Attestation of compliance

Certificate No.:	**2388AP020164001**
Product:	**Photovoltaic (PV) and battery inverter**
Brand Name:	HUAWEI
Test Model No.:	**SUN2000-8K-LC0, SUN2000-10K-LC0**
Applicant:	**Huawei Digital Power Technologies Co., Ltd.** Office 01, 39th Floor, Block A, Antuoshan Headquarters Towers, 33 Antuoshan 6th Road, Futian District, Shenzhen, 518043, P.R.C.
Report No.:	**PVGB2302WDG0164-1**

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G99/1 for photovoltaic systems with a single-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with isolating function, which can be accessed the distribution network provider at any time.

Applied rules and standards:

Engineering Recommendation G99/1-9:2022
Requirements for the connection of generation equipment in parallel with public distribution networks

DIN VDE V 0124-100:2020 (5.5.2.1 Functional safety of network and system protection)
Grid integration of generator plants - Low-voltage - Test requirements for generator units to be connected to and operated in parallel with low-voltage distribution networks

Name: Daniel Yu
Manager/ New Energy
Date: 2023-09-07

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 — **Nr. PVGB2302WDG0164-1**

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G99.			
PGM Technology:	Photovoltaic (PV) and battery inverter		
Manufacturer / applicant:	**Huawei Digital Power Technologies Co., Ltd.**		
Address:	Office 01, 39th Floor, Block A, Antuoshan Headquarters Towers, 33 Antuoshan 6th Road, Futian District, Shenzhen, 518043, P.R.C.		
Tel	-	**Fax:**	-
Email:	-	**Website:**	-

Rated values	**SUN2000-8K-LC0**	**SUN2000-10K-LC0**
Max. Input PV voltage [V]:	600	600
MPP PV voltage range [V]:	40-560	40-560
Max. Input PV current [A]:	16,0/16,0/16,0	16,0/16,0/16,0
Max. Battery voltage [V] :	600	600
Max. Battery current [A] :	25,0	25,0
Max. Battery charging power[W]:	8000(supplied by PV), 5000(supplied by Gird)	10000(supplied by PV), 5000(supplied by Gird)
Max. Battery discharge Power[W] :	8000	10000
Output AC voltage [V]:	L/N/PE, 230Vac, 50Hz	
Max. Output AC current [A]:	40,0	45,5
Nominal Output power [kW]:	8,0	10,0
Max. Output power [kVA]:	8,8	10,0

Firmware version	Software version: V100R023

Description of the structure of the power generation unit:

The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

Differences between Generating Units:

Models SUN2000-8K-LC0 and SUN2000-10K-LC0 are identical in hardware and firmware expected the components and model name are desctription as below table and the output power derated by software.

Model	**External Fan Number**
SUN2000-8K-LC0	0
SUN2000-10K-LC0	1

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G99/1. Any modification that affects the stated tests must be named by the manufacturer/supplier of the product to ensure that the product meets all requirements of the Engineering Recommendation G99/1.

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 **Nr. PVGB2302WDG0164-1**

Operating Range.	
Test 1	Voltage = 85% of nominal (195,5V) Frequency = 47Hz Power Factor = 1 Period of test 20 s
Connection:	Always connected
Limit:	Always connected
Test 2	Voltage = 85% of nominal (195,5V) Frequency = 47,5Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 3	Voltage = 110% of nominal (253V) Frequency = 51,5Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 4	Voltage = 110% of nominal (253V) Frequency = 52,0Hz Power Factor = 1 Period of test 15 minutes
Connection:	Always connected
Limit:	Always connected
Test 5	Voltage = 100% of nominal (230 V) Frequency = 50,0 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 6	Confirm that the Power Generating Module is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs-1 as measured over a period of 500ms. Note that this is not expected to be demonstrated on site.
Connection:	Always connected
Limit:	Always connected

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 — **Nr. PVGB2302WDG0164-1**

Protection. Voltage tests.

Singal Phase

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	184	2,5	184,45	2,579	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	261,38	1,082	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	273,09	0,577	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Note. For Voltage tests the Voltage required to trip is the setting ±3,45V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Frequency tests.

Function	Setting		Trip test		No trip test	
	Frequency [Hz]	Time delay [s]	Frequency [Hz]	Time delay [s]	Frequency / time	Confirm no trip
U/F stage 1	47,5	20,0	47,48	20,087	47,7Hz / 30s	No trip
U/F stage 2	47,0	0,5	47,00	0,552	47,2Hz / 19,5s	No trip
					46,8Hz / 0,45s	No trip
O/F stage 2	52,0	0,5	52,01	0,586	51,8Hz / 120s	No trip
					52,2Hz / 0,45s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting ±0,1Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The “No-trip tests” need to be carried out at the setting ±0,2Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Loss of Mains.

Inverters tested according to BS EN 62116.

Balancing load on islanded network	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
Trip time [ms]	304,1	263,0	405,0	375,5	330,2	422,2

Note. Trip time limit is 0,5s.

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 — **Nr. PVGB2302WDG0164-1**

Protection. Re-connection timer.	
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.1.	
Over Voltage	
Time delay setting	**Measured delay**
70s	71,8s
Under Voltage	
Time delay setting	**Measured delay**
70s	72,8s
Over Frequency	
Time delay setting	**Measured delay**
70s	72,6s
Under Frequency	
Time delay setting	**Measured delay**
70s	72,8s

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 180,0V	At 47,4Hz	At 52,1Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Protection. Frequency change, Stability test.				
	Start Frequency [Hz]	**Change**	**Test Duration**	**Confirm no trip**
Positive Vector Shift	49,5	+50 degrees		No trip
Negative Vector Shift	50,5	-50 degrees		No trip
Positive Frequency drift	49,0 to 51,0	+0,95Hz/sec	2,1s	No trip
Negative Frequency drift	51,0 to 49,0	-0,95Hz/sec	2,1s	No trip

Limited Frequency Sensitive Mode – Over Frequency							
1-min mean value [Hz]:	**a) 50,00**	**b) 50,45**	**c) 50,70**	**d) 51,15**	**e) 50,70**	**f) 50,45**	**g) 50,00**
1. Measurement a) to g): Active power output > 80% Pn							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
$P_{expected}$ [kW]:	N/A	9,90	9,40	8,50	9,40	9,90	N/A
$P_{measured}$ [kW]:	10,01	9,91	9,41	8,51	9,40	9,90	10,00
2. Measurement a) to g): Active power output 40% and 60% Pn							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
$P_{expected}$ [kW]:	N/A	4,90	4,40	3,50	4,40	4,90	N/A
$P_{measured}$ [kW]:	4,98	4,88	4,37	3,48	4,37	4,87	9,97

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 — **Nr. PVGB2302WDG0164-1**

Output Power with falling Frequency						
Frequency setpoint [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
Frequency [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
Active power [W]:	9914	9909	9909	9909	9911	9909
ΔP/Pmax [%]:		-0,91	-0,91	-0,91	-0,90	-0,91

Note.
No power reduction takes place in electronic inverter.

Power Quality. Harmonics.

Test: SUN2000-8K-LC0

Phase 1

SSEG rating per phase (rpp)			8,00kW			
	At 45-55% of Registered Capacity 4,00kW		**100% of Registered Capacity 8,00kW**			
Harmonic	**Measured Value (MV) in [A]**	**Measured Value (%) in [A]**	**Measured Value (MV) in [A]**	**Measured Value (%) in [A]**	**Limit in BS EN61000-3-12**	
					1 phase	**3 phase**
2nd	0,137	0,393	0,267	0,766	8,00	8,00
3rd	0,087	0,250	0,233	0,670	21,60	N/A
4th	0,045	0,128	0,068	0,195	4,00	4,00
5th	0,114	0,329	0,098	0,280	10,70	10,70
6th	0,019	0,054	0,042	0,121	2,67	2,67
7th	0,096	0,275	0,070	0,200	7,20	7,20
8th	0,013	0,036	0,018	0,052	2,00	2,00
9th	0,084	0,242	0,050	0,145	3,80	N/A
10th	0,014	0,041	0,025	0,073	1,60	1,60
11th	0,076	0,220	0,042	0,120	3,10	3,10
12th	0,010	0,030	0,016	0,046	1,33	1,33
13th	0,081	0,234	0,046	0,133	2,00	2,00
14th	0,010	0,029	0,016	0,045	N/A	N/A
15th	0,078	0,225	0,043	0,122	N/A	N/A
16th	0,012	0,033	0,017	0,050	N/A	N/A
17th	0,076	0,220	0,043	0,124	N/A	N/A
18th	0,011	0,030	0,011	0,033	N/A	N/A
19th	0,073	0,209	0,043	0,123	N/A	N/A
20th	0,013	0,037	0,012	0,034	N/A	N/A
21th	0,069	0,198	0,046	0,132	N/A	N/A
22th	0,014	0,041	0,016	0,047	N/A	N/A
23th	0,063	0,181	0,047	0,135	N/A	N/A
24th	0,013	0,039	0,014	0,040	N/A	N/A
25th	0,056	0,160	0,046	0,133	N/A	N/A
26th	0,016	0,046	0,018	0,051	N/A	N/A
27th	0,049	0,141	0,049	0,141	N/A	N/A
28th	0,013	0,038	0,022	0,063	N/A	N/A
29th	0,040	0,114	0,050	0,145	N/A	N/A
30th	0,011	0,033	0,014	0,040	N/A	N/A
31th	0,030	0,087	0,048	0,137	N/A	N/A
32th	0,011	0,032	0,017	0,049	N/A	N/A
33th	0,023	0,065	0,049	0,142	N/A	N/A
34th	0,007	0,021	0,017	0,048	N/A	N/A
35th	0,013	0,038	0,048	0,138	N/A	N/A

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 **Nr. PVGB2302WDG0164-1**

36th	0,007	0,020	0,014	0,039	N/A	N/A
37th	0,008	0,024	0,047	0,136	N/A	N/A
38th	0,007	0,019	0,019	0,056	N/A	N/A
39th	0,007	0,019	0,046	0,131	N/A	N/A
40th	0,007	0,021	0,018	0,051	N/A	N/A
THD_40[%]	--	0,941	--	1,223	23	13
PWHD_[%]	--	2,511	--	2,386	23	22

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

Test: SUN2000-10K-LC0

Phase 1

SSEG rating per phase (rpp)			10,00 kW			
	At 45-55% of Registered Capacity 5,00 kW		**100% of Registered Capacity 10,00 kW**			
Harmonic	**Measured Value (MV) in [A]**	**Measured Value (%) in [A]**	**Measured Value (MV) in [A]**	**Measured Value (%) in [A]**	**Limit in BS EN61000-3-12**	
					1 phase	**3 phase**
2nd	0,181	0,416	0,341	0,784	8,00	8,00
3rd	0,122	0,280	0,311	0,714	21,60	N/A
4th	0,053	0,123	0,092	0,211	4,00	4,00
5th	0,091	0,210	0,138	0,317	10,70	10,70
6th	0,028	0,065	0,048	0,111	2,67	2,67
7th	0,083	0,191	0,077	0,177	7,20	7,20
8th	0,016	0,036	0,017	0,040	2,00	2,00
9th	0,067	0,154	0,056	0,129	3,80	N/A
10th	0,022	0,050	0,026	0,060	1,60	1,60
11th	0,054	0,125	0,049	0,113	3,10	3,10
12th	0,012	0,027	0,014	0,033	1,33	1,33
13th	0,064	0,148	0,048	0,110	2,00	2,00
14th	0,011	0,025	0,016	0,036	N/A	N/A
15th	0,064	0,148	0,045	0,104	N/A	N/A
16th	0,014	0,032	0,016	0,036	N/A	N/A
17th	0,065	0,150	0,046	0,106	N/A	N/A
18th	0,009	0,022	0,009	0,022	N/A	N/A
19th	0,065	0,149	0,043	0,099	N/A	N/A
20th	0,012	0,028	0,017	0,038	N/A	N/A
21th	0,066	0,153	0,047	0,108	N/A	N/A
22th	0,016	0,036	0,014	0,032	N/A	N/A
23th	0,065	0,149	0,045	0,104	N/A	N/A
24th	0,014	0,033	0,014	0,032	N/A	N/A
25th	0,062	0,142	0,044	0,102	N/A	N/A
26th	0,019	0,045	0,019	0,044	N/A	N/A
27th	0,060	0,137	0,048	0,109	N/A	N/A
28th	0,017	0,040	0,022	0,050	N/A	N/A
29th	0,054	0,125	0,047	0,109	N/A	N/A
30th	0,016	0,037	0,018	0,042	N/A	N/A
31th	0,048	0,111	0,045	0,104	N/A	N/A
32th	0,019	0,044	0,015	0,034	N/A	N/A
33th	0,043	0,099	0,045	0,104	N/A	N/A
34th	0,015	0,035	0,020	0,047	N/A	N/A
35th	0,036	0,082	0,043	0,099	N/A	N/A
36th	0,015	0,034	0,018	0,042	N/A	N/A

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 **Nr. PVGB2302WDG0164-1**

37th	0,030	0,069	0,046	0,106	N/A	N/A
38th	0,014	0,032	0,018	0,041	N/A	N/A
39th	0,023	0,054	0,046	0,106	N/A	N/A
40th	0,009	0,021	0,022	0,050	N/A	N/A
THD_40[%]	--	0,117	--	0,117	23	13
PWHD_[%]	--	2,294	--	16,722	23	22

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

Power Quality. Power factor.

Output power	216,2V	230,0V	253,0V
20%	1,000	1,000	1,000
50%	1,000	1,000	1,000
75%	1,000	1,000	1,000
100%	1,000	1,000	1,000
Limit	>0,95	>0,95	>0,95

Measured at three voltage levels and at full output. Voltage to be maintained within ±1,5% of the stated level during the test.

Power Quality. Voltage fluctuation and Flicker.

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Phase 1								
Measured values at test impedance	0,036	0,001	0,000	0,031	0,013	0,000	0,153	0,108
Measured values at standard impedance	0,036	0,001	0,000	0,031	0,013	0,000	0,153	0,108
Values at maximum impedance	0,036	0,001	0,000	0,031	0,013	0,000	0,153	0,108
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Test impedance	R	0,400	Ω	Xl	0,250	Ω
	Z	0,472	Ω			
Standard impedance	R	0,400	Ω	Xl	0,250	Ω
	Z	0,472	Ω			
Maximum impedance	R	0,400	Ω	Xl	0,250	Ω
	Zmax	0,472	Ω			

Power Quality. DC injection.

Test: SUN2000-8K-LC0

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	17,4	17,1	11,1
Recorded value [%]	0,05	0,05	0,03
Limit [%]	0,25	0,25	0,25

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 — **Nr. PVGB2302WDG0164-1**

Note. Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.

Sum of all Phases

Tests are carried out at three defined power levels ±5%. At 230 V a 8kW single phase Inverter has a current output of 34,78 A so DC limit is 87 mA. These tests is undertaken in accordance with Annex A.7.1.4.4.

The % DC injection ("as % of rated AC current" below) is calculated as follows:

% DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.

Power Quality. DC injection.			
Test: SUN2000-10K-LC0			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	12,6	9,5	33,0
Recorded value [%]	0,03	0,02	0,08
Limit [%]	0,25	0,25	0,25

Note. Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.

Sum of all Phases

Tests are carried out at three defined power levels ±5%. At 230 V a 10kW single phase Inverter has a current output of 43,48 A so DC limit is 109 mA. These tests is undertaken in accordance with Annex A.7.1.4.4.

The % DC injection ("as % of rated AC current" below) is calculated as follows:

% DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.

Fault level Contribution.					
For a directly coupled SSEG			**For a Inverter SSEG**		
Phase 1					
Parameter	**Symbol**	**Value**	**Time after fault**	**Volts [V]**	**Amps [A]**
Peak Short Circuit current	I_p	N/A	20ms	-0,34V	0,053A
Initial Value of aperiodic current	A	N/A	100ms	-0,03V	-7,626A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	0,06V	0,041A
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	-0,15V	-0,074A
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,757	In seconds

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 — **Nr. PVGB2302WDG0164-1**

Self Monitoring – Solid state switching.	N/A
It has been verified that in the event of the solid state switching device failing to disconnect the Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	N/A
Note. Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open (Functional safety of the internal automatic disconnection device according to VDE 0124-100).	

Cyber security	P
Confirm that the Manufacturer or Installer of the Micro-generator has provided a statement describing how the Micro-generator has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes
Note. Different levels of access, all are password protected, only certain parameters can be changed on maintenance level. Manufacturer information provided, see test report.	

Huawei Digital Power Technologies Co., Ltd.

Manufacturer's declaration

We, （Company name: Huawei Digital Power Technologies Co., Ltd., address: Office 01, 39th Floor, Block A, Antuoshan Headquarters Towers, 33 Antuoshan 6th Road, Futian District, Shenzhen, 518043, P.R.C.）, hearby declare that all our below listed inverters comply with the cyber security requirements of the standard G99-1:

- Model no.: SUN2000-8K-LC0、SUN2000-10K-LC0;
- Requirements listed in the standard(s):
  - ETSI EN 303 645;
  - relevant aspects of PAS 1879 "Energy smart appliances – Demand side response operation – Code of practice";
  - relevant aspects of "Distributed Energy Resources – Cyber Security Connection Guidance" published by BEIS and the ENA;
  - Any other relevant standard that has been incorporated in the design of the **Power Generating Module**.

Declared by: Chen Dongxiang

Company name: Huawei Digital Power Technologies Co., Ltd.,

Responsible person: Chen Dongxiang

Page 1 of 2

Huawei Digital Power Technologies Co., Ltd.

Signature (and/or Stamp): Chen Dongxiang

Date: 2023.8.2

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Wiring functional tests if required by para. 15.2.1	N/A
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning).	N/A
Note. Type test of components wired correct together on site is part of the commissioning test. The inverter was tested in a test laboratory. The correct wiring functional test in the field has to be done by the responsible person for the installation of the plant.	

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 **Nr. PVGB2302WDG0164-1**

Logic Interface (input port) Required by paragraph 11.1.3.1	**P**
Confirm that an input port is provided and can be used to reduce the Active Power output to zero	Yes
Note. Manufacturer information provided. A Modbus signal can be used to cease Active Power output within 5 s. See test report.	
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal	Yes

COM of the external device is connected to COM of the power generation module (Figure 4).

When the switch is closed, the generating module can work normally.

When the switch is opened, the logical port has a DC voltage of 5V, and the power module reduces the active power to zero within 5 seconds.

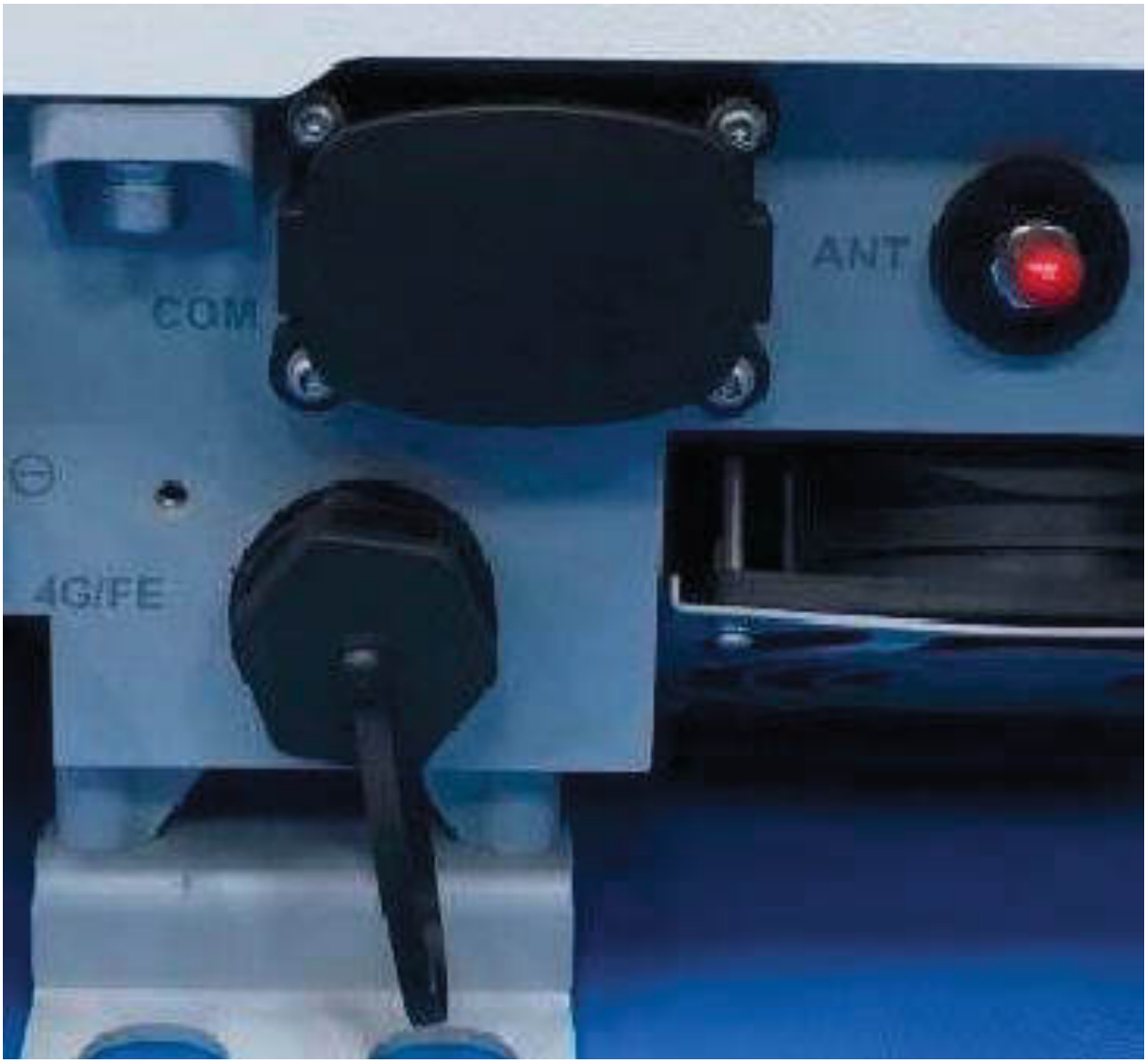

Figure 4

Additional comments