Revision-2

Schedule- 35
Standards and Labeling Program of Solar Photovoltaic Modules

1. SCOPE

This schedule specifies the energy-labeling requirement for Solar Photovoltaic (PV) modules imported or manufactured in India for electricity generation and similar use. The schedule covers all types and sizes/capacity of Solar Photovoltaic Modules.

For this schedule, the star rating shall be based on SPV module's effective efficiency as per *Appendix-A*.

This program is initiated on voluntary regime until further orders.

This schedule does not apply to:

- Concentrator Photovoltaic (CPV) Modules
- Photovoltaic Thermal (PVT) hybrid solar collectors

2. NORMATIVE REFERENCES

This schedule shall be read in conjunction with the following standards with all amendments, for the purpose of star labeling:

Number	Standard
1.	IS 14286: 2010 Crystalline Silicon terrestrial photovoltaic (PV) modules-Design qualification and type approval
2.	IS 16077:2013 Thin film terrestrial photovoltaic (PV)-Design qualification and type approval
3.	IEC 61853-3:2018 Photovoltaic (PV) module performance testing and energy rating - Part 3: Energy rating of PV module
4.	IS 12834: 2013 Photovoltaic Energy Systems – Terms, Definitions and Symbols
5.	IEC 62804 (Part 1):2022 Photovoltaic (PV) modules — Test methods for the detection of Potential-induced degradation Part 1 crystalline silicon

3. TERMINOLOGY

For this schedule, the following definitions shall apply. However, in case of dispute, the definitions given in '*IS 12834 :2013 Solar Photovoltaic Energy Systems – Terms, Definitions and Symbols*' may be referred.

3.1. Photovoltaic cell/ Solar Photovoltaic Cell / Solar Cell

Most elementary photovoltaic device.

3.1.1. Crystalline silicon PV cell

Photo Voltaic cells made of crystalline silicon.

3.1.1.1. Crystalline silicon

General category of silicon materials exhibiting a crystalline structure, i.e., showing long range ordering of the silicon atoms.

3.1.2. Thin film PV cell

Photovoltaic cell made of thin layers of semiconductor material.

3.2. Photovoltaic Device

Component that exhibits the photovoltaic effect.

3.3. Photovoltaic effect

Production of DC voltage by the absorption of photons.

3.4. PV module

Complete and environmentally protected assembly of interconnected photovoltaic cells.

3.5. PV Module efficiency

Ratio of the electric power generated by a PV module to its incident irradiance as measured under standard test conditions (STC).

4. TESTING GUIDELINES AND REQUIREMENTS

4.1 Temperature impacts the module efficiency and hence the energy generation. Therefore, temperature impact is selected as the major criteria and effective efficiency (η_{eff}) is used as a single parameter to give star label to the module.

$$\eta_{eff} = \eta_{STC}[1 + \gamma(T_m - 25)]$$

γ: Temperature coefficient of Power (%/°C)

Estimation of module temperature and impact of module temperature on annual energy generation is given in *Appendix-A*.

4.2 Assumption for Units of electricity produced in a year is:
Annual irradiation = 2100 kWh/m^2.

4.3 Test report

The results of test shall be reported in the prescribed format as given in *Appendix-B* of this schedule. Test report should be from laboratories that are either BIS recognized / NABL accredited for the standards mentioned above.

4.4 Tolerance limit

There is no negative tolerance for star rating band. The products tested must be at par or better than the star rating band minimum threshold. The scope for manufacturing and testing tolerance and other variations shall be accounted for as per relevant Indian Standards to be used while determining the Star Rating. Effective efficiency of solar PV module will be rounded off to nearest two decimal place as per IS 2:1960.

5 RATING PLAN / LABELLING PLAN

The rating plan is based on effective efficiency (η_{eff}). The star labeling scheme for Solar PV modules is given in Table-1. The effective efficiency is calculated using equation given in *Appendix-A*.

5.1 Pre-Qualification Criteria for labelling:

5.1.1 To participate in the S&L program, the performance of solar PV module must not degrade beyond 3% after subjecting it to the following design qualification tests individually.

(I) Hot-spot endurance test
(II) UV preconditioning
(III) Thermal cycling test
(IV) Humidity freeze test
(V) Damp heat test

The design qualification tests must be conducted in accordance with IS 14286: 2010/ IEC 61215: 2005 for crystalline silicon PV modules and IS 16077: 2013/ IEC 61646: 2008 for thin film PV modules.

5.1.2 The performance of solar PV modules must not degrade beyond 3% post the PID test. The modules must be tested for PID as per IS 17210 (Part 1): 2019.

5.1.3 To qualify for award of star labeling, the PV modules must meet the star labeling criteria for Solar PV modules mentioned in Table-1.

Table-1 Star labeling criteria for Solar PV modules

Validity period: 1st January 2024 to 31st December, 2025	
Star level	**Effective Efficiency η_{eff} (%)**
1 Star	>=17% & <=18%
2 Star	>18% & <=19%
3 Star	>19% & <=20%
4 Star	>20% & <=21%
5 Star	>21%

5.1.4 For user benefit and comparison, Annual Electricity Generation is displayed on star label.

5.1.5 The star labelling program will be voluntary for two years and will be reviewed thereafter, to make it mandatory.

5.2 Check testing

(a) Testing for compliance of PV modules covered under the S&L scheme with respect to BEE performance standards will be carried out in laboratories that are either BIS recognized / NABL accredited Laboratories.

(b) The samples will be picked up by BEE or its designated agency for testing as per the following sampling plan:

(i) Samples will be picked up at random from manufacturer's authorized dealer/retailer/e-market platform.

(ii) In case the sample drawn for the first check testing fails, the Bureau or its designated agency shall conduct a second check testing for which it shall buy twice the quantity of samples for the same model. If the first set of sample fails only then second check testing will be done.

(iii) The permittee/user of the label would be accordingly informed about the failure of the first check testing and shall be advised to deposit the cost of the samples, cost of check testing and transport for the second check testing in advance.

(iv) If permittee fails to deposit/pay the expenses, Bureau shall continue the verification by check testing and stop further processing of application received for new appliance/equipment of the respective permittee.

(v) Second set of samples will be picked up at random from the market for second check testing, and both samples must pass the test.

(vi) BEE or its designated agency shall inform the date of second check testing to the permittee to witness the second check testing. If the permittee is unable to witness the testing, the Bureau shall proceed with testing in the presence of BEE/Designated Agency personnel and the test result shall be binding on the permittee.

(vii) If any one of the samples fail during second check testing, the PV module will be in **non-compliance** with prescribed BEE standards and

(viii) Bureau/Designated Agency shall proceed with the following actions:

- direct the permittee, under intimation to all the State Designated Agencies, that the permittee within a period of two months from the date of issuance of such intimation, shall-
  - Withdraw all the stocks from the market to comply with the directions of the Bureau; and
  - Change the particulars displayed on advertising material.
  - Correct the star level displayed on the label of the appliance/equipment or remove the defects and deficiencies found during testing from the existing and new stock;

- publish, for the benefit of the consumers, the name of the permittee, brand name, model name or model number, logo and other specification in any national or regional daily newspaper and in any electronic or in any other manner as it deems fit within two months;

- The permittee within ten days of the conclusion of the period of two months from the date of issuance of intimation shall send the action taken report to the Bureau/Designated Agency with respect to action taken in compliance with the direction.

6 FEES

6.1 The applicant shall deposit a security fee of INR 1,00,000 for each registration as security deposit. However, applicants registered as small scale industries (SSI units), shall deposit INR 25,000, provided they submit the valid SSI registration certificate.

6.2 Application fee payable on application for each model seeking permission affix label is INR 2000/- (Rupees two thousand only).

6.3 No application fee is payable on application for renewal of permission to affix label on model.

6.4 Labeling fee for solar PV module

a) The labeling fee for solar PV module will be 0.5 Paisa per Watt only i.e 8th February 2024 to 31st December 2024.

b) The labeling fee of 1 Paisa per Watt will be applicable for 2nd year i.e 1st January 2025 to 31st December 2025.

c) The labeling fee will be waived off for 4 star and 5 star rated module during these two year i.e 1st January 2024 to 31st December 2025.

d) The labeling fee of 2 Paisa per Watt to be applied for all the categories from 3rd year onwards i.e 1st January 2026.

7 LABEL DESIGN AND MANNER OF DISPLAY

7.1 **Placement:** All PV modules awarded the star rating must display the label. The label shall be displayed on the backside of the module. The label shall also be displayed on the packaging.

For Bifacial module, sample label will be affixed on the width of the panels. The label should also be displayed on the packing.

7.2 **Material, Dimension and Shape:** The label shall be of durable material and printed as per the dimensions mentioned below:

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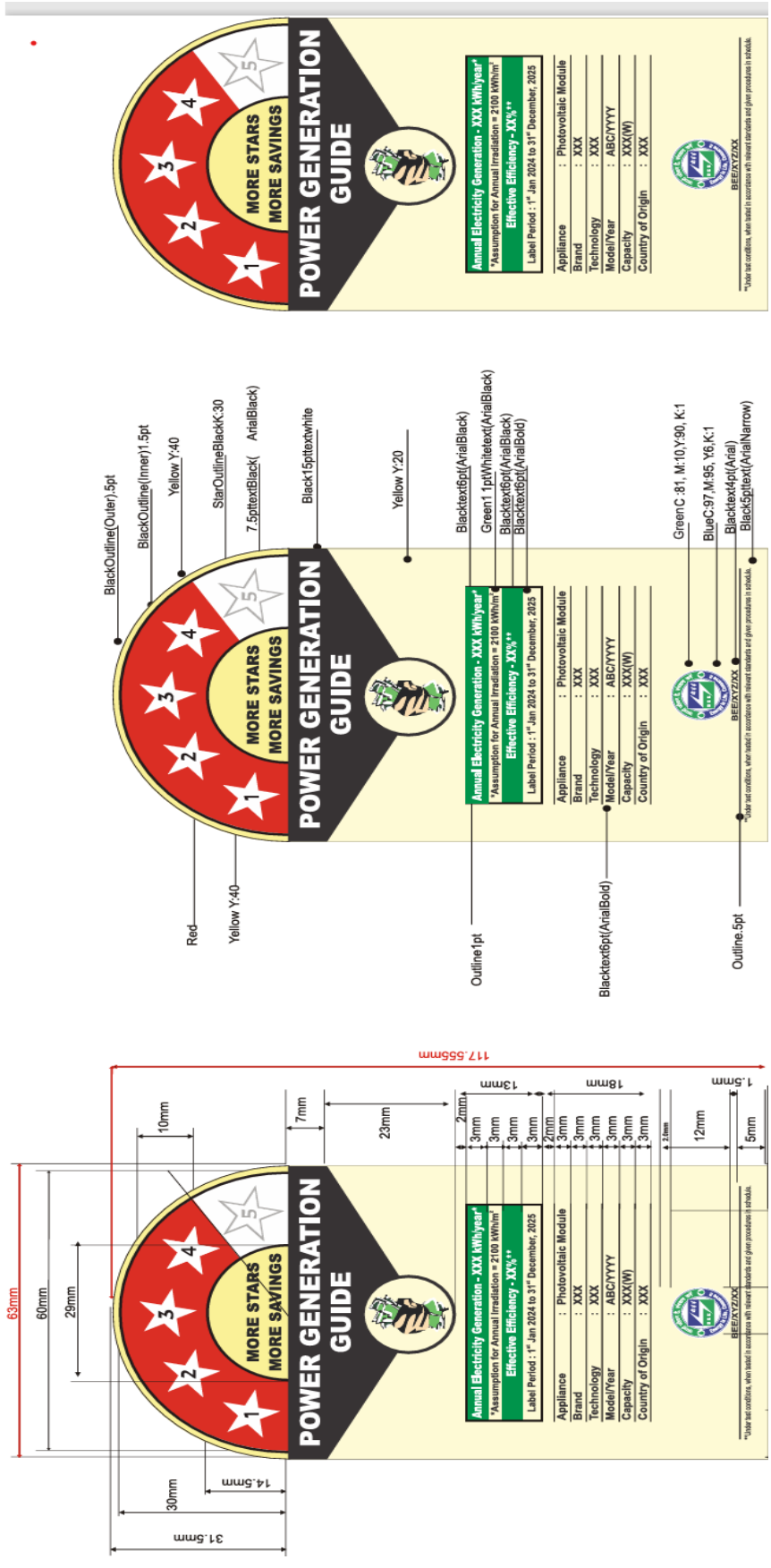
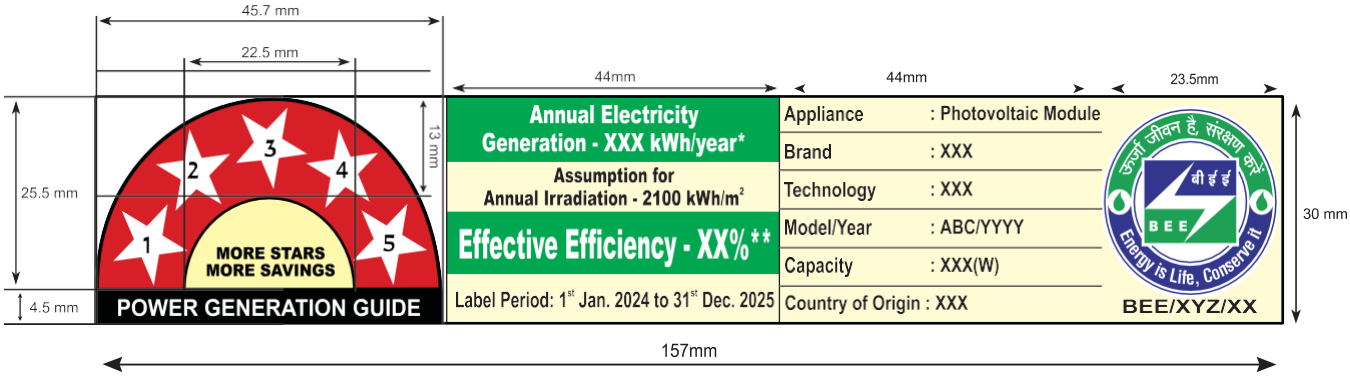
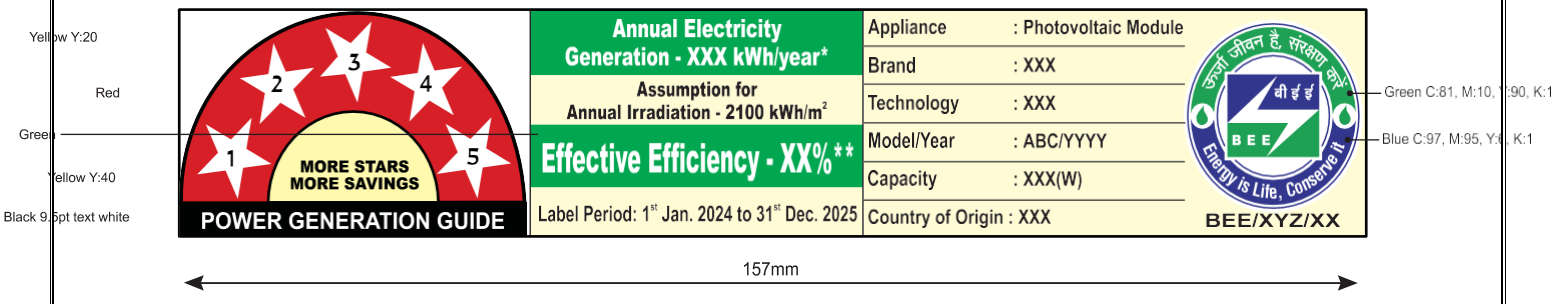
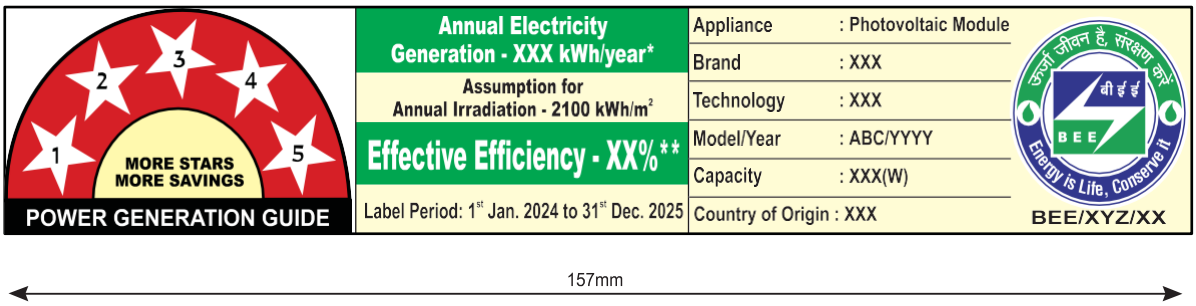


Figure 1 Label for Solar PV module







For Bi-facial module

APPENDIX–A

Symbol	Description
η_{eff} (%)	Effective Efficiency (Calculated as per equation 1)
η_{STC} (%)	Efficiency at STC
γ (%/°C)	Temperature coefficient of Power
T_m (ºC)	Module Temperature

The effective efficiency of the module is calculated by equation 1.

$$\eta_{eff} = \eta_{STC}[1 + \gamma(T_m - 25)] \quad \text{..... Equation 1}$$

- *Estimation of module temperature:*

  - Module temperature estimated using the following equation as per IEC 61853-3: 2018

$$T_m = T_{amb} + \frac{G_{POA}}{U_o + U_1 V_S}$$

Where T_{amb} is the ambient temperature
G_{POA} is the in-plane irradiance
V_S is the wind speed
The coefficient U_o describes the influence of the irradiance and U_1 the wind impact. The values of U_0 and U_1 are taken as 26.9 and 6.20 respectively.

  - Average Module temperature is assumed to be **58.5 ºC**

- *Estimation of Annual Electricity Generation*= $2100 \times \eta_{eff}/100$

where assumption for Units of electricity produced in a year is: Annual irradiation = 2100 kWh/m^2.

APPENDIX-B

Table 2 Information to be submitted by manufacturer to BEE

Laboratory name	
Address	
Date of receipt	
Test report No.	
Tested by	
Date of testing	
Reviewed by	
Brand name	
Model name / number	
Serial number	
Year of manufacture	
Nameplate capacity of the PV module	
BIS certificate for CRS	
Degradation in performance after Hot-spot endurance test	%
Degradation in performance after UV preconditioning	%
Degradation in performance after Thermal cycling test	%
Degradation in performance after Humidity freeze test	%
Degradation in performance after Damp heat test	%
Degradation value post PID test	%
Module Temperature T_m (°C)	
Effective Efficiency (η_{eff})	%
Annual Electricity Generation (kWh/year)	