MX368012A
GSM Device Test Software
Operation Manual

Fourth Edition

To ensure that the equipment is used safely, read the "For Safety" in the MG3681A Digital Modulation Signal Generator Operation Manual first.
Keep this manual with the equipment.

ANRITSU CORPORATION

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MX368012A
GSM Device Test Software
Operation Manual

30 November 2000 (First Edition)
30 November 2002 (Fourth Edition)

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1. Product Name/Model Name

Product Name: GSM Device Test Software
Model Name: MX368012A

2. Applied Directive

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

3. Applied Standards

When the MX368012A is installed in the MG3681A, the applied standard conforms to the standards of MG3681A.

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

C-tick marking

1. Product Name/Model Name

Product Name: GSM Device Test Software
Model Name: MX368012A

2. Applied Standards

When the MX368012A is installed in the MG3681A, the applied standard conforms to the standards of MG3681A.

About This Manual

This operation manual gives an outline, measurement examples, remote control, and other information on the MU368010A TDMA Modulation Unit when MX368012A GSM Device Test Software is installed.

The MU368010A TDMA Modulation Unit, which is compatible with various types of software, is fit to and used on the MG3681A Digital Modulation Signal Generator.

Operation manuals for the MG3681A Digital Modulation Signal Generator and MU368010A TDMA Modulation Unit are provided separately. Refer to them in addition to this operation manual.

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Section 1 Outline

This section explains the product outline for the MU368010A TDMA Modulation Unit with GSM device test software and the standard accessories.

1.1 Product Outline

The MX368012A GSM Device Test Software is the system software installed and used in the MU368010A TDMA Modulation Unit.
Therefore, the MU368010A TDMA Modulation Unit should be fit to the MG3680 Series Digital Modulation Signal Generator (hereinafter, referred to as this unit) to use the GSM device test software.

By installing GSM device test software in this unit, a European digital cellular telecommunications system (GSM) modulation signal can be output.

1.2 Product Configuration

The standard configuration of this unit is shown in the table below. After unpacking, confirm that all products are provided. If anything is missing or damaged, contact Anritsu or Anritsu's agents.

Item	Model name/no.	Product name	Q'ty	Remarks
Main unit	MX368012A	GSM Device Test Software	1	Compatible system: GSM (Provided by compact flash card or ATA flash memory card)
Accessories	–	PC card adapter	(1)	Only provided for compact flash card
	W1837AE	Operation manual	1	

1.3 Handling a Memory Card

This unit uses a memory card (MC) as an external memory media for data and programs.
This section explains how to handle the memory card.

1.3.1 Cautions on usage

Do not wipe with chemical materials, such as alcohol as may cause peeling or injury.

Do not bend, drop or subject the card to physical shock.

Do not place heavy items on it or put it in your hip pocket.

Do not get or expose to direct sunlight.

Do not dismantle a memory card or insert metal material, such as a clip, in its terminal post.

1.3.2 Storing

Store the memory card in the provided case when it is not used, making sure that it is placed in an area where the temperature is 4 to 53 °C and the humidity is 8 to 90 % (with no condensation).

Do not store the memory card where there is/are:

- dust and high humid
- magnetized items
- direct sunlight
- a heating source nearby

Section 2 Function Outline

This section explains basic operations of the GSM system, I/Q signal output and auxiliary signal output/input.

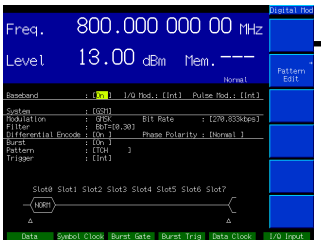
2.1 Screen Transition

Screen transition is shown below.

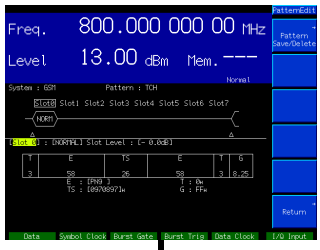
Press [Digital Mod] in the main function key

↓

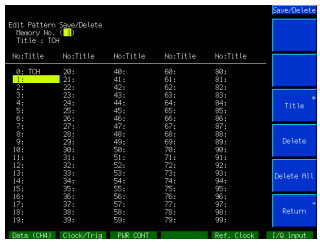
Digital Modulation setting screen



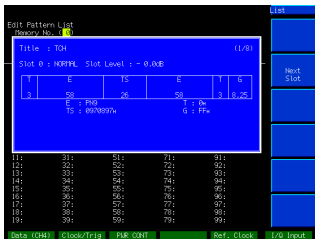
Pattern Edit screen



Pattern Save/Delete screen



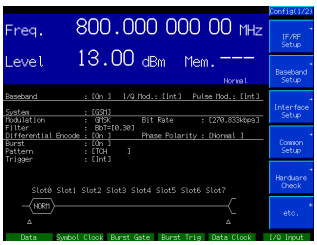
List screen



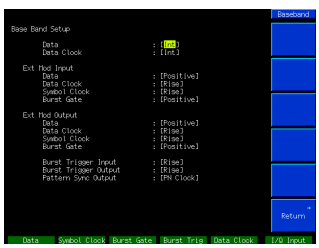
Press [Config] in the main function key

↓

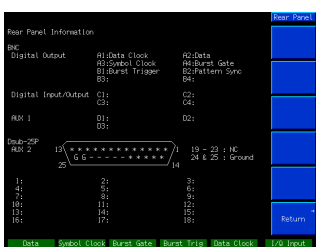
Configuration setting screen



Baseband Setup screen



Rear Panel Information screen

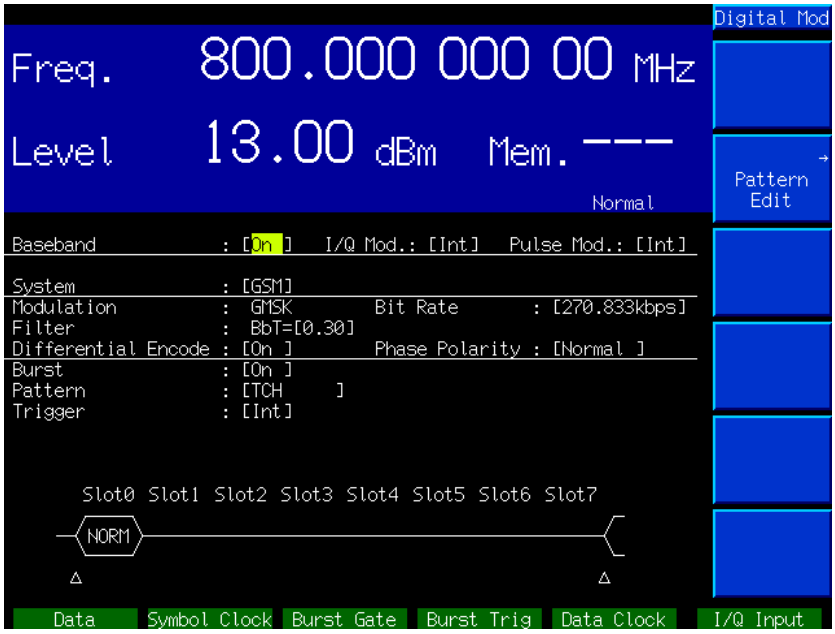


2.2 Setting the Modulation Parameter

2.2.1 Setting the Digital Modulation Parameter Setting Screen

When [Digital Mod] is pressed, the lamp is lit up and Main screen is displayed. Basic parameters related to the digital modulation can be set in this screen. Setting contents for the Main screen are explained here.

The △ marks in the diagram below indicate timing of the burst trigger signal for the frame.



(1) Baseband

Select On/Off for Baseband.

(2) I/Q Mod.

Select the I/Q signal source. Select "Int" for internal signal source (using MX368012A) and "Ext" for external input.

Default: Int

(3) Pulse Mod.

Select the control signal for the MG3680 series pulse modulation part.

Int: Selects the control signal for TDMA Modulation Unit. When Burst On is set, the pulse modulation part operates along with the burst timing. When Burst Off is set, the pulse modulation part is fixed to On state.

Ext: The pulse modulation part operates along with the external input signal without being affected by the modulation status. The external signal is input to the Pulse Input connector on the front panel.

Off: The pulse modulation part is fixed to On state.

(4) System

Set the communication system. After the communication system is selected, the modulation method, the BbT product, the bit rate are set as follows.

Communication system	Modulation method	BbT product	Bit rate
GSM	GMSK	BbT=0.3	270.833 kbps

To select GSM method, select "TDMA" and then select "GSM" in "TDMA."

(5) Filter

Set the baseband filter type.

Though BbT product is automatically set by the communication system, it can be changed in the range of 0.20 to 0.50.

(6) Bit Rate

Though bit rate is automatically set by the communication system, it can be changed in the range of 245.700 to 300.300.

(7) Differential Encode

On/Off setting of differential encode function can be set (Refer to Section 2.5 for details.)

(8) Phase Polarity

Phase polarity for the modulation data can be selected (Refer to Section 2.6 for details.)

(9) Burst

Select On/Off of the burst function.

(10) Pattern

Select internal modulation data pattern (however, the pattern items cannot be set when Data on the Baseband Setup screen is set to "Ext": external input.)

When the burst function is Off

PN9, PN15 or optional four bits (0000 to 1111) can be set.

When the burst function is On

Standard internal modulation data in the GSM system (refer to "Section 3 Detailed Explanation" for details) or data saved in the internal modulation data memory can be set.

(11) Trigger

Set the signal source for burst trigger when the burst function is On. Set "Int" for internal signal source and "Ext" for external input.

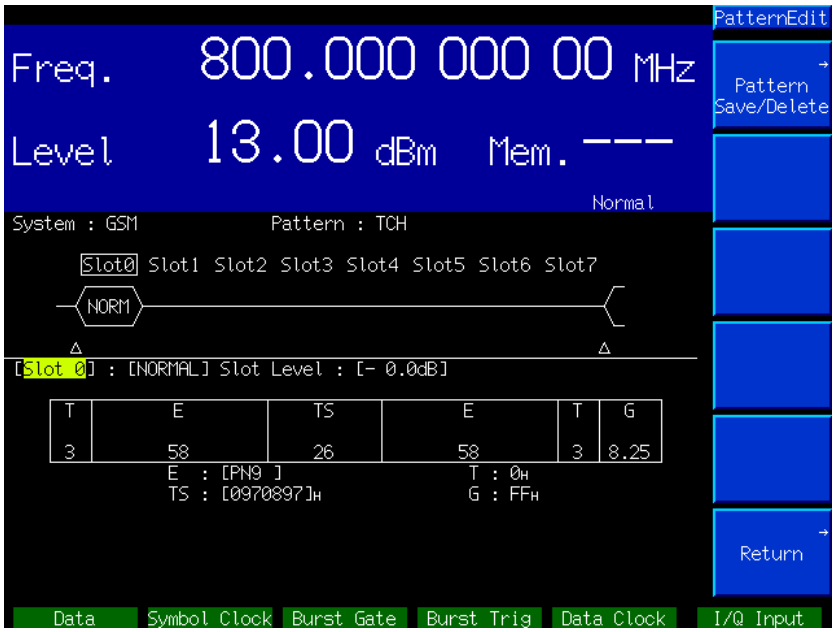
2.2.2 Using the Memory Function

Saving the modulation data (Save)

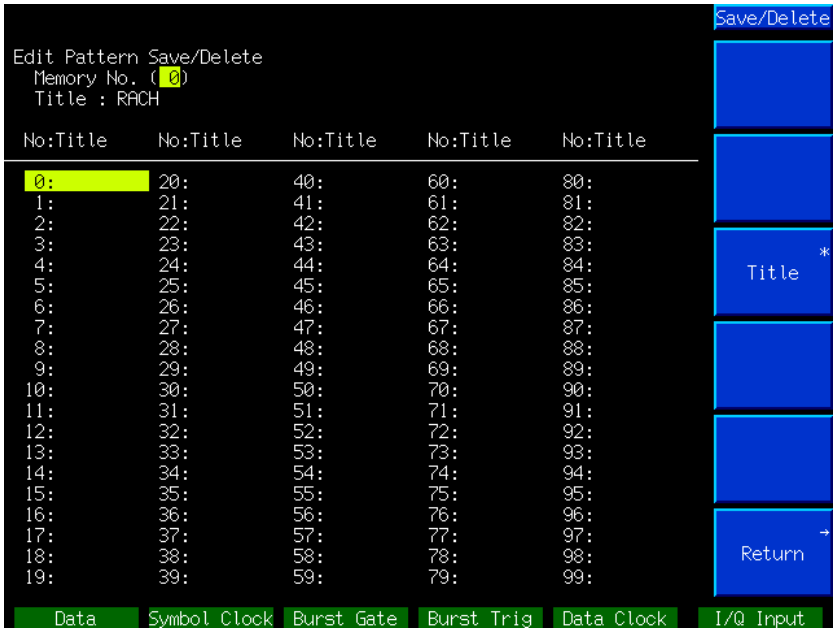
In this unit, modulation data set on the Pattern Edit screen can be saved (Save) using the memory function. Data can be saved in up to 100 memories. Moreover, title name (up to eight characters alphanumeric and symbols) can be specified. The procedures for saving modulation data are explained here.

Operation example: To save the currently set modulation data in memory No.1 with title name “ABCDEF.”

<1> Set each modulation data on the digital modulation parameter setting screen and then press F2 (Pattern Edit) to display the Pattern Edit screen.

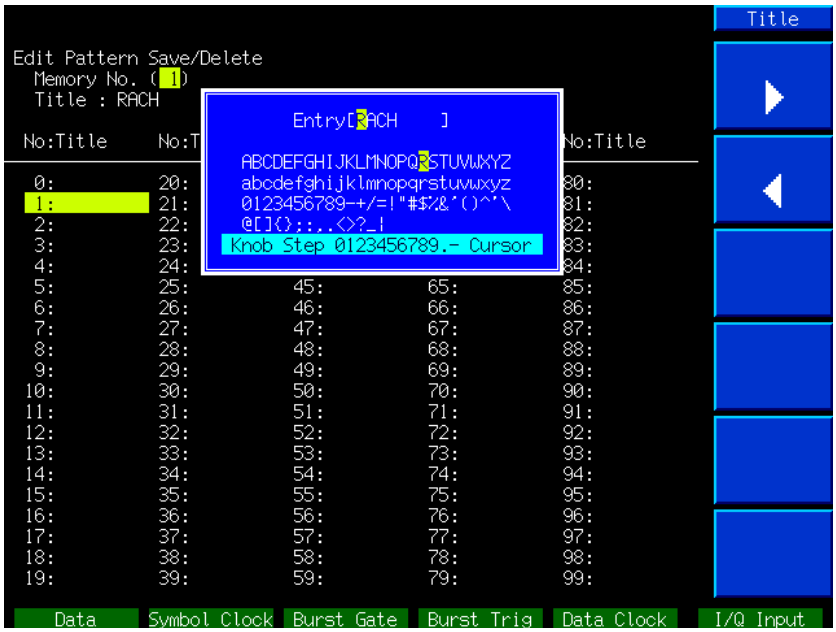


<2> By pressing F1 (Pattern Save/Delete) on the Pattern Edit screen, the Pattern Save/Delete screen is displayed. The smallest number among the numbers in which no data is saved is displayed in the Memory No. column at the left top.



<3> Shift the reverse cursor of the memory number to memory No. 1 using the cursor key. "1" should be displayed in the Memory No. column at the left top.

<4> Press F3 (Title) to display the title input screen.



<5> Shift the reverse cursor of the character group to "A" using the cursor key. "A" should be displayed in the Entry's reversed cursor.

<6> Press F1 (▷) to shift the Entry's reversed cursor to the right side. When shifting the reverse cursor of the character group to "B" using the cursor key, "B" should be displayed in the Entry's reversed cursor.

<7> Repeat the operation described in <6> until "ABCDEF" is displayed in Entry. Then press Set to define the title name of memory No.1 to "ABCDEF". Press Set again to save the modulation data to memory No.1 and to return to the Main screen.

<8> The reverse cursor for the memory numbers and the character group can be shifted with the rotary knob or the step key.

<9> When trying to write data over memory that other data has already been saved in, a confirmation window is displayed after specifying the memory number. Select "Yes" and press Set to overwrite the data.

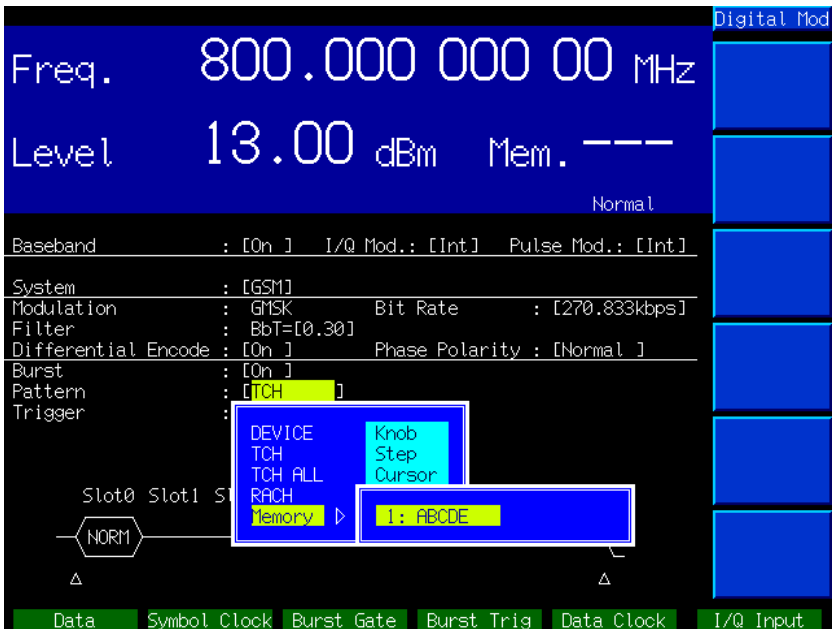
Reading the modulation data (Recall)

In this unit, the modulation data memory saved on the Pattern Edit screen can be read. The procedures for reading the modulation memory are explained here.

Operation example: To read memory No.1, title name "ABCDEF," where the modulation data is saved.

<1> Open the window for Pattern setting on the digital modulation parameter setting screen. "Memory ▷" is displayed if the internal modulation data is stored in the memory.

<2> Select this memory and press Set to open another smaller window.



<3> After the pattern is selected by pressing Set, both of the windows are closed and the selected data is read. To close only the smaller window, press Cancel.

If the number of memories are more than ten, press F1 (Previous Page) or F2 (Next Page) on the function screen with the smaller window opened so that display of the stored memory can be changed.

Deleting the internal modulation data (Delete)

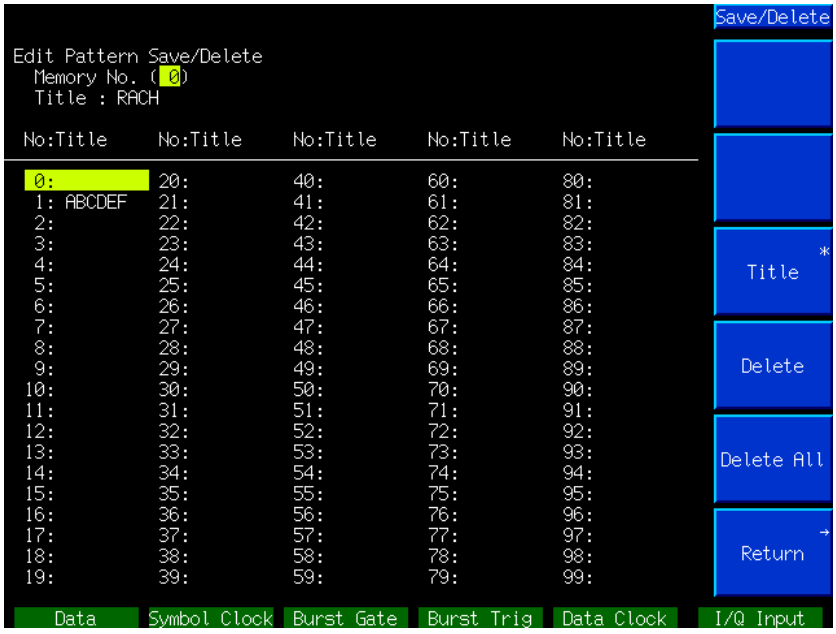
In this unit, the modulation data saved on the Pattern Edit screen can be deleted (Delete).

Procedures for deleting the modulation data are explained here.

Operation example: To delete the memory contents saved in memory No.1.

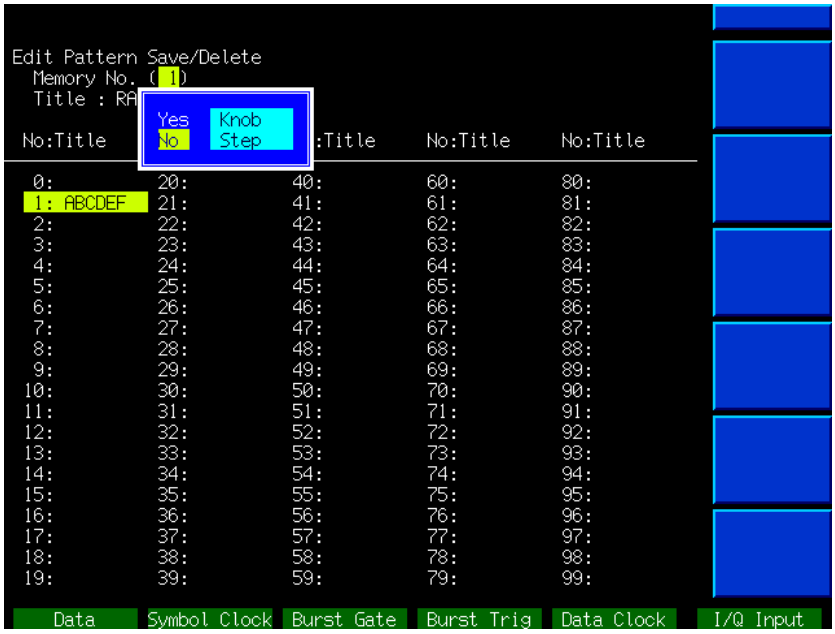
<1> Press F2 (Pattern Edit) on the digital modulation parameter.

<2> Press F1 (Pattern Save/Delete) to display the Pattern Save/Delete screen.



<3> Shift the reverse cursor for the memory number to memory No. 1 using the cursor key. "1" should be displayed in the Memory No. column at the left top.

<4> Press F2 (Delete) and Yes/No window to confirm deletion.



<5> Press Set after selecting “Yes” to escape from the Yes/No window and delete the memory contents saved in memory No.1.

The reverse cursor for the memory numbers can be shifted with the rotary knob or the step key.

Note:

If F5 (Delete All) is selected on the Patten Save/Delete screen, all the memory data on the Pattern Save/Delete screen is deleted.

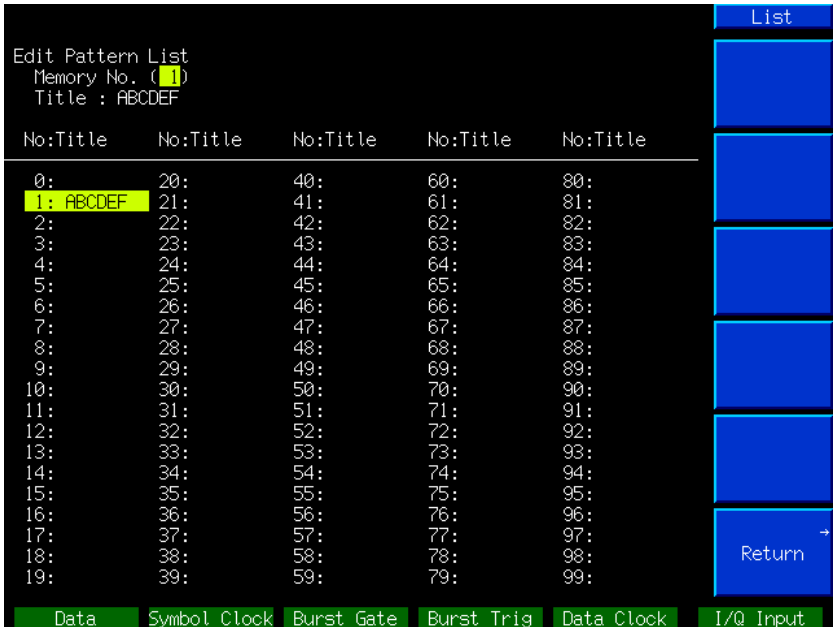
Checking the saved contents of internal modulation data (List)

In MX368012A, the list of modulation data saved on the Pattern Edit screen and contents can be confirmed using memory function. Procedures for checking the saved modulation data are explained.

Operation example: To check modulation data saved in memory No.1.

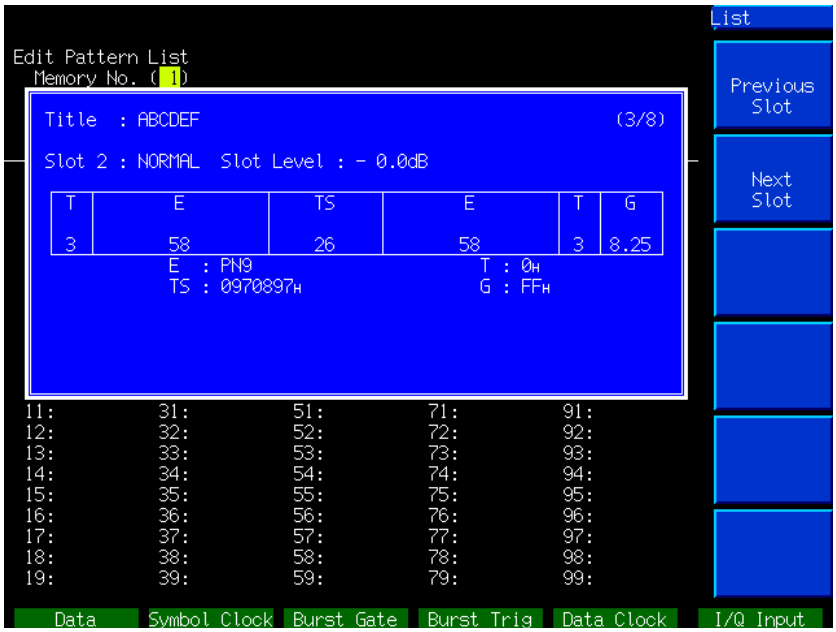
<1> Press F2 (Pattern Edit) on the digital modulation parameter to display the Pattern Edit screen.

<2> F2 (Pattern List) to display the Pattern List screen.



<3> Shift reversed cursor to memory No.1.

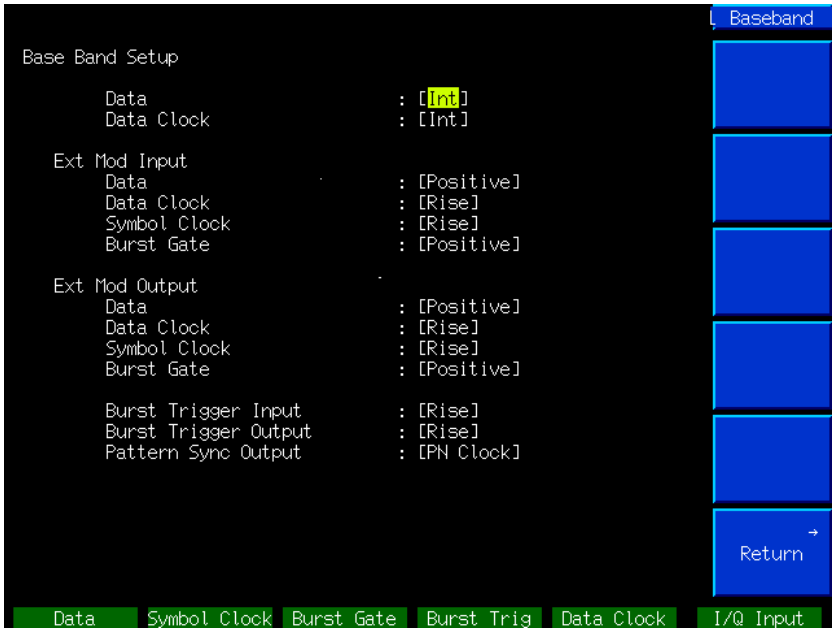
<4> Press Set to display the setting window of the modulation data saved in memory No.1 for each slot.



<5> After confirmation is completed, press Cancel to close the setting window.

2.2.3 Setting the Base Band Setup screen

Press Config and then F5 (Base Band Setup) to display the Base Band Setup screen. Setting items on the Base Band Setup screen are explained here.



(1) Data

Set Data either to internal generation (Int) or external generation (Ext).

(2) Data Clock

Set Data Clock either to internal generation (Int) or external generation (Ext).

(3) Data for Ext Mod Input

Set the external modulation input data either to Positive or Negative. If it is set to Positive, the high level for the TTL level is considered to be data "1."

(4) Data Clock for Ext Mod Input

Set the external modulation input data clock polarity either to Rising edge or Fall. Set the duty ratio for data clock to 50 %.

(5) Burst Gate Ext Mod Input

Set the external modulation input data either to Positive or Negative. If set to Positive, the high level for the TTL level is considered to be burst wave "On."

(6) Data for Ext Mod Output

Set the external modulation input data either to Positive or Negative. If set to Positive, the high level for the TTL level is considered to be data "1."

(7) Data Clock for Ext Mod Input

Set the external modulation input data clock polarity either to Rise or Fall.

(8) Burst Gate Ext Mod Output

Set the external modulation input data either to Positive or Negative.

(9) Burst trigger Input

Set burst trigger input polarity either to Rising edge or Fall.

(10) Burst trigger Output

Set burst trigger input polarity either to Rising edge or Fall.

(11) Pattern Sync Output

Set Burst to "On". When selecting the internal generation pattern, set the pattern sync output to "PN Clock", "PN Gate" or "RF Gate."

If the data is set to external input (Ext) in (1), reversed cursor cannot be shifted to Burst setting items, Pattern setting items, or Trigger setting items on the digital modulation setting parameter screen.

Setting procedures for the Base band Setup screen item are as follows.
Display the setting window using the rotary knob or step key and select the optional set value. Then, press Set to define the set value and close the window.

2.3 Outputting I/Q signal

I/Q signal output on the front panel can set signal output On/Off by setting Baseband On/Off. At the same time, the auxiliary signal on the rear panel is turned On/Off.

2.3.1 Output Level Range

The output level setting range for the I/Q signal when the GSM system is set, is shown in the table below. If optional "MG3681A-11: Extended I/Q signal output" is mounted, the output level can be changed in the range of 80 to 120 % of the level indicated in the table.

For the setting method, refer to "3.4 Baseband Signal Output Setting" in the MG3681A (main unit) operation manual.

I/Q Level	Output Impedance
500 mVrms	50 Ω

Definition of I/Q signal output level

Value of $\sqrt{I^2 + Q^2}$ at the terminal voltage when pattern is "PN9"

Terminal impedance is set to 50 Ω.

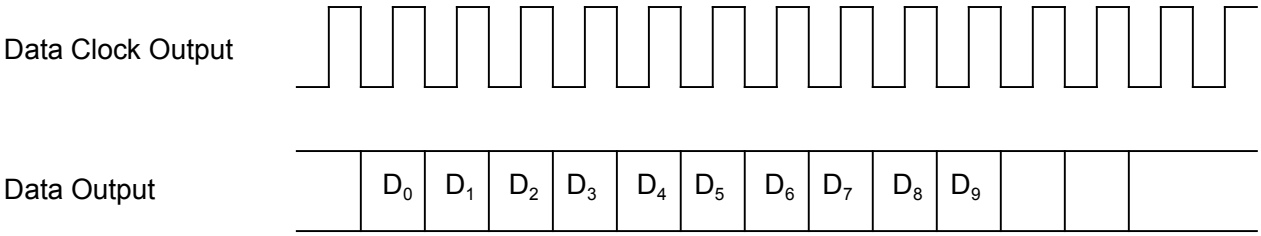
2.4 Auxiliary Signal Output/Input

2.4.1 Auxiliary Output Signal

Details on the auxiliary signal (control signal) output from the rear panel of this unit are explained here.

Data and Data Clock signals

The output timing of the Data and Data Clock signals are shown below. In the figure, the polarities of the signals are expressed as positive or rising edge.



Note:

For GMSK modulation, one-bit data consists of one symbol, the symbol clock is not required.

Pattern Sync signal

Different Pattern Sync Output signals are produced depending on whether the burst function is On or Off.

When the burst function is On

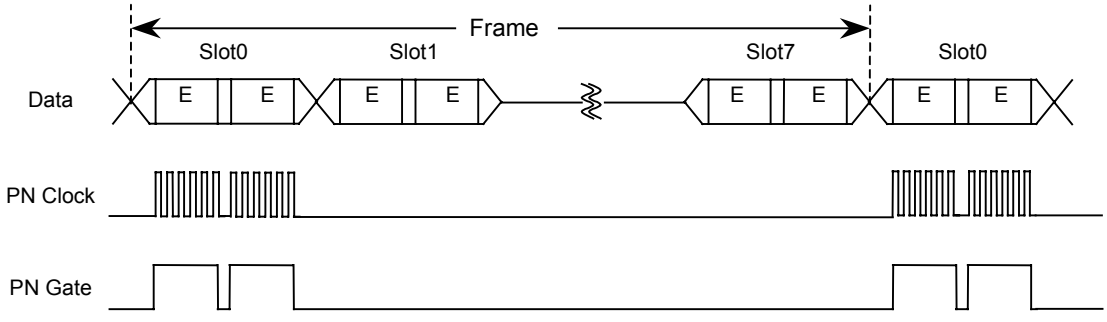
When the burst function is on, the Pattern Sync Output Signal allows a control signal synchronized with the frames to be output.

[When the "PN Clock" is selected]

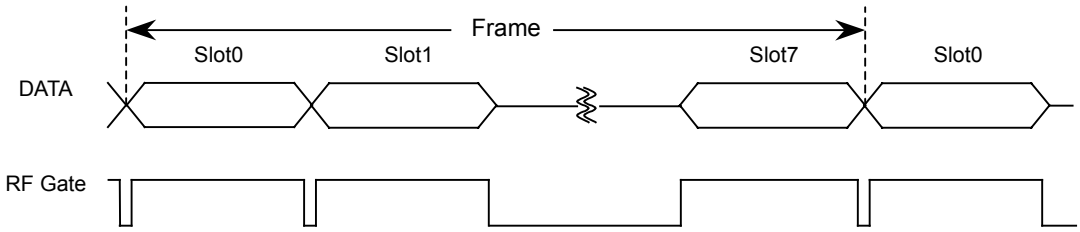
The clock signal for the pseudo-random pattern of the first output slot in the frame is output.

[When the "PN Gate" is selected]

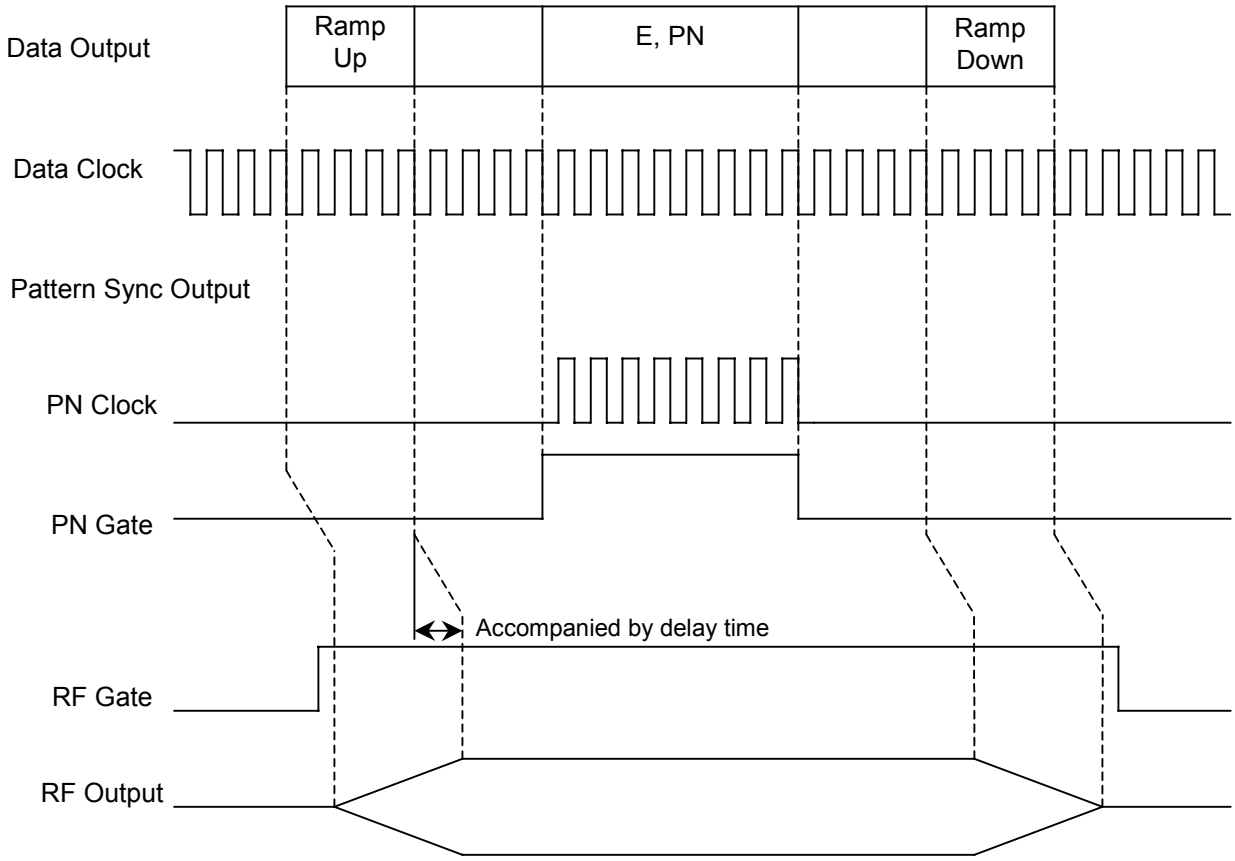
The gate signal for the pseudo random pattern of the first output slot in the frame is output.



[When the "RF Gate" is selected]
A control signal from the pulse modulation part inside the main instrument is output.



Details on the slot are shown in the figure below. The slot format in this figure is for explanation purposes only and differs from the actual system.



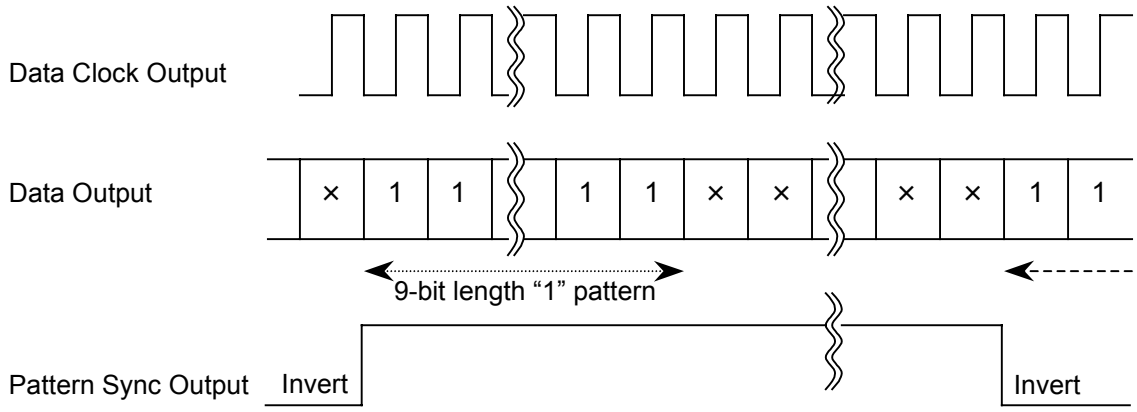
When the burst function is Off

When burst function is Off, the Pattern Sync Output signal allows a signal synchronized with the output pattern to be output.

[When the PN pattern is selected]

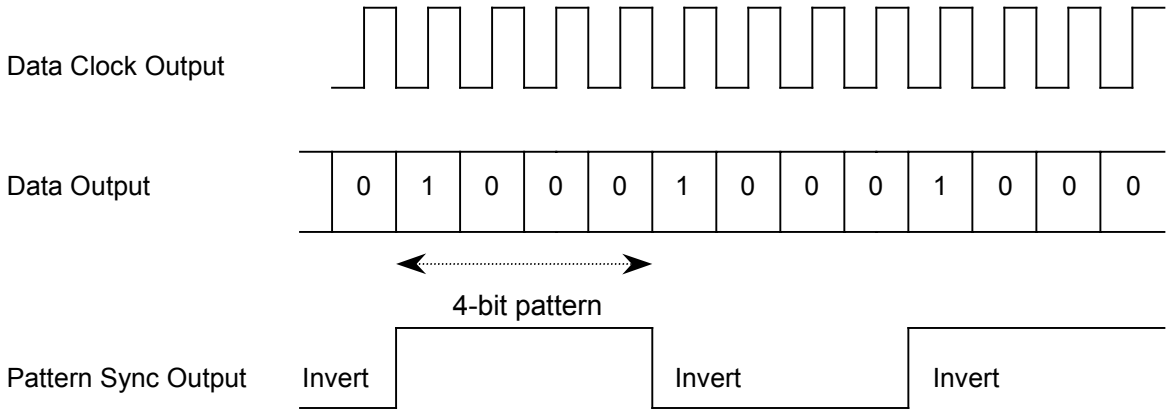
When PN9 is selected, an invert signal is output at the beginning of a pattern consisting of nine contiguous "1" bits. When PN15 is selected, an invert signal is output at the beginning of a pattern consisting of fifteen contiguous "0" bits.

The output signal when PN9 is selected is shown below:



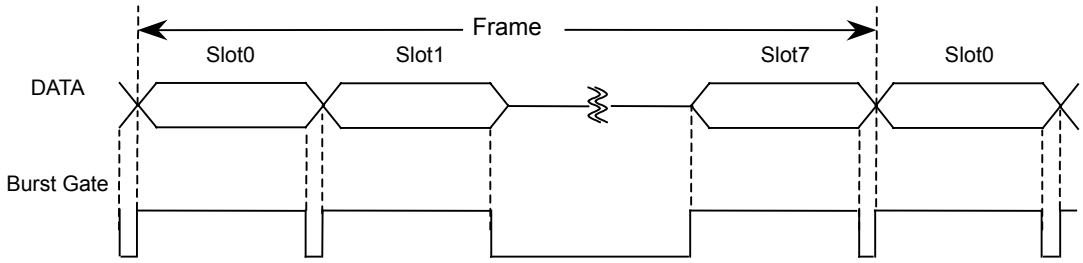
[When the 4-bit pattern is selected]

An invert signal is output at the beginning of the 4-bit pattern. The figure below is based on a "1000" 4-bit pattern.

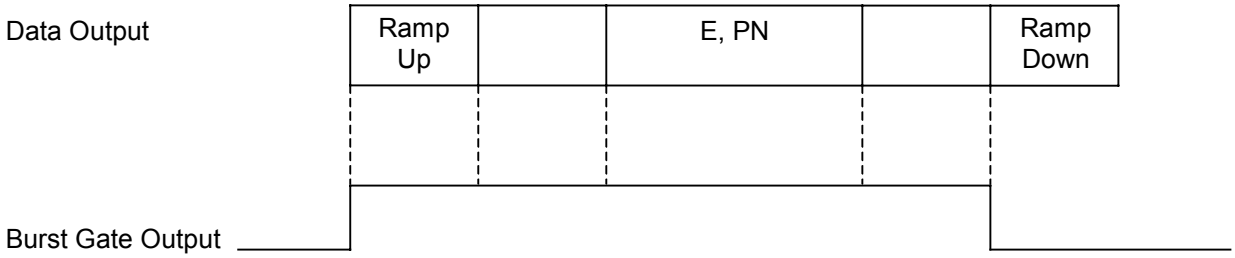


Burst Gate signal

When the burst function is On and the internal pattern is used for modulation, a signal synchronized with the output slot in the frame is output.



Details on the slot are shown in the figure below. The slot format in this figure is for explanation purposes only and differs from the actual system.

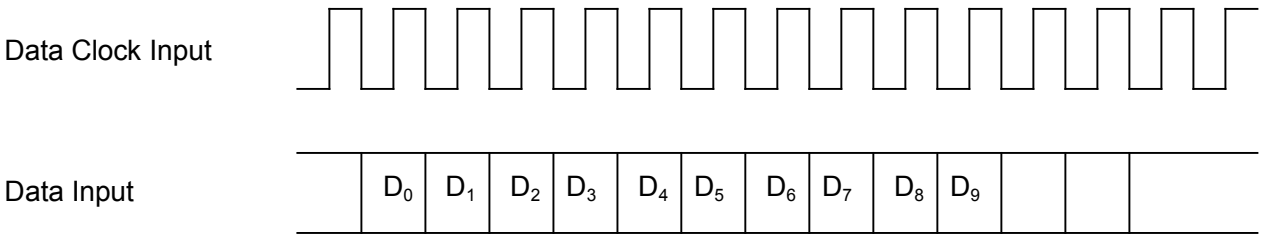


2.4.2 Auxiliary Input Signal

Details on the auxiliary signal (control signal) input to the front panel of this unit are explained here.

Data and Data Clock signals

Output timing for the Data and Data Clock signals are shown below. In the figure, the polarities of the signals are expressed as positive or rising edge.



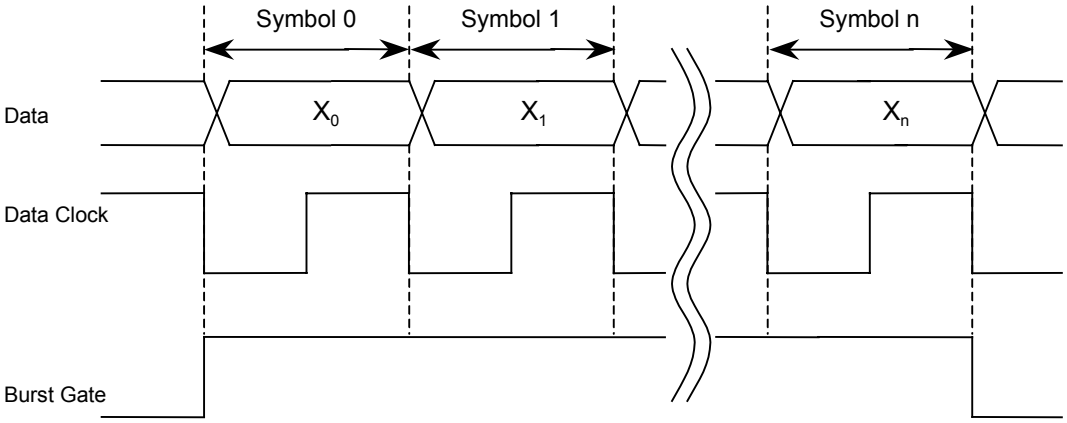
Notes:

- For GMSK modulation, one symbol consists of one-bit data, the symbol clock is not required.
- To input only data input, synchronize the timing to the output signal of the data clock output.

Burst Gate signal

When the burst function is On and data input is set to Ext, the burst date signal can be fed externally. This signal can be fed in synchronously with the data signal timing in order to generate an RF burst signal identical to the burst signal generated from the internal pattern. (This will smoothen the slope of the rising and falling edges and prevent the spectrum from deteriorating.)

Input timing for the Data, Data Clock, and Burst Gate signals are shown below.



Where, $n \geq 13$

Note:

The rising and falling edge of the power corresponds to Symbol 0, 1 and Symbol n+1, n+2, respectively.

2.5 Differential Encoding Function

This function implements a differential encoding operation pursuant to GSM Rec.05.04 when a GSM system is selected. If this function is turned on, the differential encoding operation specified below is executed.

$$\hat{d}_i = d_i \oplus d_{i-1} \qquad (d_i \in \{0,1\})$$

$\oplus$ denotes Exclusive-OR.

$$\alpha_i = 1 - 2\hat{d}_i \qquad (\alpha_i \in \{-1,+1\})$$

When α_i is +1, the phase will change in a positive direction (the frequency is shifted in a positive direction.)

Notes:

If the phase change polarity (Phase Polarity) has been set to Inverse, the phase will change in a negative direction when α_i is +1.

I and Q signal output is also subject to differential encoding.

2.6 Phase Change Polarity Selection Function

This function selects the polarity of phase during modulation. If Phase Polarity is set to Inverse, the spectrum of the modulation signal will be inverted with respect to the center of the carrier wave.

With GSM systems

When the differential encoding function is turned On (Differential Encode: On)

Normal: The phase will change in a positive direction when α_i mentioned in Section 2.5 is +1.

Inverse: The phase will change in a negative direction when α_i mentioned in Section 2.5 is +1.

When the differential encoding function is turned Off (Differential Encode: Off)

Normal: The phase will change in a positive direction when the modulation data is "1."

Inverse: The phase will change in a negative direction when the modulation data is "1."

Note:

Both I and Q signal outputs are governed by the phase change polarity setting.

2.7 Auxiliary Signal Input/Output terminal

An auxiliary signal input/output terminal does not display each signal name on the panel because it is used in other communication system software. An auxiliary signal input/output terminal in the GSM system is shown below.

Front panel

Signal names for the BNC connector on the front panel are shown in the table below. The signal names are also displayed in the bottom line of the LCD display.

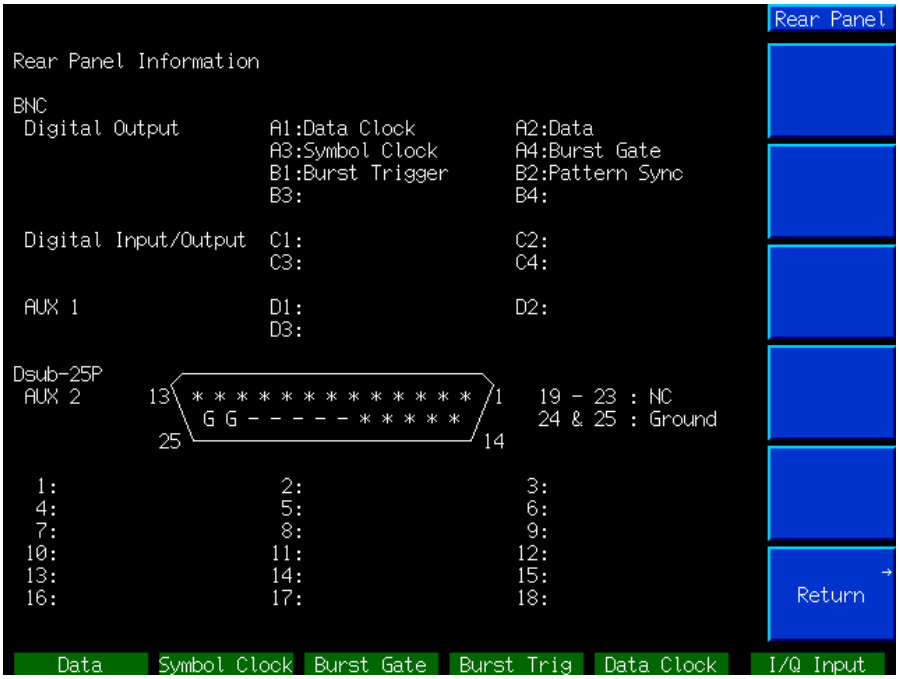
Connector names	Auxiliary signal names
Digital Input 1	Data Input
Digital Input 2	Symbol Clock Input
Digital Input 3	Burst Gate Input
Digital Input 4	Burst Trigger Input
Digital Input 5	Data Clock Input

Rear panel

Signal names for the BNC connector on the rear panel are shown in the table below. The signal names can also be confirmed on the Rear Panel Information screen.

Connector names	Auxiliary signal names
A1	Data Clock Output
A2	Data Output
A3	Symbol Clock Output
A4	Burst Gate Output
B1	Burst Trigger Output
B2	Pattern Sync Output

After pressing Config of the main function key, first press F5 (Hard Ware Check), and then F4 (Rear Panel Information) to display a signal name.

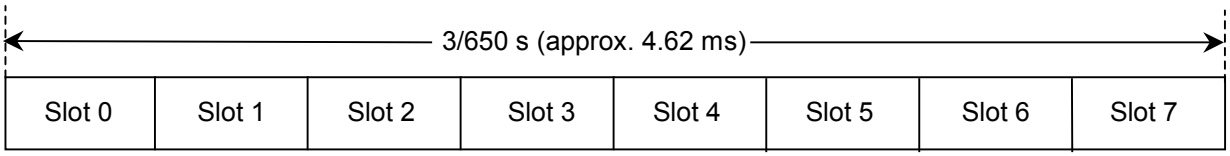


Section 3 Detailed Operations

This section explains the detailed operations, generation pattern and trigger function for the GSM system.

3.1 Frame composition

The frame consists of eight slots. Signals are generated with one frame as one cycle. The PN9/PN15 pseudo random pattern in each slot is independent for each slot, and has continuity.



3.2 Slot Composition

There are three types of slots for this system, namely, device evaluation, normal burst and random access burst.

3.2.1 Device Evaluation Slot (DEVICE)

PN	G
148	8.25

G : Guard time.....FF_H (8 bits)
PN : Pseudo-random pattern.....PN9 pseudo random pattern
(PN pattern is continuous)

[Setting parameter]
• PN : PN9 or PN15 pseudo random pattern

3.2.2 Normal Burst (NORMAL)

T	E	TS	E	T	G
3	58	26	58	3	8.25

T : Tail bits.....0_H (3 bits)
E : Encryption bits .....Independent PN9 pseudo random pattern for each slot
(The PN pattern in E of the same slot has continuity.)
TS : Training Sequence bits .....097 0897_H (26 bits)
G : Guard time.....FF_H (8 bits)

[Setting parameter]
• TS : 000 0000_H to 3FF $FFFF_H$ (26 bits)
• E : PN9 or PN15 pseudo random pattern

3.2.3 Random Access Burst (RACH)

Ta	TS	E	T	G
8	41	36	3	68.25

T : Tail bits ..... 0_H (3 bits)
Ta : Tail bits ..... $3A_H$ (8 bits)
E : Encryption bits ..... Independent PN9 pseudo random pattern for each slot
(The PN pattern in E of the same slot has continuity.)
TS : Training Sequence bits
(Training Sequence bits) ..... 096 FF33 5478_H (41 bits)
G : Guard time ..... F FFFF FFFF FFFF $FFFF_H$ (68 bits)

[Setting parameter]
• Ta : 00_H to FF_H (8 bits)
• E : PN9 or PN15 pseudo random pattern, ALL 0 or ALL 1 or 0 0000 0000_H to F FFFF $FFFF_H$ (36 bits)

3.3 Standard internal modulation data

There are four types of standard internal modulation data in the GSM system. To select the type of data, use "Pattern" in the parameter setting screen (modulation parameter setting mode).

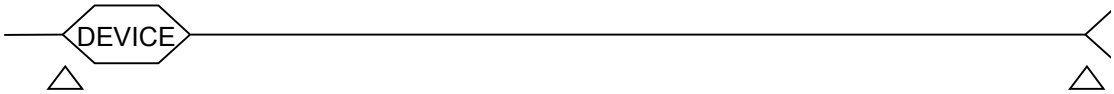
Notes:

△ indicates the position of the burst trigger.

All slots (0 to 7) cannot be set to Off simultaneously.

3.3.1 DEVICE

RF output applying device evaluation slot to slot 0

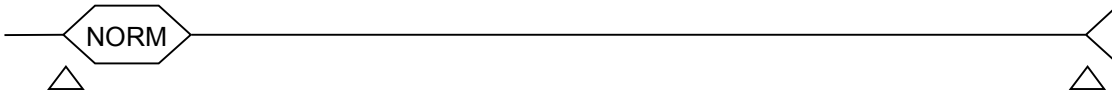


[Setting parameter]

- Slot:
  Slots 0 to 7 can be set to DEVICE or OFF.

3.3.2 TCH

RF output applying normal burst slot to slot 0

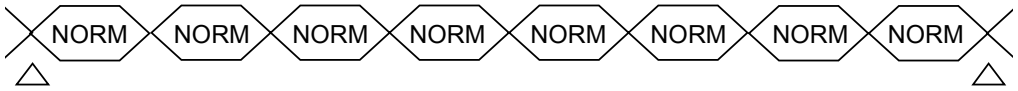


[Setting parameter]

- Slot:
  Slots 0 to 7 can be set to normal burst TCH or OFF.

3.3.3 TCH ALL

RF output applying normal burst slot to all slots 0 to 7

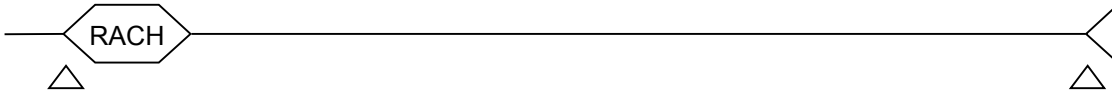


[Setting parameter]

- Slot:
  Slots 0 to 7 can be set to normal burst TCH or OFF.

3.3.4 RACH

RF output applying random access burst slot to slot 0



[Setting parameter]

- Slot:
  Slots 0 to 7 can be set to random access burst RACH or OFF.

3.4 Trigger Function

There are two trigger functions to generate a burst signal at internal modulation mode: “Internal trigger” and “External trigger.”

3.4.1 Operation of the Internal Trigger

An internal trigger works by generating a burst signal synchronous with the internal trigger signal. This trigger signal is output from the Burst Trig Output connector on the rear panel. The trigger signal is produced at every frame period. The period for the GMS system is about 4.62 ms.

3.4.2 Operation of the External Trigger

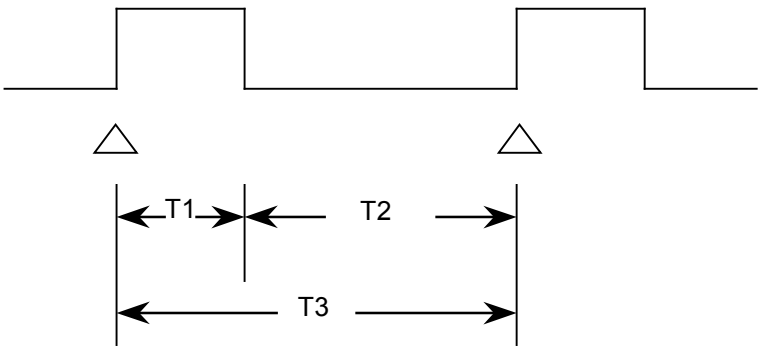
An external trigger works by generating a burst signal synchronous with the externally fed trigger signal. This trigger signal is fed to the Burst Trig Input connector on the front panel.

External trigger signal input conditions

Input level : TTL level

Polarity : Either rising or falling edge can be selected

Waveform : The waveform below illustrates a rising edge trigger waveform



T1 : 0.1 μs or more

T2 : 0.1 μs or more

T3 : burst period (frame period) ± 1 symbol

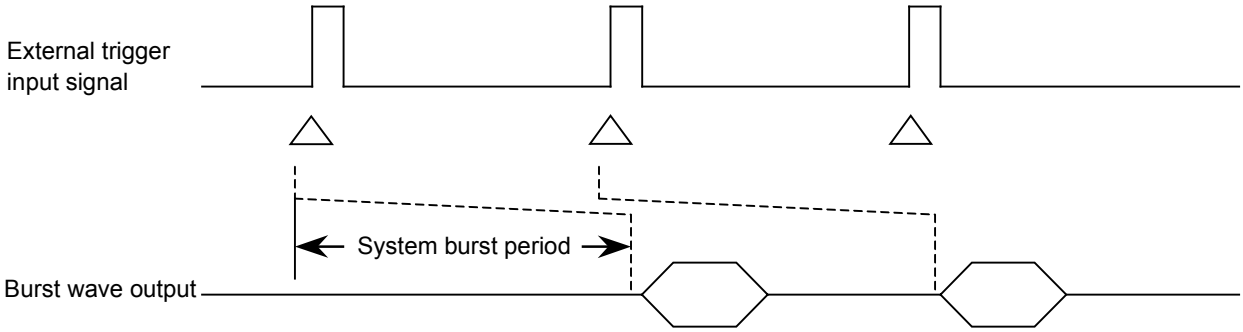
Rise/fall time: 100 ns or less

<Point>

Ringing occurring in the trigger signal waveform may cause an operation error. In this case, insert dumping resistor in the trigger signal output terminal to soften the waveform a little.

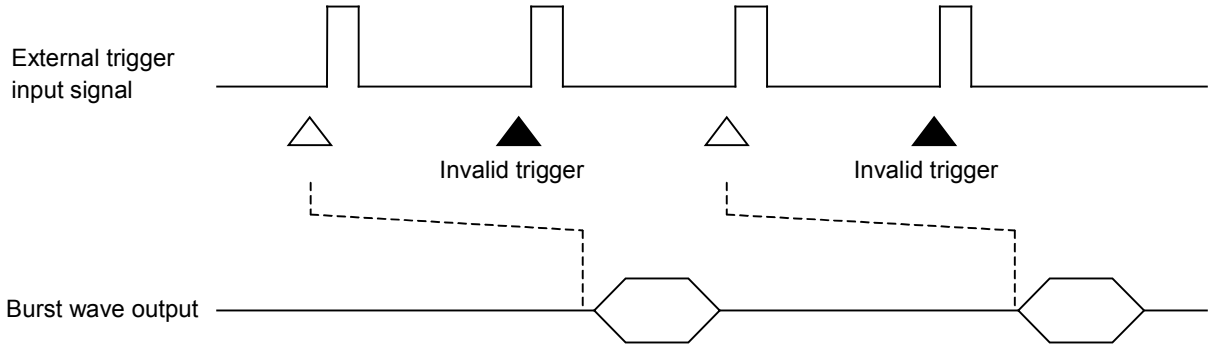
Relationship between external input trigger signal and output burst wave

The figure below illustrates that a burst wave period is produced after a delay of one burst period from the external input trigger signal.



Note:

If the period of the external input trigger signal does not satisfy the input condition in (1), the trigger signal is masked and invalidated as illustrated in the figure below. Therefore, the burst wave synchronized with the trigger signal cannot be obtained.

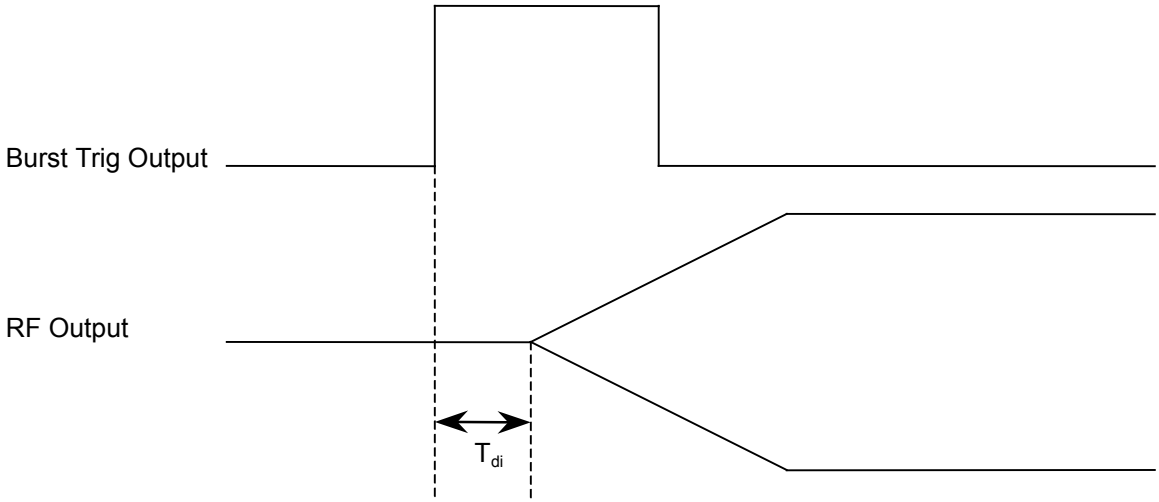


3.4.3 Output Timing of Burst Trigger and RF Signals

Pay attention to output timing of trigger and RF signals when synchronized with other equipment using the burst trigger signal for the MG3681A (Main Unit.) Output timings of trigger and RF signals are explained below.

When internal trigger signal is used

The output timing for the RF signal is shown below when synchronized with other equipment using the Burst Trig Output signal from the rear panel.



T_{di}: Represents the delay time when a burst wave is output using the internal trigger signal, which corresponds to the time from trigger signal until the start up of the first slot in the frame.

Relationship between GSM system and T_{di}

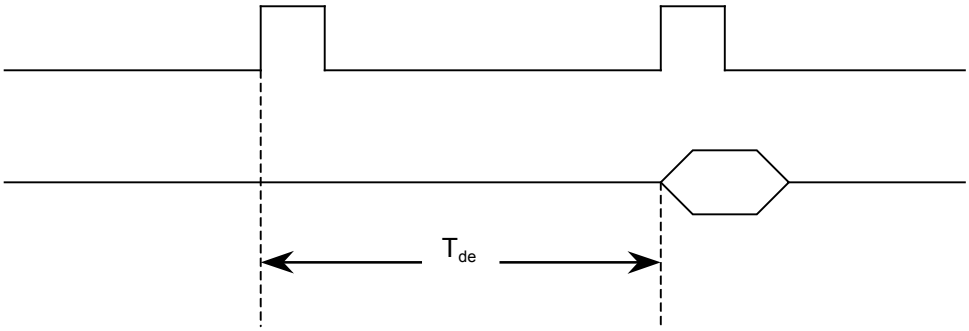
GSM: 2.51 μs (The value is a typical one, not the specification.)

Note:

The value of T_{di} includes errors due to the individual differences between equipment. In addition, the value is unique for equipment without jitter.

When external signal is used

The output timing of the RF signal is shown below when synchronized with other equipment using the Burst Trig Input signal from the front panel. The RF signal is output with a delay equivalent to approximately 1 frame period of the communication system from the trigger signal. This matches the timing of the second trigger signal to that of the RF output when a trigger signal with a frame period meeting the communication system is input.



T_{de}: Represents the delay time when a burst wave is output using the external trigger signal, which corresponds to the time from trigger signal until the start up of the first slot in the frame.

The delay time is calculated using the formula below when only the trigger signal is input to the MG3681A (main unit).

T_{de} = Frame period of communication system + T_{di} ± Synchronization error (1/16 symbol)

T_{de} : Delay time for connection only by trigger signal

T_{di} : Delay time for operation with internal trigger signal

Synchronization error: Jitter occurs within ±1/16 symbol since MG3681A (main unit) is not synchronized with the external trigger signal source.

Note:

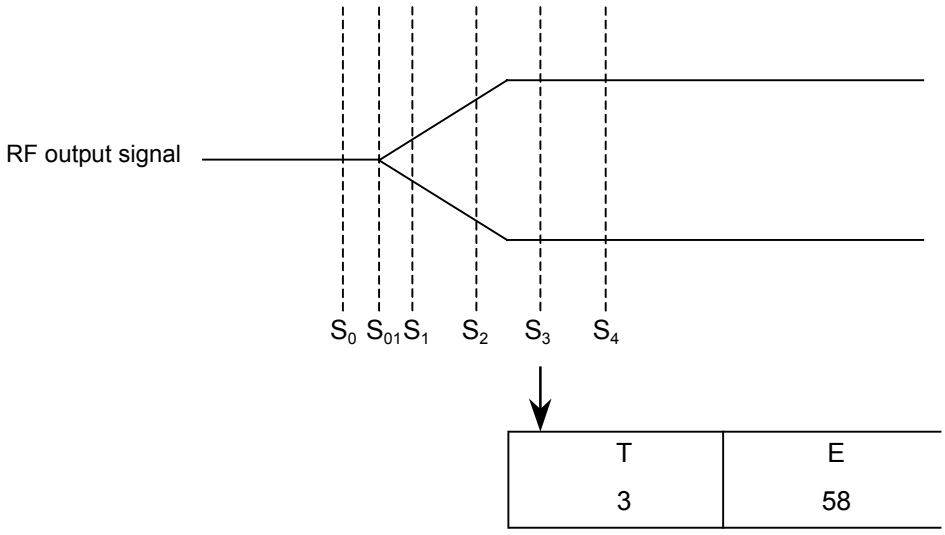
When MG3681A (main unit) is not synchronized with the external trigger signal source using the 10/13 MHz reference signal, no jitter occurs. However, the jitter value is inconsistent within a range of ±1/16 symbol.

Relationship between GSM system and T_{de}

GSM: 3/650s + 2.51 μs (The value is a typical one, not the specification.)

3.4.4 Relationship Between RF Signal and Symbol Judgment Point

Relationship between the RF output signal and symbol judgment point in a GSM system is indicated in the figure below. In the figure, correspondence between the modulation data symbol judgment point and the RF signal is explained using slot 0 of the traffic channel as an example.



S_3: First symbol formed by the tail bit

The delay time from burst trigger signal to RF output start-up is the same as that from burst trigger signal to S_{01}. S_{01} is a moment in the exact middle of S_0 and S_1. For details, refer to "3.4.3 Output Timing of Burst Trigger and RF Signals."

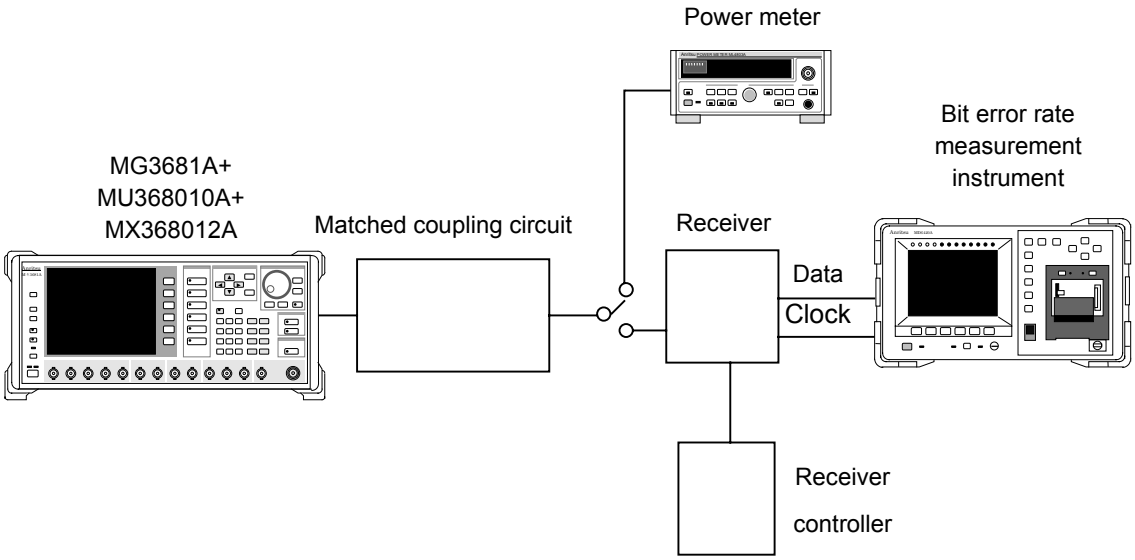
Section 4 Measurement

This section explains how to perform code error rate measurement for receivers, demodulator evaluation measurement, and modulator evaluation measurement as measurement examples when using the GSM system.

4.1 Bit Error Rate Measurement for Receiver

The procedure for measuring a receiver bit error rate when using the GSM system is explained below. In this section, a receiver that can be set to the communication channel receive-mode by an external controller without using call processing is explained. Also, Anritsu's MD6420A Data transmission analyzer is assumed used.

(1) Setup



(2) Measurement procedure

<1> Set the desired frequency and output level for this unit.

<2> Set the modulation system for this unit to "GSM."

<3> Set the modulation pattern for this unit to a receivable pattern for the receiver: TCH, for example.

<4> Connect RF output for this unit to the power meter through the matched coupling circuit. Using the power meter, adjust output level to the sensitivity test level.

<5> Switch the matched coupling circuit output to the receiver.

<6> Using the receiver controller, set the receiver to the continuous wave reception mode.

<7> Connect the receiver demodulation data output and data clock to the code error rate measuring instrument.

<8> Connect the data and clock obtained from the receiver to the respective RD (Data) and RT (Clock) connectors for the MD0626A (TTL interface unit) inserted in the rear panel of MD6420A (Bit error measurement instrument).

<9> Set the MD6420A (Bit error measurement instrument) receive timing as follows:

- If data is sampled at the rising edge of the clock, set to RT (INV) mode.
- If data is sampled at the falling edge of the clock, set to RT mode.

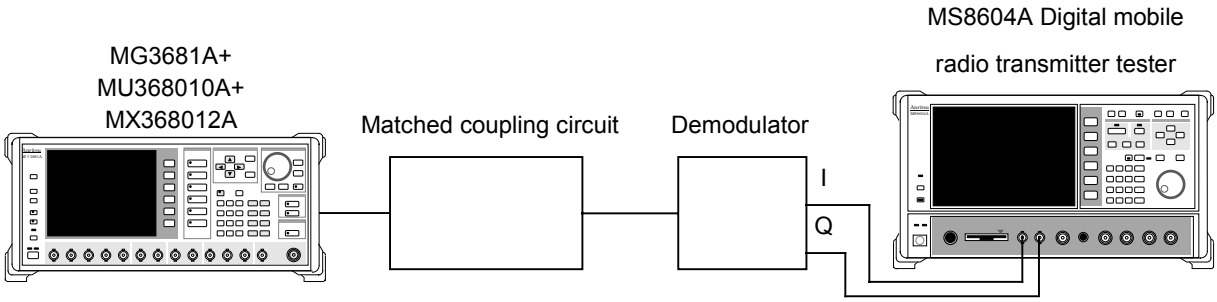
<10> Set the MD6420A (Bit error measurement instrument) modulation pattern to 2^9 -1 (PN9).
The receiver should output data and clock only for TCH of communication channel.

<11> Press MEAS on MD6420A (Bit error measurement instrument) to start the bit error rate measurement.

4.2 Quadrature Demodulator Evaluation Measurement

The procedure for performing the evaluation measurement for an quadrature demodulator when using the GSM system is explained below. In this section, an example using Anritsu's Digital mobile radio transmitter tester MS8604A is explained to evaluate the I/Q output of the demodulator. (To use MS8604A, Option 15: GMSK measurement software and Option03: I/Q input function are required.)

(1) Setup



(2) Measurement procedure

<1> Set the frequency and output level of this unit to be tested.

<2> Set the modulation system for this unit to "GSM."

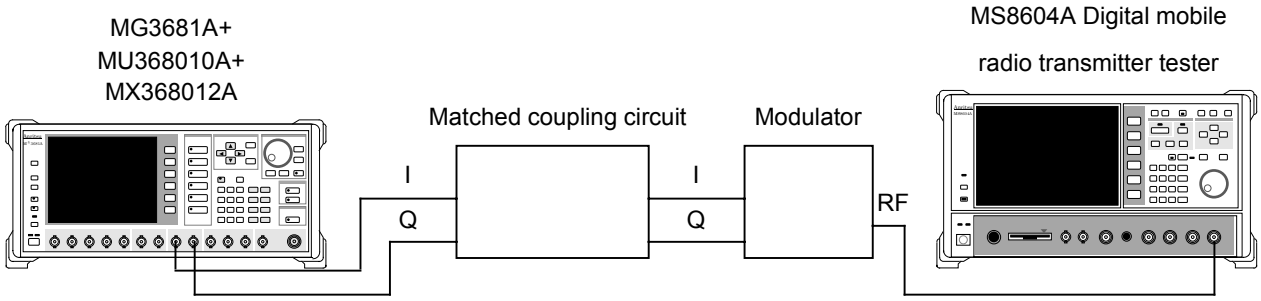
<3> Set the modulation pattern for this unit to "PN9 pseudo random pattern".

<4> Measure the I/Q signal modulation accuracy input in MS8604A.

4.3 Modulator Evaluation Measurement

The procedure for performing the evaluation measurement for a modulator evaluation measurement when using the GSM system is explained below. In this section, an example using Anritsu's Digital mobile radio transmitter tester MS8604A is explained. (To use MS8604A, Option 15: GMSK measurement software is required.)

(1) Setup



(2) Measurement procedure

<1> Set the frequency and output level of this unit to be tested. Set the desired frequency and output level for this unit.

<2> Set the modulation system for this unit to "GSM."

<3> Set the modulation pattern for this unit to "PN9 pseudo random pattern".

<4> Set MS8604A so that the modulation system and pattern set in Steps <2> and <3> can be received.

<5> Using MS8604A, measure the modulation accuracy and evaluate it. (For information on MS8604A operation, refer to the MS8604A Operation Manual.)

Section 5 Remote Control

This section explains GPIB and RS-232C device messages by function and in alphabetical order, when the MU368010A TDMA modulation unit with MX368012A GSM software installed is mounted to the MG3681A Digital modulation signal generator. For other remote controls, refer to "SECTION 4 Remote Control" in the "MG3681A Main Unit Operation Manual."

5.1 Device Messages by Function

Command Message and Query Message

The header section of a command message is represented by capital alphanumeric characters as a reserved word. The header section of a query message ends with "?". Multiple arguments divided by separators "," can be set on the argument sections of command and query messages. Argument-types are explained below.

<1> Capital letters : Reserved word

<2> Numeric value : Reserved word

<3> Lowercase characters in the argument section:

f (Frequency) : Numeric data (NR1, NR2, NR3)
Suffix code : GHZ, GZ, MHz, MZ, kHz, KZ,HZ,
HZ is applied if unit does not exist.

l (Level) (Relative value) : Numeric data (NR1, NR2, NR3 format)
Suffix code : DB
DB is applied if unit does not exist.

n (Integer number with unit) : Numeric data (NR1 format)

r (Actual number without unit) : Numeric data (NR2 format)

h (Hexadecimal without unit) : Numeric data (Hexadecimal)

s (Character string) : Alphanumeric characters with " " or ' '.

Response message

A response message is sent back to the external controller when the query message is received. It is composed of the response header section and response data section. The response data section can contain multiple response data divided by separators, ",". Response-types are explained below.

<1> Capital letters : Reserved word

<2> Numeric value : Reserved word

<3> Lowercase characters in the argument section:

f (Frequency) : Numeric data (NR1 format)
Suffix code : HZ,

l (Level) (Relative value) : Numeric data (NR2 format)
Suffix code : DB

n (Integer number with unit) : Numeric data (NR1 format)

r (Actual number without unit) : Numeric data (NR2 format)

h (Hexadecimal without unit) : Numeric data (Hexadecimal)

Note:

If a header is set to Off, the response message header and the numeric data suffix code are not output.

To set the header On/Off, refer to "MG3681A Operation Manual."

Device message list

<Common>

Item	Device message		
Control item	Command message	Query message	Response message
I/Q Mod. Internal	MODE INT IQSRC INT	MODE? IQSRC?	MODE INT IQSRC INT
I/Q Mod. External	MODE EXT IQSRC EXT	MODE? IQSRC?	MODE EXT IQSRC EXT
I/Q Modulation Off	MODE OFF IQSRC OFF	MODE? IQSRC?	MODE OFF IQSRC OFF
System GSM	SYS GSM	SYS?	SYS GSM
Baseband ON	BASEBAND ON	BASEBAND?	BASEBAND ON
Baseband OFF	BASEBAND OFF	BASEBAND?	BASEBAND OFF
Pulse Mod. ON	PMO ON	PMO?	PMO ON
Pulse Mod. OFF	PMO OFF	PMO?	PMO OFF
Pulse Mod. Internal	PMO INT	PMO?	PMO INT
Pulse Mod. External	PMO EXT	PMO?	PMO EXT
Digital	DIGITAL	–	DIGITAL

<Modulation>

Item	Device message		
Control item	Command message	Query message	Response message
Bit Rate	BITRATE r r :245.7 to 300.3	BITRATE?	BITRATE r
Filter BbT	BBT r r :0.10 to 0.80	BBT?	BBT r
Differential Encode ON	DE ON	DE?	DE ON
Differential Encode OFF	DE OFF	DE?	DE ON
Phase Polarity Normal	PP NORM	PP?	PP NORM
Phase Polarity Inverse	PP INVS	PP?	PP INVS
Burst On	BST ON	BST?	BST ON
Burst Off FILTER SPEC	BST OFF	BST?	BST OFF
Pattern PN9	PAT PN9	PAT?	PAT PN9
Pattern PN15	PAT PN15	PAT?	PAT PN15
Pattern 0000 to 1111 (Optional four-bit pattern)	PAT n n :0000 to 1111	PAT?	PAT n
Pattern Device	PAT DEV	PAT?	PAT DEV
Pattern TCH	PAT TCH	PAT?	PAT TCH
Pattern TCH All (Slots)	PAT TCA	PAT?	PAT TCA
Pattern RACH	PAT RACH	PAT?	PAT RACH
Burst Trigger Internal	BTG INT	BTG?	BTG INT
Burst Trigger External	BTG EXT	BTG?	BTG EXT

<Pattern Edit>

Item	Device message		
Control item	**Command message**	**Query message**	**Response message**
Pattern Edit	DIGBURST	–	–
Slot Number	SLOTNO n n :0 to 7	SLOTNO?	SLOTNO n
PN for each slot (Pattern = DEVICE)	PN PN9 PN PN15	PN?	PN PN9 PN PN15
On/Off for each slot (Pattern = TCH)	SLOT ON SLOT OFF	SLOT?	SLOT ON SLOT OFF
TS for each slot (Pattern = TCH)	TS h h :	TS?	TS h
E for each slot (Pattern = TCH)	E PN9 E PN15	E?	E PN9 E PN15
E for each slot (Pattern = RACH) E for each slot = User data	RE PN9 RE PN15 RE ALL0 RE ALL1 RE h	RE?	RE PN9 RE PN15 RE ALL0 RE ALL1 RE h
Tail Bit for each slot	RTA h h :	RTA?	RTA h
Slot Level for each slot	SLOTLVL l l :–20.0DB to 0.0DB	SLOTLVL?	SLOTLVL l

<SPM Save/Delete〉

Item	Device message		
Control item	**Command message**	**Query message**	**Response message**
Pattern Save	DIGSAVE	–	–
Burst Pattern Memory Save	BSAV n [,s] n :0 to 99 s :”title”	–	–

<SPM List>

Item	Device message		
Control item	**Command message**	**Query message**	**Response message**
Pattern List	DIGLIST	–	–

<Baseband Setup: Common>

Item	Device message		
Control item	Command message	Query message	Response message
Baseband: Data Internal	MID INT	MID?	MID INT
Baseband: Data External	MID EXT	MID?	MID EXT
Baseband: Data Clock Internal	MIC INT	MIC?	MID INT
Baseband: Data Clock External	MIC EXT	MIC?	MIC EXT

<Baseband Setup: Ext. Mod. Input>

Item	Device message		
Control item	Command message	Query message	Response message
Data Input Positive	EID POS	EID?	EID POS
Data Input Negative	EID NEG	EID?	EID NEG
Data Clock Input Rise	EIC RISE	EIC?	EIC RISE
Data Clock Input Fall	EIC FALL	EIC?	EIC FALL
Symbol Clock Input Rise	EIS RISE	EIS?	EIS RISE
Symbol Clock Input Fall	EIS FALL	EIS?	EIS FALL
Burst Gate Input Positive	EIB POS	EIB?	EIB POS
Burst Gate Input Negative	EIB NEG	EIB?	EIB NEG

<Baseband Setup: Ext. Mod. Output>

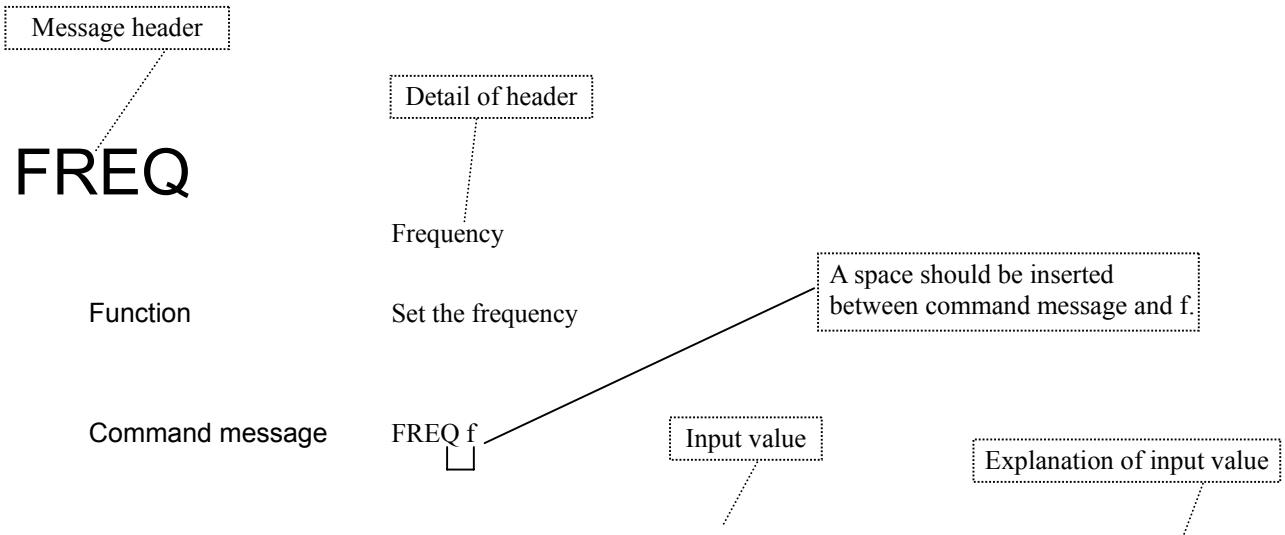
Item	Device message		
Control item	Command message	Query message	Response message
Data Output Positive	EOD POS	EOD?	EOD POS
Data Output Negative	EOD NEG	EOD?	EOD NEG
Data Clock Output Rise	EOC RISE	EOC?	EOC RISE
Data Clock Output Fall	EOC FALL	EOC?	EOC FALL
Symbol Clock Output Rise	EOS RISE	EOS?	EOS RISE
Symbol Clock Output Fall	EOS FALL	EOS?	EOS FALL
Burst Gate Output Positive	EOB POS	EOB?	EOB POS
Burst Gate Output Negative	EOB NEG	EOB?	EOB NEG

<Baseband Setup: Others>

Item	Device message		
Control item	Command message	Query message	Response message
Burst Trigger Input Rise	BTI RISE	BTI?	BTI RISE
Burst Trigger Input Fall	BTI FALL	BTI?	BTI FALL
Burst Trigger Output Rise	BTO RISE	BTO?	BTO RISE
Burst Trigger Output Fall	BTO FALL	BTO?	BTO FALL
Pattern Sync Output PN Clock	PSYNC PNCLK	PSYNC?	PSYNC PNCLK
Pattern Sync Output PN Gate	PSYNC PNGAT	PSYNC?	PSYNC PNGAT
Pattern Sync Output RF Gate	PSYNC RFGAT	PSYNC?	PSYNC RFGAT

5.2 Device Messages in Alphabetical Order

<Example>



Function	Set the frequency	
Command message	FREQ f	
Value of a	–2.99975 to 3GHZ	: –2.99975 to 3 GHz
	–2999.75 to 3000MHZ	: –2999.75 to 3000 MHz
	–2999750 to 3000000KHZ	: –2999750 to 3000000 kHz
	–2999750000.00 to 3000000000HZ	: –2999750000.00 to 3000000000 Hz
Query message	FREQ?	
Response message	FREQ f	
Example	FREQ 123MHZ	

BASEBAND Baseband

Function	Sets Baseband On/Off
Command message	`BASEBAND a`
Value of a	`ON` : Baseband On `OFF` : Baseband Off
Query message	`BASEBAND?`
Response message	`BASEBAND a`
Example	`BASEBAND ON`

BBT Filter BbT

Function	Sets BbT product value for baseband filter.
Command message	`BBT r`
Query message	`BBT?`
Response message	`BBT r`
Value of r	0.20 to 0.50 : BbT product
Example	`BBT 0.30`
Restriction	Invalid when Baseband is set to Off.

B

BITRATE

Bit Rate

Function	Sets the information transmission speed for GMSK modulation.
Command message	`BITRATE r`
Value of r	245.7 to 300.3, 270.833: Bit rate (245.7 to 300.3 kbps)
Query message	`BITRATE?`
Response message	`BITRATE r`
Example	`BITRATE 245.7`
Restriction	Invalid when Baseband is set to Off.

BSAV

Burst Pattern Memory Save

Function	Saves the burst internal modulation data to the memory.
Command message	`BSAV n [,s]`
Value of n	`0 to 99`: Pattern memory number
Value of s	Character string within 8 characters enclosed by double quotation marks or single quotation marks. Saves the currently set title if s is omitted. Saves the first eight characters of s as the title if s is over eight characters.
Example	`BSAV 5, "TEST02"`
Restriction	Invalid when Baseband or Burst selection is set to Off, or data input on the Baseband Setup screen is set to Ext.

BST

Burst

Function	Sets On/Off of Burst
Command message	`BST a`
Query message	`BST?`
Response message	`BST a`
Value of a	`ON` : Burst On `OFF` : Burst Off
Example	`BST ON`
Restriction	Invalid when Baseband is set to Off.

BTG

Burst Trigger

Function	Sets internal (Int)/external (Ext) for Burst Trigger signal.
Command message	`BTG a`
Query message	`BTG?`
Response message	`BTG a`
Value of a	`INT` : Internal (Internal generation) `EXT` : External (External input)
Example	`BTG INT`

B

BTI

Burst Trigger Input

Function	Sets the polarity for Burst Trigger Input.
Command message	`BTI a`
Query message	`BTI?`
Response message	`BTI a`
Value of a	`RISE` : Rise (Rising edge) `FALL` : Fall (Falling edge)
Example	`BTI RISE`

BTO

Burst Trigger Output

Function	Sets the polarity for Burst Trigger Output.
Command message	`BTO a`
Query message	`BTI?`
Response message	`BTO a`
Value of a	`RISE` : Rise (Rising edge) `FALL` : Fall (Falling edge)
Example	`BTI RISE`

DE

Differential Encode

Function Sets Differential Encode function On/Off.

Command message `DE a`

Query message `DE ?`

Response message `DE a`

Value of a
`ON` : Differential encode On
`OFF` : Differential encode Off

Example `DE ON`

Restriction Invalid when Baseband is set to Off.

DIGBURST

Pattern Edit Screen

Function Shifts to the Pattern Edit screen.

Command message `DIGBURST`

Response message `DIGBURST`

Example `DIGBURST`

Restriction Screen shift is not required when the parameter for Burst Internal Data Generation screen is changed in Remote. This function is invalid when Baseband or Burst is Off, or Data input for Baseband is set to Off.

D

DIGITAL

Digital Modulation Screen

Function	Shifts to the Top screen for Digital modulation.
Command message	`DIGITAL`
Response message	`DIGITAL`
Example	`DIGITAL`

DIGLIST

Pattern List Screen

Function	Shifts to the Pattern List screen.
Command message	`DIGLIST`
Response message	`DIGLIST`
Example	`DIGLIST`
Restriction	Screen shift is not required when the parameter for Burst Pattern Edit screen is changed in Remote. This function is invalid when Baseband or Burst is Off, or Data input for Baseband is set to Off.

DIGSAVE

Pattern Save Screen

Function	Shifts to the Pattern Save screen.
Command message	`DIGSAVE`
Response message	`DIGSAVE`
Example	`DIGSAVE`
Restriction	Screen shift is not required when the parameter for Burst Pattern Edit screen is changed in Remote. This function is invalid when Baseband or Burst is Off, or Data input for Baseband is set to Off.

E

E

Encryption Bit

Function	Sets E data in a slot at the normal burst.
Command message	`E a`
Query message	`E?`
Response message	`E a`
Value of a	`PN9` : PN9 (pseudo random pattern) `PN15` : PN15 (pseudo random pattern)
Example	`E PN9`
Restriction	Valid when the selected slot is at the normal burst.

EIB

Burst Gate Input Polarity

Function	Sets the polarity for Burst Gate Input.
Command message	`EIB a`
Query message	`EIB?`
Response message	`EIB a`
Value of a	`POS` : Positive (Positive logic) `NEG` : Negative (Negative logic)
Example	`EIB NEG`

EIC

Data Clock Input Polarity

Function	Sets the polarity for Data Clock Input.
Command message	`EIC a`
Query message	`EIC?`
Response message	`EIC a`
Value of a	`RISE` : Rise (Rising edge) `FALL` : Fall (Falling edge)
Example	`EIC RISE`

EID

Data Input Polarity

Function	Sets the polarity for Data Input.
Command message	`EID a`
Query message	`EID?`
Response message	`EID a`
Value of a	`POS` : Positive (Positive logic) `NEG` : Negative (Negative logic)
Example	`EID NEG`

E

EIS

Symbol Clock Input Polarity

Function Sets the polarity for Symbol Clock Input.
Symbol Clock Input can be set, but it is not used in the GSM system.

Command message `EIS a`

Query message `EIS?`

Response message `EIS a`

Value of a
`RISE` : Rise (Rising edge)
`FALL` : Fall (Falling edge)

Example
```
EIS RISE
```

EOB

Burst Gate Output Polarity

Function Sets the polarity for Burst Gate Output.

Command message `EOB a`

Query message `EOB?`

Response message `EOB a`

Value of a
`POS` : Positive (Positive logic)
`NEG` : Negative (Negative logic)

Example
```
EOB POS
```

EOC

Data Clock Output Polarity

Function	Sets the polarity for Data Clock Output.
Command message	`EOC a`
Query message	`EOC?`
Response message	`EOC a`
Value of a	`RISE` : Rise (Rising edge) `FALL` : Fall (Falling edge)
Example	`EOC FALL`

EOD

Data Output Polarity

Function	Sets the polarity for Data Output.
Command message	`EOD a`
Query message	`EOD?`
Response message	`EOD a`
Value of a	`POS` : Positive (Positive logic) `NEG` : Negative (Negative logic)
Example	`EOD POS`

E

EOS

Symbol Clock Output Polarity

Function	Sets the polarity for Symbol Clock Output. Symbol Clock Output can be set, but it is not used in the GSM system.
Command message	`EOS a`
Query message	`EOS?`
Response message	`EOS a`
Value of a	`RISE` : Rise (Rising edge) `FALL` : Fall (Falling edge)
Example	`EOS FALL`

IQSRC

I/Q Modulation Source

Function	Sets the I/Q modulation signal source.
Command message	`IQSRC a`
Query message	`IQSRC?`
Response message	`IQSRC a`
Value of a	`INT` : Internal (Internal modulation unit) `EXT` : External (External output) `OFF` : I/Q modulation stop (only the pulse modulation can be used)
Example	`IQSRC INT`

M

MIC

Modulation Input Data Clock

Function	Sets the internal(Int)/external(Ext) for Data Clock.
Command message	`MIC a`
Query message	`MIC?`
Response message	`MIC a`
Value of a	`INT` : Internal (Internal clock) `EXT` : External (External clock input)

MID

Modulation Input Data

Function	Sets the internal (Int)/external (Ext) for Data.
Command message	`MID a`
Query message	`MID?`
Response message	`MID a`
Value of a	`INT` : Internal (Internal data generator) `EXT` : External (External data input)
Example	`MID INT`

MODE

I/Q Modulation Mode

Function	Sets the I/Q modulation signal source.
Command message	`MODE a`
Query message	`MODE?`
Response message	`MODE a`
Value of a	`INT` : Internal (Internal modulation unit) `EXT` : External (External output) `OFF` : I/Q modulation stop (only the pulse modulation can be used)
Example	`MODE INT`

P

PAT

Pattern

Function Sets the modulation data pattern.

Command message `PAT a`

Query message `PAT?`

Response message `PAT a`

Value of a

Burst: Off

`PN9`	: PN9 (pseudo random pattern)
`PN15`	: PN15 (pseudo random pattern)
`0000 to 1111`	: four-bit repetition pattern

Burst: On

`DEV`	: For device evaluation
`TCH`	: Normal burst
`TCA`	: Normal burst (all slots On)
`RACH`	: Random access burst
`MEM00 to MEM99`	: Recall of specified number (00 to 99) for pattern memory.

Example `PAT PN9`

Restriction Invalid when Baseband or Burst is Off, or Data input for Baseband is set to Off.

PMO

Pulse Modulation

Function	Sets the pulse modulation to internal (Int)/external (Ext)/Off .
Command message	`PMO a`
Query message	`PMO?`
Response message	`PMO a`
Value of a	`INT` : Internal (generated in the modulation unit) `EXT` : External (input from the external) `ON` : External (input from the external) `OFF` : Off (Fix the pulse modulation to On state)
Example	`PM INT`

PN

Pseudo Random

Function	Sets the PN for the slot for device evaluation.
Command message	`PN a`
Query message	`PN?`
Response message	`PN a`
Value of a	`PN9` : PN9 (pseudo random pattern) `PN15` : PN15 (pseudo random pattern)
Example	`PN PN9`

P

PP

Phase Polarity

Function	Sets Normal/Inverse for Phase Polarity
Command message	`PP a`
Query message	`PN?`
Response message	`PP a`
Value of a	`NORM` : Normal `INVS` : Inverse
Example	`PP NORM`
Restriction	Invalid when Baseband is set to Off.

PSYNC

Pattern Sync Output Mode

Function	Select output mode for pattern synchronization signal.
Command message	`PSYNC a`
Query message	`PSYNC?`
Response message	`PSYNC a`
Value of a	`PNCLK` : Outputs PN Clock signal `PNGAT` : Outputs PN Gate signal `RFGAT` : Outputs RF Gate signal
Example	`PSYNC RFGAT`

RE

Random Access Burst Encryption Bit

Function	Sets E data for random access burst.
Command message	`RE a` `RE h`
Query message	`RE?`
Response message	`RE a` `RE h`
Value of a	`PN9` : PN9 (pseudo random pattern) `PN15` : PN15 (pseudo random pattern) `ALL0` : All bit 0 `ALL1` : All bit 1
Value of h	`000000000 to FFFFFFFFF`
Example	`RE PN9`

RTA

Random Access Burst Tail Bit

Function	Sets the tail bit data for each slot
Command message	`RTA h`
Query message	`RTA?`
Response message	`RTA h`
Value of h	`00 to FF` : Tail Bit data (hexadecimal)
Example	`RTA 3B`

S

SLOT

Slot

Function	Sets On/Off for each slot.
Command message	`SLOT a`
Query message	`SLOT?`
Response message	`SLOT a`
Value of a	`ON` : Slot On `OFF` : Slot Off `UPT` : Slot On at TCH for Uplink `UVX` : Slot On at VOX for Uplink
Example	SLOT OFF

SLOTLVL

Slot Level

Function	Sets the slot level for each slot.
Command message	`SLOTLVL l`
Query message	`SLOTLVL?`
Response message	`SLOTLVL l`
Value of l	`-20.0DB to 0.0DB:`
Example	`SLOTLVL -20.0DB`

SLOTNO

Slot Number

Function	Sets the slot numbers
Command message	`SLOTNO n`
Query message	`SLOTNO?`
Response message	`SLOTNO n`
Value of n	`0 to 7` : Slot number
Example	`SLOTNO 5`

SYS

System

Function	Select System.
Command message	`SYS a`
Query message	`SYS?`
Response message	`SYS a`
Value of a	`GSM` : GSM System
Example	`SYS GSM`

T

TS

Training Sequence

Function	Sets TS value for the normal burst.
Command message	`TS h`
Query message	`TS?`
Response message	`TS h`
Value of h	`0000000 to 3FFFFFF` : TS data (hexadecimal)
Example	`TS 0970897`

Section 6 Performance Test

This section explains required measurement instruments, setup and calibration procedures for the performance test to verify that the GSM system conforms to specifications.

6.1 About the Performance Test

The performance test is performed to verify that the GSM system conforms to specifications.
Performance tests are required at acceptance inspection, periodic inspection and post-repair performance verification.
Contact Anritsu's service department if the GSM system is found through the performance test to not meet the specifications.

The following are items that should be tested to verify the performance of the GSM system.

- I/Q signal modulation accuracy
- RF output modulation accuracy
- Modulation pattern
- Burst wave On/Off ratio

Execute performance tests at least once or twice a year as preventive maintenance for important items.

We recommend that the performance test results are noted in "Appendix C Performance test results record form"

⚠ Caution

Before executing the performance tests, this unit and all the other measuring instruments must be warmed up for at least 30 minutes so that the test is executed under stable conditions. To measure with the highest accuracy, the tests must be performed at room temperature, ac power-supply voltage fluctuations must be minimized, and noise, vibration, dust and humidity must be kept at a reasonable level.

6.2 Test Instruments

Instruments for the GSM system performance test are shown in the table below.

Performance test item	Recommended instrument	Anritsu model name
Output level accuracy	Power meter	ML4803A
	Power sensor	MA4601A
I/Q signal modulation accuracy	Digital mobile transmission tester	MS8604A Option 03, 15
RF output modulation accuracy	Digital mobile transmission tester	MS8604A Option 15
Modulation pattern	Error rate measurering instrument	MD6420A, MD0626A TTL interface unit
Burst wave On/Off ratio	Spectrum analyzer	MS2683A

6.3 Output Level Accuracy

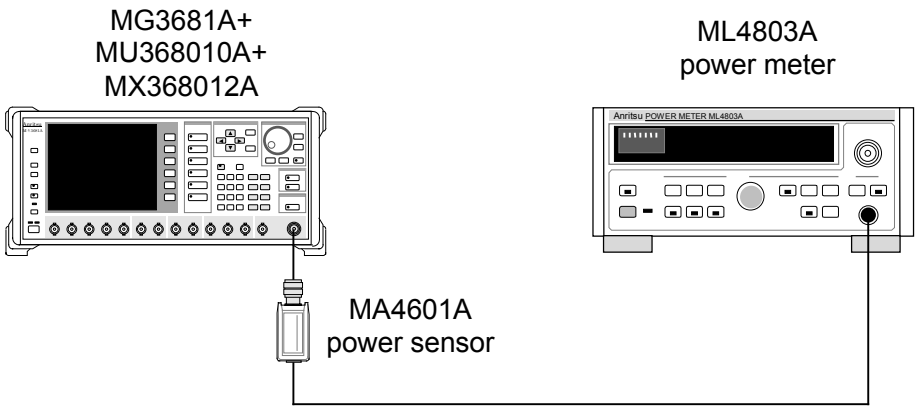
(1) Test specification

Level difference between CW and modulation..... ±1.0 dB

(2) Test instrument

- Power meter ML4803A

(3) Setup



(4) Test Procedures

<1> Set the communication system for this unit to "GSM."

<2> After pressing the [Preset] key, set the parameter below.
Baseband : On

<3> Set RF output to Off.

<4> Adjust the zero point for the power meter and calibrate the sensitivity of the sensor.

<5> Set the output level for this unit to be tested.

<6> Set the frequency to be tested.

<7> Set the calibration coefficient of the power meter sensor and measure the output level for this unit.

<8> After pressing the [Preset] key of this unit, set the parameter below.
Baseband : On
Digital Modulation : On

<9> Repeat the steps <3> to <7>

<10> Find the level difference from the results of <7> during CW and <9> during modulation.

6.4 I/Q Signal Modulation Accuracy

(1) Test specification

Modulation accuracy

Additional Function of I/Q Output (MG3681A-11) option not-installed

≤ 1° (rms), ≤ 3° (peak)

Additional Function of I/Q Output option installed

≤ 2° (rms), ≤ 5° (peak)

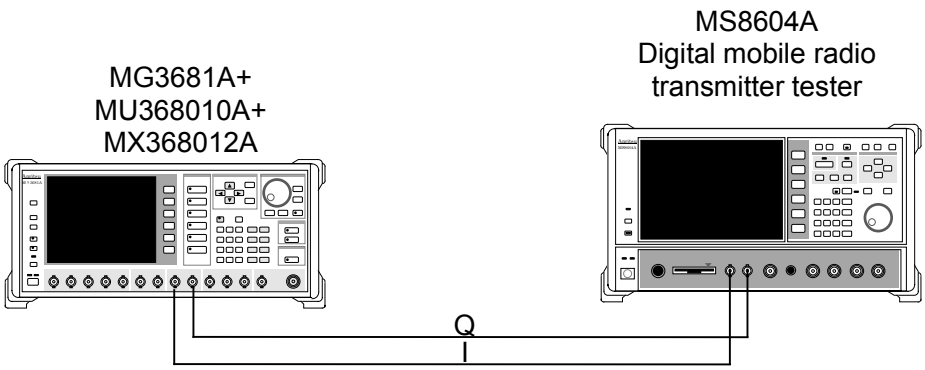
(2) Test instruments

- Digital mobile radio transmitter tester.....MS8604A

  Option 03: IQ input required for analyzing I/Q signal

  Option 15: Software for GSM required for analyzing GSM signal

(3) Setup



(4) Test procedures

<1> Set the communication system for this unit to "GSM."

<2> After pressing the [Preset] key, set the parameter below.

Baseband : On

<3> Set MS8604A so that the modulation system and pattern set in <1> and <2> can be received.

<4> Measure modulation accuracy and I/Q signal using MS8604A.

<5> Set the parameters below to this unit.

Burst : On

Pattern : TCH

<6> Set MS8604A so that the modulation pattern set in <5> can be received.

<7> Measure modulation accuracy and I/Q signal using MS8604A. (For information on MS8604A operation, refer to the MS8604A Operation manual.)

6.5 RF Output Modulation Accuracy

Confirm the modulation accuracy of the RF modulation signal output.

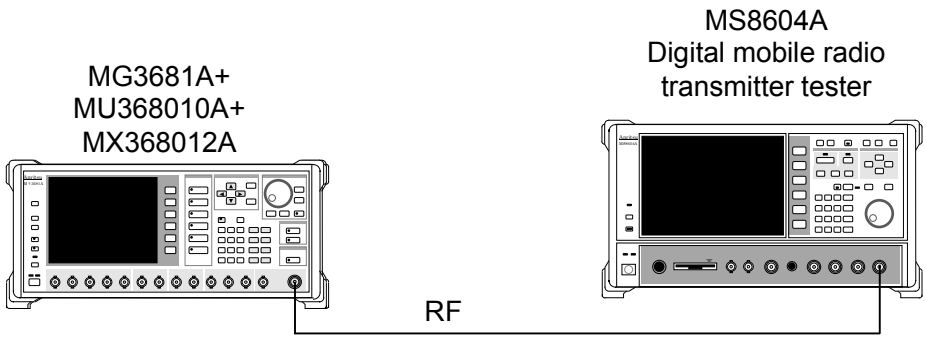
(1) Test specifications

- Frequency range 10 MHz to 2.1 GHz
- Modulation accuracy ≤ 1° (rms), ≤ 3° (peak) (Continuous Modulation)
  ≤ 1° (rms), ≤ 3° (peak) (Burst Modulation)
  at output level ≤ +5 dB, 18 to 35°C

(2) Test instrument

- Digital mobile radio transmitter tester MS8604A

(3) Setup



(4) Test procedure

<1> Set the communication system for this unit to "GSM."

<2> After pressing the [Preset] key, set the parameter below.
Baseband : On
Digital Mod : On
RF output level : –10 dBm

<3> Set the RF frequency to be tested.

<4> Set MS8604A so that the parameters set in <2> and <3> can be received.

<5> Measure the modulation accuracy of the RF modulation signal using MS8604A.

<6> Set the parameters below to this unit.
Burst : On
Pattern : TCH

<7> Set MS8604A so that the modulation pattern set in <6> can be received.

<8> Measure the modulation accuracy of the RF modulation signal using MS8604A. (For information, refer to the MS8604A Operation manual.)

6.6 Modulation Pattern

Verify the modulation pattern.

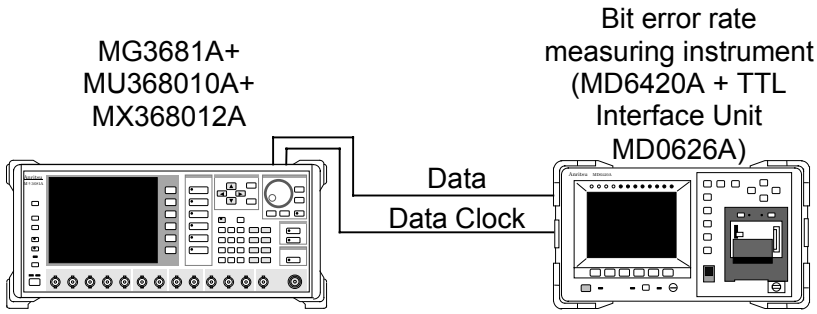
(1) Test specifications
- PN9 pseudo-random pattern.....Burst function Off
- PN9 pseudo-random pattern on slot.....Burst function On

(2) Test instruments
- Data transmission analyzer.....MD6420A

MD6420A unit required for measurement

MD0626A : TTL interface unit

(3) Setup



(4) Test procedures

The test procedures for the output level frequency character test are explained here.

<1> Set the communication system for this unit to "GSM"

<2> After pressing the [Preset] key, set the parameter below.
Baseband : On

<3> Connect data output and data clock output to the bit error rate measuring instrument. (Connect data and the clock to the respective RD (Data) and RT (Clock) connectors for the MD0626A TTL Interface Unit inserted in the MD6420A rear panel.)

<4> Set the MD6420A receive timing to RT (INV) mode.

<5> Set the MD6420A modulation pattern to 2^9 - 1 (PN9).

<6> Press the MEAS key for MD6420A to measure the bit error rate.

<7> Set the parameters below to this unit.
Burst : On
Pattern : TCH

<8> Connect the Pattern Sync output for this unit to MD6420A Clock output.

<9> Set the Pattern Sync output signal to "PN Clock" on the Baseband Set Up screen.

<10> Press the MEAS key so MD6420A will measure the bit error rate. (For information on MD6420A operation, refer to the MD6420A Operation manual.)

6.7 Burst Wave On/Off Ratio

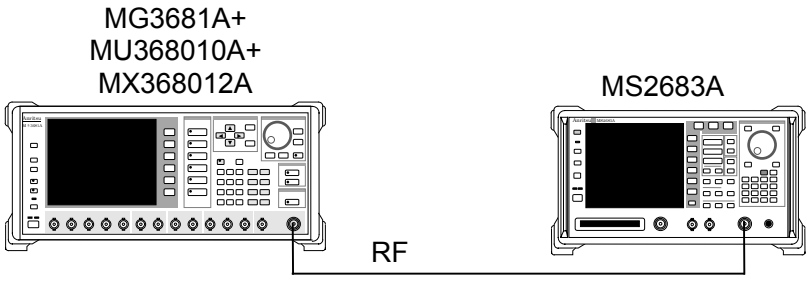
(1) Test specifications

- Frequency range.....10 MHz to 2.1 GHz
- On/Off ratio.....≥ 65 dB : 5 dBm output

(2) Test instrument

- Spectrum analyzer.....MS2683A

(3) Setup



(4) Test Procedures

Test procedure for the harmonic spurious are explained here.

<1> Set the communication system for this unit to "GSM"

<2> After pressing the [Preset] key, set the parameter below.

Baseband	: On
Digital Mod	: On
Burst	: On
RF output level	: +5 dBm

<3> Set the RF frequency to be tested.

<4> Press the [Preset] key so MS2683A will measure the code error rate. (For information on the MS2683A operation, refer to the MS2683A Operation manual.)

Time Span

Ref Level	: +10 dBm
RBW	: 300 kHz
VBW	: 300 kHz
Sweep Time	: 5 ms
Trigger Source	: Video
Trigger Level	: –30 dB
Ref Level	: +10 dBm
Detection Mode	: Average
Video Average	: 50 Count

<5> Set the frequency for MS2683A to the value set in <3>

<6> Observe the On/Off ratio for the output level in time domain.

A Specifications

(When GSM software is installed in MU368010A and fit to MG3680 series)

<table>
<tr><td colspan="2">Applicable</td><td>GSM</td></tr>
<tr><td colspan="2">Modulation method</td><td>GMSK</td></tr>
<tr><td colspan="2">Bit rate</td><td>Variable range : 243.74 to 297.92 kbps (Standard: 270.833 kbps), Resolution 0.01 kbps
Accuracy : Depends on the standard signal source accuracy of MG3680 series main unit</td></tr>
<tr><td colspan="2">Baseband filter</td><td>Gaussian filter, BbT: 0.2 to 0.5, resolution: 0.01</td></tr>
<tr><td rowspan="2">Modulation data</td><td>Continuous modulation</td><td>PN9 and PN15 pseudo random pattern and four-bit data repeat pattern</td></tr>
<tr><td>Burst modulation</td><td>Data pattern complying with GSM specifications can be output
Frame configuration
Consists of eight slots (slot 0 to 7), Frame cycle: 3/650 s (approx. 4.62 ms)
<table>
<tr><td>Slot 0</td><td>Slot 1</td><td>Slot 2</td><td>Slot 3</td><td>Slot 4</td><td>Slot 5</td><td>Slot 6</td><td>Slot 7</td></tr>
</table>
Slot configuration
1) For device evaluation (DEVICE)
<table>
<tr><td>PN
270</td><td>G
8.25</td></tr>
</table>
PN: PN9 or PN15
2) Normal burst (NORMAL)
<table>
<tr><td>T
3</td><td>E
58</td><td>TS
26</td><td>E
58</td><td>T
3</td><td>G
8.25</td></tr>
</table>
E: PN9 or PN15, TS: 0000000 to 3FFFFF
3) Random access burst (RACH)
<table>
<tr><td>Ta
8</td><td>TS
41</td><td>E
36</td><td>T
3</td><td>G
68.25</td></tr>
</table>
Ta: 00 to FF, TS: 00000000000 to 1FFFFFFFFF
E: PN9, PN15, ALL0, ALL1 or 000000000 to FFFFFFFFF</td></tr>
<tr><td rowspan="2">Auxiliary signal</td><td>Input signal</td><td>Data Clock : Clock input equivalent to the transmission speed (input range: ± 1 % of the transmission speed variable range)
Data : Data output synchronized to Data Clock
Burst Gate : Gate signal input of On/Off description for burst signal
Burst Trig : Trigger input synchronized with frame</td></tr>
<tr><td>Output signal</td><td>Data Clock : Clock input equivalent to the transmission speed
Data : Data output synchronized to Data Clock
Burst Gate : Gate signal input of On/Off description for burst signal
Burst Trig : Trigger input synchronized with frame
Pattern Sync. : Signal output synchronized with PN9, PN15 or four-bit pattern (at continuous modulation)
Gate or clock signal output of E, or On/Off signal output of RF</td></tr>
</table>

I/Q signal	Output level	$\sqrt{I^2+Q^2}$ = 500 mV (rms) * Bit rate: 270.833 kbps, Baseband filter: BbT = 0.30, continuous modulation and pattern: PN9
	Phase error	Additional Function of I/Q Output option not-installed ≤ 1° (rms), ≤ 3° (peak) (Continuous modulation, pattern: PN9) ≤ 1° (rms), ≤ 3° (peak) (Burst modulation, pattern: TCH) Additional Function of I/Q Output option installed ≤ 2° (rms), ≤ 5° (peak) (Continuous modulation, pattern: PN9) ≤ 2° (rms), ≤ 5° (peak) (Burst modulation, pattern: TCH) * Bit rate: 270.833 kbps and Baseband filter: BbT = 0.30
RF signal	Frequency range	10 to 2100 MHz
	Output level range	−143 to +13 dBm
	Level accuracy	Within ±1.0 dB for the level at CW (continuous modulation, pattern: PN 9) Within ±0.7 dB for the level at continuous modulation (burst modulation, pattern: NORMAL, and slot level: 0 dB)
	Phase accuracy	≤ 1° (rms), ≤ 3° (peak) (continuous modulation, pattern: PN9) ≤ 1° (rms), ≤ 3° (peak) (burst modulation, pattern: NORMAL) * Bit rate: 270.833 kbps, Baseband filter: BbT = 0.30, 5 dBm output and slot level: 0 dB
	Carrier leak	≤ −33 dBc (Bit rate: 270.833 kbps, Baseband filter: BbT = 0.30, continuous modulation, pattern: “0000”, and 18 to 35 °C)
	Image rejection	≤ −40 dBc (Bit rate: 270.833 kbps, Baseban d filter: BbT = 0.30, continuous modulation, pattern: “0000”)
	Adjacent channel power leakage	≤ −35 dBc/30 kHz (200 kHz offset) ≤ −66 dBc/30 kHz (400 kHz offset) (continuous modulation, pattern: PN9, +5 dBm output, Bit Rate: 270.833 kbps, Baseband Filter: Bbt: 0.30, Frequency 880 to 960 MHz, 1710 to 1880 MHz, PLL Mode: Narrow) Influence by the spurious of the MG3681A main unit is not considered.
	Burst On/Off ration	≥ 65 dB (+5 dBm)
Used firmware backup area		TDMA: 260 kbyte, FPGA: 256 kbyte

B Initial Value List

Setting	Initial Value
Digital Modulation Main Screen	
Bit Rate	270.833 kbps
Filter	BbT = 0.30
Differential Encode	On
Phase Polarity	Normal
Burst	Off
Pattern	PN9

Setting	Initial Value
Baseband Setup Screen	
Data	Int
Data Clock	Int
Ext Mod Input	
Data	Positive
Data Clock	Rise
Symbol Clock	Rise
Burst Gate	Positive
Ext Mod Output	
Data	Positive
Data Clock	Rise
Symbol Clock	Rise
Burst Gate	Positive
Burst Trigger Input	Rise
Burst Trigger Output	Rise
Pattern Sync Output	PN Clock

C Performance Test Result Sheet

Location: _____ Report No. _____
_____ Tested date _____
_____ Person in charge _____

Model type MG3681A digital modulation SG
+ MU368010A TDMA modulation unit
+ MX368012A GSM device test software

Manufacture No. _____ Temperature _____ °C
Power source frequency _____ Hz Humidity _____ %

Remarks:

Output level accuracy (Item 6.3)

Setting Frequency	Result	Specifications maximum value
10 MHz		±1.0 dB
50 MHz		
100 MHz		
300 MHz		
500 MHz		
800 MHz		
1000 MHz		
1300 MHz		
1500 MHz		
1800 MHz		
2000 MHz		
2100 MHz		

I/Q signal modulation accuracy (Item 6.4)

Setting	Result	Specifications maximum value
Burst Off		Additional Function of I/Q Output option not-installed 1.0° (rms), 3.0° (peak) Additional Function of I/Q Output option installed 2.0° (rms), 5° (peak)
Burst On		

RF signal modulation accuracy (Item 6.5)

Setting Frequency	Results	Specification maximum value
10 MHz		1° (rms), 3° (peak) (Continuous modulation) 1° (rms), 3° (peak) (Burst modulation)
50 MHz		
100 MHz		
300 MHz		
500 MHz		
800 MHz		
1000 MHz		
1300 MHz		
1500 MHz		
1800 MHz		
2000 MHz		
2100 MHz		

Modulation pattern (Item 6.6)

Setting	Results
Burst Off	□ OK □ NG
Burst On	□ OK □ NG

Burst wave On/Off ratio (Item 6.7)

Setting Frequency	Results	Specification maximum value
10 MHz		≥65 dB
50 MHz		
100 MHz		
300 MHz		
500 MHz		
800 MHz		
1000 MHz		
1300 MHz		
1500 MHz		
1800 MHz		
2000 MHz		
2100 MHz		

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