



Regione Emilia Romagna
Comune di Alfonsine (RA)
**IMPIANTO AGRIVOLTAICO
E OPERE CONNESSE**
Potenza Impianto 38,339 MWp

**PROPONENTE****LIGHTSOURCE RENEWABLE ENERGY ITALY SPV 8 S.R.L.**VIA G. LEOPARDI, 7 - 20123 MILANO (MI) - P.IVA: 11015630962 – PEC: lightsourcespv_8@legalmail.it**PROGETTAZIONE****Ing. Alberto Rizzioli**Via R. Zandonai, 4 – 44124 – FERRARA IT - P.IVA: 00522150382 – PEC: incico@pec.it
Tel.: +39 0532 202613 – email: a.rizzioli@incico.com**COLLABORAZIONI****P.Ind. Michele Lambertini**Via R. Zandonai, 4 – 44124 – FERRARA IT - P.IVA: 00522150382 – PEC: incico@pec.it
Tel.: +39 0532 202613 – email: m.lambertini@incico.com**COORDINAMENTO PROGETTUALE****SOLAR IT S.R.L.**VIA I. ALPI 4 – 46100 - MANTOVA IT - P.IVA: 02627240209 – PEC: solarit@lamiapec.it
Tel.: +390425 072 257– email: info@solaritglobal.com**TITOLO ELABORATO****Schede Tecniche**

LIVELLO DI PROGETTAZIONE	CODICE ELABORATO	FILE NAME	DATA
DEFINITIVO	PD-D02	LS15781-PG-D02_0	21/12/2022

REVISIONI

REV.	DATA	DESCRIZIONE	ESEGUITO	VERIFICATO	APPROVATO
0	21/12/2022	Emesso	MCA	MLA	ARI



SCHEDE TECNICHE

INDICE

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1. OGGETTO

La società proponente nell'ambito del proprio piano di sviluppo delle fonti energetiche rinnovabili prevede di realizzare un impianto di produzione da fonte rinnovabile - fotovoltaica - nel Comune di Alfonsine (RA) (nel seguito "Impianto FV"). Gli impianti saranno realizzati su due aree denominate S. Anna e Campeggia e saranno conformi all'impiego come Agrivoltaico.

2. SCHEDE TECNICHE

Nel seguito riportiamo le schede tecniche dei componenti principali dell'impianto di chi all'oggetto.

In virtù di una continua evoluzione dei materiali disponibili sul mercato e la sempre crescente rapidità con cui si aggiornano le tecnologie, in fase esecutiva il proponente potrà comunque prevedere materiali equivalenti di costruttori diversi.

3. PANNELLI FV

Vertex

BIFACIAL DUAL GLASS MONOCRYSTALLINE MODULE

PRODUCT: TSM-DEG21C.20

POWER RANGE: 640-665W

665W

MAXIMUM POWER OUTPUT

0~+5W

POSITIVE POWER TOLERANCE

21.4%

MAXIMUM EFFICIENCY



High customer value

- Lower LCOE (Levelized Cost Of Energy), reduced BOS (Balance of System) cost, shorter payback time
- Lowest guaranteed first year and annual degradation;
- Designed for compatibility with existing mainstream system components



High power up to 665W

- Up to 21.4% module efficiency with high density interconnect technology
- Multi-busbar technology for better light trapping effect, lower series resistance and improved current collection



High reliability

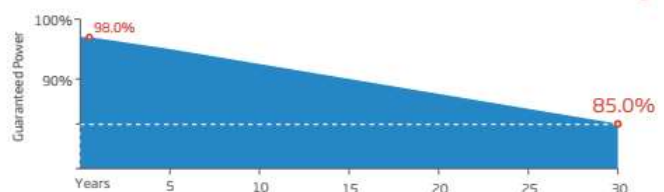
- Minimized micro-cracks with innovative non-destructive cutting technology
- Ensured PID resistance through cell process and module material control
- Resistant to harsh environments such as salt, ammonia, sand, high temperature and high humidity areas
- Mechanical performance up to 5400 Pa positive load and 2400 Pa negative load



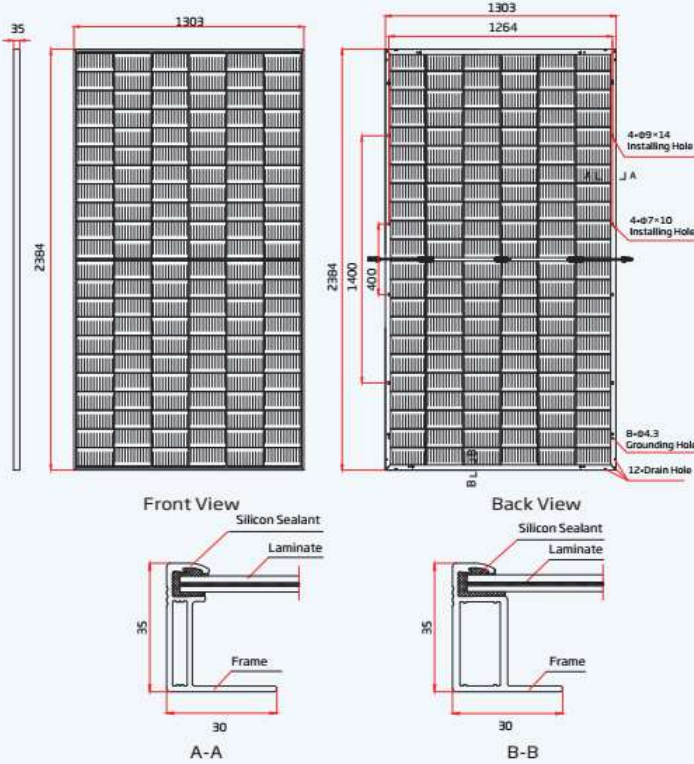
High energy yield

- Excellent IAM (Incident Angle Modifier) and low irradiation performance, validated by 3rd party certifications
- The unique design provides optimized energy production under inter-row shading conditions
- Lower temperature coefficient (-0.34%) and operating temperature
- Up to 25% additional power gain from back side depending on albedo

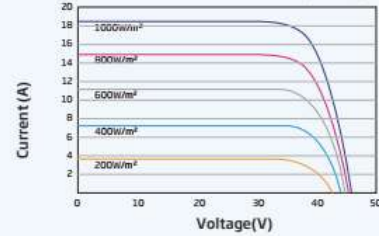
Trina Solar's Vertex Bifacial Dual Glass Performance Warranty



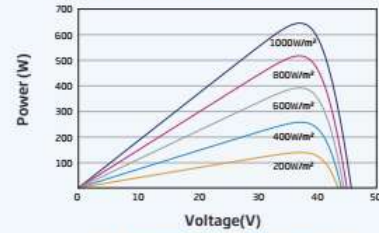
DIMENSIONS OF PV MODULE(mm)



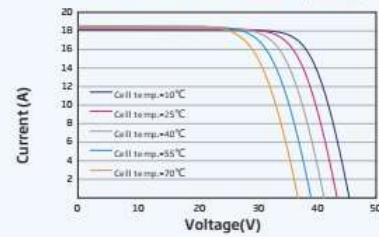
I-V CURVES OF PV MODULE(645 W)



P-V CURVES OF PV MODULE(645W)



I-V CURVES OF PV MODULE(645 W)



ELECTRICAL DATA (STC)

Peak Power Watts- P_{MAX} (Wp)*	640	645	650	655	660	665
Power Tolerance- P_{MAX} (W)			0 ~ +5			
Maximum Power Voltage- V_{MPP} (V)	37.3	37.5	37.7	37.9	38.1	38.3
Maximum Power Current- I_{MPP} (A)	17.19	17.23	17.27	17.31	17.35	17.39
Open Circuit Voltage- V_{OC} (V)	45.1	45.3	45.5	45.7	45.9	46.1
Short Circuit Current- I_{SC} (A)	18.26	18.31	18.35	18.40	18.45	18.50
Module Efficiency η_m (%)	20.6	20.8	20.9	21.1	21.2	21.4

STC: Irradiance 1000W/m², Cell Temperature 25°C, Air Mass AM1.5. *Measuring tolerance: ±3%

Electrical characteristics with different power bin (reference to 10% Irradiance ratio)

Total Equivalent power - P_{MAX} (Wp)	685	690	696	701	706	712
Maximum Power Voltage- V_{MPP} (V)	37.3	37.5	37.7	37.9	38.1	38.3
Maximum Power Current- I_{MPP} (A)	18.39	18.44	18.48	18.52	18.56	18.60
Open Circuit Voltage- V_{OC} (V)	45.1	45.3	45.5	45.7	45.9	46.1
Short Circuit Current- I_{SC} (A)	19.54	19.59	19.63	19.69	19.74	19.79
Irradiance ratio (rear/front)	10%					

Power Bifaciality: 70±5%

ELECTRICAL DATA (NOCT)

Maximum Power- P_{MAX} (Wp)	484	488	492	495	499	504
Maximum Power Voltage- V_{MPP} (V)	34.7	34.9	35.1	35.2	35.4	35.6
Maximum Power Current- I_{MPP} (A)	13.94	13.98	14.01	14.05	14.10	14.16
Open Circuit Voltage- V_{OC} (V)	42.5	42.7	42.9	43.0	43.2	43.4
Short Circuit Current- I_{SC} (A)	14.71	14.75	14.79	14.83	14.87	14.91

NOCT: Irradiance at 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s.

MECHANICAL DATA

Solar Cells	Monocrystalline
No. of cells	132 cells
Module Dimensions	2384 × 1303 × 35 mm (93.86 × 51.30 × 1.38 inches)
Weight	38.7 kg (85.3 lb)
Front Glass	2.0 mm (0.08 inches), High Transmission, AR Coated Heat Strengthened Glass
Encapsulant material	POE/EVA
Back Glass	2.0 mm (0.08 inches), Heat Strengthened Glass (White Grid Glass)
Frame	35mm(1.38 inches) Anodized Aluminium Alloy
J-Box	IP 68 rated
Cables	Photovoltaic Technology Cable 4.0mm ² (0.006 inches ²), Portrait: 280/280 mm(11.02/11.02 inches) Length can be customized
Connector	MC4 EVO2 / TS4*

*Please refer to regional datasheet for specified connector.

TEMPERATURE RATINGS

NOCT (Nominal Operating Cell Temperature)	43°C (±2°C)
Temperature Coefficient of P_{MAX}	-0.34%/°C
Temperature Coefficient of V_{OC}	-0.25%/°C
Temperature Coefficient of I_{SC}	0.04%/°C

MAXIMUM RATINGS

Operational Temperature	-40~+85°C
Maximum System Voltage	1500V DC (IEC) 1500V DC (UL)
Max Series Fuse Rating	35A

WARRANTY

12 year Product Workmanship Warranty
30 year Power Warranty
2% first year degradation
0.45% Annual Power Attenuation

(Please refer to product warranty for details)

PACKAGING CONFIGURATION

Modules per box: 31 pieces
Modules per 40' container: 558 pieces

4. COMBINER BOX

INGECON

SUN

StringBox

**SIMPLE AND SAFE
CONNECTION OF
PHOTOVOLTAIC
STRINGS, 1500 V**

12 / 16 / 18 / 20 / 24 / 32

The new INGECON® SUN StringBox is a cost-effective PV string combiner box series designed for central inverter-based PV systems. The INGECON® SUN StringBox features efficient input and output DC wiring with fully rated DC disconnect switches for safe maintenance.

When used in combination with INGECON® SUN series central inverters, the INGECON® SUN StringBox outputs can be monitored by means of the optional DC input groups monitoring kit available for B and C series.

A complete range of equipment for all types of projects

Available in models ranging from 12 to 32 inputs and 1,500 V max. DC voltage, the INGECON® SUN StringBox provide the maximum flexibility and expandability in system design. The compact and rugged IP65 enclosure is designed for installation in outdoor environments, such as roof-mounted systems and large-scale solar farms.

Maximum protection

The INGECON® SUN StringBox is a passive combiner box equipped with touch-safe DC fuse holders, DC fuses, lightning induced DC surge arresters and load disconnect switch.

PROTECTIONS

- Up to 32 pairs of DC fuses.
- Available fuses: 10A, 12A, 15A, 16A, 20A, 25A, 30A, 32A (15A standard).
- Lightning induced DC surge arresters, type 2.
- Manual DC isolating switch.

OPTIONAL ACCESSORIES

- Lightning induced DC surge arresters, type 1+2.
- Pole mounting kit.
- PV connectors.

MAIN FEATURES

- Built to minimize system costs by providing the maximum flexibility.
- Available in 12, 16, 18, 20, 24, 32 inputs configurations.
- Rated for 1,500 Vdc maximum voltage.
- Simplifies input and output wiring.
- Capability to connect up to 2 DC output cables per polarity (only for 12 and 16 inputs).
- IP65 protection rating.
- Maximum protection to corrosion and pollution thanks to the isolating polyester enclosure reinforced with fiberglass.



www.ingeteam.com
solar.energy@ingeteam.com

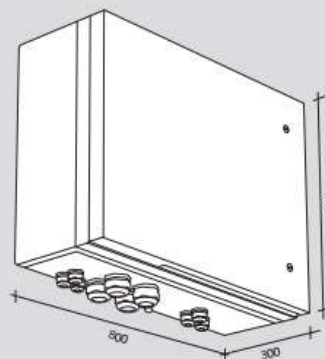
Ingeteam

INGECON SUN StringBox

1,500 V				
	StringBox 12	StringBox 12B	StringBox 16	StringBox 16B
Input				
Maximum number of input strings	12 / 24 ⁽¹⁾	12 / 24 ⁽¹⁾	16 / 32 ⁽¹⁾	16 / 32 ⁽¹⁾
Maximum current per input (A)	12 / 24	12 / 24	12 / 24	12 / 24
Number of protection fuses	12	24	16	32
Type of fuses	gPV fuses, 10 x 85 mm, 30 kA			
Available fuses	10 A, 12 A, 15 A, 16 A, 20 A, 25 A, 30 A, 32 A (15 A / 30 A standard)			
Maximum DC voltage	1,500 Vdc			
Cable inlet	M40 cable glands (n.4 cables entry diameter: 6 to 10 mm for each cable gland)			
Inlet connections	Direct connection to fuse holders or distribution bar, wiring gauge 1.5 to 16 mm ²			
Output				
Rated total current (A) ⁽²⁾	144 / 288	144 / 288	192 / 384	192 / 384
Cable outlet	Up to 2 pairs of M50 cable glands (cable diameter: 27 to 35 mm)			
Outlet connections	Direct connection on copper plates, wiring gauge up to 2 x 240 mm ² per pole			
DC switch disconnect rating (A)	315 / 400	315 / 400	315 / 400	315 / 400
SPD				
Type	Type 1 (optional: Type 1+2)			
Grounding connection	M20 cable gland (cable diameter: 7 to 13 mm, wiring gauge 2.5 to 35 mm ²)			
General Information				
Enclosure type	Outdoor use, insulating cabinet (polyester reinforced with fiberglass)			
Protection rating	IP65			
Impact strength	IK10			
Operating temperature range	-20 °C to +55 °C			
Relative humidity (non-condensing)	0 to 95%			
Maximum altitude ⁽³⁾	2,000 m a.s.l.			
DC switch handle	Internal, lockable in open position			
Consumption (W)	0 W			
Size (mm)	800 x 600 x 300 (W x H x D)			
Weight (kg)	35	36	36	38
Marking	CE			
Electrical installations	IEC 60364-7-712			
LV Switchgear standards	IEC 61439-1, IEC 61439-2, AS/NZS 61439-2, AS/NZS 5033			
Electric shock protection	Class II equipment			

Notes: ⁽¹⁾ With external over-molding in line fuses and branch connectors ⁽²⁾ Over 50 °C ambient temperature, the current will be reduced at the rate of 3.5% every °C up to 55°C ⁽³⁾ Please contact Ingeteam for altitudes higher than 2,000 m.

Size (mm)



12
35 kg.
12B / 16
36 kg.
16B
38 kg.

5. INVERTER FV

HEMK

Offers the advantages of central and string inverters. Full front access simplifies maintenance tasks.



HEMK

690V

	FRAME 2 FS2195K	FRAME 3 FS3290K	FRAME 4 FS4390K	
REFERENCES				
AC	AC Output Power (kVA/kW) @40°C ^[1]	2195	3290	
	AC Output Power (kVA/kW) @50°C ^[1]	2035	3055	
	Max. AC Output Current (A) @40°C	1837	2756	
	Operating Grid Voltage (VAC)	690V ±10%		
	Operating Grid Frequency (Hz)	50/60Hz		
	Current Harmonic Distortion (THDi)	< 3% per IEEE519		
	Power Factor (cosine phi) ^[2]	0.5 leading ... 0.5 lagging adjustable / Reactive power injection at night		
DC	DC Voltage Range ^[3]	976V - 1500V		
	Maximum DC Voltage	1500V		
	Number of Inputs	Up to 20	Up to 30	Up to 40
	Max. DC Continuous Current (A) ^[4]	2295	3443	4590
	Max. DC Short Circuit Current (A) ^[4]	3470	5205	6940
EFFICIENCY	Number of Freemaq DC/DC ^[4]	Up to 4		
	Efficiency (Max) (η) (preliminary)	98.81%	98.84%	98.90%
	Euroeta (η) (preliminary)	98.45%	98.48%	98.65%
CABINET	Dimensions [WxDxH] (ft)	9.8 x 6.5 x 7.2		
	Dimensions [WxDxH] (m)	3.0 x 2.0 x 2.2		
	Weight (lbs)	11465	11795	12125
	Weight (kg)	5200	5350	5500
	Type of Ventilation	Forced air cooling		
	Degree of Protection	NEMA 3R / IP55		
ENVIROMENT	Permissible Ambient Temperature ^[5]	-25°C to +60°C, >50°C / Active Power derating		
	Relative Humidity	4% to 100% non-condensing		
	Max. Altitude (above sea level)	2000m / >2000m power derating (Max. 4000m)		
CONTROL INTERFACE	Communication Protocol	Modbus TCP		
	Power Plant Controller	Optional		
	Keyed ON/OFF Switch	Standard		
PROTECTIONS	Ground Fault Protection	GFDI and isolation monitoring device		
	Humidity Control	Active heating		
	General AC Protection & Disconn.	Circuit breaker		
	General DC Protection & Disconn.	Fuses, DC switch-disconnectors		
	Oversvoltage Protection	Type 2 protection for AC and DC (optionally, Type 1+2)		
CERTIFICATIONS & STANDARDS	Safety	UL 1741 / CSA 22.2 No.107.1-16 / IEC 62109-1 / IEC 62109-2		
	Installation	NEC 2020 / IEC		
	Utility Interconnect	IEEE 1547:2018 / UL 1741 SB / IEC 62116:2014		

NOTES

- [1] Values at 1.00-Vac nom and cosφ=1. Consult Power Electronics for derating curves
- [2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA))^2-P(kW)^2}$
- [3] Consult Power Electronics for derating curves
- [4] Consult Power Electronics for Freemaq DC/DC connection configurations
- [5] Optional available for temperatures down to -35°C

6. TRACKER



MONOLINE⁺

1P

ADAPTED TO XXL MODULES

IN-HOUSE MANUFACTURING
* providing local content if required

BIFACIAL OPTIMIZED

TERRAIN RESPONSE

PV CLEANER TESTED
Certified by module manufacturer

MADE WITH MAGNELIS®
* Optional

General specifications

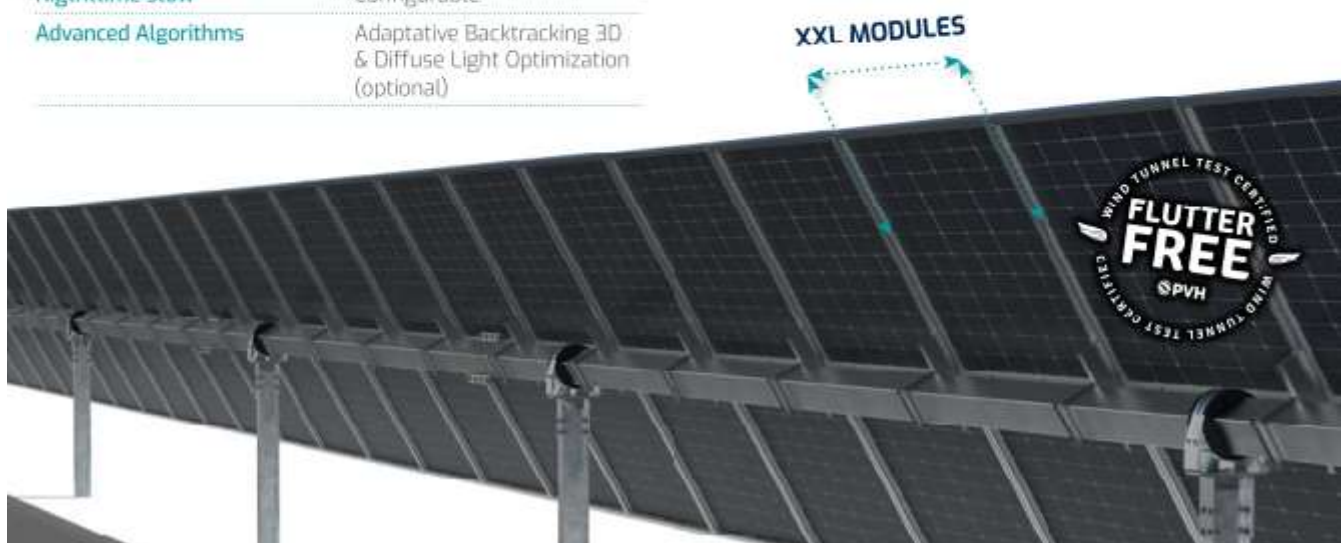
Tracker	Independent-row, horizontal single-axis
Maximum length	100 m.
Maximum width	2,5 m.
Module configuration	1 module in portrait
Rotational range	E-O: +/- 60°
Motor per MWp	Depending on the size, the type of the module and the number of modules per string, 1 motor per row. (Maximum 100 meters length)
Ground cover ratio	30-50%
Modules supported	All market available modules
Slope tolerance	N-S: up to 23.5° E-W: unlimited
Module attachment	By bolts and nuts, rivet or clamps for frameless modules
Allowable wind load	Tailored to site specific conditions
Wind alarm	Controlled by ultrasonic anemometer
Prepared for XXL modules	

Communications & Control

Solar tracking method	Astronomical algorithm
Control System	Central control unit connected to plant SCADA Redundant wireless gateways to guarantee communication Self-powered DC Motor Drive Box with auxiliary panel
SCADA interface	Modbus TCP or OPC-UA
Communication	Wireless (LoRa)
Nighttime stow	Configurable
Advanced Algorithms	Adaptative Backtracking 3D & Diffuse Light Optimization (optional)

Installation & Services

On-site training and commissioning	
Warranty	Structure: 10 years Electromechanical components: 5 years
PV Cleaner	Optional
Certifications	UL 3703, IEC 62817 on going



7. QUADRI MT

SM6

A truly professional **solution!**



Schneider Electric has developed protection, monitoring and control solutions specifically dedicated to Medium Voltage networks for over 40 years.

SM6 switchgear has been specifically designed on the basis of that extensive experience.

It also incorporates some very new solutions, giving the best in terms of continuity of service and operators' safety.

High-performance breaking devices



(*) Not available at 36 kV.

A comprehensive solution

SM6 switchgear is fully compatible with

- PowerMeter metering units.
- Easergy P3 relay and Easergy Sepam multi-function protection relays
 - Protection
 - Measurements and diagnosis.
- VIP protection self powered relay for protection. SM6 switchboards can thus be easily integrated into any monitoring and control system.
 - Local & remote indication and operation.



Enclosures able to withstand internal arcing

Internal Arc Classification: A-FL and A-FLR.

- 3-sides internal arc protection IAC: A-FL, 12.5 kA 1s, 16 kA 1s and 20 kA 1s for SM6-24 and 16 kA 1s for SM6-36.
- 4-sides internal arc protection IAC: A-FLR, 12.5 kA 1s, 16 kA 1s and 20 kA 1s for SM6-24.
- Choice of exhaust:
 - downwards exhaust
 - upwards exhaust for SM6-24.

Main characteristics



The hereunder values are for working temperatures from -5°C up to +40°C and for a setting up at an altitude below 1000 m.

Electrical characteristics

Rated voltage	Ur	kV	7.2	12	17.5	24	36
Insulation level							
Insulation	Ud	50/60 Hz, 1 min (kV rms)	20	28	38	50	70
Isolation	Ud	50/60 Hz, 1 min (kV rms)	23	32	45	60	80
Insulation	Up	1.2/50 µs (kV peak)	60	75	95	125	170
Isolation	Up	1.2/50 µs (kV peak)	70	85	110	145	195
Breaking capacity							
Transformer off load	A		16				
Cables off load	A		31.5				50
Rated current	Ir	A	400 - 630 - 1250				630-1250
Short-time withstand current	Ik/tk ⁽¹⁾	kA/1 s	25	630 - 1250			1250
			20 ⁽²⁾	630 - 1250			
			16	630 - 1250			
			12.5	400 - 630 - 1250			630-1250
Making capacity (50 Hz)	I _{ma}	kA	62.5	630	NA		
			50	630			
			40	630			
			31.25	400 - 630			630
Maximum breaking capacity (I_{sc})							
Units IM, IMC, IMB, IMM	A		630 - 800 ⁽³⁾				630
NSM-cables, NSM-busbars	A		630 - 800 ⁽³⁾				NA
QM, QMC, QMB	kA		25	20		20	
PM	kA		25				20
CVM	kA		6.3	NA			
CVM with fuses	kA		25	NA			
SF6 circuit breaker range			7.2	12	17.5	24	36
DM1-A, DM1-D, DM1-W	kA	25	630-1250				1250
		20	630-1250				
DM1-S, DM1-M	kA	25	630				NA
DM1-Z		25	1250				NA
DM2	kA	20	630				
		25	630				1250
Vacuum circuit breaker range			7.2	12	17.5	24	36
DMV-A, DMV-D	kA	25	630-1250			NA	
DMVL-A	kA	20	630				NA
DMVL-D	kA	25	630				NA

NA: Non Available

(1) 3 phases

(2) In 20 kA/3 s for SM6-24 only, consult us

(3) In 800 A, consult us.