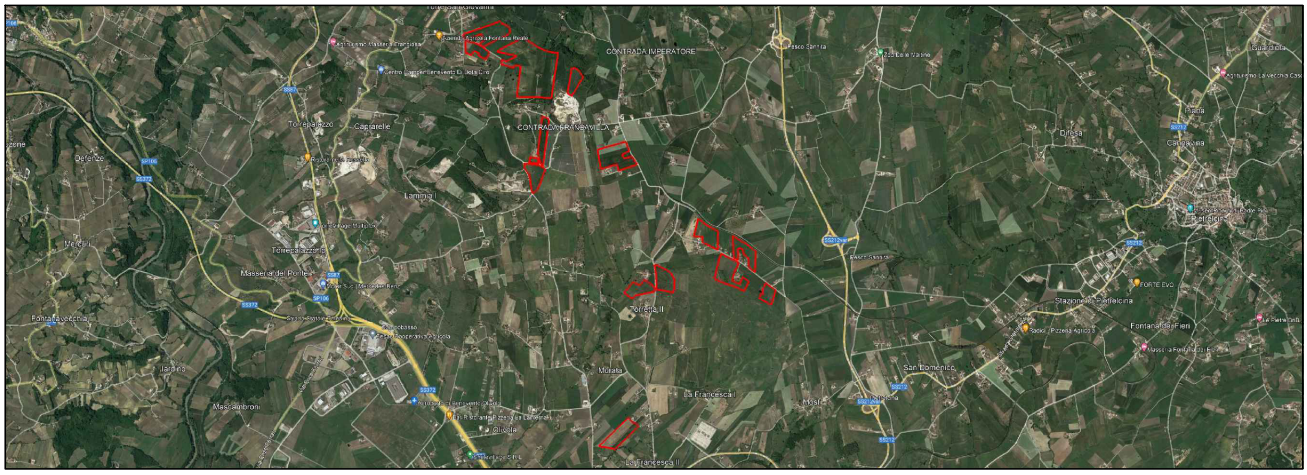
REGIONE CAMPANIA
PROVINCIA DI BENEVENTO
COMUNE DI BENEVENTO



PROGETTO PER LA REALIZZAZIONE DI UN IMPIANTO AGRI VOLTAICO DELLA POTENZA DI PICCO IN DC PARI A 48.48 MWp E MASSIMA IN IMMISSIONE IN AC PARI A 40 MW NEL COMUNE DI BENEVENTO (BN) E RELATIVE OPERE DI CONNESSIONE

PROGETTO DEFINITIVO

SCHEDE TECNICHE COMPONENTI IMPIANTO

Titolo elaborato

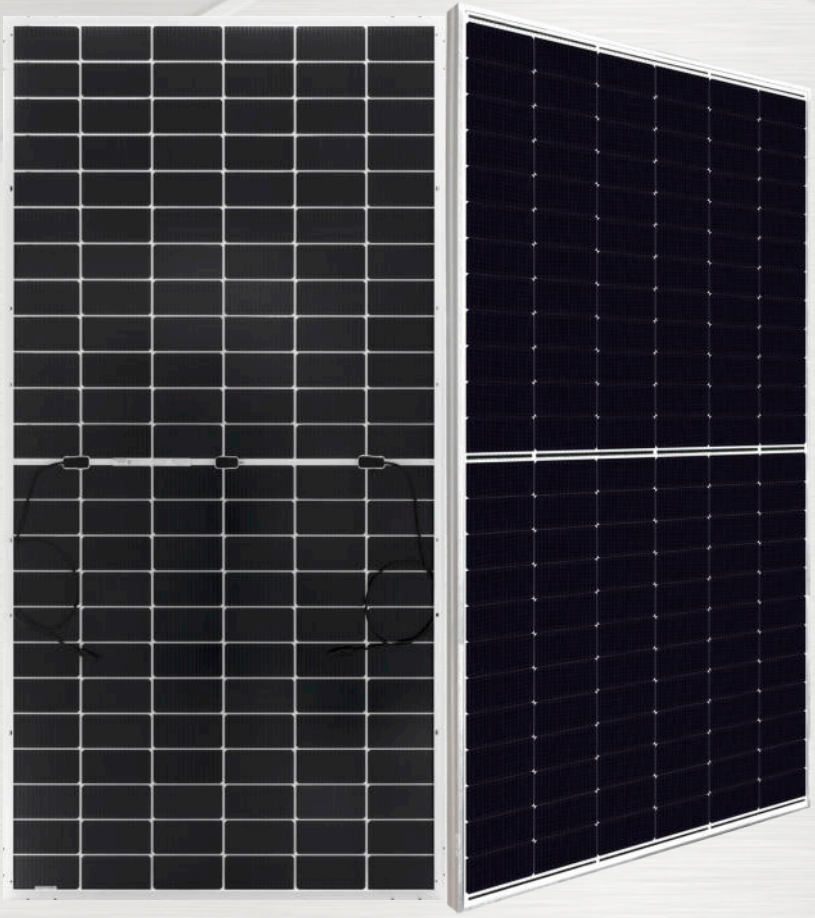
Committente	Sviluppo	Progettazione
FRANCAVILLA SOLAR PARK	emeren®	archetipo

Firme

FSPEPD012		FSPEPD012-PDF_Schede tecniche componenti impianto		/	A4
Cod. elaborato		Nome file		Scala	Formato

00	22.07.23	Emissione	Archetipo	Archetipo	Archetipo
Rev.	Data	Oggetto revisione	Redatto	Verificato	Approvato

CanadianSolar



CSI High Efficiency TOPCon Module

White Paper

CSI Solar Co., Ltd

1.Introduction

Canadian Solar is one of the world's largest suppliers of solar photovoltaic modules, system solutions, and one of the largest solar power plant developers. By October 2022, Canadian Solar has shipped more than 80GW solar modules to customers in over 160 countries worldwide and owns a global portfolio of 25GW solar PV projects and 40GWh energy storage projects. CSI solar, the majority-owned subsidiary of Candian Solar, expanded its module manufacturing capacity to 32GW in 2022 and expects to reach 50GW module manufacturing capacity by the end of 2023. In 2022, Canadian Solar was again recognized as one of the most bankable PV module brands in the world by Bloomberg New Energy Finance.

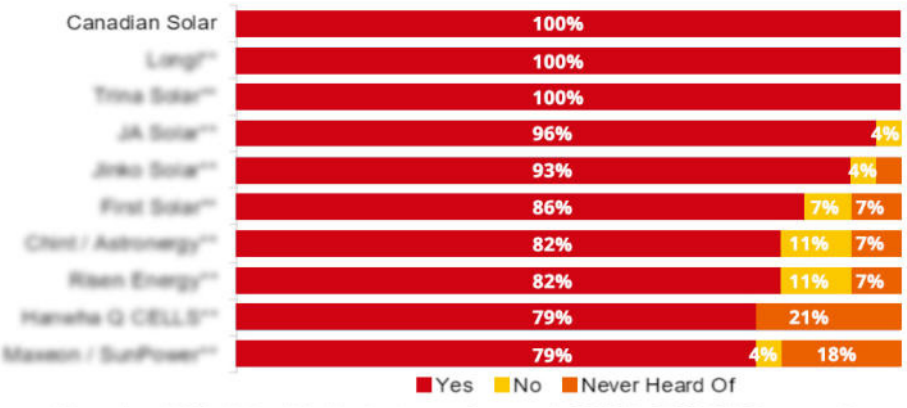


Figure 1. The world's top 10 most bankable PV module brands in BNEF's 2022 survey

CSI Solar focuses on continuously improving the performance and reliability of its solar modules and providing high quality products to customers, by actively exploring and introducing new cell and module technologies. CSI Solar was one of the first companies introducing cell and module technologies that later became industry mainstream, such as bifacial modules (back in 2010), modules with larger-format wafers (up to 210mm) and, nowadays, N-type high-efficiency cells and modules. Since 2019, CSI Solar has been developing N-type TOPCon (Tunnel Oxide Passivated Contacts) technologies, and now launches a diversified TOPCon module portfolio covering both 182mm and 210mm cells, single-glass and double-glass encapsulation, and various module sizes and power outputs to satisfy different application scenarios.

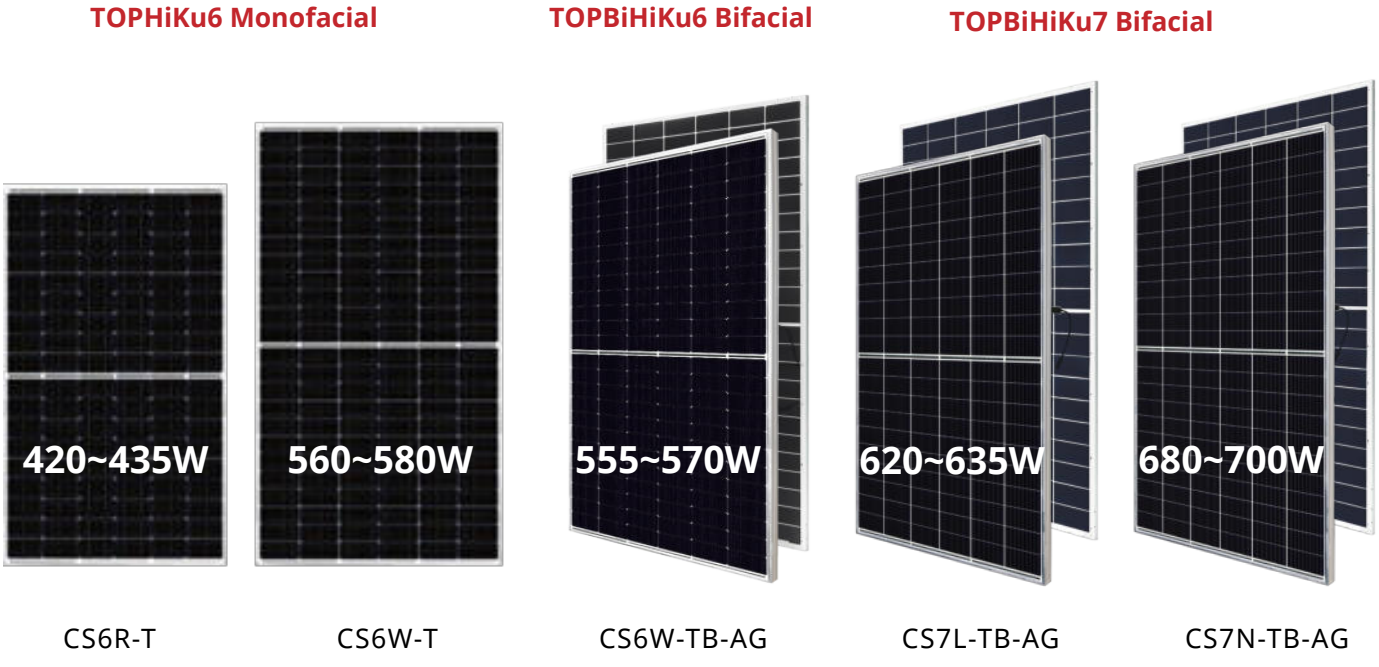


Figure 2. CSI TOPCon Module Family

Module Power (W)	420~435	560~580	555~570	620~635	680~700
Module Type	CS6R-T	CS6W-T	CS6W-TB-AG	CS7L-TB-AG	CS7N-TB-AG
Module Efficiency	22.30%	22.50%	22.10%	22.40%	22.50%
Module Size (mm)	1722×1134×30	2278×1134×30	2278×1134×30	2172×1303×33	2384×1303×33

Table 1. Key Parameters of CSI TOPCon Modules

2.More Power, Higher Reliability – Advantages of CSI TOPCon Modules

The recombination of electrons and holes on the surface and any interface is the main factor limiting cell efficiency, and various passivation technologies have been developed to reduce the recombination, from early-stage BSF (Back Surface Field) to currently popular PERC (Passivated Emitter and Rear Cell), latest HJT (Heterojunction) and nowadays TOPCon technologies. TOPCon is an advanced passivation technology, which is compatible with both P-type and N-type silicon wafers and can greatly enhance cell efficiency by growing an ultra-thin oxide layer and a doped polysilicon layer on the back of the cell to create a good interfacial passivation. When combined with N-type silicon wafers, upper efficiency limit of TOPCon cells is estimated to be 28.7%, outclassing that of PERC, which would be about 24.5%. TOPCon's processing is more compatible to the existing PERC production lines, thus balancing better manufacturing cost and higher module efficiency. TOPCon is expected to be mainstream cell technology in the coming years.

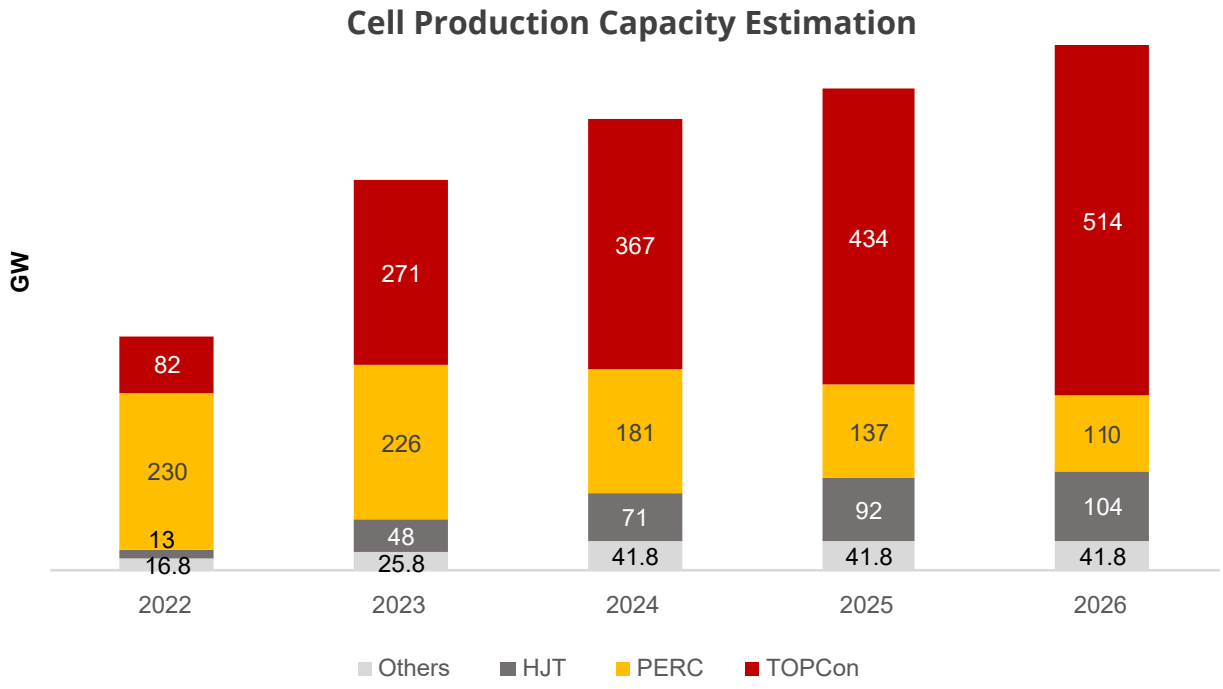
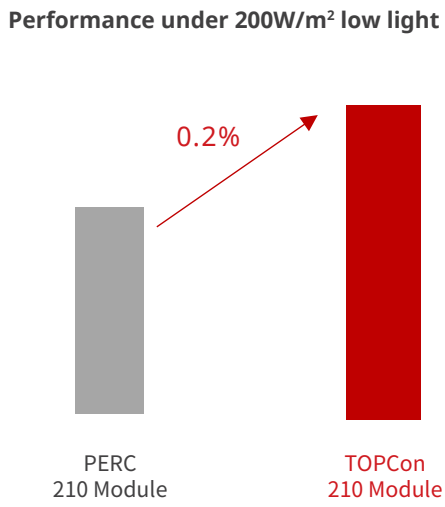


Figure 3. PV InfoLink Production Capacity Estimation

More specifically, CSI Solar has adopted the latest in-situ doping polysilicon deposition technology, efficient selective emitter (SE) technology, and backside multi-layer technology into TOPCon cells. These technologies can improve open-circuit voltage, short-circuit current by precisely controlling polysilicon film thickness, doping concentration of phosphorus and the PN junction profile. In addition, CSI R&D team have further optimized various parameters like surface optical reflection, series resistance, shunt resistance, front/ back finger design and silver paste consumption. With these efforts, cell efficiency and module performance have been improved significantly.

More Energy Yield under Low-light Environment

TOPCon modules enjoy better low-light performance. Improved low light performance is mainly related to the optimization of series resistance, leading to low saturation currents in TOPCon modules. Under low-light condition (200W/m²), performance of 210 TOPCon modules would be about 0.2% higher than 210 PERC modules .



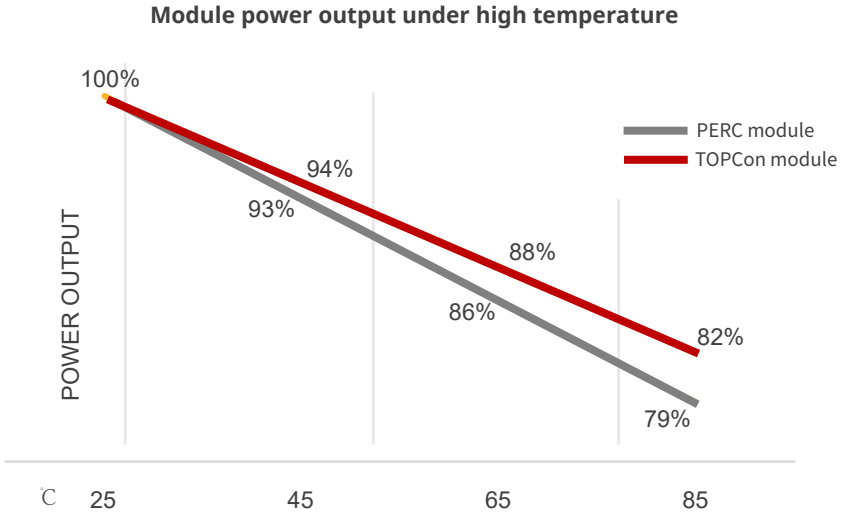
CSI TOPCon 210 module:

0.2% higher performance than PERC 210 module under low light

Figure 4. Low-light Performance Comparison

Better Power Output under High-Temperature Environment

Modules' operating temperature impacts their power output. CSI TOPCon modules are based on N-type silicon wafers with high minority carrier lifetime and higher open-circuit voltage. The higher open-circuit voltage, the better module temperature coefficient. As a result, TOPCon modules would perform better than PERC modules when operating in high temperature environments.



CSI TOPCon Module:

Higher power output under high temperature

Figure 5. Influence of module temperature on its power output

Advanced Manufacturing Technologies to Assure TOPCon Module Performance and Reliability

CSI N-Type TOPCon modules have been developed with excellence in both product design and reliable manufacturing technologies, including non-destructive cell dicing, precise soldering (Figure 6), and high-density stringing technology, which can assure modules' performance and reliability.

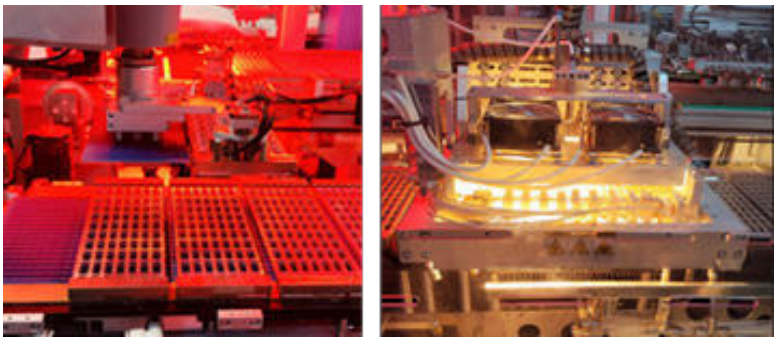
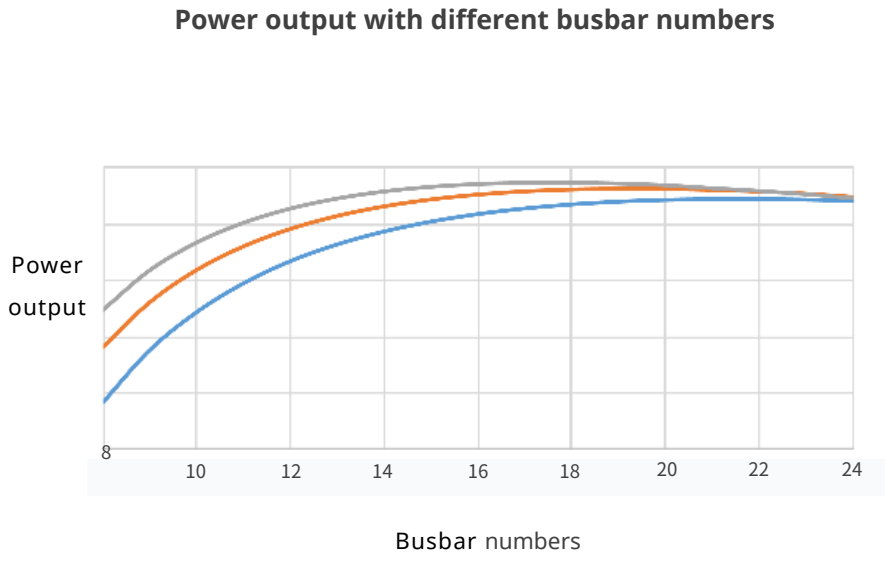


Figure 6. Non-destructive cell dicing and precise soldering for TOPCon modules

With advances of manufacturing technologies, CSI optimized the design of conductive silver fingers and busbar numbers in TOPCon cells. According to our simulation and verification, TOPBiHiKu7 series based on 210mm cells adopt 18 busbars, referred to as 18BB, and TOP(Bi)HiKu6 series based on 182mm cells adopt 16 busbars, referred to as 16BB.



CSI TOPCon Module: SMBB cell technology, improves module efficiency

Figure 7. Power simulation of different busbar

Higher Bifaciality, More Power

Bifaciality of silicon solar cells depends on their electronic properties and architecture. The minority carrier lifetime of N-type silicon wafers is inherently higher, reaching more than 2ms. Meanwhile, symmetrical design on TOPCon cells' front and back sides allows TOPCon modules to have less shading area compared with PERC modules, so that TOPCon module's bifaciality is significantly increased. CSI N-Type TOPCon modules can see bifaciality up to 85%.

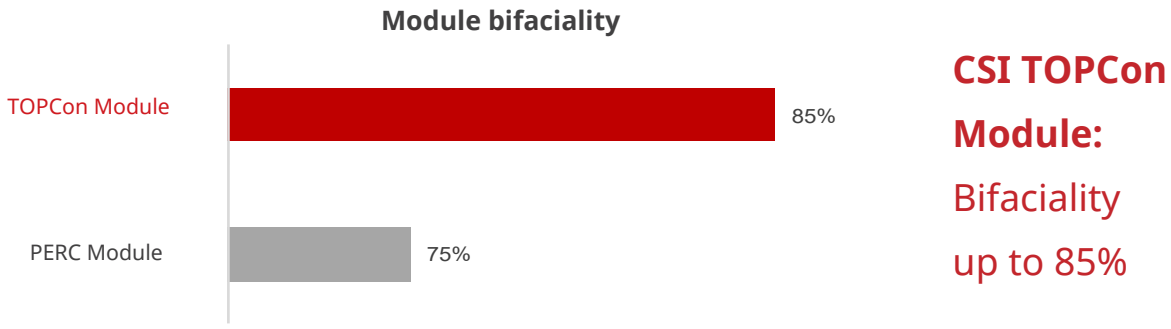


Figure 8. Bifaciality of PERC and TOPCon modules

Industry Leading Extended Reliability Testing

CSI Solar has established in-house reliability testing protocol with testing doses of 2 times and even 3 times of IEC standard to ensure great product reliability.

Testing	IEC 61730/61215 Standard	CSI Standard
DH	1000 hours	2000 hours
TC	200 cycles	400~600 cycles
HF	10 cycles	20~30 cycles
PID	96 hours	192 hours

Table 2. Comparison of IEC Standard and CSI standard

Our test results show that TOPCon modules performed similarly or better compared with well recognized PERC modules.

For example, TOPCon bifacial modules showed less than 1% power degradation after DH 2000 test, which was much lower than 5% required by IEC standard after DH1000 test.

CSI Solar optimized cells' UV resistance through proper light injection together with annealing and anti-reflection design. CSI Solar also developed a cell-level UV assessment method for daily monitoring. After UV irradiation of 60kWh/m^2, TOPCon cells showed about 0.2% less degradation compared to PERC cells.

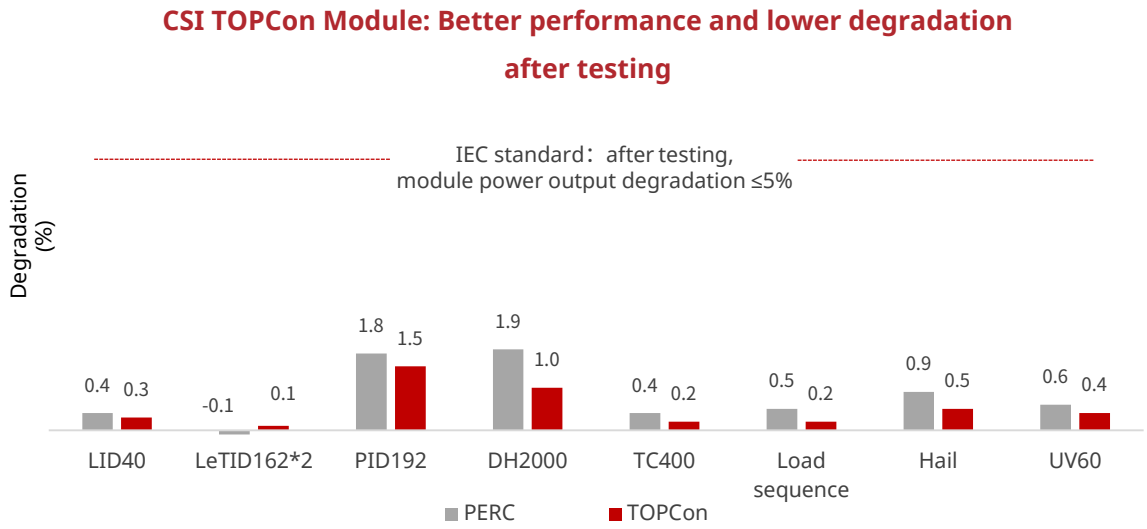
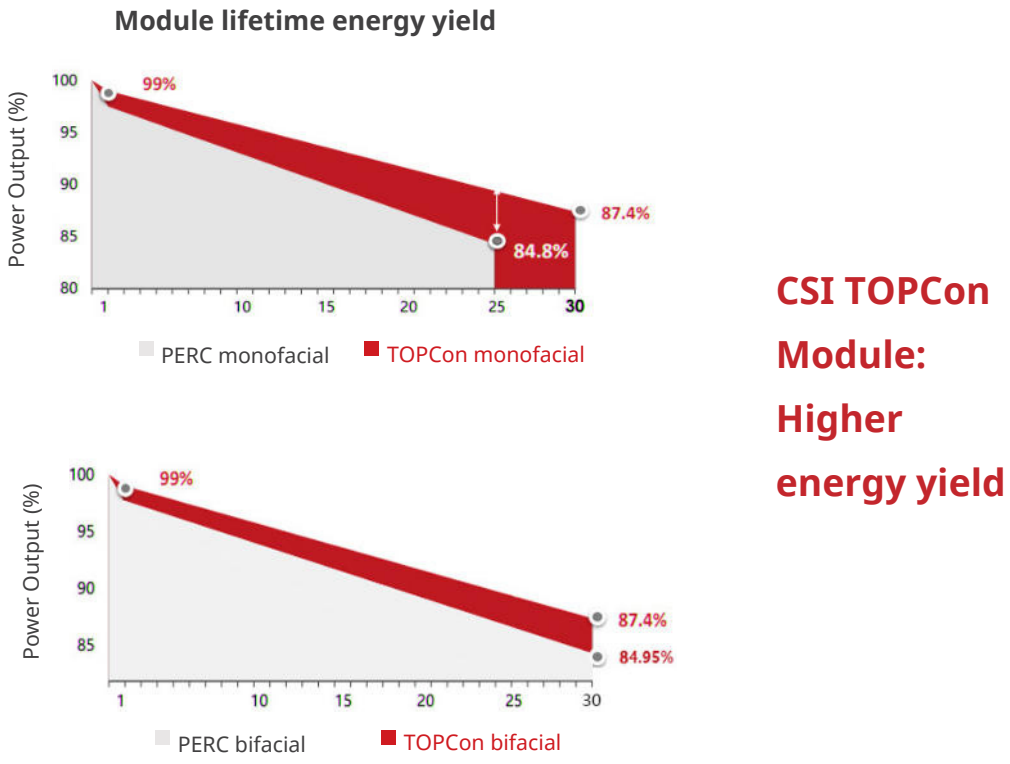


Figure 9. Reliability test results of PERC and TOPCon modules

Longer Warranty, Lower Power Degradation

Symmetrical design on the front and back sides of TOPCon cells reduces internal stress and enhances module resistance under temperature changes. Furthermore, higher minority carrier lifetime and no boron-oxygen related degradation bring TOPCon modules lower degradation rate. In addition, high quality encapsulation and advanced module manufacturing technologies further enhance TOPCon modules' performance.

CSI Solar offers 30-year power warranty for TOPCon modules and guarantees power degradation less than 1% in the first year and less than 0.4% per year thereafter. Longer module warranty and lower power degradation significantly increase power output in modules' lifetime.



CSI TOPCon Module: Higher energy yield

Figure 10. Lifetime power output of TOPCon and PERC modules

3. More Energy Yield, Lower System LCOE

More Energy Yield

In order to understand TOPCon modules' performance compared with PERC modules, we simulated system performance with CSI TOPCon (TOPBiHiKu7, 7N-TB-AG-685W) and PERC (BiHiKu7, 7N-MB-AG-660W) modules based on a 28.7MW solar farm assumed in Los Angeles, U.S.

Module	PERC Bifacial-660W	TOPCon Bifacial-685W
Power（W）	660	685
Module area(m2)	3.11	3.11
Module efficiency	21.20%	22.10%
Module Open-Circuit Voltage(V)	45.4	47.1
Annual Degradation Rate	0.45%	0.40%
Site	Los Angeles, USA	
DC System Size (MWdc)	28.7	
DC/AC Ratio	1.3	
Project site area (m2)	Same area	
Installation Method	Single-axis tracked (1 row portrait installation)	
Service Life	30 years	
Ground Coverage Ratio	0.313	0.301
Pitch (m)	7.62	7.91
Module Number/String	31	30
String Number per rack	2	
Module Number per rack	62	61
Module Power per rack (W)	40,920	41,785
Length of rack (m)	83.4	80.8
Total Module Area per rack (m2)	192.6	186.4

Table 3. Parameters used in system performance simulation

Simulation results showed that energy yield of TOPCon modules would be about 2% higher than that of PERC modules during 30-year lifetime.

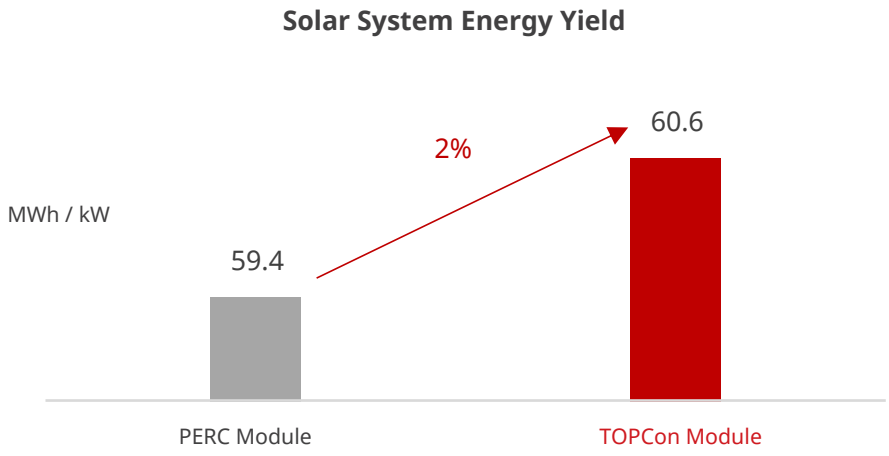


Figure 11. Comparison of energy yield between PERC and TOPCon bifacial modules

Lower BOS Cost

Due to higher efficiency of TOPCon bifacial module, less modules will be required for similar DC capacity. Subsequently, other costs for examples, installation and racks, will also be reduced, and the overall BOS cost is expected to decrease by about 1.1%.

Cost	PERC Bifacial-660W	TOPCon Bifacial-685W
Module Installation Cost	100%	96.30%
Rack Material Cost	100%	96.90%
Rack Installation Cost	100%	97.60%
Material and Installation Cost of Cable and Combiner Box	100%	98.80%
Development Cost	100%	99.20%
Total BOS Cost	100%	98.90%

Table 4. Comparison of BOS cost between PERC and TOPCon modules

Lower LCOE

Based on above simulation, we found that the LCOE of system using PERC bifacial modules would be about 28.46 US$/MWh, while the LCOE of system with TOPCon bifacial modules would be about 27.76$/MWh, about 2.3% less compared with PERC case.

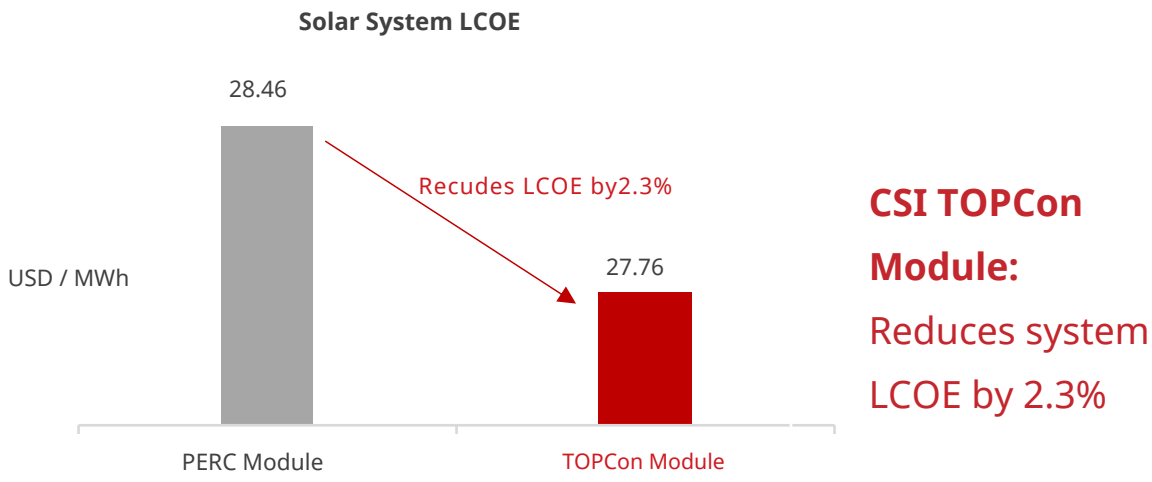


Figure12. LCOE comparison between systems with TOPCon and PERC bifacial modules

Great System Compatibility

Canadian Solar TOPCon modules are compatible with mainstream mounting systems, whether fixed mounting systems or trackers, such as Nextracker, Soltec, Array, Arctech Solar PVH and others.

Figure 13. Mainstream rack manufacturers

As to 210 TOPCon modules with larger current, they are compatible with mainstream inverter brands, for examples, Sungrow, Solis, SMA, Huawei, etc.

Figure14. Mainstream inverter suppliers

Closing note:

With 22-year expertise in solar module business and well-recognized records, CSI Solar is always excited to be able to bring customers new products. With superior performance and quality assurance, CSI N-Type TOPCon modules will bring customers lower cost of electricity and higher return on investment, help contributing to global energy transformation and creating more sunny future together with our customers.

2023 January

CSI Solar Co., Ltd
199 Lushan Road, SND, Suzhou, Jiangsu, China, 215129

website: https://csisolar.com

TRACKER Vanguard™-2P

Single-Row / Multidrive System

About TrinaTracker

Excellent Bankability
Trina Solar was ranked top in the list of "Top Bankable Module Supplier" released by Bloomberg New Energy Finance (BNF) for five consecutive years

Multiple Product Lines For All Applications
Multiple product lines developed by experienced International R&D team for meeting market demands in all application scenarios

Superb Reliability and High Quality
Leading quality management system and over 20 years product quality control experience in the industry

Efficient Engineering Design Expert
Systematic and high efficient workflow for presales service to guaratee prompt engineering design

Unified Products Delivery Management
Global supply chain management of core equipments in solar farm (modules and trackers) with unified delivery channel

Compatible with Larger Modules

Vanguard™-2P is designed to reduce LCOE with larger modules.

Compatible with modules up to 670W+.

Upgraded Multidrive System

Better wind tolerance, high adaptability and synchronization, greatly improving the stability of the system.

Innovative SuperTrack Technology

According to real-time weather and actual terrain conditions, smart algorithm dynamically optimizes tracking angle, increases receiving radiation and reduces shading loss.

UP TO 8% yield gain

More Modules Per Tracker

Designed with two-in-portrait configuration (2P), up to 4 strings of 1500V system per row.

UP TO 120 modules per tracker

Fewer Piles Per MW

7 piles per row (standard configuration), number of piles per MW has been optimized.

UP TO 45% fewer piles

OPTIMIZED BEARING DESIGN

- Global patented spherical bearings, up to 30% angle adjustability.
- Alleviate the damage caused by uneven foundation settlement during operation.
- Release the extra stress caused by the deformation of the tracker system, reduce the load and failure rate of each component.

WIND TUNNEL TESTED BY RWDI

Static load + dynamic load dual test

3D flutter stability analysis and shock response

Evaluation of precise wind load distribution on tracker system.

Full aeroelastic model test.

CE 1035

UL LISTED [PV SOLAR TRACKER] E508730

cere Certificate no. 20827-CER-E1

ISO 9001 ISO 14001 ISO 45001 BUREAU VERITAS Certification

DNV GL

TECHNICAL SPECIFICATIONS

GENERAL FEATURES

Solar tracker type	Single row Single-Axis
Tracking range	±55° (110°)
Driver	Multiple linear actuator
Configuration	Two modules in portrait (2P) up to 4 strings per tracker (1500V string)
Solar module supported	Framed
Foundation options	Direct ramming / Pre-drilling + ramming / Micropile / PHC piles
Pile section	W, compatible with IPE, IPEA
Modules attachment	Bolts, Rivets and Clips
Piles per MW (550Wp module)	~106 piles/MW (1)(120 modules per row)
(670Wp module)	~102 piles/MW (1)(102 modules per row)
Terrain adaptability	15% N-S (2)
Wind and snow loads tolerance	Tailored to site requriement
Rear shading factor	0.8%
Critical wind speed	47m/s

STRUCTURE

Material	High Yield Strength Steel
Coating	HDG, Pregalvanized & ZM(3)

CONTROLLER

Controller	Electronic board with microprocessor
Ingress protection marking	IP65
Tracking method	Astronomical algorithms + SuperTrack technology (4)
Advanced wind control	Customizable
Anemometer	Cup/Ultrasonic
Night-time stow	Configurable
Communication with the tracker	Wired option: RS485 Wireless option: LoRa/Zigbee
Operating conditions	Altitude < 4000m (5) Temperature: -30°C to 60°C (5)
Sensors	Digital inclinometer
Power (motor drive)	DC motor: 0.2kW
Power supply	Grid connection / String powered / Self-powered with battery

WARRANTY

Structure	10 years
Driver and control components	5 years

(1) Depending on layout
(2) For scenarios beyond the scope of use, please consult TrinaTracker
(3) Standard configuration. Other coating under request
(4) Includes smart tracking algorithm and smart backtracking algorithm
(5)Standard configuration. Different conditions under reques，tplease consult TrinaTracker

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Doc.number: DT-T-0001 Rev: C

TrinaTracker

PVS-16/18/20/24MH

PV combiner box for 1500 Vdc system

EFFICIENT AND SAFE

- 1500V-Specific PV fuse, both positive and negative terminal
- 1500V-Specific PV SPD with fault alarm
- String current and voltage monitoring
- Main load switch state monitoring (optional)

QUALIFIED

- CE
- Highly optimize the system wiring
- Modular desigh, easy and quick maintenance

FLEXIBLE

- Optional IP67 protection, meeting the outdoor installation and usage requirements
- Self-powered power supply with lightning protection
- Output cable cross section area 120 – 400 mm² (max. 400 mm² Al cable)
- PG Gland / MC4 terminal connector

SUNGROW
Clean power for all

Type designation	PVS-16MH	PVS-18MH	PVS-20MH	PVS-24MH
Paramerters				
Max. PV string voltage	1500V			
Max. PV string parallel inputs	16	18	20	24
Max. string input current	21 A	20 A	18.5 A	15.5 A
Max. output current	336 A	360 A	370 A	372 A
SPD	1500 Vdc Type II (optional: Type I+II)			
Input terminal type	PG Gland / MC4 terminal			
Output terminal type	120 – 400 mm²			
Protection class	IP65 / IP67 (optional)			
Environment temperature	-35 to 60 ℃			
Enironment humidity	0 – 95%			
Dimensions (W*H*D)	950*730*275 mm			
Weight	40 kg	40 kg	42 kg	44 kg
Switch disconnector handle	Internal handle			
Material	SMC			
Standard Accessories				
DC output load switch	Yes			
PV specific application SPD	Yes			
Optional Accessories				
String current and bus voltage monitoring	Optional			
RS485 communication port	Optional			
PV SPD failure monitoring	Optional			
Monitoring for load switch state	Optional			
Operator access areas IP2X	Optional			
Parallel arc fault circuit interrupter	Optional			

SG3300/4400UD-MV

Soluzione “chiavi in mano” per sistemi a 1500 Vcc con trasformatore MT integrato

ALTO RENDIMENTO

- Tecnologia avanzata a tre livelli, efficienza massima dell’inverter 99%
- Raffreddamento efficace, funzionamento a piena potenza a 40 °C

SMART O&M

- Funzioni di "zone montioring" e monitoraggio dei parametri MV integrate, per analisi on-line e risoluzione dei guasti
- Design modulare, manutenzione semplificata

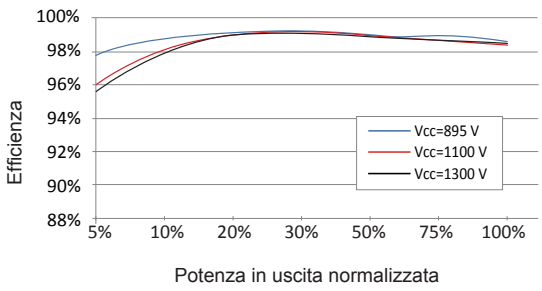
RISPARMIO SULL’INVESTIMENTO

- Bassi costi di trasporto e installazione grazie al design del container da 20 piedi
- Impianto 1500 V CC, costi di sistema ridotti
- Transformatore MT/BT, cella di media tensione e quadro di distribuzione ausiliaria integrati
- Funzione Q @ night opzionale

SUPPORTO ALLA RETE

- Conformità alle norme: IEC 61727, IEC 62116,
- IEC 62271-202, IEC 62271-200, IEC 60076
- Low/High voltage ride through (L/HVRT)
- Controllo della potenza attiva e reattiva e controllo della rampa di potenza

CURVA DI EFFICIENZA



EUROPA

SUNGROW
Clean power for all

Modello	SG3300UD-MV	SG4400UD-MV
Ingresso (CC)		
Tensione massima FV in ingresso	1500 V	
Tensione minima FV in ingresso / Tensione di avviamento	895 V / 905 V	
Intervallo di tensione MPP	895 – 1500 V	
N. di ingressi MPP indipendenti	3	4
N. di ingressi CC	15 (in opzione: 18/21 ingressi con polo negativo a terra)	20 (in opzione: 24/28 ingressi con polo negativo a terra)
Corrente massima FV in ingresso	3 * 1435 A	4 * 1435 A
Massima corrente di cortocircuito CC	3 * 5000 A	4 * 5000 A
Configurazione del generatore FV	Polo negativo a terra / Floating	
Uscita (CA)		
Potenza di uscita CA	3300 kVA a 40 °C 3795 kVA a 20 °C	4400 kVA a 40 °C 5060 kVA a 20 °C
Corrente di uscita massima inverter	3 * 1160 A	4 * 1160 A
Corrente massima in uscita CA	110 A	146 A
Intervallo di tensione CA	10 kV – 35 kV	
Frequenza nominale di rete / Intervallo di frequenza di rete	50 Hz / 45 – 55 Hz, 60 Hz / 55 – 65 Hz	
Distorsione armonica totale (THD)	< 3% (alla potenza nominale)	
Fattore di potenza alla potenza nominale / Fattore di potenza regolabile	>0,99 / 0,8 in entrata – 0,8 in uscita	
Fasi alimentazione / Connessione CA	3 / 3-PE	
Efficienza		
Efficienza massima dell'inverter	99,0%	
Efficienza europea dell'inverter	98,7%	
Trasformatore		
Potenza nominale del trasformatore	3300 kVA	4400 kVA
Potenza massima del trasformatore	3795 kVA	5060 kVA
Tensione LV / MT	0,63 kV / (10 – 35) kV	
Impedenza di corto circuito	7% (0 – ±10%) a 3300 kVA	8% (0 – ±10%) a 4400 kVA
Gruppo vettoriale	Dy11	
Tipo di raffreddamento del trasformatore	ONAN/In opzione: ONAF	
Tipo di olio	Olio minerale (privo di PCB) o olio biodegradabile su richiesta	
Protezioni e funzionalità		
Protezione ingressi CC	Sezionatore di carico + fusibile	
Protezione uscita inverter	Interruttore automatico	
Protezione uscita MT CA	Interruttore automatico	
Protezione da sovracorrente	CC Tipo II / CA Tipo II	
Monitoraggio rete / Monitoraggio delle dispersioni a terra	Sì / Sì	
Monitoraggio isolamento	Sì	
Protezione da surriscaldamento	Sì	
Funzione Q @ night	In opzione	
Dati generali		
Dimensioni (LarghezzaxAltezzaxProfondità)	6058x2896x2438 mm	
Peso	≤ 16 T	≤ 17,5 T
Grado di protezione	Inverter: IP65 / Altri: IP54	
Alimentazione ausiliaria	5 kVA (in opzione: max. 40 kVA)	
Intervallo di temperatura ambiente di esercizio	Da -35 a 60 °C (depotenziamento > 40 °C)	
Intervallo di umidità relativa consentito	0 – 100%	
Metodo di raffreddamento	Raffreddamento ad aria forzata a temperatura controllata	
Altitudine massima di esercizio	1000 m (standard) / > 1000 m (in opzione)	
Display	Indicatori LED, WLAN+WebHMI	
Comunicazione	Standard: RS485, Ethernet; in opzione: fibra ottica	
Conformità	CE, IEC 62109, IEC 61727, IEC 62116, IEC 62271-202, IEC 62271-200, IEC 60076	
Supporto rete	Funzione reattiva notturna (Q @ night; in opzione), L/HVRT, controllo potenza attiva e reattiva e controllo della rampa di potenza	

H1Z2Z2-K

CPR (UE) n° 305/11
E_{ca}

Regolamento Prodotti da Costruzione/*Construction Products Regulation*
Classe conforme norme EN 50575:2014 + A1:2016 e EN 13501-6:2014
Class according to standards EN 50575:2014 + A1:2016 and EN 13501-6:2014

DoP n° 1036/17

EN 50618	Costruzione e requisiti/*Construction and specifications*
CEI EN 60332-1-2	Propagazione fiamma/*Flame propagation*
CEI EN 50525	Emissione gas/*Gas emission*
CEI EN 50289-4-17 A	Resistenza raggi UV/*UV resistance test*
CEI EN 50396	Resistenza ozono/*Ozone resistance*
2014/35/UE	Direttiva Bassa Tensione/*Low Voltage Directive*
2011/65/CE	Direttiva RoHS/*RoHS Directive*
CA01.00546	Certificato IMQ/*IMQ Certificate*

◁HAR▷ CE NB 0051

DESCRIZIONE

Cavo unipolare flessibile stagnato per collegamenti di impianti fotovoltaici. Isolamento e guaina realizzati con mescola elastomerica senza alogeni non propagante la fiamma.

Conduttore
Corda flessibile di rame stagnato, classe 5

Isolante
Mescola LS0H di gomma reticolata speciale di qualità conforme alla norma EN 50618
LS0H = Low Smoke Zero Halogen

Guaina esterna
Mescola LS0H di gomma reticolata speciale di qualità conforme alla norma EN 50618

Colore anime
Nero

Colore guaina
Blu, rosso, nero

Marcatura a inchiostro
BALDASSARI CAVI IEMMEQU <HAR> H1Z2Z2-K 1/1 kV (sez) (anno) (m) (tracciabilità)

CARATTERISTICHE TECNICHE

Tensione massima: 1800 V c.c. - 1200 V c.a.

Temperatura massima di esercizio: 90°C

Temperatura minima di esercizio: -40°C

Temperatura minima di posa: -40°C

Temperatura massima di corto circuito: 250°C

Sforzo massimo di trazione: 15 N/mm^2

Raggio minimo di curvatura: 4 volte il diametro esterno massimo

Condizioni di impiego
Per l'interconnessione di elementi di impianti fotovoltaici. Adatti per l'installazione fissa all'esterno e all'interno, entro tubazioni in vista o incassate o in sistemi chiusi similari.
Adatti per la posa direttamente interrata o entro tubo interrato e per essere utilizzati con apparecchiature di classe II.

DESCRIPTION

Flexible single-core cable for connection in photovoltaic installations. Insulation and sheath made of elastomeric compound, halogen free and flame retardant.

Conductor
Tinned copper flexible wire, class 5

Insulation
Special LS0H cross-linked rubber compound according to EN 50618 quality
LS0H = Low Smoke Zero Halogen

Outer sheath
Special LS0H cross-linked rubber compound according to EN 50618 quality

Cores colour
Black

Sheath colour
Blue, red or black

Inkjet marking
BALDASSARI CAVI IEMMEQU <HAR> H1Z2Z2-K 1/1 kV (section) (year) (m) (traceability)

TECHNICAL CHARACTERISTICS

Maximum voltage Uo/U: *1800 V d.c. - 1200 V a.c.*

Maximum operating temperature: *90°C*

Minimum operating temperature: *-40°C*

Minimum installation temperature: *-40°C*

Maximum short circuit temperature: *250°C*

Maximum tensile stress: *15 N/mm^2*

Minimum bending radius: *4 x maximum external diameter*

Use and installation
For interconnection of photovoltaic elements. Suitable for fixed installation indoor and outdoor, in pipes exposed or embedded or in similar closed systems.
Suitable for laying directly underground or in pipe underground and to be used for class II equipment.

BALDASSARI CAVI

H1Z2Z2-K

Formazione *Formation*	Ø indicativo conduttore *Approx. conductor Ø*	Spessore medio isolante *Average insulation thickness*	Spessore medio guaina *Average sheath thickness*	Ø indicativo produzione *Approx. production Ø*	Peso indicativo cavo *Approx. cable weight*	Resistenza elettrica max a 20°C *Max. electrical resistance at 20°C*	Portata di corrente in aria libera *Current rating free in air*	
							Singolo cavo *Single cable* 60°C	2 cavi adiacenti *2 adjacent cables* 60°C
n° x mm²	mm	mm	mm	mm	kg/km	ohm/km	A	A
1 x 1,5	1,5	0,7	0,8	4,5	34	13,7	30	24
1 x 2,5	2,1	0,7	0,8	5,0	47	8,21	40	33
1 x 4	2,5	0,7	0,8	5,5	58	5,09	55	44
1 x 6	3,0	0,7	0,8	6,0	75	3,39	70	70
1 x 10	4,0	0,7	0,8	7,2	113	1,95	95	95
1 x 16	5,0	0,7	0,9	8,4	168	1,24	130	107
1 x 25	6,2	0,9	1,0	10,3	255	0,795	180	142
1 x 35	7,6	0,9	1,1	11,5	357	0,565	220	176
1 x 50	8,9	1,0	1,2	13,3	509	0,393	280	221
1 x 70	10,5	1,1	1,2	15,3	692	0,277	350	278
1 x 95	12,5	1,1	1,3	17,3	908	0,210	410	333
1 x 120	13,7	1,2	1,3	19,2	1130	0,164	480	390
1 x 150	16,1	1,4	1,4	21,3	1460	0,132	566	453
1 x 185	17,7	1,6	1,6	24,4	1752	0,108	644	515
1 x 240	19,9	1,7	1,7	26,6	2296	0,082	775	620

Energia - Applicazioni terrestri e/o eoliche
Power - Ground and/or wind farm applications

RG7H1R EPRO-SETTE™

Unipolare da 1,8/3 kV a 26/45 kV / *Single core from 1,8/3 kV to 26/45 kV*

Norma di riferimento
CEI 20-13 (IEC 60840 per 26/45 kV)

Descrizione del cavo
Anima
Conduttore a corda rotonda compatta di rame rosso
Semiconduttivo interno
Elastomerico estruso (solo per cavi con tensione ≥ 6/10 kV)
Isolante
Mescola di gomma ad alto modulo G7
Semiconduttivo esterno
Elastomerico estruso (solo per cavi con tensione ≥ 6/10 kV) pelabile a freddo
Schermatura
A filo di rame rosso
Guaina
PVC, di qualità Rz, colore rosso
Marcatura
PRYSMIAN (sigla sito produttivo) RG7H1R <tensione> <sezione> <anno>

Applicazioni
I cavi possono essere forniti con caratteristiche di:
- non propagazione dell'incendio e ridotta emissione di sostanze corrosive
- ridottissima emissione di fumi opachi e gas tossici e assenza di gas corrosivi (AFUMEX)

Accessori idonei
Terminali
ELTI (pag. 122), ELTI-1C (pag. 123), ELTO-1C (pag. 126), STI RR (pag. 130), STI GT (pag. 132), STE GT (pag. 134), FMCS 250 (pag. 136), FMCE (pag. 138), FMCTs-400 (pag. 140), FMCTXs-630/C (pag. 144)
Giunti
ECOSPEED™ (pag. 148), RETRACFIT (pag. 150)

Standard
CEI 20-13 (IEC 60840 for 26/45 kV)

Cable design
Core
Compact stranded bare copper conductor
Inner semi-conducting layer
Extruded elastomeric compound (only for rated voltage ≥ 6/10 kV)
Insulation
High module rubber compound, G7 type
Outer semi-conducting layer
Extruded cold strippable elastomeric compound (only for rated voltage ≥ 6/10 kV)
Screen
Bare copper wire
Sheath
PVC, type Rz; colour red
Marking
PRYSMIAN (production site label) RGH7H1R <rated voltage> <cross-section> <year>

Applications
Cables can be supplied with the following characteristics:
- *fire retardant and with low emission of corrosive substances*
- *low emission of opaque smoke and toxic gases and without corrosive gases (AFUMEX)*

Suitable accessories
Terminations
ELTI (pag. 122), ELTI-1C (pag. 123), ELTO-1C (pag. 126), STI RR (pag. 130), STI GT (pag. 132), STE GT (pag. 134), FMCS 250 (pag. 136), FMCE (pag. 138), FMCTs-400 (pag. 140), FMCTXs-630/C (pag. 144)
Joints
ECOSPEEDTM (pag. 148), RETRACFIT (pag. 150)

TEMPERATURA FUNZIONAMENTO / *OPERATING TEMPERATURE* 90°C

TEMPERATURA CORTOCIRCUITO / *SHORT-CIRCUIT TEMPERATURE* 250°C

CEI 20-35 EN 60332

RIGIDO / *RIGID*

Condizioni di posa / *Laying conditions*

TEMPERATURA MIN. DI POSA -0 °C / *MINIMUM INSTALLATION TEMPERATURE -0 °C*

CANALE INTERRATO / *BURIED TROUGH*

TUBO INTERRATO / *BURIED DUCT*

ARIA LIBERA / *OPEN AIR*

DIRETTAMENTE INTERRATO / *DIRECTLY BURIED*

INTERRATO CON PROTEZIONE / *BURIED WITH PROTECTION*

Energia - Applicazioni terrestri e/o eoliche
Power - Ground and/or wind farm applications

RG7H1R EPRO-SETTE™

Unipolare da 1,8/3 kV a 26/45 kV / *Single core from 1,8/3 kV to 26/45 kV*

Unipolare - conduttore di rame / *Single core - copper conductor* - RG7H1R

Dati costruttivi / *Construction charact.* - 1,8/3 kV

sezione nominale *conductor cross-section* (mm²)	diametro indicativo conduttore *approximate conductor diameter* (mm)	spessore isolante *insulation thickness* (mm)	diametro esterno massimo *maximum outer diameter* (mm)	peso indicativo del cavo *approximate weight* (kg/km)	raggio minimo di curvatura *minimum bending radius* (mm)
10	3,8	2,0	14,0	290	180
16	4,8	2,0	15,0	350	190
25	6,0	2,0	16,7	460	210
35	7,0	2,0	17,6	560	230
50	8,2	2,0	18,9	680	240
70	9,9	2,0	21,1	910	270
95	11,6	2,0	23,1	1190	300
120	13,1	2,0	24,7	1430	320
150	14,4	2,0	26,1	1680	340
185	16,1	2,0	27,8	2050	360
240	18,5	2,0	30,2	2590	390
300	21,1	2,0	32,8	3170	430
400	23,9	2,0	35,6	3980	470
500	27,1	2,2	39,6	5050	520
630	30,7	2,4	43,9	6410	580

Caratt. elettriche / *Electrical charact.* - 1,8/3 kV

sezione nominale *conductor cross-section* (mm²)	posa in aria: in piano *open air installation: flat* (A)	posa in aria: a trifoglio *open air installation: trefoil* (A)	posa interrata: in piano p=1 °C m/W *underground installation: flat p=1 °C m/W* (A)	posa interrata: a trifoglio p=1 °C m/W *underground installation: trefoil p=1 °C m/W* (A)	posa interrata: in piano p=2 °C m/W *underground installation: flat p=2 °C m/W* (A)	posa interrata: a trifoglio p=2 °C m/W *underground installation: trefoil p=2 °C m/W* (A)
10	111	87	104	99	79	74
16	145	114	133	126	100	94
25	190	149	171	162	128	120
35	230	181	204	193	153	143
50	276	219	241	227	179	168
70	345	276	294	278	219	205
95	422	339	351	332	260	244
120	487	393	399	377	295	277
150	550	446	445	421	328	308
185	635	516	500	477	370	349
240	745	617	580	550	426	403
300	855	709	650	620	478	452
400	990	824	735	700	540	510
500	1140	954	830	790	605	575
630	1300	1102	930	885	675	645

Dati costruttivi / *Construction charact.* - 3,6/6 kV

10	3,8	3,0	16,5	350	210
16	4,8	3,0	17,5	420	220
25	6,0	3,0	18,8	520	240
35	7,0	3,0	20,1	640	260
50	8,2	3,0	21,4	770	270
70	9,9	3,0	23,6	1010	300
95	11,6	3,0	25,2	1270	330
120	13,1	3,0	26,8	1520	350
150	14,4	3,0	28,1	1780	370
185	16,1	3,0	29,9	2150	390
240	18,5	3,0	32,6	2690	420
300	21,1	3,0	35,3	3320	460
400	23,9	3,0	37,7	4100	500
500	27,1	3,2	41,7	5190	550
630	30,7	3,2	46,0	6580	600

Caratt. elettriche / *Electrical charact.* - 3,6/6 kV

10	105	87	100	95	77	73
16	137	113	128	122	99	93
25	180	150	165	156	126	119
35	219	182	197	187	151	141
50	262	219	233	220	177	168
70	329	275	286	271	216	203
95	402	337	342	324	258	242
120	465	390	389	369	292	275
150	525	443	434	412	325	306
185	605	513	492	467	367	346
240	715	609	570	540	423	400
300	820	701	640	610	475	450
400	950	813	725	690	535	510
500	1100	941	820	780	605	575
630	1260	1083	915	875	670	640

Dati costruttivi / *Construction charact.* - 6/10 kV

10	3,8	3,4	19,7	440	250
16	4,8	3,4	21,1	530	270
25	6,0	3,4	22,4	650	290
35	7,0	3,4	23,3	750	300
50	8,2	3,4	24,6	890	320
70	9,9	3,4	26,4	1120	340
95	11,6	3,4	28,0	1390	360
120	13,1	3,4	29,6	1650	390
150	14,4	3,4	31,2	1920	410
185	16,1	3,4	33,4	2330	440
240	18,5	3,4	35,8	2880	470
300	21,1	3,4	38,5	3510	500
400	23,9	3,4	40,9	4310	540
500	27,1	3,4	44,9	5430	590
630	30,7	3,4	49,4	6850	650

Caratt. elettriche / *Electrical charact.* - 6/10 kV

10	105	91	98	93	77	73
16	136	117	126	120	99	93
25	178	154	163	154	127	119
35	219	186	195	185	151	141
50	260	223	231	218	177	166
70	326	279	283	268	217	203
95	398	340	340	321	258	242
120	459	395	386	366	293	275
150	520	448	431	409	326	307
185	600	516	489	464	368	347
240	705	611	565	540	424	401
300	810	703	635	605	476	451
400	935	815	720	690	535	510
500	1080	943	810	780	605	575
630	1230	1086	900	875	670	645

Energia - Applicazioni terrestri e/o eoliche
Power - Ground and/or wind farm applications

RG7H1R EPRO-SETTE™

Unipolare da 1,8/3 kV a 26/45 kV / *Single core from 1,8/3 kV to 26/45 kV*

Unipolare - conduttore di rame / *Single core - copper conductor* - RG7H1R

sezione nominale	diametro indicativo conduttore	spessore isolante	diametro esterno massimo	peso indicativo del cavo	raggio minimo di curvatura
conductor cross-section	*approximate conductor diameter*	*insulation thickness*	*maximum outer diameter*	*approximate weight*	*minimum bending radius*
(mm²)	(mm)	(mm)	(mm)	(kg/km)	(mm)

sezione nominale	posa in aria		posa interrata			
	in piano	a trifoglio	in piano	a trifoglio	in piano	a trifoglio
			p=1 °C m/W		p=2 °C m/W	
conductor cross-section	*open air installation*		*underground installation*			
	flat	*trefoil*	*flat*	*trefoil*	*flat*	*trefoil*
			p=1 °C m/W		*p=2 °C m/W*	
(mm²)	(A)	(A)	(A)	(A)	(A)	(A)

Dati costruttivi / *Construction charact.* - 8,7/15 kV

Caratt. elettriche / *Electrical charact.* - 8,7/15 kV

16	4,8	4,5	23,4	610	300	16	135	120	123	117	97	91
25	6,0	4,5	24,7	730	320	25	177	156	158	151	124	117
35	7,0	4,5	25,6	840	330	35	215	188	190	180	148	139
50	8,2	4,5	26,9	990	350	50	258	225	224	213	174	163
70	9,9	4,5	28,7	1230	370	70	323	281	276	262	212	199
95	11,6	4,5	30,3	1510	390	95	393	344	330	313	252	238
120	13,1	4,5	32,6	1800	420	120	454	398	375	357	286	270
150	14,4	4,5	33,9	2080	440	150	515	450	419	398	318	300
185	16,1	4,5	35,7	2460	470	185	590	518	475	452	359	340
240	18,5	4,5	38,1	3020	500	240	700	613	550	525	413	392
300	21,1	4,5	40,8	3660	530	300	800	704	620	590	464	441
400	23,9	4,5	43,6	4510	570	400	920	816	700	670	520	500
500	27,1	4,5	47,2	5600	620	500	1060	944	785	760	585	565
630	30,7	4,5	52,1	7090	690	630	1210	1087	870	850	645	630

Dati costruttivi / *Construction charact.* - 12/20 kV

Caratt. elettriche / *Electrical charact.* - 12/20 kV

35	7,0	5,5	27,7	940	360	35	213	190	189	182	146	141
50	8,2	5,5	29,0	1080	380	50	255	228	224	216	172	166
70	9,9	5,5	31,0	1330	400	70	320	284	274	265	209	202
95	11,6	5,5	33,1	1640	430	95	390	346	328	316	249	241
120	13,1	5,5	34,6	1920	450	120	450	399	373	360	282	273
150	14,4	5,5	36,0	2200	470	150	510	451	416	402	313	304
185	16,1	5,5	37,8	2580	490	185	585	520	471	456	354	344
240	18,5	5,5	40,2	3160	530	240	690	614	544	528	407	397
300	21,1	5,5	42,9	3800	560	300	790	705	611	595	456	446
400	23,9	5,5	45,7	4660	600	400	910	816	688	673	512	503
500	27,1	5,5	49,7	5810	660	500	1050	944	776	761	575	568
630	30,7	5,5	54,2	7260	720	630	1190	1087	873	856	645	637

Energia - Applicazioni terrestri e/o eoliche
Power - Ground and/or wind farm applications

RG7H1R EPRO-SETTE™

Unipolare da 1,8/3 kV a 26/45 kV / *Single core from 1,8/3 kV to 26/45 kV*

Unipolare da 1,8/3 kV a 45 kV / *Single core from 1,8/3 kV to 45 kV*

sezione nominale	diametro indicativo conduttore	spessore isolante	diametro esterno massimo	peso indicativo del cavo	raggio minimo di curvatura
conductor cross-section	*approximate conductor diameter*	*insulation thickness*	*maximum outer diameter*	*approximate weight*	*minimum bending radius*
(mm²)	(mm)	(mm)	(mm)	(kg/km)	(mm)

sezione nominale	posa in aria		posa interrata			
	in piano	a trifoglio	in piano	a trifoglio	in piano	a trifoglio
			p=1 °C m/W		p=2 °C m/W	
conductor cross-section	*open air installation*		*underground installation*			
	flat	*trefoil*	*flat*	*trefoil*	*flat*	*trefoil*
			p=1 °C m/W		*p=2 °C m/W*	
(mm²)	(A)	(A)	(A)	(A)	(A)	(A)

Dati costruttivi / *Construction charact.* - 18/30 kV

Caratt. elettriche / *Electrical charact.* - 18/30 kV

35	7,0	8,0	34,6	1290	450
50	8,2	8,0	34,8	1390	450
70	9,9	8,0	36,6	1660	480
95	11,6	8,0	38,3	1940	500
120	13,1	8,0	39,8	2230	520
150	14,4	8,0	41,2	2520	540
185	16,1	8,0	43,4	2960	570
240	18,5	8,0	45,8	3560	600
300	21,1	8,0	48,5	4240	640
400	23,9	8,0	51,3	5120	680
500	27,1	8,0	55,3	6300	730
630	30,7	8,0	59,8	7790	790

35	211	191	187	181	146	142
50	253	229	222	214	172	166
70	316	285	272	263	210	203
95	386	347	325	314	250	242
120	445	400	370	358	283	275
150	505	452	413	400	315	306
185	580	520	467	453	355	345
240	680	614	539	525	408	398
300	775	704	606	593	457	448
400	895	815	684	671	514	506
500	1030	943	775	761	580	572
630	1170	1085	874	860	650	644

Dati costruttivi / *Construction charact.* - 26/45 kV

Caratt. elettriche / *Electrical charact.* - 26/45 kV

70	9,9	10,0	42,2	2010	550
95	11,6	10,0	44,3	2360	580
120	13,1	10,0	45,9	2660	600
150	14,4	9,0	45,1	2810	590
185	16,1	9,0	46,9	3220	620
240	18,5	9,0	49,3	3840	650
300	21,1	9,0	52,6	4590	690
400	23,9	9,0	55,1	5440	730
500	27,1	9,0	59,1	6640	780
630	30,7	9,0	63,3	8150	840

70	318	285	264	256	205	199
95	385	346	315	305	243	237
120	443	398	358	348	275	269
150	502	449	400	389	305	299
185	576	516	451	441	344	338
240	675	609	520	511	395	390
300	769	698	585	575	442	438
400	881	807	661	654	498	495
500	1014	933	742	739	557	558
630	1178	1069	848	836	635	630