



DIGITAL FUNCTION GENERATOR

DF1906

INSTRUCTION MANUAL

DA00057652-001

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Preface

Thank you for purchasing our "DF 1906 Digital Function Generator".

Please read "Safety Precautions" on the next page first to ensure the product is used in a correct and safe manner.

■ Caution Symbols Used in This Manual

The following caution symbols are used in this manual. The instructions of these caution symbols shall be observed to ensure the equipment operator's safety and prevent damage to the equipment.

WARNING

This contains information to avoid electric shock and other risks when handling the equipment that could result in the death or bodily injury of the operator.

CAUTION

This contains information to avoid damage to the equipment when handling the equipment.

● This manual consists of the following chapters.

When you use this equipment for the first time, start from Chapter 1.

1. Overview

This chapter provides an overview and describes the features, applications, functions, and simple operation principles of this product.

2. Preparation Before Use

This chapter describes the important preparations before installation and operation.

3. Explanation of Panels and Basic Operations

This chapter describes the functions/operations and basic operations of each panel part.

Please read this chapter while operating the equipment.

4. Advanced Operations

This chapter describes a wider range of operations.

5. USB Interface

This chapter describes the remote control via USB.

6. Troubleshooting

This chapter describes how to deal with error messages and trouble.

7. Maintenance

This chapter describes the storage, repacking, and transportation as well as how to test the performance.

8. Specifications

This chapter describes the specifications (functions and performance).

— Safety Precautions —

To ensure safe use, be sure to observe the following warnings and cautions.

NF Corporation shall not be held liable for damages that arise from a failure to observe these warnings and cautions.

This product is a Class I device (with protective conductor terminal) that conforms to the IEC insulation standards.

- Be sure to observe the instructions in this instruction manual.

This instruction manual contains information for the safe operation and use of this product.

Be sure to read this information first before using this product.

All the warning items contained in this instruction manual are intended for preventing risks that may lead to serious accidents. Be sure to observe them.

- Be sure to perform the grounding.

To prevent electric shock, be sure to connect the product to an earth ground to ensure the ground resistance is 100 ohms or less.

This product is automatically grounded by connecting a 3-pin power plug to a power outlet with a protective ground contact.

- Check the power supply voltage.

This product operates at a power supply voltage described in "Grounding and Power Connection" of this instruction manual.

Before connecting to the power outlet, check that the voltage of the power outlet matches the rated power supply voltage of the product.

- If you find something strange

If this product emits smoke, abnormal smell, or abnormal noise, immediately stop use and disconnect the power cord.

If such a problem occurs, make sure that nobody can use the product until it has been repaired, and immediately report the problem to NF Corporation or one of our agents.

- Do not use the product in a gaseous atmosphere.

This may pose a risk of explosion or other danger.

- Never remove the cover.

There are high voltage parts inside this product. Never remove the cover.

Even when the inside of this product needs to be inspected, do not touch the inside. All such inspections are to be performed by service technicians authorized by NF Corporation.

- Do not modify this product.

Never modify the product. Modification of the product could cause an unexpected risk. NF Corporation may refuse to repair a modified product that has failed.

- Safety symbols

The general definitions of the safety symbols used on the product body and in the instruction manual are provided below.



Instruction manual reference symbol

This notifies the user of a potential hazard and is displayed where the user must refer to the instruction manual.



Electric shock hazard symbol

This symbol is displayed where there is a risk of electric shock under specific conditions.



Warning symbol

This contains information to avoid electric shock and other risks when handling the equipment that could result in the death or bodily injury of the operator.



Caution symbol

This contains information to avoid damage to the equipment when handling the equipment.

- Other symbols



Indicates the ON position of the power switch.



Indicates the OFF position of the power switch.



Indicates that the external conductor of the connector is connected to the case.

Table of Contents

	Page
1. Overview	1-1
1.1 Features.....	1-2
1.2 Applications.....	1-2
1.3 Function List	1-3
1.4 Operating Principle	1-4
2. Preparation Before Use	2-1
2.1 Checking Before Use	2-2
2.2 Installation.....	2-3
2.3 Grounding and Power Connection.....	2-4
2.4 Simplified Operation Check	2-5
2.5 Calibration.....	2-6
3. Explanation of Panels and Basic Operations	3-1
3.1 Panel Part Names and Operations	3-2
3.2 Display at Power On and Initial Settings	3-7
3.2.1 Before Powering On	3-7
3.2.2 Display at Power On	3-8
3.2.3 Initial Settings	3-8
3.3 I/O Connector	3-10
3.3.1 Output Connector	3-10
3.3.2 Input Connector	3-13
3.4 I/O Connection	3-14
3.5 Basic Operations	3-15
3.5.1 Display	3-15
3.5.2 Set Numeric Value	3-15
3.5.3 Select Setting Value	3-16
3.5.4 Set Frequency	3-16
3.5.5 Set Amplitude and DC Offset.....	3-17
3.5.6 Select Waveform	3-18
3.5.7 Select Oscillation Mode	3-18
3.5.8 Select Output On/Off	3-19

4. Advanced Operations	4-1
4.1 Symmetry and Duty Ratio	4-2
4.1.1 Set Symmetry (Ramp Wave)	4-2
4.1.2 Set Duty Ratio (Square Wave)	4-2
4.2 Oscillation Mode-related Settings	4-3
4.2.1 Set Mark Wave Number	4-3
4.2.2 Set Space Wave Number	4-3
4.2.3 Select SYNC OUT Function	4-4
4.2.4 Set Phase	4-4
4.2.5 Select TRIG IN Effective Polarity (Trigger Oscillation)	4-5
4.2.6 Select TRIG IN Effective Polarity (Gate Oscillation).....	4-5
4.3 Special Menu	4-6
4.3.1 Setting Memory	4-6
4.3.2 Select Output at Power On.....	4-7
4.3.3 Select Load.....	4-7
4.3.4 Set by High Level/Low Level	4-8
5. USB Interface	5-1
5.1 Preparation Before Use	5-2
5.2 Command List.....	5-3
5.3 Explanation of Commands.....	5-6
5.3.1 Language Overview.....	5-6
5.3.1.1 Subsystem Commands.....	5-6
5.3.1.2 Path Separator	5-6
5.3.1.3 Command String Simplification	5-6
5.3.1.4 Suggestion Keyword.....	5-7
5.3.2 Detailed Explanation of Commands	5-7
5.4 Command Tree	5-15
5.5 Status System.....	5-16
5.5.1 Status Byte Resister	5-17
5.5.2 Standard Event Status Register.....	5-18
5.6 Notes for Programming.....	5-19
6. Troubleshooting	6-1
6.1 Error Message	6-2
6.1.1 Power-On Errors.....	6-2
6.1.2 Errors of Remote Control via USB	6-2
6.2 Troubleshooting	6-3

7. Maintenance	7-1
7.1 Preface	7-2
7.2 Daily Maintenance	7-2
7.3 Storage, Repacking, and Transportation	7-2
7.4 How to Check Version Number	7-3
7.5 Performance Test.....	7-3
7.5.1 Frequency Accuracy Test	7-4
7.5.2 Amplitude Frequency Characteristic Test	7-4
7.5.3 Sine Wave Distortion Test	7-4
7.5.4 Square Wave Duty Ratio	7-4
7.5.5 Amplitude Accuracy Test	7-5
7.5.6 DC Offset Accuracy Test.....	7-5
7.6 Calibration.....	7-6
8. Specifications	8-1
8.1 Waveform and Output Characteristics	8-2
8.2 Output Voltage	8-4
8.3 Other Functions	8-5
8.4 Details of Initialization	8-7
8.5 General Specifications	8-8

Figures and Tables

	Page
Figure 1-1 Block Diagram	1-4
Figure 3-1 Front Panel	3-3
Figure 3-2 Rear Panel	3-5
Figure 3-3 FUNCTION OUT	3-10
Figure 3-4 SYNC OUT	3-11
Figure 3-5 TRIG IN	3-13
Figure 3-6 Display Panel	3-15
Figure 5-1 Command Tree	5-15
Figure 5-2 Status System	5-16
Figure 8-1 External Dimensions Diagram	8-9
Table 2-1 Configuration List	2-2
Table 3-1 Initial Settings	3-9
Table 5-1 DF 1906 Command List	5-3
Table 5-2 Common Commands	5-4
Table 5-3 Definition of Status Byte Register	5-17
Table 5-4 Definition of Standard Event Status Register	5-18

1. Overview

1.1 Features.....	1-2
1.2 Applications.....	1-2
1.3 Function List.....	1-3
1.4 Operating Principle	1-4

1.1 Features

The "DF 1906 Digital Function Generator" is a function generator based on a direct digital synthesizer (DDS), which is small, light, and low-priced but features high accuracy and sophisticated functionality.

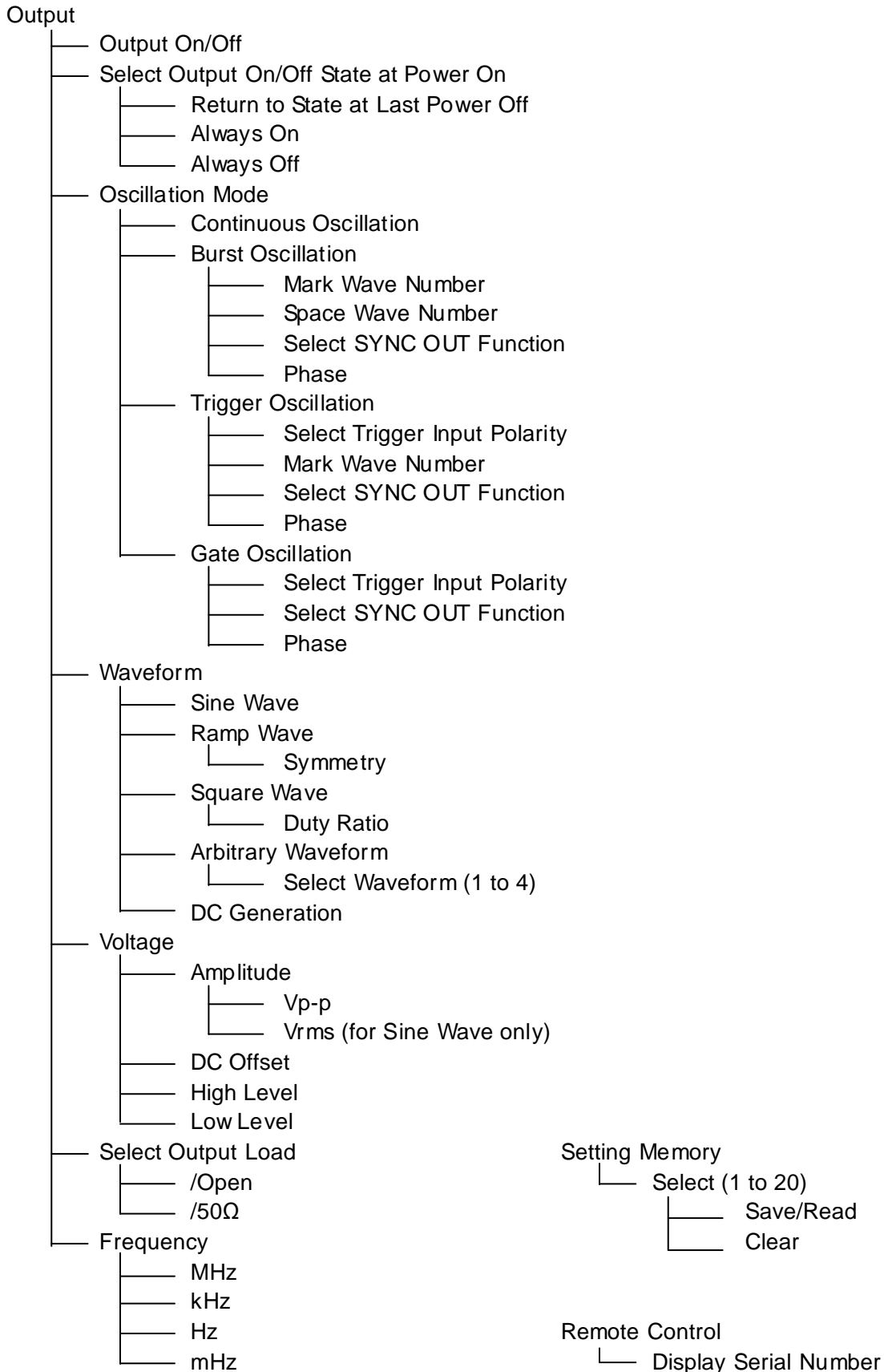
- Oscillation frequency: 0.1 mHz to 2 MHz, setting resolution: 0.1 mHz. Frequency accuracy: ± 25 ppm.
- Even if the frequency is changed, the phase is continuous and the waveform is not cut off.
- Maximum output voltage: 10 V_{p-p}/open, ± 5 V/open. DC offset up to ± 5 V/open can be superimposed.
- When the amplitude is changed, no unexpected voltage is generated. The waveform can be changed without being cut off from 0 to the maximum amplitude.
- In addition to the 4 standard waveforms: Sine wave, square wave, ramp wave, and DC, 4 arbitrary waves can also be output.
- The duty ratio can be changed for the square wave. The symmetry can be changed for the ramp wave.
- Waveform data is set via a USB connection for arbitrary waveforms.
- A wealth of oscillation modes are available.
 - Continuous oscillation
 - Burst oscillation
 - Trigger oscillation
 - Gate oscillation
- Main parameters can be read at a glance on a 40-digit x 2-line LCD display panel.
- Almost all settings can be remote controlled via USB.

1.2 Applications

- Measurement of filters, in particular of those with steep characteristics.
- Signal source of audio equipment and pulse motor using the burst oscillation mode
- Signal source of an automated measurement system
- Oscillator for various experiments

1.3 Function List

The following shows a function tree.



1.4 Operating Principle

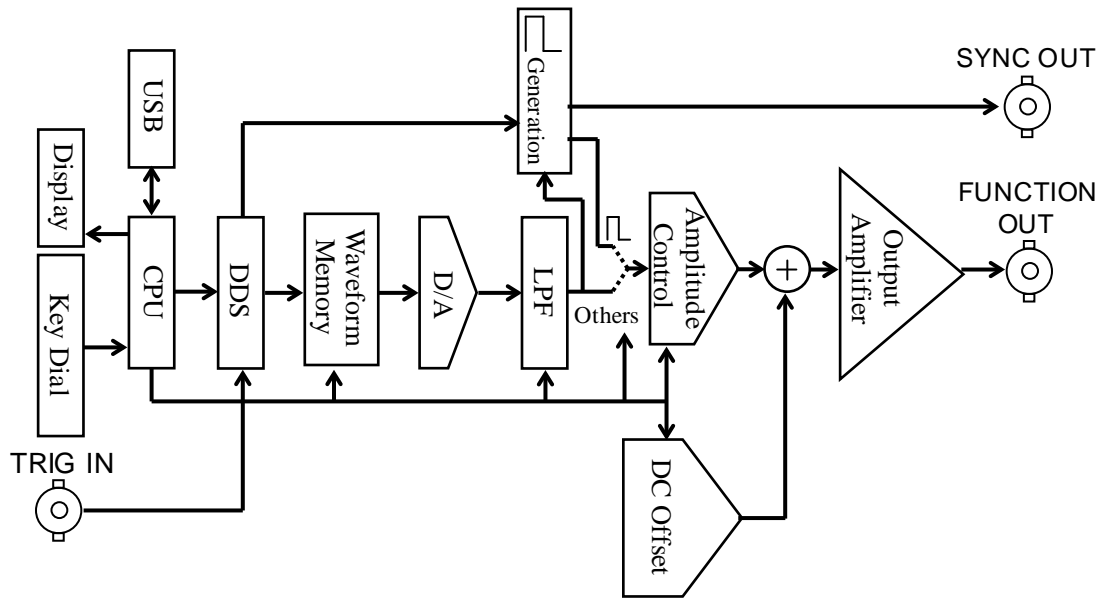


Figure 1-1 Block Diagram

- CPU performs analog control, such as display panel control, panel key and dial process, USB remote control process, DDS control, amplitude, and DC offset.
- DDS (Direct Digital Synthesizer) generates digital data at the set frequency.
- Waveform Memory converts the digital data from the DDS to standard waveform or arbitrary waveform data.
The waveform data is set from the CPU. The update rate of waveform data is approx. 6.872 MHz.
- The waveform data acquired in this way is converted to an analog signal by the D/A converter.
- LPF (Low Pass Filter) smoothens a staircase waveform output by the D/A converter.
The analog bandwidth (at the -3dB) for arbitrary waveforms and sine wave and ramp wave in the burst/trigger/gate oscillation mode is approx. 650 kHz.
- For a square wave at a duty ratio of 50% and at a frequency of 10 kHz or more, a low jitter square wave is obtained by generating a sine wave by the Waveform Memory-D/A Converter-LPF and converting it to a square wave by an analog comparator in the \square generator.
- For a square wave at a duty ratio of other than 50% or at a frequency of less than 10 kHz, a logic signal with a duty variable pulse generated by the DDS is converted to a square wave by the \square generator. This includes a one-clock (approx. 150 ns) jitter of the DDS.
- The amplitude is set in the amplitude controller. The DC generator generates a DC offset, which is added and amplified in the output amplifier to output a signal.

2. Preparation Before Use

2.1	Checking Before Use.....	2-2
2.2	Installation	2-3
2.3	Grounding and Power Connection	2-4
2.4	Simplified Operation Check	2-5
2.5	Calibration	2-6

2.1 Checking Before Use

■ Safety Check

Please read "Safety Precautions" at the beginning of this instruction manual before using the DF 1906 to ensure safety.

Furthermore, before connecting to the power supply, read "2.3 Grounding and Power Connection" to ensure safety.

■ Things to Check when Unpacking

First of all, check that the product has not been damaged during transport.

Before installing the equipment, make sure that the configuration is as specified in "Table 2-1 Configuration List".

Table 2-1 Configuration List

Main unit	1
Power cord set	1
CD-ROM (Instruction Manual, ARBITRARY WAVEFORM EDITOR DF 0106)	1

WARNING

There are high voltage parts inside this equipment. Never remove the cover.

No one except trained service technicians who have knowledge of hazard prevention is permitted to check the inside of this equipment.

2.2 Installation

■ Precautions

CAUTION

Please pay attention to the following points, otherwise the DF 1906 may be damaged.

- The DF 1906 is cooled by natural air cooling.
Install with a minimum clearance of 10 cm from the wall, etc.
- To install the DF 1906 with the rear panel facing down, be sure to raise the legs in the upper part of the rear panel.

If it is installed with the legs not raised, an excessive force is applied to the power cord and it may be damaged.

■ Installation Conditions

Install the DF 1906 in a place that satisfies the following temperature and humidity conditions.

Performance guarantee: +5 to +35°C, 5 to 85 %RH (Absolute humidity 1 to 25 g/m³, non-condensing)

Storage: -10 to +50°C, 5 to 95 %RH (Absolute humidity 1 to 29 g/m³, non-condensing)

Avoid installation in the following locations.

- Places exposed to direct sunlight, or places near a heat source.
- Places exposed to dust, salt, metallic powder, etc.
- Places exposed to corrosive gas, moisture, oil smoke, etc.
- Places exposed to vibration.
- Places near intense magnetic or electric field sources.
- Places near pulse noise sources.

When output accuracy is important, allow the equipment to warm up for at least 2 hours before use.

Keep the power cord of the DF 1906 or other equipment away from the signal cable. If the power cord and signal cable are installed close to each other, a malfunction may occur.

Pay attention to the cable placement particularly when mounting the DF 1906 in a rack, etc.

■ Handling of Panels and Case

The front panel of the DF 1906 is made of a polyester film. Avoid damage from contact with sharp or hot objects.

When the panel or case needs cleaning, wipe with a soft cloth. To remove persistent stains, wipe with a soft cloth soaked with neutral detergent and wrung out.

Do not use any organic solvents like thinner or benzene, or any chemical cleaning cloth, as they may cause the surface finish to deteriorate, tarnish, or come off.

2.3 Grounding and Power Connection

■ Grounding

 **WARNING**

Take the following precautions to avoid risk of electric shock.

Before making connections for measurement, be sure to connect the protective ground terminal to an earth ground.

The protective ground terminal of the DF 1906 is a grounding pin of the 3-pin power cord.

Be sure to insert the power plug into a 3-pin power outlet with a protective ground contact.

■ Power Supply

 **CAUTION**

To prevent damage to the DF 1906, check that the voltage of the power outlet is within the power supply voltage of the DF 1906 and then connect to the power outlet.

The DF 1906 operates from the following power outlet.

Power supply voltage range: 100 V to 240 V AC \pm 10%, 250 V or less

Power supply frequency range: 50/60 Hz \pm 2 Hz

The maximum power consumption is 25 VA.

Before connecting the power cord, check that the power switch is off.

When turning the power off and then back on, wait at least 5 seconds before turning the power back on.

 **WARNING**

There are high voltage parts inside this equipment. Never remove the cover.

2.4 Simplified Operation Check

Take the following steps to observe the output signal of the DF 1906 with an oscilloscope.

1. Connect the power cord to the outlet and then turn on the power switch.

☞ "3.2.2 Display at Power On"

2. First clear the settings.

- When you press special menu key [SPECIAL], "Memory" appears and the memory number flashes.
- When you press [TRIG / CLEAR] key, "CLEAR" appears.

☞ "4.3.1 Setting Memory"

3. Connect an oscilloscope to the FUNCTION OUT connector of the DF 1906 with a BNC cable.

- For example, configure the oscilloscope as follows.
 - Input impedance: 1 M Ω • Input sensitivity: 200 mV/DIV
 - Sweep rate: 0.2 ms/DIV • Trigger level: 0 V

4. Turn the output on and check that the sine wave is output.

- When you press output on/off key [OUTPUT], "ON" appears and the waveform is output.

☞ "3.5.8 Select Output On/Off"

5. Modify the waveform.

- When you press waveform select key [FUNCTION], the waveform display flashes.
- When you turn [MODIFY] dial, the waveform is switched.

☞ "3.5.6 Select Waveform"

6. Change the frequency.

- When you press frequency setting key [FREQUENCY], any of the digits of the frequency display flashes.
- When you press cursor movement keys [◀]/[▶], the flashing digit moves.
- When you turn modify dial [MODIFY], the number in the flashing digit increases/decreases and the frequency is changed.

☞ "3.5.4 Set Frequency"

7. Modify the amplitude.

- When you press amplitude/DC offset setting key [AMP/OFS], any of the digits of the amplitude display flashes.
- When you press cursor movement keys [◀]/[▶], the flashing digit moves.
- When you turn [MODIFY] dial, the number in the flashing digit increases/decreases and the amplitude is modified.

☞ "3.5.5 Set Amplitude and DC Offset"

8. Modify the DC offset.

- When you press amplitude/DC offset setting key [AMP/OFS] again, any of the digits of the DC offset display flashes.
- When you press cursor movement keys [◀]/[▶], the flashing digit moves.
- When you turn [MODIFY] dial, the number in the flashing digit increases/decreases and the DC offset is modified.

☞ "3.5.5 Set Amplitude and DC Offset"

To make full use of a variety of functions of the equipment safely, reading through the instruction manual at least once is recommended.

2.5 Calibration

Perform the performance test described in "7.5 Performance Test" at least once every year for the DF1906, which may vary depending on the operating environment and frequency.

Furthermore, it is recommended to perform the performance test before using the equipment for important measurements and tests.

If the performance test results do not satisfy the standards, NF Corporation will perform adjustment or calibration to restore the original performance.

If calibration is required, contact NF Corporation or one of our agents.

Charges apply for the calibration service.

3. Explanation of Panels and Basic Operations

3.1 Panel Part Names and Operations	3-2
3.2 Display at Power On and Initial Settings.....	3-5
3.2.1 Before Powering On	3-5
3.2.2 Display at Power On	3-6
3.2.3 Initial Settings	3-6
3.3 I/O Connector.....	3-8
3.3.1 Output Connector.....	3-8
3.3.2 Input Connector	3-11
3.4 I/O Connection	3-12
3.5 Basic Operations.....	3-13
3.5.1 Display	3-13
3.5.2 Set Numeric Value.....	3-13
3.5.3 Select Setting Value.....	3-14
3.5.4 Set Frequency.....	3-14
3.5.5 Set Amplitude and DC Offset.....	3-15
3.5.6 Select Waveform.....	3-16
3.5.7 Select Oscillation Mode	3-16
3.5.8 Select Output On/Off.....	3-17

3.1 Panel Part Names and Operations

This section describes the front panel and rear panel part names and operations of the DF 1906.

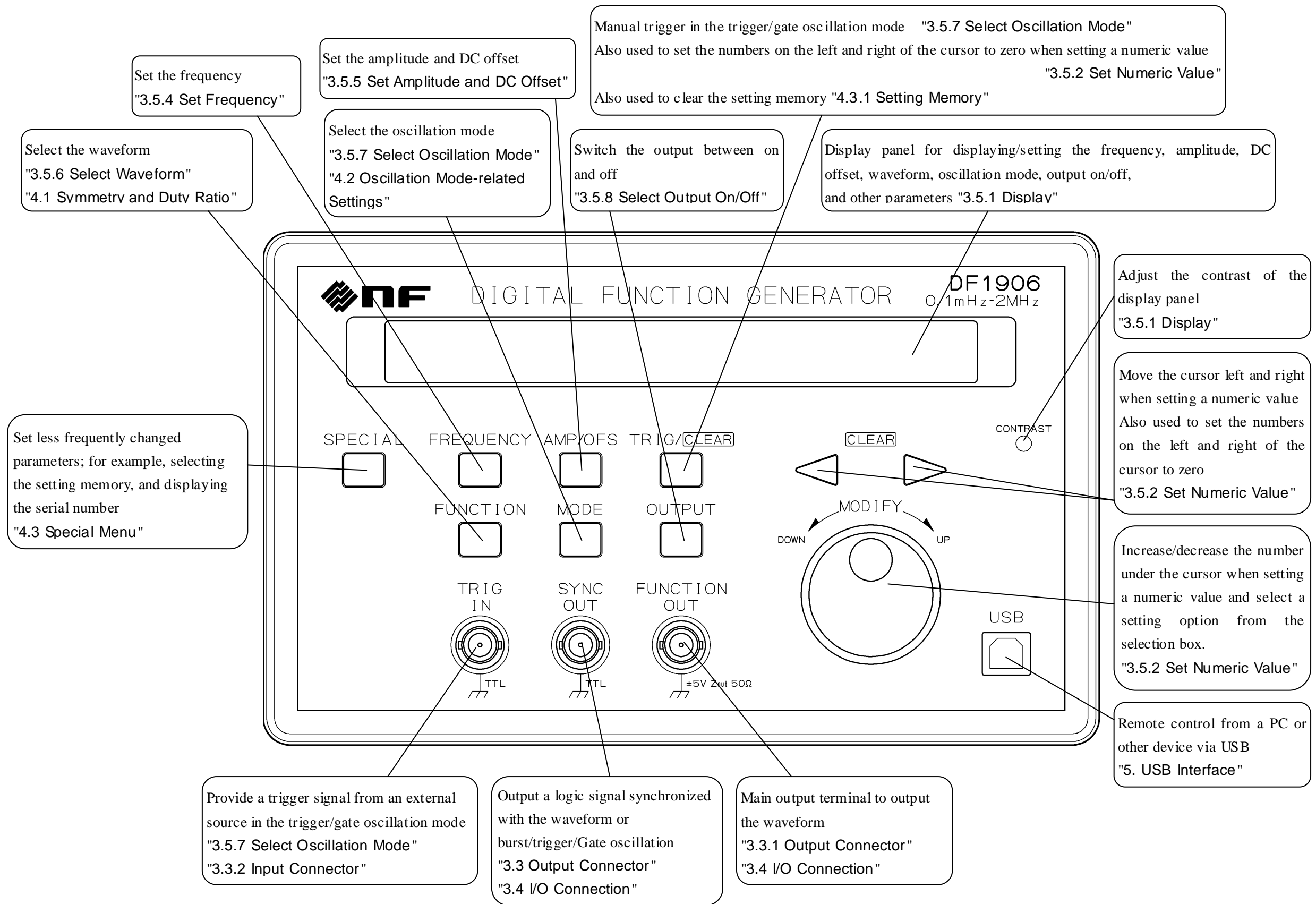
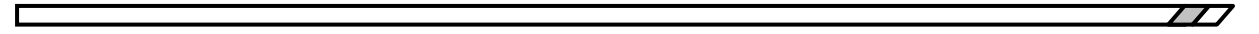


Figure 3-1 Front Panel

Rear Panel



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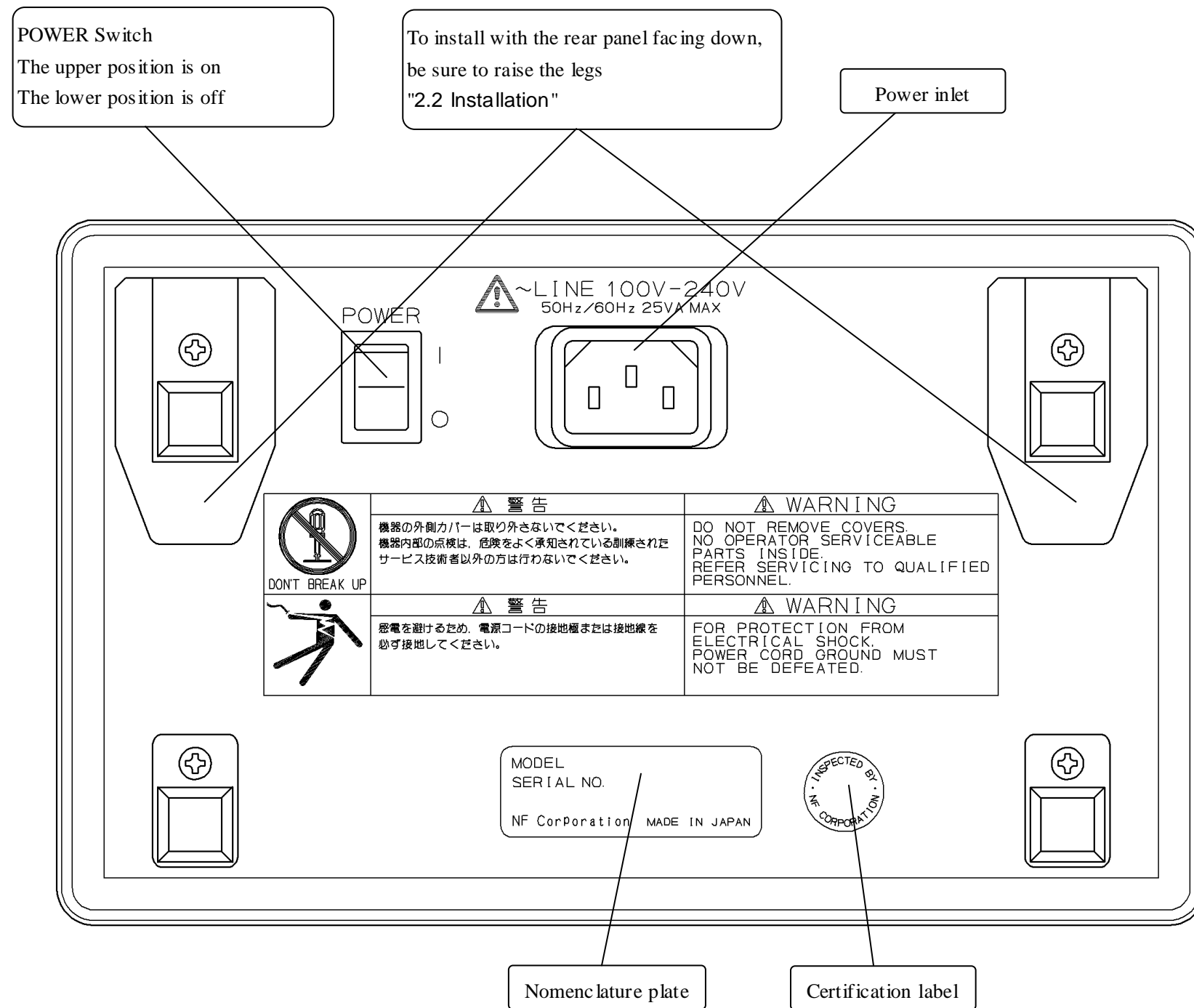
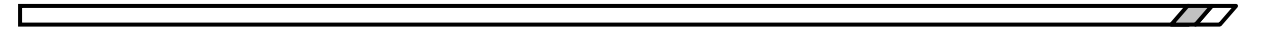


Figure 3-2 Rear Panel

Rear Panel



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3.2 Display at Power On and Initial Settings

3.2.1 Before Powering On

The DF 1906 operates from the following power outlet.

Power supply voltage range: 100 V to 240 V AC \pm 10%, 250 V or less

Power supply frequency range: 50/60 Hz \pm 2 Hz

The maximum power consumption is 25 VA.

CAUTION

To prevent damage to the DF 1906, check that the voltage of the power outlet is within the power supply voltage of the DF 1906 and then connect to the power outlet.

WARNING

Take the following precautions to avoid risk of electric shock.

Before making connections for measurement, be sure to connect the protective ground terminal to an earth ground.

The protective ground terminal of the DF 1906 is a grounding pin of the 3-pin power cord.

Be sure to insert the power plug into a 3-pin power outlet with a protective ground contact.

Before connecting the power cord, check that the power switch is off.

When turning the power off and then back on, wait at least 5 seconds before turning the power back on.

CAUTION

When turning the power off and then back on, wait at least 5 seconds before turning the power back on.

If turning on and off is repeated in a short time, the equipment may malfunction.

Take the following steps to turn on the power.


- Check that the power switch is off.
- Connect the power cord to the power inlet on the rear panel.
- Insert the plug of the power cord into a three-pin power outlet.
- Push the power switch up to the on position to turn on the equipment.

{

 Push the power switch to the up position to turn on the power.
 Push the power switch to the down position to turn off the power.

}

When the power is turned on, the start message appears on the display panel and the equipment is ready for operation.

Display when the power is turned on  "3.2.2 Display at Power On"

3.2.2 Display at Power On

First prepare for use according to the instructions in "2. Preparation Before Use".

When the power switch is set to on, first "■" is displayed to test the display panel. Check that the display has no missing pixels.

Then "DF 1906" and version are displayed in the right part of the display panel. A self-check of ROM and RAM is performed during this display. If an error is detected in ROM/RAM, the following messages are displayed.

- ROM error: "ROM CHECK ERROR"
- RAM error: "RAM CHECK ERROR"

Check that the conditions described in "Installation Conditions" in "2.2 Installation" are satisfied.

Turn off the power once, wait for at least 5 seconds, and then turn the power back on. If this message is still displayed, there is a failure. Contact NF Corporation or one of our agents.

- RAM error: "BACKUP MEMORY LOST"

This message is displayed when the battery is depleted and data cannot be stored, or when backup data is damaged for some reason.

Check that the conditions described in "Installation Conditions" in "2.2 Installation" are satisfied. If this message is displayed frequently, the battery must be replaced (for a fee). Contact NF Corporation or one of our agents.

If this message is displayed, the settings are initialized and the system is restarted.

Initialization Details ☞ "3.2.3 Initial Settings"

Other errors ☞ "6.1 Error Messages"

If there is no error when the power is turned on, the settings when the power was last turned off are automatically restored with this equipment.

(For output on/off, select any of the following options in advance: Restore to the state when power was last turned off, Always on, and Always off.)

If you want to start operation in the initial state, perform the following initialization operation.

- Press special menu key [SPECIAL] and check that "Memory" is displayed on the LCD display panel.
- Press [TRIG / CLEAR] key and check that "CLEAR" is displayed on the display panel.

Details of initialization ☞ "3.2.3 Initial Settings"

3.2.3 Initial Settings

The settings of the DF 1906 are the initial settings in the following cases.

- At the time of shipment from the factory
- When backup data is damaged when power is turned on

☞ "3.2.2 Display at Power On"

When settings are initialized by the memory clear operation (panel key operation or remote control)

☞ "4.3.1 Setting Memory"

Detail of initialization ☞ "Table 3-1 Initial Settings"

Table 3-1 Initial Settings

The initial setting values are shown in the table below.

Setting item	Initial value	Factory default or data failure	Memory initialized
Frequency	1kHz	○	○
Cursor position	1Hz digit	○	○
Unit	kHz	○	○
Amplitude	1 Vp-p	○	○
Cursor Position	0.1V digit	○	○
Unit	Vp-p	○	○
DC offset	0V	○	○
Cursor position	0.1V digit	○	○
Waveform	Sine Wave	○	○
Ramp wave symmetry	50%	○	○
Cursor position	1% digit	○	○
Square wave duty ratio	50%	○	○
Cursor position	1% digit	○	○
Arbitrary waveform	Select number	○	○
Arbitrary waveform data	All 0	○	—
Oscillation mode	Continuous Oscillation	○	○
Mark wave number	1.0	○	○
Cursor position	1 digit	○	○
Space Wave Number	1.0	○	○
Cursor Position	1 digit	○	○
SYNC OUT	PHASE	○	○
Phase	0 °	○	○
Cursor position	1 ° digit	○	○
TRIG IN Polarity (Trigger)	Fall	○	○
TRIG IN Polarity (Gate)	Low level	○	○
Special menu	Select setting memory	○	—
Memory Contents of Unselected Memory	Initialized State	○	—
Output when power on	PREV	○	○
Load	/OPEN	○	○
High level/ Low level display	OFF	○	○
Output on/off	OFF	○	○

○ : Initialized — : Not initialized

3.3 I/O Connector

3.3.1 Output Connector

■ Waveform Output (FUNCTION OUT)

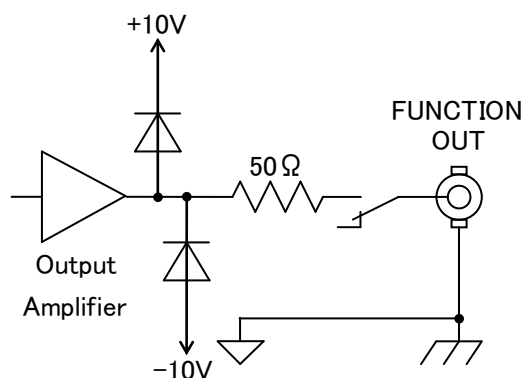


Figure 3-3 FUNCTION OUT

Maximum Output Voltage	: ± 5 V/open, ± 2.5 V/ 50Ω
Output Impedance	: 50Ω , unbalanced
Load Impedance	: 45Ω or more
State when Output Is Off	: Open when the output is off

CAUTION

Do not short-circuit the output and do not apply a signal from outside.
The DF 1906 may be damaged.

• About Output Limit

If the output voltage exceeds ± 5 V/open (± 2.5 V/ 50Ω), the output may be clipped depending on the relationship between the amplitude and DC offset setting values.

■ Synchronous Output (SYNC OUT)

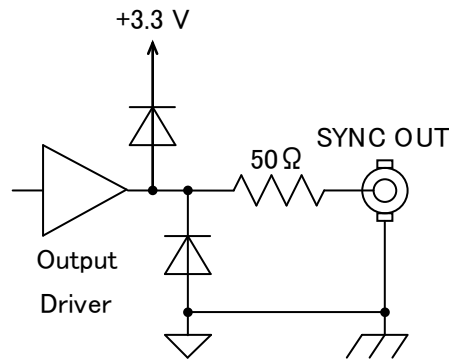


Figure 3-4 SYNC OUT

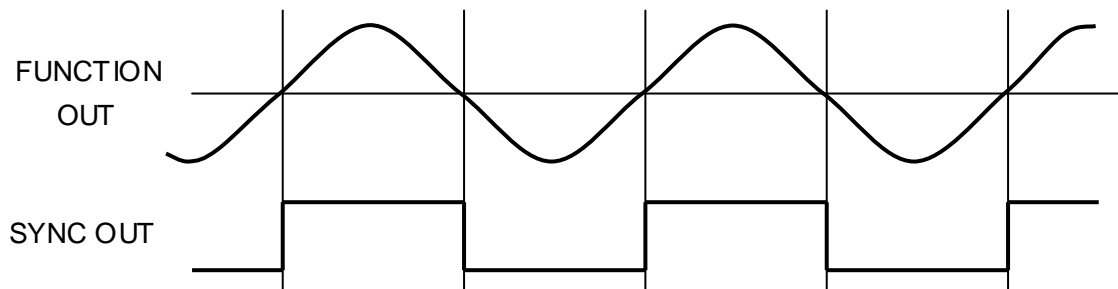
Output Waveform	: Square wave
Output Voltage	: 0 V/+3.3 V (when open)
Output Impedance	: 50 Ω, unbalanced
Load Impedance	: 45 Ω or more
State when Output Is Off	: High impedance when the output is off

⚠ CAUTION

Do not short-circuit the output and do not apply a signal from outside.
The DF 1906 may be damaged.

• At Time of Continuous Oscillation

The relationship between FUNCTION OUT signal and SYNC OUT signal at the time of continuous oscillation is as shown in the figure below.



Note: SYNC OUT signal has a jitter of approx. 150 ns p-p under the following conditions.

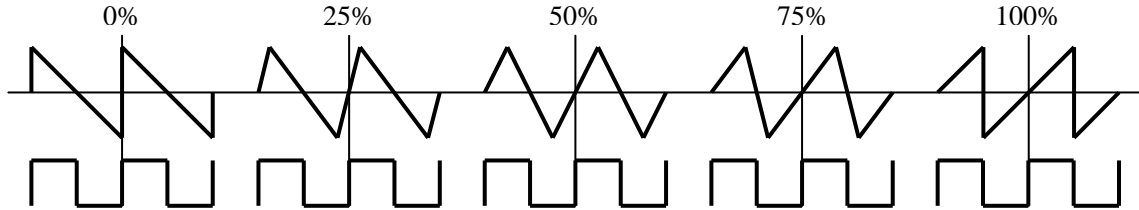
Sine wave and square wave at less than 1 kHz.

Ramp wave, ARB1 to ARB4.

Square wave with a duty ratio of other than 50%.

• Ramp Wave Symmetry Variable

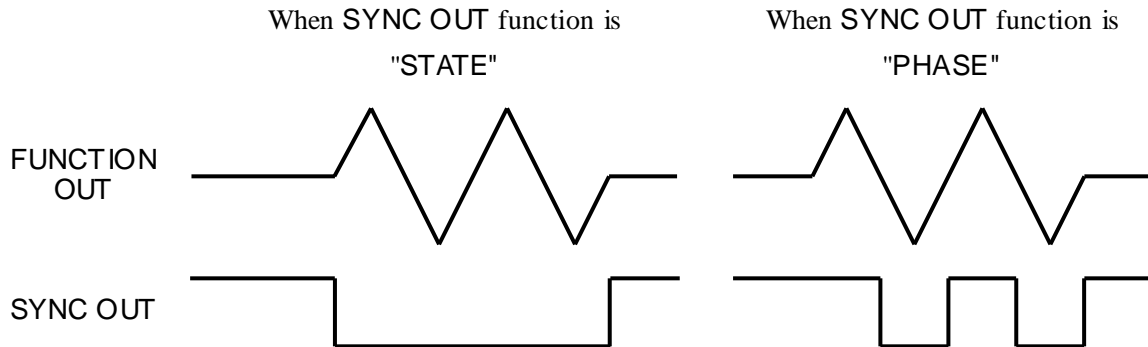
The relationship between FUNCTION OUT signal and SYNC OUT signal when the ramp wave symmetry is changed is as shown in the figure below. (Upper line: FUNCTION OUT, lower line: SYNC OUT)



• At Time of Burst/Trigger/Gate Oscillation

The relationship between FUNCTION OUT signal and SYNC OUT signal at the time of burst/trigger/gate oscillation is as shown in the figure below.

(The following figure shows an example of trigger oscillation for the following wave: Phase setting: 0°, waveform: Ramp wave with symmetry equal to 50%, and mark wave number: 2.0)



3.3.2 Input Connector

■ Trigger/Gate Input (TRIG IN)

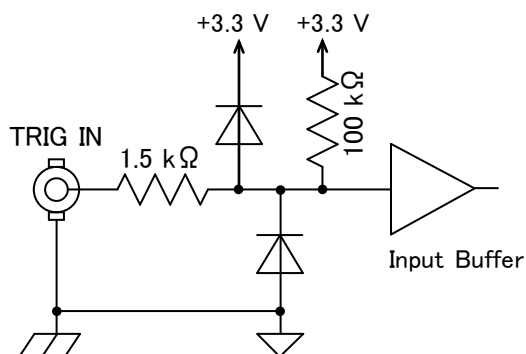


Figure 3-5 TRIG IN

Input Voltage : High Level $\geq +2.3$ V

Low Level $\leq +1.0$ V

Input Voltage Range : -0.5 V to +5.5 V

Minimum Pulse Width : 200 ns

CAUTION

Do not apply a voltage exceeding the above input voltage range.
The DF 1906 may be damaged.

3.4 I/O Connection

■ Waveform Output (FUNCTION OUT)

The output impedance of FUNCTION OUT connector is 50 Ω . (Open when the output is off.)

To maintain the flatness and waveform quality of the amplitude frequency characteristics, use a coaxial cable with a characteristic impedance of 50 Ω and terminate the input connector of the equipment to connect with 50 Ω .

If the frequency is low, it does not matter even if it is not terminated with 50 Ω .

Since the output impedance is 50 Ω , the output voltage that is actually output varies depending on the load impedance.

■ Synchronous Output (SYNC OUT)

The output impedance of SYNC OUT connector is 50 Ω . (High impedance when the output is off.)

To maintain the waveform quality, use a coaxial cable with a characteristic impedance of 50 Ω and terminate the input connector of the equipment to connect with 50 Ω .

3.5 Basic Operations

3.5.1 Display

The display panel of the DF 1906 is a 40-digit, two-line LCD and displays the items as shown in the figure below.

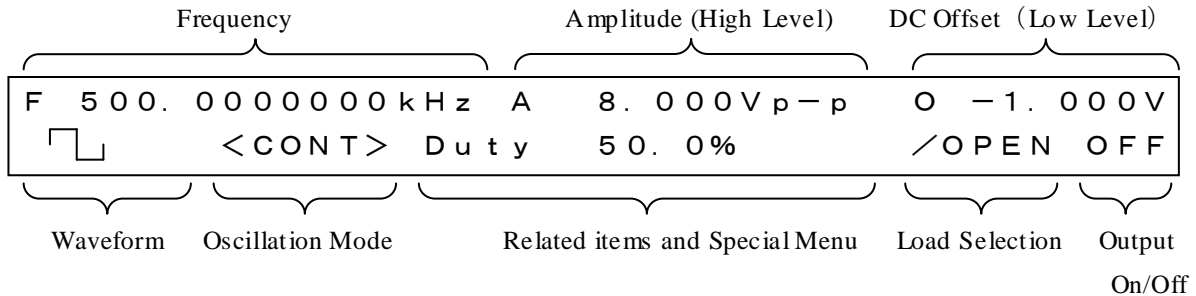


Figure 3-6 Display Panel

The contrast of the display can be adjusted by turning CONTRAST control in the lower right of the display panel.

3.5.2 Set Numeric Value

■ Cursor

The number in a particular digit position flashes in items where a numeric value is set, such as frequency and amplitude. This is called a cursor.

The cursor can be moved left and right using the [◀]/[▶] keys (cursor movement keys) in items where a numeric value is set. These keys have an auto-repeat function.

In addition, there are some items, where the cursor can be moved to subunits (such as M, k, or m) and units (V_{p-p} or V_{rms}).

■ Modify

When you turn the [MODIFY] dial, the numeric value in the digit position where the cursor is displayed increases/decreases.

However, you cannot specify a value outside the setting range.

When the cursor is displayed on a subunit or unit position, that subunit or unit can be changed.

■ Clear Numeric Value

When the cursor is located in the value position in an item where a numeric value is set and when you press the [CLEAR] key ([TRIG / CLEAR] key) while holding down either the [◀] key or [▶] key, the left/right of the digit position where the cursor is located is cleared to zero.

First, the cursor moves by one digit and the value, including the digit where the new cursor is displayed, is cleared. If the cursor is located at the end of the line from the beginning, the cursor does not move and the digit where the cursor is located is cleared.

If the cursor is not located on the value position, the numeric value cannot be cleared.

If you keep pressing the [◀] key or [▶] key, auto repeat works. When you want to clear the numeric value, press and release the [CLEAR] key quickly.

3.5.3 Select Setting Value

■ Cursor

The cursor is also displayed in the waveform and oscillation mode. However, the cursor is invalid.

■ Modify

When you turn the [MODIFY] dial, the option in the item where the cursor is displayed changes.

3.5.4 Set Frequency

When you press the frequency setting key [FREQUENCY], the cursor moves to the frequency setting value (on the right of the "F" display) on the display panel.

When you turn the [MODIFY] dial, the frequency can be set.

You can move the cursor position left and right using cursor movement keys ([◀]/[▶] keys).

When you operate the [MODIFY] dial, any of the following operations is performed depending on the cursor position.

- When the cursor is located in the value position, the value in that digit position increases/decreases.
- When the cursor is located in the subunit position (on the immediate left of "Hz"), the subunit is switched to another one.

◎ Example of an operation to set the frequency to 500 kHz

- Press the [FREQUENCY] key to enter the frequency setting mode.
- Press the [◀] key to move the cursor to 100 kHz.
- If the digit after 10 kHz is not zero, press and release the [TRIG / CLEAR] key quickly while holding down the [▶] key to clear the value. Then, press the [◀] key to move the cursor back to 100 kHz.
- Turn the "MODIFY" dial to change "1" in 100 kHz to "5."

◎ Example of an operation to set the frequency display to unit kHz

- Press the [FREQUENCY] key to enter the frequency setting mode.
- Press the [▶] key to move the cursor to the position immediately left of Hz on the right of the value part.
- Turn the [MODIFY] dial to switch between Hz / kHz / MHz / mHz.

Frequency setting range: 0.1 mHz to 2 MHz, resolution: 0.1 mHz.

The rated frequency for a ramp wave, square wave with a duty rate of other than 50%, arbitrary waveform, and burst/trigger/gate oscillation mode is up to 50 kHz, but up to 2 MHz can be set.

When cursor is located here,

set the frequency

When cursor is located here,

select the subunit

F	500.	0000000	<u>k</u> Hz	A	8.000V	p-p	0	-1.000V
□	<CONT>	Duty	50.0%	/OPEN	OFF			

3.5.5 Set Amplitude and DC Offset

"Amplitude" indicates the AC amplitude of an output signal, and "DC offset" indicates the median of an output signal.

When H (High Level) and L (Low Level) are displayed,
 ☞ "4.3.4 Set by High Level/Low Level"

For load setting, ☞ "4.3.3 Select Load"

When you press amplitude/offset setting key [AMP/OFS], the cursor moves to the amplitude setting value (on the right of the "A" display) on the display panel. When you press the key once again, the cursor moves to the DC offset setting value (on the right of the "O" display) on the display panel. (In the DC mode, the amplitude is zero and the cursor moves to the DC offset setting value.)

Amplitude setting range: 0 to 10 Vp-p/open (0 to 5 Vp-p/50 Ω), resolution: 1 mV. (Resolution is 1 mV, regardless of the Vp-p/Vrms setting and load setting.)

DC offset setting range: ±5 V/open (±2.5 V/50 Ω), resolution: 1 mV. (Resolution is 1 mV, regardless of the load setting.)

When you turn the [MODIFY] dial when the cursor is located in the amplitude setting value position, the amplitude can be set. When you turn the [MODIFY] dial when the cursor is located in the DC offset setting value position, the DC offset can be set.

You can move the cursor position left and right using cursor movement keys ([◀]/[▶] keys).

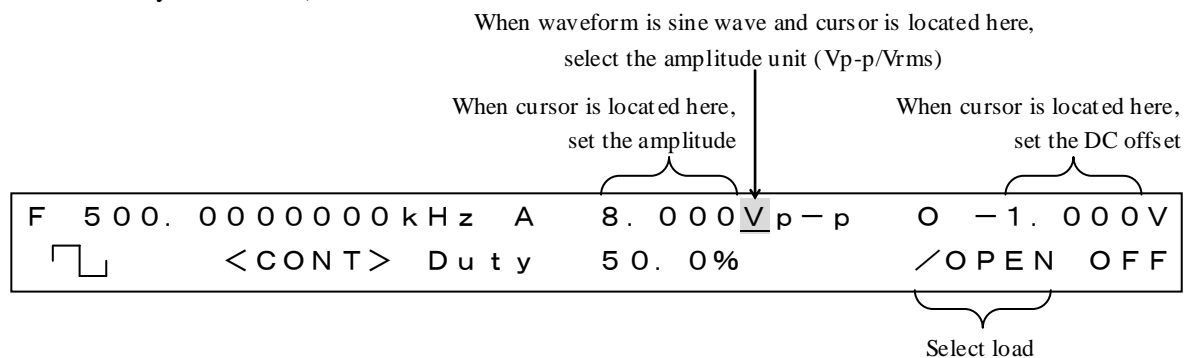
When you operate the [MODIFY] dial, any of the following operations is performed depending on the cursor position.

- When the cursor is located in the value position, the value in that digit position increases/decreases.
- When the cursor is located in the amplitude unit position (Vp-p/Vrms display) (only when the waveform is a sine wave),
 the units are toggled between Vp-p (peak-peak voltage) and Vrms (effective voltage).

◎ Example of an operation to set the amplitude to 2 Vrms

- Press the [AMP/OFS] key to enter the amplitude setting mode.
- Press the [▶] key to move the cursor to Vp-p.
- Turn the [MODIFY] dial to switch to Vrms.
- Press the [◀] key to move the cursor to 1 Vrms.
- If the digit after 1 Vrms is not zero, press and release the [TRIG / CLEAR] key quickly while holding down the [▶] key
 to clear the value. Then, press the [◀] key to move the cursor back to 1 Vrms.
- Turn the [MODIFY] dial to change "1" in 1 Vrms to "2".

If the maximum signal output with open load exceeds ±5 V as a result of the amplitude/DC offset setting, the output may be clipped. The maximum output can be expressed as ±{ (amplitude [Vp-p]÷2)+ |DC offset [V]| }. (Except for when the positive and negative maximum waveform data value is not used in arbitrary waveforms)



3.5.6 Select Waveform

The DF 1906 allows you to select a total of 8 types of waveforms: sine wave/ramp wave/square wave/DC, as well as 4 types of arbitrary waveforms (ARB).

When you press waveform selection key [FUNCTION], move the cursor to the waveform display, and turn the [MODIFY] dial, the waveform can be selected.

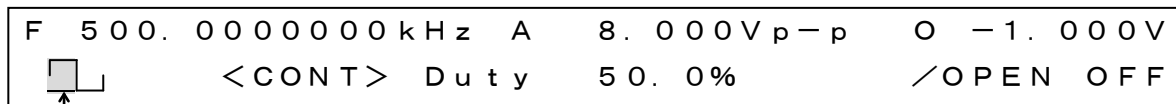
The waveform is displayed in the lower left part of the display for the sine wave/ramp wave/square wave. Only for a ramp wave with a symmetry of other than 50% or a square wave with a duty ratio of other than 50%, "Var" is also displayed on the right of the waveform display.

Set Symmetry ⚙ "4.1.1 Set Symmetry (Ramp wave)"

Set Duty Ratio ⚙ "4.1.2 Set Duty Ratio (Square wave)"

For example, "<ARB1>" to "<ARB4>" are displayed in the lower left part of the display for arbitrary waveforms 1 to 4.

Write Arbitrary Waveform Data ⚙ "5. USB Interface"



When cursor is located here, select the waveform

Symmetry when waveform is ramp wave, duty ratio when waveform is square wave

When the waveform is set or changed, oscillation stops while it is being set or changed.

3.5.7 Select Oscillation Mode

The DF 1906 allows you to select the three modes: burst/trigger/gate oscillation, in addition to the continuous oscillation.

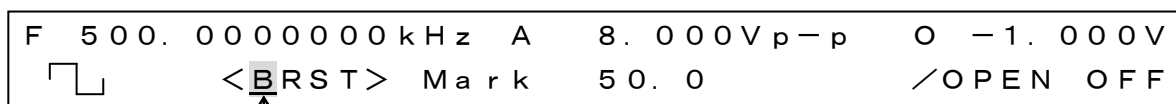
When you press oscillation [MODE] key, move the cursor to the oscillation mode display, and turn the [MODIFY] dial, the oscillation mode can be selected.

The oscillation mode is displayed as follows.

- "<CONT>" Continuous oscillation: Outputs the selected waveform continuously.
- "<BRST>" Burst oscillation: Repeats the mark wave number oscillation and space wave number stop.
- "<TRIG>" Trigger oscillation: Performs mark wave number oscillation when a trigger is activated.
- "<GATE>" Gate oscillation: Performs oscillation while a gate signal is input.

The following can be used for a trigger for trigger oscillation and for a gate signal for gate oscillation.

- [TRIG / CLEAR] key on the front panel (enabled when the key is pressed)
- External trigger input connector TRIG IN (the effective polarity can be switched)
- Command from remote control ⚙ "5. USB Interface"



When cursor is located here, select the oscillation mode

In burst/trigger/Gate oscillation mode, related items such as phase are displayed/set

The burst/trigger/gate oscillation stops in the set phase when the oscillation is stopped.

Set Phase ☞ "4.2.4 Set Phase"

The oscillation wave number (mark wave number) can be set for burst/trigger oscillation.

Set Oscillation Wave Number ☞ "4.2.1 Set Mark Wave Number"

The stop wave number (space wave number) can be set for burst oscillation.

Set Stop Wave Number ☞ "4.2.2 Set Space Wave Number"

The SYNC OUT function can be selected for burst/trigger/gate oscillation.

Select SYNC OUT Function ☞ "4.2.3 Select SYNC OUT Function"

The effective polarity for a signal that is input to the TRIG IN connector can be selected for trigger/gate oscillation.

Select TRIG IN Polarity ☞ "4.2.5 Select TRIG IN Effective Polarity (Trigger Oscillation)",
"4.2.6 Select TRIG IN Effective Polarity (Gate Oscillation)"

3.5.8 Select Output On/Off

To switch the output between on and off, press output on/off key [OUTPUT].

This key performs toggle operation. Press the key to toggle between on and off.

The current state "ON" or "OFF" is displayed on the right end of the second line of the display panel.

When "ON" is displayed, a signal is output from FUNCTION OUT and SYNC OUT connectors.

When "OFF" is displayed, no signal is output. At this point, the signal line of the BNC connector for FUNCTION OUT is held open by a mechanical relay. SYNC OUT connector is held in high impedance state by a logic IC.

F	500.0000000	kHz	A	8.000	V p-p	0	-1.000	V
	<CONT>		Duty	50.0%	/OPEN OFF			

Output ON/OFF display

(Blank)

4. Advanced Operations

4.1 Symmetry and Duty Ratio	4-2
4.1.1 Set Symmetry (Ramp Wave)	4-2
4.1.2 Set Duty Ratio (Square Wave)	4-2
4.2 Oscillation Mode-related Settings	4-3
4.2.1 Set Mark Wave Number	4-3
4.2.2 Set Space Wave Number	4-3
4.2.3 Select SYNC OUT Function	4-4
4.2.4 Set Phase	4-4
4.2.5 Select TRIG IN Effective Polarity (Trigger Oscillation)	4-5
4.2.6 Select TRIG IN Effective Polarity (Gate Oscillation)	4-5
4.3 Special Menu	4-6
4.3.1 Setting Memory	4-6
4.3.2 Select Output at Power On	4-7
4.3.3 Select Load	4-7
4.3.4 Set by High Level/Low Level	4-8

4.1 Symmetry and Duty Ratio

4.1.1 Set Symmetry (Ramp Wave)

When the ramp wave is selected, the symmetry can be changed. When you press waveform select key [FUNCTION] once again while the cursor is located in the waveform display, the cursor moves to the symmetry setting value.

When you turn the [MODIFY] dial in this state, the symmetry setting can be changed.

You can select the digit where the setting is changed by moving the cursor position left and right using cursor movement keys ([◀]/[▶] keys).

Setting range: 0% to 100%, resolution: 0.1 %.

```

F   50. 0000000 kHz  A   8. 000V p-p   O  -1. 000V
  /  Var <CONT>  Symmetry  40. 0%   /OPEN OFF
  
```

"Var" is displayed when
symmetry is other than 50%

Symmetry is displayed/set when waveform is ramp wave

When the symmetry is set or changed, oscillation stops while it is being set or changed.

4.1.2 Set Duty Ratio (Square Wave)

When the square wave is selected, the duty ratio can be changed. When you press waveform select key [FUNCTION] once again while the cursor is located in the waveform display, the cursor moves to the duty ratio setting value.

When you turn the [MODIFY] dial in this state, the duty ratio setting can be changed.

You can select the digit where the setting is changed by moving the cursor position left and right using cursor movement keys ([◀]/[▶] keys).

Setting range: 0% to 100%, resolution: 0.1 %.

0% : Fixed to low level, 100% : Fixed to high level, no pulse.

When the duty ratio is other than 50%, there is a jitter of approx. 150 ns p-p.

Therefore, the pulse may disappear when the frequency is higher than the frequency below.

$$(68.7 \times \text{duty ratio} [\%]) [\text{kHz}] \quad (\text{at } 0\% \text{ to } 50\%)$$

$$(68.7 \times (100 - \text{duty ratio} [\%])) [\text{kHz}] \quad (\text{at } 50\% \text{ to } 100\%)$$

(Example: The pulse may disappear at a frequency of 6.87 kHz or more at 0.1% or 99.9%.)

```

F   50. 0000000 kHz  A   8. 000V p-p   O  -1. 000V
  /  Var <CONT>  Duty    99. 0%   /OPEN OFF
  
```

"Var" is displayed when
duty ratio is other than 50%

When waveform is square wave, duty ratio is displayed/set

When the duty ratio is set or changed, oscillation stops while it is being set or changed.

4.2 Oscillation Mode-related Settings

4.2.1 Set Mark Wave Number

When the burst oscillation or trigger oscillation is selected in the oscillation mode, the mark wave number can be changed. Mark wave number refers to the "oscillation wave number" for burst oscillation and trigger oscillation. When you press oscillation mode select key [MODE] several times, the cursor moves to the mark wave number setting value.

When you turn the [MODIFY] dial in this state, the mark wave number can be changed.

You can move the cursor position left and right using cursor movement keys ([◀]/[▶] keys) and you can select the digit where the setting is changed using the [MODIFY] dial.

The mark wave number setting range and resolution for burst oscillation are related to the space wave number.

When the space wave number is *.5, the setting range is 0.5 to 128.0, and the wave number can be set in increments of 0.5.

When the space wave number is *.0 or trigger oscillation is selected, the setting range is 0.5 to 256, and the wave number can be set in increments of 0.5 for less than 128, and in increments of 1 for 128 or more.

F	50.0000000 kHz	A	8.000 V p-p	O	-1.000 V
	<TRIG>	Mark	100.0	/	OPEN OFF

When oscillation is burst/trigger,
oscillation wave number is displayed/set

4.2.2 Set Space Wave Number

When the burst oscillation is selected in the oscillation mode, the space wave number can be changed. Space wave number refers to the "stop wave number" for burst oscillation. When you press oscillation mode select key [MODE] several times, the cursor moves to the space wave number setting value.

When you turn the [MODIFY] dial in this state, the space wave number setting can be changed.

You can move the cursor position left and right using cursor movement keys ([◀]/[▶] keys) and you can select the digit where the setting is changed using the [MODIFY] dial.

The setting range and resolution are related to the mark wave number.

When the mark wave number is *.5, the setting range is 0.5 to 128.0, and the wave number can be set in increments of 0.5.

When the mark wave number is *.0, the setting range is 0.5 to 256, and the wave number can be set in increments of 0.5 for less than 128, and in increments of 1 for 128 or more.

F	50.0000000 kHz	A	8.000 V p-p	O	-1.000 V
	<BRST>	Space	100.0	/	OPEN OFF

When oscillation is burst, stop wave number is displayed/set

4.2.3 Select SYNC OUT Function

When any of the burst oscillation/trigger oscillation/gate oscillation is selected in the oscillation mode, the SYNC OUT function can be changed. When you press oscillation mode select key [MODE] several times, "SyncOut" is displayed in the center of the lower line and the cursor moves to the top of it.


When you turn the [MODIFY] dial in this state, the SYNC OUT output function can be selected.

When "PHASE" is selected for the function, SYNC OUT connector outputs a signal synchronized with the waveform.

When "STATE" is selected for the function, SYNC OUT connector outputs a signal synchronized with the oscillation/stop state.

SYNC OUT Function Details

☞ "Synchronous Output (SYNC OUT)" in "3.3.1 Output Connector"

F	50.0000000	kHz	A	8.000	V p-p	0	-1.000	V
	<BRST>	S	y	n	c	O	u	t
			PHASE			/	OPEN	OFF

When oscillation is burst/trigger/Gate,
SYNC OUT function is displayed/selected

4.2.4 Set Phase


When any of the burst oscillation/trigger oscillation/gate oscillation is selected in the oscillation mode, the phase can be changed. When you press oscillation mode select key [MODE] several times, "Phase" is displayed in the center of the lower line and the cursor moves to the phase setting value.

When you turn the [MODIFY] dial in this state, the phase setting can be changed.

You can move the cursor position left and right using cursor movement keys ([◀]/[▶] keys) and you can select the digit where the setting is changed using the [MODIFY] dial.

Setting range: -180° to $+180^\circ$, resolution: 0.1° .

The phase set here is held in the oscillation stop state and the oscillation starts with this phase.

F	50.0000000	kHz	A	8.000	V p-p	0	-1.000	V
	<TRIG>	Phase	-180	.	0°	/	OPEN	OFF

When oscillation is burst/trigger/gate,
Oscillation start/stop phase is displayed/set


4.2.5 Select TRIG IN Effective Polarity (Trigger Oscillation)

When the trigger oscillation is selected in the oscillation mode, the effective polarity of the TRIG IN input connector can be changed. When you press oscillation mode select key [MODE] several times, "TrigSlope" is displayed in the center of the lower line and the cursor moves to the top of this display.

When you turn the [MODIFY] dial in this state, the effective polarity of the TRIG IN input connector can be selected.

When "↓" is selected for the function, the trigger oscillation starts with the falling edge of a signal that is input to the TRIG IN connector.

When "↑" is selected for the function, the trigger oscillation starts with the rising edge of a signal that is input to the TRIG IN connector.

F	50.0000000	kHz	A	8.000V	p-p	0	-1.000V
	<TRIG>	TrigSlope	↓	/OPEN OFF			

When trigger oscillation is selected,
the effective polarity of the TRIG IN connector is displayed/selected


4.2.6 Select TRIG IN Effective Polarity (Gate Oscillation)

When the gate oscillation is selected in the oscillation mode, the effective polarity of the the TRIG IN input connector can be changed. When you press oscillation mode select key [MODE] several times, "Gate" is displayed in the center of the lower line and the cursor moves to the top of this display.

When you turn the [MODIFY] dial in this state, the effective polarity of the TRIG IN input connector can be selected.

When "Lo" is selected for the function, the oscillation starts when the signal that is input to the TRIG IN connector is at a low level, and the oscillation stops when it is at a high level.

When "Hi" is selected for the function, the oscillation starts when the signal that is input to the TRIG IN connector is at a high level, and the oscillation stops when it is at a low level.

F	50.0000000	kHz	A	8.000V	p-p	0	-1.000V
	<GATE>	Gate	Hi	/OPEN OFF			

When gate oscillation is selected,
the effective polarity of the TRIG IN connector is displayed/selected

4.3 Special Menu

4.3.1 Setting Memory

■ Setting Memory Overview

The DF1906 has setting memory that can store 20 settings, out of which you can select the setting memory content to use.

When you change the frequency, amplitude, or other setting, the change is saved to the setting memory that is selected at that time.

■ Select Setting Memory

Press special menu key [SPECIAL] to enter the memory selection mode.

"Memory" is displayed in the center of the lower line in the memory selection mode and the cursor moves to the selected memory number. When you turn the [MODIFY] dial in this state and select the setting memory, the content of the selected memory is read and almost all the settings will change.

Setting memory 1 to 20 can be used.

When you store frequently used settings in each memory location, you can switch between the settings by selecting the setting memory.

■ Clear Setting Memory

Press special menu key [SPECIAL] to enter the memory selection mode.

"Memory" is displayed in the center of the lower line in the memory selection mode and the cursor moves to the selected memory number. When you press [TRIG / CLEAR] key in this state, the selected memory content (i.e. the current settings) is initialized and "CLEAR" is displayed.

Initial Settings Details when Memory is Cleared ☞ "Table 3-1 Initial Settings"

F	500.0000000	kHz	A	8.000V	p-p	O	-1.000V
	<CONT>	Memory	1	/OPEN OFF			

Memory is displayed/selected

F	1.0000000	kHz	A	1.000V	p-p	O	0.000V
	<CONT>	Memory	1	CLEAR	/OPEN OFF		

When memory is initialized, the result is displayed like this

4.3.2 Select Output at Power On

When the power of the DF 1906 is turned on, the settings of almost all items are restored to the settings at power off.

However, you can select the output on/off state at power on.

Press special menu key [SPECIAL] to enter the output selection mode at power on ("Poweron Out" is displayed in the center of the lower line).

When you turn the [MODIFY] dial in this state, the output at power on can be selected.

- PREV → Restore to the output state when power was last turned off at power on.
- OFF → Output is always turned off at power on.
Use this setting, for example, when there is danger if the output is automatically turned on at power on.
- ON → Output is always turned on at power on.

```

F 500.0000000 kHz A 8.000V p-p O -1.000V
┌┐ <CONT> Poweron Out PREV /OPEN OFF
    
```

Output on/off at power on is displayed/selected

4.3.3 Select Load

The setting values of amplitude/DC offset or high level/low depend on which of the load options, /OPEN or /50 Ω, is selected.

Press special menu key [SPECIAL] to enter the load selection mode ("Load" is displayed in the center of the lower line).

When you turn the [MODIFY] dial in this state, the load can be selected.

- NONE → Use the voltage value with open load. (/OPEN).
- 50Ω → Use the voltage value with 50 Ω termination. (/50 Ω).

In other than the load setting mode, you can know which is selected by the display on the right of the lower line.

The output impedance of the DF 1906 is 50 Ω, so the voltage with 50 Ω termination is half that with open load.

If the load is other than 50 Ω and the load impedance is X[Ω], the voltage is $\{X/(X+50)\}$ times the voltage with open load.

```

F 500.0000000 kHz A 8.000V p-p O -1.000V
┌┐ <CONT> Load NONE /OPEN OFF
    
```

Open load or 50 Ω termination is displayed/selected

Also displayed here

```

F 500.0000000 kHz A 4.000V p-p O -0.500V
┌┐ <CONT> Load 50Ω /50Ω OFF
    
```

When 50 Ω termination is selected, the result is displayed like this

4.3.4 Set by High Level/Low Level

The output voltage can be set by high level/low level, in addition to by amplitude/DC offset, to make it easy to set various logic levels, etc.

Press special menu key [SPECIAL] to enter the output voltage setting method selection mode ("AmpHi/Lo" is displayed in the center of the lower line).

When you turn the [MODIFY] dial in this state, the output voltage setting method can be selected.

- OFF → Set/display the output voltage by amplitude/DC offset.
- ON → Set/display the output voltage by high level/low level.

In other than the voltage setting selection mode, you can know which is selected by the display of the output voltage in the upper line.

- A/O → Set/display the output voltage by amplitude/DC offset.
- H/L → Set/display the output voltage by high level/low level.

F	500.	0000000	kHz	A	5.000V	p-p	O	2.500V
	<CONT>		AmpHi/Lo			OFF	/OPEN OFF	

Amplitude/DC offset or high level/low level is displayed/selected.

F	500.	0000000	kHz	H	5.000V		L	0.000V
	<CONT>		AmpHi/Lo			ON	/OPEN OFF	

When high level/low level is selected, the result is displayed like this.

5. USB Interface

5.1. Preparation Before Use	5-2
5.2 Command List.....	5-3
5.3 Explanation of Commands	5-6
5.3.1 Language Overview	5-6
5.3.1.1 Subsystem Commands	5-6
5.3.1.2 Path Separator	5-6
5.3.1.3 Command String Simplification	5-6
5.3.1.4 Suggestion Keyword	5-7
5.3.2 Detailed Explanation of Commands	5-7
5.4 Command Tree	5-15
5.5 Status System.....	5-16
5.5.1 Status Byte Register.....	5-17
5.5.2 Standard Event Status Register	5-18
5.6 Notes for Programming	5-19

5.1 Preparation Before Use

The DF1906 can be controlled by the USB Test and Measurement Class (hereinafter USB-TMC). Almost all panel operations can be controlled and internal conditions such as setting values and errors can be read.

- The USB connector is located on the front panel.
- USB is an interface that is supposed to be used in a relatively good environment. Avoid use in places with frequent power fluctuations or noise.

Install a USB-TMC class driver on the controlling PC and connect it with a commercially-available USB cable. The installation file of this driver can be downloaded from the National Instruments Corporation website. The following describes the operation procedure until the driver is installed.

1. Search for the VISA Run-time Engine page at the National Instruments Corporation website, or select "VISA driver downloads" at the following URL.
<http://www.ni.com/support/visa/>
2. Download VISA Run-time Engine from the VISA Run-time Engine page. At this point, you need to register yourself as a user. For VISA Run-time Engine, download Version 3.3 or later.
3. The downloaded file is a self-extracting file. Extract and install the file.
4. When the installation is completed successfully, the USB-TMC class driver is installed.

For details, refer to the National Instruments Corporation website.

5.2 Command List

Table 5-1 shows a DF 1906 Command List. Table 5-2 shows IEEE488.2 common commands corresponding to those in the DF 1906.

Symbols used in Table 5-2 have the meanings defined below. The lower-case characters in keywords indicate that they can be omitted.

- Square brackets ([]) indicate the keyword that can be omitted. (Suggestion keyword)
- Vertical bar (|) indicates that one keyword is selected from multiple keywords.

Table 5-1 DF1906 Command List

Function	Command
Output Frequency	[[:SOURce]:FREQuency[:CW[:FIXed]]
Amplitude	[[:SOURce]:VOLTagE[:LEVel[:IMMediate]][:AMPLitude]
Amplitude Display Unit	[[:SOURce]:VOLTagE:UNIT
DC Offset	[[:SOURce]:VOLTagE[:LEVel[:IMMediate]]:OFFSet
Output High Level	[[:SOURce]:VOLTagE[:LEVel[:IMMediate]]:HIGH
Output Low Level	[[:SOURce]:VOLTagE[:LEVel[:IMMediate]]:LOW
Waveform	[[:SOURce]:FUNctIon[:SHAPE]
Symmetry	[[:SOURce]:FUNctIon:RAMP:SYMMetry
Duty Ratio	[[:SOURce]:PULSe:DCYCLE
Select Arbitrary Waveform Number	[[:SOURce]:FUNctIon:USER
Transfer Arbitrary Waveform Data	:TRACe DATA[:DATA]
Oscillation Mode	[[:SOURce]:MODE
Mark Wave Number	[[:SOURce]:BURSt:NCYCles
Space Wave Number	[[:SOURce]:BURSt:SPACes
Phase	[[:SOURce]:PHASe
Burst Sync	:OUTPut:SYNC:TYPE
Trigger	:TRIGger[:SEQuence[:IMMediate]]
Trigger Polarity	:TRIGger[:SEQuence]:SLOPe
Gate Level	[[:SOURce]:BURSt:GATE:POLarity {NORMal INVerted}
Output On/Off	:OUTPut[:STATe]
Initialize Settings	:MEMory:STATe:DELete
Output at Power On	:SYSTem:PON[:OUTPut]
Select Load	:OUTPut:IMPedance
Error Query	:SYSTem:ERRor?

Table 5-2 Common Commands

Common Command and Query	Name	Function
*CLS	Clear Status Command	Clears the standard event status register.
*ESE	Standard Event Status Enable Command	Sets the standard event status enable register.
*ESE?	Standard Event Status Enable Query	Queries the setting of the standard event status enable register.
*ESR?	Standard Event Status Register Query	Queries the standard event status register.
*IDN?	Identification Query	Queries the ID information of the device.
*OPC	Operation Complete Command	Generates the operation complete message (OPC) of the standard event status register when the device operation is complete. * This equipment does not generate the OPC message. (Always 0)
*OPC?	Operation Complete Query	Returns 1 when the device operation is complete. * This equipment always returns 0.
*RST	Reset Command	Executes device reset. * This equipment performs the same process as the setting memory initialization.
*SRE	Service Request Enable Command	Sets the service request enable register.
*SRE?	Service Request Enable Query	Queries the setting of the service request enable register.
*STB?	Read Status Byte Query	Queries the status byte and master summary status bit.
*TRG	Trigger Command	Command to apply a trigger, which does not do anything in this equipment. (An error does not occur.) To set a trigger, use the TRIGger subsystem command.
*TST	Self Test Query	Executes the self test of the device and returns the result. * This equipment always returns 0.
*WAI	Wait to Continue Command	Puts the equipment into the wait state until all commands and queries that have been received before are finished. * This equipment does not do anything. (An error does not occur, either.)
*RCL	Recall Command	Reads the content of the specified setting memory.

■ **Input Buffer**

- Commands can be transmitted to the input buffer at one time until the capacity of the input buffer (10,000 characters) is reached.
- The transmitted commands are stored in the input buffer once and interpreted and executed one by one.
- If an invalid command is found at the time of interpretation and execution, an error occurs and the remaining commands are not executed.
- When the interpretation and execution are finished, the input buffer is cleared and the next commands can be input.

5.3 Explanation of Commands

5.3.1 Language Overview

The following describes an overview of the language.

5.3.1.1 Subsystem Commands

Commands are grouped into some sets of remote control commands corresponding to the function groups of this equipment. Each subsystem command has a hierarchical structure and a colon (:) is defined as the path separator.

5.3.1.2 Path Separator

A path separator (:) separates the current keyword from the next lower-level keyword. Every time a colon (:) is detected in the command string, the current path moves down one level.

However, if a colon (:) is used at the top of the command string, it means that the current path is set as the route. Note that the colon (:) at the top can be arbitrarily omitted.

If a semicolon (;) is used to separate the command string, the same level of subsystem command can be accessed without changing the current path.

:SOUR:FREQ 1000

↑ ↑ ↑

① ② ③

- ① Sets the current path as the route
- ② SOURce subsystem command (SOURce is a route command)
- ③ FREQuency command belonging to the SOURce subsystem

5.3.1.3 Command String Simplification

In the command structure, commands (including some parameters) are expressed in a combination of uppercase and lowercase alphabet letters. Out of which the uppercase alphabet letters represent an abbreviated form of the command. In the command syntax, commands are case-sensitive for convenience sake, but actually they are not case-sensitive. (1) to (3) below are all acceptable but (4) and (5) cause an error.

ex) **SOURce:FREQuency?**

- (1) SOUR:FREQ?
- (2) SOURCE:FREQUENCY?
- (3) sour:freq?
- (4) SOURC:FREQUE?
- (5) sou:frequency?

5.3.1.4 Suggestion Keyword

Keywords in square brackets indicate suggestion keywords which can be omitted. The equipment performs the same operation, regardless of whether the suggestion keywords are omitted or not. Command strings in (1) to (5) below make all the same settings for the equipment.

ex) **[[:SOURce]:VOLTage[:LEVeI][:IMMediate][:AMPLitude]**

- (1) :SOUR:VOLT:LEV:IMM:AMPL 10VPP
- (2) :VOLT:LEV:IMM:AMPL 10VPP
- (3) :VOLT:LEV 10VPP
- (4) :VOLT 10VPP
- (5) :SOUR:VOLT:AMPL 10VPP

5.3.2 Detailed Explanation of Commands

The following describes the function and command syntax of each of the commands listed in Table 5-1.

[Meaning of Symbols]

- Square brackets ([]) indicate the keyword that can be omitted. (Suggestion keyword)
- Curly brackets ({ }) enclose the parameter in the command string.
- Vertical bar (|) separates multiple keyword options.
- Angle brackets (< >) indicate that a numeric value needs to be specified.

[Remarks]

- The DF 1906 commands include both commands and queries. Herein both are called commands for convenience sake. "?" at the end of a keyword indicates a query.
- A response message to each command does not have a header.

- **[[:SOURce]:FREQuency[:CW|:FIXed] <frequency>**

[[:SOURce]:FREQuency?

Explanation: Sets/queries the frequency.

Parameter: Frequency

0.0001 (0.1 mHz) to 2000000.0000 (2 MHz)

Response: Returns the setting frequency in [Hz].

Numeric data is transferred as ASCII byte in NR2 format.

ex) **FREQ?**

100.0000

•[:SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude] <amplitude> VPP|VRMS
[:SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude]?

Explanation: Sets/queries the output voltage.

Parameter: Output voltage [Vp-p] or [Vrms]

0.000 (0 Vp-p) to 10.000 (10 Vp-p)

0.000 (0 Vrms) to 3.535 (3.535 Vrms)

Response: Returns the setting voltage in [Vp-p].

Numeric data is transferred as ASCII byte in NR2 format.

ex) VOLT?

10.000

Remark: The setting of voltage in Vrms is only valid when the sine wave is selected for the waveform type, but when a waveform other than the sine wave is selected, an error occurs.

•[:SOURce]:VOLTage:UNIT {VPP|VRMS}
[:SOURce]:VOLTage:UNIT?

Explanation: Sets/queries the display unit of the output voltage.

Parameter: Output voltage display unit

VPP

VRMS

Response: Returns VPP or VRMS.

ex) VOLT:UNIT?

VPP

Remark: The Vrms setting is only valid when the sine wave is selected for the waveform type, but when a waveform other than the sine wave is selected, an error occurs.

•[:SOURce]:VOLTage[:LEVel][:IMMediate]:OFFSet <offset>
[:SOURce]:VOLTage[:LEVel][:IMMediate]:OFFSet?

Explanation: Sets/queries the DC offset voltage.

Parameter: DC offset voltage [V]

-5.000 (-5 V) to +5.000 (+5 V)

Response: Returns the set DC offset voltage in [V].

Numeric data is transferred as ASCII byte in NR2 format.

ex) VOLT:OFFS?

5.000

•[:SOURce]:VOLTage[:LEVel][:IMMediate]:HIGH <high>

[:SOURce]:VOLTage[:LEVel][:IMMediate]:HIGH?

Explanation: Sets/queries the high-level voltage.

Parameter: High level [V]

-5.000 (-5 V) to +5.000 (+5 V)

Response: Returns the set high-level voltage in [V].

Numeric data is transferred as ASCII byte in NR2 format.

ex) VOLT:HIGH?

5.000

•[:SOURce]:VOLTage[:LEVel][:IMMediate]:LOW <low>

[:SOURce]:VOLTage[:LEVel][:IMMediate]:LOW?

Explanation: Sets/queries the low-level voltage.

Parameter: Low level [V]

-5.000 (-5 V) to +5.000 (+5 V)

Response: Returns the set low-level voltage in [V].

Numeric data is transferred as ASCII byte in NR2 format.

ex) VOLT:LOW?

-5.000

•[:SOURce]:FUNCtion[:SHAPE] {SINusoid|RAMP|SQUare|USER1|USER2|USER3|USER4|DC}

[:SOURce]:FUNCtion[:SHAPE]?

Explanation: Sets/queries the output waveform type.

Parameter: Output waveform type

SINusoid (Sine wave)

RAMP (Ramp wave)

SQUare (Square wave)

USER1 (Arbitrary wave 1)

USER2 (Arbitrary wave 2)

USER3 (Arbitrary wave 3)

USER4 (Arbitrary wave 4)

DC (DC output)

Response: Returns any of SIN, RAMP, SQU, USER1, USER2, USER3, USER4, and DC.

ex) FUNC?

SIN

•[:SOURce]:FUNCtion:RAMP:SYMMetry <symmetry>

[:SOURce]:FUNCtion:RAMP:SYMMetry?

Explanation: Sets/queries the symmetry of the ramp wave.

Parameter: Symmetry [%]

0.0 (0%) to 100.0 (100%)

Response: Returns the set symmetry in [%].

Numeric data is transferred as ASCII byte in NR2 format.

ex) FUNC:RAMP:SYMM?

50.0

•[:SOURce]:PULSe:DCYCLE <duty cycle>

[:SOURce]:PULSe:DCYCLE?

Explanation: Sets/queries the duty ratio of the square wave.

Parameter: Duty ratio [%]

0.0 (0%) to 100.0 (100%)

Response: Returns the set duty ratio in [%].

Numeric data is transferred as ASCII byte in NR2 format.

ex) PULS:DCYCL?

50.0

•[:SOURce]:FUNCtion:USER <arb number>

[:SOURce]:FUNCtion:USER?

Explanation: Sets/queries the arbitrary waveform number for transferring the arbitrary waveform data.

Parameter: Arbitrary waveform number

1 to 4

Response: Returns the selected arbitrary waveform number.

Numeric data is transferred as ASCII byte in NR1 format.

ex) FUNC:USER?

1

·:TRACe[DATA[:DATA] <binary block>

Explanation: Prepares for transferring the arbitrary waveform data. When this command is set and then a binary data block is transferred, it is recorded as arbitrary waveform data in the waveform memory.

Parameter: Transfer data length, Use "#48192."

This has the following meaning.

- # The first character of the parameter is "#."
- Parameter length Any one character ("1" to "9") after "#" indicates the length (number of digits) of the parameter.
- Data length The number string indicated by the parameter length indicates the length of the data (byte number) to be transferred. Be sure to specify 4096 words (8192 bytes).

ex) Prepare for transferring 4096-word (8192-byte) arbitrary waveform data.

TRAC #48192

Note: The length of the waveform data that can be transferred at one time is fixed to 4096 words. Transfer a 4096-word binary data block.

·[:SOURce]:MODE {CONT|BRST|TRIG|GATE}

[:SOURce]:MODE?

Explanation: Sets/queries the oscillation mode.

Parameter: Oscillation mode

- CONT (Continuous oscillation)
- BRST (Burst oscillation)
- TRIG (Trigger oscillation)
- GATE (Gate oscillation)

Response: Returns any of CONT, BRST, TRIG, and GATE.

ex) MODE?

CONT

·[:SOURce]:BURSt:NCYCles <num mark>

[:SOURce]:BURSt: NCYCles ?

Explanation: Sets/queries the oscillation wave number for burst oscillation and trigger oscillation.

Parameter: Oscillation wave number

0.5 to 256

Response: Returns the set oscillation wave number.

Numeric data is transferred as ASCII byte in NR2 format.

ex) BURS:NCYC?

10.0

Remark: The oscillation wave number can be set in increments of 0.5 wave for burst oscillation when both the mark wave number and space wave number are 128 or less.

·[:SOURce]:BURSt:SPACes <num space>

[:SOURce]:BURSt:SPACes?

Explanation: Sets/queries the stop wave number for burst oscillation.

Parameter: Stop wave number

0.5 to 256

Response: Returns the set stop wave number.

Numeric data is transferred as ASCII byte in NR2 format.

ex) BURS:SPAC?

10.0

Remark: The stop wave number can be set in increments of 0.5 wave for burst oscillation when both the mark wave number and space wave number are 128 or less.

·[:SOURce]:PHASe <phase>

[:SOURce]:PHASe?

Explanation: Sets/queries the oscillation stopping phase for burst oscillation, etc.

Parameter: Phase [deg]

-180.0(-180deg) to +180.0(+180deg)

Response: Returns the set phase in [deg].

Numeric data is transferred as ASCII byte in NR2 format.

ex) PHAS?

90.0

·:OUTPut:SYNC:TYPE {PHASe|STATe}

:OUTPut:SYNC:TYPE?

Explanation: Sets/queries the SYNC OUT output type.

Parameter:

PHASe (Waveform synchronous output)

STATe (Oscillation state synchronous output)

Response: Returns PHAS or STAT.

ex) OUTP:SYNC:TYPE?

PHAS

·:TRIGger[:SEQuence][:IMMediate] {0|1}

Explanation: Controls the trigger or gate signal.

Parameter:

In trigger mode

0 (No change)

1 (Trigger input)

In gate mode

0 (Gate off)

1 (Gate on)

·:TRIGger[:SEQuence]:SLOPe {POSitive|NEGative}

:TRIGger[:SEQuence]:SLOPe?

Explanation: Sets/queries the slope where the trigger input is validated.

Parameter:

POSitive (Rise)

NEGative (Fall)

Response: Returns POS or NEG.

ex) TRIG:SLOP?

POS

·[:SOURce]:BURSt:GATE:POLarity {NORMal|INVerted}

[:SOURce]:BURSt:GATE:POLarity?

Explanation: Sets/queries the level where the gate input is validated.

Parameter:

NORMal(HIGH)

INVerted(LOW)

Response: Returns NORM or INV.

ex) BURS:GATE:POL?

NORM

·:OUTPut[:STATe] {OFF|ON}

:OUTPut[:STATe]?

Explanation: Sets/queries the output on/off.

Parameter:

OFF (Output off)

ON (Output on)

Response: Returns 0 (OFF) or 1 (ON).

ex) OUTP?

1

·:MEMory:STATe:DELeTe

Explanation: Initializes the selected setting memory.

Parameter: None

·:SYSTem:PON[:OUTPut] {POFF|PON|LAST}

:SYSTem:PON[:OUTPut]?

Explanation: Sets/queries the output state immediately after power on.

Parameter:

POFF (Power off)

PON (Power on)

LAST (Output state at power off)

Response: Returns any of POFF, PON, and LAST.

ex) SYST:PON?

POFF

·:OUTPut:IMPedance {0|1}

:OUTPut:IMPedance?

Explanation: Sets/queries the load impedance for converting the amplitude/DC offset (Hi/Lo level) display value.

Parameter:

0 (open)

1 (50 Ω)

Response: Returns 0 or 1.

ex) OUTP:IMP?

1

·:SYSTem:ERRor?

Explanation: Queries the error state.

Parameter: None

Response: Returns the error number. Returns 0 if no error occurred.

Error Number ↗ “6.1.2 Errors of Remote Control via USB”

5.4 Command Tree

Figure 5-1 shows the command tree for each DF 1906 subsystem.

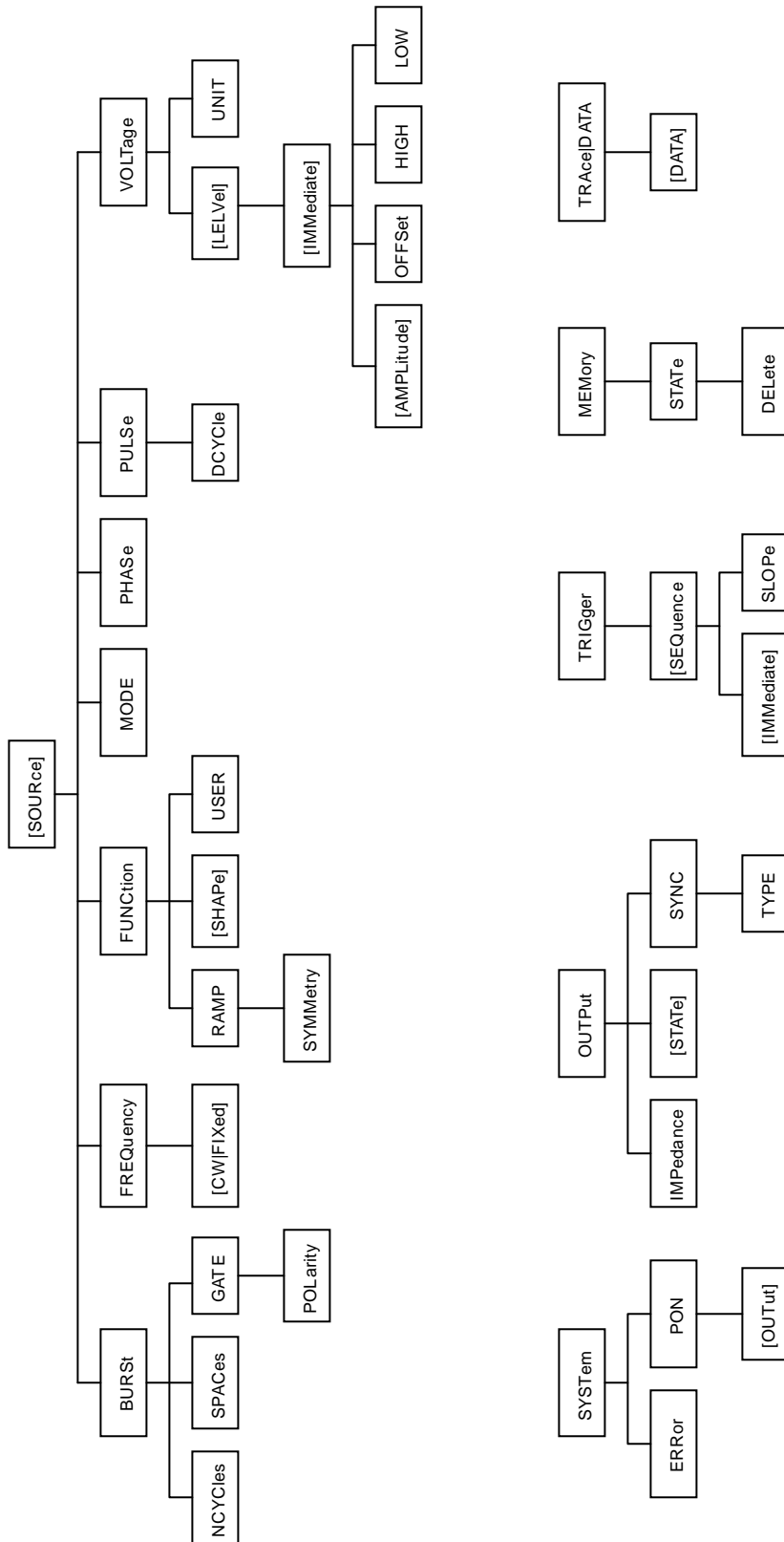


Figure 5-1 Command Tree

5.5 Status System

The DF1906 has a minimum set of status groups defined in IEEE488.2. Figure 5-2 shows a status system of the DF1906.

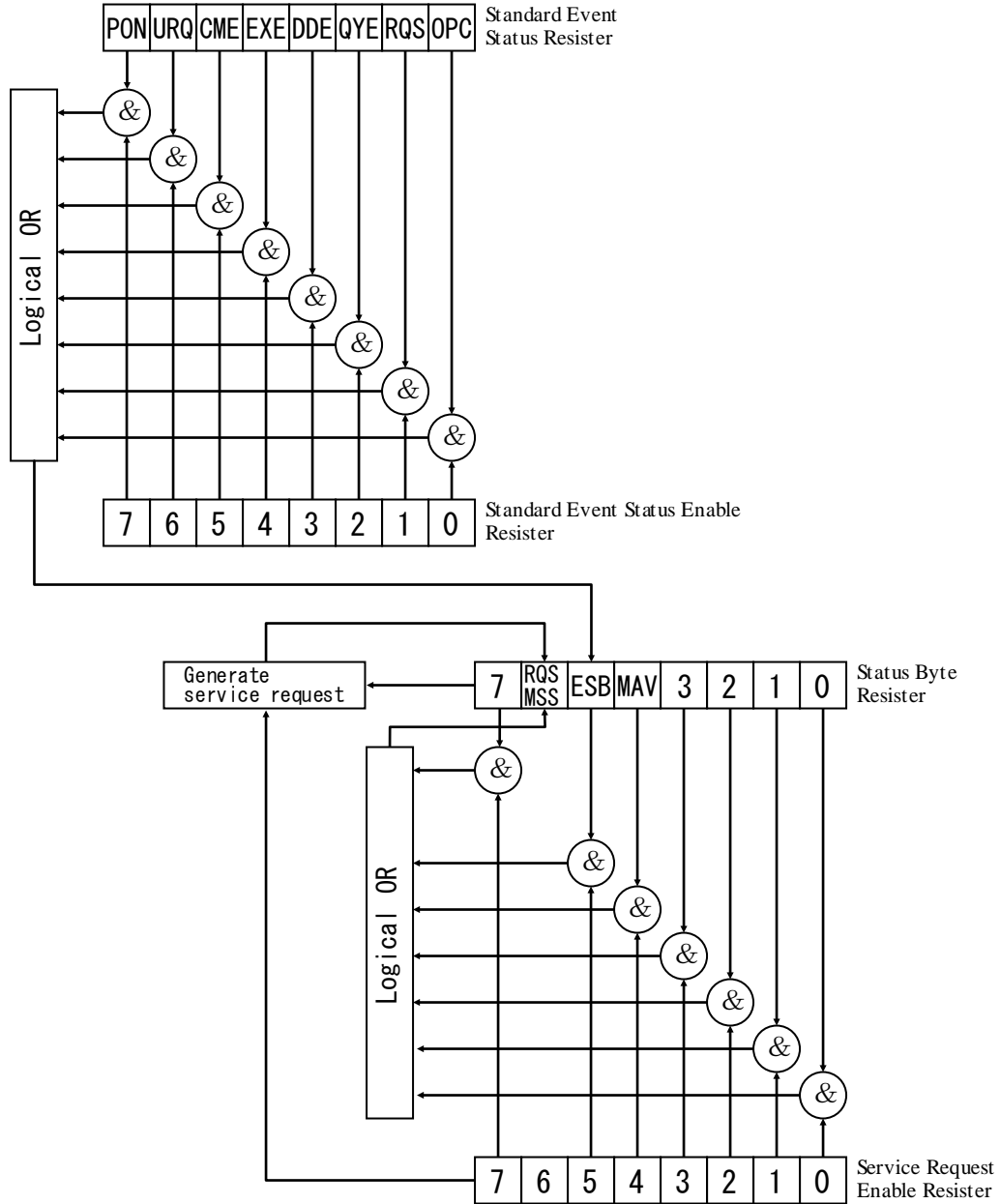


Figure 5-2 Status System

5.5.1 Status Byte Resister

Table 5-3 shows the definition of the status byte resister. The bits that are set to 1 are validated in the service request enable register and the status byte register uses the logical OR of the valid bits to generate a service request.

The status byte can be read by a serial poll or *STB? query.

Table 5-3 Definition of Status Byte Register

Bit	Weight	Description
7	128	Always 0 (unused)
RQS / MSS (6)	64	This is defined as RQS (Request Service) for serial poll and is used to inform the controller whether or not the equipment has generated a service request. When you perform serial poll, this bit is cleared to 0. This is defined as MSS (Master Status Summary) for *STB? query and acts as the summary bit of the status byte. MSS is not cleared until the cause of the valid bit is removed.
ESB (5)	32	ESB (Event Status Bit) acts as the summary bit of the standard event status resistor. When any of the valid bits of the standard event status resistor is set to 1, this is set to 1, and when all bits are set to 0, this is cleared to 0.
MAV (4)	16	When a response to the query is written to the response message queue and is ready for output, MAV (Message Available Bit) is set to 1. When the response message queue becomes empty, this is cleared to 0.
3	8	Always 0 (unused)
2	4	Always 0 (unused)
1	2	Always 0 (unused)
0	1	Always 0 (unused)

■ About Checking Status when Making Query

Normally when you just receive a response message after sending a query command for a query, you will be able to receive a response correctly. You do not necessarily need to check the MAV bit of the status byte. When you proceed with the operation while checking the MAV bit, send a query command, then perform serial poll to check that the MAV bit of the status byte is set to 1, then read the response message and check that the MAV bit is set to 0, and then proceed to the next operation.

5.5.2 Standard Event Status Register

Table 5-4 shows the definition of the standard event status register. When a bit in the standard event status enable register is set to 1, the corresponding bit in the standard event status register becomes effective, and when any effective bit in that register becomes 1, the ESB bit in the status byte register is set to 1.

The standard event status register can be read by an *ESR? query.

All bits are cleared by reading the register by an *ESR? query, or by using a *CLS command, or by turning the power back on. (However, the PON bit is set to 1 when the power is turned back on)

Table 5-4 Definition of Standard Event Status Register

Bit	Weight	Description
PON (7)	128	Power on bit This is set to 1 at power on. When this is cleared to 0 by reading the register, it remains 0 until the power is turned back on.
PON (6)	64	User request bit Always 0 (unused)
CME (5)	32	Command error When there is a syntax error in the program code, this is set to 1.
EXE (4)	16	Execution error When the parameter is outside the setting range, or when there is inconsistency in the setting, this is set to 1.
DDE (3)	8	Equipment definition error Always 0 (unused)
QYE (2)	4	Query error When an attempt is made to read data in an empty buffer for storing response messages or when data is lost in a buffer for storing response messages, this is set to 1.
RQC (1)	2	Request control Always 0 (unused)
OPC (0)	1	Operation complete When the processing of the OPC command is all finished, this is set to 1. * This bit is always 0 with this equipment .

5.6 Notes for Programming

■ Remote

There is no remote state for this equipment. The panel operation is possible while the equipment is controlled by a PC, so make sure that you do not accidentally change the settings by unintentional panel operation.

■ Arbitrary Waveform Data

Arbitrary waveform data is a binary data block, so transfer it separately from the proceeding command part of the ASCII program message. Be sure to specify 4096 words (8192 bytes) when transferring the arbitrary waveform data. If the data exceeds or falls short of that size, an error occurs or a correct waveform cannot output.

■ Note for Sending Commands from USB Interface

When sending a command, LF (0AH) must be added as a program message terminator to the end of the string to be sent. If a command is sent without adding LF, it will not work correctly.

(Blank)

6. Troubleshooting

6.1 Error Messages	6-2
6.1.1 Errors at Power On	6-2
6.1.2 Errors of Remote Control via USB.....	6-2
6.2 Troubleshooting.....	6-3

6.1 Error Message

If an error occurs during power-on self testing, an error message is displayed. If an incorrect setting is made from USB, an error message is displayed.

The following shows the content and cause of error messages and the necessary remedial action.

6.1.1 Power-On Errors

Error Message	Cause	Necessary Action
ROM CHECK ERROR	Internal ROM sum check error.	Contact NF Corporation or one of our agents.
RAM CHECK ERROR	Internal RAM read/write error.	
BACKUP MEMORY LOST	Data backed up by battery is damaged.	If this error message is still displayed after turning the power off and back on several times, the backup battery is depleted. Contact NF Corporation or one of our agents. The settings will be initialized and started again.

6.1.2 Errors of Remote Control via USB

Error Message	Error Content
ERR01:LIMIT OVER	Set parameter is out of the setting range.
ERR02:HEADER ERROR	Set command string name is invalid.
ERR03:SYNTAX ERROR	Set parameter number is invalid. Set parameter data format is invalid. Parameter is missing. Set command string format is invalid. Query function for the command used for a query is disabled. The top of the transfer data length set for transferring the arbitrary waveform data is not '#.' Set binary data size is not 8192 bytes.
ERR04:HALF WAVENUM X	Mark wave number of *.5 cannot be set because the space wave number is 129 or more. Space wave number of *.5 cannot be set because the mark wave number is 129 or more.
ERR05:FULL WAVENUM X	Mark wave number of 129 or more cannot be set because the space wave number is *.5. Space wave number of 129 or more cannot be set because the mark wave number is *.5.

Continue to the next page

Continued from the previous page

ERR06:RMS UNAVAILABLE	Amplitude in Vrms cannot be set because the waveform is not a sine wave. Vrms for the amplitude display unit cannot be set because the waveform is not a sine wave.
ERR07:BUFFER OVER	Set data exceeding 10,000 bytes at a time caused the command buffer to overflow. Buffer (256 bytes) for storing response messages overflowed.

6.2 Troubleshooting

If you suspect a problem, take any of the following remedial actions. If the problem still cannot be resolved, contact NF Corporation or one of our agents.

Description	Possible Cause	Remedial Action
Power cannot be turned on	Power source out of the rated range is used	Use a power source within the rated range
	Malfunction due to external noise, etc.	Install the equipment in a location with good environmental conditions.
Panel operation is not possible	Key or [MODIFY] dial is deteriorated	Contact NF Corporation or one of our agents for repair
Output value is abnormal	Warm-up is not sufficient	Allow the equipment to warm up for at least 2 hours after power on
	Ambient temperature and humidity are out of the performance guarantee range	Use the equipment in an environment within the specifications
	DC offset is applied	Set the DC offset to 0 V
	Vrms is used for the unit	Set Vp-p for the unit
	Load option is /50 Ω	Set /OPEN for the load option
Does not work as described in the instruction manual	Settings are not initialized (setting memory is not cleared)	Many of the descriptions presume settings have been initialized Initialize the settings

7. Maintenance

7.1 Preface	7-2
7.2 Daily Maintenance	7-2
7.3 Storage, Repacking, and Transportation	7-2
7.4 How to Check Version Number	7-3
7.5 Performance Test.....	7-3
7.5.1 Frequency Accuracy Test.....	7-4
7.5.2 Amplitude Frequency Characteristic Test	7-4
7.5.3 Sine Wave Distortion Test	7-4
7.5.4 Square Wave Duty Ratio Test	7-4
7.5.5 Amplitude Accuracy Test.....	7-5
7.5.6 DC Offset Accuracy Test.....	7-5
7.6 Calibration	7-6

7.1 Preface

The following maintenance tasks are required to keep the equipment in tip-top condition.

- Operation Inspection Check whether the equipment operates correctly.
- Performance Test Check whether the equipment satisfies the specified ratings.
- Adjustment and Calibration If the ratings are not satisfied, adjustment and calibration will be performed by NF Corporation to restore the original performance.
- Fault Repair If performance is not improved, NF Corporation checks the cause and location of the fault, and carries out repairs.

This instruction manual describes easy performance testing procedures.

For advanced inspection, adjustment, calibration and fault repair, contact NF Corporation or one of our agents.

The following measurement equipment is required for performance testing.

- Oscilloscope Bandwidth: 50 MHz or more
- Frequency counter Standard oscillator stability: within 0.5×10^{-6}
- AC voltmeter (high accuracy type) TrueRMS type, accuracy: within $\pm 0.2\%$,
Bandwidth: 50 kHz or more
- AC voltmeter (wide band type) TrueRMS type, relative accuracy: within $\pm 0.2\%$,
Bandwidth: 10 MHz or more
- DC voltmeter Accuracy: within $\pm 0.01\%$
- Distortion meter Full scale: 0.1% or less, frequency range: 100 kHz or more

7.2 Daily Maintenance

Install the DF 1906 in a location that satisfies the installation conditions.

Installation Conditions ☞ "Installation Conditions" in "2.2 Installation"

When the panel or case needs cleaning, wipe with a soft cloth. To remove persistent stains, wipe with a soft cloth soaked with neutral detergent and wrung out.

Do not use any organic solvents like thinner or benzene, or any chemical cleaning cloth, as they may cause the surface finish to deteriorate, tarnish, or come off.

7.3 Storage, Repacking, and Transportation

Store the DF 1906 in a location that satisfies the installation conditions.

Installation Conditions ☞ "Installation Conditions" in "2.2 Installation"

When repacking for transport, use a carton with adequate strength and enough space for sufficient padding to withstand the weight and protect the equipment.

During transport, handle with care to avoid strong impacts.

7.4 How to Check Version Number

The firmware version of the DF 1906 is displayed for several seconds in the lower right part at power on.

The version number can also be read by USB remote control query command "*IDN?".

Remote Control via USB ☞ "5. USB Interface"

7.5 Performance Test

A performance test is performed as part of preventative maintenance to prevent performance deterioration of the DF 1906.

A performance test is conducted when necessary to verify performance during acceptance inspection, periodic inspection, and after repair of the DF 1906.

If the specifications are not satisfied after a performance test, calibration or repair is required. Contact NF Corporation or one of our agents.

Before a performance test, check the following points.

- The voltage of the power line is 100 V to 240 V AC $\pm 10\%$, however, 250 V or less
- The ambient temperature is within $23 \pm 5^\circ\text{C}$.
- The ambient humidity is within 20 to 70% RH.
- No condensation.
- Warming up for at least 2 hours.

Observe the following points when performing a performance test.

- When use of a coaxial cable is specified, use a coaxial cable with a characteristic impedance of 50 Ω , with a thickness of RG-58A/U or more, with a length of 1 m or less, and with a BNC connector on both ends.
- When 50 Ω termination is specified, set the input of the measuring instrument to be connected to 50 Ω . If the input cannot be set to 50 Ω with your measuring instrument, attach a 50 Ω coaxial terminator (feed-through terminator) to the input of your measuring instrument.
- Before a performance test, initialize the settings and turn the output on.

Initialize Settings ☞ "Clear Setting Memory" in "4.3.1 Setting Memory"

7.5.1 Frequency Accuracy Test

Connection: FUNCTION OUT → Frequency counter input (50 Ω termination)

Use a coaxial cable.

Setting: Frequency 100 kHz, Amplitude 10 V_{p-p}/open, square wave after initializing the settings

Measurement: Measure the frequency with a frequency counter.

Judgment: ±25 ppm (99.9975 kHz to 100.0025 kHz) , Pass

However, an aging error (±5 ppm/year) occurs with those for which many years have elapsed since production.

7.5.2 Amplitude Frequency Characteristic Test

Connection: FUNCTION OUT → AC voltmeter (wide band type) (50 Ω termination)

Use a coaxial cable.

Setting: Amplitude 10 V_{p-p}/open after initializing the settings

Measurement: First, measure the voltage at 1 kHz and use the result as a reference value.

Change the frequency, measure the voltage, and convert it to a relative value [dB] from the reference value.

Judgment: ±0.2 dB (100 kHz or less), +1 dB/-3 dB (100 kHz to 2 MHz) , Pass

7.5.3 Sine Wave Distortion Test

Connection: FUNCTION OUT → Distortion meter (50 Ω termination)

Use a coaxial cable.

Setting: Amplitude 10 V_{p-p}/open after initializing the settings

Measurement: Change the frequency and measure the distortion.

Set the frequency bandwidth of the distortion meter to 500 kHz or less.

Judgment: 0.1% or less (10 kHz or less), 0.2% or less (10 kHz to 100 kHz) , Pass

7.5.4 Square Wave Duty Ratio

Connection: FUNCTION OUT → Oscilloscope (50 Ω termination)

Use a coaxial cable.

Setting: Amplitude 10 V_{p-p}/open, square wave after initializing the settings

Measurement: Measure the duty ratio with an oscilloscope. (Unless the duty ratio measurement accuracy of an oscilloscope is much better than 1%, subtract the oscilloscope's accuracy from the acceptable error of 1% and make a judgement.)

Judgment: Duty ratio 50%±1% (49% to 51%) , Pass

When the duty ratio is other than 50%, or the frequency is less than 1 kHz, there is a jitter of approx. 150 ns.

In this case, use a measuring instrument that can measure the average value of the duty ratio.

7.5.5 Amplitude Accuracy Test

Connection: FUNCTION OUT → AC voltmeter (high accuracy type) (no 50 Ω termination)

Use a coaxial cable.

Setting: Amplitude display unit Vrms after initializing the settings

Measurement: Change the amplitude setting and measure the RMS voltage [Vrms].

Judgment: Within the rating range in the table below , Pass

Amplitude Setting	Rating Range
3.5 Vrms	3.4719 Vrms to 3.5281 Vrms
3.0 Vrms	2.9744 Vrms to 3.0256 Vrms
2.5 Vrms	2.4769 Vrms to 2.5231 Vrms
2.0 Vrms	1.9794 Vrms to 2.0206 Vrms
1.5 Vrms	1.4819 Vrms to 1.5181 Vrms
1.0 Vrms	0.9844 Vrms to 1.0156 Vrms
0.5 Vrms	0.4869 Vrms to 0.5131 Vrms
0.0 Vrms	0.0000 Vrms to 0.0106 Vrms

7.5.6 DC Offset Accuracy Test

Connection: FUNCTION OUT → DC voltmeter (no 50 Ω termination)

Setting: DC mode after initializing the settings

Measurement: Change the DC offset setting and measure the DC output voltage.

Judgment: Within the rating range in the table below , Pass

DC Offset Setting	Rating Range
+5 V	+4.945 V to +5.055 V
+4 V	+3.950 V to +4.050 V
+3 V	+2.955 V to +3.045 V
+2 V	+1.960 V to +2.040 V
+1 V	+0.965 V to +1.035 V
0 V	-0.030 V to +0.030 V
-1 V	-1.035 V to -0.965 V
-2 V	-2.040 V to -1.960 V
-3 V	-3.045 V to -2.955 V
-4 V	-4.050 V to -3.950 V
-5 V	-5.055 V to -4.945 V

7.6 Calibration

If the performance test results do not satisfy the standards, NF Corporation will perform adjustment or calibration to restore the original performance.

If calibration is required, contact NF Corporation or one of our agents.

Charges apply for the calibration service.

8. Specifications

8.1 Waveform and Output Characteristics	8-2
8.2 Output Voltage	8-4
8.3 Other Functions.....	8-5
8.4 Details of Initialization	8-6
8.5 General Specifications	8-7

Values indicating the accuracy (range) are guaranteed values.
Values without accuracy are typical values.

8.1 Waveform and Output Characteristics

• Waveforms (FUNCTION OUT)

Output waveforms	Sine Wave, Ramp Wave (symmetry variable), Square Wave (duty variable), DC, Arbitrary Wave
Waveform vertical resolution	12 bits
Output waveforms, frequenc	Sine Wave, Square Wave (duty ratio 50%): 0.1 mHz to 2 MHz Ramp Wave, Square Wave (duty ratio other than 50%), Arbitrary Wave, and Burst/Trigger/Gate modes : 0.1 mHz to 50 kHz Frequency setting can be set up to 2 MHz. The whole of arbitrary waveform can be continuously output at up to 1.6 kHz
Frequency	
Setting resolution	0.1 mHz
Accuracy	±25 ppm (±0.0025%)
Aging	±5 ppm/year
Ramp Wave symmetry variable	
Setting range	0 to 100%
Setting resolution	0.1%
Other	Oscillation stops while the setting is changed.
Square Wave duty ratio variable	
Setting range	0 to 100%
Setting resolution	0.1%
Other	Oscillation stops while the setting is changed. The pulse may disappear when the frequency setting is higher than the frequency as follows. ($68.7 \times \text{duty ratio} [\%]$)[kHz] (at 0% to 50%) ($68.7 \times (100 - \text{duty ratio}) [\%]$)[kHz] (at 50% to 100%)
Arbitrary Waveform	
Data Size	4 K words However, 1 K words = 1024 words
Arbitrary Waveform wave number	Arbitrary waveform wave number, which is backed up waveforms, can be used by switching them. 4 waves (backup by battery)
Arbitrary Waveform data	Write by a remote interface Data : -2048 to +2047

- **Output characteristics (FUNCTION OUT)**

- Frequency characteristics of amplitude

- Sine Wave, continuous oscillation, 50 Ω load, 0 V DC offset, 5 V_{p-p}/50 Ω amplitude, frequency 1 kHz reference, RMS value measurement

- 100 kHz or lower : ± 0.2 dB

- 100 kHz to 2 MHz : +1, -3 dB

- Spectrum purity

- Sine wave continuous oscillation, 50 Ω load, 0 V DC offset, 5 V_{p-p}/50 Ω amplitude

- Total harmonic distortion

- 10 Hz to 10 kHz : 0.1% or less (bandwidth 500 kHz)

- 10 kHz to 100 kHz : 0.2% or less (bandwidth 500 kHz)

- Harmonic spectrum 100 kHz to 2 MHz : -40 dBc

- Spurious 100 kHz to 2 MHz : -50 dBc

- Square Wave waveform characteristics

- Square Wave, continuous oscillation, 50 Ω load, 0 V DC offset, 5 V_{p-p}/50 Ω amplitude

- Rising/Falling time 100 ns

- Overshoot 5% of the amplitude peak to peak

- Duty accuracy

- Duty ratio 50% : $\pm 1\%$ of waveform period (100 kHz or lower)

- Duty ratio other than 50%

- : $\pm 1\%$ of waveform period, 150 ns p-p jitter (50 kHz or lower)

8.2 Output Voltage

• Signal output (FUNCTION OUT)

Amplitude

Setting/Display unit	Sine Wave : Vp-p/Vrms (Selectable) Other than Sine Wave : Vp-p only
	In addition to the amplitude and DC offset, high level and low level are available for setting/displaying. 50 Ω load/open conversion (selectable)
Setting range	Vp-p : 0.000 to 10.000 Vp-p/open, 0.001 Vp-p resolution Vrms : 0.000 to 3.535 Vrms/open, 0.001 Vrms resolution However, the output changes in 2.5 mVp-p steps.
Accuracy	Continuous oscillation, Sine Wave, 1 kHz, load open, RMS value measurement $\pm(0.5\%$ of setting + 30 mVp-p)

DC offset

Setting/Display	In addition to the amplitude and DC offset, high level and low level are available for setting/displaying. 50 Ω load/open conversion (selectable)
Setting range	± 5.000 V/open, 0.001 V resolution However, the output changes in 1.25 mVp-p steps.
Accuracy	$\pm(0.5\%$ of setting + 30 mV) when DC is set for the waveform

Mutual constraints of amplitude and DC offset

If the output voltage exceeds ± 5 V/open, the output waveform may clip.

High Level/Low Level

Setting range	± 5.000 V/open, 0.001 V resolution
Mutual constraints	Limited to high level \geq low level
Output impedance	50 Ω , unbalanced
Load impedance	45 Ω or more
Output connector	Front panel, BNC receptacle (FUNCTION OUT)

• Synchronous output (SYNC OUT)

Functions	Continuous oscillation mode: Waveform sync signal Burst/Trigger/Gate oscillation mode: Select waveform sync signal or oscillation state sync signal
Output voltage	TTL level/open (Hi-Level: 3.3 V)
Output connector	Front panel, BNC receptacle (SYNC OUT)

8.3 Other Functions

• Oscillation mode

Oscillation mode	CONT, BRST, TRIG, GATE
	CONT : Continuous oscillation.
	BRST : Repeats oscillation of the mark wave number, and stop of the space wave number.
	TRIG : Performs oscillation of the mark wave number by the trigger signal
	GATE : Performs oscillation while the gate signal is valid.
Mark wave number	Number of oscillation cycle for Burst and Trigger oscillation mode.
	0.5 to 128.0 : 0.5 increments
	1 to 256 : 1.0 increments (Both mark and space wave numbers need to be integers)
Space wave number	Number of stop cycle for Burst oscillation mode.
	0.5 to 128.0 : 0.5 increments
	1 to 256 : 1.0 increments (Both mark and space wave numbers need to be integers)
Phase	Oscillation start/stop phase for Burst, Trigger, and Gate oscillation mode
Setting range	$\pm 180.0^\circ$
Setting resolution	0.1° Resolution
Trigger source	Logical sum of the triggers by external trigger input, panel key and remote interface
External trigger input	
Trigger polarity	Rise/Fall for trigger oscillation mode (selectable) High level/Low level for gate oscillation mode (selectable)
Input level	TTL level
Impedance	Pull-up to +3.3 V at 100 k Ω
Minimum pulse width	200 ns
Trigger delay	800 ns
Trigger jitter	150 ns p-p
Input connector	Front panel, BNC receptacle (TRIG IN)

• Output on/off

Function	FUNCTION OUT: Switch by a mechanical relay, open when output is off SYNC OUT: Switch by 3-state logic, high impedance when output is off
State at power on	On, off, the state at power off (selectable)

- **Settings backup, setting memory**

Settings backup	Backup by lithium battery
Backup period	For 3 years or more, when storage at room temperature (battery replacement is charged)
State at power on	Almost all settings are restored to the state at power off.
Setting memory	Stores almost all setting items
Setting memory number	1 to 20
Settings initialize Function	Set the default values for almost all setting items. For the initial values, refer to "8.4 Details of Initialization"

8.4 Details of Initialization

- Details of Initialization

Refer to "Table 3-1 Initial Settings" in "3.2.3 Initial Settings"

- When Errors Occur in Event of Battery Depletion

Refer to "Table 3-1 Initial Settings" in "3.2.3 Initial Settings"

8.5 General Specifications

- **I/O ground**

Connect all signal I/O ground by wires to the chassis.

- **Remote interface**

USB interface (USB 1.1 full speed)

USB-TMC

- **Power supply**

Power supply voltage range 100-240 V \pm 10%, but 250 V or less

Frequency range 50/60 Hz \pm 2 Hz

Power consumption 25 VA or less

Overvoltage category II

- **Environmental conditions**

Ambient temperature and humidity ranges

Operation guarantee +5 to +35°C, 5 to 85% RH (however, absolute humidity of 1 to 25 g/m³, no condensing)

Storage -10 to +50°C, 5 to 95%RH (however, absolute humidity of 1 to 29 g/m³, no condensing)

Pollution degree 2

- **Insulation resistance**

20 M Ω or more (with 500 V DC, between all power input terminals and chassis)

- **Withstand voltage**

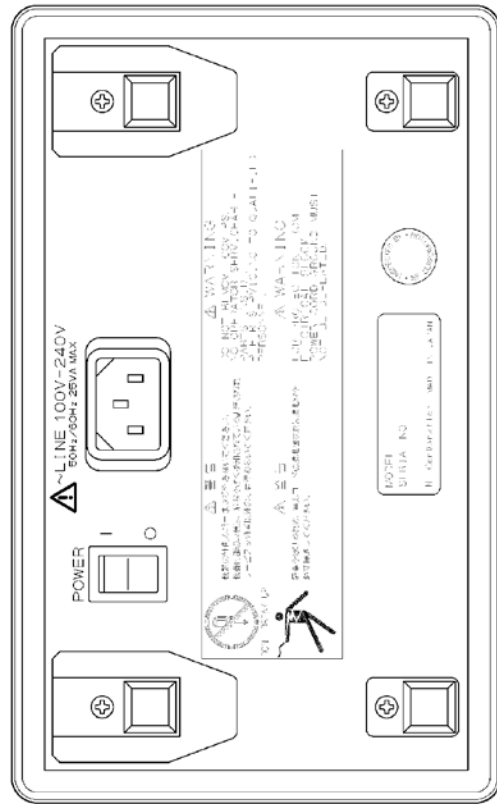
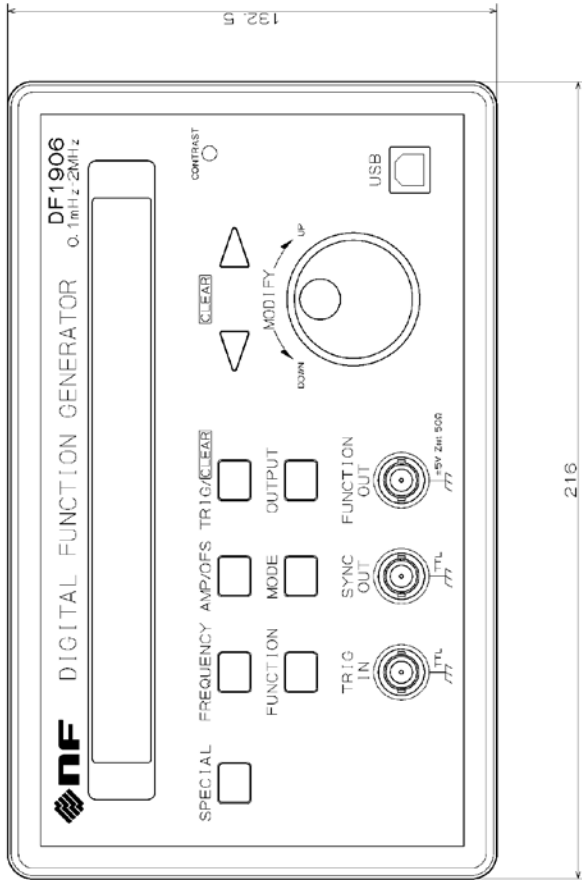
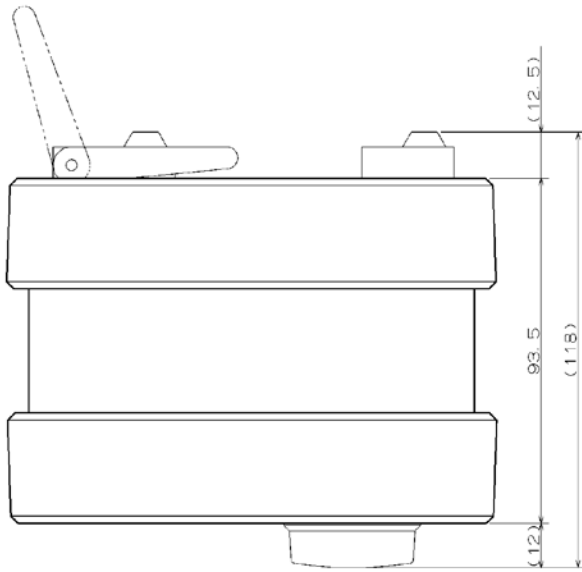
AC 1500 V (between all power input terminals and chassis)

- **External Dimensions**

216 (W) \times 132.5 (H) \times 93.5 (D) mm (without protrusions)

- **Weight**

Approx. 1.2 kg (excluding accessories, weight of the main unit only)



Surface Treatment
 Front Panel: Plastic sheet, ultra-light gray (Munsell 6PB9 2/0.1)
 Rear Panel: Paint, light gray (Munsell 6PB7 6/1.2 semi gloss)
 Cover: Paint, light gray (Munsell 6PB7 6/1.2 leather tone)

Figure 8-1 External Dimensions Diagram

WARRANTY

NF Corporation certifies that this product was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory.

All **NF** products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. During the warranty period, **NF** will repair the defective product without any charge for the parts and labor. For repair service under warranty, the product must be returned to either **NF** or an agent designated by **NF**. Purchaser shall prepay all shipping charge, duties and taxes for the product to either **NF** or the agent from another country, and shipping charge for the return of the product to purchaser shall be paid by **NF** side.

This warranty shall not apply to any defect, failure or damage caused by a) improper use; b) improper or inadequate maintenance and care; or c) modification by purchaser or personnel other than **NF** representatives.

NF Corporation

WABUN: (DA00013371)

If there are any misplaced or missing pages, we will replace the manual. Contact the sales representative.

NOTES

- Reproduction of the contents of this manual is forbidden by applicable laws.
- The contents of this manual may be revised without notice.
- Information provided in this manual is intended to be accurate and reliable. However, we assume no responsibility for any damage regarding the contents of this manual.
- We assume no responsibility for influences resulting from the operations in this manual.

DF1906 INSTRUCTION MANUAL

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