Form A2-3: Compliance Verification Report for Type A Inverter Connected Power Generating Modules

This form should be used by the **Manufacturer** to demonstrate and declare compliance with the requirements of EREC G99. The form can be used in a variety of ways as detailed below:

1. To obtain **Fully Type Tested** status (≤ 50 kW)

   The **Manufacturer** can use this form to obtain **Fully Type Tested** status for a **Power Generating Module** by registering this completed form with the Energy Networks Association (ENA) Type Test Verification Report Register. Tests 1 – 15 must all be completed and compliant for the **Power Generating Module** to be classified as **Fully Type Tested**.

2. To obtain **Type Tested** status for a product

   This form can be used by the **Manufacturer** to obtain **Type Tested** status for a product which is used in a **Power Generating Module** by registering this form with the relevant parts completed with the Energy Networks Association (ENA) Type Test Verification Report Register.
   Where the **Manufacturer** is seeking to obtain **Type Tested** status for an **Interface Protection** device the appropriate section of Form A2-4 should be used.

3. One-off Installation

   This form can be used by the **Manufacturer** or **Installer** to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99. This form shall be submitted to the **DNO** as part of the application.

A combination of (2) and (3) can be used as required, together with Form A2-4 where compliance of the **Interface Protection** is to be demonstrated on site.

Note:

Within this Form A2-3 the term **Power Park Module** will be used but its meaning can be interpreted within Form A2-3 to mean **Power Park Module**, **Generating Unit or Inverter** as appropriate for the context. However, note that compliance shall be demonstrated at the **Power Park Module** level.

If the **Power Generating Module** is **Fully Type Tested** and registered with the Energy Networks Association (ENA) Type Test Verification Report Register, the Installation Document (Form A3-1 or A3-2) should include the **Manufacturer's** reference number (the system reference), and this form does not need to be submitted.

Where the **Power Generating Module** is not registered with the ENA Type Test Verification Report Register or is not **Fully Type Tested** this form (all or in parts as applicable) needs to be completed and provided to the **DNO**, to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99.

PGM technology		Transformerless inverter	
Manufacturer name		Rayleigh Instruments Limited	
Address		Raytel House, Cutlers Road, South Woodham Ferrers, Essex, CM3 5WA	
Tel	01245428500	Web site	www.rayleigh.com
E:mail	sales@rayleigh.com		
Registered Capacity		50 kW	

Energy storage capacity for **Electricity Storage** devices	100/200 kWh

There are four options for Testing: (1) **Fully Type Tested**(≤ 50 kW), (2) **Type Tested** product, (3) one-off installation, (4) tested on site at time of commissioning. The check box below indicates which tests in this Form have been completed for each of the options. With the exception of **Fully Type Tested PGM**s tests may be carried out at the time of commissioning (Form A4). **Type Tested** status is suitable for devices > 50 kW where the power quality aspects need consideration on a site by site basis in accordance with EREC G5 and EREC P28.
Insert Document reference(s) for **Manufacturers' Information**

Tested option:	**1. Fully Type Tested**	**2. Type Tested product**	**3. One-off Manufacturers' Info.**	**4. Tested on Site at time of Commissioning**
0. **Fully Type Tested** - all tests detailed below completed and evidence attached to this submission		**N/A**	**N/A**	**N/A**
1. Operating Range	**N/A**			
2. PQ – Harmonics				
3. PQ – Voltage Fluctuation and Flicker				
4. PQ – DC Injection (**Power Park Module**s only)				
5. **Power Factor** (PF)				
6. Frequency protection trip and ride through tests				
7. Voltage protection trip and ride through tests				
8. Protection – Loss of Mains Test, Vector Shift and RoCoF Stability Test				
9. **LFSM-O** Test				
10. Protection – Reconnection Timer				
11. Fault Level Contribution				

There are four options for Testing: (1) **Fully Type Tested**(≤ 50 kW), (2) **Type Tested** product, (3) one-off installation, (4) tested on site at time of commissioning. The check box below indicates which tests in this Form have been completed for each of the options. With the exception of **Fully Type Tested PGM**s tests may be carried out at the time of commissioning (Form A4). **Type Tested** status is suitable for devices > 50 kW where the power quality aspects need consideration on a site by site basis in accordance with EREC G5 and EREC P28.
Insert Document reference(s) for **Manufacturers' Information**

Tested option:	**1. Fully Type Tested**	**2. Type Tested product**	**3. One-off Manufacturers' Info.**	**4. Tested on Site at time of Commissioning**
12. Self-monitoring Solid State Switch				
13. Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)				
14. Logic Interface (input port)				
15. Cyber security				

Manufacturer compliance declaration. - I certify that all products supplied by the company with the above **Type Tested Manufacturer**'s reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site **Modification**s are required to ensure that the product meets all the requirements of EREC G99.

Signed		On behalf of	Rayleigh Instruments Limited

Note that testing can be done by the **Manufacturer** of an individual component or by an external test house.

Where parts of the testing are carried out by persons or organizations other than the **Manufacturer** then that person or organization shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.

A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules – test record

1. Operating Range: Tests should be carried with the **Power Generating Module** operating at **Registered Capacity** and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within ± 5 % of the apparent power value set for the entire duration of each test sequence.

Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time.

The **Interface Protection** shall be disabled during the tests.

In case of a PV **Power Park Module** the PV primary source may be replaced by a DC source.

In case of a full converter **Power Park Module** (eg wind) the primary source and the prime mover I**nverter**/rectifier may be replaced by a DC source.

Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement "Pass", "No disconnection occurs", etc. Graphical evidence is preferred.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz, **Power Factor** = 1, Period of test 20 s	Voltage: 340.12 V (Three phase L-L voltage) Frequency: 47.00 Hz Power Factor = 1 Test duration: 20 s Confirmation of operation: Yes
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Voltage: 342.51 V (Three phase L-L voltage) Frequency: 47.50 Hz Power Factor = 1 Test duration: 90 minutes Confirmation of operation: Yes
Test 3 Voltage = 110% of nominal (253 V)., Frequency = 51.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Voltage: 441.15 V(Three phase L-L voltage) Frequency: 51.50 Hz Power Factor = 1 Test duration: 90 minutes Confirmation of operation: Yes
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, **Power Factor** = 1, Period of test 15 minutes	Voltage: 441.18 V(Three phase L-L voltage) Frequency: 52.00 Hz Power Factor = 1 Test duration: 90 minutes Confirmation of operation: Yes

Test 5 Voltage = 100% of nominal (230 V), Frequency = 50.0 Hz, **Power Factor** = 1, Period of test = 90 minutes	Voltage: 399.18 V(Three phase L-L voltage) Frequency: 52.00 Hz Power Factor = 1 Test duration: 90 minutes Confirmation of operation: Yes
Test 6 RoCoF withstand 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 500 ms. Note that this is not expected to be demonstrated on site.	Confirmation of operation: Yes

2. Power Quality – Harmonics:

For **Power Generating Module**s of **Registered Capacity** of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5. These tests should be carried out as specified in BS EN 61000-3-12, and measurements for the 2nd – 13th harmonics should be provided. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 610000-3-12 for three phase equipment. For three phase **Power Generating Module**s, measurements for all phases should be provided.

For **Power Generating Module**s of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC G5.

The rating of the **Power Generating Module** (per phase) should be provided below, and the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWHD) should be provided at the bottom of this section.

Power Generating Module tested to BS EN 61000-3-12

Power Generating Module rating per phase (rpp)			16.7		kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)		
Single or three phase measurements (for single phase measurements, only complete L1 columns below).			Three phase					
Harmonic	At 45-55% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.511	0.641	0.756	0.71%	0.89%	1.05%	8%	8%
3	0.144	0.050	0.151	0.20%	0.07%	0.21%	21.6%	Not stated

4	0.144	0.050	0.151	0.20%	0.07%	0.21%	4%	4%
5	1.108	1.087	1.123	1.54%	1.51%	1.56%	10.7%	10.7%
6	0.187	0.144	0.072	0.26%	0.20%	0.10%	2.67%	2.67%
7	0.554	0.533	0.526	0.77%	0.74%	0.73%	7.2%	7.2%
8	0.050	0.144	0.187	0.07%	0.20%	0.26%	2%	2%
9	0.036	0.022	0.014	0.05%	0.03%	0.02%	3.8%	Not stated
10	0.036	0.043	0.065	0.05%	0.06%	0.09%	1.6%	1.6%
11	0.194	0.180	0.194	0.27%	0.25%	0.27%	3.1%	3.1%
12	0.021	0.022	0.014	0.03%	0.03%	0.02%	1.33%	1.33%
13	0.115	0.101	0.115	0.16%	0.14%	0.16%	2%	2%
THD[27]				2.05%	2.04%	2.16%	23%	13%
PWHD[28]				2.66%	2.66%	2.73%	23%	22%
Harmonic	At 100% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured value (MV) in Amps			Measured value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	1.541	1.490	1.951	2.14%	2.07%	2.71%	8%	8%
3	0.173	0.086	0.187	0.24%	0.12%	0.26%	21.6%	Not stated
4	1.217	1.303	1.188	1.69%	1.81%	1.65%	4%	4%
5	1.015	0.986	1.044	1.41%	1.37%	1.45%	10.7%	10.7%
6	0.180	0.187	0.072	0.25%	0.26%	0.10%	2.67%	2.67%
7	0.698	0.734	0.698	0.97%	1.02%	0.97%	7.2%	7.2%
8	0.173	0.187	0.274	0.24%	0.26%	0.38%	2%	2%
9	0.072	0.029	0.043	0.10%	0.04%	0.06%	3.8%	Not stated
10	0.094	0.072	0.086	0.13%	0.10%	0.12%	1.6%	1.6%

[27] THD = Total Harmonic Distortion

[28] PWHD = Partial Weighted Harmonic Distortion

11	0.331	0.331	0.360	0.46%	0.46%	0.50%	3.1%	3.1%
12	0.036	0.022	0.043	0.05%	0.03%	0.06%	1.33%	.33%
13	0.238	0.216	0.216	0.33%	0.30%	0.30%	2%	2%
THD[29]				0.238	0.216	0.216	23%	13%
PWHD[30]				5.06%	8.29%	8.15%	23%	22%

3. Power Quality – Voltage fluctuations and Flicker:

For **Power Generating Module**s of **Registered Capacity** of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. Results should be normalised to a standard source impedance, or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable Maximum Impedance.

For **Power Generating Module**s of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC P28.

The standard test impedance is 0.4 Ω for a single phase **Power Generating Module** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Power Generating Module** (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):

d max normalised value = (Standard impedance / Measured impedance) x Measured value.

Where the **Power Factor** of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the standard impedance.

The stopping test should be a trip from full load operation.

The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.

The test date and location must be declared.

Test start date	20th FEB. 2023	Test end date	31st Mar. 2023
Test location	TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, P.R. China		

	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	P st	P lt 2 hours
Measured Values at	0.187%	0.127%	0%	0.124%	0.065%	0%	0.154	0.056

[29] THD = Total Harmonic Distortion

[30] PWHD = Partial Weighted Harmonic Distortion

test impedance								
Normalised to standard impedance	0.175%	0.112%	0%	0.114%	0.062%	0%	0.103	0.035
Normalised to required maximum impedance	0.107%	0.102%	0%	0.109%	0.052%	0%	0.112	0.022
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.24	Ω	Xl	0.15	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	Xl	0.15 * 0.25 ^	Ω
Maximum Impedance	R		Ω	Xl		Ω

* Applies to three phase and split single phase **Power Generating Module**s. Delete as appropriate.

^ Applies to single phase **Power Generating Module** and **Power Generating Module**s using two phases on a three phase system. Delete as appropriate.

4. Power quality – DC injection: The tests should be carried out on a single **Generating Unit**. Tests are to be carried out at three defined power levels ±5%. At 230 V a 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be 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) / Vphase. The % DC injection should not be greater than 0.25%.

Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded DC value in Amps	0.137	0.122	0.116	0.133	0.155	0.103	0.082	0.153	0.159
as % of rated AC current	0.190%	0.170%	0.161%	0.184%	0.215%	0.143%	0.118%	0.213%	0.220%
Limit	0.25%			0.25%			0.25%		

5. Power Factor: The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be

greater than 0.95 to pass. Voltage to be maintained within ±1.5% of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	1.00	1.00	1.00
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with the Annex A.7.1.2.3. For trip tests, frequency and time delay should be stated. For "no trip tests", "no trip" can be stated.

Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.49 Hz	20.000s	47.7 Hz 30 s	No trip
U/F stage 2	47 Hz	0.5 s	46.99 Hz	0.503s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52 Hz	0.5 s	52.02 Hz	0.500s	51.8 Hz 120.0 s	No trip
					52.2 Hz 0.45 s	No trip

Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. 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 ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

7. Protection – Voltage tests: These tests should be carried out in accordance with Annex A.7.1.2.2. For trip tests, voltage and time delay should be stated. For "no trip tests", "no trip" can be stated.

Note that the value of voltage stated below assumes a **LV** connection This should be adjusted for **HV** taking account of the VT ratio as required.

Function	Setting		Trip test			"No trip tests"	
	Voltage	Time delay	Voltage		Time delay	Voltage /time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	L1-L2	318.58	2.500s	188 V 5.0 s	No trip
			L2-L3	318.01	2.500s		
			L3-L1	318.79	2.500s		

						180 V 2.45 s	No trip
O/V stage 1	1.14 pu (262.2 V)	1.0 s	L1-L2 L2-L3 L3-L1	318.58 318.01 318.79	1.00s 1.00s 1.00s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	L1-L2 L2-L3 L3-L1	438.73 438.80 438.67	0.50s 0.50s 0.50s	269.7 V 0.95 s	No trip
						277.7 V 0.45 s	No trip

Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. 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 ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

8.Protection – Loss of Mains test: These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.

The following sub set of tests should be recorded in the following table.

Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5s[31]	67.5ms	93.5ms	130.0ms	80.0ms	88.5ms	160.0ms

Loss of Mains Protection, Vector Shift Stability test: This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip under positive / negative vector shift.

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.5 Hz	+50 degrees	No trip
Negative Vector Shift	50.5 Hz	- 50 degrees	No trip

[31] If the device requires additional shut down time (beyond 0.5 s but less than 1 s) then this should be stated on this form.

Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip for the duration of the ramp up and ramp down test.			
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}	2.1 s	No trip
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.1 s	No trip

9. Limited Frequency Sensitive Mode – Overfrequency test: The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%. This test should be carried out in accordance with Annex A.7.1.3, which also contains the measurement tolerances.	
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.	**Y/N**
Alternatively, test results should be noted below:	

Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00Hz ±0.01Hz	50023.64W	50.00 Hz	51000W	-
Step b) 50.45Hz ±0.05Hz	49533.94W	50.45 Hz		-
Step c) 50.70Hz ±0.10Hz	47437.03W	50.70 Hz		-
Step d) 51.15Hz ±0.05Hz	43659.27W	51.15 Hz		-
Step e) 50.70Hz ±0.10Hz	47369.56W	50.70 Hz		-
Step f) 50.45Hz ±0.05Hz	49502.06W	50.45 Hz		-
Step g) 50.00Hz ±0.01Hz	49978.32W	50.00 Hz		
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00Hz ±0.01Hz	25173.92W	50.00 Hz	26000W	-
Step b) 50.45Hz ±0.05Hz	24511.58W	50.45 Hz		-

Step c) 50.70Hz ±0.10Hz	22010.40W	50.70 Hz		-
Step d) 51.15Hz ±0.05Hz	17508.27W	51.15 Hz		-
Step e) 50.70Hz ±0.10Hz	22010.40W	50.70 Hz		-
Step f) 50.45Hz ±0.05Hz	24511.58W	50.45 Hz		
Step g) 50.00Hz ±0.01Hz	25186.79W	50.00 Hz		

10. Protection – Re-connection timer

Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 10.1. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Power Generating Module** does not reconnect at the voltage and frequency settings below; a statement of "no reconnection" can be made.

Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
20 s	See below	At 1.16 pu (266.2 V **LV** connection, 127.6 V **HV** connection assuming 110 V ph-ph VT)	At 0.78 pu (180.0 V **LV** connection, 85.8 V **HV** connection assuming 110 V ph-ph VT)	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Power Generating Module** does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection
Recover to normal operation range after confirmation of no reconnection		At 1.12 Un L – N	At 0.82 Un L – N	At 47.6 Hz	At 51.9 Hz
Confirmation that the **Power Generating Module** Shall re connect		38.0 s	37.0 s	40.0 s	38.0 s

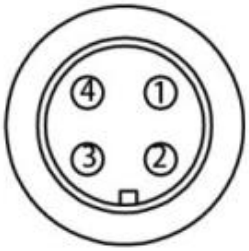
11. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5. Please complete each entry, even if the contribution to the fault level is zero.

For **Inverter** output

Time after fault	Volts			Amps		
20ms	L1-L2	L2-L3	L3-L1	L1-L2	L2-L3	L3-L1
100ms	460V	520V	310V	116A	116A	114A
250ms	420V	40V	50V	109A	10A	10A
500ms	0V	0V	0V	0A	0A	0A
Time to trip	52.84 ms			In seconds		

12. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.6.	
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 s.	NA
13. Wiring functional tests: If required by para 15.2.1.	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA
14. Logic interface (input port)	
Confirm that an input port is provided and can be used to shut down the module	Yes
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used)	Yes

5) The inverter use COM port as logic interface. External control command is sent via RS-485 signal and connected with pin 3 and pin4 of COM port.



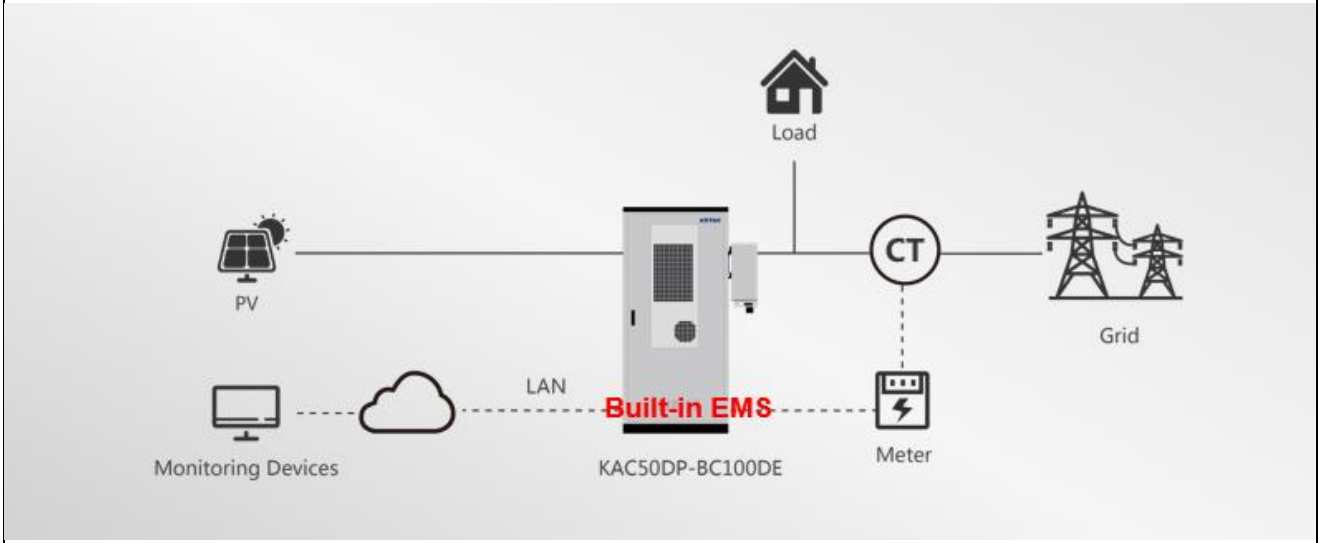
PIN	Network
1	CAN-H
2	CAN-L
3	RS485-A
4	RS485-B

Figure 6-5 Connection Diagram of COM Port

15. Cyber security	
Confirm that the **Power Generating Module** has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes
Additional comments.	

The standard configuration of the devices employs KSTAR monitoring platform. KSTAR has taken reasonable steps to protect the device from cyber-attack according to ETSI EN 303 645, including points below:
1) passwords are used;
2) pre-installed passwords are used;
3) software components are not updateable;
4) the device is constrained;
5) the device is not constrained;
6) telemetry data being collected;
7) personal data is processed on the basis of consumers' consent;
8) the device allowing user authentication;
9) the device supports automatic updates and/or update notifications;

1) The monitoring configuration is shown as the picture below. Only the Built-in EMS has the access to the internet via 4G, Ethernet or Wi-Fi.



2) All communications between internal components of the inverter, and supplied External Power Meter(s), take place via appropriate serial lines (RS485, CanBus).

3) The only communication port between the inverter and the external parties is enabled by the built in EMS as picture above shows;

4) All communications between the KSTAR server and the subjects/parties are cyber- protected by SSL technology.