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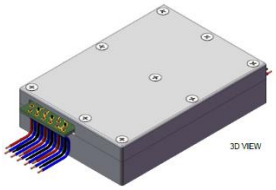
SGBF 19V-40V; 40V-60V; 90V-110V Input 60W output DC/DC converters Space application

Design

The Arc Power 60 W isolated DC/DC converter series is a design, based on European components, made to keep robust performance in the harsh space environment.
The design complies with the derating rules specified in ECSS-Q-ST-30-11C, up to 75°C.
The converter is switching at a fix frequency, in the range 380kHz-420khz, and take the advantages of magnetic feedback (no optocoupler used) resulting in high radiation tolerance levels.
The metal baseplate is designed to dissipate the power reducing the temperature stress on junctions of silicon devices. The case can be fixed to the structure by means of 4 screws to achieve robustness against vibrations, and proper thermal conductivity.
The 60W DC/DC series is equipped with a differential mode filter and doesn't need an additional differential mode filter cell outside the module.
The design documentation includes worst case, part stress analysis, FMEA and reliability prediction. Full manufacturing data package can be delivered together with the hardware.
Customization of input and output voltages available.



Features

- Input voltage options: 19V-40V; 40V-60V; 90V-110V.
- Input fault tolerance 80V (for the 20V-40V and 40V-60V); 120V (for the 90V-110V)
- Operating temperature range: -40°C ÷ +75°C (60W @75°C, within ECSS-Q.ST-30-11C derating rules); -40°C to +125°C without applying derating.
- ON/OFF capability
- Input under-voltage protection with activation hysteresis
- Output over-voltage latching protection
- Over-voltage protection status monitor
- Radiation tolerance[1]:
  - TID: 25kard; 50krad or 100Krad
  - SEE 62 MeV-cm2/mg
- Magnetic coupled feedback
- Integrated Differential Mode Filter
- External frequency synchronization
- Export restriction free
- Trimming of the main output
- Test points to externally test the loop stability

[1] Radiation tolerance based on components screening and unit level analysis.

Block diagram (single output)

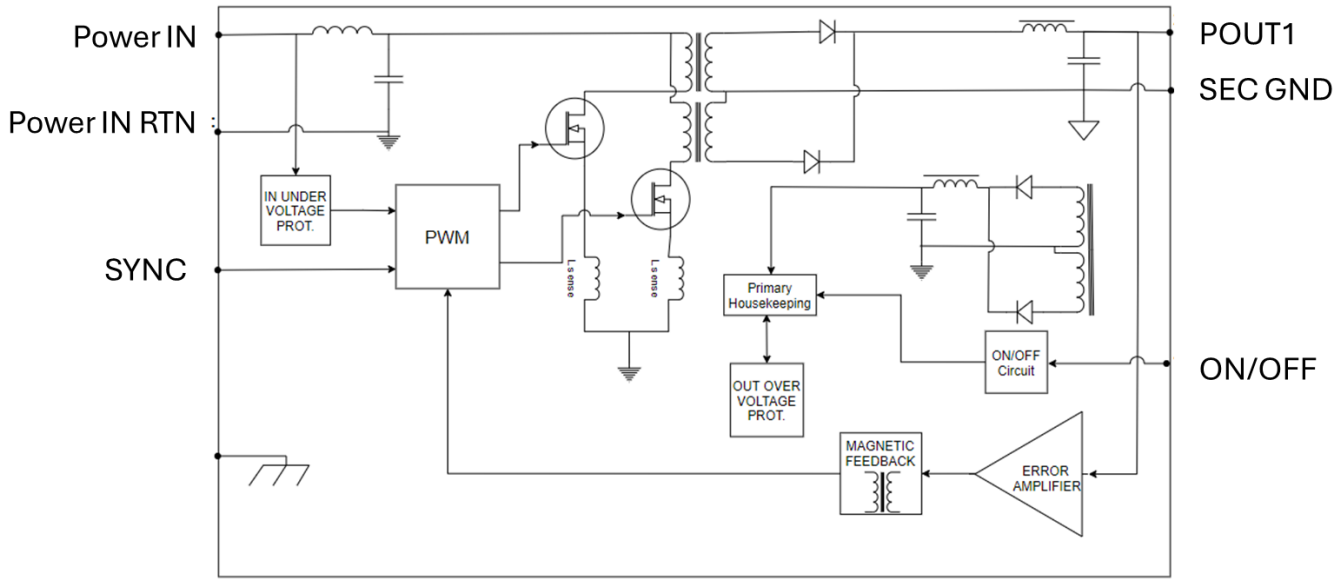


Figure 1: Block Diagram

Electrical characteristics and performances SGBF5012S

Performances in the range [-40°C; +75°C], input voltage 50V, full load (unless otherwise specified).

Parameter	Description	Min	Typ	Max	Unit
Input Section					
Operating input voltage	Continuous	40	50	60	V
Fault input voltage tolerance	Continuous	-	-	80	V
Under voltage lockout	Turn ON	-	-	36	V
	Turn OFF	-	-	35	V
Current Consumption	Inhibited	-	3	7	mA
	No Load	-	40	50	mA

Parameter	Description	Min	Typ	Max	Unit
Ripple current	Full load, 20Hz to 10Mhz	-	5	7	mApp
Output Section					
Output Voltage	T_{CASE} = 25°C	11.95	12.00	12.05	V
	T_{CASE} = -40°C ÷ +75°C	11.90	-	12.10	V
Power		-	-	60	W
Current	Output	0	-	5.0	A
Ripple voltage	Switching frequency	-	15	20	mVpp
Spikes	High frequency		100		mVpp
Line regulation	V_{IN} = 40V to 60V input	-	2	6	mV
Load regulation	No Load to Full Load	-	2	6	mV
Load step output transient	Half Load to Full Load	-	-	300	mV_{PK}
Load step recovery		-	-	0.6	msec
Start up output overshoot	0V to 50V	-	-	0	mV_{PK}
Start up delay	0V to 50V	-	20	25	msec
Functions					
Inhibit	OFF PIN 17 grounded to PRI_GND) (I_sink <0.5mA)	Short to primary ground (or <1V)			V
	ON PIN 17 high impedance or > 9V	Left open (or >9V)			-

Parameter	Description	Min	Typ	Max	Unit
Overvoltage Protection	Activation above nominal output voltage (load output from 15W to 50W)	10	-	30	%
Other data					
Efficiency		-	85	87	%
Capacitive load		0	-	300	µF
Switching frequency (single power switch)	Without external synchronization	190	200	210	kHz
Clock frequency	Without external synchronization	380	400	420	kHz
Isolation (input to output)		10	-	-	MΩ
Storage temperature		-55°C	-	125°C	°C
Soldering temperature		-	-	300	°C

Table 1: Electrical characteristics – SGBF5012S

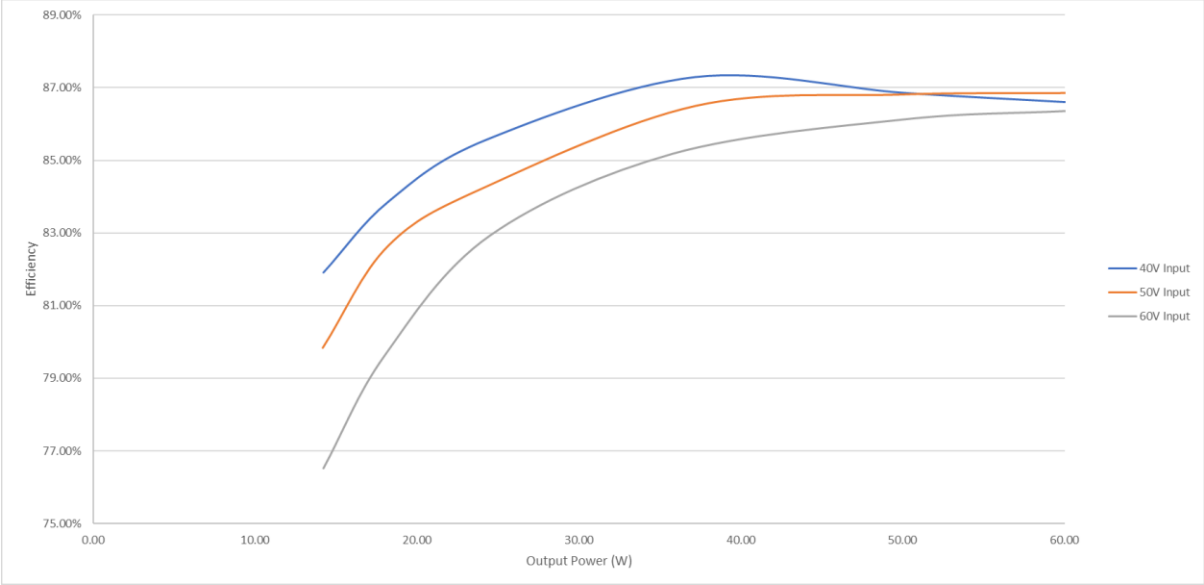


Figure 2: Efficiency curves SGBF5012S

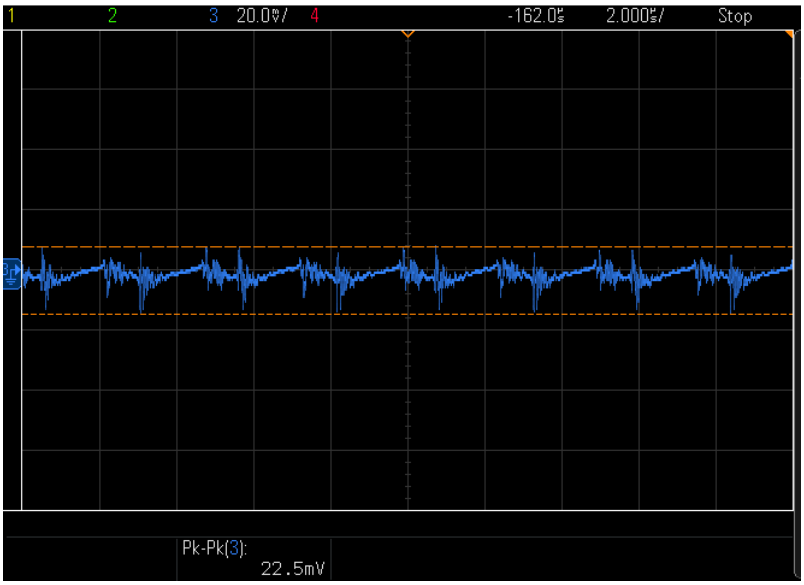


Figure 3: Output voltage ripple, 60W output Power – SGBF5012S

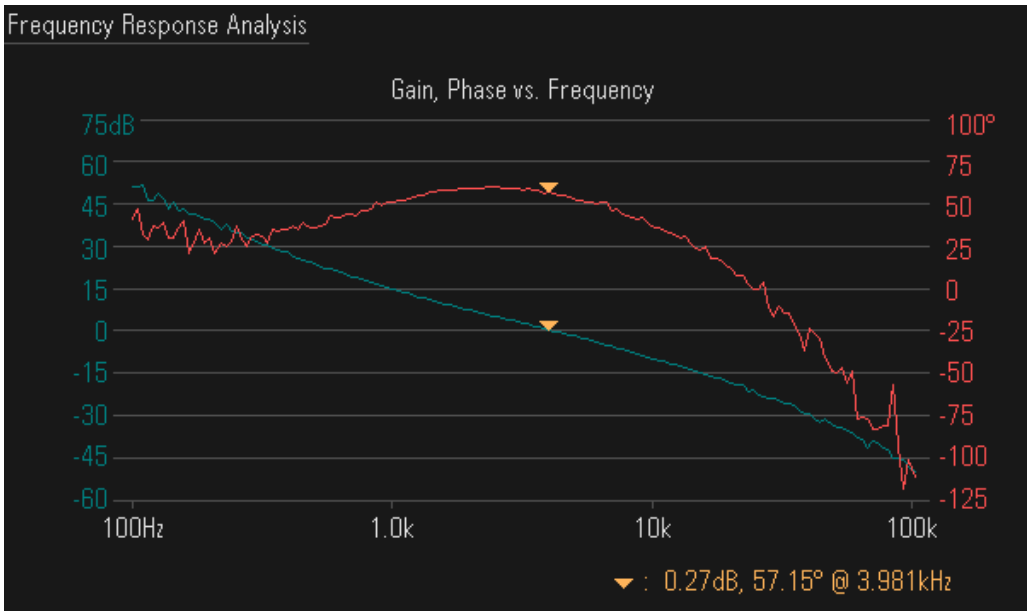


Figure 4: Stability SGBF5012S 15W output Power 50V Input Voltage – SGBF5012S

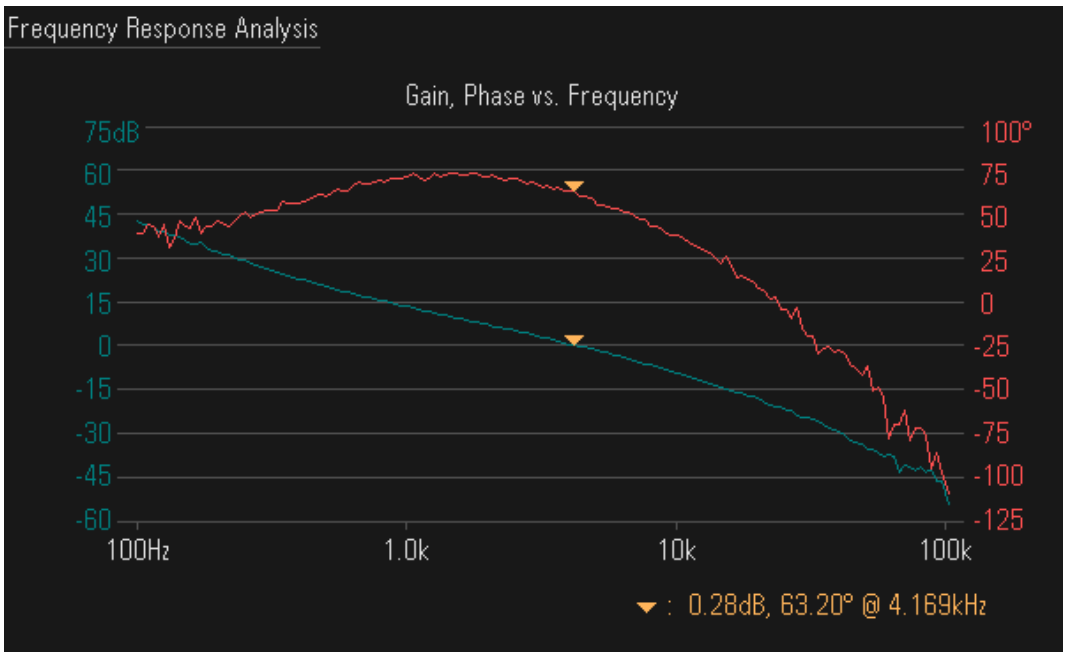


Figure 5: Stability SGBF5012S 60W output Power 50V Input Voltage – SGBF5012S

Electrical characteristics and performances SGBF9912S

Performances in the range [-40°C; +75°C], input voltage 100V, full load (unless otherwise specified).

Parameter	Description	Min	Typ	Max	Unit
Input Section					
Operating input voltage	Continuous	90	100	110	V
Fault input voltage tolerance	Continuous	-	-	120	V
Under voltage lockout	Turn ON	-	-	88	V
	Turn OFF	-	-	86	V
Current Consumption	Inhibited	-	5	7	mA
	No Load	-	40	50	mA
Ripple current	Full load, 20Hz to 10Mhz	-	5	7	mApp
Output Section					
Output Voltage	T_{CASE} = 25°C	11.95	12.00	12.05	V
	T_{CASE} = -40°C ÷ +75°C	11.90	-	12.10	V
Power		-	-	60	W
Current	Output	0	-	5	A
Ripple voltage	Switching frequency	-	15	20	mVpp
Spikes	High frequency		100		mVpp
Line regulation	V_{IN} = 40V to 60V input	-	2	5	mV
Load regulation	No Load to Full Load	-	2	5	mV

Parameter	Description	Min	Typ	Max	Unit
Load step output transient	Half Load to Full Load	-	-	300	mV_{PK}
Load step recovery		-	-	0.6	msec
Start up output overshoot	0V to 100V	-	-	0	mV_{PK}
Start up delay	0V to 100V	-	20	25	msec
Functions					
Inhibit	OFF PIN 17 grounded to PRI_GND) (I_sink <0.5mA)	Short to primary ground (or <1V)			V
	ON PIN 17 high impedance or > 9V	Left open (or >9V)			-
Overvoltage Protection	Activation above nominal output voltage (load output from 15W to 50W)	10	-	25	%
Other data					
Efficiency		-	80	82	%
Capacitive load		0	-	300	µF
Switching frequency	Without external synchronization	380	400	420	kHz
Clock frequency	Without external synchronization	380	400	420	kHz
Isolation (input to output)	500 V_{DC}	10	-	-	MΩ
Storage temperature		-55°C	-	125°C	°C
Soldering temperature		-	-	300	°C

Table 2: Electrical characteristics – SGBF9912S

Mechanical and Electrical Interface:

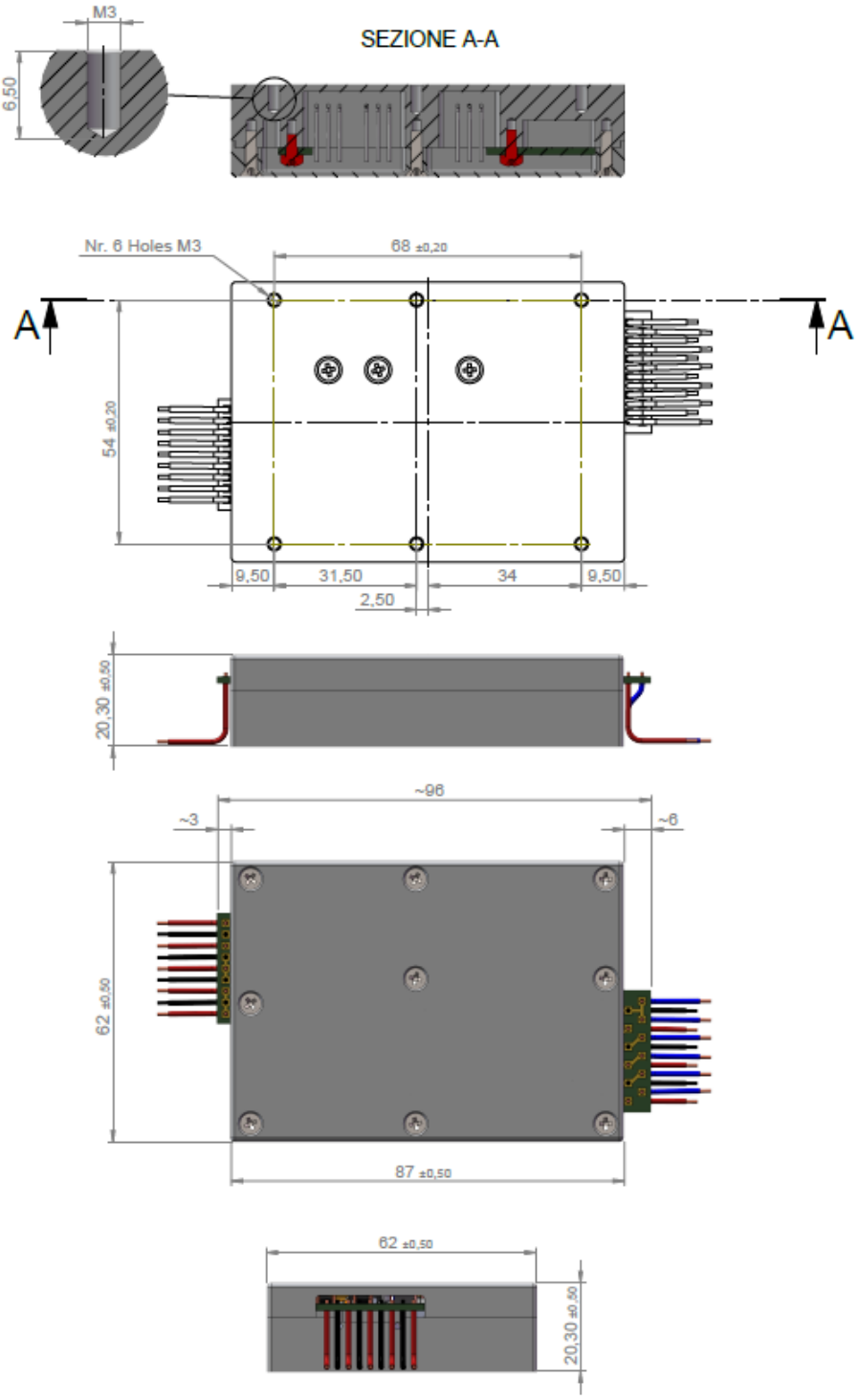
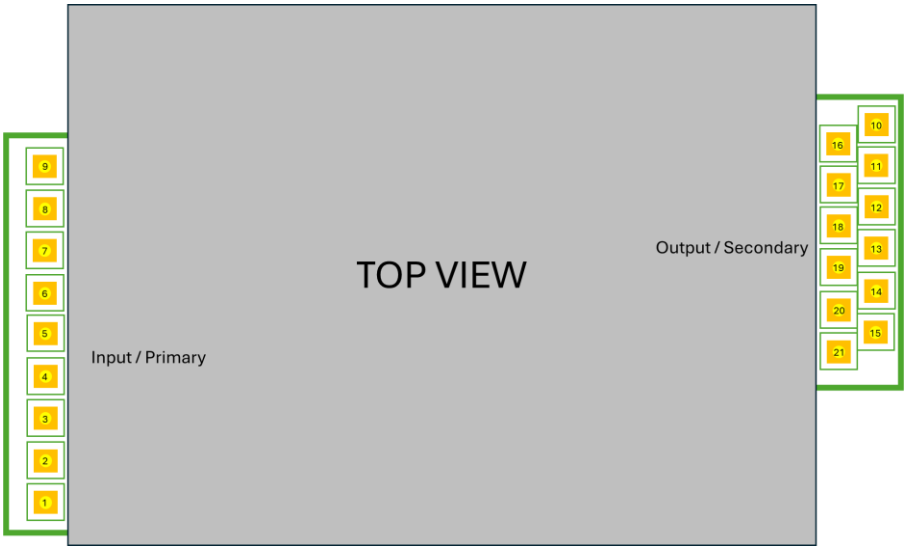


Figure 6: Mechanical Interface

Pin function:



Input/Primary side connections:

Function	Connection number	Interface	Description
Power IN	1, 2, 3	3 x AWG 22	Positive Bus Voltage
Power IN RTN	4,5,6	3 x AWG 22	Bus Voltage Return
SYNC	7	1 x AWG 22	High impedance synchronization signal
OV Status Signal	8	1 x AWG 22	<1V OV protection Not Tripped; 9V to 12V in case the out OV protection has tripped. Leave it floating or acquire with high impedance receiver.
ON/OFF	9	1 x AWG 22	Connect to primary ground=DC/DC OFF; Floating Connection=DC/DC ON

Table 3: Input/primary side electrical interfaces

Output/Secondary side connections:

Function	Connection number	Interface	Description
POUT1	10,11,16	3 x AWG 22	Main output POIUT1
Trimm	15	1 x AWG22	Fine trimming point for POUT1: connect a resistor to POUT1 to decrease the POUT1; connect a resistor to SEC_GND to increase POUT1
POUT2	14,20	2 x AWG22	Positive cross-regulated output POUT2
POUT3	12,18	2 x AWG22	Negative cross-regulated output POUT3
SEC GND	13,17,19	3 x AWG 22	Secondary Ground – return path for the output currents
Loop test	21	1 x AWG22	Test point to measure gain and phase margin

Table 4: Output/Secondary side electrical interfaces

Ordering information:

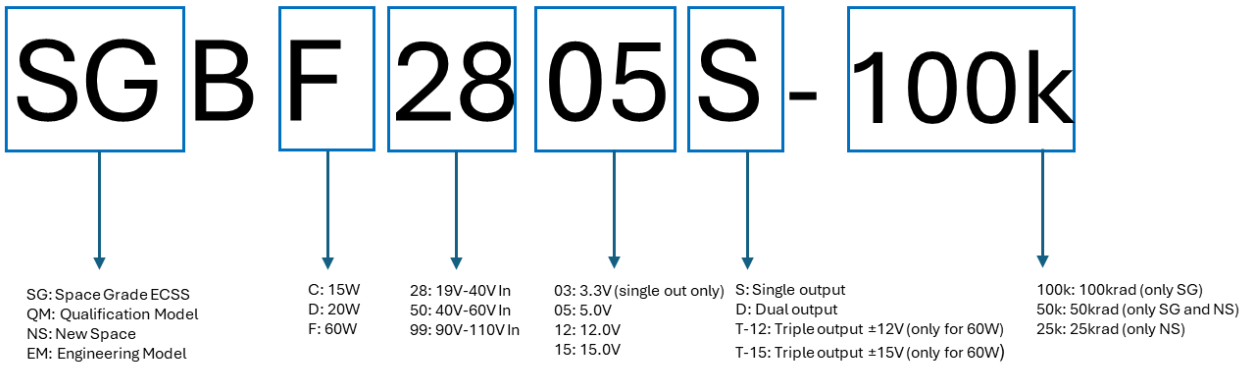


Figure 7: Part Number definition

For **customization of the product** (input voltage range, output voltages, etc.), or additional information please contact info@arc-power.com.

Code Quality Level	Quality Level	Description
SG	Space Grade	Assembly processes ECSS compliant; PCB ESCC level; components ESCC grade 1, JANS, JANTXV; TID test at component level on batch used for the production.
QM	Qualification Model	Assembly processes ECSS compliant; PCB ESCC level, components electrical and mechanical the same as the SG but may have lower level of screening and belongs not to radiation tested batches.
NS	New Space	IPC Class 3 assembly processes; PCB IPC Class 3; Components not individually screened or procured according to automotive specification. The full assembly is screened by means of thermal cycling: • Number of cycles:10 • Temperature: -35°C / +80°C • Ramp up & down: 4°C/min. • Dwell time: 20 minutes Components batches not TID tested if the technology has proven TID performances with at least 100% margin on the program TID requirements. Available NS 25krad and 50krad options.
EM	Engineering Model	Mechanical and electrical equivalent to the other quality levels but not screened at component or DC/DC module level. Not suitable for vacuum test. Assembled with industrial standard. Recommended for early prototyping.

Table 5: Quality level codes

Commercial Part Number	Input Bus	Output Voltages	Maximum Power	TID (Krad)	Level
SGBF2805S-100k	19V-40V	5V	50W	100	Space Grade
SGBF2812S-100k	19V-40V	12V	60W	100	Space Grade
SGBF2815S-100k	19V-40V	15V	60W	100	Space Grade
SGBF2805D-100k	19V-40V	5V; -5V	50W	100	Space Grade
SGBF2812S-100k	19V-40V	12V; -12V	60W	100	Space Grade
SGBF2815S-100k	19V-40V	15V; -15V	60W	100	Space Grade
SGBF2803T-12-100k	19V-40V	3.3V; 12V; -12V	50W	100	Space Grade
SGBF2803T-15-100k	19V-40V	3.3V; 15V; -15V	50W	100	Space Grade
SGBF2805T-12-100k	19V-40V	5V; 12V; -12V	60W	100	Space Grade
SGBF2805T-15-100k	19V-40V	5V; 15V; -15V	60W	100	Space Grade
SGBF5005S-100k	40V-60V	5V	50W	100	Space Grade
SGBF5012S-100k	40V-60V	12V	60W	100	Space Grade
SGBF5015S-100k	40V-60V	15V	60W	100	Space Grade
SGBF5005D-100k	40V-60V	5V; -5V	50W	100	Space Grade
SGBF5012S-100k	40V-60V	12V; -12V	60W	100	Space Grade
SGBF5015S-100k	40V-60V	15V; -15V	60W	100	Space Grade
SGBF5003T-12-100k	40V-60V	3.3V; 12V; -12V	50W	100	Space Grade
SGBF5003T-15-100k	40V-60V	3.3V; 15V; -15V	50W	100	Space Grade
SGBF5005T-12-100k	40V-60V	5V; 12V; -12V	60W	100	Space Grade
SGBF5005T-15-100k	40V-60V	5V; 15V; -15V	60W	100	Space Grade
SGBF9905S-100k	90V-110V	5V	50W	100	Space Grade
SGBF9912S-100k	90V-110V	12V	60W	100	Space Grade
SGBF9915S-100k	90V-110V	15V	60W	100	Space Grade
SGBF9905D-100k	90V-110V	5V; -5V	50W	100	Space Grade
SGBF9912S-100k	90V-110V	12V; -12V	60W	100	Space Grade
SGBF9915S-100k	90V-110V	15V; -15V	60W	100	Space Grade
SGBF9903T-12-100k	90V-110V	3.3V; 12V; -12V	50W	100	Space Grade
SGBF9903T-15-100k	90V-110V	3.3V; 15V; -15V	50W	100	Space Grade
SGBF9905T-12-100k	90V-110V	5V; 12V; -12V	60W	100	Space Grade
SGBF9905T-15-100k	90V-110V	5V; 15V; -15V	60W	100	Space Grade
QMBF2805S	19V-40V	5V	50W	-	Qualification Model
QMBF2812S	19V-40V	12V	60W	-	Qualification Model
QMBF2815S	19V-40V	15V	60W	-	Qualification Model

Commercial Part Number	Input Bus	Output Voltages	Maximum Power	TID (Krad)	Level
QMBF2805D	19V-40V	5V; -5V	50W	-	Qualification Model
QMBF2812S	19V-40V	12V; -12V	60W	-	Qualification Model
QMBF2815S	19V-40V	15V; -15V	60W	-	Qualification Model
QMBF2803T-12	19V-40V	3.3V; 12V; -12V	50W	-	Qualification Model
QMBF2803T-15	19V-40V	3.3V; 15V; -15V	50W	-	Qualification Model
QMBF2805T-12	19V-40V	5V; 12V; -12V	60W	-	Qualification Model
QMBF2805T-15	19V-40V	5V; 15V; -15V	60W	-	Qualification Model
QMBF5005S	40V-60V	5V	50W	-	Qualification Model
QMBF5012S	40V-60V	12V	60W	-	Qualification Model
QMBF5015S	40V-60V	15V	60W	-	Qualification Model
QMBF5005D	40V-60V	5V; -5V	50W	-	Qualification Model
QMBF5012S	40V-60V	12V; -12V	60W	-	Qualification Model
QMBF5015S	40V-60V	15V; -15V	60W	-	Qualification Model
QMBF5003T-12	40V-60V	3.3V; 12V; -12V	50W	-	Qualification Model
QMBF5003T-15	40V-60V	3.3V; 15V; -15V	50W	-	Qualification Model
QMBF5005T-12	40V-60V	5V; 12V; -12V	60W	-	Qualification Model
QMBF5005T-15	40V-60V	5V; 15V; -15V	60W	-	Qualification Model
QMBF9905S	90V-110V	5V	50W	-	Qualification Model
QMBF9912S	90V-110V	12V	60W	-	Qualification Model
QMBF9915S	90V-110V	15V	60W	-	Qualification Model
QMBF9905D	90V-110V	5V; -5V	50W	-	Qualification Model

Commercial Part Number	Input Bus	Output Voltages	Maximum Power	TID (Krad)	Level
QMBF9912S	90V-110V	12V; -12V	60W	-	Qualification Model
QMBF9915S	90V-110V	15V; -15V	60W	-	Qualification Model
QMBF9903T-12	90V-110V	3.3V; 12V; -12V	50W	-	Qualification Model
QMBF9903T-15	90V-110V	3.3V; 15V; -15V	50W	-	Qualification Model
QMBF9905T-12	90V-110V	5V; 12V; -12V	60W	-	Qualification Model
QMBF9905T-15	90V-110V	5V; 15V; -15V	60W	-	Qualification Model
EMBF2805S	19V-40V	5V	50W	-	Engineering Model
EMBF2812S	19V-40V	12V	60W	-	Engineering Model
EMBF2815S	19V-40V	15V	60W	-	Engineering Model
EMBF2805D	19V-40V	5V; -5V	50W	-	Engineering Model
EMBF2812S	19V-40V	12V; -12V	60W	-	Engineering Model
EMBF2815S	19V-40V	15V; -15V	60W	-	Engineering Model
EMBF2803T-12	19V-40V	3.3V; 12V; -12V	50W	-	Engineering Model
EMBF2803T-15	19V-40V	3.3V; 15V; -15V	50W	-	Engineering Model
EMBF2805T-12	19V-40V	5V; 12V; -12V	60W	-	Engineering Model
EMBF2805T-15	19V-40V	5V; 15V; -15V	60W	-	Engineering Model
EMBF5005S	40V-60V	5V	50W	-	Engineering Model
EMBF5012S	40V-60V	12V	60W	-	Engineering Model
EMBF5015S	40V-60V	15V	60W	-	Engineering Model
EMBF5005D	40V-60V	5V; -5V	50W	-	Engineering Model
EMBF5012S	40V-60V	12V; -12V	60W	-	Engineering Model
EMBF5015S	40V-60V	15V; -15V	60W	-	Engineering Model
EMBF5003T-12	40V-60V	3.3V; 12V; -12V	50W	-	Engineering Model
EMBF5003T-15	40V-60V	3.3V; 15V; -15V	50W	-	Engineering Model
EMBF5005T-12	40V-60V	5V; 12V; -12V	60W	-	Engineering Model
EMBF5005T-15	40V-60V	5V; 15V; -15V	60W	-	Engineering Model
EMBF9905S	90V-110V	5V	50W	-	Engineering Model
EMBF9912S	90V-110V	12V	60W	-	Engineering Model
EMBF9915S	90V-110V	15V	60W	-	Engineering Model
EMBF9905D	90V-110V	5V; -5V	50W	-	Engineering Model
EMBF9912S	90V-110V	12V; -12V	60W	-	Engineering Model
EMBF9915S	90V-110V	15V; -15V	60W	-	Engineering Model

Commercial Part Number	Input Bus	Output Voltages	Maximum Power	TID (Krad)	Level
EMBF9903T-12	90V-110V	3.3V; 12V; -12V	50W	-	Engineering Model
EMBF9903T-15	90V-110V	3.3V; 15V; -15V	50W	-	Engineering Model
EMBF9905T-12	90V-110V	5V; 12V; -12V	60W	-	Engineering Model
EMBF9905T-15	90V-110V	5V; 15V; -15V	60W	-	Engineering Model
NSBF2805S-50k	19V-40V	5V	50W	50	New Space
NSBF2812S-50k	19V-40V	12V	60W	50	New Space
NSBF2815S-50k	19V-40V	15V	60W	50	New Space
NSBF2805D-50k	19V-40V	5V; -5V	50W	50	New Space
NSBF2812S-50k	19V-40V	12V; -12V	60W	50	New Space
NSBF2815S-50k	19V-40V	15V; -15V	60W	50	New Space
NSBF2803T-12-50k	19V-40V	3.3V; 12V; -12V	50W	50	New Space
NSBF2803T-15-50k	19V-40V	3.3V; 15V; -15V	50W	50	New Space
NSBF2805T-12-50k	19V-40V	5V; 12V; -12V	60W	50	New Space
NSBF2805T-15-50k	19V-40V	5V; 15V; -15V	60W	50	New Space
NSBF5005S-50k	40V-60V	5V	50W	50	New Space
NSBF5012S-50k	40V-60V	12V	60W	50	New Space
NSBF5015S-50k	40V-60V	15V	60W	50	New Space
NSBF5005D-50k	40V-60V	5V; -5V	50W	50	New Space
NSBF5012S-50k	40V-60V	12V; -12V	60W	50	New Space
NSBF5015S-50k	40V-60V	15V; -15V	60W	50	New Space
NSBF5003T-12-50k	40V-60V	3.3V; 12V; -12V	50W	50	New Space
NSBF5003T-15-50k	40V-60V	3.3V; 15V; -15V	50W	50	New Space
NSBF5005T-12-50k	40V-60V	5V; 12V; -12V	60W	50	New Space
NSBF5005T-15-50k	40V-60V	5V; 15V; -15V	60W	50	New Space
NSBF9905S-50k	90V-110V	5V	50W	50	New Space
NSBF9912S-50k	90V-110V	12V	60W	50	New Space
NSBF9915S-50k	90V-110V	15V	60W	50	New Space
NSBF9905D-50k	90V-110V	5V; -5V	50W	50	New Space
NSBF9912S-50k	90V-110V	12V; -12V	60W	50	New Space
NSBF9915S-50k	90V-110V	15V; -15V	60W	50	New Space
NSBF9903T-12-50k	90V-110V	3.3V; 12V; -12V	50W	50	New Space
NSBF9903T-15-50k	90V-110V	3.3V; 15V; -15V	50W	50	New Space
NSBF9905T-12-50k	90V-110V	5V; 12V; -12V	60W	50	New Space
NSBF9905T-15-50k	90V-110V	5V; 15V; -15V	60W	50	New Space

Commercial Part Number	Input Bus	Output Voltages	Maximum Power	TID (Krad)	Level
NSBF2805S-25k	19V-40V	5V	50W	25	New Space
NSBF2812S-25k	19V-40V	12V	60W	25	New Space
NSBF2815S-25k	19V-40V	15V	60W	25	New Space
NSBF2805D-25k	19V-40V	5V; -5V	50W	25	New Space
NSBF2812S-25k	19V-40V	12V; -12V	60W	25	New Space
NSBF2815S-25k	19V-40V	15V; -15V	60W	25	New Space
NSBF2803T-12-25k	19V-40V	3.3V; 12V; -12V	50W	25	New Space
NSBF2803T-15-25k	19V-40V	3.3V; 15V; -15V	50W	25	New Space
NSBF2805T-12-25k	19V-40V	5V; 12V; -12V	60W	25	New Space
NSBF2805T-15-25k	19V-40V	5V; 15V; -15V	60W	25	New Space
NSBF5005S-25k	40V-60V	5V	50W	25	New Space
NSBF5012S-25k	40V-60V	12V	60W	25	New Space
NSBF5015S-25k	40V-60V	15V	60W	25	New Space
NSBF5005D-25k	40V-60V	5V; -5V	50W	25	New Space
NSBF5012S-25k	40V-60V	12V; -12V	60W	25	New Space
NSBF5015S-25k	40V-60V	15V; -15V	60W	25	New Space
NSBF5003T-12-25k	40V-60V	3.3V; 12V; -12V	50W	25	New Space
NSBF5003T-15-25k	40V-60V	3.3V; 15V; -15V	50W	25	New Space
NSBF5005T-12-25k	40V-60V	5V; 12V; -12V	60W	25	New Space
NSBF5005T-15-25k	40V-60V	5V; 15V; -15V	60W	25	New Space
NSBF9905S-25k	90V-110V	5V	50W	25	New Space
NSBF9912S-25k	90V-110V	12V	60W	25	New Space
NSBF9915S-25k	90V-110V	15V	60W	25	New Space
NSBF9905D-25k	90V-110V	5V; -5V	50W	25	New Space
NSBF9912S-25k	90V-110V	12V; -12V	60W	25	New Space
NSBF9915S-25k	90V-110V	15V; -15V	60W	25	New Space
NSBF9903T-12-25k	90V-110V	3.3V; 12V; -12V	50W	25	New Space
NSBF9903T-15-25k	90V-110V	3.3V; 15V; -15V	50W	25	New Space
NSBF9905T-12-25k	90V-110V	5V; 12V; -12V	60W	25	New Space
NSBF9905T-15-25k	90V-110V	5V; 15V; -15V	60W	25	New Space

Table 6: Available 60W-50W DC/DC converters modules