Blackout Sheet — Irradiance Threshold Justification (OD 2.3 / 2.5)

Sun Safe LLC • Rev. B, Oct 21, 2026 (supersedes Apr 12, 2026) • Thresholds are inventor-defined test criteria, not NEC values • Patent pending, US 64/026,462

CORE EQUATIONS & MODULE PARAMETERS

$$OD = -\log_{10}(T) \quad T = 10^{(-OD)} \quad G_{trans} = T \times G_{ambient} \quad I_{sc}(G) = I_{sc,STC} \times G_{trans} \div 1000$$

Beer-Lambert law (Bouguer 1729, Lambert 1760, Beer 1852). Linear Isc–irradiance relation: King, Boyson & Kratochvil, Sandia SAND2004-3535, 2004, pp. 9–12. Phase 1 test module: Suniva OPT255-60-4-100, **Isc_STC = 8.71 A** (test-unit nameplate; replaces 9.05 A in Rev. A). UL 2011 tarp-test modules: 8.11 A Isc (UL 2011 §9.1.2). High-current comparison: Canadian Solar CS6W-585T, Isc_STC = 14.00 A.

TABLE 1 — OD 2.3 (T = 0.005012) • minimum specification

Ambient G (W/m²)	Source	G_trans (W/m²)	Suniva Isc (mA)	CS6W-585T Isc (mA)	vs 7 W/m²	CS6W vs 125 mA
800	Phase 1 test floor (NOCT irradiance, IEC 61215-2:2016 §4.5)	4.01	34.9	56.1	PASS	PASS (+68.9 mA)
1,000	STC reference (IEC 60904-3)	5.01	43.7	70.2	PASS	PASS (+54.8 mA)
1,400	Design basis: UL 2011, “can approach 1400 W/m²” (PDF p. 56)	7.02	61.1	98.2	AT LIMIT	PASS (+26.8 mA)
1,466	San Diego, CA: Lappalainen & Kleissl, JRSE 12(4) 043502, 2020	7.35	64.0	102.9	FAIL	PASS (+22.1 mA)
1,528	Norway: Yordanov et al., IEEE J. Photovolt. 3(1) 271–277, 2013	7.66	66.7	107.2	FAIL	PASS (+17.8 mA)
1,832	Andes, 3,400 m: Emck & Richter, J. Appl. Meteor. Climatol. 47, 2008	9.18	80.0	128.5	FAIL	FAIL (-3.5 mA)

TABLE 2 — OD 2.5 (T = 0.003162) • design target

Ambient G (W/m²)	Source	G_trans (W/m²)	Suniva Isc (mA)	CS6W-585T Isc (mA)	vs 7 W/m²	CS6W vs 125 mA
800	Phase 1 test floor (NOCT irradiance, IEC 61215-2:2016 §4.5)	2.53	22.0	35.4	PASS	PASS (+89.6 mA)
1,000	STC reference (IEC 60904-3)	3.16	27.5	44.3	PASS	PASS (+80.7 mA)
1,400	Design basis: UL 2011, “can approach 1400 W/m²” (PDF p. 56)	4.43	38.6	62.0	PASS	PASS (+63.0 mA)
1,466	San Diego, CA: Lappalainen & Kleissl, JRSE 12(4) 043502, 2020	4.64	40.4	64.9	PASS	PASS (+60.1 mA)
1,528	Norway: Yordanov et al., IEEE J. Photovolt. 3(1) 271–277, 2013	4.83	42.1	67.6	PASS	PASS (+57.4 mA)
1,832	Andes, 3,400 m: Emck & Richter, J. Appl. Meteor. Climatol. 47, 2008	5.79	50.5	81.1	PASS	PASS (+43.9 mA)

CEILINGS

	7 W/m² reached at ambient	125 mA reached at ambient (CS6W-585T, 14.00 A)	125 mA reached at ambient (Suniva, 8.71 A)
OD 2.3	1,397 W/m²	1,781 W/m²	2,863 W/m²
OD 2.5	2,214 W/m²	2,823 W/m²	4,538 W/m²

NOTES & SOURCES

Current 125 mA	Field measurement-noise gate: on a clamp reading in amps, 0.10 A is noise and 0.11 A still passes; 0.13 A fails. Proves an 8–9.5 A short collapsed to the meter floor. It is not an arc or shock limit; minimum arc current is material-specific and arcing has been reported below traditional minimums (Ney Contact Manual, pp. 23–25).
Shock reference 40 mA	NFPA 70E 2027 First Draft, FR-102, proposed 390.2(2): dc shock hazard “100 volts and 40 milliamperes” (draft text). UL 2011 (PDF p. 23) body-current bands: 0–2 mA Safe, 2.1–40 Perception, 40.1–240 Lock On, >240 Electrocution. A source cannot drive more body current than its short-circuit current.
Irradiance 7 W/m²	Keeps a 14.00 A module under 125 mA (98 mA) and stays above the noise floor of the field irradiance meters. OD 2.3 = $-\log_{10}(7 \div 1{,}400) = 2.301$.
Peak irradiance	OD 2.3 is $-\log_{10}(7 \div 1{,}400) = 2.301$ rounded down, so at exactly 2.3 the sheet reaches 7.02 W/m² at 1,400 W/m² (7 W/m² at 1,397 W/m²). 1,466 / 1,528 / 1,832 W/m² are reported cloud-enhancement peaks, not absolute maxima. At OD 2.3 the 7 W/m² line is exceeded above 1,400 W/m²; OD 2.5 holds to ~2,200 W/m².
Changes from Rev. A	Isc 9.05 A → 8.71 A (nameplate). “Arc cannot initiate” basis removed. “NEC 690.8(A) design basis” label removed. Both irradiance and current results shown for every row. “Highest documented” labels removed.