TEST REPORT

No.:RZ195200802

Sample Description: HYBRID SOLAR INVERTER

Model/Specification/Grade: PH18-5048 PLUS

Applicant: SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD

Applicant Address: 5F,Building 11,Rundongsheng Industrial Park,Longzhu,Xixiang,BaoanDistrict,Shenzhen,Guangdong,China

Date of Receipt: 2019-08-06

Test Period: 2019-08-26 to 2019-08-29

Test Location: Xili Experimental Base

Shenzhen Academy of Metrology & Quality Inspection (Stamp)

Approved by: 蔡纯(主任)

Issue Date：2019-08-31

Signature: 蔡纯

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Complaint hotline：0755-27528392（龙华 Longhua）

TEST REPORT

Sample Information：

Sample Description: HYBRID SOLAR INVERTER
Trade Mark: MUST
Model/Specification/Grade: PH18-5048 PLUS
Serial/Batch No. of Sample: ---------------
Manufactured Date: ---------------
Manufacturer: MUST（GUANGDONG）ENERGY TECHNOLOGY CO.,LTD
Manufacturer Address: ---------------
Sample Quantity: 1PC
Sample Description before Testing: Normal

Client Information：

Applicant: SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD
Applicant Address: 5F,Building 11,Rundongsheng Industrial Park,Longzhu,Xixiang,BaoanDistrict,Shenzhen,Guangdong,China
Applicant Telephone: 0755-29108002
Applicant Post Code: ---------------

Test Information：

Date of Receipt: 2019-08-06
Applicant No.: 7385737
Enviroment Condition: (25.4-26.8) ℃ （46-60） %RH
Sampling Method: Delivered by Applicant
Judgment Basis: IEC 61683:1999 Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
Test Standard: IEC 61683:1999 Photovoltaic systems - Power conditioners - Procedure for measuring efficiency

Test Conclusion：

See the report for details.

Tested by：陈官路 陈官路　　　　Checked by：李菊欢 李菊欢

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General product information:

The equipment is a multi-function inverter/charger, combining function of inverter, solar charger and battery charger to offer uninterruptiple power support with portable size. It's not only single phase stand-alone type inverter but also a single phase on-grid type inverter. The following illustration shows basic application of this equipment.

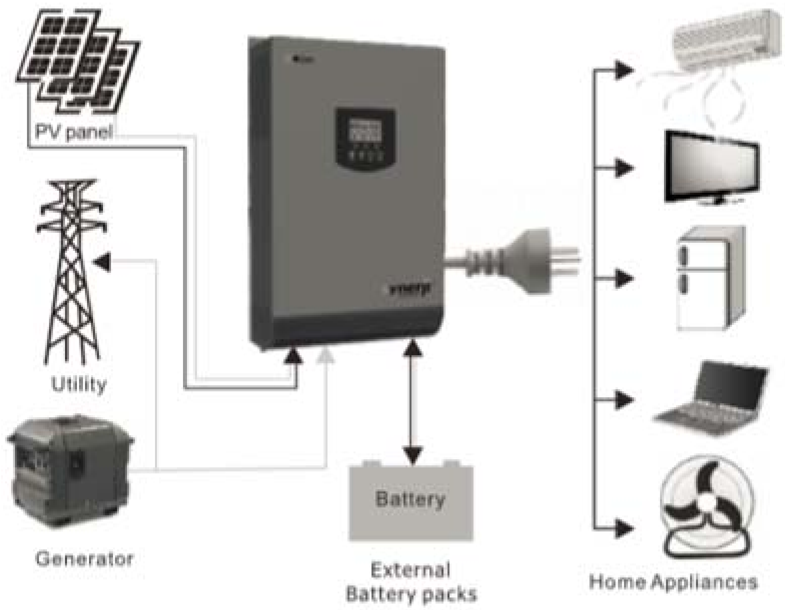

Figure 1 Hybrid Power System

Ratings:

Model	PH18-5048 PLUS
Input voltage (V)	48V d.c.
Input current (A)	118A
Rated output Voltage (V)	230Va.c
Rated output Current (A)	22A
Rated output Frequency (Hz)	50/60Hz
Rated output Power (W)	5000W
Out Voltage waveform	Pure Sine Wave
Weight (kg)	10.05
Size (mm) (W×D×H)	295*488*141

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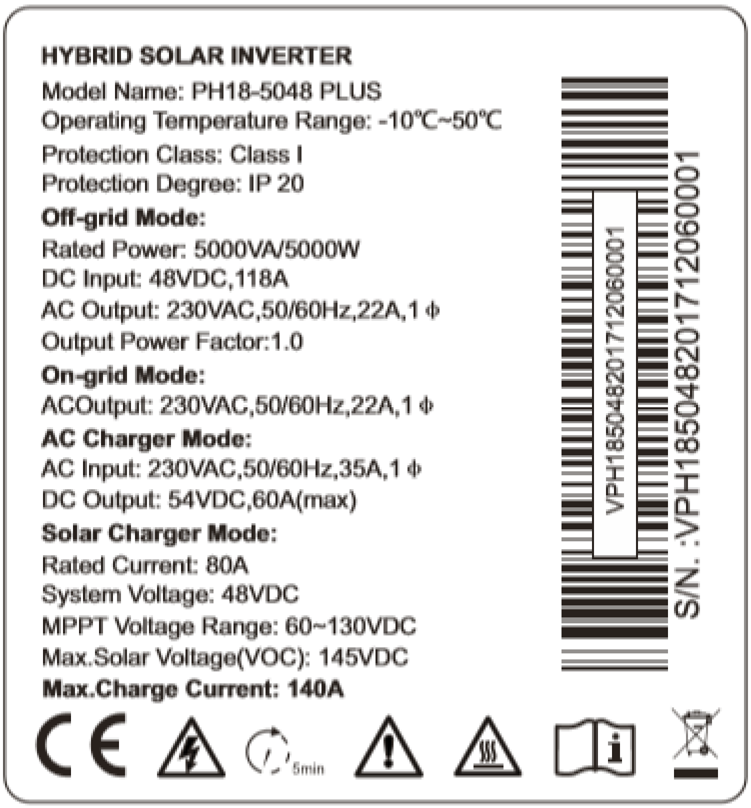
Copy of marking plate



Possible test case verdicts:

- test case does not apply to the test object .... :	N/A
- test object does meet the requirement .... :	Pass (P)
- test object was not evaluated for the requirement......:	N/E
- test object does not meet the requirement .... :	Fail (F)

TEST REPORT

Clause	Requirement-Test	Result-Remark	Verdict
4	Efficiency measurement conditions		P
	Efficiency is measured under the conditions in the following clauses.	Refer to Table 1.	P
	Specific conditions may be excluded by mutual agreement when those conditions are outside the manufacturer's allowable operating range.		N/A
4.1	DC power source for testing		P
	For power conditioners operating with fixed input voltage, the d.c. power source is a storage battery or constant voltage power source to maintain the input voltage	Constant voltage power source used to maintance the input voltage.	P
	For power conditioners that employ maximum power point tracking (MPPT) and shunt-type power conditioners, either a photovoltaic array or a photovoltaic array simulator is utilized.		N/A
4.2	Temperature		P
	All measurements are to be made at an ambient temperature of 25 °C ± 2 °C.	(25.4-26.8)°C	P
	Other ambient temperatures may be allowed by mutual agreement. However, the temperature used must be clearly stated in all documentation.		N/A
4.3	Output voltage and frequency		P
	The output voltage and frequency are maintained at the manufacturer's stated nominal values.	230Vac, 50/60Hz	P
4.4	Input voltage	The equipment under test is both a stand-alone type inverter and a on-grid type inverter.	P
	Measurements performed in each of the following tests are repeated at three power conditioner input voltages:		P
	a) manufacturer's minimum rated input voltage;		P
	b) the inverter's nominal voltage or the average of its rated input range;		P
	c) 90 % of the inverter's maximum input voltage.		P

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Clause	Requirement-Test	Result-Remark	Verdict
	In the case where a power conditioner is to be connected with a battery at its input terminals, only the nominal or rated input voltage may be applied.		P
4.5	Ripple and distortion		P
	Record input voltage and current ripple for each measurement. Also record output voltage and current distortion (if a.c.) or ripple (if d.c.). Ensure that these measurements remain within the manufacturer's specified values.		P
4.6	Resistive loads/utility grid		P
	At unity power factor, or at the intrinsic power factor of grid-connected inverters without power factor adjustment, measure the efficiency for power levels of 10 %, 25 %, 50 %, 75 %, 100 % and 120 % of the inverter's rating. Stand-alone inverters are also measured at a power level of 5 % of rated. The power conditioner test is conducted with a specified resistive and reactive grid impedance.	Refer to Table 1.	P
4.7	Reactive loads		N/A
	For stand-alone inverters, measure the efficiency with a load which provides a power factor equal to the manufacturer's specified minimum level (or 0,25, whichever is greater) and at power levels of 25 %, 50 % and 100 % of rated VA.		N/A
	Repeat for power factors of 0,5 and 0,75 (do not go below the manufacturer's specified minimum PF) and power levels of 25 %, 50 %, and 100 % of rated VA.		N/A
4.8	Resistive plus non-linear loads		N/A
	For stand-alone inverters, measure the efficiency with a fixed non-linear load (total harmonic distortion (THD) = (80 ± 5) %) equal to (25 ± 5) % of the inverter's rated VA plus sufficient resistive load in parallel to achieve a total load of 25 %, 50 % and 100 % of rated VA.		N/A
	Repeat the measurements with a fixed non-linear load equivalent to (50 ± 5) % of the inverter's rated VA plus sufficient resistive load in parallel to achieve a total load of 50% and 100% of rated VA.		N/A
	The type of non-linear load must be clearly stated in all documentation.		N/A

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Clause	Requirement-Test	Result-Remark	Verdict
4.9	Complex loads		N/A
	When a non-linear plus a sufficient reactive load condition is specified for stand-alone inverters, measure the efficiency with a fixed non-linear load (THD = (80 ± 5) %) equal to (50 ± 5) % of the inverter's rated VA plus a sufficient reactive load (PF = 0,5) in parallel to achieve a total load of 50 % and 100 % of rated VA.		N/A
	The type of complex load is clearly stated in all documentation.		N/A

Clause	Requirement-Test	Result-Remark	Verdict
5	Efficiency calculations		P
5.1	Rated output efficiency		P
	Rated output eficiency shall be calculated from measued data as follows: $\eta_R = (P_o / P_i) \times 100$	Refer to Table 1.	P
5.2	Partial output efficiency		P
	Partial output efficiency shall be calculated from measured data as follows: $\eta_{par} = (P_{op} / P_{ip}) \times 100$	Refer to Table 1.	P
5.3	Energy efficiency		P
	Energy efficiency shall be calculated from measured data as follows: $\eta_E = (W_o / W_i) \times 100$	Refer to Table 1.	P
5.4	Efficiency tolerances		N/A
	When an efficiency value has been guaranteed, the tolerance of this value shall be within the value at rated conditions indicated in the table 2.		N/A

Clause	Requirement-Test	Result-Remark	Verdict
6	Conditions of loading for output ports		P
6.1	Test circuit		P
	Figure 1 shows recommended test circuits for power conditioners which have a single-phase a.c. output or d.c. output. It can as well as be regared as a single-phase representation of a test set-up for multiphase power conditioners.		P

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Clause	Requirement-Test	Result-Remark	Verdict
	Figure 1a is applied to standard-alone power and ultity-interactive power conditionners respectively.		P
	The propoesed test circuits in figure 1 are not mandatory, but together with the test descriptions, are intended to establish a base for mutual agreement between user and manufacturer.		P
	The type of power source shall be indicated on all tests and shall adhere to the requirements of 4.1		P
6.2	Measurement procedure		P
	a) Efficiency is calculated with equation (1) or (2) using measured Pi, Po or Pip, Pop. DC input power Pi, Pip can be measured by wattmeter W1, or determined by multiplying the d.c. voltmeter V1 and d.c. ammeter A1 readings. Output power Po, Pop is measured with wattmeter W2.		P
	b) DC input voltage, which is measured by d.c. voltmeter V1, shall be varied in the defined range where the output current, which is measured with a.c. ammeter A2, is varied from low output to the rated output.		P
	c) An average indicating instrument shall be used for the d.c. voltmeter and d.c. ammeter. A true r.m.s. type of indicating instrument shall be used for the a.c. voltmeter and a.c. ammeter. The d.c. wattmeter W1 shall be a d.c. measuring type. The wattmeter W2 shall be an a.c. or d.c. measuring type according to the output.		P
	d) Power factor (PF in per cent) can be measured by a power factor meter PF, or calculated from the readings of V2, A2, W2 and as follows: PF = (W2/(V2 x A2)) x 100		P
	e) Each meter may be an analogue type or a digital type. The measurement accruacy shall be better than 5 % of the full-scale value for each power measured. Digital power instruments for W1 and W2 are also recommended.		P

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Clause	Requirement-Test	Result-Remark	Verdict
	f) An MPPT dynamically adjusts the input voltage so as to maximize the output power. In principle, the monitoring equipment shall sample all of the electrical parameters, such as input voltage and current, output power and current, within the update period of the MPPT. If the MPPT and input source (PV array or PV array simulator) interact in such a way that the input voltage varies by less than 5 %, then averaging of readings is acceptable. The averaging period shall be 30 s or longer.		N/A

Clause	Requirement-Test	Result-Remark	Verdict
7	Loss measurement		P
7.1	No-load loss		P
	No-load loss shall be measured as follows.		P
	If the power conditioner is a stand-alone type, the reading of d.c. input voltage, output voltage and frequency is given with meters V1, V2 and F respectively in figure 1a, and shall be adjusted to the rated values.		P
	The no-load loss is thus the indicated value of d.c. input wattmeter, W1, when the load is disconnected from the power conditioner.	Refer to Table 1.	P
	If the power conditioner is a utility-interactive type, the reading of d.c. input voltmeter V1, a.c. output voltmeter V2 and frequency meter F in figure 1b shall be adjusted to meet the specified voltages and frequency.		P
	No-load loss is thus the indicated value of d.c. input wattmeter, W1, when a.c. wattmeter, W2, indicates a zero value. For the measurement, allow the power conditioner time to transfer to its no-load operating state, if applicable.	Refer to Table 2.	P
7.2	Standby loss		N/A
	Standby loss shall be measured as follows.		N/A
	If the power conditioner is a utility-interactive type, standby loss is defined as the consumption of utility power when the power conditioner is not operating but is under standby condition. Standby loss is indicated with a. c. wattmeter, W2 in figure 1b at the rated a.c. output voltage.		N/A

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Clause	Requirement-Test	Result-Remark	Verdict
	If the power conditioner is a stand-alone type, standby loss is defined as the consumption from the d.c. source when the power conditioner is not operating but is under standby condition. Standby loss is indicated with d.c. wattmeter, W1 in figure 1a (without a.c. or d.c. output voltage).		N/A

Annex A	Power conditioner description		P
	A power conditioner is defined in IEC 61277.		P
	Some types of photovoltaic system configurations relate to their purpose and size. Figure A.1 shows the generic system configuration proposed in IEC 61277. In figure A.1, the power conditioner (PC) is inside the dotted line. The power conditioner may consist of one or more of the following: d.c. conditioner, d.c./d.c. interface, inverter, a. c./a.c. interface, a.c. utility interface, and a part of master control and monitoring (MCM) subsystem. The power flows are indicated by the arrows. When a PV system has a d.c. storage subsystem, it is assumed that the storage is connected to the input of the power conditioner in parallel with the array (see figures A.2 and A.3).	The equipment under test is both a single phase stand-alone type inverter and a single phase on-grid type inverter. As a stand-alone type, the power flow diagram is indicated as figure A.1. As a on-grid type inverter, the power flow diagram is indicated as figure A.2.	P
	Under normal conditions, the power conditioner a.c. output voltage and frequency are constant value when the system is connected to the utility grid (in a utility-interactive type) or to the a.c. loads (in a stand-alone type). However, when a.c. loads consist of pumps or blowers with variable speed induction motors, the a.c. voltage and frequency may be variable.	The a.c. output voltage and frequency are constant value.	P
	In this standard, systems with a constant a.c. output voltage and frequency as well as systems with a d.c. output are discussed. Figures A.2 and A.3 show the configuration of the PV system and the power conditioner described in this standard.	With a constant a.c. output voltage and frequency	P

Annex B	Power efficiency and conversion factor		P

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Clause	Requirement-Test	Result-Remark	Verdict
	There are two types of efficiencies shown in IEC 60146-2; one is a power efficiency, the other is a conversion factor. Power efficiency is defined as the ratio of active output power and active input power. Conversion factor is the ratio between output and input fundamental power levels. The formulae for these two parameters: $\eta_P = (P_{aAC}/P_{aDC}) \times 100 \quad (\%)$ $\eta_C = (P_{fAC}/P_{fDC}) \times 100 \quad (\%)$		P
	Active power Pa is calculated as $P_a = \frac{1}{T}\int_0^T v(t)i(t)dt \text{ or } = \frac{1}{T}\int_0^T p(t)dt$		P
	The difference between the above two efficiencies is due to the evaluation of the harmonic components. IEC 60146 unifies them into power efficiency. Their differences depend on their voltage and current waveforms as shown in table B.1 and are only meaningful in case 5. Considering the purpose of IEC standards and the illustration in table B.1, the power efficiency is used as the efficiency of power conditioners.		P
	As shown in table B.1, case 1 or case 4, the difference between C and P is only 0.1% when the d.c. voltage and current ripple are 10 %pp, or when a.c. 5th r.m.s. voltage content is 2 % and the 5th current content is 5 %. This means that the conversion factor is practically the same as the power efficiency. It shall, however, be noted that in the case of a square wave, as in case 5, the power efficiency shall be used because the difference is large, i. e., $\eta C/\eta P$ = 0,81.		P
	The integration time (duration of one cycle) T shall be 30 s or more and the resultant mean power efficiency value shall be used as the efficiency of the power conditioner.		P

Annex C	Weighted-average energy efficiency		N/A
	The energy of a power conditioner depends on both the irradiance profile and the load profile. The energy efficiency of a power conditioner shall be calculated by the ratio of the output to the input energy actually measured over a certain period (such as a month or a year).		N/A

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Clause	Requirement-Test	Result-Remark	Verdict
	For reference, a method of estimating the energy efficiency using a weighted-average energy efficiency is described.		N/A
	The weighted-average energy efficiency, ηWT , is calculated as the sum of the products of each power level efficiency and related weighting coefficient.		N/A
	When the system is a utility-interactive type without a storage subsystem, the weighting coefficients depend on a regional irradiance duration curve.		N/A
	When the system is a stand-alone type with a storage subsystem, the weighting coefficients depend on the load duration curve.		N/A
	Clauses C.1 and C.2 show the calculation procedures for ηWT for utility-interactive systems and stand-alone systems.		N/A
C.1	ηWT of power conditioner for utility-interactive PV systems		N/A
	Utility-interactive PV systems, which have no storage and for which reverse-power flow is accepted, are described. In this case, d.c. power generated by the PV array is supplied direct into the power conditioner (PC). Almost all of the input power to the PC is converted to a. c. power. A part of it is dissipated as the PC loss.		N/A
	The weighted-average energy efficiency, WT, is an index to evaluate annual energy efficiency in which a weighting coefficient, Ki, is used for each input power level. Here, the irradiance is divided into several discrete levels. By using a duration time Ti, d.c. input power level, PIi, output power level, POi,and PC efficiency, i, for each level i, WT is defined as follows: $\eta_{WT} = \frac{\sum P_{Oi} \cdot T_i}{\sum P_{Ii} \cdot T_i} = \frac{P_{I1} \cdot \eta_{1} \cdot T_1 + \cdots + P_{In} \cdot \eta_{n} \cdot T_n}{P_{I1} \cdot T_1 + \cdots + P_{In} \cdot T_n} = K_1 \cdot \eta_1 + K_2 \cdot \eta_2 + \cdots + K_n \cdot \eta_n$		N/A

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Clause	Requirement-Test	Result-Remark	Verdict
	If the irradiance duration curve is given as shown in figure C.1, equation (C.1) can be rewritten as follows: $\eta_{WT} = \frac{1T_1}{T_{WT}}\eta_{1/4} + \frac{2T_2}{T_{WT}}\eta_{2/4} + \frac{3T_3}{T_{WT}}\eta_{3/4} + \frac{4T_4}{T_{WT}}\eta_{4/4} \geq \eta_{ER}$ $T_{WT} = 1T_1 + 2T_2 + 3T_3 + 4T_4$		N/A
C.2	ηWT of power conditioner for stand-alone PV systems		N/A
	In stand-alone PV systems with a storage subsystem, power generated from the PV array is stored and stabilized by the batteries. DC power is converted into regulated d.c. power or constant-voltage and constant-frequency a.c. power by a power conditioner (PC) and supplied to the load. In this case, some fraction of the generated power is dissipated as a loss in the batteries and power conditioner.		N/A
	The calculation of the weighted-average energy efficiency, WT， for stand-alone PV systems requires weighting coefficients for respective load levels.		N/A
	By using a load duration time Ti, d.c. input power PIi, a.c output power POi and PC efficiency for respective load level i, WT isdefined as follows: $\eta_{WT} = \frac{\sum P_{Oi}\cdot T_i}{\sum P_{Ii}\cdot T_i} = \frac{\sum P_{O1}\cdot T_1 + \cdots + P_{On}\cdot T_n}{P_{I0}\cdot T_0 + P_{O1}\cdot T_1/r_{j1} + P_{On}\cdot T_n/r_{jn}}$ $= \frac{1}{K_0 + K_1/r_{j1} + \cdots + K_n/r_{jn}}$		N/A

Annex D	Derivation of efficiency tolerance in table 2		N/A

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Table 1	**Efficiency measurement (stand-alone mode)**							**P**
Model			PH18-5048 PLUS					
Ambient temperature			(25.4-26.8)℃					
Output rated power			5000W					
Input rated voltage			48V					
No-load loss power			64.3 W					
Total load, % of rated VA		5%	10%	25%	50%	75%	100%	120%
Stand alone inverter with battery supply								
Voltage	Pac/Pac,r[%]:	5.00%	10.02%	25.03%	50.16%	75.12%	100.49%	--
	Output efficiency							
Vnorminal	Vac[V]	230.75	230.72	230.54	230.40	230.21	230.10	---
	Iac[A]	1.09	2.17	5.43	10.89	16.32	21.84	--
	Pop [W]	250.20	500.76	1251.29	2507.89	3755.87	5024.38	--
	PF	1.00	1.00	1.00	1.00	1.00	1.00	--
	Vdc[V]	48.07	48.24	48.15	48.21	48.25	48.61	--
	Idc[A]	6.58	11.85	28.08	56.40	85.71	114.92	--
	Pip [W]	316.05	571.03	1349.22	2704.37	4103.78	5533.43	--
	ηpar[%]	79.16	87.69	92.74	92.74	91.52	90.80	--
	Uthd[%]	0.88	1.38	0.76	0.66	0.80	0.97	--
	Ithd[%]	2.08	1.63	0.90	0.71	0.87	1.00	--
Vnorminal	Power efficiency							
	PaAC[W]	251.87	504.13	1259.77	2524.50	3780.89	5057.68	--
	PaDC[W]	316.17	571.35	1352.12	2718.64	4136.00	5586.87	--
	ηP[%]	79.66	88.23	93.17	92.86	91.41	90.53	--
	Conversion factor							
	PfAC[W]	250.11	500.71	1251.38	2507.18	3755.38	5023.40	--
	PfDC[W]	316.17	571.35	1352.12	2718.64	4136.00	5586.87	--
	ηC[%]	79.11	87.64	92.55	92.22	90.80	89.91	--

TEST REPORT

Table 1	Efficiency measurement (stand-alone mode)							P
Vnorminal	Energy efficiency							
	Wo [Wh] (5min.)	20.99	42.01	104.98	210.38	315.07	421.47	--
	Wi [Wh] (5min.)	26.51	47.91	113.20	226.86	344.27	464.17	--
	ηE=(Wo / Wi)×100%	79.17	87.69	92.74	92.73	91.52	90.80	--

Note:
ηRis the rated output efficiency.
ηpar is the partial output efficiency.
ηE is the energy efficiency.
The inverter can not overload to 120%.
As a stand-alone type, the power flow diagram is indicated as figure A.1.

Table 2	Efficiency measurement (Utility-interactive mode)							P
Model			PH18-5048 PLUS					
Ambient temperature			(25.4-26.8)℃					
PV Input voltage			60V					
Output rated power			5000W					
No-load loss power			59.69W					
Total load, % of rated VA		5%	10%	25%	50%	75%	100%	120%
Voltage	Pac/Pac,r[%]	--	10.19%	24.72%	48.93%	77.43%	100.07%	--
Vnorminal	Output efficiency							
	Vac[V]	--	229.56	229.54	229.59	229.65	230.25	---
	Iac[A]	--	2.94	5.79	10.96	17.12	21.98	--
	Pop [W]	--	509.72	1236.15	2446.66	3871.46	5003.29	--
	PF	--	0.76	0.93	0.97	0.98	0.99	--
	PV voltage [V]	--	60.69	60.32	60.98	59.68	64.81	--
	PV current [A]	--	8.10	20.90	41.05	59.84	65.85	--

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Table 2	Efficiency measurement (Utility-interactive mode)							P
Vnormina l	PV power [W]	--	491.21	1260.02	2499.42	3568.37	4248.44	--
	Battery voltage [V]	--	52.18	52.11	52.81	52.32	52.22	--
	Battery current [A]	--	1.90	1.86	3.30	12.94	24.57	--
	Battery power Pb[W]	--	98.90	96.66	173.84	672.82	1283.06	--
	Total input power(Pv+Pb) Pip[W]	--	590.11	1356.69	2673.26	4241.19	5531.50	--
	ηpar	--	86.38	91.12	91.52	91.28	90.45	--
	Uthd[%]	--	0.58	0.51	0.43	0.32	0.44	--
	Ithd[%]	--	7.93	8.68	5.58	4.77	4.93	--
Vnormina l	Power efficiency							
	PaAC[W]	--	522.68	1271.51	2533.55	3997.19	5171.74	--
	PaDC[W]	--	590.27	1357.49	2677.06	4248.61	5551.11	--
	ηP	--	88.55	93.67	94.64	94.08	93.17	--
	Conversion factor							
	PfAC[W]	--	501.21	1225.27	2454.28	3858.49	5012.50	--
	PfDC[W]	--	590.27	1357.49	2677.06	4248.61	5551.11	--
	ηC	--	84.91	90.26	91.68	90.82	90.30	--
Vnormina l	Energy efficiency							
	Wo [Wh] (1min.)	--	8.71	21.19	42.23	66.62	86.20	--
	Wpv [Wh] (1min.)	--	8.46	21.66	43.14	61.45	73.22	--
	Wbattery [Wh] (1min.)	--	1.70	1.66	2.98	11.59	22.09	--
	Wi(Wpv+ Wbattery) [Wh] (1min.)	--	10.16	23.32	46.12	73.04	95.31	--
	ηE=(Wo /Wi)× 100	--	85.73	90.87	91.57	91.21	90.44	--

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Table 2	Efficiency measurement (Utility-interactive mode)							P
Model		PH18-5048 PLUS						
Ambient temperature		(25.4-26.8)℃						
PV Input rated voltage		95V						
Output rated power		5000W						
No-load loss power		59.69W						
Total load, % of rated VA		5%	10%	25%	50%	75%	100%	120%
Voltage	Pac/Pac,r[%]	--	10.47%	25.14%	51.03%	74.84%	102.44%	--
Vnormina l	Output efficiency							
	Vac[V]	--	229.40	229.39	229.45	229.57	230.23	---
	Iac[A]	--	2.98	5.88	11.40	16.57	22.53	--
	Pop [W]	--	523.36	1256.86	2551.59	3741.92	5122.10	--
	PF	--	0.77	0.93	0.98	0.98	0.99	--
	PV voltage [V]	--	100.28	99.22	97.47	97.64	101.88	--
	PV current [A]	--	4.89	12.49	25.80	38.50	43.63	--
	PV power Pv [W]	--	489.95	1238.72	2512.38	3754.06	4428.93	--
	Battery voltage [V]	--	52.14	52.62	52.52	52.89	54.21	--
	Battery current [A]	--	2.58	2.98	5.44	7.11	23.03	--
	Battery power Pb[W]	--	134.78	156.62	284.74	374.97	1243.43	--
	Total input power(Pv+Pb) Pip[W]	--	624.73	1395.34	2797.12	4129.03	5672.37	--
	ηpar	--	83.77	90.08	91.22	90.62	90.30	--
	Uthd[%]	--	0.63	0.53	0.43	0.34	0.47	--
	Ithd[%]	--	6.91	8.20	5.93	4.83	4.01	--

TEST REPORT

Table 2	Efficiency measurement (Utility-interactive mode)							P
Vnormina l	Power efficiency							
	PaAC[W]	--	540.96	1306.65	2635.43	3873.07	5293.08	--
	PaDC[W]	--	624.82	1395.85	2800.04	4135.52	5693.44	--
	ηP	--	86.58	93.61	94.12	93.65	92.97	--
	Conversion factor							
	PfAC[W]	--	523.65	1274.12	2552.39	3748.54	5120.17	--
	PfDC[W]	--	624.82	1395.85	2800.04	4135.52	5693.44	--
	ηC	--	83.81	91.28	91.16	90.64	89.93	--
	Energy efficiency							
	Wo [Wh] (1min.)	--	9.02	21.78	43.92	64.55	88.22	--
	Wpv [Wh] (1min.)	--	8.45	21.40	43.27	64.76	76.29	--
	Wbattery [Wh] (1min.)	--	2.31	2.68	4.89	6.49	21.39	--
	Wi(Wpv+ Wbattery) [Wh] (1min.)	--	10.76	24.08	48.15	71.25	97.68	--
	ηE=(Wo /Wi)× 100	--	83.77	90.44	91.21	90.59	90.31	--
Model			PH18-5048 PLUS					
Ambient temperature			(25.4-26.8)℃					
PV Input rated voltage			117V					
Output rated power			5000W					
No-load loss power			59.69W					
Total load, % of rated VA		5%	10%	25%	50%	75%	100%	120%
Voltage	Pac/Pac,r[%]	--	10.42%	24.33%	49.35%	77.21%	99.65%	--

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Table 2	**Efficiency measurement (Utility-interactive mode)**							P
Vnormina l	Output efficiency							
	Vac[V]	--	229.45	229.52	229.59	229.64	230.17	---
	Iac[A]	--	2.98	5.71	11.06	17.08	21.91	--
	Pop [W]	--	521.02	1216.57	2467.26	3860.50	4982.50	--
	PF	--	0.76	0.93	0.97	0.98	0.99	--
	Pv voltage [V]	--	120.55	119.08	117.59	116.34	124.50	--
	Pv current [A]	--	4.04	9.88	20.19	31.50	34.73	--
	Pv power Pv [W]	--	486.10	1176.29	2372.46	3661.58	4311.46	--
	Battery voltage [V]	--	52.03	52.89	53.02	52.37	52.18	--
	Battery current [A]	--	2.60	3.37	6.44	11.57	23.54	--
	Battery power Pb[W]	--	135.16	178.12	339.73	603.09	1228.26	--
	Total input power(Pv+Pb) Pip[W]	--	621.26	1354.41	2712.19	4264.67	5539.72	--
	ηpar[%]	--	83.86	89.82	90.97	90.52	89.94	--
	Uthd[%]	--	0.62	0.51	0.42	0.32	0.43	--
	Ithd[%]	--	7.10	9.37	5.54	4.69	4.06	--
	Power efficiency							
	PaAC[W]	--	534.78	1259.51	2554.51	3986.62	5145.46	--
	PaDC[W]	--	621.81	1355.24	2715.32	4270.97	5553.07	--
	ηP[%]	--	86.00	92.94	94.08	93.34	92.66	--
	Conversion factor							
	PfAC[W]	--	512.21	1221.06	2475.45	3848.21	4974.75	--
	PfDC[W]	--	621.81	1355.24	2715.32	4270.97	5553.07	--
	ηC[%]	--	82.37	90.10	91.17	90.10	89.59	--

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Table 2	Efficiency measurement (Utility-interactive mode)							P
Vnorminal	Energy efficiency							
	Wo [Wh] (1min.)	--	8.91	20.99	42.58	66.44	85.76	--
	Wpv [Wh] (1min.)	--	8.37	20.29	40.88	63.06	74.22	--
	Wbattery [Wh] (1min.)	--	2.33	3.08	5.93	10.42	21.15	--
	Wi(Wpv+ Wbattery) [Wh] (1min.)	--	10.70	23.37	46.81	73.47	95.37	--
	ηE=(Wo /Wi)× 100%	--	83.29	89.84	90.96	90.43	89.92	--

Note:
ηRis the rated output efficiency.
ηpar is the partial output efficiency.
ηE is the energy efficiency.
The inverter can not overload to 120%.
As a on-grid type inverter, the power flow diagram is indicated as figure A.2.

TEST REPORT

The front of the sample


The back of the sample

--End of test report--