



PPH-Series

Programmable High Precision DC Power Supply

FEATURES

- 3.5" TFT LCD Display
- High Measurement Resolution: 1 mV/0.1 μ A for 5 mA range.
- Transient Recovery Time: $\leq 40 \mu$ S within 100 mV ; $< 80 \mu$ s within 20 mV
- Current Sink Function
- Pulse Current Measurement (Pulse width min. : 33 μ s)
- Long Integration Current Measurement
- Built-in DVM Measurement Function
- Sequence Function (Sequence power output)
- Built-in Battery Simulation Function (CH1 of PPH-15xxD)
- OVP, OCP, OTP & Temperature Display for Heat Sink
- Support USB (Device & Host)/GPIB/LAN
- Five Groups of Save/Recall Setting
- External Relay Control

GW INSTEK
Simply Reliable

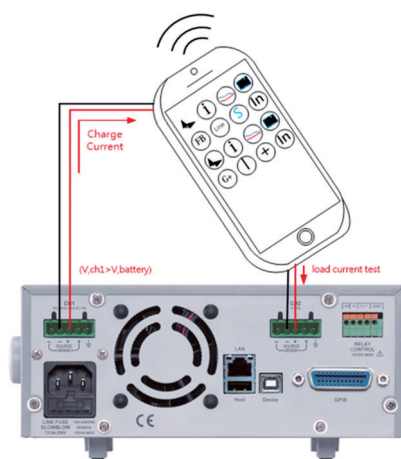
Swift Responses with Accurate Measurement

PPH-Series high precision measurement capability achieves the maximum resolution of 1 mV/0.1 μ A and the smallest pulse current width of 33 μ s that satisfy customers' measurement application requirements of high resolution and pulse current. Fast load current variation will result in voltage sag for general power supplies that will have an impact on DUT's internal circuit operation. PPH-Series is equipped with the excellent transient recovery time, which can, in less than 40 μ s, recover the output voltage to within 100 mV of the previous voltage output when the current level changes from 10 % to 100 % of the full scale. Furthermore, conventional power supplies do not have sufficient response speed to promptly respond to set voltage value once the set voltage is changed. PPH-15xxD has a rise time of 0.2 ms and a fall time of 0.3 ms, which are 100 times faster than that of conventional power supplies. Therefore, PPH-15xxD can provide DUT with a stable output voltage even when DUT is operating under large transient current output. The internal high-speed sampling circuit design of PPH-15xxD, with the sample rate of 64 K, can conduct pulse current measurement without using a current probe and oscilloscope. The current read back accuracy is 0.2 %+1 μ A (equals to 11 μ A) at 5 mA range, and the read back resolution is 0.1 μ A that allow DUT to be measured with a high accuracy level. Unlike battery, general power supplies, which do not have the characteristics of fast transient recovery time, can not maintain a stable power supply for cellular phone, wireless device, and wearable device which produce large transient pulse current load for hundreds of μ s to dozens of ms when in use. PPH-15xxD, different from general power supplies, has the characteristics of fast transient recovery time. While simulating battery to output pulse current, PPH-15xxD can quickly compensate the voltage drop caused by pulse current. PPH-15xxD's CH1 has the built-in battery simulation function, which can define output impedance settings so as to accurately simulate battery's impedance characteristics during battery discharge. Fast transient recovery time and built-in battery simulation function together facilitate PPH-15xxD to accurately simulate battery's real behavior pattern so as to conduct product tests.

PPH-15xxD is not only suitable for simulating battery, charger and supplying power to DUT, but also ideal for simulating an electronic load to conduct discharge tests with its sink current capability. The sink current function allows PPH-15xxD to simulate a voltage source with the sink current capability. The maximum sink current of PPH-15xxD's CH1 is 3.5 A and for CH2 is 3 A. Long integration current measurement can be utilized to conduct average current measurement for periodical pulse current in a long period of time that is applied to analyze power consumption for a period of time. One of the applications is to measure the average power consumption of a cellular phone in use so as to conduct the internal RF module parameter analysis. The maximum pulse current measurement range of CH1 is 5 A and for CH2 is 3 A. The built-in sequence function of CH1 provides users with 1000 steps to edit sequential outputs, including voltage, current and execution time. The built-in DVM function of CH2 has a voltage range from 0 to +20VDC that saves users the cost of purchasing an additional voltage meter.

PPH-15xxD provides OTP function and shows heat sink temperature on the upper right corner of the display screen. Other than that, features such as five sets of system setting values for the SAVE/RECALL function, 10 sets of Power On Setup Settings, Key-Lock function to prevent unauthorized inputs, temperature-controlled fan to reduce noise, hardcopy to save screen information, and external relay control device together augment PPH-15xxD's usability. PPH-Series supports test requirements of Profile1, Profile2 and Profile3 from USB Power Delivery(PD) constructed by USB-IF association.

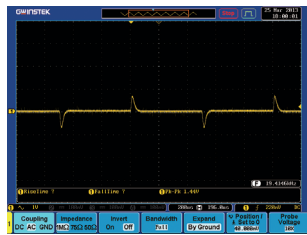
A. MOBILE COMMUNICATIONS APPLICATIONS



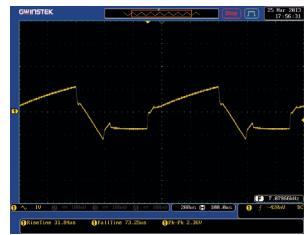
The battery simulation function and pulse current measurement function of PPH-15xxD are ideal for mobile communications measurements including tests of cellular phone, wireless, blue tooth peripheral and wearable device. Monitoring pulse current of cellular phone in use is a very important test, which can be done by using one channel to simulate load and the other channel to simulate USB charging device. By so doing, charging and measuring current changes can be achieved at the same time.

A Charger-simulating Source and Load Current Test

B. FAST RESPONSE TO LOAD AND VOLTAGE CHANGES



PPH-Series



Conventional Power Supply

When DUT such as cellular phone switches to idling, receiving or transmitting mode, the current drawn from power supply changes over tenfold. The sudden current change will cause the supplied voltage to drop as well. The conventional power supply is considered a dull device since it will take several milliseconds for the dropped voltage to return to the original level. PPH-15xxD is designed to simulate battery response when a significant voltage

drop occurs. Recovery time of 40 μ s or less is guaranteed when the maximum voltage drop is within 100mV. Moreover, when users change the voltage level and conventional power supply does not have sufficient speed to reach the set level, PPH-15xxD provides a rise time of 0.2 ms and a fall time of 0.3 ms, which are hundreds times faster than that of the conventional power supplies.

C. ACCURATE LOW CURRENT MEASUREMENT



0.1 μ A Resolution for PPH-Series

PPH-Series provides 0.2 %+1 μ A readback accuracy and 0.1 μ A resolution for high precision of current measurement. For example, when portable device works in the sleep or standby

mode, the current is drawn at a low level. The low current consumption under standby or sleep mode can be measured accurately.

D. MEASUREMENTS FOR POWER CONSUMPTION ANALYSIS



Voltage and Current Waveforms of the Receiving Signals of a Cellular Phone

One particular requirement of power consumption for portable wireless communications devices is Pulse Current. Portable devices such as cellular phones must transmit and receive (detect) signal periodically by drawing pulse current instead of constant current from battery to ensure devices' sound connection in network. To analyze the transient power consumption of a DUT, the peak of short pulse current and average current measurements

over a long period of time are crucial. PPH-Series provides pulse current and long integration functions, the former can measure the peak value of a pulse, the latter can measure the average value of pulses. PPH-Series provides DUT with pulse current measurement and analyzes the transient power consumption to qualify the device for specified power consumption requirements.

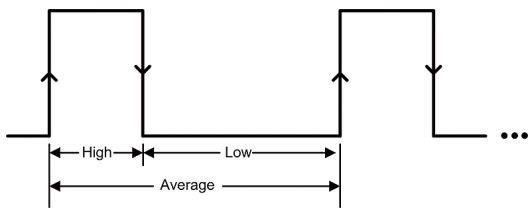
E. LONG INTEGRATION CURRENT MEASUREMENT



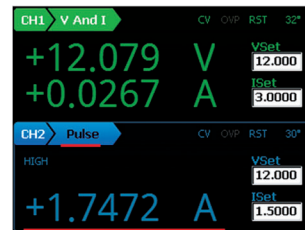
Long Integration Current Measurement

Long integration current measurement is to measure the average current of periodical pulse current in a long period of time. The measured pulse current must be a complete periodical waveform or multiple complete periodical waveforms. The total measurement time is up to 60 seconds. Measurements can be taken from pulse's positive edge trigger or negative edge trigger. Users can also take measurements from the beginning of power output. Long integration current measurement is to analyze power consumption for a period of time. For instance, users can measure the average power consumption of a cellular phone in use to analyze its internal RF module parameters.

F. PULSE CURRENT MEASUREMENTS



The Time Specified for the Measurement



Pulse Current Measurement

PPH-Series DC power supply can perform current measurements for pulsing loads. Its several built-in measurement modes include :

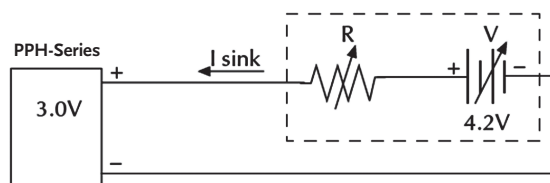
- High Measured Current—measure the peak current of the pulse train.
- Low Measured Current—measure the low current of the pulse train.
- Average Transmit Current—measure the average current of the pulse train.

The high, low, and average measurements of a pulse are illustrated as above :

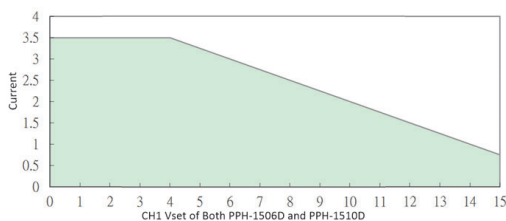
To avoid false pulse detection, users can use a trigger level of up to 5A(CH1). All pulses, noise or other transients that are less than set trigger level will be ignored. The manual integration time range setting is 33 μ s to 833,333 μ s. Pulse current measurement can measure transient current consumption to provide the information for the allocation of power supply system for products' preliminary design, i.e. power supply circuits, battery selections for clients' product analyses. Portable communications products, i.e. RF modules and designs based upon blue tooth system can better use pulse current measurement function.

G. SINK CURRENT FUNCTION

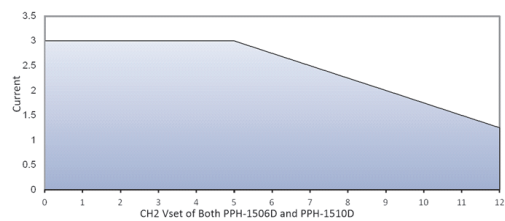
PPH-Series and an Electrical Potential Circuit



Allowable Sink Current for 3.5A



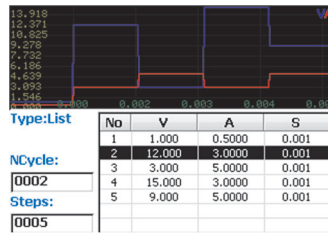
Allowable Sink Current for 3A



When connecting with an electric potential circuit and the output voltage of the tested electric potential circuit is greater than that of PPH-Series by approximately 0.3V to 2.5V, PPH-Series will automatically convert its power supply role to the sink current role acting as a load of voltage source. At this time, the voltage setting

of PPH-Series can be regarded as the CV setting of an electronic load. A single PPH-Series can be used to charge battery and to simulate battery's load to consume power without extra instruments. PPH-Series is ideal for tests on battery and portable charger.

H. SEQUENCE FUNCTION

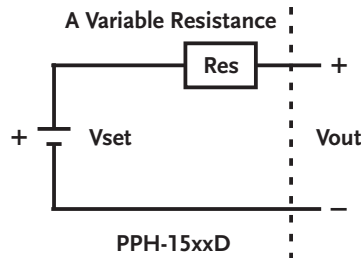


Functional Setting Page for Sequence Function

For the practical usage, PPH-15xxD can be programmed to output a sequential voltage variation according to the requirements. There are 1000 steps for users to edit output voltage, current and execution time. Programmable execution

time range is from 0.001 second to 3600 seconds and the resolution is 0.001 second. Programmable recurring frequency is from 1 to 9999 or it can be set to infinite execution (set recurring frequency to 0).

I. BATTERY SIMULATION FUNCTION

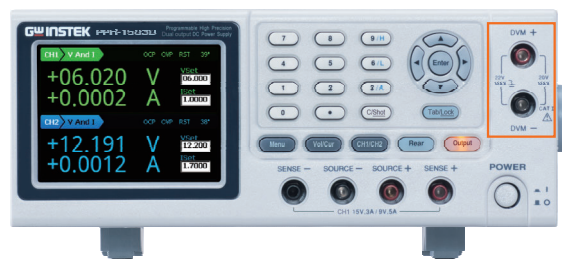


Battery Equivalent Model

PPH-15xxD's battery simulation function is equivalent to a variable resistance circuit internally connected in series to simulate battery's output impedance. The function can also be regarded as a power supply with a variable internal resistor. The variable internal resistance range is from 0.000Ω to 1.000Ω and

the resolution is $1m\Omega$. PPH-15xxD can be utilized as a battery or an ideal voltage source V_{set} to be connected with variable resistance Res in series. The following diagram shows battery simulation to produce output voltage V_{out} .

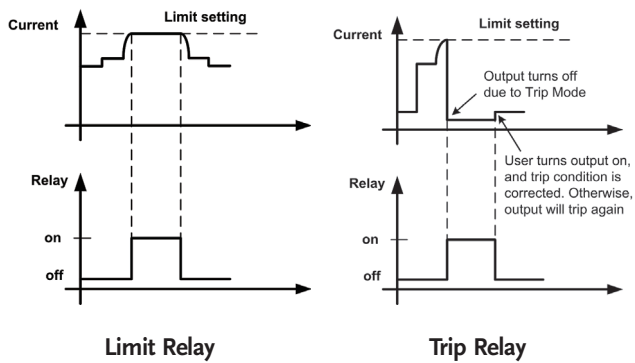
J. BUILT-IN DIGITAL VOLTMETER



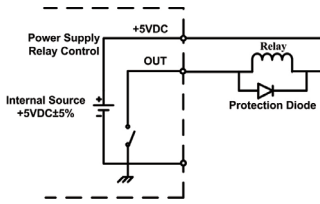
DVM Input for PPH-15xxD

The built-in Digital Volt-Meter (DVM) of PPH-Series has a dedicated input terminal located on the front panel. With the DC voltage measurement range from 0 to +20VDC, PPH-Series not only provides power supply for DUT but also measures the voltage on DUT. The read back accuracy reaches $\pm(0.05\%+3mV)$ and read

back resolution is 1mV. Users are able to save the cost of purchasing an extra voltage meter. Furthermore, DVM measurements can be remotely controlled by SCPI commands via a PC.

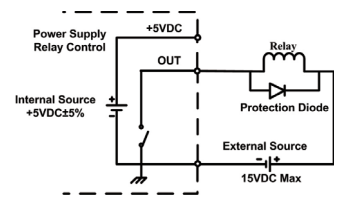


Relay Can be Driven by Using Internal +5 V or External Power Source :



+5 VDC Relay Output

Using the +5 VDC relay output to drive an external relay. Ensure the current does not exceed 150 mA.



External Power Source

Using an external power source to drive the external relay. The voltage of the source can not exceed 15 V and the current can not exceed 150 mA.

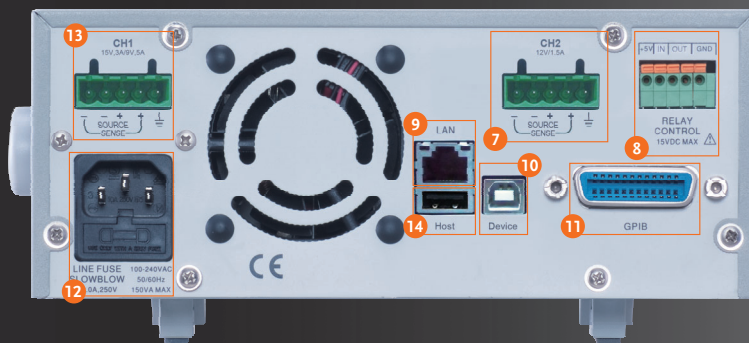
PPH-Series provides Limit relay and Trip relay modes and is equipped with corresponding output ports, in which output signals control external relay. Under Limit relay mode and the current limit is reached, PPH-Series will switch from Constant Voltage to Constant Current automatically. Under "Trip relay" mode and the current limit is reached, PPH-Series will turn output off. Furthermore, External Relay control can be used if users simultaneously use other devices for test system. When "Limit Relay" mode is selected and the current limit is reached, External

Relay control signal will go high and will return back to the low level when the current level goes back below the constant current setting. When "Trip Relay" mode is selected and the current limit is reached, the relay control signal will go high and the output is disabled. When the output goes back on and the current is less than the current setting, the relay control signal will back to the low level. Users can use relay control signal to control other devices for test system.

SELECTION GUIDE

Model		PPH-1503D	PPH-1506D	PPH-1510D
Channel		2	2	2
Dual Range Output	Channel 1	0 V to 15 V / 0 A to 3 A or 0 V to 9 V / 0 A to 3 A	0 V to 15 V / 0 A to 3 A or 0 V to 9 V / 0 A to 3 A	0 V to 15 V / 0 A to 3 A or 0 V to 9 V / 0 A to 3 A Rear Terminal: 0 A to 10 A (0 V to 4.5 V)
	Channel 2	0 V to 12 V / 0 A to 1.5 A	0 V to 12 V / 0 A to 3.0 A	0 V to 12 V / 0 A to 3.0 A
Display		3.5-inch TFT LCD	3.5-inch TFT LCD	3.5-inch TFT LCD
Current Measurement Range		5 A / 500 mA / 5 mA (CH1)	5 A / 500 mA / 5 mA (CH1)	5 A / 500 mA / 5 mA (CH1)
CV & CC		V	V	V
DVM Measurement Function		V (CH2)	V (CH2)	V (CH2)
Pulse Current Measurement		V	V	V
Long Integration Current Measurement		V	V	V
Battery Simulation		V (CH1)	V (CH1)	V (CH1)
Automated Sequential Output		V (CH1)	V (CH1)	V (CH1)
High Measurement Resolution		V (1 mV / 0.1 μA)	V (1 mV / 0.1 μA)	V (1 mV / 0.1 μA)
Sink Current Capability		V (Max: 3.5 A)	V (Max: 3.5 A)	V (Max: 3.5 A)
Selectable Output From Front or Rear Panel		V	V	V
Relay Output Control		V	V	V
Memory		5 sets	5 sets	5 sets
Sample Rate		64 k	64 k	64 k
Lock Function		V	V	V
Protection Function		OVP, OCP, OTP	OVP, OCP, OTP	OVP, OCP, OTP
Four Wire Output Open Circuit Protection		V	V	V
Temperature Display for Heat Sink		V	V	V
Standard Interface	GPIO	V	V	V
	USB	V (TMC)	V (TMC)	V (TMC)
	LAN	V	V	V

PANEL INTRODUCTION



1. LCD Display
2. Operation Keys
3. Voltmeter Terminals (DVM)
4. Function Keys
5. Output Terminals (SOURCE and SENSE)
6. Power On/Off Switch
7. CH2 Output
8. External Relay Control Port
9. LAN Port
10. USB Port
11. GPIB Port
12. AC Power Socket and Fuse
13. CH1 Output
14. USB Port (Host)

ORDERING INFORMATION

PPH-1503D	63 W High Precision Dual Channel Output DC Power Supply (CH1: 15 V / 3 A or 9 V / 5 A, CH2: 12 V / 1.5 A)
PPH-1506D	81 W High Precision Dual Channel Output DC Power Supply (CH1: 15 V / 3 A or 9 V / 5 A, CH2: 12 V / 3.0 A)
PPH-1510D	81 W High Precision Dual Channel Output DC Power Supply (CH1: 15 V / 3 A or 9 V / 5 A or 4.5 V / 10 A (Rear Terminal); CH2: 12 V / 3 A)

ACCESSORIES

Power cord x 1 (Region dependent), Test Lead GTL-207A x 1, GTL-203A x 1, GTL-204 x 1

OPTIONAL ACCESSORIES

GTL-203A	Test Lead, Banana to Alligator, European Terminal, Max. Current 3 A, 1000 mm
GTL-204A	Test Lead, Banana to Alligator, European Terminal, Max. Current 10 A, 1000 mm
GTL-207A	Test Lead, Banana to Probe Test Lead, 800 mm
GTL-246	USB Cable (USB 2.0 A-B Type, approx. 1200 mm)
GRA-450-J	Rack Mount Kit for JIS type
GRA-450-E	Rack Mount Kit for EIA type

FREE DOWNLOAD

PC Software, LabVIEW Driver

SPECIFICATIONS		
OUTPUT RATING		
Number of Output Channel	2	
Channel No.	CH1	CH2
Max. Power	45 W	PPH-1503D: 18 W ; PPH-1506D: 36 W ; PPH-1510D: 36 W
Typical Reading Time *2 *3	31 ms	
DC GENERAL		
Measurement Time Choices *1	0.01 to 10 PLC, 0.01 PLC/step	
Average Readings	1 to 10	
Typical Reading Time *2 *3	31 ms	
DC VOLTAGE OUTPUT (23 °C ± 5 °C)		
Output Voltage	0 V to 15 V	0 V to 12 V
Output Accuracy	± (0.05 % + 10 mV)	
Programming Resolution	2.5 mV	
Readback Accuracy *3	± (0.05 % + 3 mV)	
Readback Resolution	1 mV	
Output Voltage Rising Time	0.20 ms (10 % to 90 %)	
Output Voltage Falling Time	0.30 ms (90 % to 10 %)	
Load Regulation	0.01 % + 2 mV	
Line Regulation	0.5 mV	
Stability *4	0.01 % + 0.5 mV	
Recovery Time (1000 % Load Change)	< 40 μs (< 100 mV, Rear); < 50 μs (< 100 mV, Front); < 80 μs (< 20 mV)	
Ripple & Noise *5	3 mVrms (0 to 1 MHz); 8 mVpp (20 Hz to 20 MHz) (≤ 5 A); 12 mVpp (20 Hz to 20 MHz) (> 5 A)	
DC CURRENT OUTPUT (23 °C ± 5 °C)		
Output Current	0 A to 5 A (0 V to 9 V) or 0 A to 3 A (9 V to 15 V) 0 A to 10 A (Rear 0 V to 4.5 V) (1510D at Rear Output)	0 A to 1.5 A (PPH-1503D) 0 A to 3.0 A (PPH-1506D/1510D)
Source Compliance Accuracy	1.5 A / 3.0 A & 5 A range: ± (0.16 % + 5 mA) ; 500 mA range: ± (0.16 % + 0.5 mA) ; 5 mA range: ± (0.16 % + 5 μA)	
Programmed Source Resolution	5 A range: 1.25 mA 500 mA range: 0.125 mA 5 mA range: 1.25 μA	1.5 A / 3.0 A range: 1.25 mA
Readback Accuracy *3	5 A range: ± (0.2 % + 400 μA) 500 mA range: ± (0.2 % + 100 μA) 5 mA range: ± (0.2 % + 1 μA)	1.5 A / 3.0 A range: ± (0.2 % + 400 μA) 5 mA range: ± (0.2 % + 1 μA)
Readback Resolution	1.5 A / 3.0 A & 5 A range: 100 μA ; 500 mA range: 10 μA ; 5 mA range: 0.1 μA	
Current Sink Capacity	0 V to 4 V: 3.5 A 4 V to 15 V: 3.5 A - (0.25 A/V) x (Vset - 4 V)	0 V to 5 V: 2 A (PPH-1503D) ; 3 A (PPH-1506D/1510D) 5 V to 12 V: 2.0 A - (0.1 A/V) x (Vset - 5 V) (PPH-1503D) 3.0 A - (0.25 A/V) x (Vset - 5 V) (PPH-1506D/1510D)
Load Regulation	0.01 % + 1 mA	
Line Regulation	0.5 mA	
Stability *4	--	
DVM		
Input Voltage Range	0 VDC to 20 VDC	
Input Impedance	20 MΩ	
Maximum Input Voltage	-3 V, +22 V	
Reading Accuracy *3	± (0.05 % + 3 mV)	
Reading Resolution	1 mV	
PULSE CURRENT MEASUREMENT		
Trigger Level	5 mA to 5 A, 5 mA/step	5 mA to 1.5 A / 3.0 A, 5 mA/step
High Time/Low Time/Average Time	33.3 μs to 833 ms, 33.3 μs/step	
Trigger Delay	0 s to 100 ms, 10 μs/steps	
Average Readings	1 to 100	
Long Integration Pulse Timeout	1 s to 63 s	
Long Integration Measurement Time	850 ms (60 Hz) / 840 ms (50 Hz) to 60 s, or AUTO time 16.7 ms/steps (60 Hz), 20 ms/steps (50 Hz)	
Long Integration Trigger Mode	Rising, Falling, Neither	
RESISTANCE		
Range	0.001 Ω to 1.000 Ω	
Programmed Resolution	0.001 Ω	
Programmed Accuracy	± (0.5 % + 0.01 Ω)	
OVP		
OVP Range	Auto, OFF, ON (1.00 V to 15.2 V)	Auto, OFF, ON (1.00 V to 12.2 V)
Resolution	10 mV	
Accuracy	0.8 V	50 mV
OTHERS		
Output Terminal	Front/Rear Panel	Rear Panel
DVM Input	--	Front Panel
User_Definable Power_Up States	5 sets	
Rear Panel Connector	5 Pin x 2: Output x 2, Sense x 2, Ground x 1	
Temperature Coefficient	0.1 x specification / °C	
Relay Control Connector	150 mA / 15 V, 5 V output, 100 mA	
Insulation	Chassis And Terminal	20 MΩ or above (DC 500V)
	Chassis And AC Cord	30 MΩ or above (DC 500V)
GENERAL SPECIFICATIONS		
Display	3.5" TFT LCD	
Interface	USB (TMC), LAN, GPIB	
Programming	IEEE-488.2 (SCPI)	
Operation Environment	Temperature to satisfy the specification: 18 °C to 28 °C; Operating temperature: 0 °C to 40 °C Relative Humidity: ≤ 80 %, 0 °C to 40 °C Installation category: CAT II; Operating Altitude: 2000 meters	
Storage Environment	Temperature: -20 °C to 70 °C; Humidity: < 80	
Input Power *6	AC 100 V to AC 240 V, 50 Hz or 60 Hz	
Power Consumption	160 W (PPH-1503D), 180 W (PPH-1506D), 210 W (PPH-1510D)	
Dimensions	222 mm x 86 mm x 363 mm (W x H x D)	
Weight	Approx. 4.5 kg	

Note: *1. PLC = Power Line Cycle, 1PLC = 16.7 ms For 60 Hz Operation, 20 ms For 50 Hz Operation;
 *2. Display OFF, Speed Includes Measurement And Binary Data Transfer Out Of GPIB;
 *3. PLC = 1;
 *4. STABILITY: Following 15 Minute Warm-Up, The Change In Output Over 8 Hours Under Ambient Temperature, Constant Load, And Line Operating Conditions;
 *5. The Ground Ring Of The Probe Is Pressed Directly Against The Output Ground Of The Power Supply And The Tip Is In Contact With The Output Voltage Pin.
 *6. Auto Detected At Power-Up;

Specifications subject to change without notice. PH-15XXD SeriesGD1BH_202604

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