



## Truly Hybrid

- Multiple energy sources (PV, Batteries, Ultracaps etc.) connected through a common DC-Link
- Equipped with Black Start, full reactive power support and grid stabilization features
- Integrated EMS for all hybrid applications
- Compatible with all type of market available storage technologies

## High Flexibility

- Conforms to all relevant grid codes worldwide
- Several options with number of MPPT and DC inputs
- Project specific energy management system implementation
- Standard design with a possibility of project specific customization

## Standard & Robust

- Low transport cost due to 20ft, 30ft and 40ft containerized solution
- 20 years design life
- Standardized high-quality and robust components selection for worldwide spare parts availability

## User friendly Solution

- Single solution for multiple applications
  - Plug & Play
  - Pre-assembled for saving commissioning time
  - Remote monitoring
- Supports multiple communication protocols (Modbus, CAN bus, PROFINET etc.)

## MSC SOLAR HYBRID / 1000 / 2000 / 3000 / 1700 / 3500 / 5300

An Innovative Turnkey Solution for PV Hybrid Power Plants

MSC Solar Hybrid converter is a technological breakthrough in today's Microgrid and Hybrid energy market. Multiple energy sources (PV, batteries, Ultracapacitors, diesel generator etc.) can be connected to the DC-link of the MSC Solar Hybrid converter, thus reducing installation costs and achieving a higher level of system integration. With Freqcon's very reliable, robust and fully integrated EMS, any project specific energy management strategy can be implemented. MSC Solar Hybrid is also an ideal choice for the new generation PV power plants operating at 1500 V DC.

MSC Solar Hybrid is an On-Grid and Off-Grid inverter equipped with black start and grid stabilization capability. It is compatible with almost all market available energy storage technologies such as lithium-ion, lead-acid or redox-flow batteries. With its multi-source converter technology, multiple storage technologies can also be connected in parallel with the same inverter.

With a design life of 20 years, integrated with project adapted medium-voltage components and packed inside a standardized 20ft, 30ft or 40ft container, MSC Solar HYBRID offers an ultimate solution for worldwide hybrid and microgrid project applications. When it comes to Hybrid or Microgrid projects with storage and grid stabilization applications, MSC Solar HYBRID is unmatched in quality and flexibility.

Technical Data	MSC Solar Hybrid 1000
<b>PV side (DC)</b>	
MPP voltage range $V_{DC}$ (at 25°C / 35°C / at 50°C)	50 to 950 V / 950 V / 950 V
Min. input voltage $V_{DC, min}$ / Start voltage VDC, Start	50 V / 50 V
Max. input voltage $V_{DC, max}$	<b>1100 V</b>
Max. input current $I_{DC, max}$ (at 35°C / at 50°C)	1600 A / 1500 A
Number of DC inputs	Customer Specific (optional)
Available DC fuse sizes (per Input)	100A, 200A, 250A, 350A, 400 A, 450 A, 500 A
<b>Battery side (DC)</b>	
DC voltage range (at 25°C / at 50°C)	50 V to 950 V / 950 V
Minimal / Maximal DC voltage	50 V / 950 V
Maximal DC current (at 25°C / at 50°C)	1600 A / 1500 A
Number of DC cables per polarity	Customer Specific
<b>Grid side (AC)</b>	
Nominal AC power at $\cos \phi = 1$ (at 35°C / at 50°C)	1140 kVA / 1000 kVA
Nominal AC power at $\cos \phi = 0.8$ (at 35°C / at 50°C)	912 kW / 800 kW
Nominal current $I_{AC, nom} = \text{Max. output current } I_{AC, max}$	1650 A
Max. total harmonics distortion	< 3% at nominal power
Nominal AC voltage / Nominal AC voltage range	400 V / 350 to 690 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short circuit ratio at the AC terminals	> 2
Power factor at rated power / displacement power factor adjustable	1 / 0.0 overexcited to 0.0 underexcited
<b>Efficiency</b>	
Max. MSC efficiency DC to DC / Max. MSC efficiency AC to DC / MSC European efficiency AC to DC	99.4 % / 98.3 % / 97.8 %
<b>Protective Devices</b>	
Input-side disconnection point	Fuse and DC load-break switch
DC overvoltage protection	Surge arrester, type I
AC overvoltage protection (optional)	Surge arrester, class I
Output-side disconnection point MV	Medium-voltage vacuum circuit breaker
Output-side disconnection point LV	Air circuit breaker
Ground-fault-monitoring / remote ground-fault monitoring	optional
Insulation monitoring	optional
Degree of protection: electronics / connection area / air duct (according to IEC 62305-1)	IP 54
Galvanic isolation	●
<b>General Data</b>	
Dimensions of the 20-foot High Cube ISO container (W / H / D) <sup>5)</sup>	6058 mm / 2896 mm / 2438 mm
Weight	< 18 t
Self-consumption (max. / partial load / average) <sup>1)</sup>	< 4 kW / < 3 kW / < 1.5 kW
Self-consumption (stand-by) <sup>1)</sup>	< 300 W
Degree of protection according to IEC 60529	Control rooms IP23D, inverter electronics IP54
Environment: standard / chemically active / dusty	● / ○ / ○
Degree of protection according to IEC 60721-3-4 (4C1, 4S2 / 4C2, 4S2 / 4C2, 4S4)	● / ○ / ○
Maximum permissible value for relative humidity	15% to 95%
Max. operating altitude above mean sea level 1000 m / 2000 m / 3000 m / 4000	● / ○ / ○ / ○ (earlier temperature-dependent de-rating)
Fresh air consumption of inverter and transformer	20000 m <sup>3</sup> /h
<b>Features</b>	
DC terminal	With busbar
AC connection	With busbar
Communication	Ethernet, Modbus Master, Modbus Slave, PROFINET, CAN bus
Communication with Freqcon string monitor (transmission medium optional)	Modbus TCP / Ethernet (FO, MM, Cat-5)
Tap changer for MV-transformer: without / with	● / ○
Shield winding for MV-Transformer: without / with	● / ○
Communication package	○
Station enclosure color	Customer Specific
Blackstart capability: without / with	○ / ●
Reactive power control and grid stabilization: without / with	○ / ●
Accessories for medium-voltage switchgear: without / auxiliary contacts / motor for transformer feeder / cascade control / monitoring	● / ○ / ○ / ○ / ○
Oil containment: without / with (integrated)	● / ○
Industry standards (for other standards see the inverter datasheet)	IEC 62271-202, IEC 62271-200, IEC 60076, CSC certificate, EN 50588-1
Integrated Energy Management System: without / with	○ / ●
Type designation	MSC 1000 Hybrid Converter

MSC Solar Hybrid 2000	MSC Solar Hybrid 3000
50 to 950 V / 950 V / 950 V	50 to 950 V / 950 V / 950 V
50 V / 50 V	50 V / 50 V
<b>1100 V</b>	<b>1100 V</b>
3200 A / 3000 A	4800 A / 4500 A
Customer Specific (optional)	Customer Specific (optional)
100A, 200A, 250A, 350A, 400 A, 450 A, 500 A	100A, 200A, 250A, 350A, 400 A, 450 A, 500 A
50 V to 950 V / 950 V	50 V to 950 V / 950 V
50 V / 950 V	50 V / 950 V
3200 A / 3000 A	4800 A / 4500 A
Customer Specific	Customer Specific
2280 kVA / 2000 kVA	3420 kVA / 3000 kVA
1824 kW / 1600 kW	2736 kW / 2400 kW
3300 A	4950 A
< 3% at nominal power	< 3% at nominal power
400 V / 350 to 690 V	400 V / 350 to 690 V
50 Hz / 47 Hz to 53 Hz	50 Hz / 47 Hz to 53 Hz
60 Hz / 57 Hz to 63 Hz	60 Hz / 57 Hz to 63 Hz
> 2	> 2
1 / 0.0 overexcited to 0.0 underexcited	1 / 0.0 overexcited to 0.0 underexcited
99.4 % / 98.3 % / 97.8 %	99.4 % / 98.3 % / 97.8 %
Fuse and DC load-break switch	Fuse and DC load-break switch
Surge arrester, type I	Surge arrester, type I
Surge arrester, class I	Surge arrester, class I
Medium-voltage vacuum circuit breaker	Medium-voltage vacuum circuit breaker
Air circuit breaker	Air circuit breaker
optional	optional
optional	optional
IP 54	IP 54
•	•
9120 mm / 2896 mm / 2438 mm	12032 mm / 2896 mm / 2438 mm
< 30 t	< 30 t
< 8 kW / < 6 kW / < 3 kW	< 12 kW / < 9 kW / < 4.5 kW
< 300 W	< 300 W
Control rooms IP23D, inverter electronics IP54	Control rooms IP23D, inverter electronics IP54
• / ○ / ○	• / ○ / ○
• / ○ / ○	• / ○ / ○
15% to 95%	15% to 95%
• / ○ / ○ / ○ (earlier temperature-dependent de-rating)	/ ○ / ○ / ○ (earlier temperature-dependent de-rating)
20000 m³/h???	20000 m³/h???
With busbar	With busbar
With busbar	With busbar
Ethernet, Modbus Master, Modbus Slave, PROFINET, CAN bus	Ethernet, Modbus Master, Modbus Slave, PROFINET, CAN bus
Modbus TCP / Ethernet (FO, MM, Cat-5)	Modbus TCP / Ethernet (FO, MM, Cat-5)
• / ○	• / ○
• / ○	• / ○
○	○
Customer Specific	Customer Specific
○ / •	○ / •
○ / •	○ / •
• / ○ / ○ / ○ / ○	• / ○ / ○ / ○ / ○
• / ○	• / ○
IEC 62271-202, IEC 62271-200, IEC 60076, CSC certificate, EN 50588-1??	IEC 62271-202, IEC 62271-200, IEC 60076, CSC certificate, EN 50588-1
○ / •	○ / •
MSC 2000 Hybrid Converter	MSC 3000 Hybrid Converter

Technical Data	MSC Solar Hybrid 1700
<b>PV side (DC)</b>	
MPP voltage range VDC (at 25°C/ 35°C / at 50°C)	50 to 1400 V / 1400 V / 1400 V
Min. input voltage VDC, min / Start voltage VDC, Start	50 V / 50 V
Max. input voltage VDC, max	<b>1500 V</b>
Max. input current IDC, max (at 35°C / at 50°C)	1600 A / 1500 A
Number of DC inputs	Customer Specific (optional)
Available DC fuse sizes (per Input)	100A, 200A, 250A, 350A, 400 A, 450 A, 500 A
<b>Battery side (DC)</b>	
DC voltage range (at 25°C / at 50°C)	50 V to 1400 V / 1400 V
Minimal / Maximal DC voltage	50 V / 1400 V
Maximal DC current (at 25°C / at 50°C)	1600 A / 1500 A
Number of DC cables per polarity	Customer Specific
<b>Grid side (AC)</b>	
Nominal AC power at $\cos \phi = 1$ (at 35°C / at 50°C)	1970 kVA / 1790 kVA
Nominal AC power at $\cos \phi = 0.8$ (at 35°C / at 50°C)	1576 kW / 1432 kW
Nominal current $I_{AC, nom} = \text{Max. output current } I_{AC, max}$	1650 A
Max. total harmonics distortion	< 3% at nominal power
Nominal AC voltage / Nominal AC voltage range	690 V / 600 to 700 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short circuit ratio at the AC terminals	> 2
Power factor at rated power / displacement power factor adjustable	1 / 0.0 overexcited to 0.0 underexcited
<b>Efficiency</b>	
Max. MSC efficiency DC to DC / Max. MSC efficiency AC to DC / MSC European efficiency AC to DC	99.4 % / 98.3 % / 97.8 %
<b>Protective Devices</b>	
Input-side disconnection point	Fuse and DC load-break switch
DC overvoltage protection	Surge arrester, type I
AC overvoltage protection (optional)	Surge arrester, class I
Output-side disconnection point MV	Medium-voltage vacuum circuit breaker
Output-side disconnection point LV	Air circuit breaker
Ground-fault-monitoring / remote ground-fault monitoring	optional
Insulation monitoring	optional
Degree of protection: electronics / connection area / air duct (according to IEC 62305-1)	IP 54
Galvanic isolation	•
<b>General Data</b>	
Dimensions of the 20-foot High Cube ISO container (W / H / D) <sup>3)</sup>	6058 mm / 2896 mm / 2438 mm
Weight	< 18 t
Self-consumption (max. / partial load / average) <sup>1)</sup>	< 4 kW / < 3 kW / < 1.5 kW
Self-consumption (stand-by) <sup>1)</sup>	< 300 W
Degree of protection according to IEC 60529	Control rooms IP23D, inverter electronics IP54
Environment: standard / chemically active / dusty	• / ○ / ○
Degree of protection according to IEC 60721-3-4 (4C1, 4S2 / 4C2, 4S2 / 4C2, 4S4)	• / ○ / ○
Maximum permissible value for relative humidity	15% to 95%
Max. operating altitude above mean sea level 1000 m / 2000 m / 3000 m / 4000	• / ○ / ○ / ○ (earlier temperature-dependent de-rating)
Fresh air consumption of inverter and transformer	20000 m <sup>3</sup> /h
<b>Features</b>	
DC terminal	With busbar
AC connection	With busbar
Communication	Ethernet, Modbus Master, Modbus Slave, PROFINET, CAN bus
Communication with Freqcon string monitor (transmission medium optional)	Modbus TCP / Ethernet (FO, MM, Cat-5)
Tap changer for MV-transformer: without / with	• / ○
Shield winding for MV-Transformer: without / with	• / ○
Communication package	○
Station enclosure color	Customer Specific
Blackstart capability: without / with	○ / •
Reactive power control and grid stabilization: without / with	○ / •
Accessories for medium-voltage switchgear: without / auxiliary contacts / motor for transformer feeder / cascade control / monitoring	• / ○ / ○ / ○ / ○
Oil containment: without / with (integrated)	• / ○
Industry standards (for other standards see the inverter datasheet)	IEC 62271-202, IEC 62271-200, IEC 60076, CSC certificate, EN 50588-1
Integrated Energy Management System: without / with	○ / •
Type designation	MSC 1700 Hybrid Converter

MSC Solar Hybrid 3500	MSC Solar Hybrid 5300
50 to 1400 V / 1400 V / 1400 V	50 to 1400 V / 1400 V / 1400 V
50 V / 50 V	50 V / 50 V
<b>1500 V</b>	<b>1500 V</b>
3200 A / 3000 A	4800 A / 4500 A
Customer Specific (optional)	Customer Specific (optional)
100A, 200A, 250A, 350A, 400 A, 450 A, 500 A	100A, 200A, 250A, 350A, 400 A, 450 A, 500 A
50 V to 1400 V / 1400 V	50 V to 1400 V / 1400 V
50 V / 1400 V	50 V / 1400 V
3200 A / 3000 A	4800 A / 4500 A
Customer Specific	Customer Specific
3940 kVA / 3580 kVA	5910 kVA / 5370 kVA
3152 kW / 2864 kW	4728 kW / 4296 kW
3300 A	4950 A
< 3% at nominal power	< 3% at nominal power
400 V / 350 to 690 V	400 V / 350 to 690 V
50 Hz / 47 Hz to 53 Hz	50 Hz / 47 Hz to 53 Hz
60 Hz / 57 Hz to 63 Hz	60 Hz / 57 Hz to 63 Hz
> 2	> 2
1 / 0.0 overexcited to 0.0 underexcited	1 / 0.0 overexcited to 0.0 underexcited
99.4 % / 98.3 % / 97.8 %	99.4 % / 98.3 % / 97.8 %
Fuse and DC load-break switch	Fuse and DC load-break switch
Surge arrester, type I	Surge arrester, type I
Surge arrester, class I	Surge arrester, class I
Medium-voltage vacuum circuit breaker	Medium-voltage vacuum circuit breaker
Air circuit breaker	Air circuit breaker
optional	optional
optional	optional
IP 54	IP 54
•	•
9120 mm / 2896 mm / 2438 mm	12032 mm / 2896 mm / 2438 mm
< 18 t	< 18 t
< 4 kW / < 3 kW / < 1.5 kW	< 4 kW / < 3 kW / < 1.5 kW
< 300 W	< 300 W
Control rooms IP23D, inverter electronics IP54	Control rooms IP23D, inverter electronics IP54
• / o / o	• / o / o
• / o / o	• / o / o
15% to 95%	15% to 95%
• / o / o / o (earlier temperature-dependent de-rating)	• / o / o / o (earlier temperature-dependent de-rating)
20000 m <sup>3</sup> /h	20000 m <sup>3</sup> /h
With busbar	With busbar
With busbar	With busbar
Ethernet, Modbus Master, Modbus Slave, PROFINET, CAN bus	Ethernet, Modbus Master, Modbus Slave, PROFINET, CAN bus
Modbus TCP / Ethernet (FO, MM, Cat-5)	Modbus TCP / Ethernet (FO, MM, Cat-5)
• / o	• / o
• / o	• / o
o	o
Customer Specific	Customer Specific
o / •	o / •
o / •	o / •
• / o / o / o / o	• / o / o / o / o
• / o	• / o
IEC 62271-202, IEC 62271-200, IEC 60076, CSC certificate, EN 50588-1	IEC 62271-202, IEC 62271-200, IEC 60076, CSC certificate, EN 50588-1
o / •	o / •
MSC 3500 Hybrid Converter	MSC 5300 Hybrid Converter