

CEA | PV MAGAZINE PROGRAM TEST REPORT

SUPPLIER | GCL

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1. INTRODUCTION

As part of CEA’s engagement in developing and supervising PV Magazine’s test program at Gsola, CEA has developed a testing protocol and flowchart, a scoring system, a methodology and a reporting structure that it will be used to run this program. This report presents the test results and scoring grades for this product.

2. SCORING SYSTEM

2.1. Test flowchart and protocol

The following is a high-level flowchart of the testing procedure, describing the steps, and tests to be followed. Detailed checklists have been delivered to Gsola, that will also serve as records of the process.

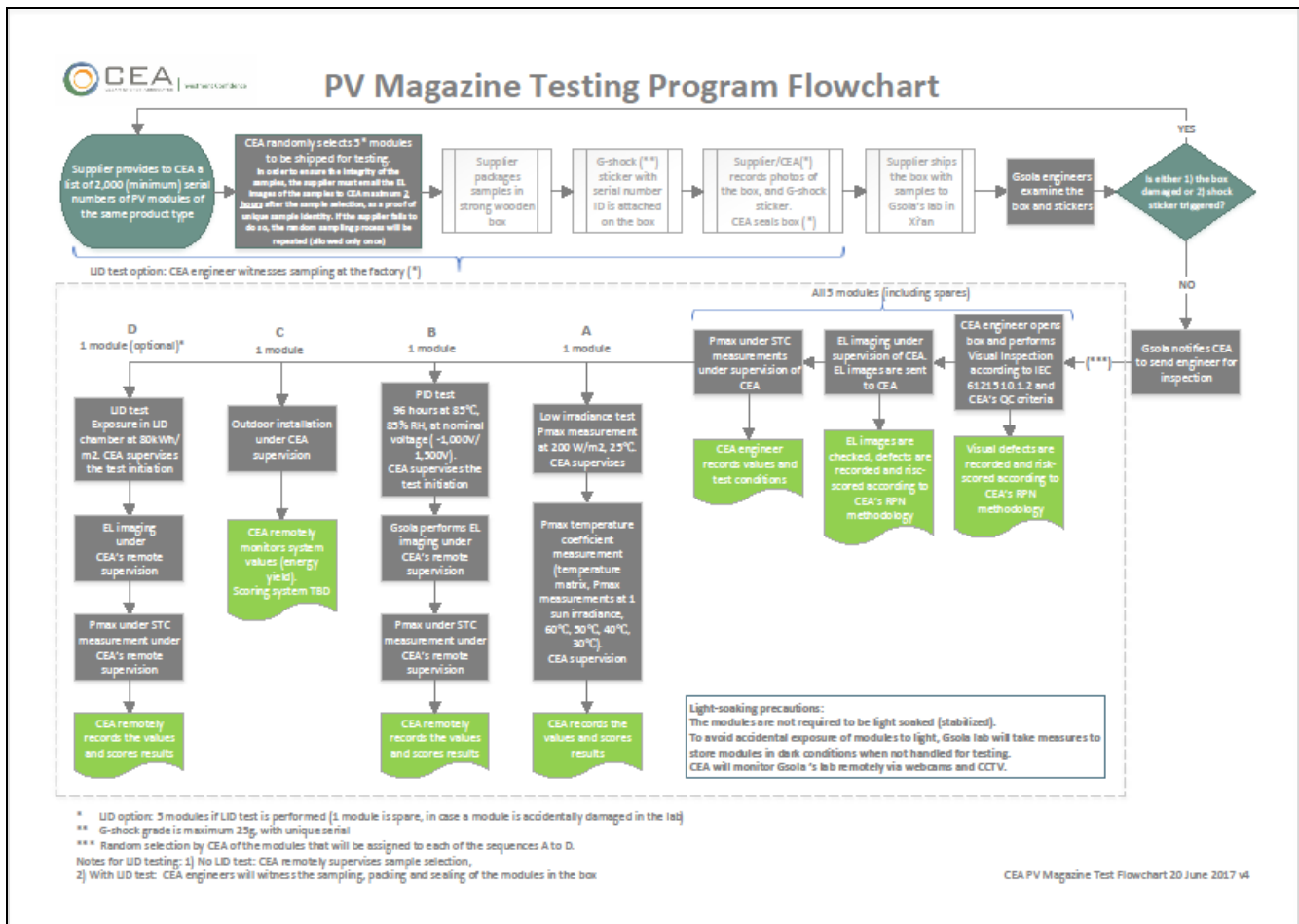


Figure 1 Test flowchart

2.2. Scoring methodology

For every product, 5 samples have been shipped to Gsola’s lab to conduct the tests and inspections according to the above flowchart.

The following table describes the inspections and tests that have been applied on all products:

Table 1 Test/inspection grading system overview

	Test/inspection	# of samples	Method	Values	Average grade weight	Grades
1	Visual inspection	5	Inspection	RPN Scores	10%	1-100
2	EL image inspection	5	Inspection	RPN Scores	10%	1-100
3	Low irradiance efficiency loss	1	Test	%	25%	1-100
4	Pmax Temperature coefficient	1	Test	%/°C	25%	1-100
5	PID loss	1	Test	%	30%	1-100
6	LID loss (optional)	1	Test	%	NA	1-100
7	Outdoor installation and yield measurement	1	Energy Yield Monitoring	Periodic kWh/kWp	NA	NA

Notes:

1. The RPN scoring method has been developed by CEA and is used to evaluate and create risk scores of Visual and EL defects.
2. The weights are used to calculate the average grade for tests 1-5.

A number within the 1-100 range will be used to grade the results, so that the overall ranking of the products will reflect general industry practices and requirements:

Table 2 Detailed scoring system

	Grade range:	100	90	80	70	60	50	40	30	20	10	0
1	Visual inspection (RPN scores)	0	0.74	2.20	4.39	7.30	10.94	15.30	20.39	26.20	32.74	≥ 40
2	EL image (RPN scores)	0.00	2.03	4.62	7.75	11.43	15.65	20.43	25.75	31.62	38.03	≥ 45.00
3	Low irradiance loss	≤ -2.00%	-0.02%	1.78%	3.41%	4.87%	6.16%	7.27%	8.21%	8.98%	9.58%	≥ 10.00%
4	Pmax Temp. coefficient	≥ -0.300%	-0.343%	-0.382%	-0.417%	-0.448%	-0.475%	-0.498%	-0.517%	-0.532%	-0.543%	≤ -0.550%
5	PID loss	≤ 0.0%	0.7%	1.6%	2.7%	4.0%	5.5%	7.2%	9.1%	11.2%	13.5%	≥ 16.0%
6	LID loss (optional)	≤ -0.50%	0.35%	1.20%	2.05%	2.90%	3.75%	4.60%	5.45%	6.30%	7.15%	≥ 8.00%

Notes:

1. The Visual and EL Inspection RPN scores will be divided by the number of samples, to normalize the score, as the total number of samples may vary.
2. The correspondence of the scores/test results to the grades follows a binomial or linear relationship, anchored to certain key values that are generally accepted and employed in the PV industry. For example, a PID loss of 5%, which is the pass/fail threshold of the related IEC standard, will give a grade close to 50. In this sense, grades below 50 indicate a product performance that is below a generally acceptable threshold.

The scoring system shown in Table 2 is preliminary, and will be adjusted as the testing program develops, in order to better reflect the products standing per industry standards.

3. TEST DETAILS

This sample lot consists of 3 modules, one of which has been used as a spare for the chamber and outdoor testing, in case a module is accidentally damaged during handling at the lab. Refer to Table 3 and Table 4 for test sample and product information.

Table 3 Test sample information

Sample #	Serial number	Lab code
1	122003142630378	PVT200518A-03-01
2	12200315263108	PVT200518A-03-02
3	122003152631055	PVT200518A-03-03

Table 4 Product information

Model	GCL-M3/72H-380
Cell technology	Mono PERC
Cell number	144
Cell format	Half cut
Number of busbars	9
Junction box	IP68 rated
Laminate construction	Framed glass/glass

3.1. Visual inspection

All 3 modules of each product sample lot have undergone visual inspection, according to CEA’s quality criteria for visual inspection. The defects found has been evaluated according to CEA’s scoring system. The scoring system is a modified version of CEA’s proprietary RPN (risk priority number) system, based on the formula $RPN\ score = Severity \times Detectability$.

Table 5 Product picture

Front Side	Rear Side

The following table shows the visual inspection results, normalized for the number of tested modules:

Table 6 Visual inspection results

GCL-M3/72H-380	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Score	Grade
Visual inspection	None	None	None			0	100

3.2. EL image Inspection

The same sample lot was inspected for EL defects.

Table 7 shows the EL inspection results normalized for the number of tested modules. Visual and EL inspection scores are shown below in Figure .

Table 7 EL image inspection results

GCL-M3/72H-380	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Score	Grade
EL image inspection	None	None	None			0	100

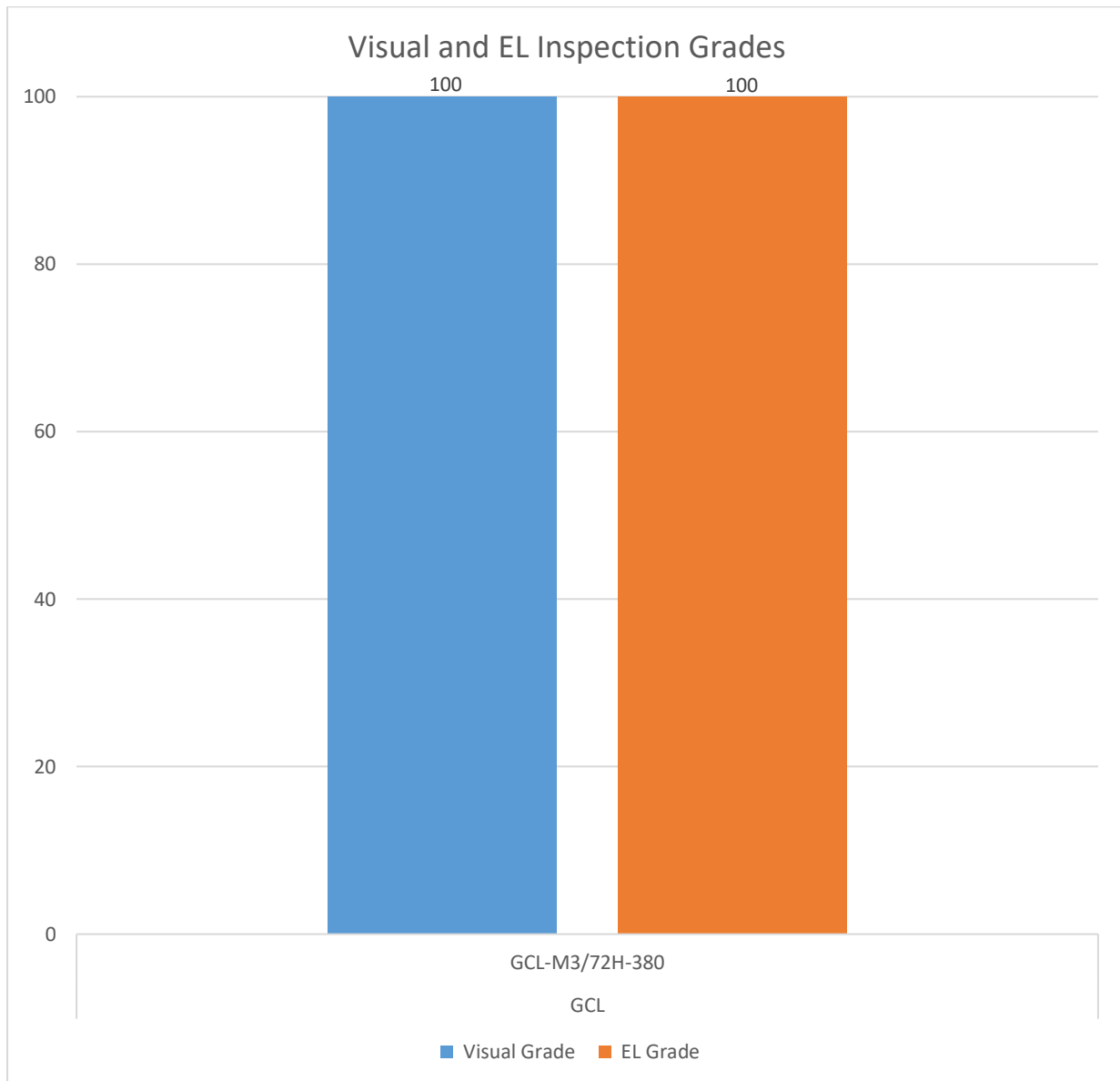


Figure 2 Visual and EL inspection results

3.3. Low irradiance efficiency loss test

The efficiency loss is calculated by the following formula:

$$\text{Efficiency loss} = 1 - \left[\left(\frac{\text{Pmax at low irradiance conditions}}{\text{Pmax at STC}} \right) * \left(\frac{1,000}{200} \right) \right]$$

Table 8 and Figure 3 show the low irradiance efficiency test results for the front side.

Table 8 Low irradiance test results

GCL-M3/72H-380	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side low irradiance efficiency loss (%)	5.10%					58

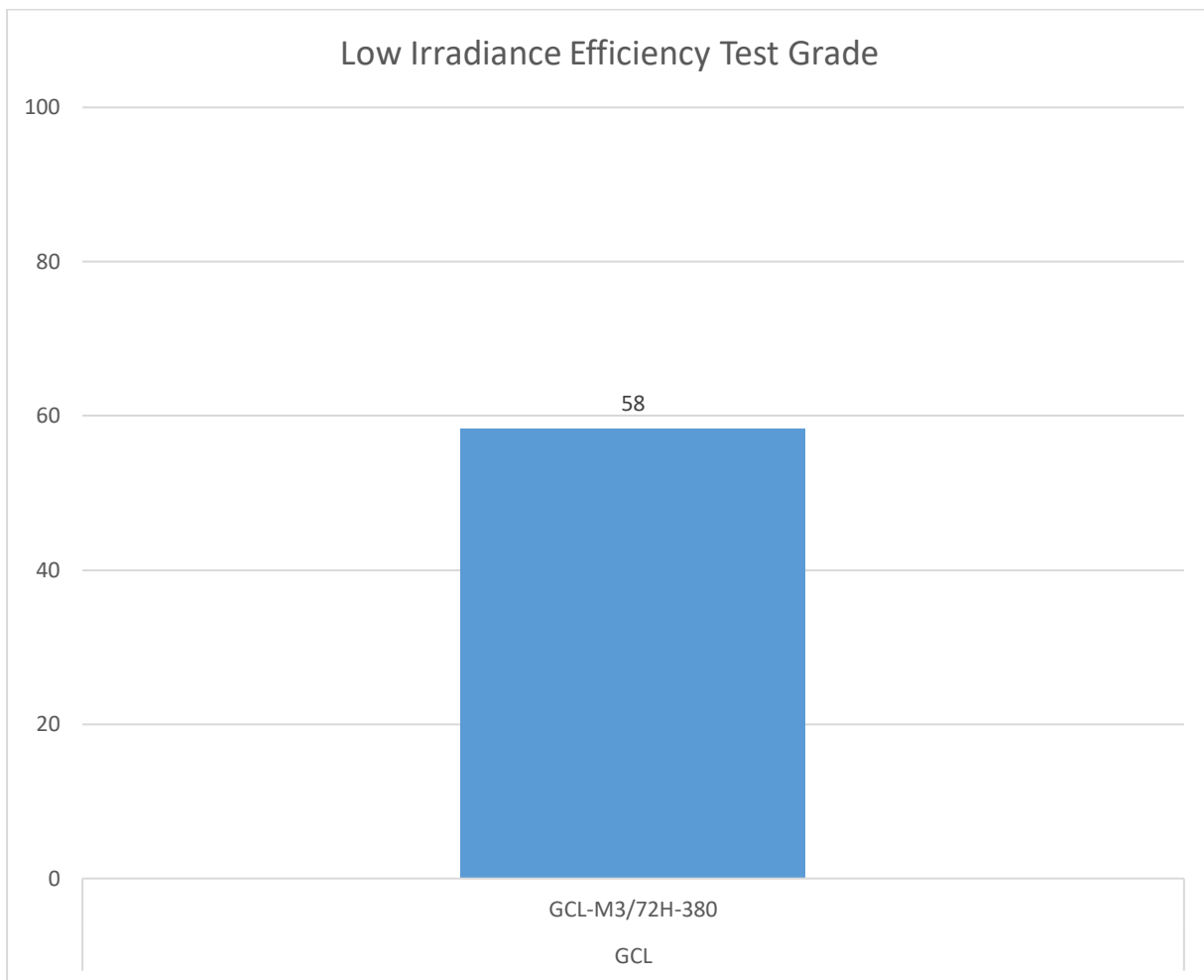


Figure 3 Low irradiance test result

3.4. Pmax temperature coefficient test

Table 9 and Figure 4 depict the Pmax temperature coefficient test results.

Table 9 Pmax temperature coefficient test result

GCL-M3/72H-380	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Pmax Temperature coefficient (%/°C)	-0.38%					81

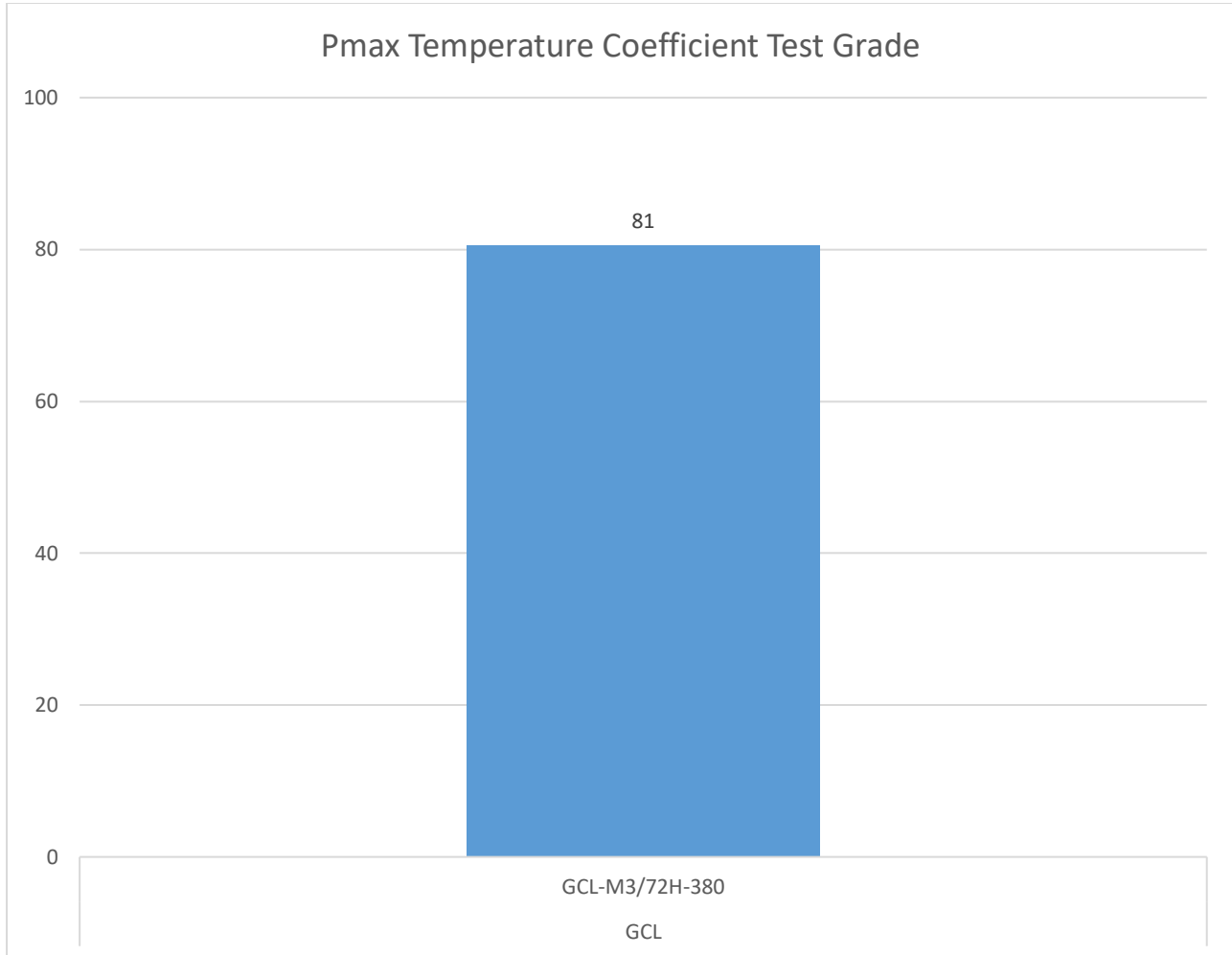


Figure 4 Pmax temperature coefficient test result

3.5. PID loss test

Table 10 and Figure 5 depicts the PID loss test results for the front side at **1500 V**:

Table 10 PID loss test result

GCL-M3/72H-380	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Grade
Front side PID loss (%)		3.16%				67

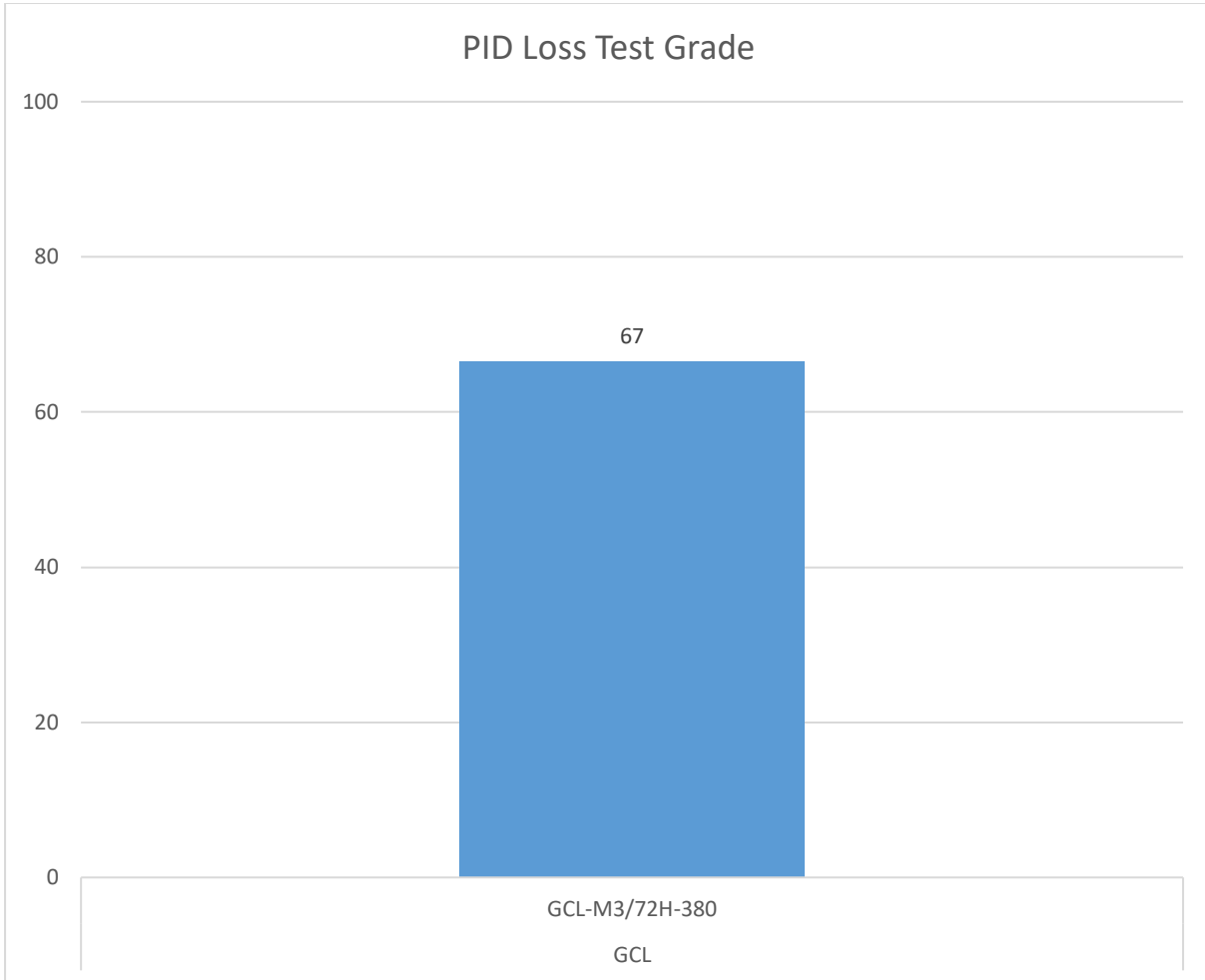


Figure 5 PID loss test result

3.6. Score overview

Figure 6 shows the overview of the test scores. Figure 7 shows the average score.

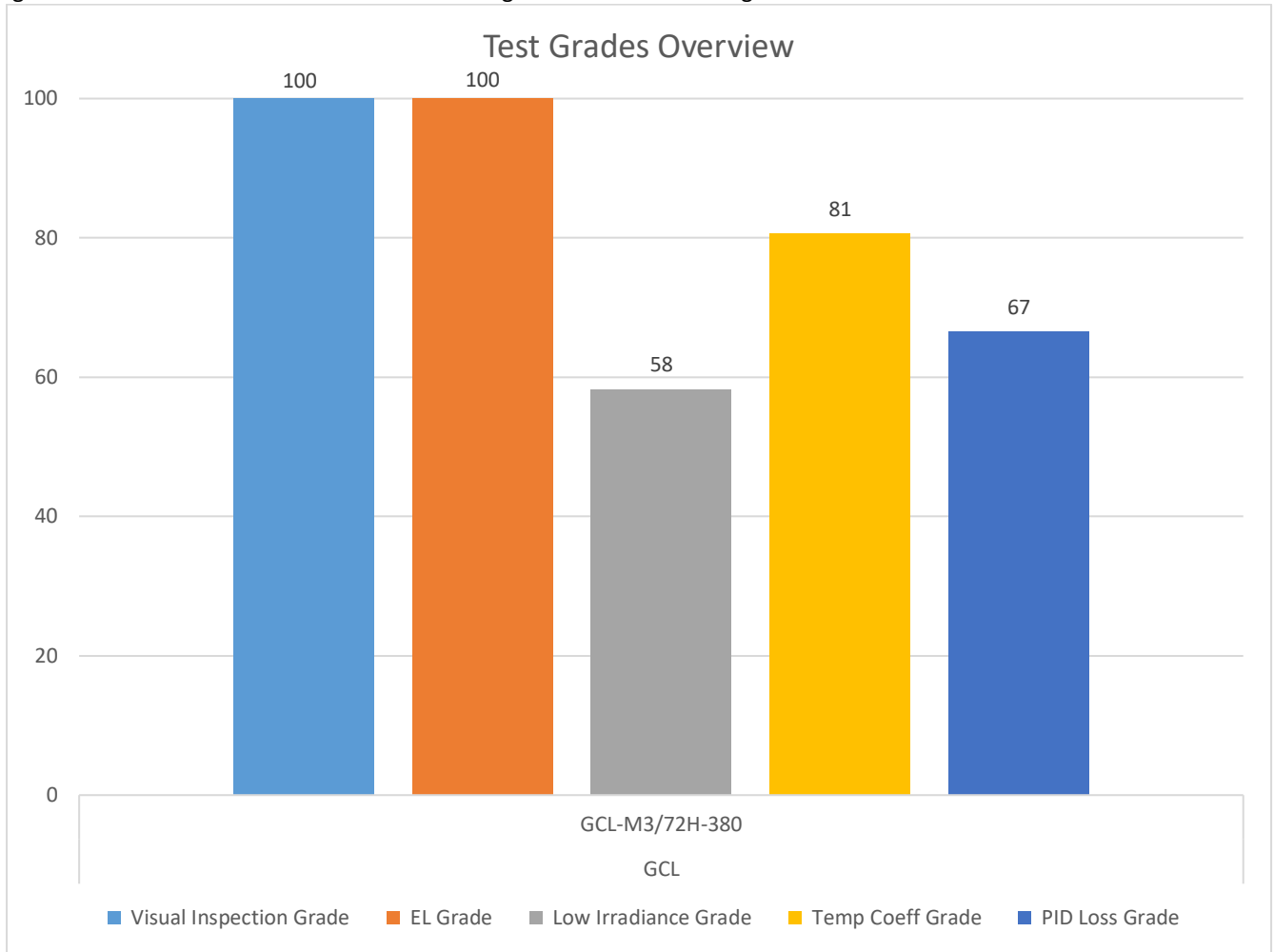


Figure 6 Test results overview

NOTE: The Average grade does **NOT** include the LID test, as it is optional and not performed for all products.

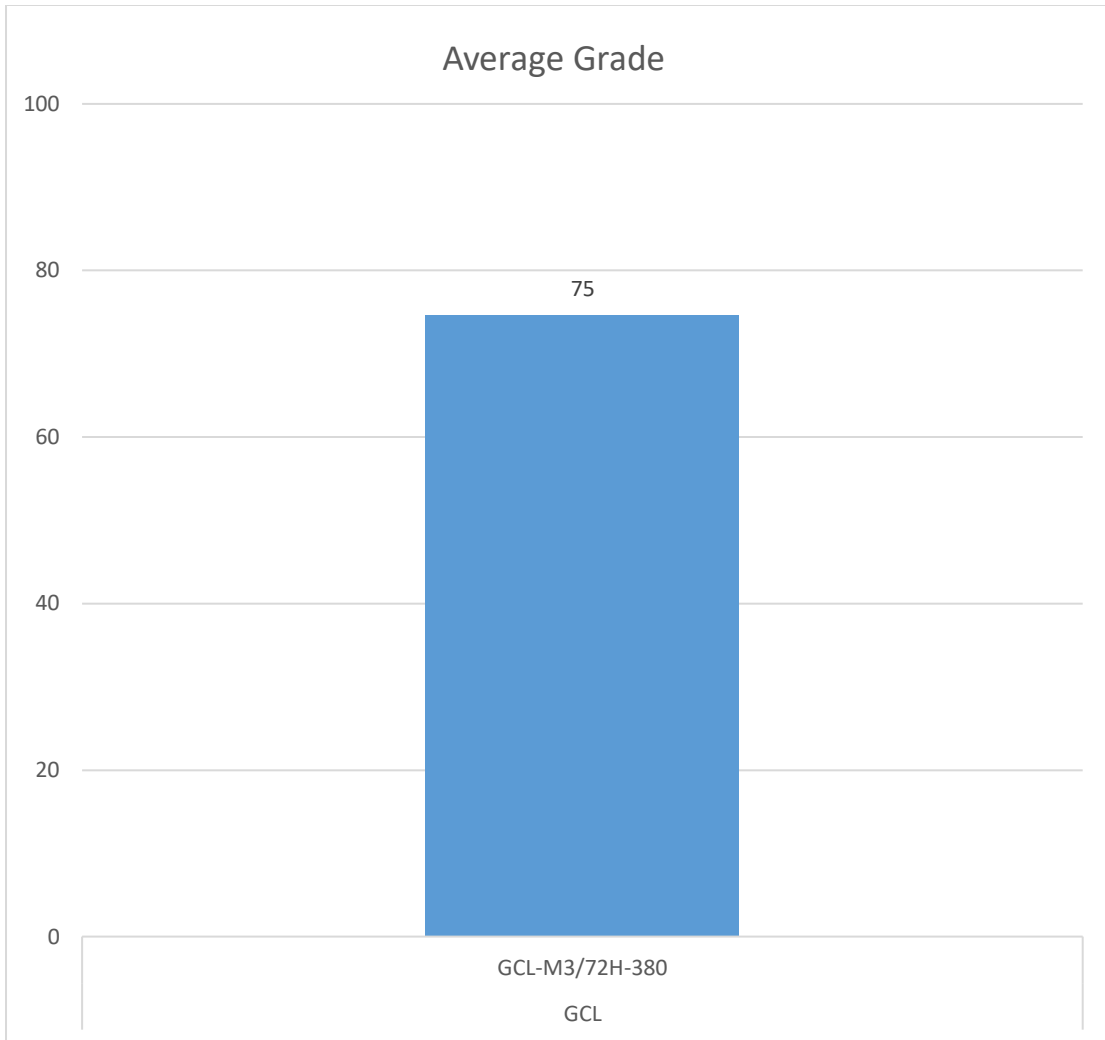


Figure 7 Average test grade

Appendix 1 - GCL-M3/72H-380 Datasheet



GCL-M3/72H
Monocrystalline Module
370-405W



405W
Maximum Power Output

20.6%
Maximum Module Efficiency

0~+5W
Power Output Guarantee

Cell Type



5BB



Ideal choice for large scale ground installation



Selected encapsulating material and stringent production process control ensure the product is highly PID resistant and snail trails free



Special cutting and soldering technology leads to low hotspot risk



Sand blowing test, salt mist test and ammonia test passed to endure harsh environments



Optimized system performance due to module level current sorting

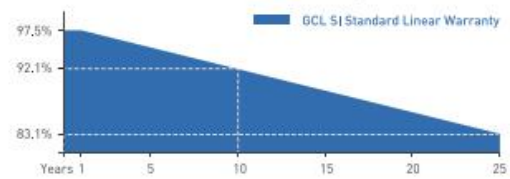


Highly transparent self-cleaning glass brings additional yield and easy maintenance

GCL Delivers Reliable Performance Over Time

- World-class manufacturer of crystalline silicon photovoltaic modules
- Fully automatic facility and world-class technology
- Rigorous quality control to meet the highest standard: ISO9001:2015, ISO14001:2015 and OHSAS: 18001 2007
- Tested for harsh environments (salt mist, ammonia corrosion and sand blowing test: IEC 61701, IEC 62716, DIN EN 60068-2- 68)
- Long term reliability tests
- 2x100% EL inspection ensuring defect-free modules

Linear Performance Warranty



10 Years Product Warranty 25 Years Linear Power Warranty

* Please refer to GCL standard warranty for details

Additional Insurance Backed by Swiss RE



GCL-M3/72H

Monocrystalline Module 370-405W

Electrical Specification (STC*)

	P _{max} (W)	370	375	380	385	390	395	400	405
Maximum Power	P _{max} (W)	370	375	380	385	390	395	400	405
Maximum Power Voltage	V _{mp} (V)	38.51	38.87	39.22	39.57	39.92	40.27	40.61	40.96
Maximum Power Current	I _{mp} (A)	9.61	9.65	9.69	9.73	9.77	9.81	9.85	9.89
Open Circuit Voltage	V _{oc} (V)	47.13	47.43	47.73	48.03	48.33	48.63	48.93	49.23
Short Circuit Current	I _{sc} (A)	10.16	10.19	10.22	10.25	10.29	10.33	10.36	10.39
Module Efficiency (%)	(%)	18.8	19.0	19.3	19.5	19.8	20.0	20.3	20.6
Power Output Tolerance	(W)	0~+5							

* Irradiance 1000W/m², Module Temperature 25°C, Air Mass 1.5

Electrical Specification (NOCT*)

	P _{max} (W)	276.43	279.83	284.38	287.82	291.65	295.13	298.24	301.37
Maximum Power	P _{max} (W)	276.43	279.83	284.38	287.82	291.65	295.13	298.24	301.37
Maximum Power Voltage	V _{mp} (V)	35.90	36.20	36.60	36.90	37.20	37.50	37.80	38.10
Maximum Power Current	I _{mp} (A)	7.70	7.73	7.77	7.80	7.84	7.87	7.89	7.91
Open Circuit Voltage	V _{oc} (V)	43.90	44.20	44.50	44.80	45.00	45.30	45.60	45.80
Short Circuit Current	I _{sc} (A)	8.22	8.24	8.26	8.29	8.32	8.35	8.38	8.40

* Irradiance 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s

Mechanical Data

Number of Cells	144 Cells (6×24)
Dimensions of Module L*W*H (mm)	1986×992×35 mm (78.19×39.1×1.38 inches)
Weight (kg)	22.6 kg
Glass	High transparency solar glass 3.2mm (0.13 inches)
Backsheet	White
Frame	Silver, anodized aluminium alloy
J-Box	IP68 Rated
Cable	4.0mm ² (0.006 inches ²), 300mm (11.8 inches)
Number of diodes	3
Wind/ Snow Load	2400Pa/ 5400Pa*
Connector	MC Compatible

* For more details please check the installation manual of GCLSI

Temperature Ratings

Nominal Operating Cell Temperature (NOCT)	44±2°C
Temperature Coefficient of I _{sc}	+0.06%/°C
Temperature Coefficient of V _{oc}	-0.30%/°C
Temperature Coefficient of P _{max}	-0.38%/°C

Packaging Configuration

Module per box	30 pieces
Module per 40' container	660 pieces

Maximum Ratings

Operational Temperature	-40~+85°C
Maximum System Voltage	1500V DC
Max Series Fuse Rating	20A

Optional

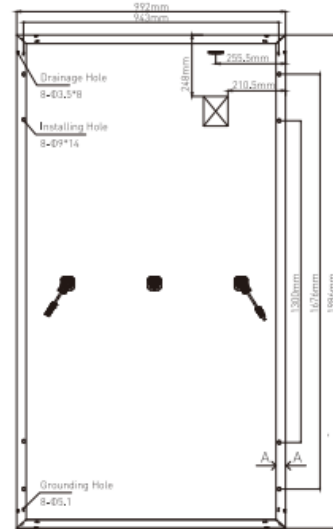
Connector: Original MC4



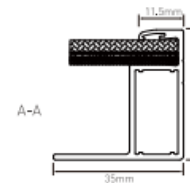
Contact Us for More Information

website: www.gclsi.com email: gclsisales@gclsi.com

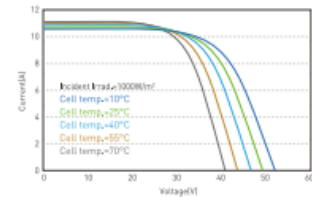
Module Dimension



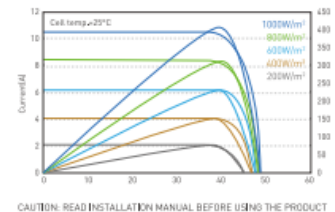
Back View



I-V Curve at Different Temperature (405W)



I-V/P-V Curve at Different Irradiation (405W)



CAUTION: READ INSTALLATION MANUAL BEFORE USING THE PRODUCT

Bringing Green Power To Life

GCL-EN-M3/72H-S-2019-V2.0