

How to use the 2 kW two-channel interleaved PFC based on the STNRGPF12 digital controller

Introduction

The STEVAL-IPFC12V1 2 kW interleaved PFC kit is based on the [STNRGPF12](#) digital controller and consists of a power board, control board and adapter board. The [STNRGPF12](#) is a digital configurable ASIC developed by STMicroelectronics, which can drive up to two channels in an interleaved PFC for industrial applications.

The [STNRGPF12](#) digital controller on the control board implements mixed signal (analog/digital) average current mode control in CCM at fixed frequency. The analog section ensures cycle-by-cycle current regulation, while digital control manages the non-time-critical operations. You can use the [eDesignSuite](#) software available on the ST website to configure the [STNRGPF12](#) to satisfy the specifications of each interleaved PFC.

Figure 1. STEVAL-IPFC12V1 evaluation kit with power, control and adapter boards



1 Safety instructions

Danger:

The evaluation board uses voltage levels that can cause serious injury and even death.

Do not touch any components immediately after disconnecting the input power supply as the charged capacitors need time to discharge.

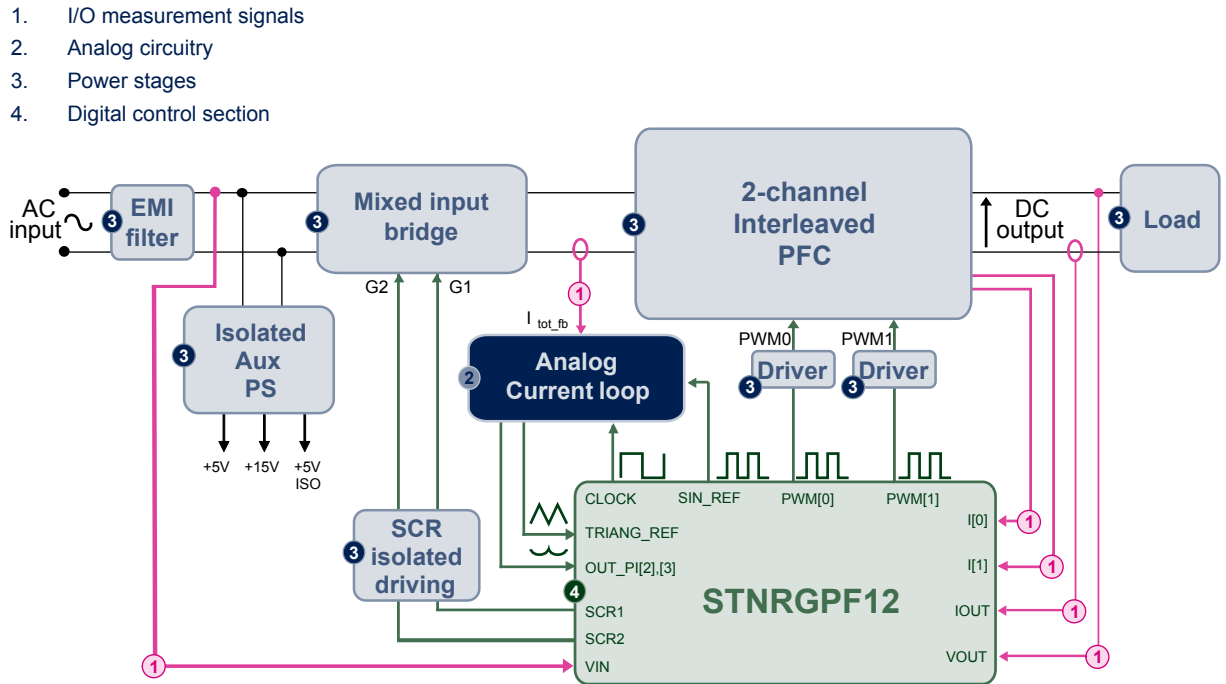
Due to the high power density, board components and heat sinks can become very hot and cause severe burns when touched.

This board is intended for use by skilled technical personnel who are suitably qualified and familiar with the installation, use and maintenance of power electronic systems. The same personnel must be aware of and must apply national accident prevention rules.

The electrical installation shall be completed in accordance with the appropriate requirements (e.g., cross-sectional areas of conductors, fusing, and GND connections).

2 STEVAL-IPFC12V1 evaluation kit overview

Figure 2. STEVAL-IPFC12V1 block diagram



The STEVAL-IPFC12V1 implements mixed signal (analog/digital) control, combining the flexibility of a programmable high end digital solution with the responsiveness and accuracy of analog componentry. The inner current loop consists of an analog proportional-integral (PI) compensator that ensures the highest possible bandwidth and cycle-by-cycle regulation. The outer voltage loop is performed by a digital PI controller with fast dynamic response.

2.1 Board features

The 2 kW interleaved PFC evaluation kit features:

- A modular design with the following separate boards:
 - STEVAL-IPFC12P1 power board
 - STEVAL-IPFC12C1 control board
 - STEVAL-IPFC01A1 adapter board
- 2-channel interleaved PFC
- Input voltage range: 90 to 265 V_{AC} (50 or 60 Hz)
- Maximum output power: 2 kW at 230 V_{AC}; 1 kW at 115 V_{AC};
- Output voltage: 400 V
- Fixed frequency average current mode control and CCM operation
- Mixed-signal, semi-digital approach
- Programmable phase shedding
- Cooling System management
- Programmable fast overcurrent and thermal protection
- Digital inrush current limiter function performed with relay
- Soft startup and burst mode management
- Load current and input voltage feed forward
- Channel current balance function

- Two status LEDs to signal nominal and fault conditions
- Browser GUI tool ([eDesignSuite](#)) for driver customization
- Serial communication port for
 - [STNRGPF12](#) programming
 - PFC parameter monitoring

3 How to use the STEVAL-IPFC12V1 evaluation board

To perform functional and efficiency testing, you need the following equipment:

- Programmable AC source with power > 2 kW
- DC electronic load or load resistor > 2 kW
- Power analyzer
- Digital oscilloscope

The STEVAL-IPFC12V1 board can be tested up to 2 kW at 230 V_{RMS} and 1 kW at 115 V_{RMS}, in a frequency range between 47 and 63 Hz.

Note: Any load or passive oscilloscope probe must be isolated from the input source of the PFC.

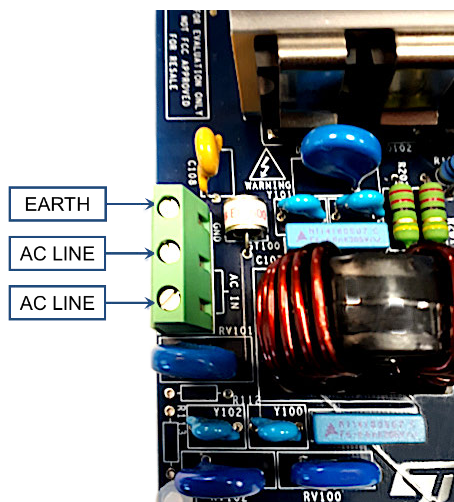
3.1 How to connect and start the STEVAL-IPFC12P1 power board

Step 1. Insert the STEVAL-IPFC12C1 control board in connector J301 on the STEVAL-IPFC12P1 power board.

Step 2. Connect one of the following AC supplies to the J100 connector on the STEVAL-IPFC12P1 power board:

- 230 V at 50 Hz
- 115 V at 60 Hz

Figure 3. STEVAL-IPFC12P1 AC supply connection



- Step 3.** Connect the load wires to the output terminals on J300 of the STEVAL-IPFC12P1 power board. The actual load (electronic dc load, load resistors, inverter, etc.) must remain disconnected until the soft startup sequence has completed. The correct polarity is indicated on the board.

Figure 4. STEVAL-IPFC12P1 DC output connection



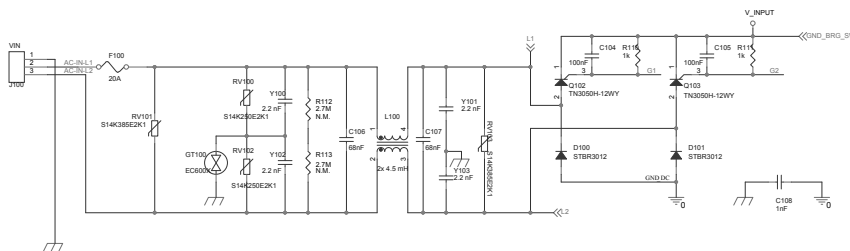
- Step 4.** Supply one of the following input voltage and frequency ranges while no load is connected on the output:
- 185 – 265 V_{AC} at 47 - 53 Hz
 - 90 – 140 V_{AC} at 57 – 63 Hz

3.1.1

STEVAL-IPFC12P1 power board startup sequence

1. The appropriate AC input voltage is applied under a no load condition.
2. When the input voltage rises above 60 V, the auxiliary power supply starts and generates the auxiliary voltages (15 V_{DC} and 5 V_{DC}) for the drivers and the signal conditioning circuitry.
3. Once the auxiliary voltages are nominal, the inrush current limiter phase begins by charging the output capacitor until the DC voltage reaches the peak input voltage. The current is limited by the SCRs Q102 and Q103.

Figure 5. STEVAL-IPFC12P1 input section



4. The **STNRGPF12** then checks for any output current flow:
 - If there is no current, the **STNRGPF12** closes the contacts of a mechanical relay in parallel with resistor R101.
 - If any current is detected, the **STNRGPF12** will keep the relay contacts on R300 open (so the board cannot start) until the current falls to zero.
5. After the inrush limiter phase, the soft startup procedure is activated and the output voltage rises up to 436 VDC, at which point the PFC enters burst mode to regulate the output voltage between 416 and 436 VDC.
6. The green LED D2 on the control board indicates when the sequence has finished and the PFC is ready for the load to be connected.

7. Once you connect the load:
 - the output voltage is regulated to 400 V $\pm$ 2 V.
 - for 185 – 265 V 50 Hz mains, the maximum output power is 2000 W
 - for 90 – 140 V 60 Hz mains, the maximum output power is 1000 W

4 PFC controller customization with eDesign Suite

The eDesignSuite suite software tool developed by STMicroelectronics helps you configure ST products power conversion applications. You can use it to customize the PFC controller for a specific application: you start by entering the main specifications for your design and then generate an automatic design or follow a sequential process to build a highly customized design.

Figure 6. PFC specifications

The screenshot shows the 'Design Wizard' window with the 'IPFC Specifications' tab selected. The window is divided into a left sidebar with 'Design Steps' and a main area for 'IPFC Specifications'.

Design Steps:

- IPFC Specifications (selected)
- Input Stage
- Boost Inductor
- Power Switch
- Boost Diode
- Output Stage
- Input Voltage Sensing
- Input Current Sensing
- Switch Current Sensing
- Input Over Current Protection
- Output Voltage Sensing
- Output Current Sensing
- Triangular Waveform Generator
- Current Control Loop
- Voltage Control Loop
- Additional Features

IPFC Specifications:

Mains: EU Range Line -> Neutral

Parameter	min	max
Voltage range	185 Vac	265 Vac
Frequency range	47 Hz	53 Hz
Nominal Voltages	230 vac	2nd vac

Output:

Nominal Output Voltage	400 V
Maximum Power or Current	2000 W
Output Voltage Ripple	20 vpp
Hold-up time	20 ms
Minimum Voltage after line drop	300 V
Maximum Voltage	448 V

Other Parameters:

Number of interleaved Channels	2
Switching Frequency or Period	60 kHz
Inductor Current Ripple Percentage	55 %
Expected Power Factor	0.99
Expected Average Efficiency	97 %

At the bottom of the window, there are buttons for 'Prev', 'Next', 'Auto Complete', and 'Cancel'.

Figure 7. PFC step-by-step design



RELATED LINKS

See RM0446 for details on how to use eDesignSuite to generate specialized firmware

5 Status LEDs and fault conditions

The STEVAL-IPFC12C1 control board has the following status LEDs:

- a green LED connected to STNRGPF12 pin 15 (PFC_OK)
- a red LED connected to STNRGPF12 pin 14 (PFC_FAULT)

5.1 Normal operation

During normal operation, the green LED (D1) on the STEVAL-IPFC12C1 control board remains lit to indicate that the PFC is operating under allowable conditions.

5.2 Fault conditions

When a fault is detected, the red LED (D2) on the STEVAL-IPFC12C1 control board lights up and the green LED (D1) turns off. The device stops all switching activities and turns off the fan.

After a fault condition, the board must be reset by switching off the AC input voltage and discharging the output capacitors.

Note:

Warning: Do not short the output terminals to discharge the capacitors as the high discharge current may damage the output current sensing circuitry.

The following conditions will trigger a fault protection:

- A mismatch between frequency and voltage or highly distorted input voltage waveforms that inhibit frequency measurement. For example, if the input voltage is 230 V_{RMS} but the mains frequency is 60 Hz, or if the input voltage is 115 V_{RMS} and the mains frequency is 50 Hz.
- Overcurrent condition on at least one PFC channel. This protection prevents PFC inductor saturation.
- Overvoltage protection on output voltage if the output voltage exceeds 440 V_{DC}
- Overvoltage protection on input voltage:
 - for 115 V nominal supply: above 140 V
 - for 230 V nominal supply: above 265 V
- Over-temperature protection when the ambient temperature of the board exceeds the threshold setting.

5.3 Wait conditions

In addition to the conditions that trigger PFC_OK and PFC_FAULT, there are other conditions that are indicated with both LEDs are off:

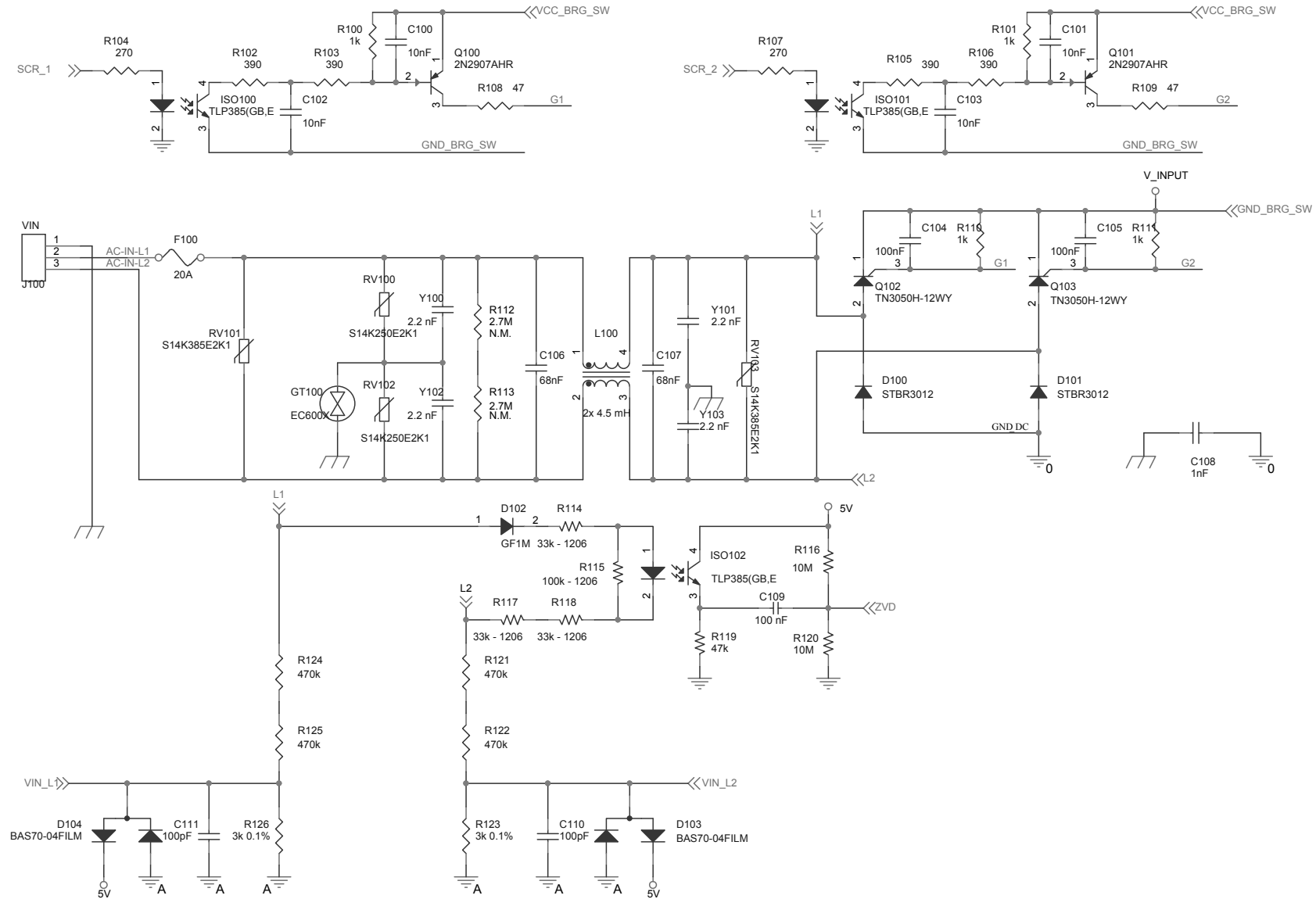
- Undervoltage condition on the output when the DC bus voltage falls below 340 V.
- Undervoltage condition on input when the input rms voltage falls below 90 V at 60 Hz or 185 V at 50 Hz.
- Input voltage dropout when the input voltage signal disappears for more than 25 ms.

Under these conditions, the STNRGPF12 will drive both LEDs on the control board off and will wait until the conditions have cleared before repeating the startup sequence.

6 STEVAL-IPFC12V1 schematic diagrams

6.1 STEVAL-IPFC12P1 power board schematics

Figure 8. STEVAL-IPFC12P1 schematic - input section



STEVAL-IPFC12P1 power board schematics

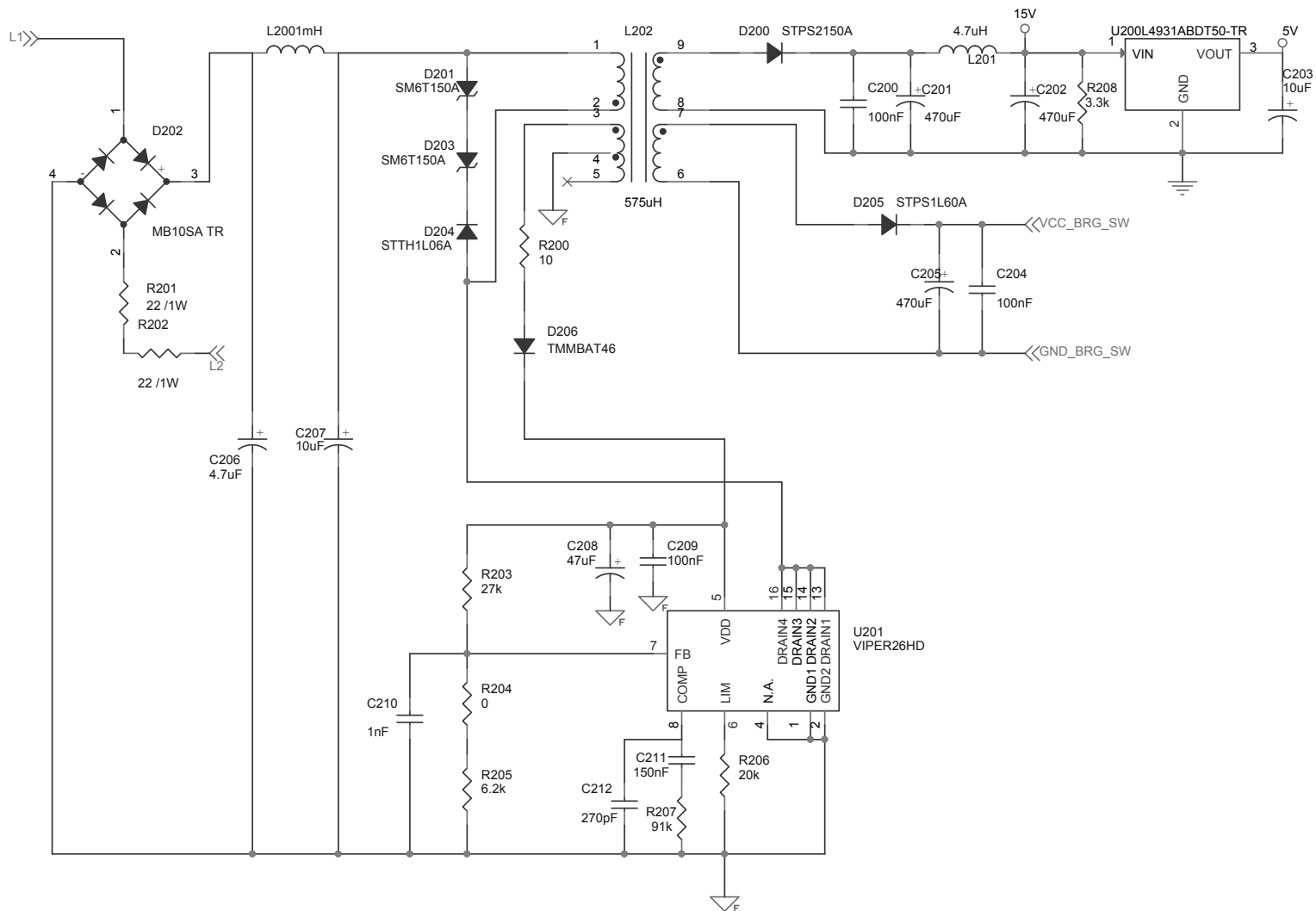


Figure 10. STEVAL-IPFC12P1 schematic - boost interleaving section

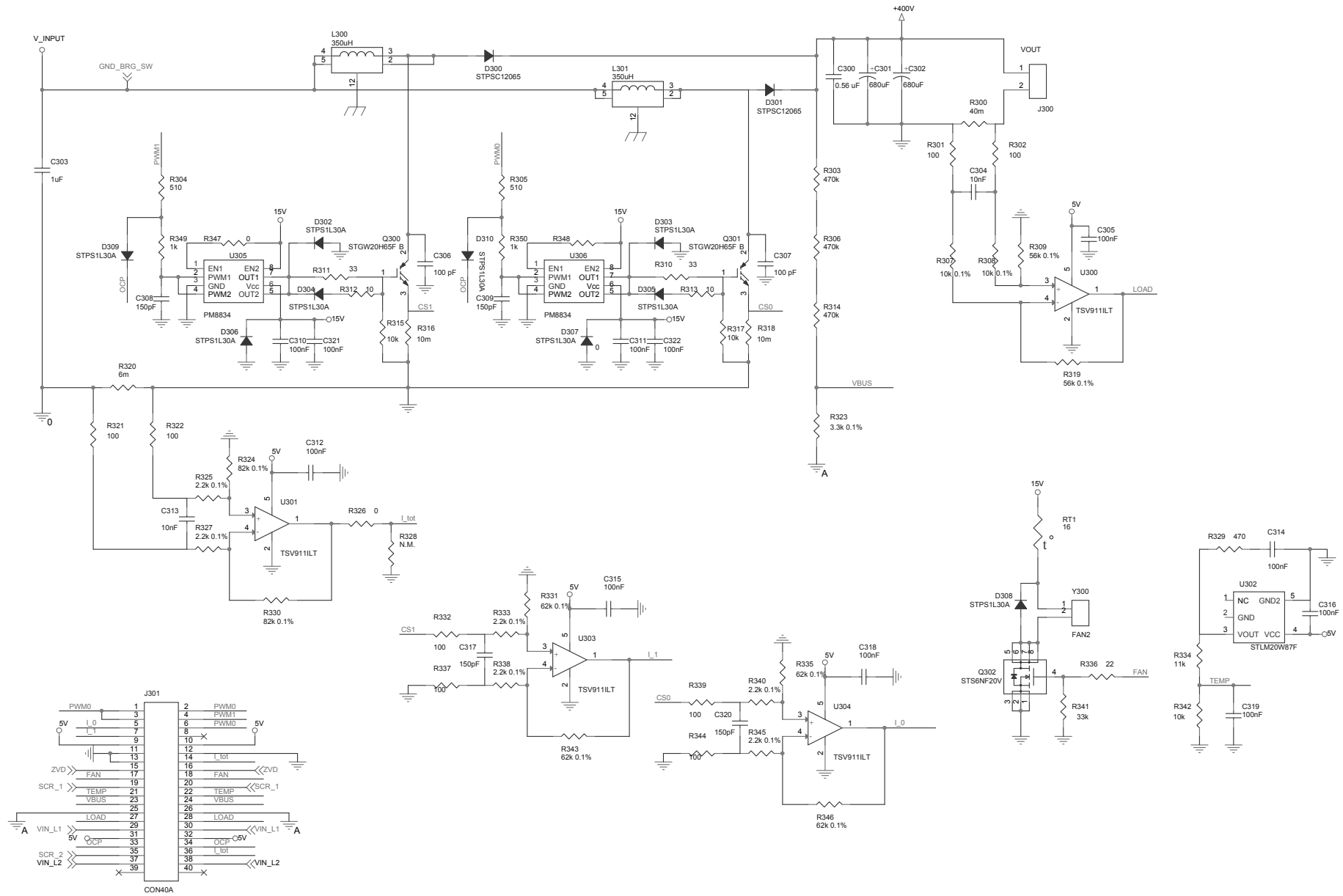
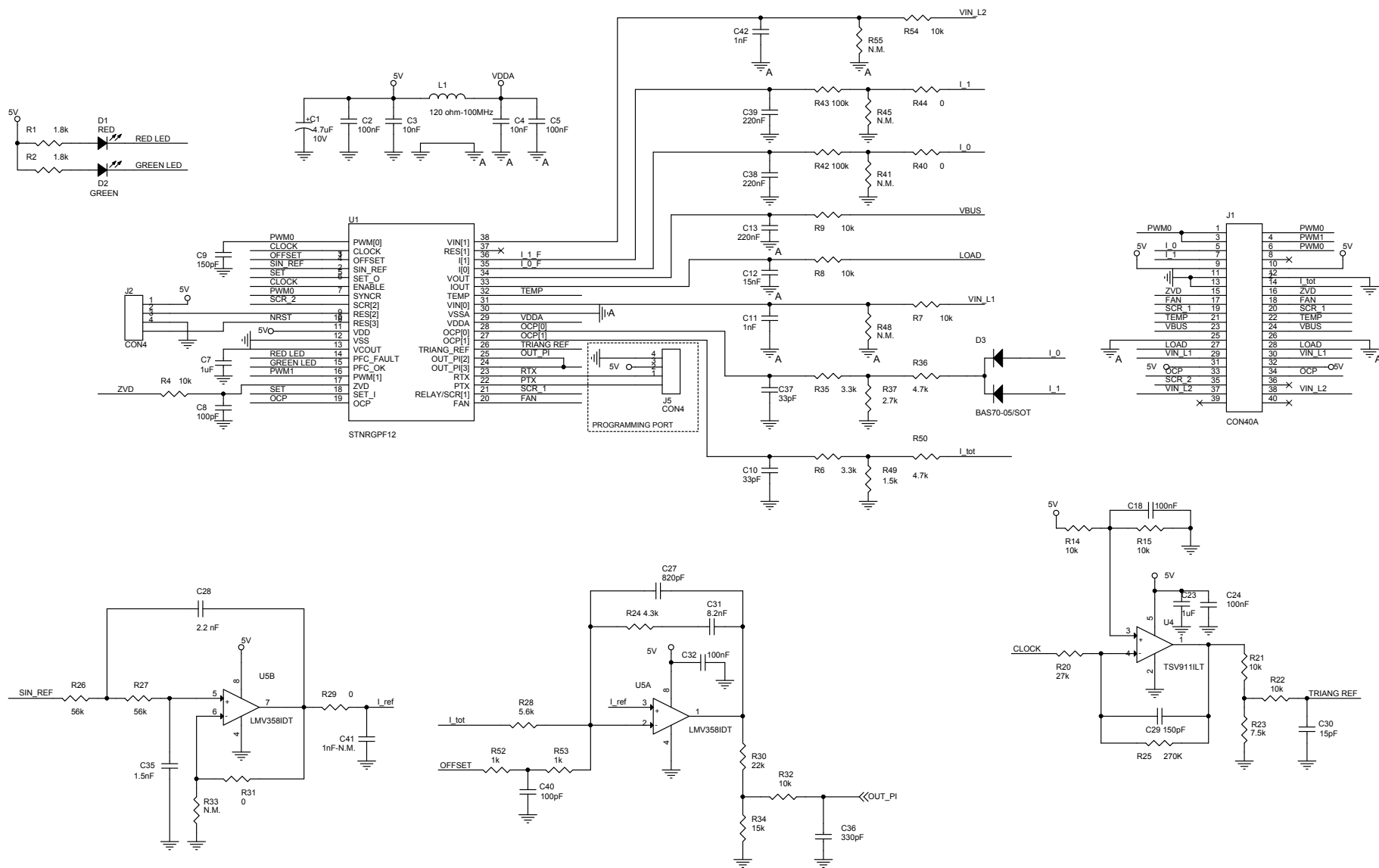
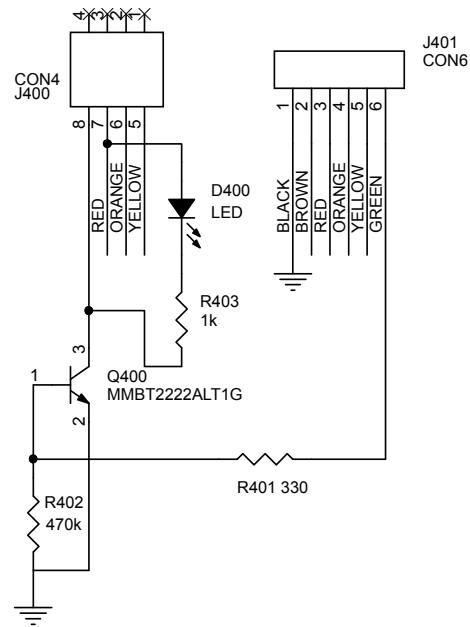


Figure 11. STEVAL-IPFC12C1 schematic



6.3 STEVAL-IPFC01A1 adapter board schematic

Figure 12. STEVAL-IPFC01A1 schematic



7 STEVAL-IPFC12V1 bill of materials

Table 1. STEVAL-IPFC12V1 bill of materials

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	1	-	STEVAL-IPFC12P1	Power board	ST	not available separately
2	1	-	STEVAL-IPFC12C1	Control board	ST	not available separately
3	1	-	STEVAL-IPFC01A1	adapter board	ST	not available separately

7.1 STEVAL-IPFC12P1 power board bill of materials

Table 2. STEVAL-IPFC12P1 bill of materials

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	6	C100, C101, C102, C103, C304, C313	10nF, 50V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
2	17	C104, C105, C109, C200, C204, C209, C305, C310, C311, C312, C314, C315, C316, C318, C319, C321, C322	100nF, 50V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
3	2	C106, C107	68nF, 305Vac, $\pm 10\%$	POLYPROPYLENE X2 FILM CAP, Trough hole lead spacing 15mm	EPCOS	B32922C3683K000
4	1	C108	1nF, 500Vdc, $\pm 20\%$	Ceramic disc cap, Trough hole lead spacing 10mm	VISHAY BC COMPONENTS	VY1102M35Y5UG63V0
5	6	C110, C111, C317, C320, C308, C309	150pF, 50V, $\pm 5\%$	C0G Ceramic Capacitor, SMD 0603	ANY	ANY
6	3	C201, C202, C205	470 μ F, 25Vdc, $\pm 20\%$	Electrolytic capacitor +105°, TH 8mm diameter, 3.5mm lead spacing	ANY	ANY
7	1	C203	10 μ F, 25V, $\pm 20\%$	Electrolytic capacitor +105°, Trough hole lead spacing 2mm - 5mm diameter	ANY	ANY
8	1	C206	4.7 μ F, 450V, $\pm 20\%$	Electrolytic capacitor +105°, Trough hole lead spacing 5mm	ANY	ANY
9	1	C207	10 μ F, 450V, $\pm 20\%$	Electrolytic capacitor +105°, Trough hole lead spacing 5mm	ANY	ANY

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
10	1	C208	47 μ F, 25V, $\pm$ 20%	Electrolytic capacitor +105°, Trough hole lead spacing 2mm - 5mm diameter	ANY	ANY
11	1	C210	1nF, 50V, $\pm$ 10%	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
12	1	C211	150nF, 50V, $\pm$ 10%	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
13	1	C212	270pF, 50V, $\pm$ 10%	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
14	1	C300	0.56 μ F, 450V, $\pm$ 10%	POLYPROPYLENE FILM CAP, Trough hole lead spacing 22.5mm	EPCOS	B32673P6564K000
15	2	C301, C302	680 μ F, 450V, $\pm$ 20%	Electrolytic capacitor +105°, Trough hole lead spacing 10mm	Nichicon	LGM2W681MELC40
16	1	C303	1 μ F, 520V, $\pm$ 10%	POLYPROPYLENE FILM CAP, Trough hole lead spacing 15mm		B32672P5105K000
17	2	C306, C307	100 pF, 630 Vdc, $\pm$ 5%	POLYPROPYLENE FILM CAP, Trough hole lead spacing 5mm	KEMET	PFR5101J630J11L4BULK
18	2	D100, D101	1200V, 30A	High voltage rectifier for bridge applications, DO-247	ST	STBR3012W
19	1	D102	1000V, 1A	General Purpose Rectifier Diode, SMA	ON Semiconductor	GF1M
20	2	D103, D104	70V, 70mA	Schottky diode, SOT23	ST	BAS70-04FILM
21	1	D200	150V, 2A	Power schottky diode, SMA	ST	STPS2150A
22	2	D201, D203	150V	TRANSIL, SMB	ST	SM6T150A
23	1	D202	1000V, 0.5A	Bridge rectifier, SMD	Fagor Electronica	MB10SA TR
24	1	D204	1000V, 1A	Turbo 2 ultrafast high voltage rectifier, SMA	ST	STTH1L06A
25	1	D205	60V, 1A	Power schottky diode, SMA	ST	STPS1L60A
26	1	D206	100V, 150mA	Small signal Schottky diode, SMD Minimelf	ST	TMMBAT46FILM

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
27	2	D300, D301	600V, 12A	600 V power Schottky silicon carbide diode, TO220AC	ST	STPSC12065D
28	9	D302, D303, D304, D305, D306, D307, D308, D309, D310	30V, 1A	Power schottky diode, SMA	ST	STPS1L30A
29	1	F100	20A, 250Vac, 20A	Cylindrical Fuse Class gG/gL and aM, SMD 10x3 mm	Bel Fuse Inc.	SMM 20
30	1	GT100	EC600X, 540V, 5kA	Gas Discharge Tube for circuit protection, Trough hole	EPCOS	B88069X0780S102
31	3	ISO100, ISO101, ISO102	80V, 50mA	Optocoupler, SMD	Toshiba	TLP385(GB,E
32	1	J100	VIN, 630V, 17.5A	PCB terminal block, Trough hole lead spacing 7.5mm	Phoenix Contact	1717033
33	1	J300	VOUT, 300Vac, 25A	PCB terminal block, Trough hole lead spacing 7.62mm	RS	790-1130
34	1	J301	CON40A, 550Vac, 6.9A	Connector 2 ways 2.54mm, Trough hole lead spacing 2.54mm	SAMTEC	ESQ12037GD
35	1	L100	2x4.5mH, 250V, 18A, -30% +50%	Common Mode Power Line, Trough hole	WURTH ELEKTRONIK	7448051804
36	1	L200	1mH, 0.8A, ±20%	Radial Leaded Wire Wound Inductor, Radial	WURTH ELEKTRONIK	7447480102
37	1	L201	4.7µH, 1.9A, ±20%	SMD Inductors, SMD 4.5x4mm	RS Pro	740-9372
38	1	L202	560 µH, 0.48A, ±10%	Switch Mode Transformer, Through hole	AQ Magnetica OR Würth Elektronik	2198.0028 OR 750318021
39	2	L300, L301	350µH 12A _{PK} 1kW	Power inductor, through hole	AQ Magnetica OR Würth Elektronik	2097.0016 OR 750318020
40	2	Q100, Q101	60V, 0.6A	PNP Transistor, Trough hole TO 18	MULTICOMP	2N2907A
41	2	Q102, Q103	1200V, 30A	SCR THYRISTOR, TO247	ST	TN3050H-12WY
42	2	Q300, Q301	650V, 20A	Trench gate field-stop IGBT, TO-247	ST	STGW20H65FB
43	1	Q302	20V, 6A	N-channel 20 V, Power MOSFET, SO8	ST	STS6NF20V

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
44	2	RV100, RV102	250VAC, $\pm 10\%$	METAL OXIDE VARISTORS, Trough hole	EPCOS	B72214P2251K101
45	2	RV101, RV103	385VAC, $\pm 10\%$	METAL OXIDE VARISTORS, Trough hole	EPCOS	B72214P2381K101
46	6	R100, R101, R110, R111, R349, R350	1k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
47	4	R102, R103, R105, R106	390, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
48	2	R104, R107	270, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
49	2	R108, 109	47, 600V, $\pm 5\%$	Metal oxid film resistor, AXIAL	TE Connetivity	ROX2SJ47R
50	2	R112, R113 (not mounted)	2.7M, 200V, $\pm 5\%$	Metal film resistor, AXIAL	ANY	ANY
51	3	R114, R117, R118	33k, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
52	1	R115	100k, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
53	2	R116, R120	10M, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
54	1	R119	47k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
55	7	R121, R122, R124, R125, R303, R306, R314	470k, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
56	2	R123, R126	3k 0.1%, 50V, $\pm 0.1\%$	Metal film resistor, SMD 0603	ANY	ANY
57	1	R200, R312, R313	10, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
58	2	R201, R202	22, 500V, $\pm 5\%$	Wirewound Anti-Surge Resistor, AXIAL	TE Connectivity	EP1W22RJ
59	1	R203	27k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
60	1	R204	240, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
61	2	R205, R342	10k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
62	1	R206	12k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
63	1	R207	91k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
64	1	R208	3.3k, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
65	1	R300	40m, $\pm 1\%$	WSHM 7W Power Metal Strip Resistor, SMD2818	VISHAY	WSHM2818R0400FEA

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
65A	1	R300 option	40m, $\pm 1\%$	WSR3 Power Metal Strip Resistor, SMD 4527	VISHAY	WSR3R0400FEA
66	8	R301, R302, R321, R322, R332, R337, R339, R344	100, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
67	2	R304, R305	510, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
68	2	R307, R308	10k, 75V, $\pm 0.1\%$	Metal film resistor, SMD 0603	Panasonic	ERA3AEB103V
69	2	R309, R319	56k, 75V, $\pm 0.1\%$	Metal film resistor, SMD 0603	Panasonic	ERA3AEB563V
70	2	R310, R311	33, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
71	2	R315, R317	10k, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
72	2	R316, R318	10m, $\pm 1\%$	Wirewound Res., Precision, SMD 2512	OHMITE	MCS3264R010FER
73	1	R320	6m, $\pm 1\%$	Metal film resistor, SMD	Panasonic	ERJMS4HF6M0U
74	1	R323	3.3k, 75V, $\pm 0.1\%$	Metal film resistor, SMD 0603	Panasonic	ERA3AEB332V
75	2	R324, R330	82k, 75V, $\pm 0.1\%$	Metal film resistor, SMD 0603	Panasonic	ERA3AEB823V
76	6	R325, R327, R333, R338, R340, R345	2.2k, 75V, $\pm 0.1\%$	Metal film resistor, SMD 0603	Panasonic	ERA3AEB222V
77	1	R326	0, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
78	1	R328 (not mounted)	50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
79	1	R329	470, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
80	4	R331, R335, R343, R346	62k 0.1%, 75V, $\pm 0.1\%$	Metal film resistor, SMD 0603	Panasonic	ERA3AEB623V
81	1	R334	11k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
82	1	R336	22, 200V, $\pm 1\%$	Metal film resistor, 1206	ANY	ANY
83	1	R341	33k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
84	2	R347, R348	0, 200V, $\pm 1\%$	High Power Thick Film Resistor, 1206	ANY	ANY
86	1	RT1	15	Termistore NTC, TH lead spacing 5mm	EPCOS	B57236S0160M000
87	1	U200	-	low drop voltage regulators, DPAK	ST	L4931ABDT50-TR
88	1	U201	800V	Off-line all-primary-sensing switching regulator, SO16N	ST	VIPER26HDTR

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
89	4	U300, U301, U303, U304	5V	Wide-bandwidth (8MHz) rail to rail input/output 5V CMOS Op-Amp, single , SOT23-5L	ST	TSV911ILT
90	1	U302	5V	Ultra-low current 2.4 V precision analog temperature sensor, SOT323-5L	ST	STLM20W87F
91	2	U305, U306	-	4 A dual low side MOSFET driver, SO8	ST	PM8834TR
92	4	Y100, Y101, Y102, Y103	2.2 nF, 250V, $\pm 20\%$	Ceramic disc cap, T H lead spac. 7.5 mm	MURATA	DE2E3KY222MA3BM02F
93	1	Y300	FAN2	DC Axial Fan +Heatsink	Fischer Elektronik	LAM 4 K 150 12
94	8	Y3 lock-in-retaining springs	-	retaining springs	Fischer Elektronik	THFU 1
95	1	Thermal Film 140 x 25 mm	-	Thermal conductivity Thin film 140 X 25 mm	BERGQUIST	BP100-0.005-00-12/12
96	4	Nylon Spacer	-	Hex Threaded Spacer	DURATOOL	D01496
96	4	Nylon Nut	-	M3 Hexagon Full Nut Double Chamfer	TR FASTENINGS	-

7.2 STEVAL-IPFC12C1 control board bill of materials

Table 3. STEVAL-IPFC12C1 bill of materials

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	1	C1	4.7 μ F, 16V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0805	ANY	ANY
2	5	C2, C5, C18, C24, C32	100nF, 50V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
3	2	C3, C4	10nF, 25V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	AVX	06033C103KAT2A
4	2	C7, C23	1 μ F, 25V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
5	2	C8, C40	100pF, 50V, $\pm 5\%$	C0G Ceramic Capacitor, SMD 0603	ANY	ANY
6	2	C9, C29	150pF, 50V, $\pm 5\%$	C0G Ceramic Capacitor, SMD 0604	ANY	ANY
7	2	C10, C37	33pF, 50V, $\pm 5\%$	C0G Ceramic Capacitor, SMD 0603	ANY	ANY

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
8	2	C11, C42	1nF, 50V, $\pm 5\%$	C0G Ceramic Capacitor, SMD 0603	ANY	ANY
9	1	C12	15nF, 50V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
10	3	C13, C38, C39	220nF, 50V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
11	1	C27	820pF, 50V, $\pm 5\%$	COG Ceramic Capacitor, SMD 0603	ANY	ANY
12	1	C28	2.2 nF, 50V, $\pm 5\%$	C0G Ceramic Capacitor, SMD 0603	ANY	ANY
13	1	C30	15pF, 50V, $\pm 5\%$	COG Ceramic Capacitor, SMD 0603	ANY	ANY
14	1	C31	8.2nF, 50V, $\pm 10\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
15	1	C35	1.5nF, 50V, $\pm 5\%$	C0G Ceramic Capacitor, SMD 0603	ANY	ANY
16	1	C36	330pF, 50V, $\pm 5\%$	COG Ceramic Capacitor, SMD 0603	ANY	ANY
17	1	C41 N.A.	1nF, 50V, $\pm 5\%$	X7R Ceramic Capacitor, SMD 0603	ANY	ANY
18	1	D1	RED, 1.85V, 20mA	High efficiency red diffused LED 3mm, SMD 0805	Kingbright	KP-2012SRC-PRV
19	1	D2	GREEN, 2.1V, 20mA	High efficiency green diffused LED 3mm, SMD 0805	Kingbright	KPHCM-2012CGCK
20	1	D3	BAS70-05, 70V, 70mA	Low capacitance, series inductance and resistance Schottky diode, SOT23	ST MICROELECTRONICS	BAS70-05FILM
21	1	J1	CON40A, 250Vac, 3A	Right angle PIN header connector, dual row, T. H. lead spacing 2.54 x 2.54mm	Wurth Elektronik	61304021021
22	2	J2, J5	CON4, 250Vac, 3A	T. H. PIN Header Connector, single row, T. H. lead spacing 2.54mm	Wurth Elektronik	61300411121
23	1	L1	120 Ω , 100MHz	Ferrite, SMD 0603	Wurth Elektronik	74279262
24	2	R1, R2	1.8k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
25	6	R4, R8, R9, R21, R22, R32	10k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
26	4	R7, R14, R15, R54	10k, 50V, $\pm 0.1\%$	Metal film resistor, SMD 0603	Panasonic	ERA3APB103V
27	2	R6, R35	3.3k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
28	1	R20	27k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
29	1	R23	7.5k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
30	1	R24	4.3k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
31	1	R25	270K, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
32	2	R26, R27	56k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
33	1	R28	5.6k, 50V, $\pm 1\%$	Metal film resistor, SMD 0604	ANY	ANY
34	4	R29, R31, R40, R44	0, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
35	1	R30	22k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
36	5	R33, R41, R45, R48, R55 N.A.	N.A., 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
37	1	R34	15k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
38	2	R36, R50	4.7k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
39	1	R37	2.7k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
40	2	R42, R43	100k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
41	1	R49	1.5k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
42	2	R52, R53	1k, 50V, $\pm 1\%$	Metal film resistor, SMD 0603	ANY	ANY
43	1	U1	5V	Digital controller, TSSOP38	ST MICROELECTR ONICS	STNRGPF12
44	1	U4	5V	Single rail to rail I/O 8MHz OpAmp, SOT23-5L	ST MICROELECTR ONICS	TSV911ILT
45	1	U5	5V	LOW POWER I/O rail to rail dual OpAmp, SO8	ST MICROELECTR ONICS	LMV358IDT

7.3 STEVAL-IPFC01A1 adapter board bill of materials

Table 4. STEVAL-IPFC01A1 bill of materials

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	1	D400	LED	High Efficiency Red LED 3mm, through hole	Kingbright	L-7104ID
2	1	J400	CON4	4-contact 2.54mm female SIL Board-to-board Socket, through hole	HARWIN	M20-7890446
3	1	J401	CON6	Right angle male connector 1 way 6 circuits 2.54mm, through hole	ANY	ANY
4	1	Q400	40 V, 0.6 A	General Purpose Transistors, NPN Silicon	ON Semiconductor	SMMBT2222ALT1G
5	1	R401	330	Metal film resistor, 0805	ANY	ANY
6	1	R402	470k	Metal film resistor, 0805	ANY	ANY
7	1	R403	1K	Metal film resistor, 0805	ANY	ANY

Revision history

Table 5. Document revision history

Date	Version	Changes
15-Mar-2019	1	Initial release.
8-Jul-2020	2	Updated Table 2. STEVAL-IPFC12P1 bill of materials

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