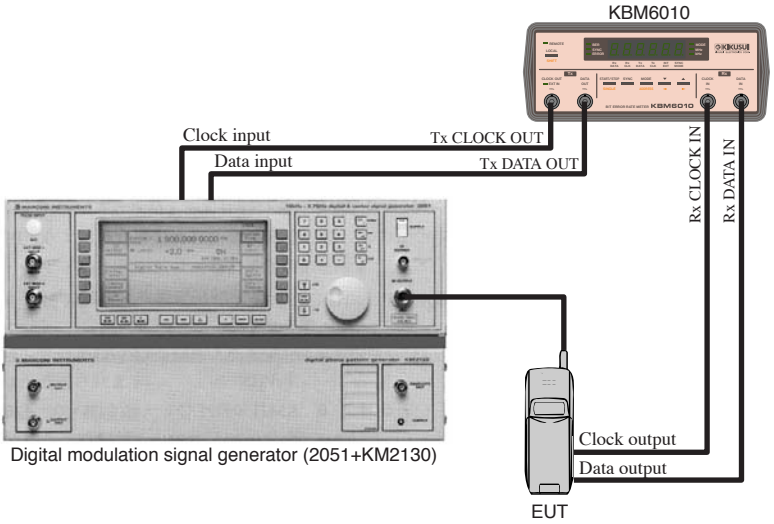


Fig. 3-2 Connections for Measurement Using Data and the Clock from the Pattern Generation Section

■ Starting measurement

Pressing the START/STOP key starts measurement.

For measurement in the single measurement mode, see Section 2.7, “Single measurement mode.” For measurement with AUTO RESYNC off, see Section 2.8, “SYNC key.”

Case 3: Measurements using data from the pattern generation section and an external clock

In this case study we will measure error rates using data from the pattern generation section and an external clock.

⚠CAUTION • This measurement uses the Meter Tx DATA CLOCK OUT as the external clock input terminal. Switch Tx DATA CLOCK OUT to the input mode and check that EXT IN LED lights. Only then input the external clock.

■ Setting the Meter panel

Proceed as follows.

For the details of each setting, see Section 2.5, “Panel settings.”

- Output frequency
  Arbitrary (the internal clock frequency is invalid since an external clock is used.)
- Measurement range
  Set a range corresponding to the error rate to be measured.
- Data pattern
  Choose a pattern to be used for measurement.
- Tx clock
  Choose “0: EXT” (external).

  Tx CLOCK EXT IN LED on the panel lights, and Tx data synchronizes with the external clock.
- Tx clock polarity
  Set to the specification of the digital modulation signal generator.
- Rx clock polarity
  Set to the EUT clock output.
- Rx data polarity
  Set to the EUT data output.

■ Connections

Connect the Meter Tx DATA OUT to the data input of the digital modulation signal generator and the Meter Tx DATA CLOCK OUT (EXT IN) to the clock output of the digital modulation signal generator. Connect the EUT clock and data output to the Meter Rx CLOCK IN and Rx DATA IN, respectively.

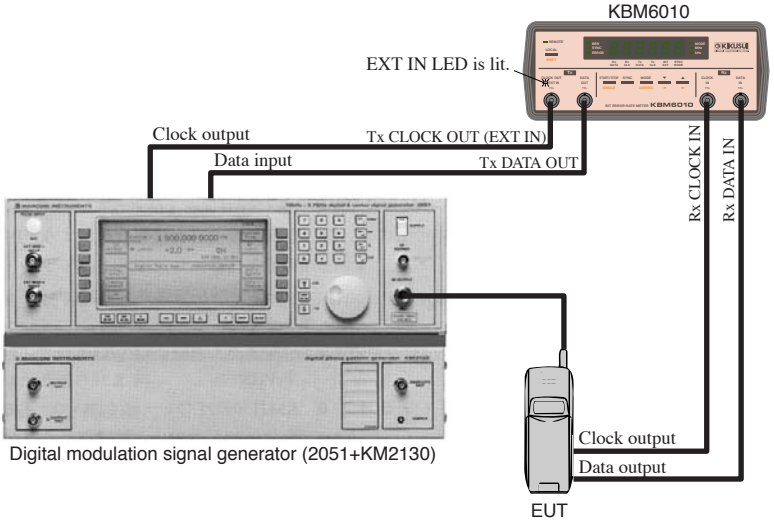


Fig. 3-3 Connections for Measurement Using Data from the Pattern Generation Section and an External Clock

■ Starting measurement

Pressing the START/STOP key starts measurement.

For measurement in the single measurement mode, see Section 2.7, “Single measurement mode.” For measurement with AUTO RESYNC off, see Section 2.8, “SYNC key.”

Chapter 4 GPIB Control

This chapter describes preparation for remote control of the Meter with the aid of the GPIB interface and messages communicated between controller and Meter.

4.1 General description

The use of the GPIB interface allows a program to control the Meter operation, including panel setting and the start and stop of measurement, from an external controller (computer).

The electric and mechanical specifications of the Meter GPIB interface conform to IEEE Std. 488.1-1987.

4.2 Connecting the GPIB cable

1. – Turn all POWER switches of devices constituting the GPIB system, including the Meter, off.
2. – Connect the GPIB cable to the 24-pin GPIB connector on the Meter rear panel.

⚠CAUTION
- Always use a GPIB cable conforming to IEEE Std. 488.1-1987.
- Firmly tighten the cable connector lock screw.
- Do not stack three or more connectors in series.
- Do not move the devices with the cable connected.

NOTE
- Limit the total number of devices including controllers connected to the bus to a maximum of 15.
- Limit the cable length between devices to a maximum of 2 m.
- Limit the total length of the cables to a maximum of 20 m.

4.3 Setting the GPIB address

The Meter GPIB address is set to 02 at shipment from the factor and after initialization. To change the address, proceed as follows.

1. – Press the ADDRESS key while pressing the SHIFT key.
2. – The current address appears on the display (Fig. 4).
3. – Using the ▲ or ▼ key, choose a desired address. You can set the address between “00” and “30”.

⚠ CAUTION • Do not set the same address within the same bus.

To exit the address setting mode, press the START/STOP key.

4. – Turn the Meter power on again. The address set becomes valid after power-on.

Fig. 4-1 Address Display

This case shows address “02”.

4.4 Messages and terminators

This section presents a terminology of communications between the controller and the device and describes the terms (Fig. 4-2).

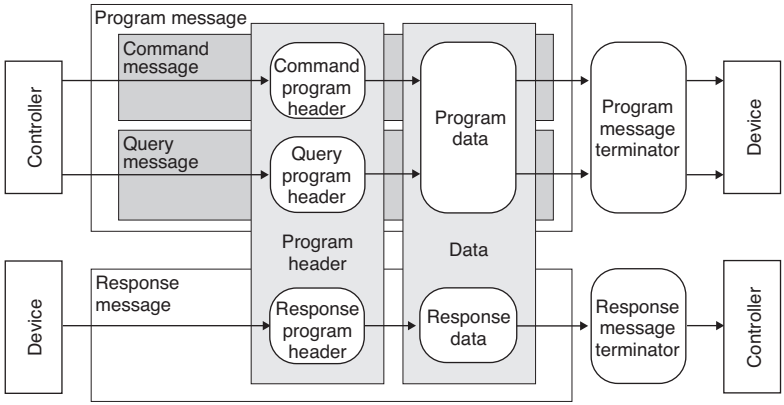


Fig. 4-2 Messages and Terminators

4.4.1 Messages

A communication sent from the controller to a device is called a program message. A communication sent from a device to the controller is called a response message.

A message comprises the program header and the data.

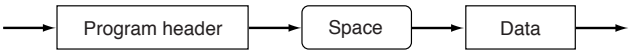
Program message

Program messages are classified into the command message and the query message.

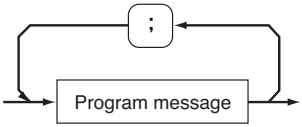
A command message executes a particular function of a device and changes settings. A query message inquires about device settings and statuses.

Writing a program message

- Put a space (ASCII: 20h) between the program header and the data.



- Program messages can be linked with ";" (ASCII: 3Bh).



4.4.2 Terminators

A mark to show the end of a program message is called a program message terminator. A mark to show the end of a response message is called a response message terminator.

Program message terminator

You can use one of the following without presetting it:

LF / LF + EOI / EOI / CR + EOI.

NOTE •You cannot use CR alone without EOI.

Response message terminator

The default is "CR + LF + EOI". Depending on the TRM command message, you can change it to one of the following:

CR + LF + EOI / LF + EOI / EOI / CR + EOI.

4.5 Device message

A program message and a response message supported by a device are collectively called a device message.

The following paragraphs explains device messages that are supported by the Meter one by one.

NOTE • Of the device messages, those beginning with "*" are messages common to GPIB that do not depend on devices.

Abbreviations of program headers

Many program headers included in the messages described below can be written in abbreviations. The capital letters in a program header constitute the program header abbreviation.

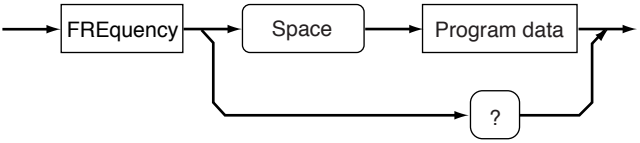
"FREquency" for instance can be abbreviated "FRE" or "fre". Either capital or small letters will do. Thus you can write "FREQUENCY", "frequency", "Fre" and so on.

FREquency

Sets and inquires about the Tx clock frequency.

■ Program message

• Structure



• Program data (frequency setting)

Min.:	100 Hz
Max.:	10 MHz
Resolution:	1 kHz (10.000 MHz to 1.000 MHz)
	100 Hz (999.9 kHz to 100 Hz)
Data type:	real number
Suffix multiplier:	k (kilo); M (mega); none
Suffix unit:	HZ (hertz)

[Ex.] Setting the frequency to 1 MHz:
FRE 1 MHZ
FRE 1000000
FRE 1E6

NOTE

- You can use “1E6” in place of “M” and “1E3” in place of “K”.
- Round off to the nearest ten. Lower numbers are deemed to be errors. A value set lower than the resolution is rounded off.

■ Response message

Responding to “FRE?”, this message returns the frequency of the current Tx clock.

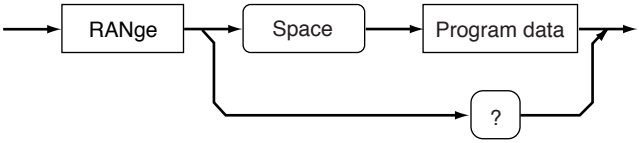
[Ex.] When the current frequency is 1 MHz, the message returns:
“1000000”.

RANge

Sets and inquires about the measurement range.

■ Program message

• Structure



• Program data (range code)

Data type: Character
Range code 0: 1E04 (10000)
1: 1E05 (100000)
2: 1E06 (1000000)
3: 1E07 (10000000)
4: 1E08 (100000000)

[Ex.] Setting the measurement range to 1E06:
RAN 2

■ Response message

Responding to "RAN?", this message returns the current measurement range code.

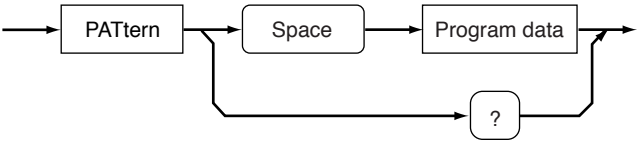
[Ex.] When the current measurement range is 1E06, the message returns:
"2".

PATtern

Sets and inquires about the output data pattern and measurement pattern.

■ Program message

• Structure



• Program data (character)

Data type: Character
Pattern: ALL0
ALL1
PN9
PN11
PN15
PN20
PN20N
PN23

NOTE • "PN20N" refers to "PN20" without zero-suppress.

[Ex.] Setting the measurement pattern to PN9:
PAT PN9

■ Response message

Responding to "PAT?", this message returns the current pattern.

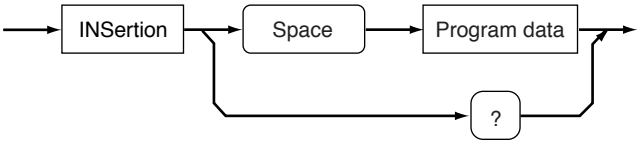
[Ex.] When the current pattern is PN9, the message returns: "PN9".

INSertion

Inserts an error in an output pattern or inquires about the error insertion code.

■ Program message

• Structure



• Program data (error insertion code)

Data type: Character
Error insertion code: 0: none
1: inserts error “1.00E-1”
2: inserts error “1.00E-2”
3: inserts error “1.00E-3”
4: inserts error “1.00E-4”
5: inserts error “1.00E-5”
6: inserts error “1.00E-6”
7: inserts error “1.00E-7”

[Ex.] Setting the error insertion code to 1.00E-2:
INS 2

■ Response message

Responding to “INS?”, this message returns the current error insertion code.

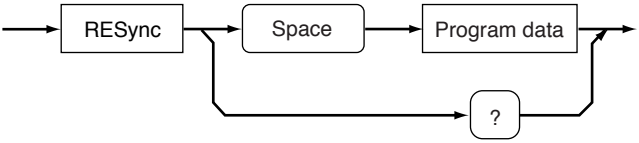
[Ex.] When the current error insertion code is 1.00E-2, the message returns:
“2”.

RESync

Sets AUTO RESYNC and inquires about its status.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: ON or "1": AUTO RESYNC is turned on
OFF or "0": AUTO RESYNC is turned off

[Ex.] Turning AUTO RESYNC off:
INS OFF

■ Response message

Responding to "RES?", this message returns the status (on/off) of AUTO RESYNC.

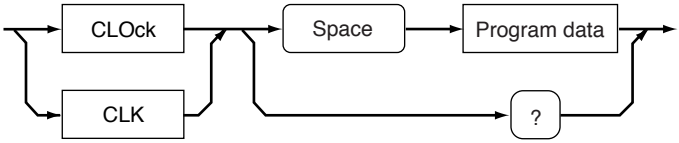
[Ex.] When the current AUTO RESYNC mode is off, the message returns:
"OFF".

CLOck or CLK

Sets the Tx clock and inquires about its status.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: "INT" or "1": internal Tx clock
"EXT" or "0": external Tx clock

[Ex.] Setting the Tx clock to external:
CLO EXT

■ Response message

Responding to "CLO?", this message returns the status of the Tx clock.

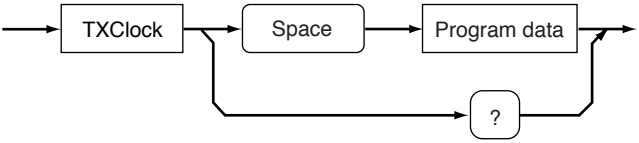
[Ex.] When the current Tx clock is internal, the message returns:
"INT".

TXClock

Sets and inquires about the polarity of the Tx clock.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: "POS" or "1": Rising edge
"NEG" or "0": Falling edge
(POS: Positive; NEG: Negative)

[Ex.] Setting the Tx clock to the falling edge:
TXC NEG

■ Response message

Responding to "TXC?", this message returns the polarity of the Tx clock.

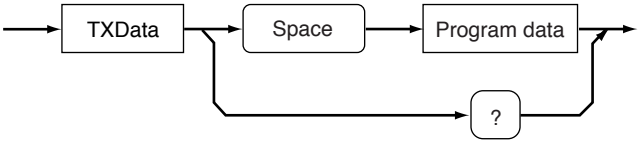
[Ex.] When the current Tx clock is set to the rising edge, the message returns:
"POS".

TXData

Sets and inquires about the polarity of the Tx data.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: "NOR" or "1": Not inverted
"INV" or "0": Inverted
(NOR: Normal; INV: Inverse)

[Ex.] Inverting Tx data:
TXD INV

■ Response message

Responding to "TXD?", this message returns the polarity of the Tx data.

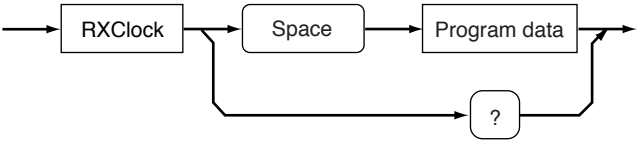
[Ex.] When the current Tx data is inverted, the message returns:
"INV".

RXClock

Sets and inquires about the polarity of the Rx clock.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: "POS" or "1": Rising edge
"NEG" or "0": Falling edge
(POS: positive; NEG: negative)

[Ex.] Setting the Rx clock to the falling edge:
RXC NEG

■ Response message

Responding to "RXC?", this message returns the polarity of the Rx clock.

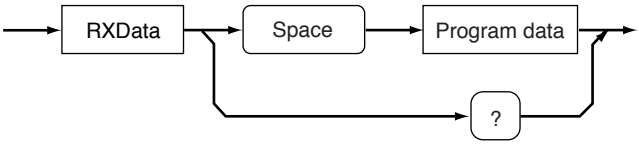
[Ex.] When the current Rx clock is set to the rising edge, the message returns:
"POS".

RXData

Sets and inquires about the polarity of the Rx data.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: "NOR" or "1": Not inverted
"INV" or "0": Inverted
(NOR: Normal; INV: Inverse)

[Ex.] Inverting Rx data:
RXD INV

■ Response message

To "RXD?", returns the polarity of the Rx data.

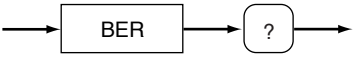
[Ex.] When the current Rx data is inverted, the message returns:
"INV".

BER? (query message only)

Inquiries about the bit error rate value.

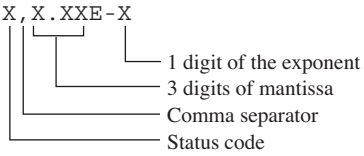
■ Query message

• Structure



■ Response message

To “BER?”, returns the current bit error rate value as follows:



Status code
- N: Normal
- B: Busy (under measurement; in this status, the measured value returned is the previous measurement data)
- H: HOLD (halts measurement)
- h : Single mode measurement completed
- S : Synchronization Loss (failed synchronization; in this status the measured value returned is 1.00E-0)

[Ex.] When an error of 1.00E-4 is measured normally, the message returns:
“N, 1.00E-4”.

STArt (command message only)

Starts measurement.

■ Command message

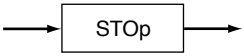
- **Structure**

STOp (command message only)

Holds measurement.

■ Command message

- **Structure**

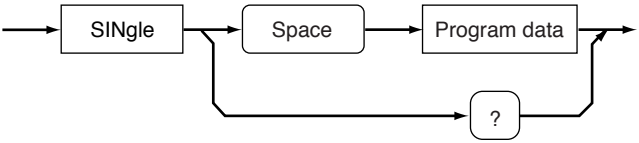


SINgle

Sets the measurement mode to single (one-shot) or inquires about the current measurement mode.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: ON or “1”: Single measurement on
OFF or “0”: Single measurement off
(i.e., continuous measurement on)

[Ex.] Setting the measurement mode to single:
SIN ON

■ Response message

To “SIN?”, returns the status (on/off) of the single measurement mode.

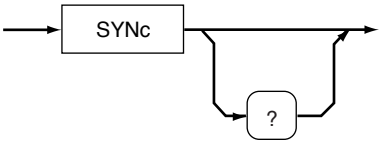
[Ex.] When the current single measurement mode is off, the message returns:
“OFF”.

SYNc

Establishes synchronization when AUTO RESYNC is off, and inquires about the status of synchronization.

■ Program message

• Structure



■ Response message

Responding to “SYN?”, this message returns the current status of synchronization as follows:

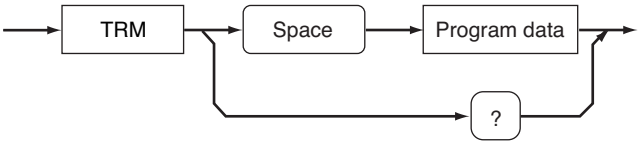
“1” when synchronization is established;
“0” when synchronization fails;

TRM

Sets the Meter response message terminators.

■ Program message

• Structure



• Program data (character)

Data type: Character
Setting: 0: CR+LF+EOI
1: LF+EOI
2: EOI
3: CR+EOI

[Ex.] Setting the response message terminator to LF + EOI:
TRM 1

■ Response message

Responding to "TRM?", this message returns the current response message terminator.

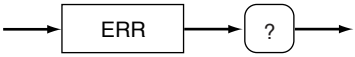
[Ex.] When the current response message terminator is CR + LF + EOI, the message returns:
"0".

ERR? (query message only)

Inquires about the Meter error status.

■ Query message

• Structure



■ Response message

To “ERR?”, returns the error status using the following codes:

0: No error
1: Reserved
2: Receiving buffer overflow
3: Program message syntax error (an unsupported command received)
4: Program data syntax error or out-of-range error
5: Program message not in current use received

*RST (command message only)

Returns the Meter settings to those set at shipment from the factory (excluding the GPIB address).

■ Command message

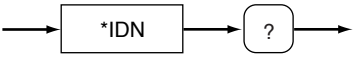
- **Structure**

*IDN? (query message only)

Inquires about the Meter model number.

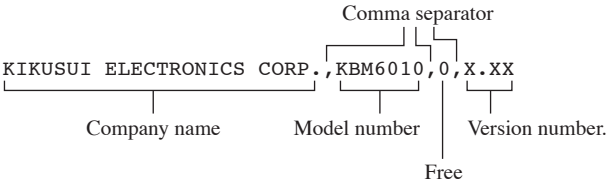
■ Query message

- **Structure**



■ Response message

To "*IDN?", returns the Meter model number as follows:



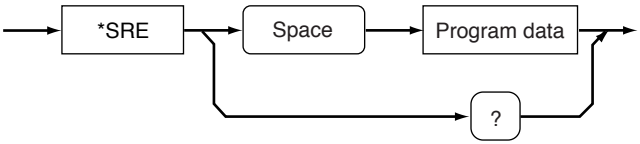
*SRE

Sets and resets the bits of the service request enable register. Inquires about the content of the register.

NOTE • Bit 6 of the register cannot be set.

■ Program message

• Structure



• Program data

Min.: 00h
Max.: FFh
Resolution: 01h
Data type: character

[Ex.] Setting the service request enable register to 01h:
*SRE #H01

■ Response message

Responding to "*SRE?", this message returns the content of the service request enable register.

[Ex.] When the data is 01h, the message returns:
"#H01".

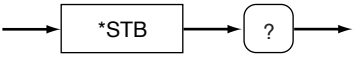
For the details of the service request enable register, see Section 4.6, "Register."

*STB? (query message only)

Inquires the content of the status byte register.

■ Query message

• Structure



■ Response message

Responding to "*STB?", this message returns the content of the status byte register.

[Ex.] When the content of the status byte register is 01h, the message returns:
"#H01".

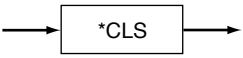
For the details of the status byte register, see Section 4.6, "Register."

*CLS (command message only)

Resets the status byte register.

■ Command message

• Structure



4.6 Register

Fig. 4-3 shows the structures of the status byte and service request enable registers.

To enable a bit of the status byte register, the bit of the service request enable register corresponding to the bit in question of the status byte register must have been set to “1”. Bit 6, however, cannot be set.

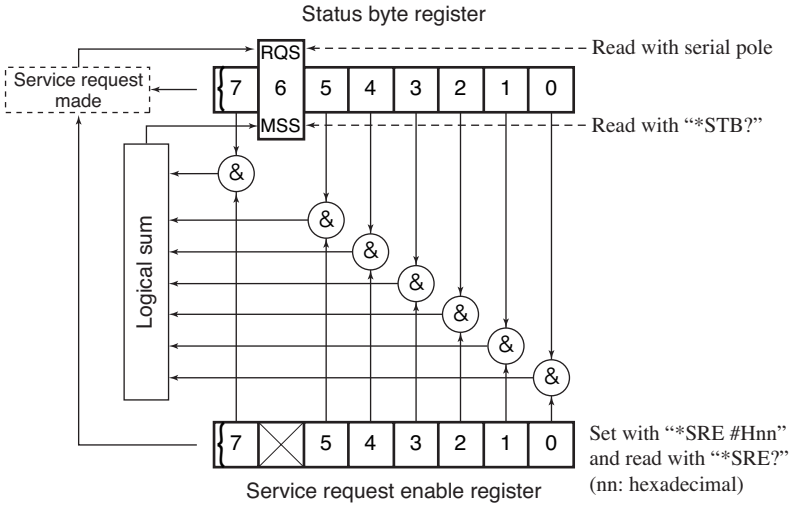


Fig. 4-3 Register Structure

In the bits of both registers, status byte and service request enable, “1” represents “set,” and “0” represents “reset.”

Table 4-1 lists the functions of each bit.

Table 4-1 Bit Functions

Status byte register and service request enable register		
Bit		Description
7	Free	
6	RQS (Request)	Evidence that a service request has been made. Is reset when being read with the serial pole.
	MSS (Master Summary Status)	Logical sum of the status byte register and service request enable register. Is read with “ *STB” .
5	Free	
4	Free	
3	Error	An error occurred in the received message.
2	Sync loss	Synchronization failed
1	Bit error detection	A bit error was detected.
0	End	Measurement in the single mode completed.

4.7 Sample program

Shown below is a sample program for GPIB-control KBM6010 written in Microsoft Visual Basic using a National Instruments GPIB board with NI-488.2 specifications.

This program measures bit error rate in the single mode and displays the measurement taken only once.

```
Option Explicit

Private Sub cmdSend_Click()

  ' Define variables
  ' ------------------------------------------------------------------
  Dim strDevName As String
  Dim ud As Integer
  Dim cbLen As Integer
  Dim strHex As String
  Dim bySTB As Byte
  Dim bMeasend As Boolean
  Dim strRsp As String
```

```
    edtErrorRate.Text = ""
    DoEvents
    strRsp = Space(256)
    '
    ' Set Meter
    ' ------------------------------------------------------------------
    strDevName = "DEV2"
    Call ibfind(strDevName, ud)       ' Open GPIB device
    Call ibwrt(ud, "*RST")            ' Initialize
    Call ibwrt(ud, "*CLS")            ' Clear status byte register
    Call ibwrt(ud, "RAN 4")           ' Set measurement range to 1E08
    Call ibwrt(ud, "INS 7")           ' Set error insertion to 1E-07
    Call ibwrt(ud, "SIN ON")          ' Set measurement mode to single
    '
    ' Poling of measurement completion bit
    ' ------------------------------------------------------------------
    Do
    strRsp = Space(256)
    Call ibwrt(ud, "*STB?")           ' Send command to read status byte
                                      ' register
    Call ibrd(ud, strRsp)             ' Put status byte register value
                                      ' in a variable
    strRsp = "&" & Mid$(strRsp, 2, 3) ' Convert stored string from #Hnn
                                      ' into &Hnn
    bySTB = Val(strRsp)               ' Convert string into number
    bMeasend = bySTB Mod 2            ' Remainder from dividing value
                                      ' by 2
    Loop While bMeasend = False       ' Loop until Lowest bit of status
                                      ' byte register becomes "1"
                                      ' (remainder from dividing by 2
                                      ' is 1)
    '
    ' Fetch BER value
    ' ------------------------------------------------------------------
    strRsp = Space(256)
    Call ibwrt(ud, "BER?")            ' Send command to fetch BER value
    Call ibrd(ud, strRsp)             ' Read BER value and put it in a
                                      ' variable
    edtErrorRate.Text = strRsp        ' Display BER value in text box

End Sub
```

Chapter 5 Names and Functions of Parts

This chapter presents the names and functions of the switches, connectors, and other parts on the front and rear panels.

5.1 Front panel

See Fig. 5-1.

1 LOCAL (SHIFT)

Changes the control state of the Meter from remote to local. When the Meter is in the local control state, this switch serves as the SHIFT key.

2 REMOTE LED

Lights when the Meter is under GPIB remote control.

3 Display

7-segment LED

Displays error rates and settings.

BER LED

Lights when an error rate is displayed.

SYNC LED

Lights when synchronization is established.

ERROR LED

Lights when a bit error is detected during measurement.

MODE LED

Lights when a measurement range, data pattern, error insertion, or the clock/data/synchronous mode setting is displayed.

MHz LED

Lights when a Tx clock frequency (1 MHz to 10 MHz) is displayed.

kHz LED

Lights when a Tx clock frequency (0.1 kHz to 999.9 kHz) is displayed.

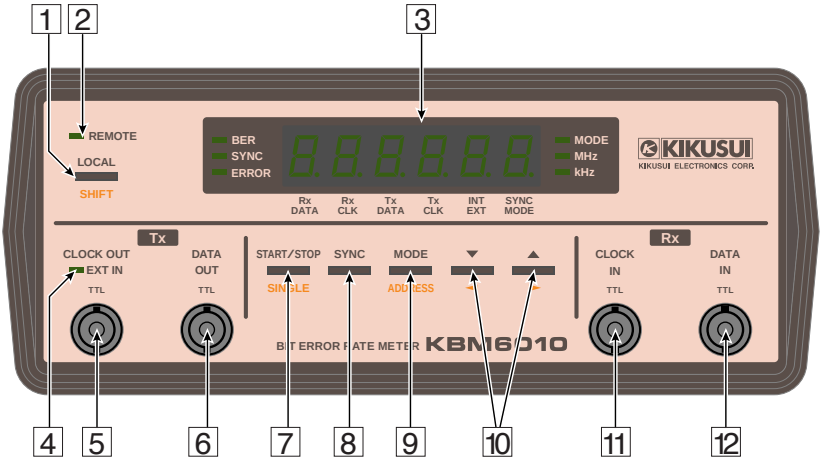


Fig. 5-1 KBM6010 Front Panel

4 Tx CLOCK EXT IN LED

Lights when a Tx clock is set as external input.

5 Tx CLOCK OUT

Tx clock I/O terminal.

6 Tx DATA OUT

Tx data output terminal.

Output is a data pattern synchronized with a Tx clock.

7 START/STOP (SINGLE)

Starts and stops measurement. Pressing this key while pressing the SHIFT key produces the single measurement mode.

8 SYNC

Allows manual operation to establish synchronization if AUTO RESYNC is turned off. Pressing this key while pressing the SHIFT key displays the ROM version number.

9 MODE (ADDRESS)

Selects a mode desired. Pressing this key while pressing the SHIFT key selects the GPIB address setting mode.

10 ▼/▲ (◀/▶)

Changes the setting of each setting mode.

11 Rx CLOCK IN

Rx clock input terminal.

12 Rx DATA IN

Rx data input terminal.

Inputs data synchronized with an Rx clock.

5.2 Rear panel

See Fig. 5-2.

13 FUSE

Fuse holder for an AC input fuse.

Serves also as the selector of the input power voltage range.

⚠WARNING • Incorrect handling may cause electric shock. Always observe the instructions provided in Section 1.4, “Checking input power and the fuse.”

---

14 AC LINE

Connector for input power connection. Insert the AC power cord.

⚠WARNING • Incorrect handling may cause electric shock. Always observe the instructions provided in Section 1.5, “AC power cord Connection.”

---

15 ⏚

Grounding terminal.

⚠WARNING • Ground the Meter without fail. For details, see Section 1.6, “Grounding.”

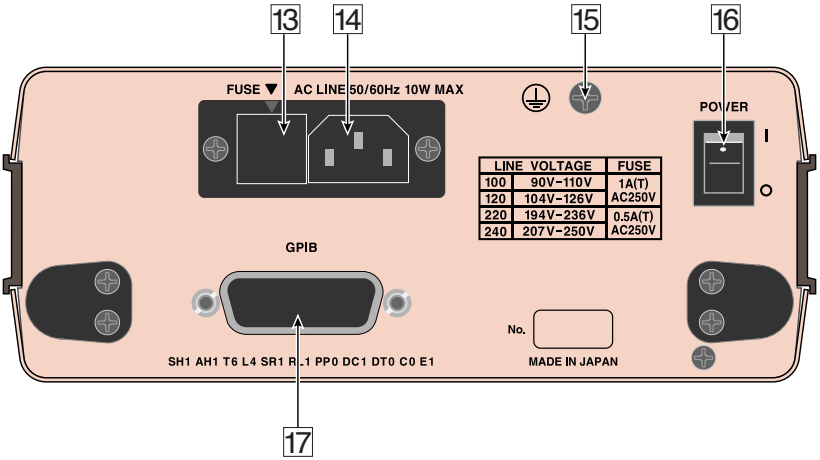


Fig. 5-2 KBM6010 Rear Panel

16 POWER

Power switch. Placing this in the "I" position turns power on. Placing in the "O" position turns power off.

17 GPIB

24-pin GPIB interface connector conforming to IEEE Std. 488.1-1987

Chapter 6 Maintenance

This chapter describes maintenance and calibration needed for the Meter. To maintain your Meter at its initial performance for a long time, periodical maintenance, checks, and calibration are a must.

6.1 Cleaning

When the Meter surfaces including the panels trap dirt, gently wipe them with a soft cloth imbibed in a neutral detergent diluted with water.

⚠WARNING
- Before starting cleaning, be sure to turn the POWER switch off and unplug the AC power cable.
- Do not use volatile chemicals such as a thinner and benzine. These may ruin the appearance, discoloring the surfaces, erase printing, whitening the display, and so forth.

6.2 Checking

■ AC power cable

Check for torn covering, loose or cracked plugs, and so on.

⚠WARNING
- Torn covering and similar damage may cause electric shock. Immediately stop using the cable.

For the purchase of accessory supplies, contact Kikusui distributor/agent.

6.3 Calibration

The Meter has received the required calibration before shipment. Nevertheless, changes occur over time, requiring calibration once in a while.

For calibration, ask Kikusui distributor/agent.

6.4 Replacing back-up batteries

The Meter backs up the panel settings with the incorporated batteries during power outages. If the panel settings when the power is turned back on differ from those before you turned it off, the batteries have run out.

While the service life of a battery depends on the environment of use, a guideline is three years after purchase.

For battery replacement, inquire Kikusui distributor/agent.

Chapter 7 Specifications

This chapter presents the electric, mechanical, and general specifications of the Meter.

The electric specifications assume that:

- The Meter is used within the specified guarantee temperature and humidity after 30 min of warming up.

7.1 Pattern generation section

Data output

Data patterns	Conform to ITU-T recommendation O.151 and O.153 ALL0, ALL1, PN9 (O.153), PN11 (O.153), PN15 (O.151), PN 20 (O.151), PN20 (no zero-suppress), PN23 (O.151)
Output level	TTL (*1)
Polarity switching	Selectable between “not inverted” and “inverted.”
Error insertion	0, 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}
Connector	BNC

Clock I/O

Clock selection	Select internal or external from the panel.	
When internal clock is in use		
	Output frequency range	100 Hz to 10 MHz
	Frequency stability	± 100 ppm
	Resolution	100 Hz (100 Hz to 1 MHz) 1 kHz (1 MHz to 10 MHz)
When external clock is in use		
	Input frequency	DC to 10 MHz
I/O level	TTL (*1)	
Polarity switching	Selectable between “not inverted” and “inverted”	
Connector	BNC	

7.2 Error rate measurement section

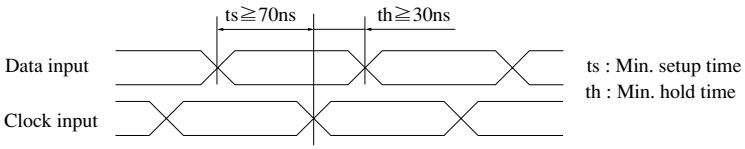
Data input

Data patterns	Conform to ITU-T recommendation O.151 and O.153 ALL0, ALL1, PN9 (O.153), PN11 (O.153), PN15 (O.151), PN 20 (O.151), PN20 (no zero-suppress), PN23 (O.151)
Data speed	DC to 10 Mbits/s
Input level	TTL (*1)
Polarity switching	Selectable between “not inverted” and “inverted.”
Connector	BNC

Clock input

Frequency range	DC to 10 MHz
Input level	TTL (*1)
Polarity switching	Selectable between “not inverted” and “inverted”
Connector	BNC

*1 HC14 is used for the input circuit of the Meter to avoid the malfunction caused by noises. The Input signal should be input within the range of 4.2-5.0 V as "H" level and the range of 0-1.2 V as "L" level. Moreover, we recommend securing time as shown in the figure below to measure a timing of the data input and clock input of the error rate measurement section.



On the other hand, A-CMOS is used for the output circuit of the Meter.

Error rate measurement

Measurement range	10^{4} to 10^{8}
Displayed range	1 x 10^{-8} to 9.99 x 10^{-1} (mantissa: 3 digits; exponent: 1 digit)
Synchronizing method	32-bit continuous pattern synchronization
Synchronous mode	AUTO RESYNC on/off

7.3 General specifications

Power supply

Input power voltage	Selectable via selector on rear panel 90 to 110 / 104 to 126 / 194 to 236 / 207 to 250 VAC
Rated frequency	50/60 Hz
Power consumption	15 VA (10 W) maximum

GPIB interface

Conforms to IEEE Std. 488.1-1987.

Interface functions:	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0, E1

Mechanical

External dimensions	See section 7.4, “External Dimension diagram”
Weight	Approx. 3 kg (6.61 lb)

Operating environment

Specifications guarantee temperature and humidity
5 to 35°C (41 to 95 °F),
20 to 85% (no condensation)

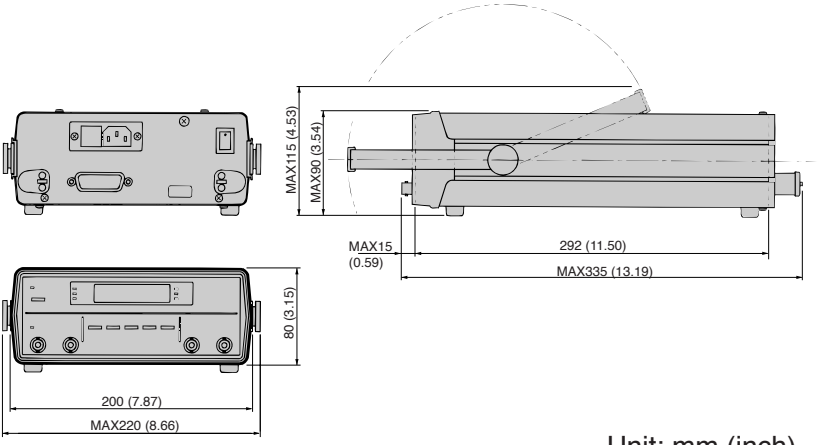
Operating temperature and humidity
0 to 40°C (32 to 104 °F),
20 to 85% (no condensation)

Storage temperature and humidity
-25 to 70°C (-13 to 158 °F),
20 to 90% (no condensation)

Accessories

AC power cord	1 piece
Fuse	(1A(T)250V: 1 piece, 0.5A(T)250V: 2 pieces) or (1A(T)250V: 2 pieces, 0.5A(T)250V: 1 piece) Different types of fuses are provided in accordance with the settings of the line voltage range at the time of delivery.
Operation Manual	1 copy

7.4 External dimension diagram



Unit: mm (inch)

Fig. 7-1 KBM6010 External Dimension Diagram

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