TEST REPORT

IEC 61683

Photovoltaic systems – Power conditioners – Procedure for measuring efficiency

Report Number. ..... :	64.290.15.04848.01
Date of issue..... :	29 February 2016
Total number of pages ..... :	10 Pages
Testing laboratory..... :	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch
Address..... :	5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West, Guangzhou 510656, P. R. China
Testing location ..... :	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch 5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West, Guangzhou 510656, P. R. China
Applicant's name..... :	INVT Solar Technology (ShenZhen) Co., Ltd.
Address..... :	No.7 Building Gaofa Industrial Park, Longjing, Nanshan District, 518055 Shenzhen, PEOPLE'S REPUBLIC OF CHINA
Test specification:	
Standard ..... :	IEC 61683:1999 (First Edition)
Test procedure ..... :	Test report
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC61683A
Test Report Form(s) Originator.... :	TÜV SÜD Product Service GmbH
Master TRF..... :	Dated 2014-10

General disclaimer:

The test results presented in this report relate only to the object tested.
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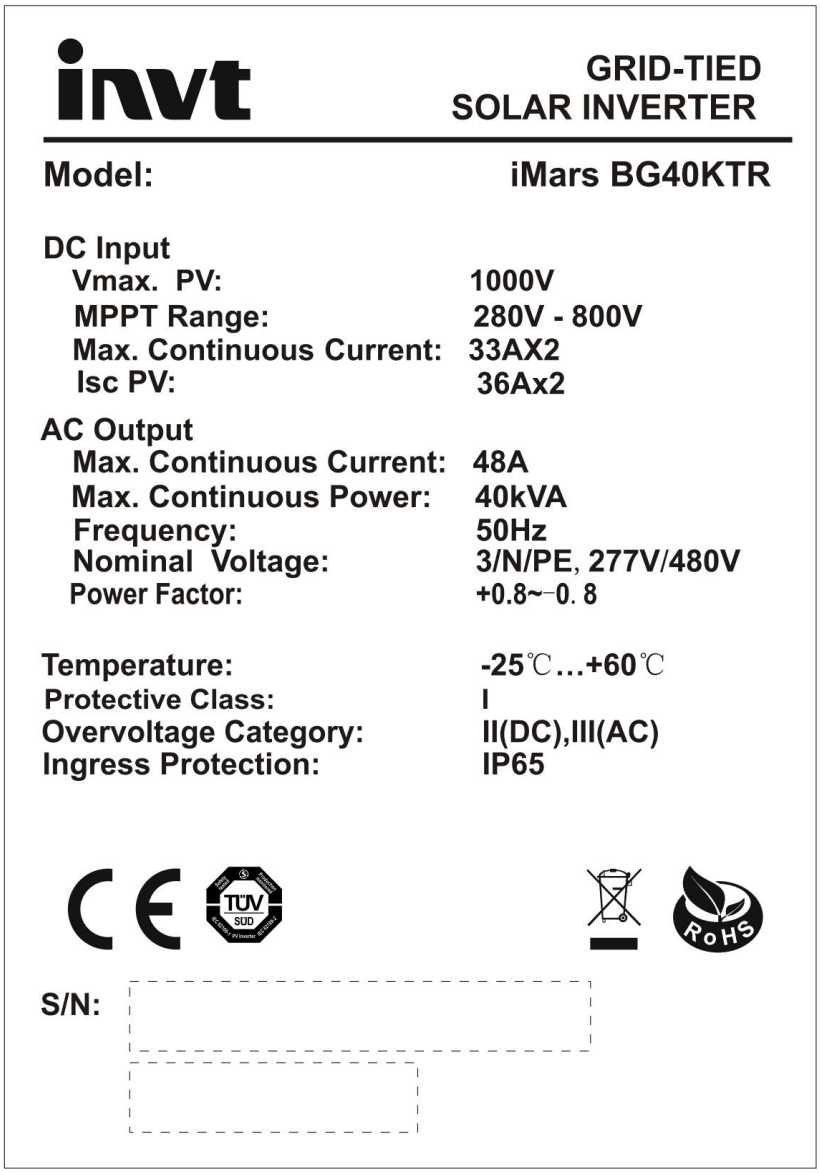
Test item description .....:	PV grid-interactive inverter
Trade Mark .....:	invt
Manufacturer.....:	INVT Solar Technology (ShenZhen) Co., Ltd.
Model/Type reference .....:	iMars BG40KTR
Ratings .....:	See page 3

Responsible Testing Laboratory (as applicable), testing procedure and testing location:

☒	Testing location / address .....:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch 5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West, Guangzhou 510656, P. R. China
	Tested by (name + signature).....:	Richard Li
	Approved by (+ signature).....:	Billy Qiu

Copy of marking plate:



Note: The above artwork nameplate may be only a draft. For the final production, the additional markings or other words which do not conflict with this standard, may be added.

Test item particulars..... :	
Classification of installation and use..... :	Fixed, permanent connection;
Supply Connection..... :	TN or TT system
..... :	
Possible test case verdicts:	
- test case does not apply to the test object .....:	N/A
- test object does meet the requirement .....:	P (Pass)
- test object does not meet the requirement .....:	F (Fail)
Testing.....:	
Date of receipt of test item .....:	14 October 2015
Date (s) of performance of tests.....:	29 October 2015 ~ 30 October 2015
General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☒ comma / ☐ point is used as the decimal separator.**	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒ **Not applicable**
Name and address of factory (ies) .....: Shenzhen INVT Electric Co., Ltd. Zone A, Juyuan Industrial areas, Tang Wei Fuyong street, Baoan District, 518103 Shenzhen, PEOPLE'S REPUBLIC OF CHINA	

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Clause	Requirement – Test	Measuring result – Remark	Verdict
4	Efficiency measurement conditions		P
	Efficiency is measured under the conditions in the following clauses.		P
	Specific conditions may be excluded by mutual agreement when those conditions are outside the manufacturer's allowable operating range.		P
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.		N/A
	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.	Two photovoltaic array simulators used.	P
4.2	Temperature		P
	All measurements are to be made at an ambient temperature of 25 °C ± 2 °C.	25 °C ± 2 °C ambient temperature as applicant's required	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.	3N~, 277/480 V, 50 Hz	P
4.4	Input voltage		P
	Measurements performed in each of the following tests are repeated at three power conditioner input voltages: a) manufacturer's minimum rated input voltage; b) the inverter's nominal voltage or the average of its rated input range; c) 90 % of the inverter's maximum input voltage.		P
	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.	No battery connected	N/A
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

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	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.	The PV grid-interactive inverter can't output 120%of it's nominal power	P
	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.	grid-connected inverters	N/A
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.	grid-connected inverters	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
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
5	Efficiency calculations		P
5.1	Rated output efficiency		P
5.2	Partial output efficiency		P

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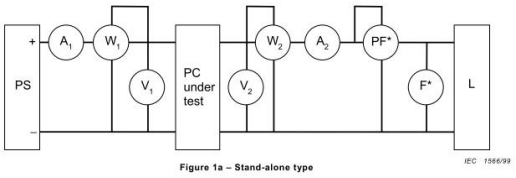
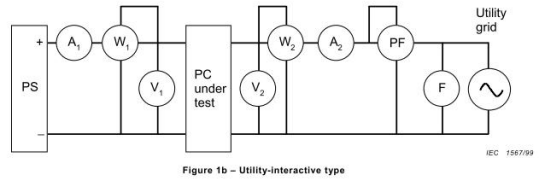
5.3	Energy efficiency		N/A
5.4	Efficiency tolerances		N/A
6	Conditions of loading for output ports		P
6.1	Test circuit		P
	Figure 1a is applied to standard-alone power conditioners		N/A
	 Figure 1a – Stand-alone type		N/A
	Figure 1b is applied to utility-interactive power conditioners		P
	 Figure 1b – Utility-interactive type PC power conditioner PS variable voltage-current d.c. power supply A_1 DC ammeter A_2 AC or d.c. ammeter W_1 DC wattmeter W_2 AC or d.c. wattmeter L load F frequency meter V_1 DC voltmeter V_2 AC or d.c. voltmeter PF power factor meter		P
6.2	Measurement procedure		P
7	Loss measurement		P
7.1	No-load loss		P
7.2	Standby loss		P
Annex A	Power conditioner description		--
Annex B	Power efficiency and conversion factor		--
Annex C	Weighted-average energy efficiency		--
Annex D	Derivation of efficiency tolerance in table 2		--

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Clause	Requirement – Test	Measuring result – Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**							
Model		iMars BG40KTR						
Test ambient temperature		26 °C						
Test condition		Two PV simulators used, each settings: V_{MPPT}=620 Vdc, Vmax=775 Vdc, Isc=2x36 A						
Total load, % of rated VA		5%	10%	20%	25%	30%	50%	75%	100%
Input voltage (Vdc)		621,1	621,1	621,2	621,0	621,0	621,0	620,7	620,3
Input current (Adc)		3,27	6,63	13,19	16,65	19,98	33,17	49,50	65,56
Input power (kW)		2,029	4,120	8,190	10,340	12,400	20,590	30,710	40,670
Output voltage (Vac)	L1-N	278,3	278,0	278,0	278,06	278,1	278,2	278,2	278,3
	L2-N	278,2	277,8	277,9	277,93	278,0	278,0	278,1	278,1
	L3-N	278,4	277,9	277,9	277,91	277,8	278,0	278,0	278,0
Output current (Aac)	L1	2,32	4,74	9,45	11,94	14,35	23,86	35,65	47,96
	L2	2,44	4,90	9,68	12,19	14,62	24,21	36,05	47,84
	L3	2,44	4,90	9,70	12,20	14,63	24,24	36,11	47,92
Output frequency (Hz)		50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00
Power factor (PF)	L1	0,9932	0,9959	0,9982	0,9987	0,9990	0,9996	0,9997	0,9998
	L2	0,9909	0,9938	0,9969	0,9979	0,9983	0,9992	0,9994	0,9996
	L3	0,9964	0,9976	0,9990	0,9993	0,9994	0,9998	0,9998	0,9999
Output active power (kW)	L1	0,631	1,294	2,601	3,229	3,968	6,618	9,900	13,331
	L2	0,661	1,341	2,668	3,369	4,043	6,711	10,009	13,291
	L3	0,664	1,344	2,695	3,375	4,046	6,719	10,023	13,309
Output active power (kW)		1,956	3,979	7,934	10,043	12,057	20,047	29,933	39,931
Output apparent power (kVA)		1,999	4,043	8,010	10,099	12,116	20,102	29,981	39,971
Efficiency (η)		96,40%	96,59%	96,99%	97,20%	97,22%	97,36%	97,47%	98,18%

Supplementary information:

(1) The above parameters are logged about 2 minutes of average values after the stabilization of the MPP tracking, MPPT range (output full load): 620 ~ 800 Vdc specified by manufacture,

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Clause	Requirement – Test	Measuring result – Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**							
Model		iMars BG40KTR						
Test ambient temperature		26 °C						
Test condition		Two PV simulators used, each settings: V_{MPPT}=710 Vdc, Vmax=887,5 Vdc, Isc=2x36 A						
Total load, % of rated VA		5%	10%	20%	25%	30%	50%	75%	100%
Input voltage (Vdc)		710,5	710,4	710,4	710,3	710,3	710,3	710,1	710,9
Input current (Adc)		2,87	5,98	11,71	14,43	17,43	29,13	43,26	57,45
Input power (kW)		2,043	4,280	8,290	10,250	12,400	20,690	30,710	40,770
Output voltage (Vac)	L1-N	277,9	278,0	278,0	278,1	278,1	278,2	278,2	278,4
	L2-N	277,9	277,9	277,9	277,9	278,0	278,0	278,0	278,1
	L3-N	277,9	277,8	278,0	277,9	279,9	278,0	278,0	278,1
Output current (Aac)	L1	2,35	4,92	9,57	11,86	14,38	24,02	35,76	47,64
	L2	2,44	5,07	9,80	12,10	14,63	24,32	36,14	47,87
	L3	2,43	5,08	9,81	12,12	14,65	24,37	36,20	47,96
Output frequency (Hz)		50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00
Power factor (PF)	L1	0,9955	0,9976	0,9988	0,9992	0,9992	0,9998	0,9999	0,9999
	L2	0,9929	0,9960	0,9979	0,9985	0,9986	0,9995	0,9997	0,9998
	L3	0,9977	0,9988	0,9993	0,9996	0,9995	0,9999	1,0000	1,0000
Output active power (kW)	L1	0,637	1,350	2,643	3,275	3,983	6,667	9,936	13,245
	L2	0,665	1,394	2,705	3,344	4,050	6,748	10,035	13,298
	L3	0,666	1,396	2,709	3,349	4,056	6,760	10,048	13,322
Output active power (kW)		1,967	4,139	8,057	9,968	12,088	20,175	30,019	39,865
Output apparent power (kVA)		2,006	4,188	8,112	10,027	12,137	20,220	30,060	39,911
Efficiency (η)		96,30%	96,77%	97,17%	97,28%	97,43%	97,53%	97,75%	97,79%

Supplementary information:

(1) The above parameters are logged about 2 minutes of average values after the stabilization of the MPP tracking, MPPT range (output full load): 620 ~ 800 Vdc specified by manufacture,

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Clause	Requirement – Test	Measuring result – Remark	Verdict

TABLE	**Efficiency recording and efficient calculation sheet**							
Model		iMars BG40KTR						
Test ambient temperature		26 °C						
Test condition		Two PV simulators used, each settings: V_{MPPT}=800 Vdc, Vmax=1000 Vdc, Isc=2x36 A						
Total load, % of rated VA		5%	10%	20%	25%	30%	50%	75%	100%
Input voltage (Vdc)		801,3	801,2	801,4	801,3	801,3	801,0	800,8	800,7
Input current (Adc)		2,621	5,241	10,18	12,75	15,29	25,76	38,25	50,94
Input power (kW)		2,099	4,197	8,150	10,220	12,250	20,630	30,630	40,770
Output voltage (Vac)	L1-N	278,1	278,1	278,0	278,1	278,1	278,3	278,2	278,4
	L2-N	277,9	277,9	278,0	277,9	278,1	278,1	278,0	278,2
	L3-N	277,9	278,0	277,9	278,0	277,9	278,1	278,0	278,2
Output current (Aac)	L1	2,42	4,84	9,43	11,83	14,20	23,95	35,61	47,92
	L2	2,49	4,95	9,63	12,03	14,42	24,22	35,95	47,89
	L3	2,49	4,98	9,66	12,06	14,44	24,27	36,01	47,87
Output frequency (Hz)		50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00
Power factor (PF)	L1	0,9976	0,9986	0,9988	0,9995	0,9996	0,9999	0,9999	0,9999
	L2	0,9962	0,9975	0,9979	0,9990	0,9993	0,9997	0,9997	0,9998
	L3	0,9988	0,9993	0,9993	0,9998	0,9998	0,9999	0,9999	1,0000
Output active power (kW)	L1	0,663	1,334	2,603	3,275	3,939	6,652	9,889	13,322
	L2	0,683	1,367	2,660	3,330	3,997	6,735	9,981	13,308
	L3	0,685	1,371	2,664	3,337	4,001	6,748	9,997	13,299
Output active power (kW)		2,031	4,072	7,927	9,942	11,936	20,111	29,867	39,929
Output apparent power (kVA)		2,055	4,106	7,983	9,986	11,973	20,148	29,914	39,977
Efficiency (η)		96,78%	97,03%	97,17%	97,35%	97,45%	97,50%	97,53%	97,94%

Supplementary information:

(1) The above parameters are logged about 2 minutes of average values after the stabilization of the MPP tracking, MPPT range (output full load): 620 ~ 800 Vdc specified by manufacture,

……, End of test report……,…,,