2UCD190000E002 Rev C

PCS100 ESS

Grid Connect Interface for Energy Storage Systems 100kVA to 10MVA

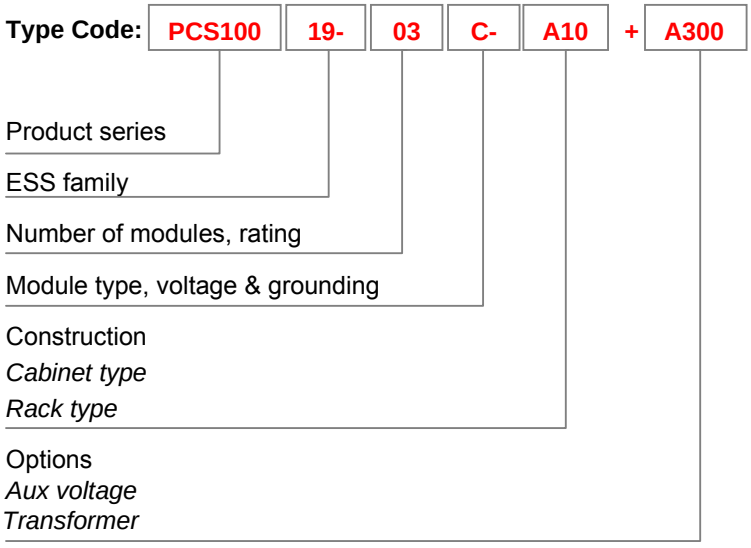
Technical Catalogue

How to select your ESS?

Choice1: Simply contact your local ABB sales office and let them know what you want. Use this catalogue as a reference for more information.

OR

Choice2: Build up your own ordering code by 6 steps. Each step is accompanied by a reference to a page that is filled with useful information.



Product Series

PCS100	19-	03	C-	A10	+	A300

Overview

The PCS100 ESS range is part of a family of energy storage system converter products available from ABB. Based around a low voltage converter platform the PCS100 ESS provides wide bandwidth performance with a flexible and highly modular power electronic configuration. New energy storage devices such as new generation batteries, flywheel and super capacitors provide the opportunity to store energy from the electricity grid and return it when required. This offers a huge range of options to strengthen and enhance the performance, quality and reliability of smart electricity grids.

The PCS100 ESS allows control of both real power (P) and reactive power (Q) based on the system requirement. Advanced control features in the "Virtual Generator™" mode of operation make the PCS100 ESS look like a true power system component.
The converter behaves together with the power system like a traditional synchronous machine. This is achieved through power electronic control and there are no large spinning masses. Inertia is modelled with the system enabling it to deliver to or draw power from the grid dependent on the rate of change of system frequency.

In case of grid supply loss the system can shut down (acc. to anti-islanding standards) or be set to operate in island mode, where the PCS100 ESS operates disconnected from the main grid but continues to supply local loads. When the grid returns the PCS100 can re-synchronise the islanded network allowing seamless transfer back to grid connect mode.

User Benefits

– Power system load levelling (deferred network and generation investment)
– Increases network stability and transmission capacity (increased use of renewable)
– Delivers grid compliance for renewable and generation systems
– Damps disturbances and oscillations in critical system configurations
– Modular design for highest availability
– Based on LV converter platform especially developed for power quality issues (no adapted VSD)

Features

– Allows a range of energy storage devices to be coupled to the grid
– Dynamic power control (P)
– Dynamic reactive power control (Q)
– Generator emulation control mode
– Grid stabilisation features (synthetic inertia and active damping)
– High and low voltage ride through
– Black start option

Applications

– Integration of renewable energy (to meet grid codes regarding HVRT, LVRT, ZVRT)
– Load levelling for generation utilization
– Spinning reserve in case of line loss
– Frequency regulation
– Peak shaving (end user)

Technical Specification

PCS100	19-	03	C-	A10	+	A300

Mains connection

Voltage	Connect to any LV or MV with a standard transformer
Frequency	50 or 60 Hz

Performance

Efficiency	> 97% at rated power (exc. transformer)
Voltage accuracy	+/- 1%
Frequency accuracy	+/- 0.1%
Power accuracy	+/- 3%
Overload capability	10 min 120 % 30 sec 150% 2 sec 200% (75 % preload for 200%)
MTTR	< 30 min by module exchange

Environmental limits

Cabinet rating	IP21 or IP 23
Rack rating	IP20
Ambient temp.	0-50ºC, de-rating for temps > 40ºC (2%/K)
Pollution degree	2
Cooling	Forced air ventilation
Altitude	< 1000m. De-rate 1.2% per 100m above 1000m, maximum 3000m
Humidity	0-95% non-condensing
Noise	75-85 dBA @ 2m
Enclosure colour	RAL 7035 for cabinets

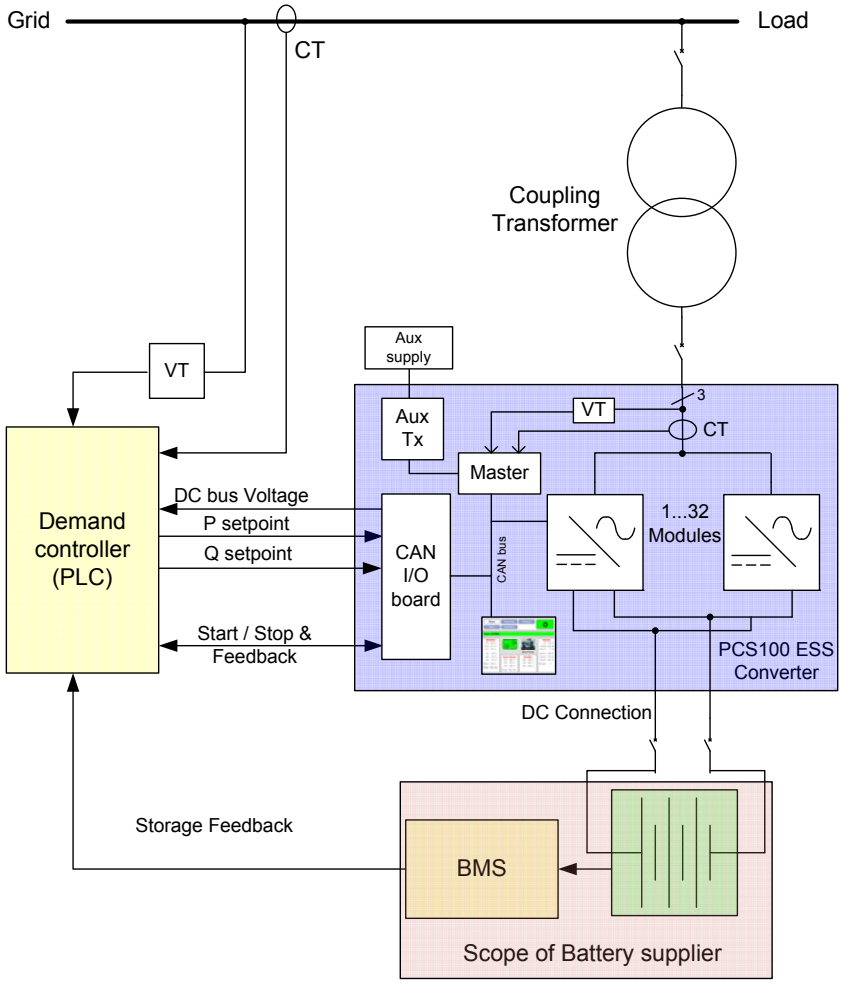
Interface, programmable I/O's

Operator Interface	Colour touch screen
2 analog inputs	
Voltage signal	-10 to +10 V, Rin > 200kΩ
Current signal	0 (4) to 20 mA, Rin = 100Ω
Maximum delay	< 10 ms
Resolution	0.1 %
Accuracy	± 2%
2 analog outputs	
Voltage signal	-10 to +10 V
Current signal	0 (4) to 20 mA, load < 500 Ω
Maximum delay	< 50 ms
Accuracy	± 2 %
9 digital inputs	
Voltage signal	24 V DC, with internal or external supply, PNP & NPN
Input impedance	2.5 kΩ
Maximum delay	< 10 ms
1 PTC input	
7 relay outputs	
Rated voltage	250 V ac/1~, 30 V dc
Current	1 A
Serial communication	
Modbus RTU	RS-485
Modbus TCP/IP	Ethernet via colour touch screen (read only)
Remote monitoring	Ethernet web server via colour touch screen

Product compliance, Standards

IEEE 519
ISO 9001 Quality assurance system
IEC 62103 / EN 50178
IEEE 1547 (pending)
CE (pending)
UL 1741 (pending)

System Overview: Example for a typical battery ESS



CT	Current transducer
VT	Voltage transducer
BMS	Battery management system (usually delivered by battery manufacturer)
PLC	Programmable logic control, overriding control for specific application. It may contain both BMS and application control, Interfacing to the PCS100 can be e.g. hardwired or through RS485 Modbus
Aux Tx	Auxiliary supply for PCS100. Can be sourced from grid or externally
Coupl. Tx	The AC connection voltage of the PCS100 depends on the batteries used. Therefore usually a coupling transformer is needed.

Power Module Types

PCS100	19-	03	C-	A10	+	A300

Number of modules

01-06 for cabinets
01-32 for racks

Module type

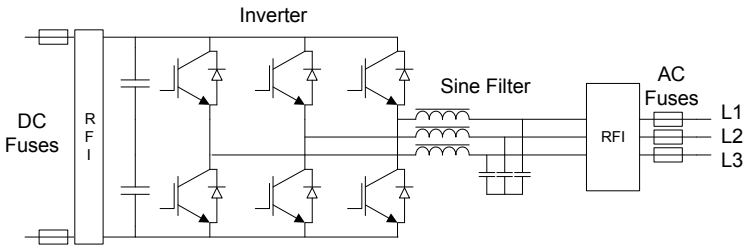
C – 1000 Vdc (750-1120 Vdc), 480Vac (150-480 Vac), 105 Aac, 50/60 Hz, ac transformer coupled (floating), dc side RFI is grounded.

D – 750 Vdc (250-820 Vdc), 480Vac (150-480 Vac), 150 Aac, 50/60 Hz, ac transformer coupled (floating), dc side RFI is grounded.

All PCS100 products use the same LV power modules which employ IGBT's and integrated sinusoidal filters The ac and dc power connections of each module are protected by high speed semiconductor fuses. Multiple modules are connected in parallel to provide higher power.

The modules differ for the voltage range possible for the dc link. The modules are current rated and the available power output depends on the ac coupling voltage. The ac coupling voltage is further defined by the lowest possible dc link voltage. This is the minimum operational or discharging voltage of the storage.

An example of how to size PCS100 ESS converters is given later in this document. In addition an AC coupling transformer is needed to isolate the common mode voltage generated by the inverter switching. This ensures electromagnetic interference compatibility and allows the DC side to be ground referenced if desired.



Sizing example for a battery ESS

The following minimum data is needed to size a PCS100 ESS converter:

- Nominal DC operating voltage of battery string
- Max. charging DC voltage of battery string
- Min. operational DC voltage of battery string
- AC voltage tolerance of the grid
- Nominal Power output of the converter

Battery suppliers can deliver this data for their battery strings.

For example we may have a nominal power demand for the system of 250 kW.
The grid voltage is 400 V/3~, 50 HZ, +/-10%.

Example of battery string data:

Qty of cells	low DC Voltage	nom. DC Voltage	high DC Voltage	kW @ LV DC	kW @ NV DC	kW @ HV DC	Energy Wh
21	439	483	588	132	145	176	24360
22	460	506	616	138	152	185	25520
23	481	529	644	144	159	193	26680
24	502	552	672	150	166	202	27840
25	523	575	700	157	173	210	29000
26	543	598	728	163	179	218	30160
27	564	621	756	169	186	227	31320
28	585	644	784	176	193	235	32480

If we are free to choose the string voltage out of the table given above, we would go for 28 battery cells in series connection as this voltage fits best for our 750Vdc D type converter modules (max 820Vdc).
The high DC voltage is the maximum charging voltage for the battery. The low DC voltage is the minimum operating voltage of the battery string. The min. op. voltage is also the design voltage for the converter sizing as we must be able to deliver the requested power at that battery voltage level.

28 battery cells have a minimum operating voltage of 585V DC. This is the minimum DC-link voltage where the PCS100 ESS must be able to deliver the required output power.

From this DC voltage the converter can connect to 413 V AC/3~. The voltage tolerance of the grid is 10 %. To be able to deliver full power output at 110% nominal voltage we need to lower the coupling voltage from 413V by 10% so the coupling voltage will be around 370 V AC/3~.

If the specification is asking for full power at 90% nominal voltage we need 10% current reserve. So a 150A module would be sized using 135 A. Mostly the requirement is only to be able to operate at e.g. 90% remaining voltage but not at full power.

To meet the +/- 10 % voltage tolerance criteria we have 135 A @ 370V ac coupling voltage. With 370 V ac we get 86.5 kVA out of one module. To achieve the demanded 250 kW we need one PCS100 ESS with 3 modules and 2 of the 28 battery cell strings in parallel.

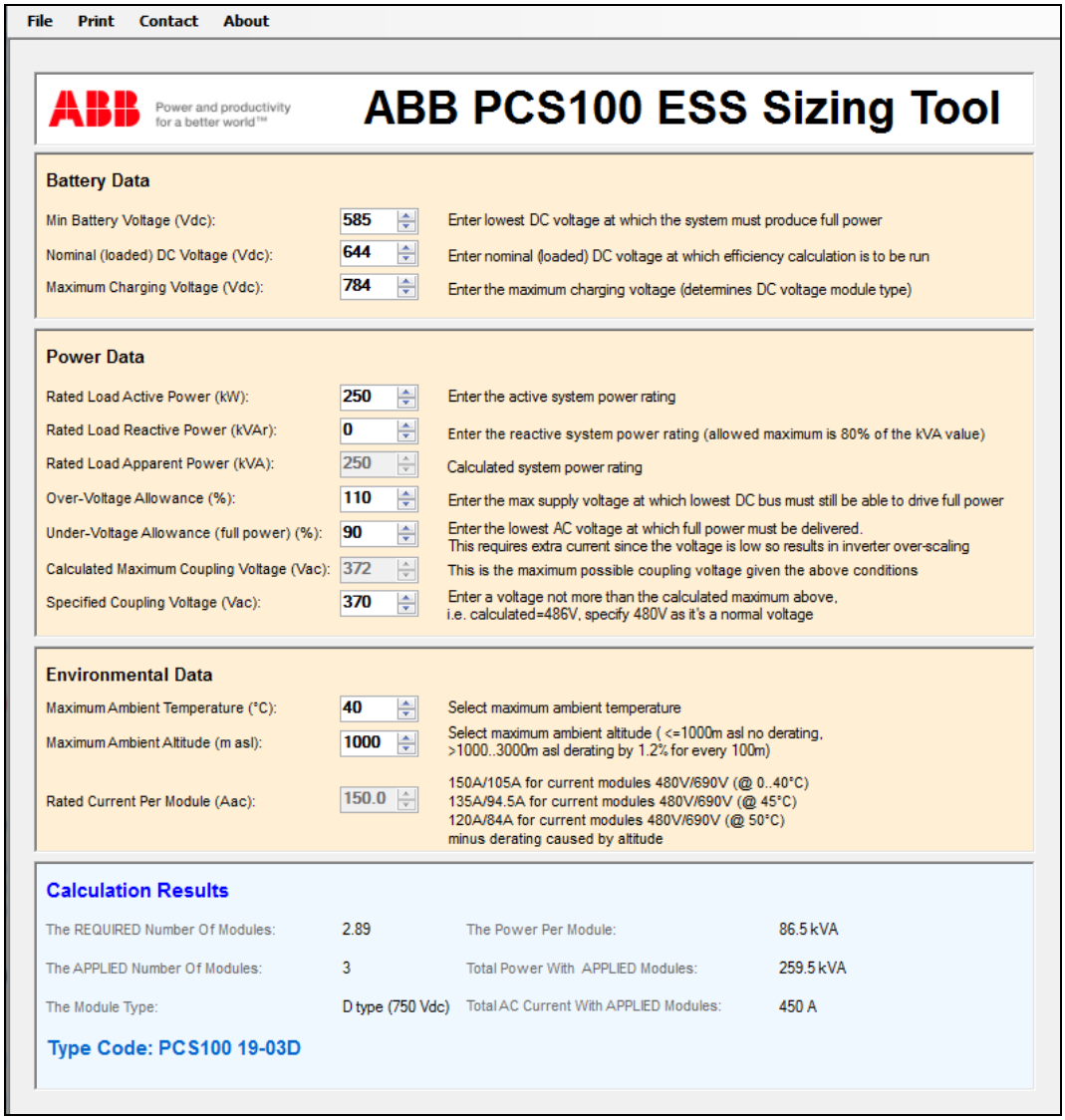
The coupling transformer specification will be 260 kVA (250kVA + 3% losses), 400V/370V/3~

This sizing example is also shown in the sizing tool application on the following page.

Sizing Tool

To assist with sizing PCS100 ESS systems a Sizing Tool has been developed and can be downloaded from ABB.com. A screen shot of the sizing tool is shown below.

To use the sizing tool, enter in values to the white cells. The tool will then calculate the number and type of modules needed for the application.



Typical Rating Table for D Type Modules (750 Vdc)

PCS100	19-	03	D-	A10	+	A300

Rating for a typical PCS100 ESS system with the following requirements:
550 - 820 Vdc operating voltage
+/-10% grid voltage tolerance,
100% power at 100-110% ac voltage.

The ac coupling voltage would be 350 V and the current rating 150 A per module. So the power rating per module is 90.9 kW.

Continious Operation 550-780Vdc					Overload 150% for 30s		Type Code	No. of modules
S kVA	P kW *	Q kVAr *	Iac A	Idc A	S kVA	Iac A		
91	91	91	150	180	136	228	PCS100 19-01D	1
182	182	182	300	360	273	456	PCS100 19-02D	2
273	273	273	450	540	409	684	PCS100 19-03D	3
364	364	364	600	720	545	912	PCS100 19-04D	4
455	455	455	750	900	682	1140	PCS100 19-05D	5
545	545	545	900	1080	818	1368	PCS100 19-06D	6
636	636	636	1050	1260	954	1596	PCS100 19-07D	7
727	727	727	1200	1440	1091	1824	PCS100 19-08D	8
818	818	818	1350	1620	1227	2052	PCS100 19-09D	9
909	909	909	1500	1800	1364	2280	PCS100 19-10D	10
1000	1000	1000	1650	1980	1500	2508	PCS100 19-11D	11
1091	1091	1091	1800	2160	1636	2736	PCS100 19-12D	12
1182	1182	1182	1950	2340	1773	2964	PCS100 19-13D	13
1273	1273	1273	2100	2520	1909	3192	PCS100 19-14D	14
1364	1364	1364	2250	2700	2045	3420	PCS100 19-15D	15
1454	1454	1454	2400	2880	2182	3648	PCS100 19-16D	16
1545	1545	1545	2550	3060	2318	3876	PCS100 19-17D	17
1636	1636	1636	2700	3240	2454	4104	PCS100 19-18D	18
1727	1727	1727	2850	3420	2591	4332	PCS100 19-19D	19
1818	1818	1818	3000	3600	2727	4560	PCS100 19-20D	20
1909	1909	1909	3150	3780	2863	4788	PCS100 19-21D	21
2000	2000	2000	3300	3960	3000	5016	PCS100 19-22D	22
2091	2091	2091	3450	4140	3136	5244	PCS100 19-23D	23
2182	2182	2182	3600	4320	3272	5472	PCS100 19-24D	24
2273	2273	2273	3750	4500	3409	5700	PCS100 19-25D	25
2363	2363	2363	3900	4680	3545	5928	PCS100 19-26D	26
2454	2454	2454	4050	4860	3681	6156	PCS100 19-27D	27
2545	2545	2545	4200	5040	3818	6384	PCS100 19-28D	28
2636	2636	2636	4350	5220	3954	6612	PCS100 19-29D	29
2727	2727	2727	4500	5400	4091	6840	PCS100 19-30D	30
2818	2818	2818	4650	5580	4227	7068	PCS100 19-31D	31
2909	2909	2909	4800	5760	4363	7296	PCS100 19-32D	32

* Total power $S^2=P^2+Q^2$, full P and Q not possible at the same time.

Rating Example based on 750 Vdc modules (D type).

The rating of the PCS100 ESS depends on the storage system it is connected to.

Depending on the requirements and storage used the size of the PCS100 ESS can be significant different. Please use the sizing tool or contact your local ABB for support**.**

Typical Rating Table for C Type Modules (1000 Vdc)

PCS100	19-	03	C-	A10	A300

Rating for a typical ESS system with the following requirements:
750 - 1120 Vdc operating voltage
+/-10% grid voltage tolerance,
100% power at 100-110% ac voltage.

The ac coupling voltage would be 475 V and the current rating 105 A per module. So the power rating per module is 86.7 kW.

Continious Operation 750-1065Vdc					Overload 150% for 30s		Type Code	No. of modules
S kVA	P kW *	Q kVAr *	Iac A	Idc A	S kVA	Iac A		
87	87	69	105	126	130	160	PCS100 19-01C	1
173	173	139	210	252	260	319	PCS100 19-02C	2
260	260	208	315	378	390	479	PCS100 19-03C	3
347	347	277	420	504	520	638	PCS100 19-04C	4
434	434	347	525	630	650	798	PCS100 19-05C	5
520	520	416	630	756	780	958	PCS100 19-06C	6
607	607	486	735	882	910	1117	PCS100 19-07C	7
694	694	555	840	1008	1040	1277	PCS100 19-08C	8
780	780	624	945	1134	1170	1436	PCS100 19-09C	9
867	867	694	1050	1260	1301	1596	PCS100 19-10C	10
954	954	763	1155	1386	1431	1756	PCS100 19-11C	11
1040	1040	832	1260	1512	1561	1915	PCS100 19-12C	12
1127	1127	902	1365	1638	1691	2075	PCS100 19-13C	13
1214	1214	971	1470	1764	1821	2234	PCS100 19-14C	14
1301	1301	1040	1575	1890	1951	2394	PCS100 19-15C	15
1387	1387	1110	1680	2016	2081	2554	PCS100 19-16C	16
1474	1474	1179	1785	2142	2211	2713	PCS100 19-17C	17
1561	1561	1248	1890	2268	2341	2873	PCS100 19-18C	18
1647	1647	1318	1995	2394	2471	3032	PCS100 19-19C	19
1734	1734	1387	2100	2520	2601	3192	PCS100 19-20C	20
1821	1821	1457	2205	2646	2731	3352	PCS100 19-21C	21
1907	1907	1526	2310	2772	2861	3511	PCS100 19-22C	22
1994	1994	1595	2415	2898	2991	3671	PCS100 19-23C	23
2081	2081	1665	2520	3024	3121	3830	PCS100 19-24C	24
2168	2168	1734	2625	3150	3251	3990	PCS100 19-25C	25
2254	2254	1803	2730	3276	3381	4150	PCS100 19-26C	26
2341	2341	1873	2835	3402	3511	4309	PCS100 19-27C	27
2428	2428	1942	2940	3528	3641	4469	PCS100 19-28C	28
2514	2514	2011	3045	3654	3771	4628	PCS100 19-29C	29
2601	2601	2081	3150	3780	3902	4788	PCS100 19-30C	30
2688	2688	2150	3255	3906	4032	4948	PCS100 19-31C	31
2774	2774	2220	3360	4032	4162	5107	PCS100 19-32C	32

* Total power $S^2=P^2+Q^2$, full P and Q not possible at the same time.

Rating Example based on 1000 Vdc (C type) modules

The rating of the PCS100 ESS depends on the storage system it is connected to.

Depending on the requirements and storage used the size of the PCS100 ESS can be significant different. Please use the sizing tool or contact your local ABB for support**.**

Mechanical Solution

PCS100	19-	03	C-	A10	+	A300

Construction

Xxx

Ax0 – standard cabinet in 1 row based on (800 x 800) mm sections
A**x0** – no. of 800 mm sections (width) for standard cabinet (max. 6 modules per 800mm)
→ possible combination is A10
Bx0 – standard rack in 1 row, a rack can have sections of 1000 mm width
B**x0** – number of 1000mm sections (max. 8 modules per 1000mm)
→ possible combinations for racks: 1-8 modules → B10, 9-16 modules → B20,

Cxx – customized cabinet solution, the following numbers are serial numbers for solutions

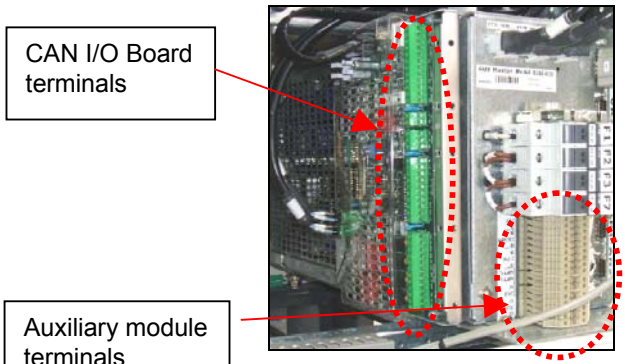
Standard cabinets

The standard cabinet has a footprint of about 800mm x 800 mm. A maximum of 6 inverter modules can fit into a standard cabinet. The Graphical Display Module (GDM) is always mounted in the door of the Inverter enclosure.

Dimensions, weight, losses and air flow for a standard cabinet

Dimensions (mm)			Weight	Heat dissipation	Air flow		Type Code	No. of modules
H	W	D	kg	kW	m3/hr	CFM		
2154	809	804	330	2.9	600	353	PCS100 19-01C/D-A10	1
2154	809	804	410	5.8	1200	707	PCS100 19-02C/D-A10	2
2154	809	804	490	8.7	1800	1060	PCS100 19-03C/D-A10	3
2154	809	804	570	11.6	2400	1414	PCS100 19-04C/D-A10	4
2154	809	804	650	14.5	3000	1767	PCS100 19-05C/D-A10	5
2154	809	804	730	17.4	3600	2120	PCS100 19-06C/D-A10	6

Standard cabinet with 6 power modules



Auxiliary supply & master module with CAN I/O board mounted

Standard racks

Racks are used for easy containerization. The racks have two different footprints of 1000mm x 800mm per section for 1-8 modules and 2000mm x 800mm for 9-16 modules. Empty slots will be covered by a blanking plate. The modules are installed in 2 levels with AC/DC busbars running between the 2 levels. Busbars can be terminated to either end of the rack. Usually a termination cabinet containing AC/DC breakers is installed by the system integrator.

	
16 module Rack	The **master controller** and the auxiliary supply for each system are built on a baseplate for integration into a control cabinet.

Dimensions, weight, losses and air flow for standard racks

Dimensions (mm)			Weight	Heat dissipation	Air flow		Type Code	No. of modules
H	W	D	kg	kW	m3/hr	CFM		
2200	1041	703	557	12	2400	1414	PCS100 19-04C/D-B10	4
2200	1041	703	628	15	3000	1767	PCS100 19-05C/D-B10	5
2200	1041	703	700	17	3600	2120	PCS100 19-06C/D-B10	6
2200	1041	703	771	20	4200	2474	PCS100 19-07C/D-B10	7
2200	1041	703	842	23	4800	2827	PCS100 19-08C/D-B10	8
2200	2041	703	1015	26	5400	3181	PCS100 19-09C/D-B20	9
2200	2041	703	1095	29	6000	3534	PCS100 19-10C/D-B20	10
2200	2041	703	1175	32	6600	3887	PCS100 19-11C/D-B20	11
2200	2041	703	1255	35	7200	4241	PCS100 19-12C/D-B20	12
2200	2041	703	1335	38	7800	4594	PCS100 19-13C/D-B20	13
2200	2041	703	1415	41	8400	4948	PCS100 19-14C/D-B20	14
2200	2041	703	1495	44	9000	5301	PCS100 19-15C/D-B20	15
2200	2041	703	1575	46	9600	5654	PCS100 19-16C/D-B20	16
2200	2x2041*	703	1930	49	10200	6008	PCS100 19-17C/D-B40	17
2200	2x2041*	703	2010	52	10800	6361	PCS100 19-18C/D-B40	18
2200	2x2041*	703	2090	55	11400	6715	PCS100 19-19C/D-B40	19
2200	2x2041*	703	2170	58	12000	7068	PCS100 19-20C/D-B40	20
2200	2x2041*	703	2250	61	12600	7421	PCS100 19-21C/D-B40	21
2200	2x2041*	703	2330	64	13200	7775	PCS100 19-22C/D-B40	22
2200	2x2041*	703	2410	67	13800	8128	PCS100 19-23C/D-B40	23
2200	2x2041*	703	2490	70	14400	8482	PCS100 19-24C/D-B40	24
2200	2x2041	703	2570	73	15000	8835	PCS100 19-25C/D-B40	25
2200	2x2042	703	2650	75	15600	9188	PCS100 19-26C/D-B40	26
2200	2x2043	703	2730	78	16200	9542	PCS100 19-27C/D-B40	27
2200	2x2044	703	2810	81	16800	9895	PCS100 19-28C/D-B40	28
2200	2x2045	703	2890	84	17400	10249	PCS100 19-29C/D-B40	29
2200	2x2046	703	2970	87	18000	10602	PCS100 19-30C/D-B40	30
2200	2x2047	703	3050	90	18600	10955	PCS100 19-31C/D-B40	31
2200	2x2048	703	3130	93	19200	11309	PCS100 19-32C/D-B40	32

* 2m + 1m rack available on request

Options

PCS100	19-	03	C-	A10	+	A300

The options for all PCS100 are defined by additional codes (so called pluscodes). Each option has an own code and will be added to the type code by a plus. The options are categorized.

User Interfaces

A standard PCS100 ESS contains a GDM (graphic display module) and one CAN-I/O-board (CIOB). The GDM has a Ethernet port providing Modbus TCP/IP (read only) and the remote viewing of the GDM screens. The CAN-I/O-board (CIOB) also contains a serial RS485 Modbus connection.

- A101 No graphic display module (colour touch screen)

Auxiliary Supply

The PCS100 ESS requires a separate supply feed to power the control circuit and fans.
For **cabinet systems** there is an options of higher voltage auxiliary voltage (for line to line connections);

+A400 Aux power input, 380-400-415-480 V/1~

For the all systems the default auxiliary supply of 110-220-230V V/1~ is available.

For Rack systems a separate 230V/1~ fan supply of 200VA per module is also required.

Grid Voltage Sensor

A grid voltage sensor is required for re-synchronisation to the grid if the converter is operating in an island situation. The maximum input voltage is 480V/3~

+A300 Voltage sensing board for remote synchronization to the grid
(needed if island mode is planned to resynchronize to the utility grid)

Coupling Transformer (for 1 and 2 module systems)

+T Standard transformers are used, please specify separate voltage etc.
For paralleled ESS systems (not modules) use separate transformers or transformers with multiple secondary windings.

+T679 For 2 module C type system, 750-1120Vdc.
Grid side 400V 50Hz or 480V 60Hz, PCS side 480V. 130kVA cont, 170kVA 15min

+T700 For 2 module D type system, 470-820Vdc.
Grid side 400V 50Hz or 480V 60Hz, PCS side 300V. 150kVA

Operating Modes

A PCS100 ESS can be configured to operate in different modes depending on the application. This means the PCS100 ESS is extremely flexible and suited to all common energy storage applications.

Current Source Mode

When operating in current source mode the PCS100 inverters provide balanced 3 phase sinusoidal currents to the grid, regardless of grid conditions such as unbalance or harmonics. The current source mode also provides rapid sub cycle response to power commands for highly dynamic system requirements. Examples where current source mode would be used is together with wind parks where fast support for the grid is required in the event of a low voltage event.

Voltage Source Mode

The ABB voltage source operating mode is a unique operating mode for a power electronic converter whereby the converter mimics the behaviour of regular rotary generators. Termed ABB Virtual Generator™ the PCS100 voltage source mode interfaces to the grid with a balanced 3 phase voltage. The benefit of this is a natural correction of grid unbalance and harmonics by the ESS. In addition physical inertia is modelled into the PCS100 control system, providing a damping response to the frequency in the grid via the storage connected to the PCS100 ESS.

The voltage source mode is the ideal control mode for stabilising small or weak grids. In addition the voltage source mode can provide a fixed voltage and frequency to an islanded grid.

Control Modes

Dynamic Power Flow control

The PCS100 receives signed references for P (real power) and Q (reactive power). These references can be set manually via the GDM or dynamically via the analog inputs or RS-485 Modbus. The signed reference for Q defines inductive or capacitive reactive power. For the real power it defines whether energy is delivered from the storage to the grid or vice versa.

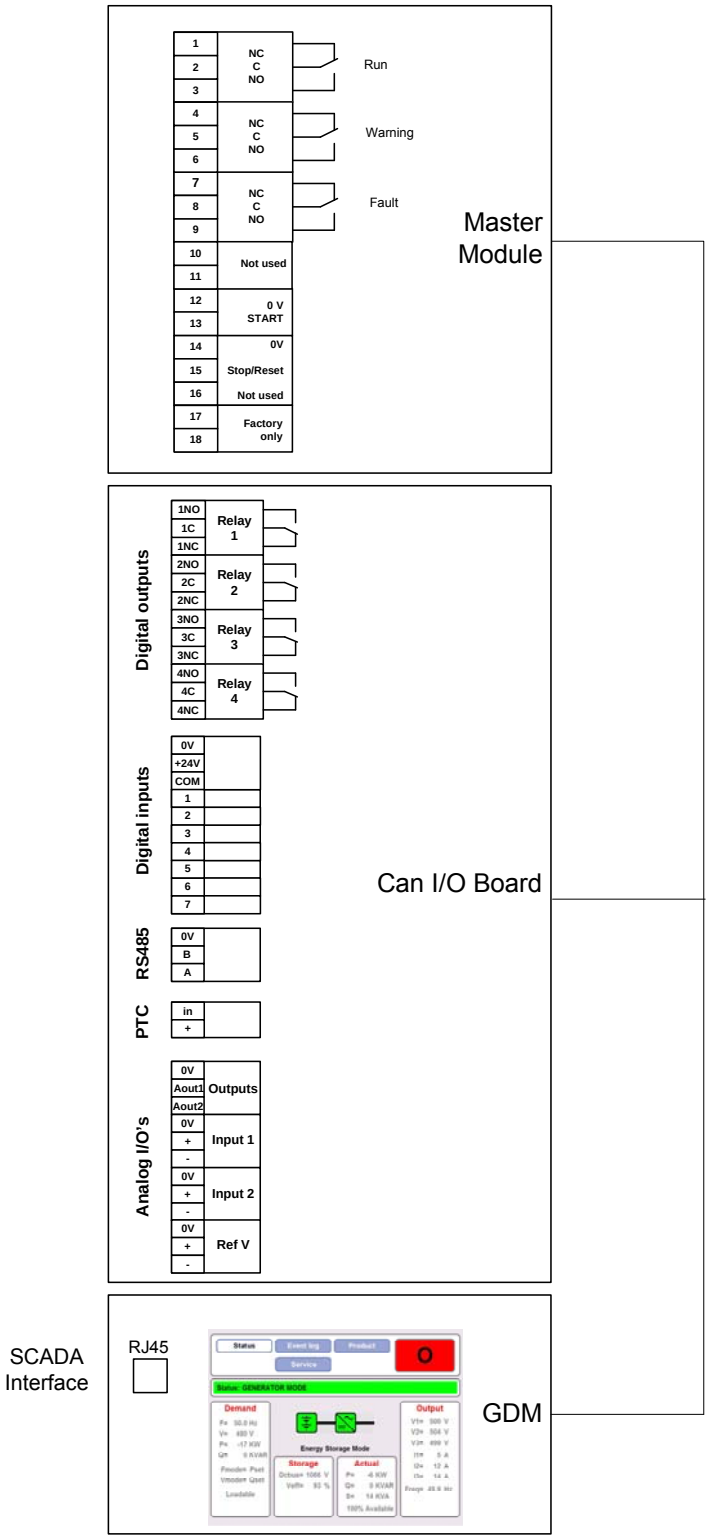
Applications where Dynamic Power Flow control is used include;

- Frequency Regulation (P)
- Load levelling / peak shaving (P)
- Renewable generation smoothing (P & Q)
- Voltage or power factor control (Q)

Voltage and Frequency Control (Island)

In voltage and frequency control the PCS100 controls its own voltage and frequency, enabling it to create a micro or islanded grid (island) should a problem occur with the utility. When the local PCS100 grid is disconnected from the utility the PCS100 will support the local loads with minimal disturbance. The monitoring and indicating of a grid failure can be done externally or by internal supervision based on frequency/voltage monitoring. After return of the grid the PCS100 can resynchronize the island & allow seamless reconnection to the grid. Voltage and Frequency control is possible in the Voltage Source operating mode only. Mode changing between power flow control and voltage & frequency control is possible without stopping the PCS100.

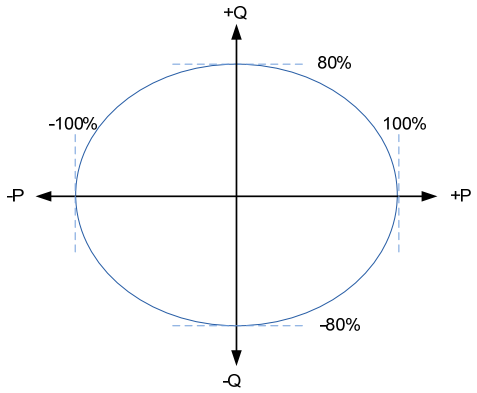
Control Connections



Operating Capabilities

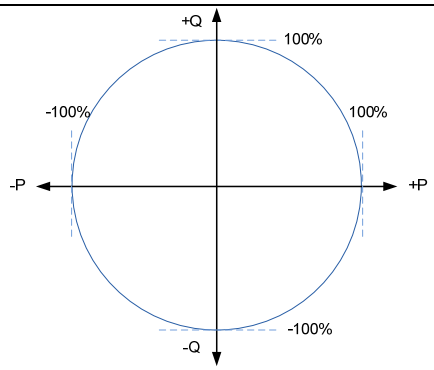
Reactive Power Capability

The PCS100 ESS independently controls the real power (P) and reactive power (Q). Providing independent control of the real and reactive power allows the system operator to use the reactive capacity of the PCS100 during times where the real power demand is low, providing voltage support or power factor compensation. The reactive power capacity of the PCS100 ESS depends on the module type as defined below. Independent values for P,Q and S power limits can be programmed into the PCS100 ESS.



C Type Module

The continuous VAr capability of the C Type module is 80% of the nominal rating, as shown in the above diagram.

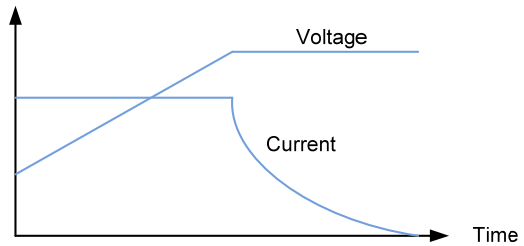


D Type Module

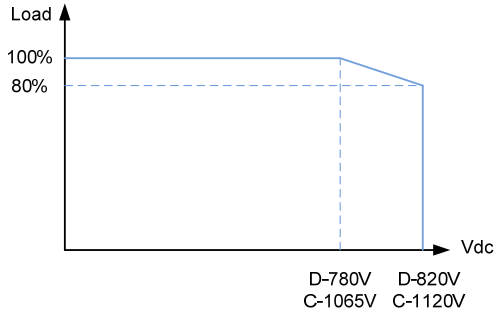
The continuous VAr capability of the D Type module is 100% of the nominal rating, as shown in the above diagram.

DC Voltage Capability

The PCS100 ESS is designed primarily for using batteries as the DC storage element. As such the characteristics typical of batteries are used to optimise the operating range of the PCS100. In particular the maximum DC operating voltage has been specified to allow a constant voltage type charging profile, as a result the current required to charge the battery at the maximum DC voltage reduces. If continuous full power operation is required above the nominal DC voltage (750Vdc and 1000Vdc) then de-rating is required.



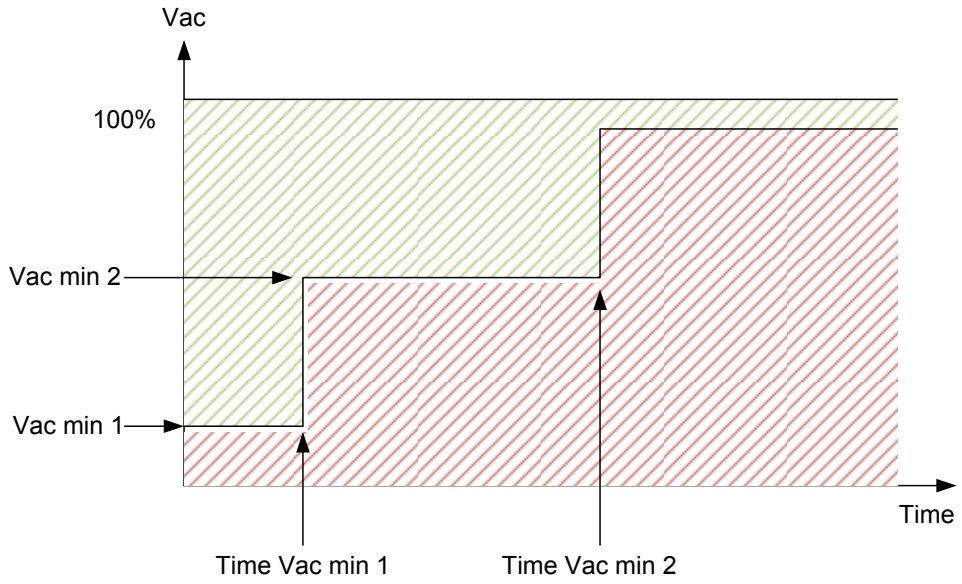
Typical battery CC/CV charging profile. Power requirement reduces once maximum DC voltage is reached



De-rating curve for continuous operation at high DC voltages

LVRT Feature

The PCS100 ESS low voltage ride through (LVRT) function allows the user to customize the low voltage ride through behavior to meet specific grid code requirements. Two voltage levels and time thresholds can be programmed via the GDM menus. The PCS100 ESS will operate within these limits, and trip off if either the time or voltage level is exceeded. The minimum voltage level for Vac min 1 is 15%.



In addition to the time and voltage levels, a voltage threshold can be set where for AC voltages below the threshold the real power reference will be overridden to 0%. Reactive power can continue to be supplied for grid support applications.

Energy Saving Standby Feature

The PCS100 ESS incorporates a low power standby function to reduce idle losses. This function works by comparing the P and Q power references to a threshold level. If both the P and Q references are below their respective threshold the converter will transition to Standby status. While in Standby the power module IGBT switching is blocked, which significantly reduces the converter losses to auxiliary power only. Should the P or Q references rise above the threshold the PCS100 ESS will instantly restart, providing the demanded power.

Power Module Redundancy Feature

The PCS100 Advanced Redundancy feature represents a further milestone of power electronics reliability and availability improvements.

It allows uninterrupted operation in case of a module failure with N-1 reduced capability. The faulty module will trip offline while the rest of the system continues.

Value:

Reduces power output in a failure only by a small fraction of the total system power.

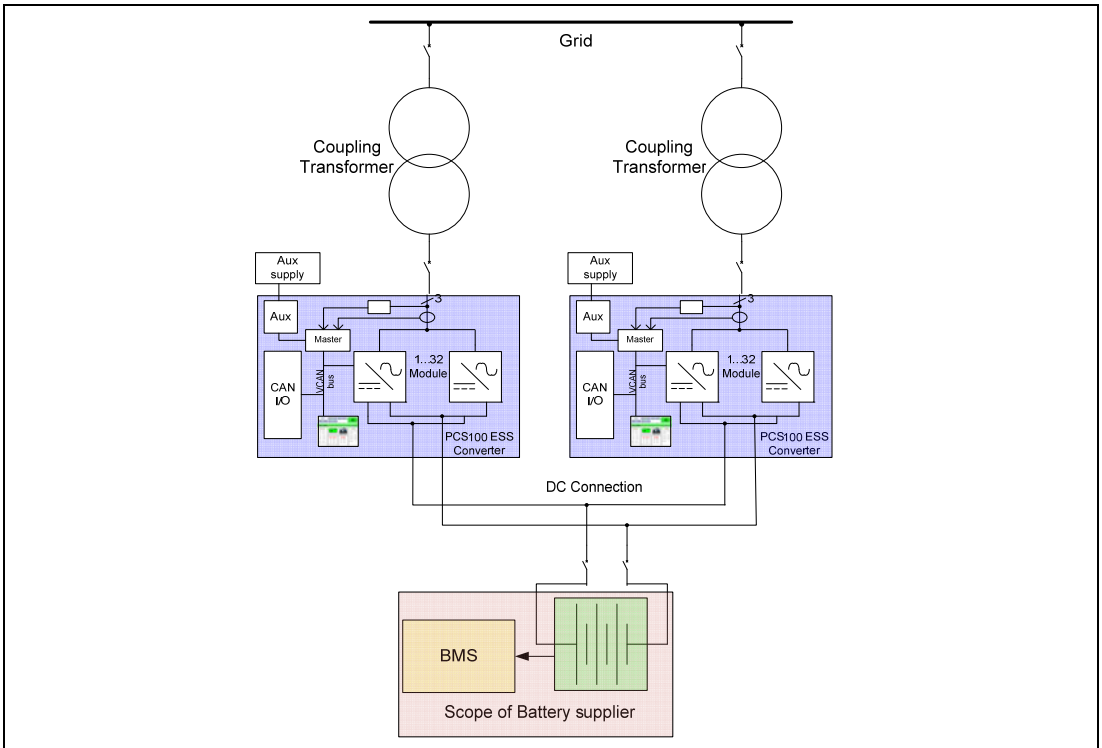
Enables built in n+1 configurations by adding a spare module to achieve breakthrough levels in power availability.

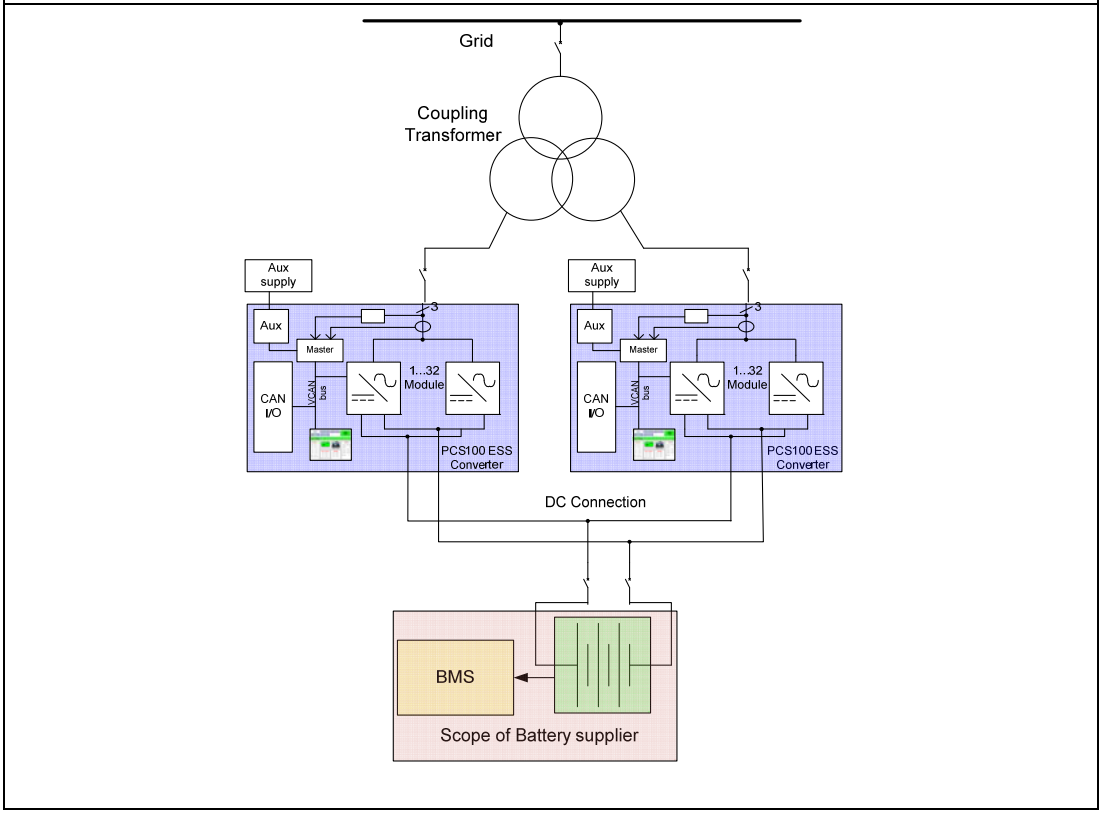
Allows flexible planning of converter repair/faulty module replacement.

Parallel Systems

To achieve larger power ratings PCS100 ESS systems can be operated in parallel. When operating in parallel each ESS system (where a system is one group of power modules controlled by one master controller) must have its own isolated AC connection to the grid.

This can be achieved via dual transformers or a multiple secondary transformer, shown below.

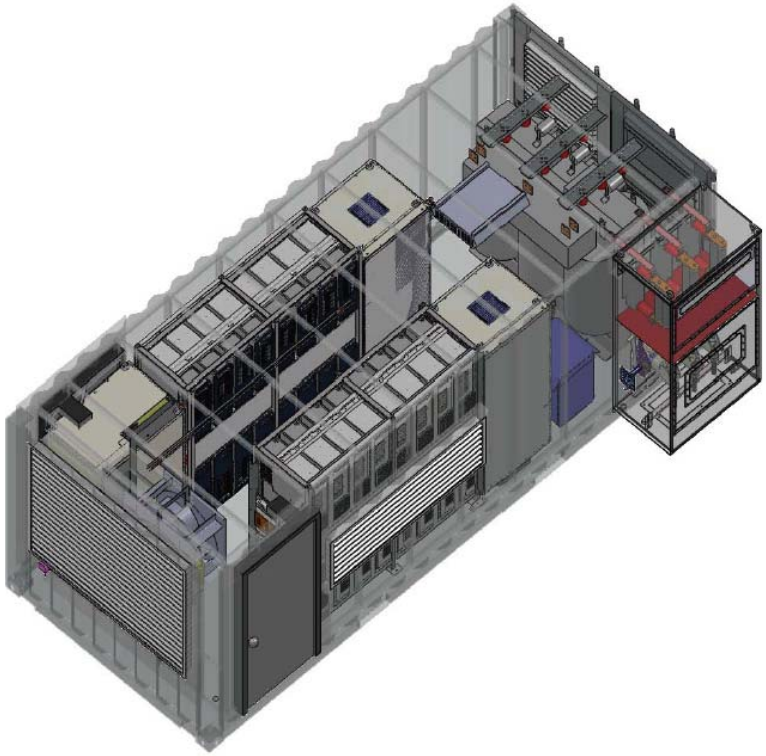




Examples of Systems

PCS100 19-02C A10 +T679
Single ESS cabinet with integrated coupling transformer in the bottom (behind door). Auxiliary supply and master controller with I/O in the top right corner

PCS100 19-06D A10
ESS cabinet with 6 power modules.
Aux. supply and master controller with I/O in the bottom right corner.



Layout for a 2 MVA system with integrated dry type transformer in a 20 foot container

For more information and local contact details please refer to:

www.abb.com/powerelectronics, energy storage & grid stabilization

Power Electronics