IWATSU

Volume 2

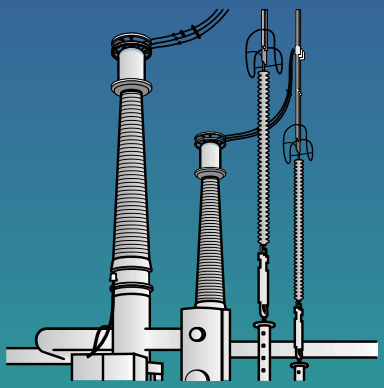
POWER ELECTRONICS MEASURING INSTRUMENTS CATALOG

Greatly contributing to the development of power electronics equipment.

High Voltage measurement

Lightning

Switch Gear



Device Evaluation

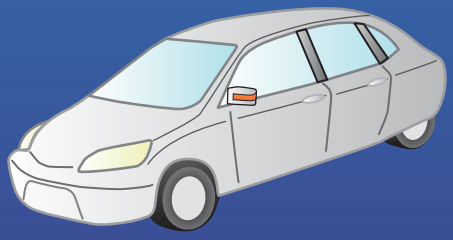
Material Evaluation

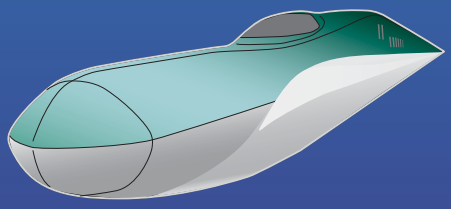
Circuit Evaluation

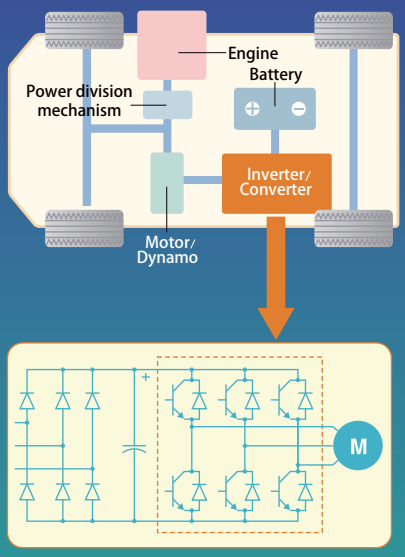
PWM control

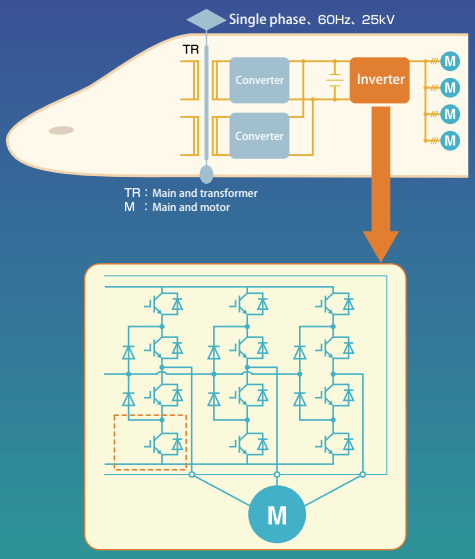
Electric Vehicles

High-speed railways









Long-distance switch

High and low inverter switch signals

Inverter power

Power device characteristics

Lightning surges

Large common mode voltage on small signal

Inverter gate control

Power device switching

Semiconductor Curve Tracer CS-3000 Series

Power device characteristics

Best suited for measuring the characteristics of different types of semiconductors including IGBTs, MOSFETs, transistors, and diodes.

Isolation Measurement System DM-8000

High and low inverter switch signals | Large common mode voltage on small signal | Inverter power | Long-distance switch | Lightning surges

Support for floating, broad-bandwidth, multi-channel and simultaneous measurements, as well as floating measurements for ultra-high voltage.

Delay Pattern Generator (6-channel Pulse Generator) DG-8000

Inverter gate control | Power device switching

Easily generates pulses for 6 independent channels in addition to complicated pulses required for testing multi-phase inverters.

Semiconductor Curve Tracer CS-3000 Series

CS-3100 / CS-3200 / CS-3300

- Maximum peak voltage: 3,000V (high-voltage mode for all models)
- Maximum peak current: 1,000A (CS-3300 high-current mode)
- All models support the leakage mode (cursor resolution: 1pA)
- USB for Screen copying and setup saving
- LAN interface for remote control

CS-3200 / CS-3300

CS-3100

New Semiconductor Curve Tracer CS-5000 Series

CS-5100 / CS-5200 / CS-5300 Custom Order

Best suited for measuring the breakdown of a power device which has 3,300V withstand voltage

- Maximum peak voltage: 5,000V (high voltage mode)

	Max. peak current (Max. peak pulse current)	Max. peak voltage
CS-3000 Series	75mA (150mA)	3,000V
CS-5000 Series	25mA (25mA)	5,000V

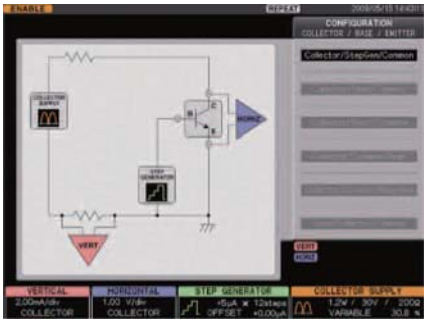
- Maximum peak current: 1,000A (CS-5300 high current mode)
- The CS-5000 Series achieved 5,000V of max. peak voltage with the same size as the CS-3000 Series.

*All models of CS-5000 Series are equipped with the CS-302 Fixture(M) as standard.

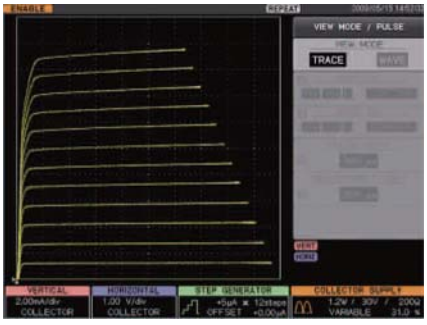
Lineup

Items	Product name	Model number	Remarks
Main unit	Semiconductor curve tracer	**CS-3100**	3000V / without HC mode - CS-301 / CS-500
	Semiconductor curve tracer	**CS-3200**	3000V / 400A with (HC mode) - CS-302 / CS-500
	Semiconductor curve tracer	**CS-3300**	3000V / 1000A with (HC mode) - CS-302 / CS-500
Fixture	Fixture S	**CS-301**	Standard for CS-3100.
	Fixture M	**CS-302**	Standard for CS-3200 and CS-3300.
Test adapter	Test adapter	**CS-500**	A test adapter is supplied with the main unit.
	TO-type test adapter	**CS-501**	Socket suited to the TO-type package (with three terminals)
Alligator clip	Small alligator clip (red) x 10	**CS-001**	Option for CS-302 fixture M
	Small alligator clip (black) x 10	**CS-002**	Option for CS-302 fixture M
Software options	Semiconductor parameter search	**CS-800**	A software option to be installed in the CS-3000 series.
	Semiconductor parameter measurement	**CS-810**	To be used on the (optional) PC when the CS-800 is installed in the main unit.

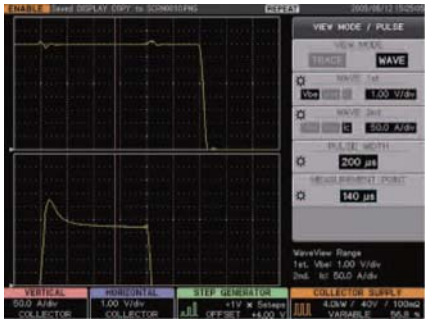
User-friendly measurement screen



Graphical configuration selection



Transistor I-V characteristic example (TRACE mode)



Vbe and Ic waveforms in the High-current pulse mode (WAVE mode)

Support for a maximum peak voltage of 3,000V and a maximum peak current of 1,000A

Display
The 8.4-inch clear screen displays the waveform details. This large screen displays the menu and parameters without limiting the waveform grid.

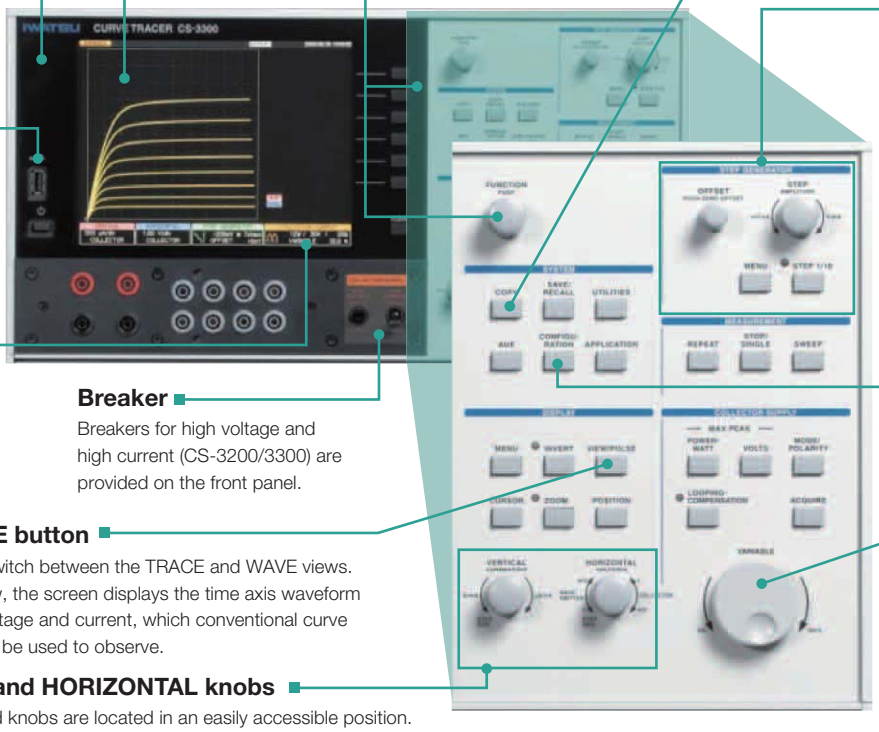
Fast activation

Menu operation section
Use the function knob and function keys to operate the menu.

COPY button

Step generator
The step setting and offset can be manipulated using this dedicated knob.

Connectivity
The CS-3000 series features a USB port on the front panel to facilitate report creation. Screen images can be saved to a USB device by pressing the COPY button.



Readout
The readout display, which is color-coded by function, displays operation settings in an easy-to understand way.

Breaker
Breakers for high voltage and high current (CS-3200/3300) are provided on the front panel.

CONFIGURATION button
This shows the connection and signal application status on the display.

VIEW/PULSE button
This is used to switch between the TRACE and WAVE views. In the WAVE view, the screen displays the time axis waveform of the applied voltage and current, which conventional curve tracers could not be used to observe.

VERTICAL and HORIZONTAL knobs
These dedicated knobs are located in an easily accessible position.

VARIABLE knob
This is used to adjust the output voltage of the collector supply. A durable knob is employed due to frequent use.

Standard accessories for the CS-3100

When the CS-501 is mounted.

CS-301 fixture S

CS-500 test adapter

*CS-501 is optional.

Standard accessories for the CS-3200 and CS-3300

With the patch panel removed

CS-500 test adapter

CS-302 fixture M

Wire set

CS-500 test adapter

The CS-500 Test adapter is supplied with the product. Use this adapter to connect the prepared jig to the fixture.

CS-501 TO-type test adapter

This socket is suited to the TO-type package (with three terminals). The supported lead distance is from 1.52 to 4.57mm.

CS-001 (red x 10pcs.), CS-002 (black x 10pcs.) Small alligator clips

These small alligator clips can be attached to the wire set supplied with the CS-302 fixture.

Power Curve Tracer CS-10000 Series

CS-10800/CS-10400 Custom Order

Best suited for measuring the characteristics of power devices

• Ultra-high voltage and high current

The following HV and HC functions are added to the CS-3100

High voltage mode	10kV(+DC only)
High current mode	8,000A(CS-10800) 4,000A(CS-10400) Pulse width/Pulse interval/ Measuring point variable

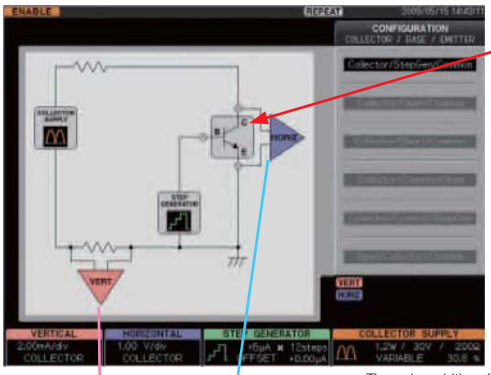
10 kV curve tracer Custom Order

Ideal for measuring the withstand voltage characteristic of high voltage diode thyristors

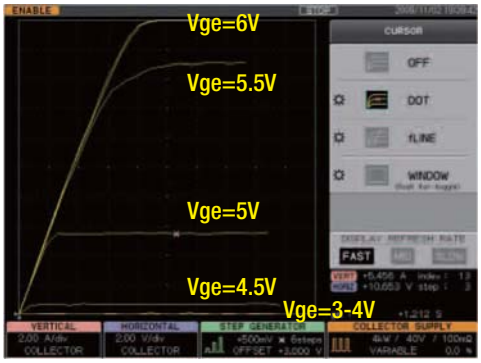
Output section	
Voltage waveform	Commercial power supply half-wave rectification waveform
Maximum voltage	10kV at peak (without load)
Maximum current	100mA at peak
Display section	
Voltage axis sensitivity	50V/div to 1,000V/div, 5 ranges at 1-2-5 step
Current axis sensitivity	0.1mA/div to 10mA/div, 7 ranges at 1-2-5 step

Observation of I-V curves as well as applied waveforms of voltage and current

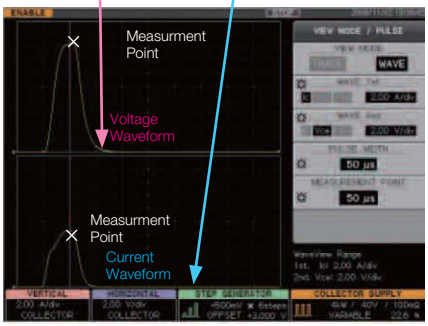
Application of the current and voltage pulses in the high current mode

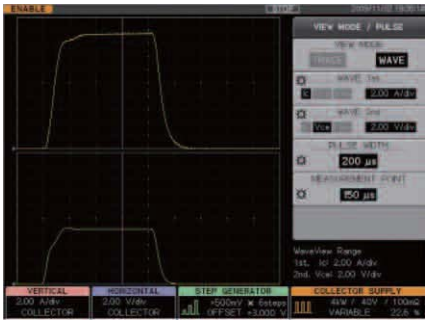


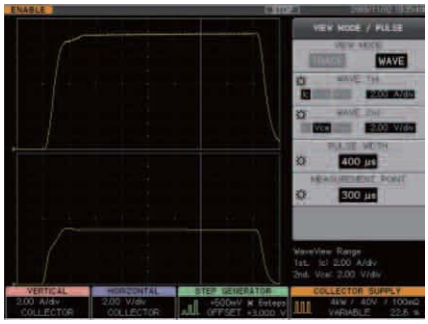
Example of measuring MOSFET "current - voltage" characteristics



The pulse widths of the applied current and voltage and the measurement point can be specified in a range between 50µs and 400 µs (CS-3200 and CS-3300).







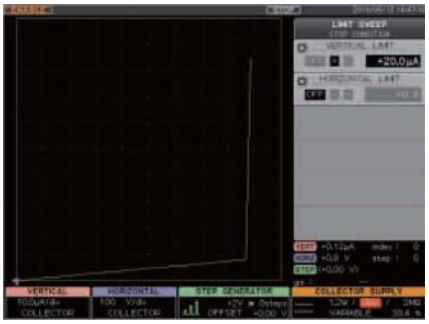
The SWEEP TYPE can be selected with DOWN, UP, and CUSTOM (all models).
With CUSTOM specified, the range between specified values can be swept.

CS-800 semiconductor parameter search (optional)

The main unit software option that supports the voltage and current limit function, as well as the automatic Vth measurements.

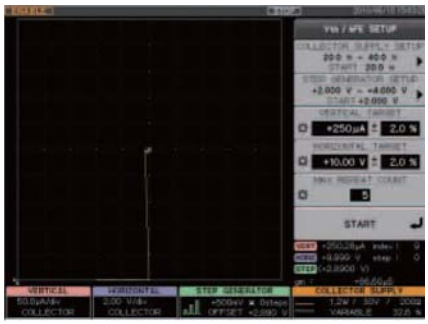
LIMIT SWEEP

If the voltage and current limit values are specified before SWEEP operations, the operations stop at the next measurement point after the limit value has been exceeded.



Vth and hFE SETUP

Vth and hFE can be automatically measured.



Example of automatic Vth measurement

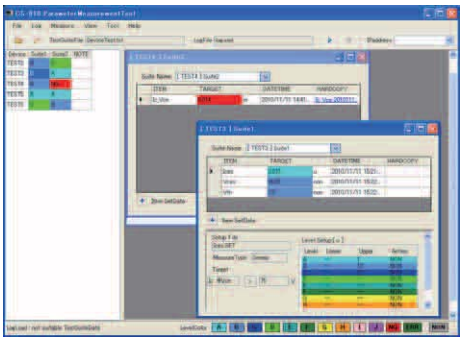
Remote tool

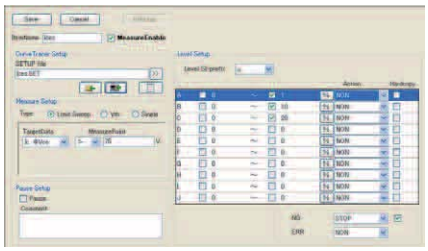
If the use of a USB memory is not permitted for security reasons, a copy of the screen, measurement results in the CSV format, and other data can be directly transferred to the PC via a LAN.

*The Remote tool can be downloaded from the Iwatsu website (freeware)

CS-810 semiconductor parameter measurement (optional)

A PC application used to connect the main unit incorporating CS-800 and an (optional) PC via a LAN. This application automatically performs measurements by applying the measurement conditions specified using the PC to determine whether the data is appropriate or not.



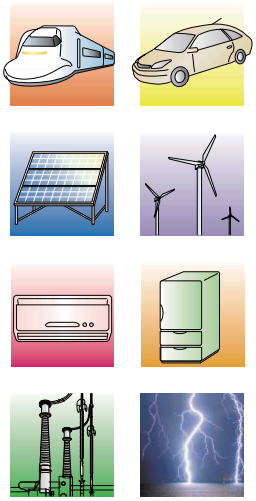


Semiconductor Curve Tracer CS-3000 Series Specifications

<table>
<tr><th colspan="2">Model</th><th>SC-3100</th><th colspan="2">CS-3200</th><th colspan="2">CS-3300</th></tr>
<tr><td colspan="7">Collector supply</td></tr>
<tr><td rowspan="2">Mode</td><td>High voltage</td><td colspan="5">AC, ± Rectified SIN, ± DC, ± LEAKAGE</td></tr>
<tr><td>High current</td><td>—</td><td colspan="4">Pulse only</td></tr>
<tr><td colspan="2" rowspan="2">Maximum peak power</td><td colspan="5">120mW, 1.2W, 12W, 120W, 390W
*390W can be selected excluding the maximum peak voltage setting in the 3,000V range.</td></tr>
<tr><td>—</td><td colspan="2">High current mode (400W, 4kW)</td><td colspan="2">High current mode (400W, 4kW, 10kW)</td></tr>
<tr><td colspan="2" rowspan="4">High voltage mode</td><td colspan="2">Maximum peak current (maximum peak pulse current)</td><td colspan="3">Maximum peak voltage</td></tr>
<tr><td colspan="2">75mA (150mA)</td><td colspan="3">3,000V (2,500V for AC)</td></tr>
<tr><td colspan="2">750mA (1.5A)</td><td colspan="3">300V</td></tr>
<tr><td colspan="2">7.5A (15A)</td><td colspan="3">30V</td></tr>
<tr><td colspan="2">Loop compensation</td><td colspan="5">The stray capacitance between the collector terminal and the ground of the fixture is compensated by the hardware in the high voltage mode.
Digital compensation is also available.</td></tr>
<tr><td colspan="2" rowspan="4">High current mode
(pulse only)</td><td rowspan="4">—</td><td>Maximum peak current</td><td>Maximum peak voltage</td><td>Maximum peak current</td><td>Maximum peak voltage</td></tr>
<tr><td>400A</td><td>40V</td><td>1,000A</td><td>40V</td></tr>
<tr><td>40A</td><td>40V</td><td>400A</td><td>40V</td></tr>
<tr><td colspan="2"></td><td>40A</td><td>40V</td></tr>
<tr><td colspan="2">Pulse width/ measurement point</td><td>—</td><td colspan="4">The pulse width is variable in the range between 50µs and 400µs.
Measurement points can be specified (with a resolution of 10µs/step).</td></tr>
<tr><td colspan="2">Maximum data points</td><td colspan="5">20 to 1,000 points can be specified per trace.</td></tr>
<tr><td colspan="7">Step generator</td></tr>
<tr><td colspan="2">Current mode</td><td colspan="5">Amplitude range: 50nA to 200mA, 21 ranges at 1-2-5 step
Maximum current: 20 times STEP AMPLITUDE setting/Offset: ±10 times STEP AMPLITUDE setting</td></tr>
<tr><td colspan="2">Voltage mode</td><td colspan="5">Amplitude range: 50mV to 2V, 6 ranges, at 1-2-5 step
Maximum voltage: 20 times STEP AMPLITUDE setting/Offset: ±10 times STEP AMPLITUDE setting</td></tr>
<tr><td colspan="2">Step rate</td><td>Staircase wave: Twice 50Hz or 60Hz
(50Hz or 60Hz in the AC mode)</td><td colspan="4">Staircase wave: Twice 50Hz or 60Hz (50Hz or 60Hz in the AC mode)
Pulse: The pulse changes in the range between 80ms and 1,000ms.
(The lowest frequency limited by the maximum peak power consumption setting.)</td></tr>
<tr><td colspan="2">Pulse step</td><td colspan="5">The pulse width is variable in the range from 100µs to 400µs at 10µs resolution.</td></tr>
<tr><td colspan="2">Number of steps</td><td colspan="5">0 to 20 steps</td></tr>
<tr><td colspan="7">AUX output</td></tr>
<tr><td colspan="2">Range</td><td colspan="5">OFF, -40V to +40V, variable with at 100mV resolution</td></tr>
<tr><td colspan="7">Vertical axis</td></tr>
<tr><td rowspan="3">Collector current</td><td rowspan="2">Range</td><td colspan="5">High voltage mode: 1µA/div to 2A/div, 20 ranges at 1-2-5 step</td></tr>
<tr><td>—</td><td colspan="2">High current mode:
100mA/div to 50A/div, 9 ranges, at 1-2-5 step</td><td colspan="2">High current mode:
100mA/div to 100A/div, 10 ragnes, at 1-2-5 step</td></tr>
<tr><td>Accuracy</td><td colspan="5">2% of readout + 0.05 × VERT/div setting or better (The internal loop correction error below must be added to the formula.)
3kV range: 6µA, 300V range: 1µA, 30V range: 0.5µA (Defined for the current level of 10% or larger for each voltage range.)</td></tr>
<tr><td rowspan="2">Emitter current (LEAKAGE)</td><td>Range</td><td colspan="5">1 nA/div - 2 mA/div, 20 ranges, at 1-2-5 step</td></tr>
<tr><td>Accuracy</td><td colspan="5">2% of readout + 0.05 × VERT/div setting +1nA or lower</td></tr>
<tr><td colspan="7">Horizontal axis</td></tr>
<tr><td rowspan="3">Collector voltage</td><td rowspan="2">Range</td><td colspan="5">High voltage mode: 50 mV/div to 500 V/div, 13 ranges, at 1-2-5 step</td></tr>
<tr><td>—</td><td colspan="4">High current mode: 50mV/div to 5V/div, 7 ranges, at 1-2-5 step</td></tr>
<tr><td>Accuracy</td><td colspan="5">2% of readout + 0.05 × HORIZ/div setting or better</td></tr>
<tr><td rowspan="2">Base/ emitter voltage</td><td>Range</td><td colspan="5">50mV/div to 5V/div, 7 rages, at 1-2-5 step</td></tr>
<tr><td>Accuracy</td><td colspan="5">2% of readout + 0.05 × HORIZ/div setting or better</td></tr>
<tr><td colspan="7">Miscellaneous</td></tr>
<tr><td colspan="2">Display</td><td colspan="5">8.4-inch color TFT-LCD (SVGA 800 x 600 pixels)</td></tr>
<tr><td colspan="2">Data sav/recall</td><td colspan="5">Internal: Memory (setup: 256, REF waveform: 4)
External: Removable storage connected to the USB port (setup, waveform sav/recall, screen hard copy)</td></tr>
<tr><td colspan="2">USB</td><td colspan="5">1 port (USB1.1)</td></tr>
<tr><td colspan="2">Remote control</td><td colspan="5">Remote control by LAN: 1 port (100BASE-TX)</td></tr>
<tr><td colspan="2">Power supply/Power consumption</td><td colspan="5">Power supply input range: 100V to 240V AC, 50/60 Hz/ Power consumption: 500VA</td></tr>
<tr><td colspan="2">Accessories</td><td>CS-301 (fixture S) / CS-500 (test adapter) /
operation manual, power cablecord</td><td colspan="4">CS-302 (fixture M) / CS-500 (test adapter) /
wire set, operation manual, power cable</td></tr>
<tr><td colspan="7">Mechanism section</td></tr>
<tr><td colspan="2">Dimensions (mm)</td><td>Approx. 424 (W) x 555.2 (L) x 221 (H)
(without the external projection portion)</td><td colspan="4">Approx. 424 (W) x 555.2 (L) x 354.5 (H) (without the external projection portion)</td></tr>
<tr><td colspan="2">Weight</td><td>Approx. 30kg (without optional accessories)</td><td colspan="4">Approx. 45kg (without optional accessories)</td></tr>
<tr><td colspan="2">Environmental conditions</td><td colspan="5">Operating temperature: 0 to +40°C, performance guarantee temperature: +10 to +35°C</td></tr>
</table>

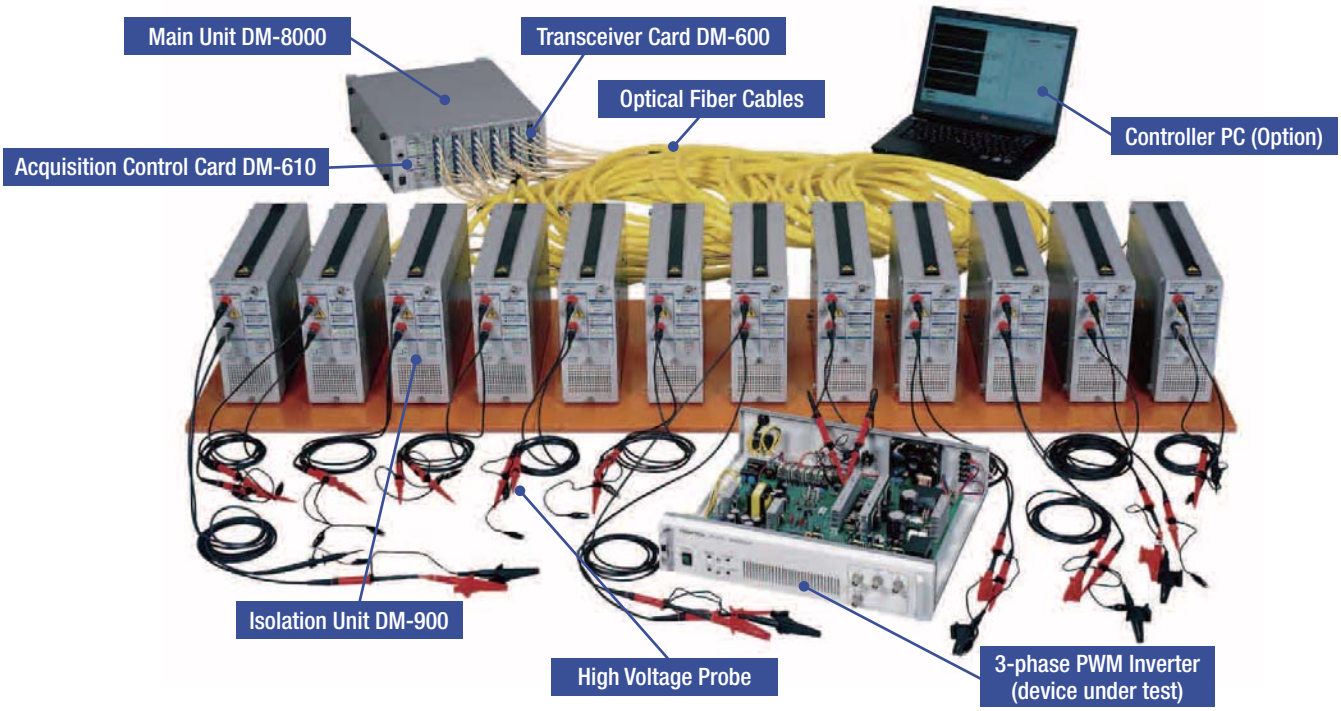
Isolation measurement system

DM-8000



- The input block, control block and display block are isolated with optical fiber cables (DM-900/L, DM-910/L.)
- Frequency bandwidth: DC to 500MHz
- Simultaneous multi-channel measurement of many channels of different reference potentials (2 to 24 channels) (DM-900/L, DM-400/L.)
- Long-life battery drive.
  (The system can be driven by three batteries for about 12 hours.)(DM-900/L, DM-910/L.)
- Measurement using long memory (DM-900/L, DM-910/L, DM-400/L.)
- Simultaneous measurements of the inverter's switching waveform and ON-voltage (DM-910/L.)
- Also supports synchronous measurements with the non-isolated unit (DM-400/L.)

Example: Isolation Unit DM-900 x 12units (24ch)



Lineup

Items	Model
Main unit	**DM-8000**
High-speed main unit *1	**DM-8000H**
Acquisition control card	**DM-610**
Transceiver card (optical x 2)	**DM-600**
Transceiver card (optical x 1, metal x 1)	**DM-620**
Transceiver card (metal x 2)	**DM-630**
Isolation unit (500k points) *2	**DM-900**
Isolation unit (16M points) *2	**DM-900L**
Isolation unit (high resolution, 500 k points) *3	**DM-910**
Isolation unit (high resolution, 16 M points) *3	**DM-910L**
Acquisition unit (500k points) *4	**DM-400**
Acquisition unit (16M points) *4	**DM-400L**

*1 Performance is improved when using three or more units with a memory length exceeding 100k-points.
*2 With insulation case
*3 With insulation case. Optional probe is required for voltage measurements.

Items	Model
Optical fiber cable S (2m) *5	**DM-002**
Optical fiber cable S (5m) *5	**DM-004**
Optical fiber cable (5m)	**DM-005**
Optical fiber cable (10m)	**DM-006**
Optical fiber cable (20m)	**DM-007**
Optical fiber cable (50m)	**DM-008**
Optical fiber cable (100m)	**DM-009**
Optical fiber cable (200m)	**DM-010**
Acquisition cable (2m)	**DM-105**
Acquisition cable (5m)	**DM-106**
Battery pack	**DM-551**
Battery pack (set of three battery packs) *6	**DM-553**

*4 Non-isolation type unit driven by AC power only.
*5 Optical cable set without sheath.
*6 Standard item for isolation unit.

Isolation with Optical Fiber cable (2 to 200 m)

The input block, control block and display block are isolated by an optical fiber cable. Owing to the fact that isolation units are isolated from each other by optical fiber cables, it is possible to simultaneously measure signals that have different reference potentials, such as signals from the high and low-side switch of an inverter or from the primary and secondary sides of a power converter.

DM-8000 main unit / High-speed DM-8000H main unit

Up to 12 isolation units and acquisition units can be connected. An acquisition control card for capture control and up to 6 specially designed transceiver cards can be installed onto the main unit. The gigabit Ethernet-enabled high-speed main unit (DM-8000) improves the waveform update speed when using 3 or more units. The interlock control terminal is on the rear panel.

DM-610 acquisition control card

This card controls waveform capture in measurement units. It also provides a non-isolated external trigger input, which can be changed to an external trigger output terminal.

DM-600 transceiver card

Two isolation units can be connected per card.

DM-620 optical and metal transceiver card

One isolation unit and one acquisition unit can be connected per card.

DM-630 metal transceiver card

Two acquisition units can be connected per card.

LAN cable

LAN terminal

Interlock contact

Optical fider cable | Optical fider cable | Acquisition cable

DM-900 (500k)/DM-900L (16M) isolation units

The units are operated by a built-in battery to perform floating measurements.

Frequency bandwidth: DC to 500MHz, highest sampling rate: 2GS/s, memory length: 500k points (DM-900), 16M points (DM-900L), input: 2 channels (not isolated), interface: optical interface (set of three interfaces.)

Insulation case

Withstand voltage: 10kV

(Standard accessory)

DM-910 (500k)/DM-910L (16M) isolation units (high resolution)

The units are operated by a built-in battery to perform floating measurements.

The high resolution enables the simultaneous measurement of switching waveforms and on-voltage. Frequency bandwidth: DC to 500MHz, highest sampling rate: 2GS/s, memory length: 500k points (DM-910), 16M points (DM-910L), input: 1 channel, interface: optical interface (set of three interfaces.)

Insulation case

Withstand voltage: 10kV

(Standard accessory)

DM-400 (500k)/DM-400L (16M) acquisition units

The units can continuously operated with an AC power source.

These units are best suited to the non-isolated measurement of grounded power probes, for example.

Frequency bandwidth: DC to 500MHz, highest sampling rate: 2GS/s, memory length: 500k points (DM-400), 16M points (DM-400L), input: 2 channels (not isolated), interface: electric interface (one set.)

DM-553 Li-ion battery (built-in)

The battery can be inserted or removed from the front of the isolation unit. It uses three batteries to enable the unit to continuously operate for twelve hours.

The battery can be charged with the use of the main unit.

The DM-900/L and DM-910/L are supplied with three batteries.

DM-002 to DM-010 optical fiber cables

The optical fiber cables are resistant to bending and external pressure.

Cable length: 2m to 200m
*1-2-5 step length
Without cover: 2m or 5 m
With cover: 5m to 200m

IE-1196 probe especially designed for the DM-910 (custom mode)

The probe is a low distortion probe that supports the DM-910's high resolution.

Frequency bandwidth: DC 200MHz
Probe ratio: 100:1
Cable length: 1.5m

DM-105/DM-106 acquisition cables

Interface cables especially designed for the acquisition unit. These cables are connected to the unit and transceiver by electrical signals from the DM-400/L.

Cable length: 2 or 5m

The DM-9xxL long memory isolation unit enables detailed analysis during a basic inverter duty cycle.

The DM-900L and DM-910L long memory isolation units enable detailed analysis of individual carrier signals while capturing a base duty cycle.

Gate driving waveform of the U, V, and W phases on the high side of a 3-phase inverter.

A fundamental duty cycle (16ms on the sample screen) can be captured at a rate of 1GS/s.

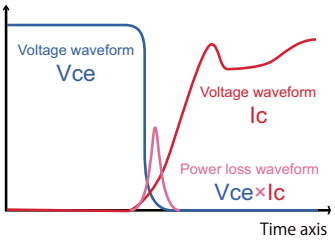
View with zoom display.

Up to 24 CH at a high voltage and wide bandwidth can be simultaneously measured.

Control PC (optional)

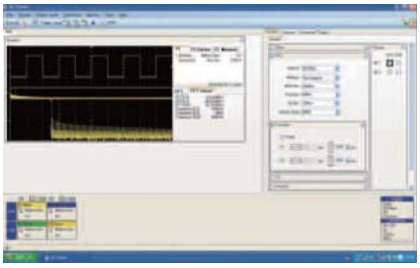
Waveform monitoring and other system operations are remotely performed using the standard IS Viewer (software). The IS Viewer can be used off-line as well, and is therefore useful for data organization at locations remote from the measurement site.

The many operation functions provided by the IS Viewer facilitate power loss and other measurement.



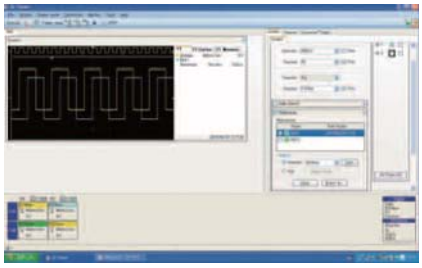
The Vce, Ic, output voltage and current waveforms of the upper and lower arms of an inverter can be simultaneously measured.
dv/dt, di/dt, and other parameters, such as power loss, can be easily calculated from the measurement waveforms.

Functions of the IS viewer



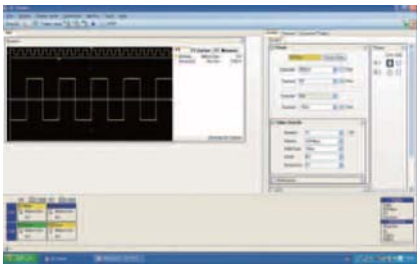
FFT function

This function is used for the frequency analysis of measured waveforms.



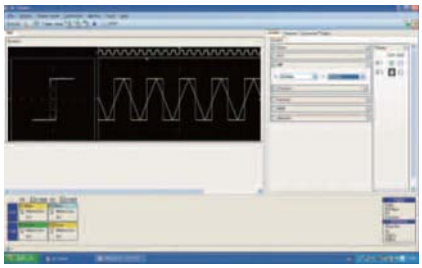
Reference display function

This function is used to compare waveforms.



Edge search function

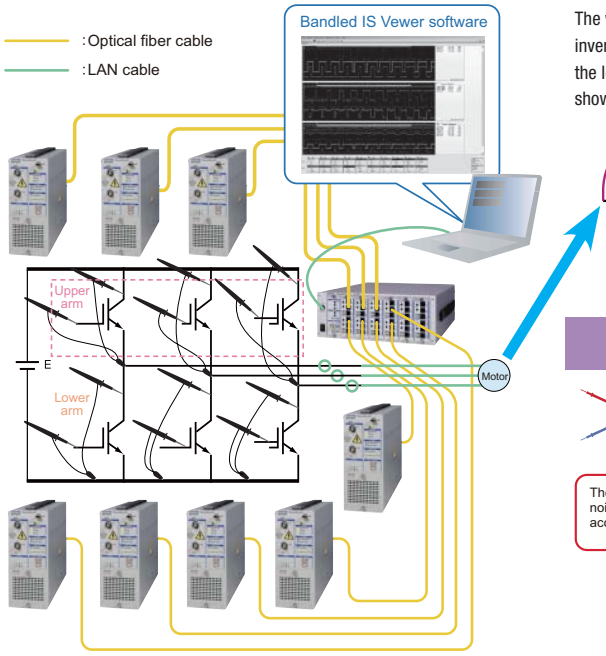
This function is used to automatically detect the edge of a monitored waveform and display selected edges.



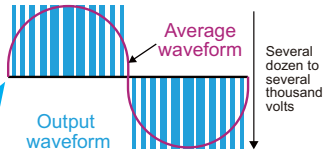
X-Y display function

This function is used to evaluate the SOA (safe operation area) and other items.

Multi-channel floating measurements (simultaneous measurement example of the upper and lower arms of a 3-phase inverter)

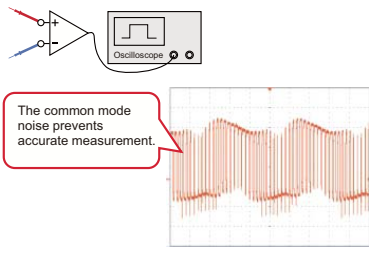


The waveform of voltage output from the 3-phase inverter that drives a motor or other device (shown in the left-hand figure) is a pulse voltage waveform, as shown in the figure below.

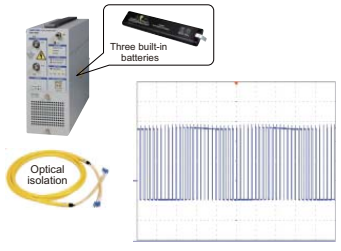


Differential probes were used for this type of measurement in the past, but this resulted in the waveform sometimes being distorted, and it was sometimes difficult to ensure sufficient measurement bandwidth due to constraints of the common mode rejection ratio or withstand common mode voltage. With optical fiber isolation, this isolation system can accurately monitor signals without being affected by these constraints.

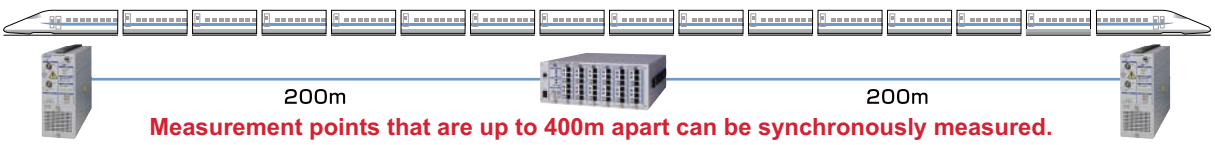
Measuring Vge of the upper arm with differemtial input



Measuring Vge of the upper arm with isolation input



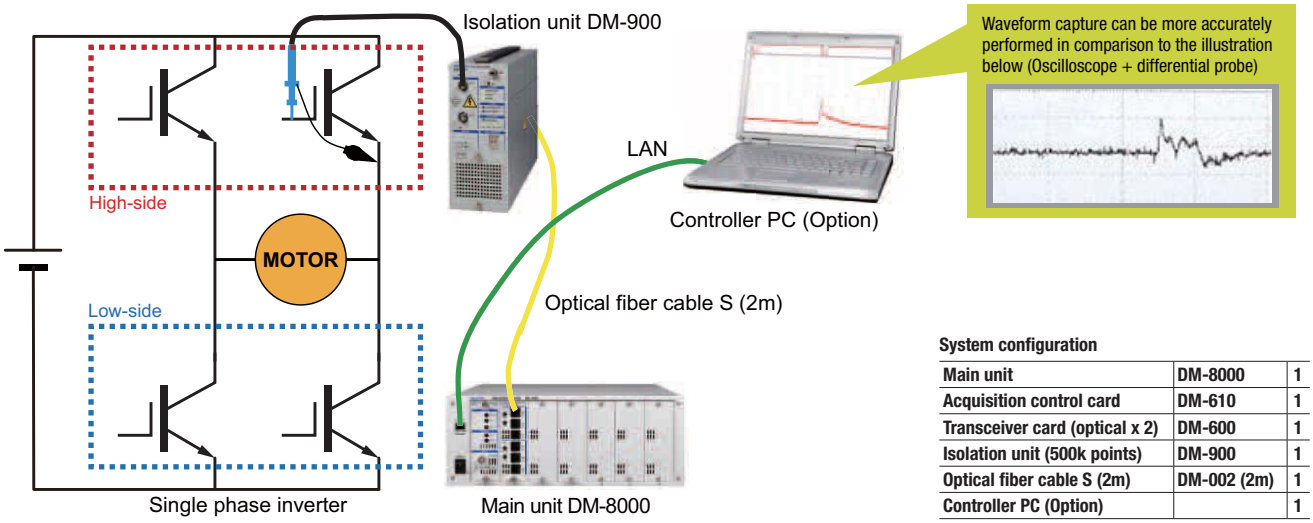
Remote measurement (up to 400m)



Measurement points that are up to 400m apart can be synchronously measured.

System configuration

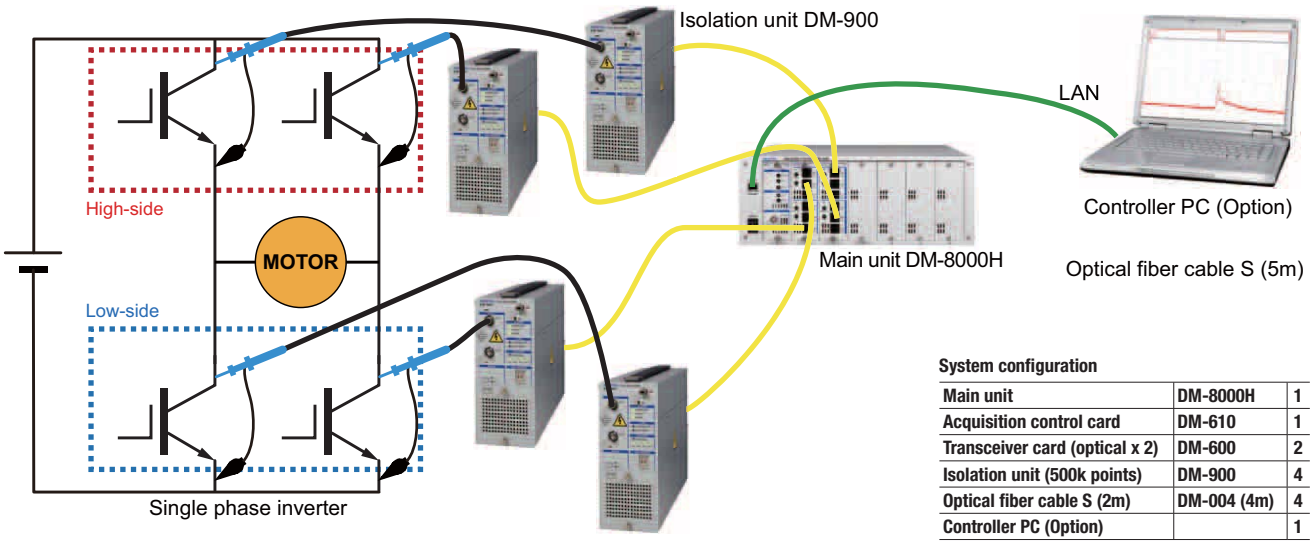
IGBT Gate voltage measurements in the high-side switch of a single phase inverter (one unit)



System configuration

Main unit	DM-8000	1
Acquisition control card	DM-610	1
Transceiver card (optical x 2)	DM-600	1
Isolation unit (500k points)	DM-900	1
Optical fiber cable S (2m)	DM-002 (2m)	1
Controller PC (Option)		1

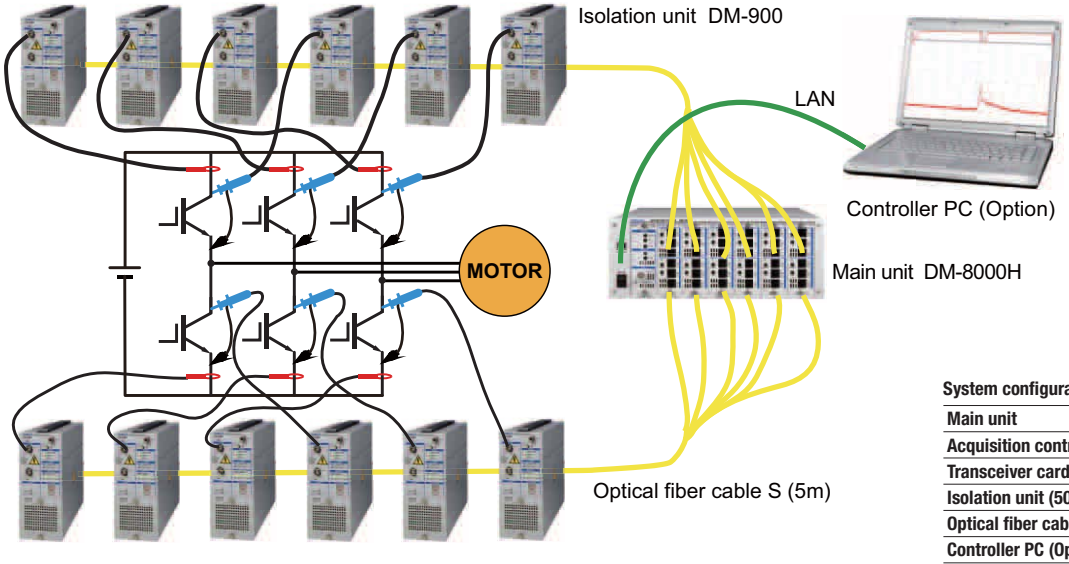
IGBT Vce voltage measurements in the high-side switch of single phase inverters (four units)



System configuration

Main unit	DM-8000H	1
Acquisition control card	DM-610	1
Transceiver card (optical x 2)	DM-600	2
Isolation unit (500k points)	DM-900	4
Optical fiber cable S (2m)	DM-004 (4m)	4
Controller PC (Option)		1

IGBT Vce voltage & Ic current measurements of 3-phase, 2-level inverters (twelve units)



System configuration

Main unit	DM-8000H	1
Acquisition control card	DM-610	1
Transceiver card (optical x 2)	DM-600	6
Isolation unit (500k points)	DM-900	12
Optical fiber cable S (2m)	DM-004 (5m)	12
Controller PC (Option)		1

Isolation System DM-8000 Specifications

DM-900L/DM-910L Isolation Unit and DM-400/L Acquisition Unit

Model	DM-900	DM-900L	DM-910	DM-910L	DM-400	DM-400L
Signal input unit						
Frequency Bandwidth (-3 dB)	500MHz					
Bandwidth limiter	20MHz / 100Mhz					
Input impedance	1MΩ // 16pF				1MΩ // 16pF or 50Ω	
Maximum input voltage	400V max (DC+peakAC<=5kHz) CAT I					
Number of channels	2 (channels are not isolated)		1		2 (Not isolated)	
Input coupling	GND, DC1 MΩ, AC1 MΩ		GND, DC1MΩ		GND, DC1MΩ, AC1MΩ, DC50Ω	
Input sensitivity	2mV / div~10V / div, 1-2-5 steps		CH1-MAIN: 50mV / div~5V / div, 1-2-5 steps CH2-ZOOM: 2mV / div~1V / div, 1-2-5 steps		2mV / div~10V / div, 1-2-5 steps	
Offset range	2mV / div~50m V / div, ±1V *1 100mV / div~500m V / div, ±10V *2 1V / div~10V / div, ±100V *3		CH1-MAIN: 50mV / div~500m V / div, ±10V *2 1V / div~5V / div, ±100V *3 CH2-ZOOM: 2mV / div~20mV / div, ±2V *1 50mV / div~1V / div, ±20V *2		2mV / div~50m V / div, ±1V *1 100mV / div~500m V / div, ±10V *2 1V / div~10V / div, ±100V *3	
Offset accuracy	± (1.0% + 0.5% of full-scale + X) X:*1 1mV, *2 10mV, *3 100mV					
DC gain accuracy	± (1.5% + 0.5% of full-scale)					
Probe sensitivity	10:1, 100:1, 1000:1 (Auto detection/manual settings)					
Sample rate	1GS/s (2GS/s during interleave)					
Vertical axis resolution	8bits					
Maximum memory length	500k points/ch	16M points/ch	500k points/ch	16M points/ch	500k points/ch	16M points/ch
Trigger system unit						
Trigger sources	CH1, CH2		CH-1-MAIN		CH1, CH2	
Trigger slope	Positive / Negative					
Coupling	AC, DC, HFREJ, LFREJ					
Level range	125% of full-scale					
Interface						
Interface	1 set of 3 optical interfaces (optical fiber cable: 2m to 200m)				1 set of electrical interfaces (wire cable:2 or 5m)	
Power supply and battery unit						
Internal battery	3 battery packs (unit can operate on one battery)				—	
Battery charging	Can be charged by the main unit				—	
Power consumption	120VAmax (when using AC power)				40VAmax	
Battery operation time	Approx. 12 hours of continuous operation (when using 3 batteries)				—	
Battery charging time	Approx. 6 hours				—	
AC power supply	AC100 to 240 (50/60Hz)					
Calibration signal						
Calibration signal	0.6V / 6V (selectable)					
Mechanical unit						
Dimensions (mm)	122.4 (H) X 258.4 (W) X 544 (D)				96.4 (H) X 171.6 (W) X 322.6 (D)	
Weight	Approx. 7kg (excluding battery packs and accessories) Battery pack weight: Approx. 660g per pack				2.6kg	
Operating temperature	0°C to +40°C					
Performance guaranteed temperature	+10°C to +35°C					
Accessories						
Battery pack	3				—	
Power supply cable	1					

DM-8000/DM-8000H Main Unit

* When the DM-610 acquisition control card is installed

Transceiver card connection	
Number of slots	6 (Max. 12 isolation units and/or acquisition units can be connected.)
Time axis	
Sweep range	1ns/div to 20s/div
Clock accuracy	10ppm
Acquisition mode	Normal, peak
Trigger system	
Mode	Auto,Normal,Single,Stop
Source	Up to 24 CH
Type	Edge,Pulse width
Trigger delay	Available
Interface	
Ethernet port	DM-8000: (10BASE-T/100BASE-TX)×3, DM-8000H: (1000BASE-T)×3
Power supply unit	
AC power supply	100V to 240V (50/60Hz)
Power consumption	DM-8000: 100VA max, DM-8000H: 130VA max
Mechanical unit	
Dimensions and weight	132(H) × 351(W) × 420(D), Available. 6.9kg
Operating temperature	0°C to +40°C
Performance guaranteed temperature	10°C to +35°C
Accessories	
LAN cable	1
Power supply cable	1
Operation manual	CD-R(1)
Control software	IS Viewer DM-800 CD-R (1)

Note #1: Intel and Pentium are registered trademarks or trademarks of Intel Corporation and its subsidiary companies in the United States of America and other countries.
Note #2: Windows is a registered trademark or trademark of Microsoft Corporation in the United States of America and other countries.

DM-600/DM-620/DM-630 Transceiver Card

Number of isolation / acquisition units connected	DM-600: 2 (DM-900/L, DM-910/L)
	DM-620: 1 (DM-900/L, DM-910/L) +1 (DM-400/L)
	DM-630: 2 (DM-400/L)
Operation indicator	Status display via LED
Mechanism	Card inserted in main unit (DM-8000)
Operating temperature	0°C to +40°C
Performance guaranteed temperature	+10°C to +35°C

IS Viewer DM-800 (supplied with the DM-8000/DM-8000H main unit)

* IS Viewer is installed in the controlling computer (option) and is used to operate the isolation system and to monitor waveforms.

Main function	
Operations	+, -, ×, ÷, |×|, |÷|, ∫, dy/dx
Parameter measurements	Max, Min, p-p, Top, Base, Top-Base, RMS, Cycle RMS, Mean, Cycle Mean, +/-Overshoot, Transition Time, dv/dt, Freq, Period, +/-Pulse Count, +/-Pulse Width, Duty, Integral, Integral (abs), Integral (pos), Integral (neg), Skew (%), Skew (Level)
Other functions	XY display, FFT, Cursor, smoothing, channel de-skew, re-scale, off-line viewer
Waveform storage	CSV
Saving images	BMP,PNG,Clipboard
Saving setups	with / without waveforms
Controlling computer	
CPU	Intel® Pentium®4 Processor or later
RAM	2GB or larger
OS	Windows® XP Professional SP3
	Windows® Vista Business SP2
Display	At least WXGA (1280 x 768 pixels) recommended (SXGA (1280 x 1024 pixels) is required for full display.)

Optional probes for the isolation system

High Voltage Probes

High Voltage Probes

Model	Bandwidth (MHz)	Attenuation ratio 1: x	Withstand voltage (duty 10%)	Withstand voltage (duty 50%)	DC	Length (m)	Remarks
PHV1000-RO	400	100	6kV (500ms cycle)	3.5kV (100ms cycle)	1kV	2	CAT I
PHVS1000-RO	400	1000	6kV (duty 10% 500ms cycle)	3.5kV (100ms cycle)	1kV	2	CAT I
PHV641-LRO	380	100	4kV (200ms cycle)	3.5kV (60ms cycle)	3kV (+AC peak)	1.2	AC rms 2kV
PHV661-LRO	380	100	6kV (200ms cycle)	5kV (60ms cycle)	4kV (+AC peak)	1.2	AC rms 2.8kV
PHV4002-3/0,6RO	100	1000	40kV (100ms cycle)	30kV (30ms cycle)	20kV (+AC peak)	3	AC rms 14kV

PHV1000-RO

PHV6xx-LRO

High Voltage Probes

HV-P60

DC to 50MHz, DC to 60kV,
pulse 80kV

The probe stand (SK-301) is optional.

Specifications and performance

Input/output ratio: 2000:1
Input RC: 1000MΩ,
5pF ± 2pF DC to 50MHz

HV-P30

DC to 50MHz, DC to 30kV,
pulse 40kV

Specifications and performance

Input/output ratio: 1000:1
Input RC: 100MΩ,
5pF ± 2pF DC to
50MHz

Current Probes

SS-250 CE

DC to 100MHz,
MAX 30A rms

SS-240A CE

DC to 50MHz,
MAX 30A rms

SS-270 CE

DC to 2MHz,
MAX 500A rms

SS-260 CE

DC to 10MHz,
MAX 150A rms

Specifications and performance

Model		SS-250	SS-240A	SS-270	SS-260
Frequency Bandwidth		DC to 100MHz(-3dB)	DC to 50MHz(-3dB)	DC to 2MHz(-3dB)	DC to 10MHz(-3dB)
Maximum input current	Maximum input range	30A rms	30A rms	500A rms	150A rms
	Maximumpeak current	50A peak, non-continuous	50A peak, non-continuous 50A peak at pulse width <= 10 µs	700A peak, non-continuous	300A peak, non-continuous
Output sensitivity		0.1 V/A		0.01V/A	
Sensitivity accuracy		±1.0% of reading ±10mA for probes only (in the range from 0 to 30A rms, DC, and AC 45 to 66Hz)		±1.0% of reading ±5mV for probes only (in the range from 0 to 500A rms, DC, and AC 45 to 66Hz)	±1.0% of reading ±1mV for probes only (in the range from 0 to 150A rms, DC, and AC 45 to 66Hz)
		±2.0% of reading for probes only (50A peak or less and over 30A rms, DC, and in the range of AC 45 to 66Hz)		±2.0% of reading for probes only (700A peak or less and over 500A rms, DC, and in the range of AC 45 to 66Hz)	±2.0% of reading for probes only (300A peak or less and over 150A rms, DC, and in the range of AC 45 to 66Hz)
Noise		2.5mA rms or less (observed with an 20MHz oscilloscope)		25mA rms or less (observed with an 20MHz oscilloscope)	
Power consumption		5.3VA max.	5.6VA max.	7.2VA max	5.5VA max
Measureble wire diameter		ø5mm		ø20mm	

PS-26

POWER supply for SS-250/SS-240A/SS-270/SS-260

Delay Pattern Generator (6 channel pulse generator)

DG-8000

Seamless change

The frequency, pulse width, and other settings can be seamlessly changed during oscillation.

Tracking function

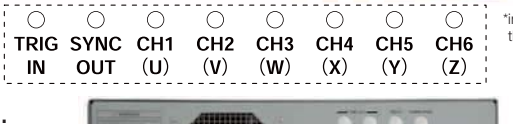
Parameters can be changed simultaneously for each channel.

Operation pattern control (DG-802)

The operation pattern option enables continuous operation testing.

Synchronization of multiple generators (DG-602)

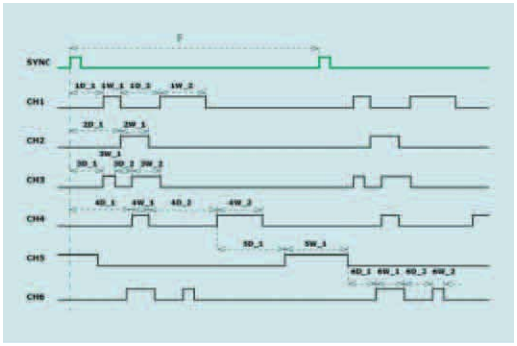
The quick synchronization option enables three generators (18 channels) to synchronously output data.



*input/output on the front

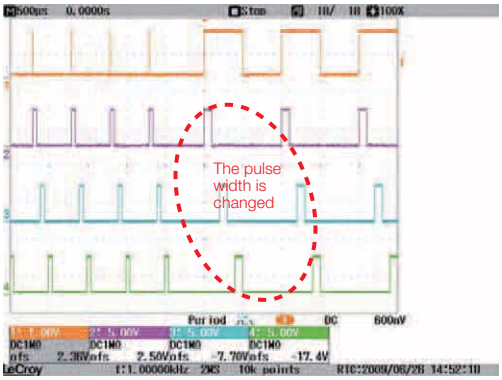
Rear panel configuration of a standard model

Setting parameters and output examples of 6 channel independent pulse output



BASIC mode

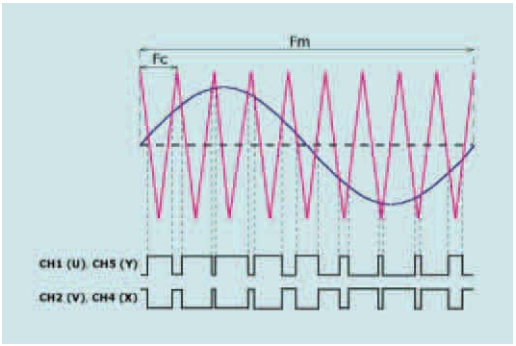
Pulses can be easily generated by specifying any dependency, delay value, and width value for each of 6CH. The output level can also be individually specified for each CH.



Tracking function

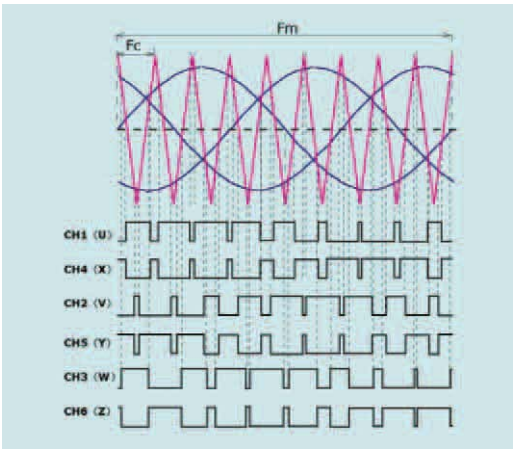
The pulse width, delay time, and other settings can be changed simultaneously for any combination of CH. Output example when the pulse width of channels 1 to 3 is changed simultaneously.

Signal generation method and output examples of the inverter option



Single-phase bipolar output in the INVERTER mode

Pulses can be easily generated by specifying the carrier frequency (Fc), modulation signal frequency (Fm), and modulation depth (that is, the rate of the modulation signal amplitude to the carrier amplitude).



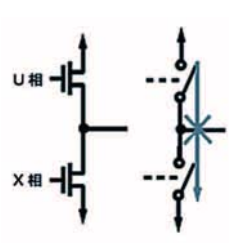
3-phase 2-level in the INVERTER mode

Pulses can be easily generated by specifying the carrier frequency (Fc), modulation signal frequency (Fm), and modulation period (that is, the rate of the modulation signal amplitude to the carrier amplitude).

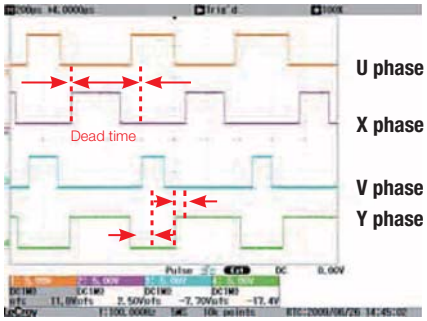
Lineup

Items	Product name	Model number	Incorporated function
Main unit	Delay pattern generator	**DG-8000**	—
Software option	Inverter and PPG option	**DG-801**	INVERTER mode
			PPG mode
	Test adapter	**DG-802**	Operation pattern function
Hardware option	External modulation option	**DG-601**	External modulation function
	Quick synchronization option	**DG-602**	Quick synchronization function

Gap control to prevent the high and low side switches of devices from being turned on simultaneously

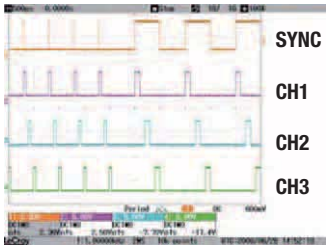


Short circuits are dangerous

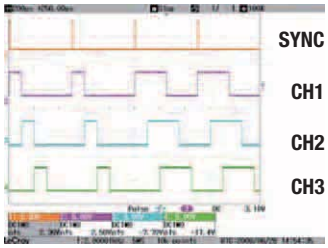


If the phase U and X devices in the above illustration are turned on at the same time, they short-circuit, causing danger and damage.
The DG-8000 gap time control function automatically generates the specified dead time as shown in the illustration. Even if the frequency or cycle changes, the dead time remains constant. The gap time can be changed even during oscillation. It is also possible to turn devices on at the same time by specifying a negative value.

Independent control of the time axis and vertical axis



Changing the frequency



Changing the output level

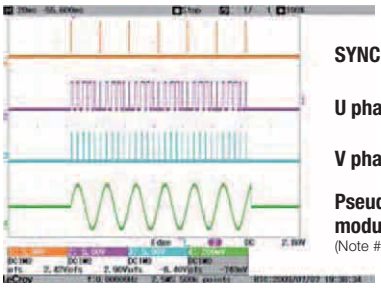
The parameters related to the time axis and those related to the vertical axis are separately controlled. These parameters can be changed manually or by using remote commands.

Support of ORed output on channel 1

Channel 1 has an ORed output function, which logically adds up to 6 sets of double pulses, making twelve pulses of specified channels, and outputs the result.

Easy generation of PWM signals

The inverter and PPG option (DG-801) enables you to output control signals for the buck chopper, single-phase uni-polar, single-phase bi-polar, and 3-phase 2-level. The modulation frequency and modulation depth can be changed even during oscillation. This is convenient for testing inverters because it is possible to obtain output to which pulse width modulation created from the inner sine wave and triangle wave is applied.



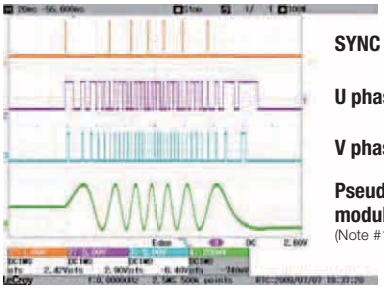
Note #1:
The modulation signal is shown only for explanatory purposes. This signal is not output from the DG-8000.

When using the PPG function, this generator functions as a signal generator for complicated logic modulation waves on 6 channels using predetermined pulse patterns. Waveform patterns can be created using the waveform creation application (which is available free of charge.)

Configuration example
DG-8000 main unit: 1
DG-801 inverter and PPG option: 1

Variable control of the PWM signal frequency

The operation pattern option (DG-802) is convenient for continuous operation testing because it enables variable control of the frequency and modulation depth (in the inverter mode only). The patterns for such control are controlled using predetermined arbitrary waveforms. These waveforms can be created using the waveform creation application (which is available free of charge.)



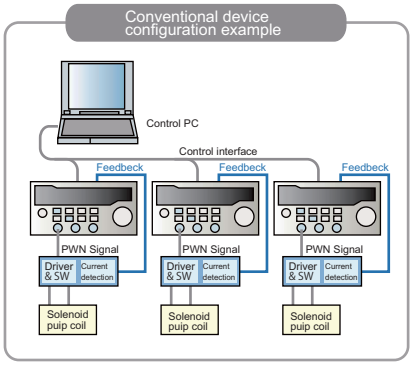
The illustration on the left shows an example of when a trapezoid waveform signal is used to apply frequency modulation.

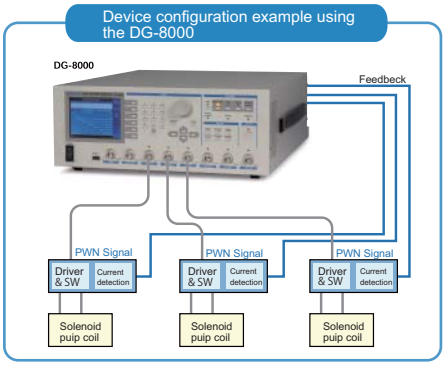
Note #1:
The modulation signal is shown only for explanatory purposes. This signal is not output from the DG-8000.

Configuration example
DG-8000 main unit: 1
DG-801 inverter and PPG option: 1
DG-802 operation pattern option: 1

In the inverter mode, faulty patterns during the gap time can be inserted intentionally at regular intervals by using the error insertion function.

Application example: Continuous operation test of solenoid and other elements that control electromagnetic valves



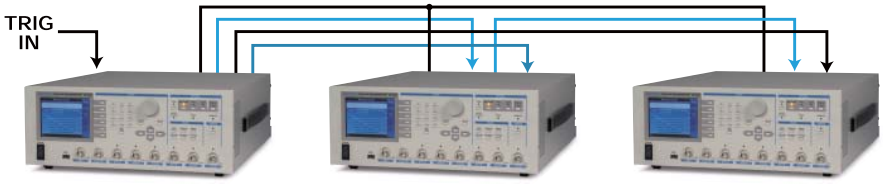


The external modulation option (DG-601) enables external control of the following functions:

- Modulation of the pulse width and delay in the basic mode
- Control of the modulation depth in the inverter mode
- Control of the frequency and modulation depth for operation patterns

Configuration example
DG-8000 main unit: 1
DG-802 operation pattern option: 1
DG-601 external modulation options

Parallel operation of three generators to support output from 18 channels



6 channels + 6 channels + 6 channels = 18 channels

The quick synchronization option (DG-602) quickly enables up to 3 generators to synchronously operate by connecting BNC cables to the rear panel. If one of the generators goes down, the remaining two generators also shut down their output as a failsafe when this function is used.

Configuration example
DG-8000 main unit: 1
DG-602 quick synchronization options: 3

Delay Pattern Generator DG-8000 Specifications

Common specifications

Pulse output terminal	
Number of channels	6CH
Output level	±10V (open) / ±5V (50ohm)
Output range	2 ranges (large/small)
Output logic	Positive/negative
Output impedance	50 ohm
ORed output	Effective channels among channels 1 to 6 are ORed and the result is output (from channel 1)
Other output terminals	
SYNC OUT output	BNC terminal (1)
IRREGULAR output	BNC terminal (1)
ALARM output	BNC terminal (1)
10 MHz REF output	BNC terminal (1)
REAR TRIG output	Quick synchronization operation option (DG-602), BNC terminal (1)
Input terminals	
TRIG	BNC terminal (1), input: ±5V,max., threshold: ±1/2 of input level, variable
TRIG INH/RDY	BNC terminal (1), TTL level
Emergency stop input	BNC terminal (1), TTL level
10 MHz REF input	BNC terminal (1), 1V P-P ±100ppm or less required
Frequency control input	For the external modulation option (DG-601) and operation pattern option (DG-802), BNC terminal (1)
External modulation (PWM)	For the external modulation option (DG-601), BNC terminal (3)
REAR TRIG input	For the quick synchronization operation option (DG-602), BNC terminal (1)
ALARM SENSE input	For the quick synchronization operation option (DG-602), BNC terminal (1)
Output control	
Oscillation start/stop	The button to turn all channels on or off immediately
Individual setting	To turn all channels on or off immediately
When oscillation stops	Select relay OFF or set the output level to 0.
LED indicators	
TRIG'd	Indicates when TRIG is applied.
OUTPUT, channels 1 to 6	Indicates when output is enabled and on.
REMOTE	Indicates up in the REMOTE status.
INHIBIT/READY	Indicates up when oscillation is READY.
Pulse generation	
Oscillation mode	CONT, TRIG'd CONT, TRIG, GATE
Gap control	Supported. *Gap control is a function that ensures non-overlapping time when phases V and X, phases U and Y, and phases W and Z overlap each other by specifying a delay or pulse width. This function can be also used to intentionally make these phases overlapped.
Interface	
TRIG'd	USB1.1 storage function only (Waveform file and Setup file)
Remote (LAN)	100BASE-TX, 10BASE-T
Remote (GPIB)	Supported as standard
Screen display	
LCD	4.7-inch color LCD
Resolution	320 x 240 pixcels
Others	
SETUP save/recall	Supported (10 internal memories)
Power-saving mode	Supported
Beep function	Supported
Status display	Supported
Power supply unit	
AC power supply	AC 100V to AC 240V (50/60 Hz)
Power consumption	190VA,max
Mechanical section	
External dimensions (mm)	Approx. 400 (W) x 150 (H) x 497 (D) (without external projections)
Weight	Approx. 8kg
Environment	
Operating temperature	0°C to +40°C (without condensation)
Operating humidity	85% R.H. or less at +40°C
Storage temperature	-20°C to +60°C
Accessories	
Power cable	1
Operation manual	CD-R (1)

The following modulations can be applied by using the DG-601 external modulation option when the main unit function is in the Basic mode:

PWM modulation
The pulse width can be changed by an external input signal. The modulation depth can be individually specified for each external input channel (U/V/W) and freely allocated to output channels.
Delay modulation
The delay value can be changed by an external input signal. The modulation depth can be individually specified for each external input channel (U/V/W) and freely allocated to output channels.

Other specifications

BASIC mode	
Mode	Independent control of 6 CH, 3-phase pattern A/B
6 independent channels	
Number of pulses	SINGLE pulse/ DOUBLE pulse
Frequency/cycle	1mHz to 10MHz (1mHz or 9-digit resolution) 100ns to 1,000 s (10ns or 9-digit resolution)
Frequency/cycle accuracy	±50ppm
Standard channel	Select SYNC or both edges of the smallest channel
Delay	0ns, 10ns to 1,000s (10ns or 9-digit resolution)
Pulse width	0ns, 50ns to 1,000s (10ns or 9-digit resolution)
PHASE	0° to 360° (minimum resolution: 0.01°, frequency-dependent) 0% to 100% (minimum resolution: 0.001%, frequency-dependent)
DUTY	0° to 360° (minimum resolution: 0.01°, frequency-dependent) 0% to 100% (minimum resolution: 0.001%, frequency-dependent)
Gap time setting	0 to ±1 cycle or 1 s, max.
Gap resolution	Frequency specifying : Gap in 20 ns or 6 digits Cycle specifying : Gap in 10 ns or 6 digits
Frequency dividing function	Supported
Frequency dividing setting range	1 to 65,535
Tracking	Multiple parameters can be changed simultaneously.
Internal modulation	PWM modulation and delay modulation
3-phase pattern A	
Oscillation mode	CONT, TRIG'd CONT, GATE
Cycle (Tc)	Determined by setting Tw1 and Tw2. Tc = (Tw1+Tw2) x 3
Tw1 and Tw2 setting range	0 ns, 100 ns to 100 s
Tw3 setting range	0 ns, 100 ns or more (Fc minus- Tw1)
Pulse width setting resolution	100 ns or 9 digits
Gap control	By setting Tw3.
Operation change during oscillation	Parameters can be seamlessly changed.
3-phase pattern B	
Oscillation mode	CONT, TRIG'd CONT, GATE
Cycle (Tc)	Determined by setting Tw and Tw3. Tc = Tw2+Tw3
Tw1 setting range	0ns, 100 ns to 100 s
Tw2 setting range	0ns, 100 ns or up to more (Fc-2 x Tw1)
Tw3 setting range	100ns to 100s
Pulse width setting resolution	100ns or 9 digits
Gap control	Realized by setting Tw2.
Operation change during oscillation	Parameters can be seamlessly changed.

Inverter mode (with the DG-801 inverter and PPG option mounted)	
Mode	Buck chopper, single-phase uni-polar, single-phase bi-polar 3-phase 2-level
Common setting parameters	
Carrier frequency	100 mHz to 1 MHz
Modulation frequency	1 mHz to 10 kHz
Other parameters	Modulation depth, modulation steps, gap time, and others

PPG mode (with the DG-801 inverter and PPG option mounted)	
Frequency specifying mode	
Frequency	1mHz to 10MHz (1mHz or 6-digit resolution)
Memory length	10kW or 100kW
Clock specifying mode	
CK frequency	100Hz to 100MHz (resolution: 1mHz or 6 digits)
Memory length	10kW or 100kW

Operation pattern (with the DG-802 operation pattern option mounted)	
Frequency control	The frequency (cycle) can be controlled using any waveform or external input.
Frequency control input	BNC terminal (1)
Modulation control	INVERTER mode only. The modulation can be controlled using any waveform or external input.
Faulty pattern insertion	Supported

External modulation (with the DG-601 external modulation option mounted)	
External modulation input	BNC terminal (3)
Frequency control input	BNC terminal (1)
Input range	2 ranges (-2 to +2V or 0 to +2V)
Input impedance	Approx. 1M ohm
Resolution	12 bits
Frequency characteristics	100kHz, amplitude of 90% or more (1kHz standard)

External modulation (with the DG-601 external modulation option mounted)	
REAR TRIG output	BNC terminal (2)
REAR TRIG input	BNC terminal (1)
ALARM SENSE input	BNC terminal (1)

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