

YY Series(Hybrid SiC)

Series	Device	Description
YY S ser.	SYIM776-SF	3Φ 20A 600V, PFC 40A 600V (Up to 100 kHz)
	SYIM776-SFT	3Φ 20A 600V, PFC 40A 600V (Up to 100 kHz), With NTC
YY AA ser.	SYIM776-SAA	3Φ 20A 600V, PFC 40A 600V (Up to 100 kHz)
	SYIM776-SAAT	3Φ 20A 600V, PFC 40A 600V (Up to 100 kHz), With NTC

Features

- Fully insulated single in-line power module, integrated with three-phase full bridge and PFC
- Using IMS insulated and heat-dissipating substrate
- SIP (single in line) fully insulated package structure is adopted
- Three-phase full bridge 20A 600V, PFC 40A 600V
- Active high, compatible with TTL / CMOS level
- Integrated bootstrap functionality
- S ser PFC uses SiC-SBD.^{note1}
- AA ser PFC and inverter uses SiC-SBD.^{note2}
- Independent inverter and PFC over-current shutdown
- Under-voltage lockout at all channels
- Cross-conduction prevention
- Fault signal output
- Independent low side IGBT emitter
- Built-in NTC thermistor for temperature monitor^{note3}

Description

YY series MIPS is a modular intelligent power system with three-phase full bridge inverter and PFC, optimize PCB size and system costs, simplify PCB assembly, improve reliability of electronic system, which reduce the comprehensive cost of electronic system. It is suitable for electronic system such as consumer electronics and Low power industrial equipment with motor drive and single-phase PFC. The package structure is good thermal conduction and electrical isolation. The product has over current, over temperature, under voltage and other protection functions and good EMI performance. Three-phase inverter adopts low power consumption IGBT and FRD, which is suitable for 5~20kHz carrier frequency. The PFC uses SiC-SBD to improve the conversion efficiency and system reliability, and is suitable for switching frequencies below 100 kHz.

Device Features

- 3Φ Inverter IGBT: 600V 20A ($T_c=25^{\circ}\text{C}$)
- PFC IGBT: 600V 40A ($T_c=25^{\circ}\text{C}$)

Target Applications

- Inverter
- Converter

Note1: S-Series model PFC utilizes SiC-SBD.(for SYIM776-SS(T))

Note2: AA-Series model PFC and inverter utilizes SiC-SBD.(for SYIM776-SAA(T))

Note3: The model with T integrates NTC temperature detection function internally.

Product information

Model	Package	Marking	Packing Type	Quantity
SYIM776-SX	SIP35-A	SYIM776-SXX	8 PCS/TUBE	64PCS/INNER BOX 384PCS/CARTON BOX

Internal Electrical Schematic

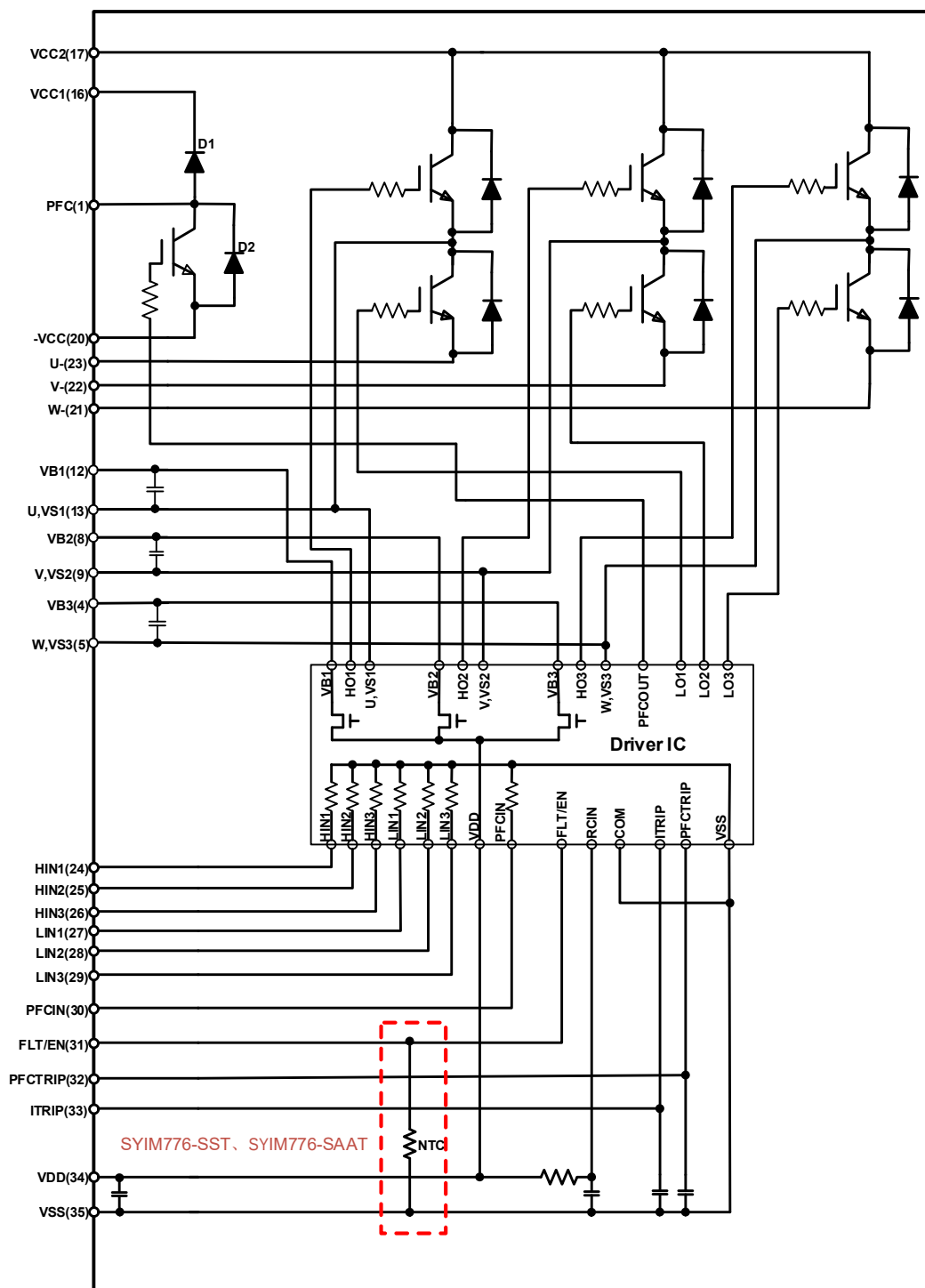
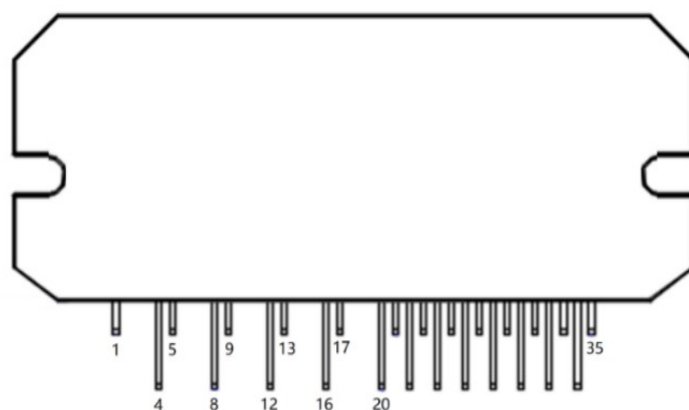


Figure 1 Module Circuit Diagram

Note: SYIM776-SST、SYIM776-SAAT built in NTC thermistor;
SYIM776-SS 、SYIM776-SAA there is no thermistor.

Pin Assignment



引脚序号	符号	描述
1	PFC	PFC IGBT collector
2	/	/
3		
4	VB3	W-phase high side floating IC supply voltage
5	W,VS3	W-phase high side floating IC supply offset voltage
6	/	/
7		
8	VB2	V-phase high side floating IC supply voltage
9	V,VS2	V-phase high side floating IC supply offset voltage
10	/	/
11		
12	VB1	U-phase high side floating IC supply voltage
13	U,VS1	U-phase high side floating IC supply offset voltage
14	/	/
15		
16	VCC1	PFC rectifier diode output
17	VCC2	Bus voltage input terminal
18	/	/
19		
20	-VCC	PFC IGBT emitter
21	W-	W-phase low side emitter
22	V-	V-phase low side emitter
23	U-	U-phase low side emitter
24	HIN1	U-phase high side gate driver input
25	HIN2	V-phase high side gate driver input
26	HIN3	W-phase high side gate driver input
27	LIN1	U-phase lower axle drive signal input
28	LIN2	V-phase lower axle drive signal input
29	LIN3	W-phase lower axle drive signal input
30	PFCIN	PFC drive signal input
31	FLT/EN/VTH	Fault output / Temperature monitor (SYIM776-SST、SYIM776-SAAT)
32	PFCTrip	PFC Over current shutdown input
33	ITrip	Over current shutdown input
34	VDD	Low side control supply
35	VSS	Low side control negative supply

Absolute Maximum Ratings (V_{DD}=15V, V_{GE}=15V, T_C=25°C if not stated otherwise)

Module Section

Symbol	Parameter	Condition	min	max	Unit
V _{ISO}	Isolation test voltage	RMS, f=60Hz, t=1min	-	2000	V _{RMS}
T _{J(HVIC/IGBT/FRD)}	Operating junction temperature range	-	-40	150	°C
T _C	Operating case temperature range	-	-40	125	
T _{STG}	Storage temperature range	-	-50	150	

PFC Section

Symbol	Parameter	Condition	min	max	Unit
I _{O_PFC}	PFC Output current	T _J ≤150°C	-	40	A
I _{PK_PFC}	PFC Maximum peak output current	T _J ≤150°C, t _{Pulse} ≤1ms	-	80	
P _{D_PFC}	Power dissipation per IGBT	T _C =25°C	-	58	W

Inverter Section

Symbol	Parameter		Condition	min	max	Unit
V _{CES} / V _{RRM}	Max. blocking voltage		I _C =250μA	-	600	V
V _{CC(Surge)}	DC link supply voltage (surge) of P-N		-	-	500	
V _{CC}	DC link supply voltage of P-N		-	-	450	
I _O	Output current		T _J ≤150°C	-	20	A
I _{PK}	Maximum peak output current		T _J ≤150°C, t _{Pulse} ≤1ms	-	40	
P _D	Power dissipation per IGBT	SYIM776-SS(T)	T _C =25°C	-	36	W
		SYIM776-SAA(T)		-	21	

Control Section

Symbol	Parameter	Condition	min	max	Unit
V _{DD}	Module supply voltage	-	-0.3	20	V
V _{BS}	High side floating supply voltage (V _B vs. V _S)	-	-1	20	
V _{IN}	LIN, HIN, PFCIN, FLT/EN Input voltage	-	-0.5	V _{DD} +0.5	
V _{FLT/EN}	FLT/EN Output Voltage	-	-0.5	V _{DD} +0.5	
V _{ITRIP}	ITRIP Input voltage	-	-0.5	5	
V _{PFCTRIP}	PFCTRIP Input voltage	-	-2	5	

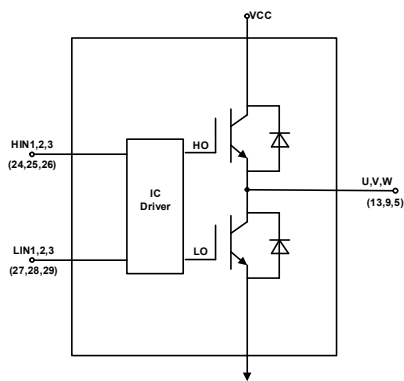
Thermal characteristics

Symbol	Parameter	Condition	min	max	Unit
R _{TH(J-C)INVG}	Inverter IGBT J-C thermal resistance	-	-	4.1	°C/W
R _{TH(J-C)INVD}	Inverter FRD J-C thermal resistance	SYIM776-SS(T)	-	7.3	°C/W
		SYIM776-SAA(T)	-	4.5	
R _{TH(J-C)PFCG}	PFC IGBT J-C thermal resistance	-	-	2.6	°C/W
R _{TH(J-C)PFCD}	PFC FRD J-C thermal resistance	-	-	2.3	°C/W

Recommended Operating Condition

Input / output logic sequence diagram Figure2。 The power module should work within the recommended conditions, The listed voltages are all based on the COM terminal。

Symbol	Parameter	min	Typ	max	Unit
V _{CC}	DC link supply voltage of P-N	-	300	400	V
V _{BS}	High side floating supply voltage (V _B vs. V _S)	12.5	15	17.5	
V _{DD}	Low side supply voltage	13.5	15	18	
V _{IN}	LIN, HIN, PFCIN, ITRIP, FLT/EN input voltage	0	-	5	
f _{P_INV}	PWM frequency (Inverter)	-	-	20	kHz
f _{P_PFC}	PWM frequency (PFC)	-	-	100	
DT	Dead time	2	-	-	μs
PW _{IN(ON)}	Minimum input pulse width	0.5	-	-	
PW _{IN(OFF)}		0.5	-	-	
T	Torque of mounting screw (M3 Screw)	0.8	-	1.0	N·m



FLT/EN	ITRIP	HIN1,2,3	LIN1,2,3	U,V,W
1	0	1	0	VCC
1	0	0	1	0
1	0	0	0	OFF
1	0	1	1	OFF
1	1	X	X	OFF
0	X	X	X	OFF

Figure 2 Input-Output logic table

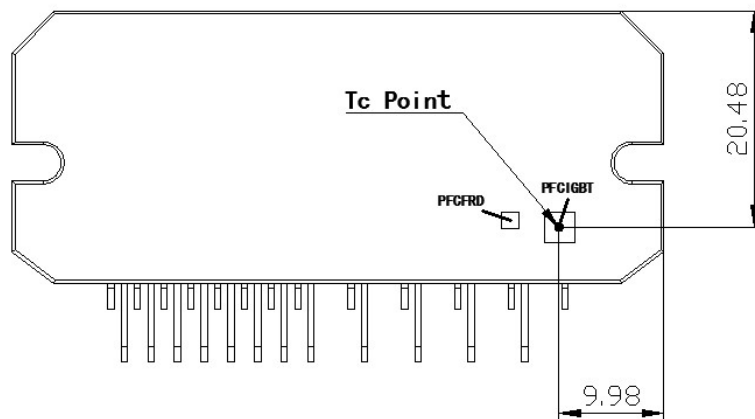


Figure 3 T_C measurement point

Electrical Characteristics

Static Parameters ($V_{DD}=15V$, $V_{GE}=15V$, $T_C=25^{\circ}C$ if not stated otherwise)

PFC Section

Symbol	Parameter	condition	min	Typ	max	Unit
$V_{CE(sat)}$	Collector-Emitter saturation voltage	$I_C=40A$	-	2.1	2.6	V
I_{CES}	Collector-Emitter leakage current	$V_{IN}=0V$, $PFC=600V$	-	-	0.1	mA
		$V_{IN}=0V$, $PFC=600V$, $T_J=125^{\circ}C$	-	-	1.0	
V_{FM1}	Diode forward voltage(D1)	$I_F=40A$	-	2.0	2.5	V
V_{FM2}	Diode forward voltage(D2)	$I_F=2A$	-	0.8	1.1	

Inverter Section

Symbol	Parameter	condition	min	Typ	max	Unit
$V_{CE(sat)}$	Collector-Emitter saturation voltage	$I_C=20A$	-	1.9	2.3	V
I_{CES}	Collector-Emitter leakage current	$V_{IN}=0V$, $V_{CC}=600V$	-	-	0.1	mA
		$V_{IN}=0V$, $V_{CC}=600V$, $T_J=125^{\circ}C$	-	-	1.0	
V_{FM}	Diode forward voltage	SYIM776-SS(T)	$I_F=20A$	-	1.8	V
		SYIM776-SAA(T)		-	2.0	

Control Section

Symbol	Parameter	condition	min	Typ	max	Unit
$V_{IN,TH+}$	LIN, HIN, PFCIN, FLT/EN Logic "1" input voltage	-	2.9	-	-	V
$V_{IN,TH-}$	LIN, HIN, PFCIN, FLT/EN Logic "0" input voltage	-	-	-	1.0	
V_{BSUV+}	VBS supply under voltage positive going threshold	-	10.2	11.1	12.5	
V_{BSUV-}	VBS supply under voltage negative going threshold	-	10	10.9	12.3	
V_{DDUV+}	VDD supply under voltage positive going threshold	-	10.2	11.1	12.5	
V_{DDUV-}	VDD supply under voltage negative going threshold	-	10	10.9	12.3	
V_{ITRIP}	ITRIP threshold voltage	-	0.45	0.50	0.55	
$V_{PFCTRIP}$	PFC _{TRIP} threshold voltage	-	-0.25	-0.31	-0.37	μA
I_{QBS}	VBS Quiescent supply current	-	-	-	30	
I_{QDD}	VDD Quiescent supply current	-	-	-	10	mA
I_{IN+}	LIN, HIN, PFCIN current	$V_{IN}=3.3V$	-	700	-	
I_{IN-}	LIN, HIN, PFCIN current	$V_{IN}=0V$	-	0	1	
I_{ITRIP+}	ITRIP current	$V_{ITRIP}=0.45V$	-	2	-	
I_{ITRIP-}	ITRIP Zero voltage current	$V_{ITRIP}=0V$	-	0	1	
$I_{PFCTRIP+}$	PFCTRIP current	$V_{PFCTRIP}=250mV$	-	-17	-	

IPFCTRIPO	PFCTRIPO Zero voltage current	$V_{PFCTRIPO} = 0V$	-	-13	-	
R_{FLT}	Fault Low level on state resistance	-	-	50	100	Ω
$V_{F(BSD)}$	Bootstrap diode forward voltage	$I = 1mA$	-	1	1.5	V

Dynamic Parameters ($V_{DD} = 15V$, $V_{GE} = 15V$, $T_C = 25^\circ C$ if not stated otherwise)

PFC Section

Symbol	Parameter	condition	min	Typ	max	Unit
t_{ON}	Turn-on propagation delay time	$I_C = 40A$, $V_{CC} = 350V$, $H = 500\mu H$, $V_{IN} = 0V$ or $V_{IN} = 5.0V$	-	0.30	-	μs
t_{OFF}	Turn-off propagation delay time		-	0.41	-	

Inverter Section

Symbol	Parameter	condition	min	Typ	max	Unit
t_{ON}	Turn-on propagation delay time	$I_C = 20A$, $V_{CC} = 350V$, $H = 5mH$, $V_{IN} = 0V$ or $5V$	-	0.71	-	μs
t_{OFF}	Turn-off propagation delay time		-	1.27	-	

Control Section

Symbol	Parameter	condition	min	Typ	max	Unit
t_{FLT}	FLT trigger delay time (Figure 13)	-	-	0.7	-	μs
t_{FLT_CLR}	FLT clearance delay time (Figure 13)	-	1.1	1.7	2.5	ms
t_{ITRIP}	ITRIP to shutdown propagation delay (Figure 13)	-	-	1.2	-	μs
$t_{PFCTRIPO}$	PFCTRIPO to shutdown propagation delay	-	-	1.1	-	μs

NTC characteristic (IM776-SST、IM776-SAAT)

Symbol	Parameter	condition	min	Typ	max	Unit
R_{25}	$25^\circ C$ resistance	$T_C = 25^\circ C$	99	100	101	k Ω
R_{100}	$100^\circ C$ resistance	$T_C = 100^\circ C$	5.18	5.38	5.60	
B	B constant ($25^\circ C \sim 50^\circ C$)	$R_2 = R_1 e^{[B(1/T_2 - 1/T_1)]}$	4208	4250	4293	K
TEMP	temperature range	-	-40	-	125	$^\circ C$

NCP15WF104F03RC								NCP15WF104F03RC							
R25 100 k ohm +/- 1 %				R25 100 k ohm +/- 1 %				R25 100 k ohm +/- 1 %				R25 100 k ohm +/- 1 %			
B(25/50) 4250 K +/- 1 %				B(25/50) 4250 K +/- 1 %				B(25/50) 4250 K +/- 1 %				B(25/50) 4250 K +/- 1 %			
TEMP.	R-low	R-center	R-high	TEMP.	R-low	R-center	R-high	TEMP.	R-low	R-center	R-high	TEMP.	R-low	R-center	R-high
(deg.C)	(k ohm)	(k ohm)	(k ohm)	(deg.C)	(k ohm)	(k ohm)	(k ohm)	(deg.C)	(k ohm)	(k ohm)	(k ohm)	(deg.C)	(k ohm)	(k ohm)	(k ohm)
-40	4191.5221	4397.1193	4612.3399	2	313.2543	320.1216	327.1067	44	41.8896	42.6745	43.4699	86	8.2806	8.5722	8.8733
-39	3904.3007	4092.8737	4290.1256	3	296.9408	303.2866	309.737	45	40.1341	40.9035	41.6835	87	7.9988	8.2834	8.5772
-38	3638.6865	3811.717	3992.5763	4	281.5705	287.4335	293.3892	46	38.4593	39.2132	39.9778	88	7.7279	8.0055	8.2924
-37	3392.015	3551.7485	3717.6457	5	267.0836	272.4995	277.9974	47	36.8626	37.601	38.3503	89	7.4673	7.7383	8.0182
-36	3165.3767	3311.2358	3463.4696	6	253.4246	258.4264	263.5006	48	35.34	36.0629	36.797	90	7.2167	7.4811	7.7543
-35	2954.6027	3088.5989	3228.3492	7	240.5415	245.1598	249.8418	49	33.8878	34.5953	35.3142	91	6.9764	7.2344	7.5012
-34	2759.2514	2882.3958	3010.735	8	228.386	232.6491	236.968	50	32.5022	33.1946	33.8983	92	6.7453	6.9971	7.2575
-33	2578.0968	2691.3096	2809.213	9	216.9132	220.8471	224.8299	51	31.1818	31.8591	32.5479	93	6.5228	6.7685	7.0228
-32	2410.0177	2514.137	2622.4921	10	206.0809	209.7098	213.3813	52	29.9215	30.5839	31.2579	94	6.3086	6.5494	6.7967
-31	2253.9885	2349.7776	2449.3926	11	195.85	199.1962	202.5794	53	28.7183	29.366	30.0253	95	6.1024	6.3365	6.5789
-30	2109.07	2197.225	2288.8359	12	186.1838	189.2681	192.3843	54	27.5694	28.2026	28.8474	96	5.9031	6.1316	6.3682
-29	1974.402	2055.5577	2139.8353	13	177.0481	179.8896	182.7585	55	26.472	27.0909	27.7215	97	5.7112	5.9341	6.1652
-28	1849.1959	1923.9316	2001.4876	14	168.411	171.0275	173.6673	56	25.4236	26.0284	26.6449	98	5.5263	5.7439	5.9695
-27	1732.7288	1801.5732	1872.9656	15	160.2427	162.6506	165.0781	57	24.4218	25.0127	25.6154	99	5.3482	5.5606	5.7808
-26	1624.337	1687.7731	1753.5114	16	152.512	154.7264	156.9573	58	23.4643	24.0416	24.6306	100	5.1766	5.3839	5.5989
-25	1523.4112	1581.8805	1642.4297	17	145.197	147.2321	149.2807	59	22.5489	23.1128	23.6884	101	5.0119	5.2143	5.4243
-24	1429.2026	1483.0995	1538.8751	18	138.2731	140.142	142.0219	60	21.6737	22.2243	22.7867	102	4.8531	5.0507	5.2558
-23	1341.4177	1391.1132	1442.5055	19	131.7174	133.4322	135.1557	61	20.8365	21.3743	21.9237	103	4.7001	4.893	5.0934
-22	1259.5795	1305.4128	1352.7786	20	125.5083	127.0802	128.659	62	20.0357	20.5607	21.0974	104	4.5526	4.7409	4.9366
-21	1183.249	1225.5307	1269.1963	21	119.6263	121.0658	122.5104	63	19.2694	19.782	20.3062	105	4.4103	4.5942	4.7853
-20	1112.0223	1151.0367	1191.3009	22	114.0515	115.3684	116.6887	64	18.536	19.0364	19.5484	106	4.2731	4.4527	4.6393
-19	1045.5274	1081.5351	1118.671	23	108.7664	109.9695	111.1748	65	17.834	18.3225	18.8224	107	4.1407	4.3161	4.4984
-18	983.4216	1016.6613	1050.9194	24	103.7544	104.8521	105.9508	66	17.1633	17.6401	18.1283	108	4.013	4.1843	4.3624
-17	925.3889	956.0796	987.6893	25	99	100	101	67	16.521	16.9884	17.4631	109	3.8898	4.057	4.231
-16	871.1382	899.4806	928.6522	26	94.3906	95.3981	96.3975	68	15.9058	16.36	16.8254	110	3.7709	3.9342	4.1042
-15	820.4005	846.5788	873.5051	27	90.0373	91.0322	92.029	69	15.3164	15.7596	16.2141	111	3.6561	3.8156	3.9817
-14	772.9276	797.111	821.9688	28	85.8993	86.889	87.8813	70	14.7516	15.1841	15.6278	112	3.5452	3.7011	3.8634
-13	728.4903	750.8341	773.7859	29	81.9732	82.9561	83.9424	71	14.209	14.631	15.0641	113	3.4383	3.5905	3.749
-12	686.8767	707.5237	728.7184	30	78.247	79.2216	80.2004	72	13.6888	14.1006	14.5234	114	3.3349	3.4836	3.6386
-11	647.8909	666.9723	686.5469	31	74.7099	75.6752	76.6453	73	13.19	13.5918	14.0045	115	3.2351	3.3804	3.5318
-10	611.3519	628.9892	647.0685	32	71.3511	72.306	73.2682	74	12.7117	13.1037	13.5065	116	3.1393	3.2812	3.4292
-9	577.0418	593.3421	610.0418	33	68.1608	69.1042	70.0537	75	12.2529	12.6354	13.0285	117	3.0466	3.1853	3.33
-8	544.8642	559.9309	575.3567	34	65.1296	66.0608	66.9986	76	11.8139	12.1871	12.5708	118	2.9571	3.0926	3.2341
-7	514.6742	528.6016	542.8516	35	62.2488	63.1671	64.0926	77	11.3926	11.7567	12.1312	119	2.8706	3.0031	3.1413
-6	486.3375	499.2124	512.377	36	59.5102	60.415	61.3275	78	10.9883	11.3436	11.7091	120	2.787	2.9164	3.0516
-5	459.7296	471.6321	483.7943	37	56.9061	57.7969	58.6958	79	10.6002	10.9468	11.3036	121	2.7057	2.8322	2.9643
-4	434.7669	445.7716	457.0092	38	54.4292	55.3056	56.1905	80	10.2276	10.5657	10.9139	122	2.6271	2.7508	2.8799
-3	411.305	421.4796	431.8627	39	52.0726	52.9343	53.8048	81	9.8697	10.1996	10.5395	123	2.5511	2.672	2.7982
-2	389.2453	398.6521	408.2455	40	49.83	50.6766	51.5325	82	9.526	9.8479	10.1796	124	2.4777	2.5958	2.7192
-1	368.496	377.1927	386.056	41	47.6969	48.5283	49.3693	83	9.1958	9.5098	9.8336	125	2.4066	2.522	2.6427
0	348.9722	357.0117	365.1999	42	45.666	46.482	47.3079	84	8.8785	9.1849	9.5009				
1	330.5751	338.0059	345.569	43	43.7319	44.5325	45.3431	85	8.5736	8.8726	9.181				

NTC Temperature characteristic

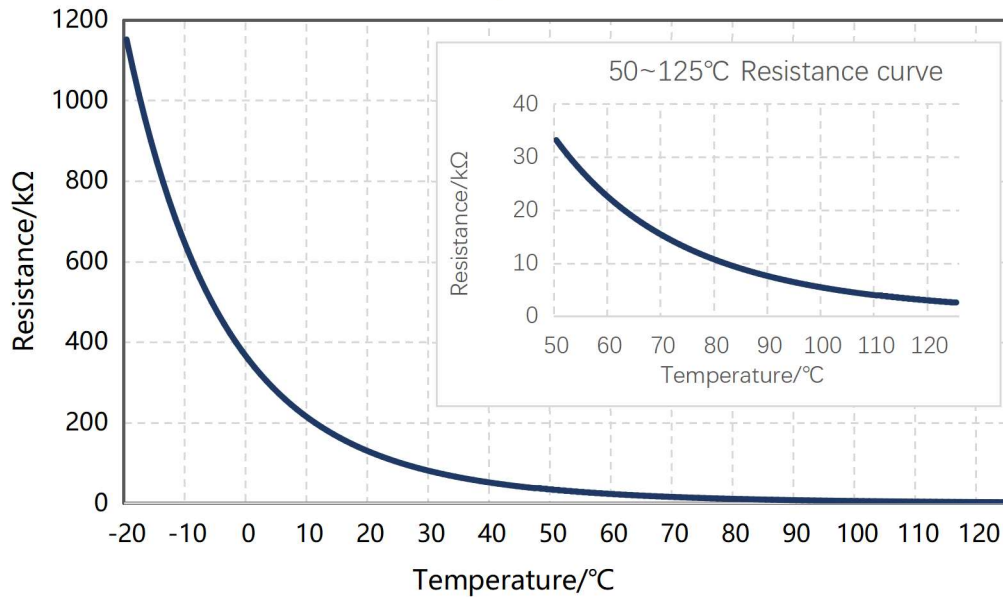


Figure 4 NTC Temperature - Resistance

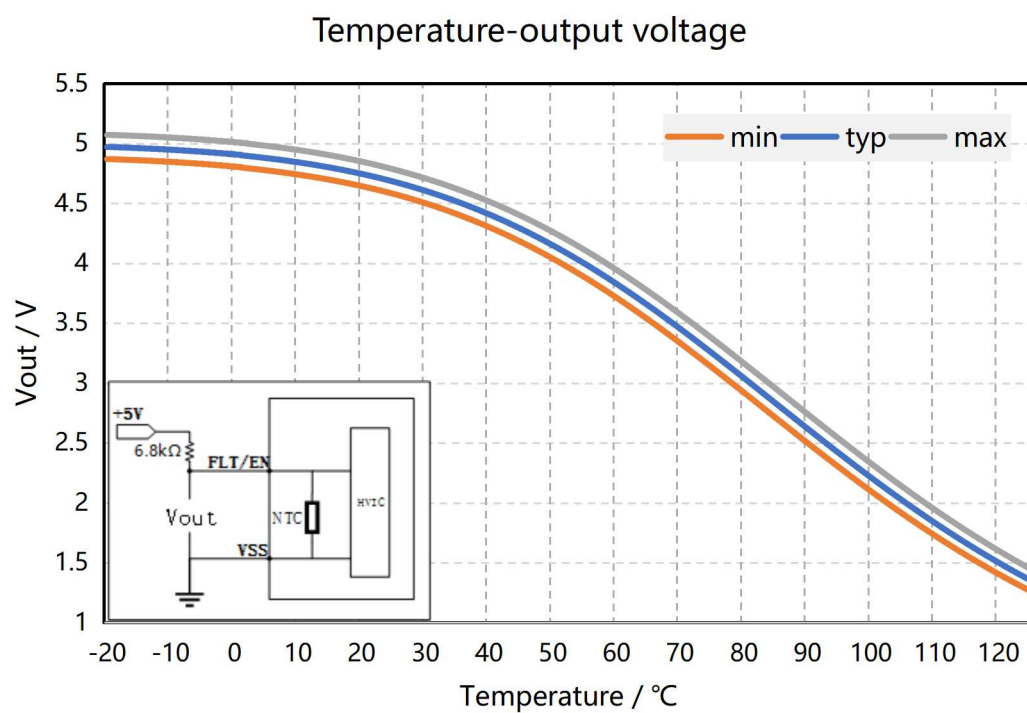


Figure 5 NTC Temperature - Voltage

Mechanical Characteristics and Ratings

Symbol	Parameter	condition	min	Typ	max	Unit
T	Mounting torque	M3 screw	1.5	-	-	N • m
CTI	Comparative Tracking Index	-	600	-	-	V
BKCurve	Curvature of module backside	Only convex faces are allowed	0	-	100	μm

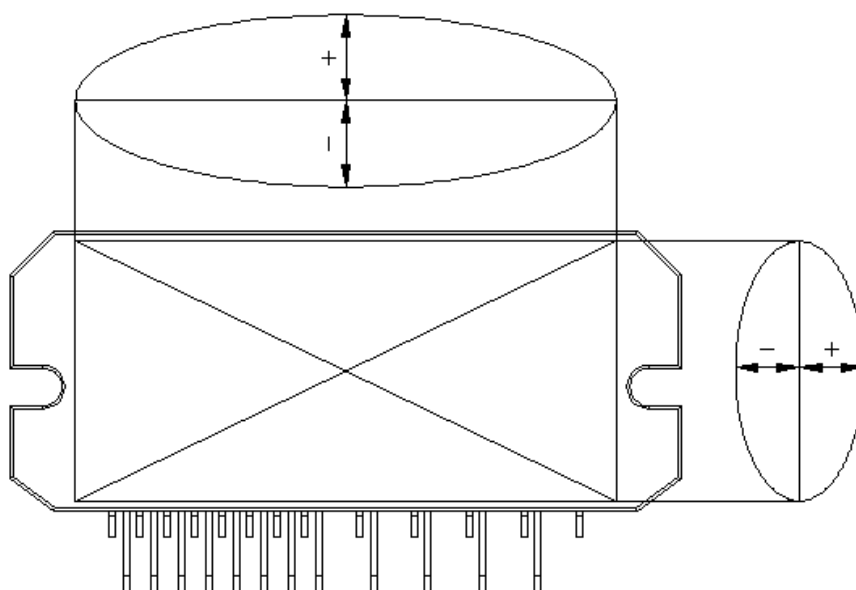


Figure 6 Backside curvature measurement position

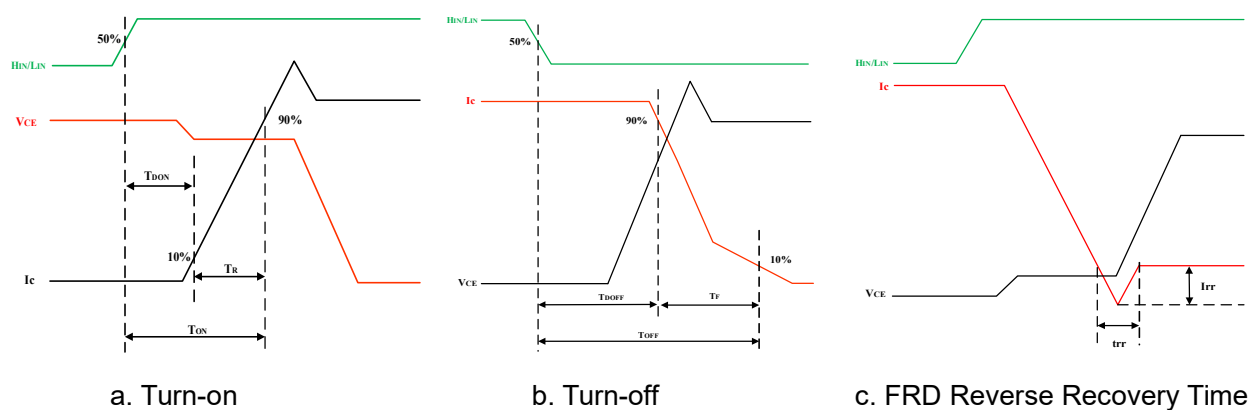


Figure 7 Switching times definition

$f_p=10\text{kHz}$, RMS output current for inverter:

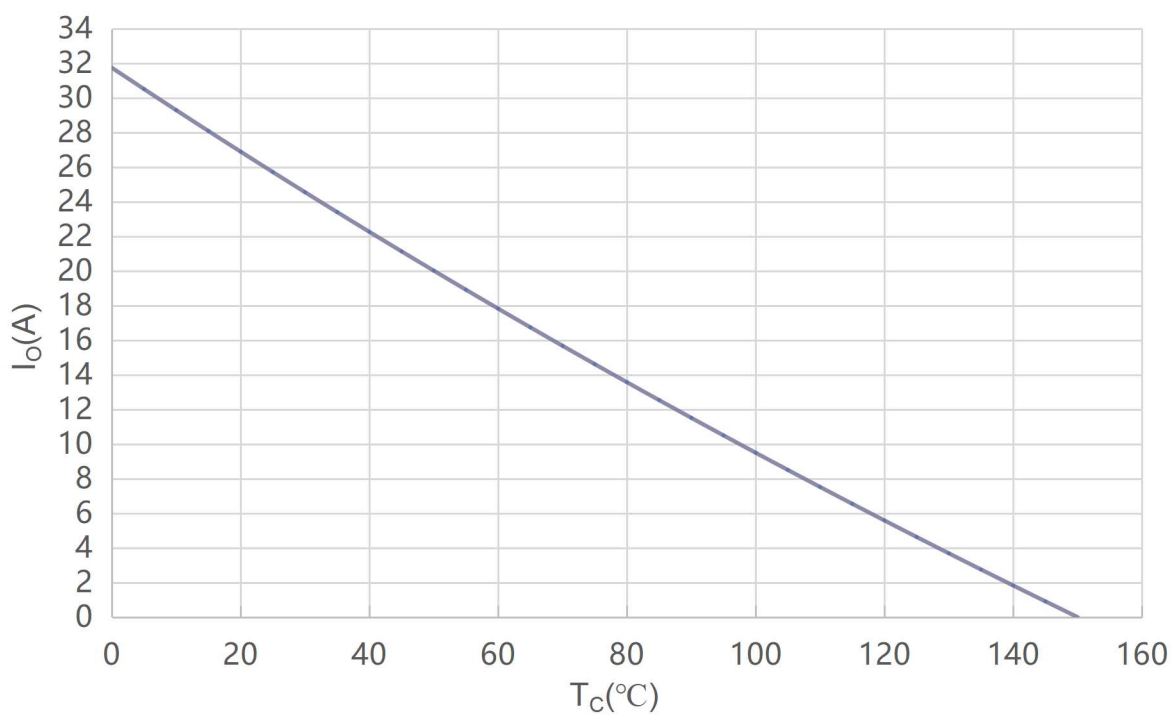


Figure 8 Maximum operating current SOA (Inverter Section)

$f_{P_PFC}=40\text{kHz}$, I_{O_PFC} vs. T_C for PFC-IGBT:

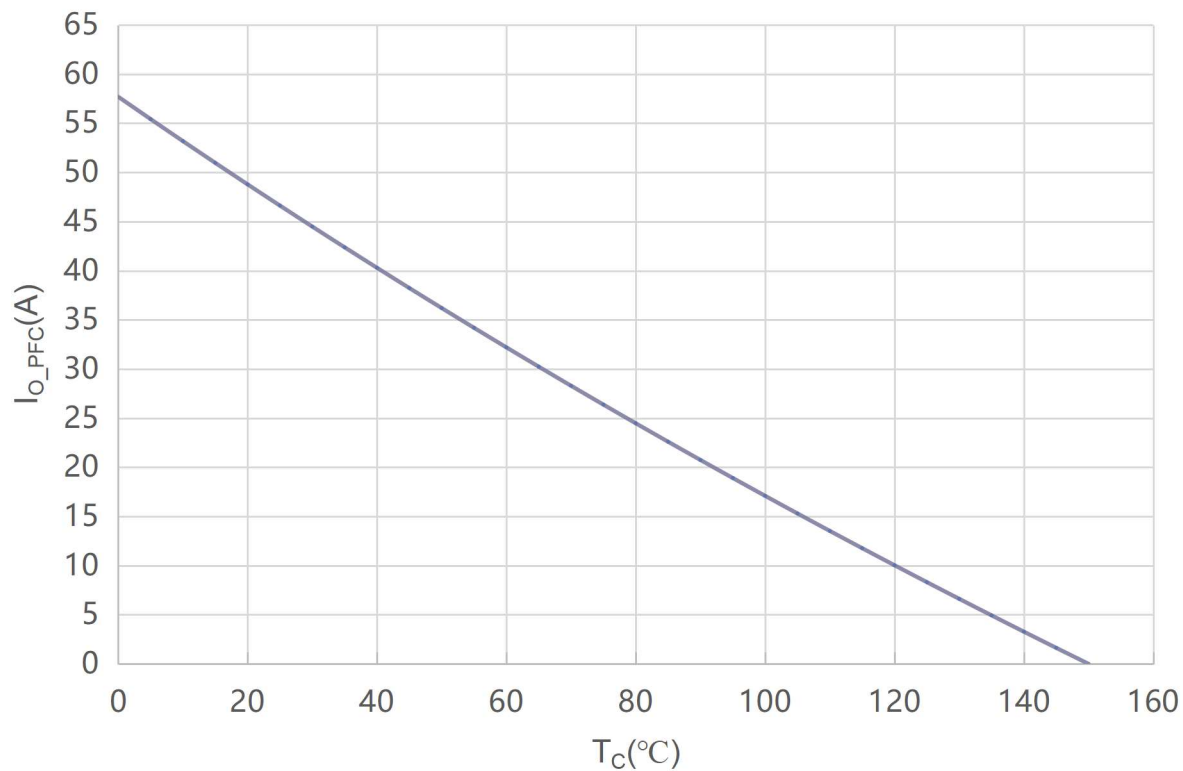


Figure 9 Maximum operating current SOA (PFC Section)

$f_{P_PFC}=60\text{kHz}$, I_{O_PFC} vs. T_C for PFC-IGBT:

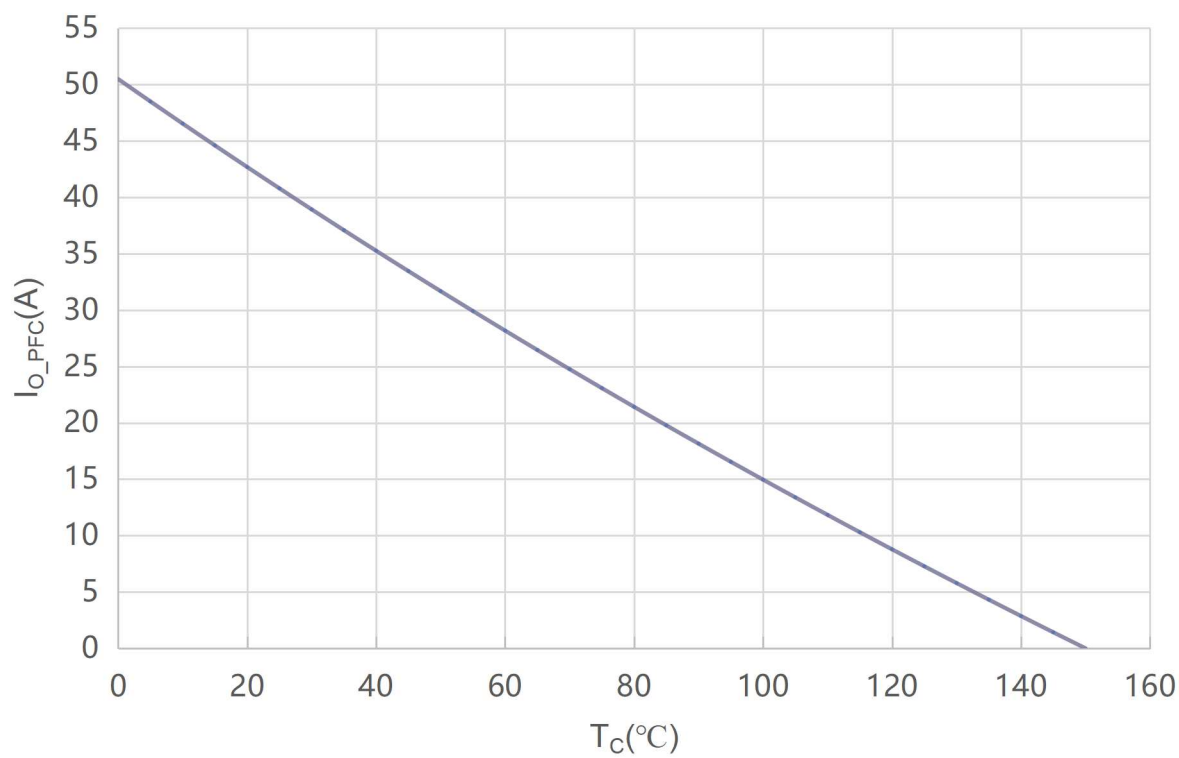


Figure 10 Maximum operating current SOA (PFC Section)

$f_{P_PFC}=80\text{kHz}$, I_{O_PFC} vs. T_C for PFC-IGBT:

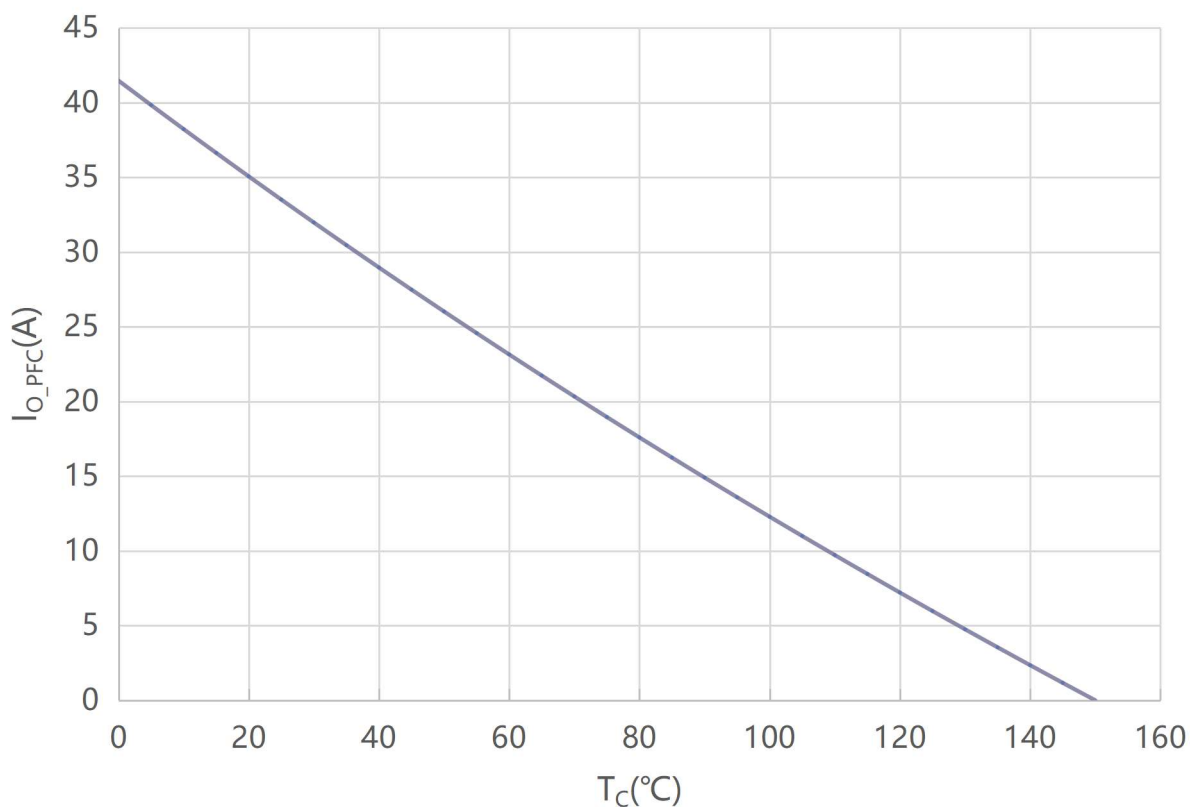


Figure 11 Maximum operating current SOA (PFC Section)

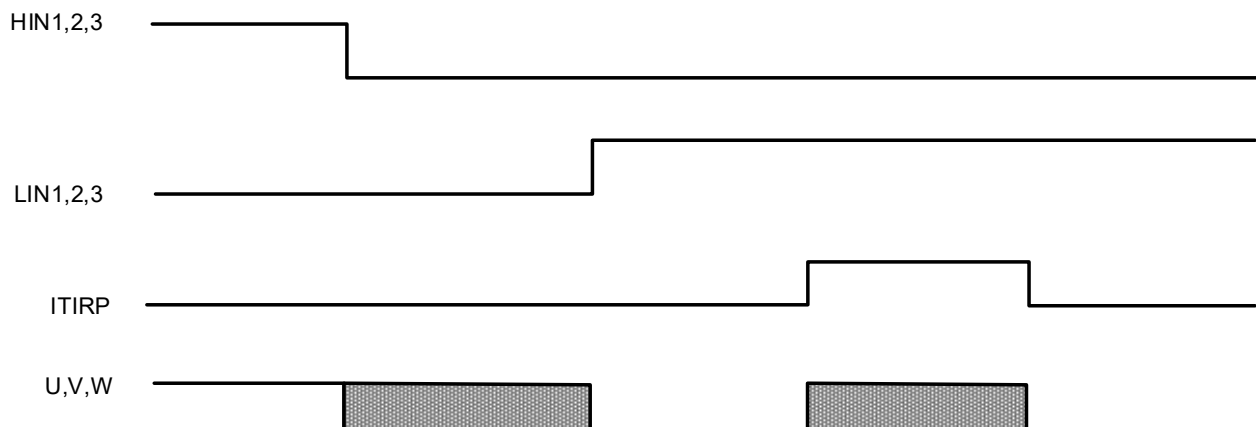


Figure 12 ITRIP timing chart

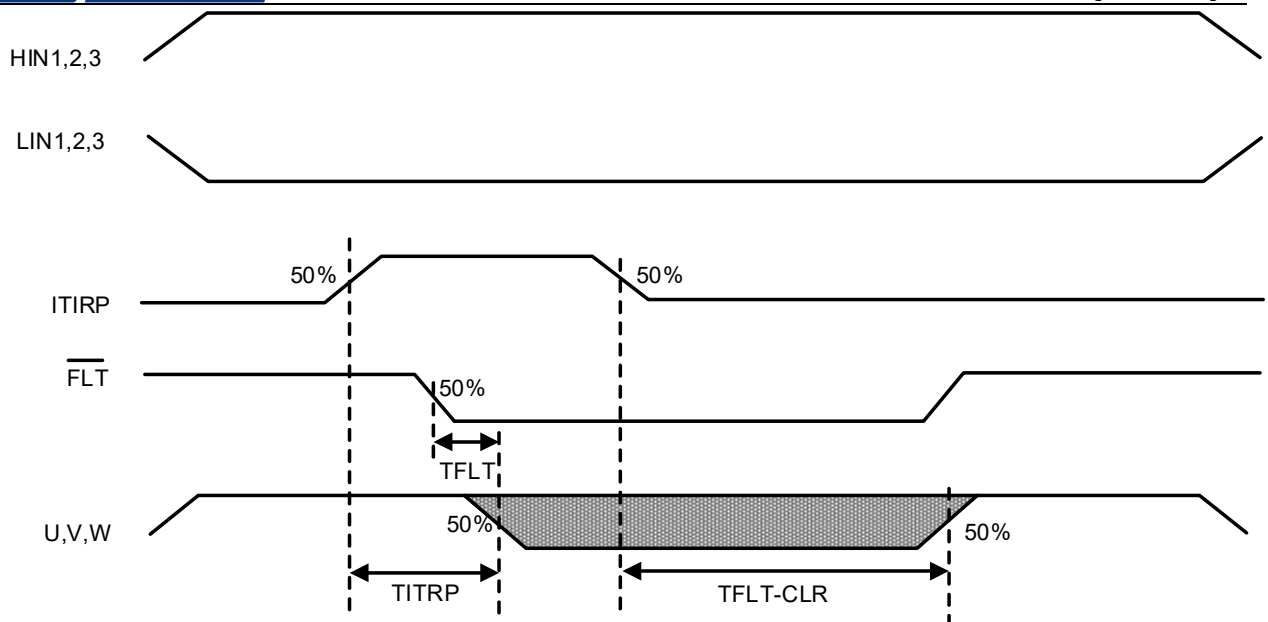


Figure 13 ITRIP、FLT time waveform

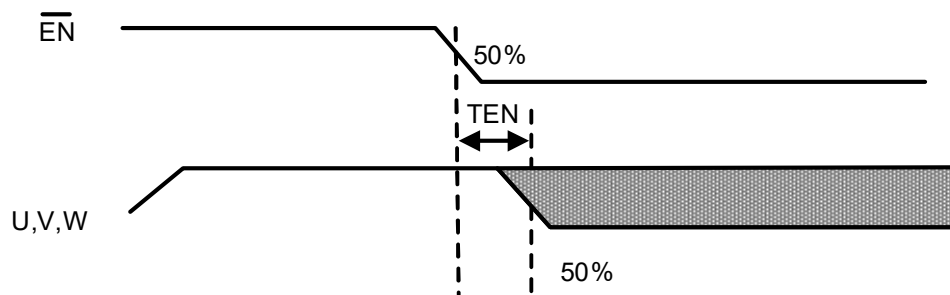


Figure 14 EN time waveform

Note: The shaded area indicates that both the upper and lower bridges are off, At this time, the output voltage of half bridge is determined by the direction of load current.

Circuit of a Typical Application

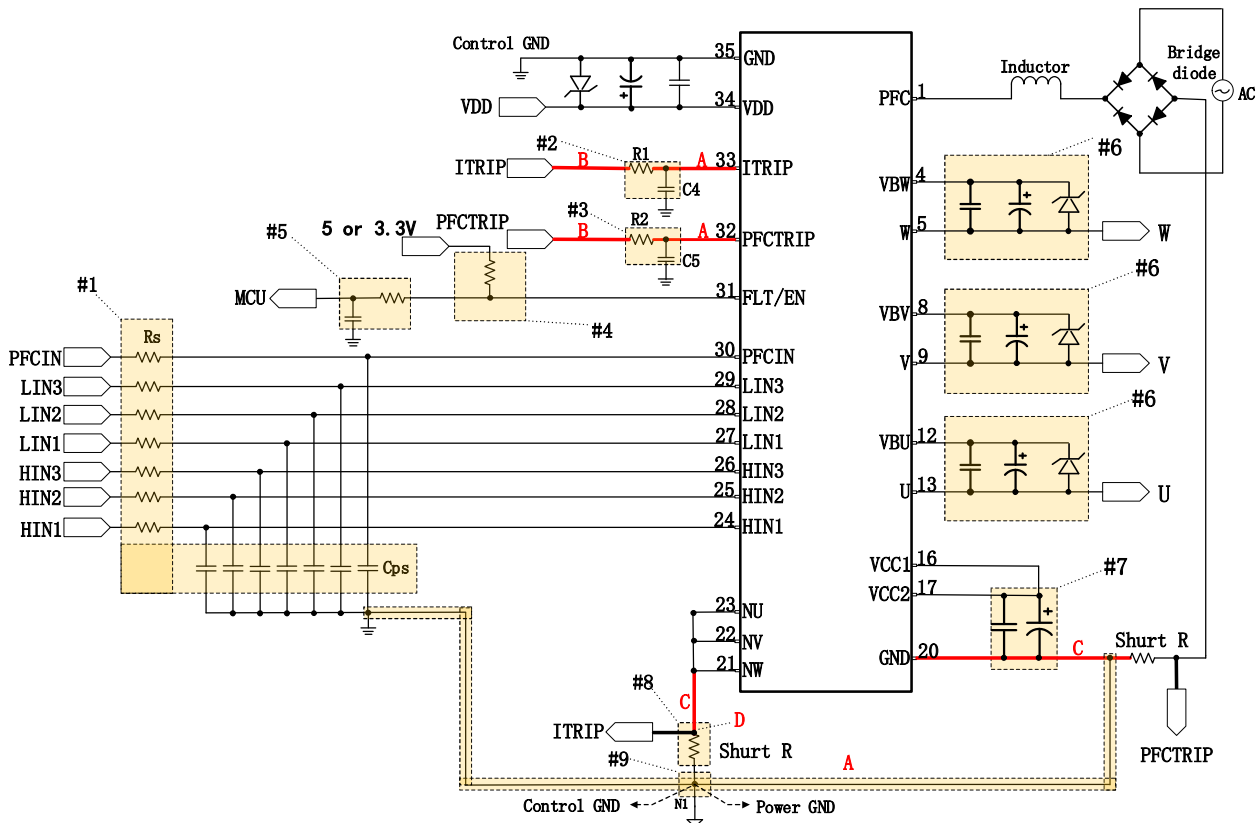


Figure 15 Application circuit

1. Input circuit

- Input signal is active-HIGH type. There is a 4.7kΩ resistor inside the HVIC to pull down each input signal line to GND.
- RC coupling circuits is recommended for the prevention of input signal oscillation. $R_S \cdot C_{PS}$ time constant should be selected in the range 50~150ns (recommended $R_S=100\Omega$, $C_{PS}=1nF$).
- The capacitors should be located close to MIPS terminals (to COM terminal especially).

2. ITRIP circuit

- R_1 , C_4 of RC filter for preventing protection circuit malfunction is recommended to select tight tolerance, temp-compensated type.
- The capacitor must be located close to ITRIP and COM terminals.
- The time constant $R_1 \cdot C_4$ should be set so that SC current is shut down within 2μs (1.5μs~2μs is general value). SC interrupting time might vary with the wiring pattern, so the enough evaluation on the real system is necessary.
- To prevent malfunction, the wiring of A, B, C should be as short as possible.
- The point D at which the wiring to ITRIP filter is divided should be near the terminal of shunt resistor. NU, NV, NW terminals should be connected at near NU, NV, NW terminals.

3. PFCTRIP circuit

- R_2 , C_5 of RC filter for preventing protection circuit malfunction is recommended to select tight tolerance, temp-compensated type.
- The capacitor must be located close to PFCTRIP and COM terminals.

- The time constant $R_2 \cdot C_5$ should be set so that SC current is shut down within $2\mu s$ ($1.5\mu s \sim 3\mu s$ is general value). SC interrupting time might vary with the wiring pattern, so the enough evaluation on the real system is necessary.
- In order to avoid malfunction, PFCT RIP can even be pulled up to MCU power supply from 3.3V to 5V by a $10K \Omega$ resistor, or grounded by a 0Ω resistor.

4. FAULT circuit

- FLT/EN output is open-drain type. This signal line should be pulled up to the positive side of the MCU or control power supply with a resistor that makes I_{FO} below 2 mA.

5. FLT/EN/VTH circuit (IM776-SST、IM776-SAAT)

- FLT/EN output is open-drain type. This signal line should be pulled up to the positive side of the MCU or control power supply with a resistor that makes I_{FO} below 2 mA.
- This terminal should be pulled up to the bias voltage of 5V/3.3V through a proper resistor to define suitable voltage for temperature monitoring.
- It is recommended that RC filter is placed close to the controller.

6. VB-VS circuit

- Capacitors for high side floating supply voltage should be placed close to VB and VS terminals.
- Additional high frequency capacitors, typically $0.1\mu F$, are strongly recommended.
- The zener diode or transient voltage suppressor should be adopted for the protection of HVIC from the surge destruction between each pair of control supply terminals (recommended zener diode is 20V/1W, which has the lower zener impedance characteristic than about 15Ω).

7. Snubber capacitor

- To prevent surge destruction, the wiring between the smoothing capacitor and the P&GND pins should be as short as possible. The use of a high-frequency non-inductive capacitor of around $0.1 \sim 1\mu F$ between the P and GND pins is recommended.

8. Shunt resistor

- SMD type shunt resistors are strongly recommended to minimize its internal stray inductance.
- The point D at which the wiring to ITRIP filter is divided should be near the terminal of shunt resistor. NU, NV, NW terminals should be connected at near NU, NV, NW terminals.

9. Ground pattern

- If control GND is connected with power GND by common broad pattern, it may cause malfunction by power GND fluctuation.
- It is recommended to connect control GND and power GND at only a point N1 (near the terminal of shunt resistor).

10. Noise

- If high frequency noise superimposed to the control supply line, HVIC malfunction might happen and cause MIPS erroneous operation.
To avoid such problem, line ripple voltage should meet $dV/dt \leq \pm 1V/\mu s$, $V_{ripple} \leq 2Vp-p$.

Package

Outline

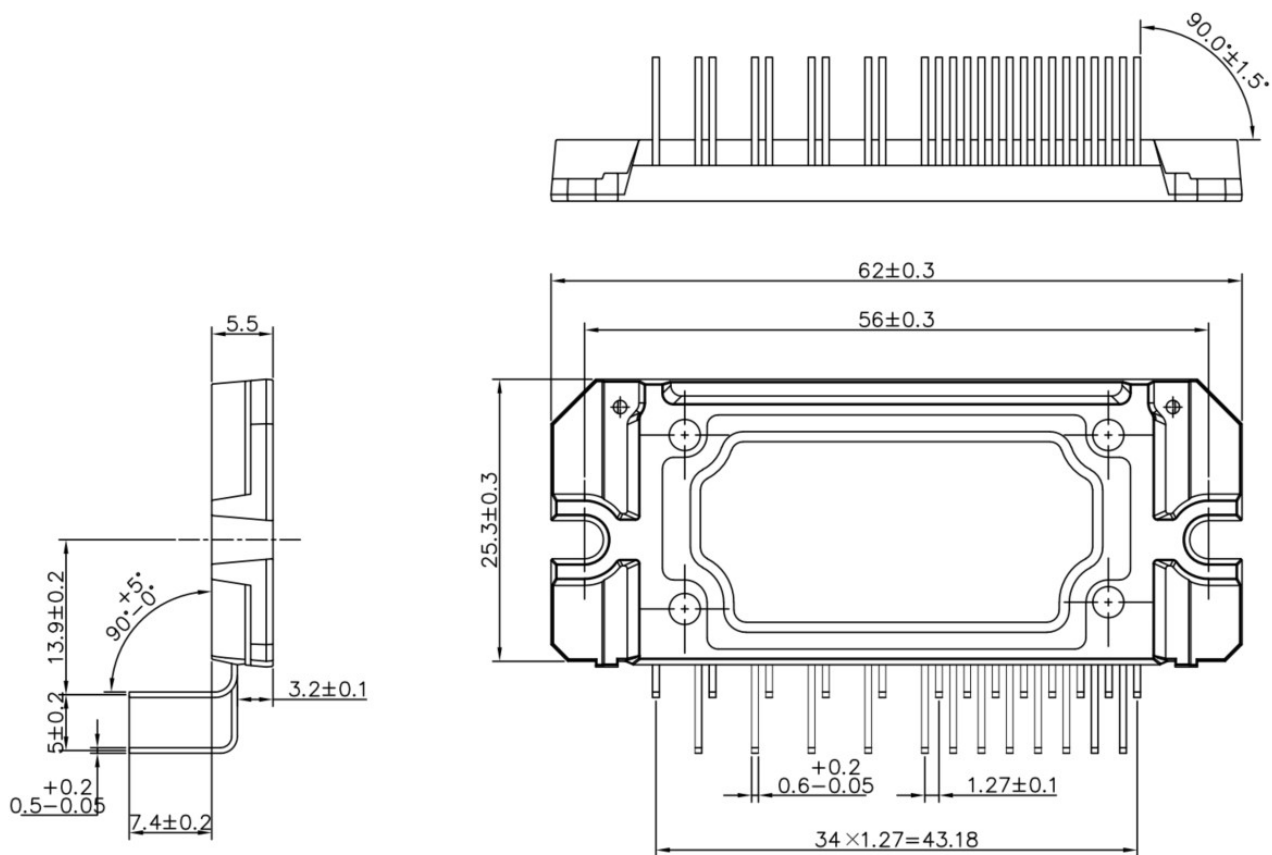


Figure 16 Package Outline

Note: Dimension in mm.