DG Series

Series	Device	Description
DG G ser.	SYIM676-DG	3Φ 20A 600V, (Up to 15kHz)
	SYIM676-DGT	3Φ 20A 600V, (Up to 15kHz), With NTC

Features

- Fully insulated Double in line power module, integrated with three-phase full bridge
- Using IMS insulated and heat-dissipating substrate
- DIP (Double in line) fully insulated package structure is adopted
- Three-phase full bridge 20A 600V
- Active high, compatible with TTL / CMOS level
- Integrated bootstrap functionality
- Independent inverter over-current shutdown
- Under-voltage lockout at all channels
- Cross-conduction prevention
- Fault signal output
- Independent low side IGBT emitter
- Integrated bootstrap functionality
- Temperature monitor（for IM676-DGT）

Description

D G series MIPS is a modular intelligent power system with three-phase full bridge inverter , 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. 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, Exposed package structure with metal substrate ， IPM high heat dissipation can be realized . which is suitable for 5~15kHz carrier frequency.

Device Features

- 3Φ Inverter IGBT: 600V 20A（T_C=25℃）

Target Applications

- Motor drive for consumer electronics
- Low power industrial motor drives

Product information

Model	Package	Marking	Packing Type	Quantity
SYIM676-DXX	DIP26-A	SYIM676-DXX	11PCS/TUBE	144PCS/INNER BOX 1584PCS/CARTON BOX

Internal Electrical Schematic

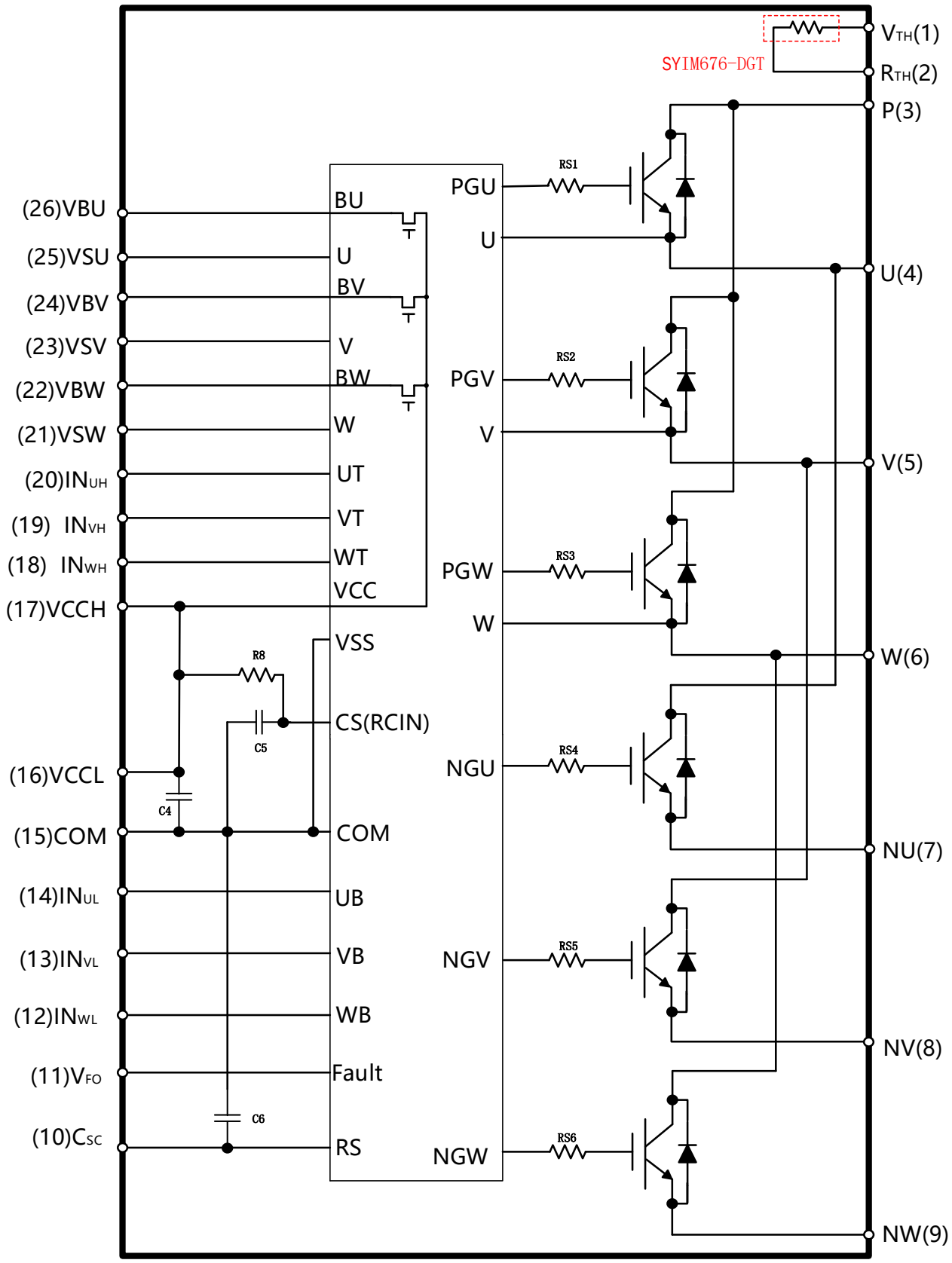
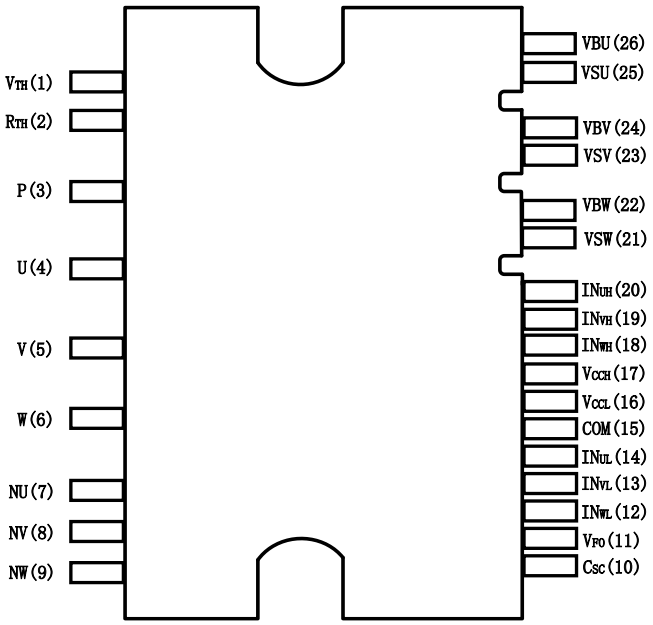


Figure 1 Module Circuit Diagram

Note: SYIM676-DGT built in NTC thermistor；SYIM676-DG there is no thermistor.

Pin Assignment



引脚序号	符号	描述
1	V_{TH}	Thermistor Bias Voltage
2	R_{TH}	Series Resistor for the Use of Thermistor (Temperature Detection)
3	P	Bus voltage input terminal
4	U	Output for U Phase
5	V	Output for V Phase
6	W	Output for W Phase
7	N_U	Negative DC–Link Input for U Phase
8	N_V	Negative DC–Link Input for V Phase
9	N_W	Negative DC–Link Input for W Phase
10	C_{SC}	Over current shutdown input
11	V_{FO}	Fault output
12	IN_{WL}	Signal Input for Low-side W Phase
13	IN_{VL}	Signal Input for Low-side V Phase
14	IN_{UL}	Signal Input for Low-side U Phase
15	COM	Common Supply Ground
16	V_{CCL}	Low side control supply
17	V_{CCH}	High side control supply
18	IN_{WH}	Signal Input for High-side W Phase
19	IN_{VH}	Signal Input for High-side V Phase
20	IN_{UH}	Signal Input for High-side U Phase
21	V_{SW}	W-phase high side floating IC supply offset voltage
22	V_{BW}	W-phase high side floating IC supply voltage
23	V_{SV}	V-phase high side floating IC supply offset voltage
24	V_{BV}	V-phase high side floating IC supply voltage
25	V_{SU}	U-phase high side floating IC supply offset voltage
26	V_{BU}	U-phase high side floating IC supply voltage

Absolute Maximum Ratings (V_{DD}=15V, V_{GE}=15V, T_C=25℃ 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	

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	T_C=25°C	-	38	W

Control Section

Symbol	Parameter	Condition	Min	Max	Unit
V_{DD}	Module supply voltage		-	20	V
V_{BS}	High side floating supply voltage (V_B vs. V_S)		-	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_{CSC}	CSC Input voltage		-0.5	5	

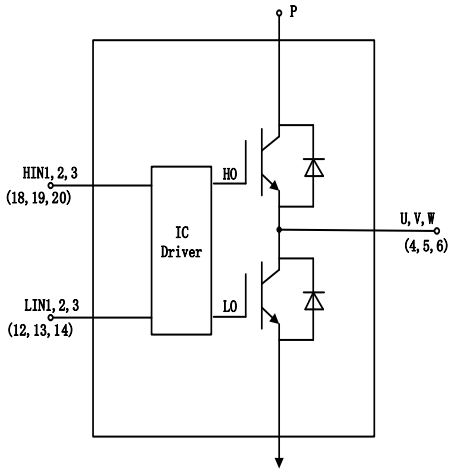
Thermal characteristics

Symbol	Parameter	Condition	Min	Max	Unit
$R_{TH(J-C)INVG}$	Inverter IGBT J-C thermal resistance		-	2.6	°C/W
$R_{TH(J-C)INVD}$	Inverter FRD J-C thermal resistance		-	3.7	°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}	High\Low side supply voltage	13.5	15	18	
V_{IN}	LIN, HIN, PFCIN, CSC, FLT/EN input voltage	0	-	5	
f_{P_INV}	PWM frequency (Inverter)	-	-	15	kHz
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



C_{sc}	$HIN_{1,2,3}$	$LIN_{1,2,3}$	U,V,W	V_{FO}
0	1	0	P	1
0	0	1	0	1
0	0	0	OFF	1
0	1	1	OFF	1
1	X	X	OFF	1
X	X	X	OFF	0

Figure 2 Input-Output logic table

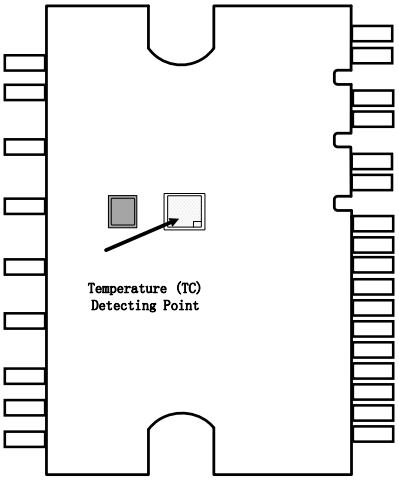


Figure 3 T_C measurement point

Electrical Characteristics

Static Parameters (V_{DD}=15V, V_{GE}=15V, T_C=25℃ if not stated otherwise)

Inverter Section

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$V_{CE(sat)}$	Collector-Emitter saturation voltage	I_C=20A	-	2.3	2.7	V
I_{CES}	Collector-Emitter leakage current	V_{IN}=0V,V_{CC}=600 V, TC=25℃	-	-	0.1	mA
		V_{IN}=0V,V_{CC}=600 V, T_C=125°C	-	-	1	
V_{FM}	Diode forward voltage	I_F=20A	-	1.7	2.3	V

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		-	-	0.8	
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	11.4	12.5	
V_{DDUV-}	VDD supply under voltage negative going threshold		10	11.2	12.3	
V_{FOH}	output high level	4.7 kΩ to 5 V Pull-up	4.5	-	-	
V_{FOL}	output low level		-	-	0.5	
V_{csc}	csc threshold voltage		0.45	0.50	0.55	
I_{QBS}	VBS Quiescent supply current		-	17	30	μA
I_{QDD}	VDD Quiescent supply current		-	-	2.7	mA
I_{IN+}	LIN, HIN, PFCIN current	V_{IN} =3.3V	-	100	-	μA
I_{IN-}	LIN, HIN, PFCIN current	V_{IN} =0V	-1	0	1	
I_{csc+}	High CSC input bias current	V_{csc} =3.3V	-	3.3	6	
I_{csc-}	Low CSC input bias current	V_{csc} =0V	-1	0	-1	
R_{FLT}	Fault Low level on state resistance		-	50	100	Ω

Dynamic Parameters (V_{DD}=15V, V_{GE}=15V, T_C=25℃ if not stated otherwise)

Inverter Section

Symbol	Parameter	Condition	Min	Typ	Max	Unit
t_{ON}	Turn-on propagation delay time	I_C=20A, V_{CC}=330V, V_{IN}=0V or 5V, Inductive load	-	0.75	1.20	μs
t_{con}	Open process time		-	0.45	0.75	
t_{OFF}	Turn-off propagation delay time		-	0.90	1.45	
t_{COFF}	turn-off process time		-	0.30	0.45	
t_{rr}	reverse recovery time		-	0.12	-	

Control Section

Symbol	Parameter	Condition	Min	Typ	Max	Unit
t_{FLT}	FLT trigger delay time (Figure 9)		-	0.55	-	μs
t_{FLT_CLR}	FLT clearance delay time (Figure 9)		1.1	1.7	2.5	ms
T_{csc}	CSC to shutdown propagation delay (Figure 9)		-	1.5	-	μs

NTC characteristic (SYIM676-DGT)

Symbol	Parameter	Condition	Min	Typ	Max	Unit
R_{25}	25°C resistance	T_C=25°C	99	100	101	kΩ
R_{100}	100°C resistance	T_C=100°C	5.18	5.38	5.60	
B	B constant (25°C~50°C)	$R_2=R_1e^{[B(1/T2-1/T1)]}$	4208	4250	4293	K
TEMP	temperature range		-40	-	125	°C

NCP15WF104F03RC
R25 100 k ohm +/- 1 %
B(25/50) 4250 K +/- 1 %

TEMP. (deg.C)	R-low (k ohm)	R-center (k ohm)	R-high (k ohm)	TEMP. (deg.C)	R-low (k ohm)	R-center (k ohm)	R-high (k ohm)
-40	4191.5221	4397.1193	4612.3399	2	313.2543	320.1216	327.1067
-39	3904.3007	4092.8737	4290.1256	3	296.9408	303.2866	309.737
-38	3638.6865	3811.717	3992.5763	4	281.5705	287.4335	293.3892
-37	3392.915	3551.7485	3717.6457	5	267.0836	272.4995	277.9074
-36	3165.3767	3311.2358	3463.4696	6	253.4246	258.4264	263.5006
-35	2954.6027	3088.5989	3228.3492	7	240.5415	245.1598	249.8418
-34	2759.2514	2882.3958	3010.735	8	228.386	232.6491	236.968
-33	2578.0968	2691.3096	2809.213	9	216.9132	220.8471	224.8299
-32	2410.0177	2514.137	2622.4921	10	206.0809	209.7098	213.3813
-31	2253.9885	2349.7776	2449.3926	11	195.85	199.1962	202.5794
-30	2109.07	2197.225	2288.8359	12	186.1838	189.2681	192.3843
-29	1974.402	2055.5577	2139.8353	13	177.0481	179.8896	182.7585
-28	1849.1959	1923.9316	2001.4876	14	168.411	171.0275	173.6673
-27	1732.7288	1801.5732	1872.9656	15	160.2427	162.6506	165.0781
-26	1624.337	1687.7731	1753.5114	16	152.512	154.7264	156.9573
-25	1523.4112	1581.8805	1642.4297	17	145.197	147.2321	149.2807
-24	1429.2026	1483.0995	1538.8751	18	138.2731	140.142	142.0219
-23	1341.4177	1391.1132	1442.5055	19	131.7174	133.4322	135.1557
-22	1259.5795	1305.4128	1352.7786	20	125.5083	127.0802	128.659
-21	1183.249	1225.5307	1269.1963	21	119.6263	121.0658	122.5104
-20	1112.0223	1151.0367	1191.3009	22	114.0515	115.3684	116.6887
-19	1045.5274	1081.5351	1118.671	23	108.7664	109.9695	111.1748
-18	983.4216	1016.6613	1050.9194	24	103.7544	104.8521	105.9508
-17	925.3889	956.0796	987.6893	25	99	100	101
-16	871.1382	899.4806	928.6522	26	94.3996	95.3981	96.3975
-15	820.4005	846.5788	873.5051	27	90.0373	91.0322	92.029
-14	772.9276	797.111	821.9688	28	85.8993	86.889	87.8813
-13	728.4903	750.8341	773.7859	29	81.9732	82.9561	83.9424
-12	686.8767	707.5237	728.7184	30	78.247	79.2216	80.2004
-11	647.8909	666.9723	686.5469	31	74.7099	75.6752	76.6453
-10	611.3519	628.9882	647.0685	32	71.3511	72.306	73.2662
-9	577.0418	593.3421	610.0418	33	68.1608	69.1042	70.0537
-8	544.8642	559.9309	575.3567	34	65.1296	66.0608	66.9986
-7	514.6742	528.6016	542.8516	35	62.2488	63.1671	64.0926
-6	486.3375	499.2124	512.377	36	59.5102	60.415	61.3275
-5	459.7296	471.6321	483.7943	37	56.9061	57.7969	58.6958
-4	434.7669	445.7716	457.0092	38	54.4292	55.3056	56.1905
-3	411.305	421.4796	431.8627	39	52.0726	52.9343	53.8048
-2	389.2453	398.6521	408.2455	40	49.83	50.6766	51.5325
-1	368.496	377.1927	386.056	41	47.6969	48.5283	49.3693
0	348.9722	357.0117	365.1999	42	45.666	46.482	47.3079
1	330.5751	338.0058	345.569	43	43.7319	44.5325	45.3431

NCP15WF104F03RC
R25 100 k ohm +/- 1 %
B(25/50) 4250 K +/- 1 %

TEMP. (deg.C)	R-low (k ohm)	R-center (k ohm)	R-high (k ohm)	TEMP. (deg.C)	R-low (k ohm)	R-center (k ohm)	R-high (k ohm)
44	41.8896	42.6745	43.4699	86	8.2806	8.5722	8.8733
45	40.1341	40.9035	41.6835	87	7.9988	8.2834	8.5772
46	38.4593	39.2132	39.9778	88	7.7279	8.0055	8.2924
47	36.8626	37.601	38.3503	89	7.4673	7.7383	8.0182
48	35.34	36.0629	36.797	90	7.2167	7.4811	7.7543
49	33.8878	34.5953	35.3142	91	6.9764	7.2344	7.5012
50	32.5022	33.1946	33.8983	92	6.7453	6.9971	7.2575
51	31.1818	31.8591	32.5479	93	6.5228	6.7685	7.0228
52	29.9215	30.5839	31.2579	94	6.3086	6.5484	6.7967
53	28.7183	29.366	30.0253	95	6.1024	6.3365	6.5789
54	27.5694	28.2026	28.8474	96	5.9031	6.1316	6.3682
55	26.472	27.0909	27.7215	97	5.7112	5.9341	6.1652
56	25.4236	26.0284	26.6449	98	5.5263	5.7439	5.9695
57	24.4218	25.0127	25.6154	99	5.3482	5.5606	5.7808
58	23.4643	24.0416	24.6306	100	5.1766	5.3839	5.5989
59	22.5489	23.1128	23.6884	101	5.0119	5.2143	5.4243
60	21.6737	22.2243	22.7867	102	4.8531	5.0507	5.2558
61	20.8365	21.3743	21.9237	103	4.7001	4.893	5.0934
62	20.0357	20.5607	21.0974	104	4.5526	4.7409	4.9366
63	19.2694	19.782	20.3062	105	4.4103	4.5942	4.7853
64	18.536	19.0364	19.5484	106	4.2731	4.4527	4.6393
65	17.834	18.3225	18.8224	107	4.1407	4.3161	4.4984
66	17.1633	17.6401	18.1283	108	4.013	4.1843	4.3624
67	16.521	16.9864	17.4631	109	3.8898	4.057	4.231
68	15.9058	16.36	16.8254	110	3.7709	3.9342	4.1042
69	15.3164	15.7596	16.2141	111	3.6561	3.8156	3.9817
70	14.7516	15.1841	15.6278	112	3.5452	3.7011	3.8634
71	14.209	14.631	15.0641	113	3.4383	3.5905	3.749
72	13.6888	14.1006	14.5234	114	3.3349	3.4836	3.6386
73	13.19	13.5918	14.0045	115	3.2351	3.3804	3.5318
74	12.7117	13.1037	13.5065	116	3.1393	3.2812	3.4292
75	12.2529	12.6354	13.0285	117	3.0466	3.1853	3.33
76	11.8139	12.1871	12.5708	118	2.9571	3.0926	3.2341
77	11.3926	11.7567	12.1312	119	2.8706	3.0031	3.1413
78	10.9883	11.3436	11.7091	120	2.787	2.9164	3.0516
79	10.6002	10.9468	11.3036	121	2.7057	2.8322	2.9643
80	10.2276	10.5657	10.9139	122	2.6271	2.7508	2.8799
81	9.8697	10.1996	10.5395	123	2.5511	2.672	2.7982
82	9.526	9.8479	10.1796	124	2.4777	2.5958	2.7192
83	9.1958	9.5098	9.8336	125	2.4066	2.522	2.6427
84	8.8785	9.1849	9.5009				
85	8.5736	8.8726	9.181				

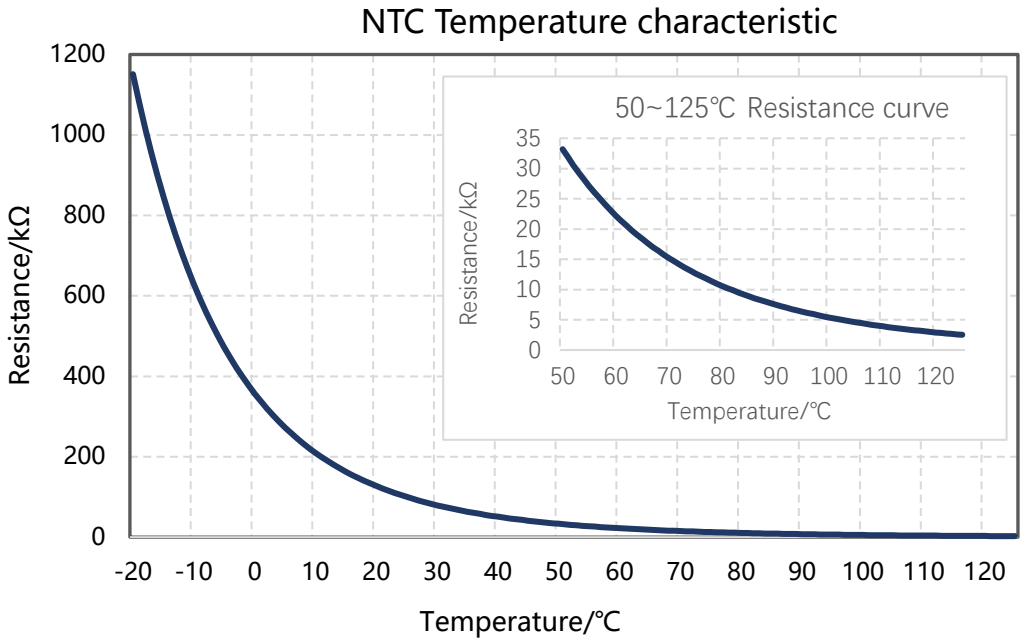


Figure 4 NTC Temperature - Resistance

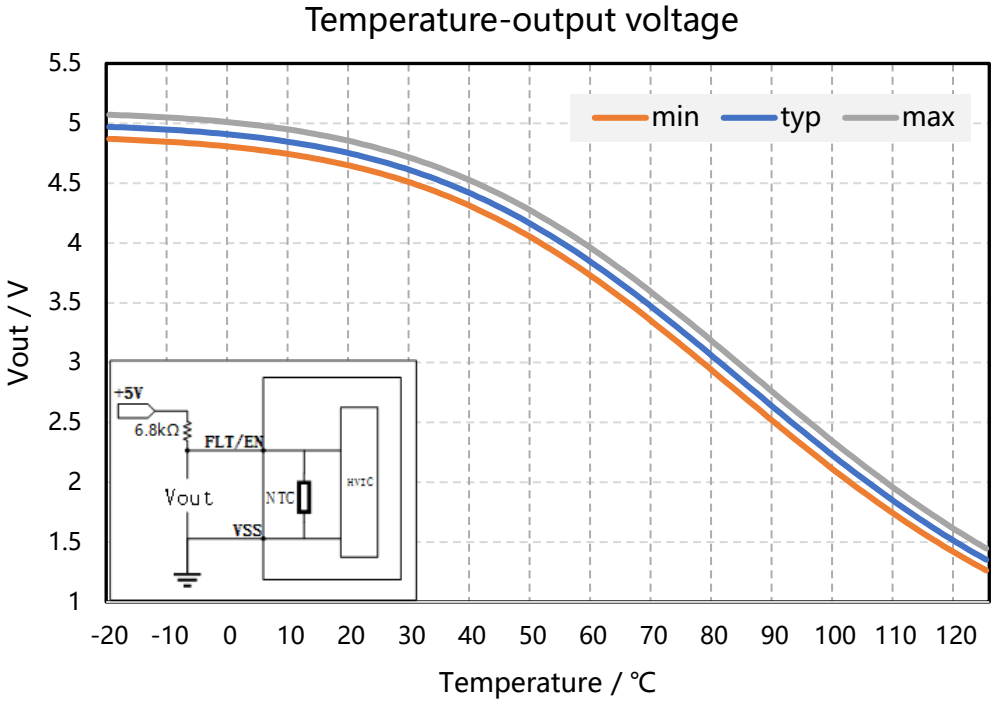


Figure 5 NTC Temperature – Voltage

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

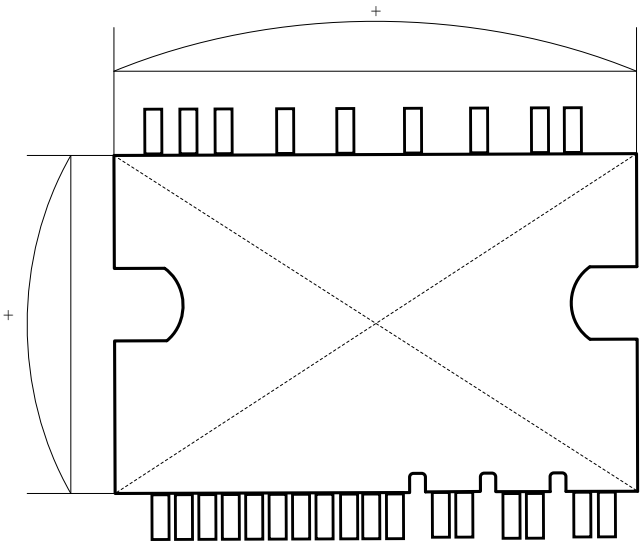
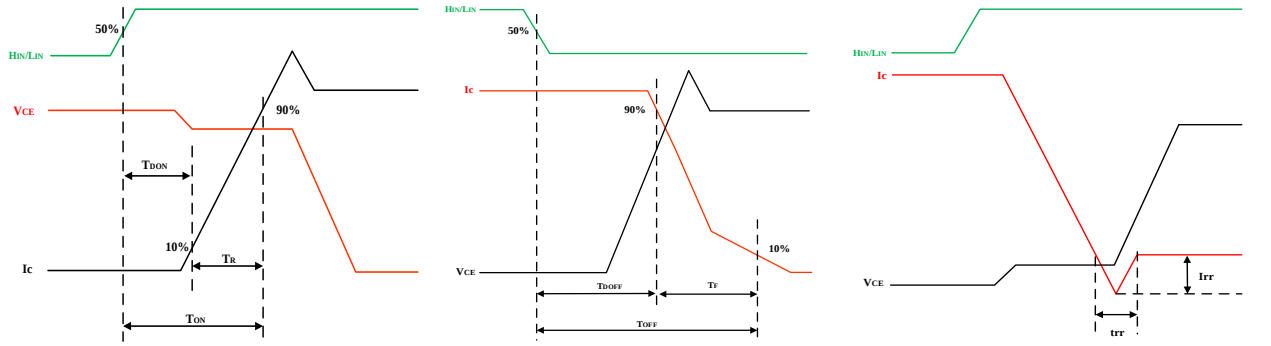


Figure 6 Backside curvature measurement position



a. Turn-on b. Turn-off c. FRD Reverse Recovery Time

Figure 7 Switching times definition

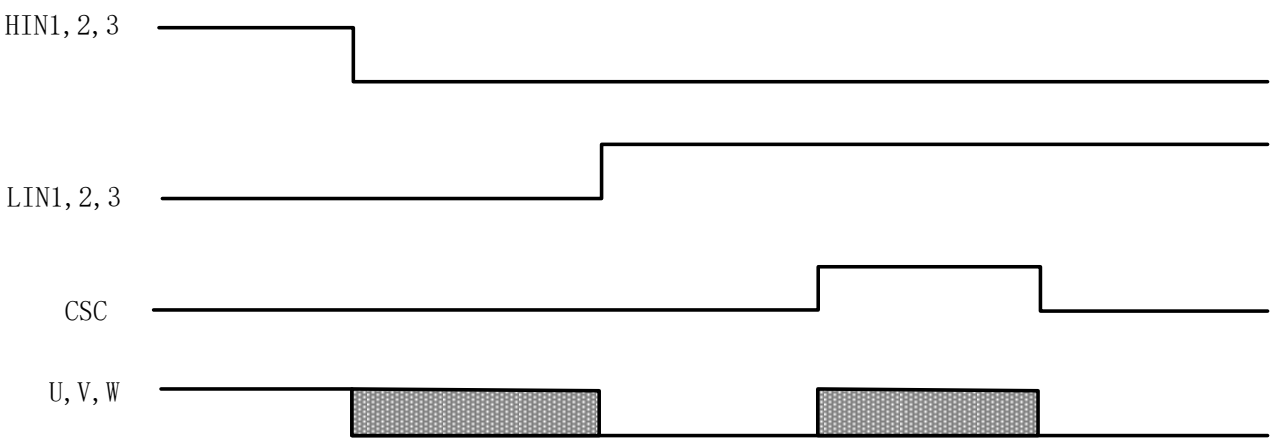


Figure 8 CSC timing chart

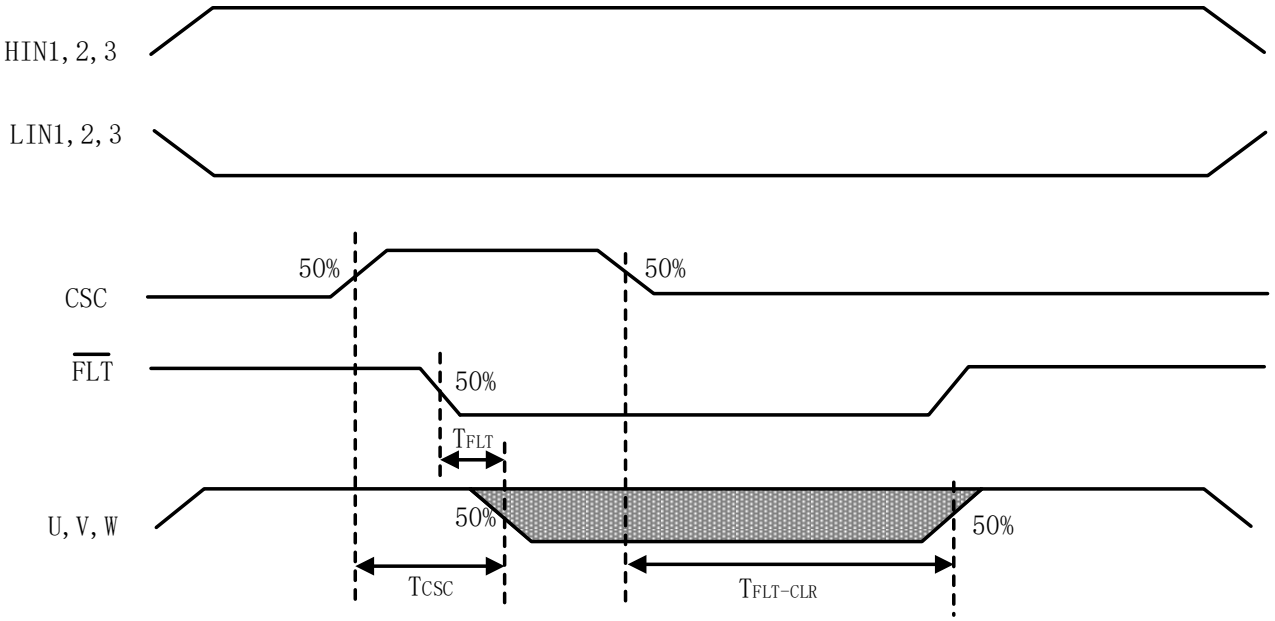


Figure 9 CSC、FLT time waveform

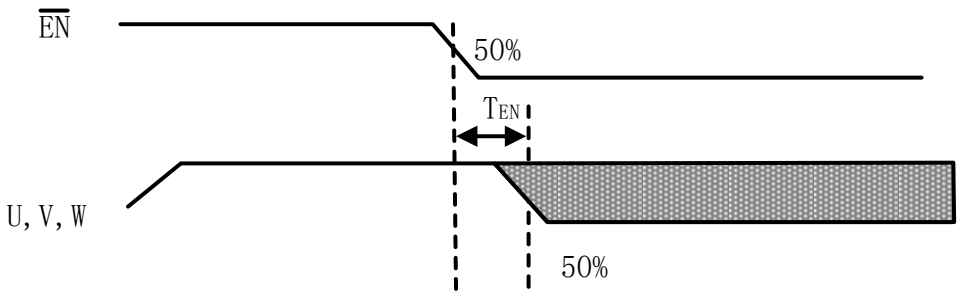


Figure 10 EN time waveform

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.

f_P=10kHz, RMS output current for inverter：

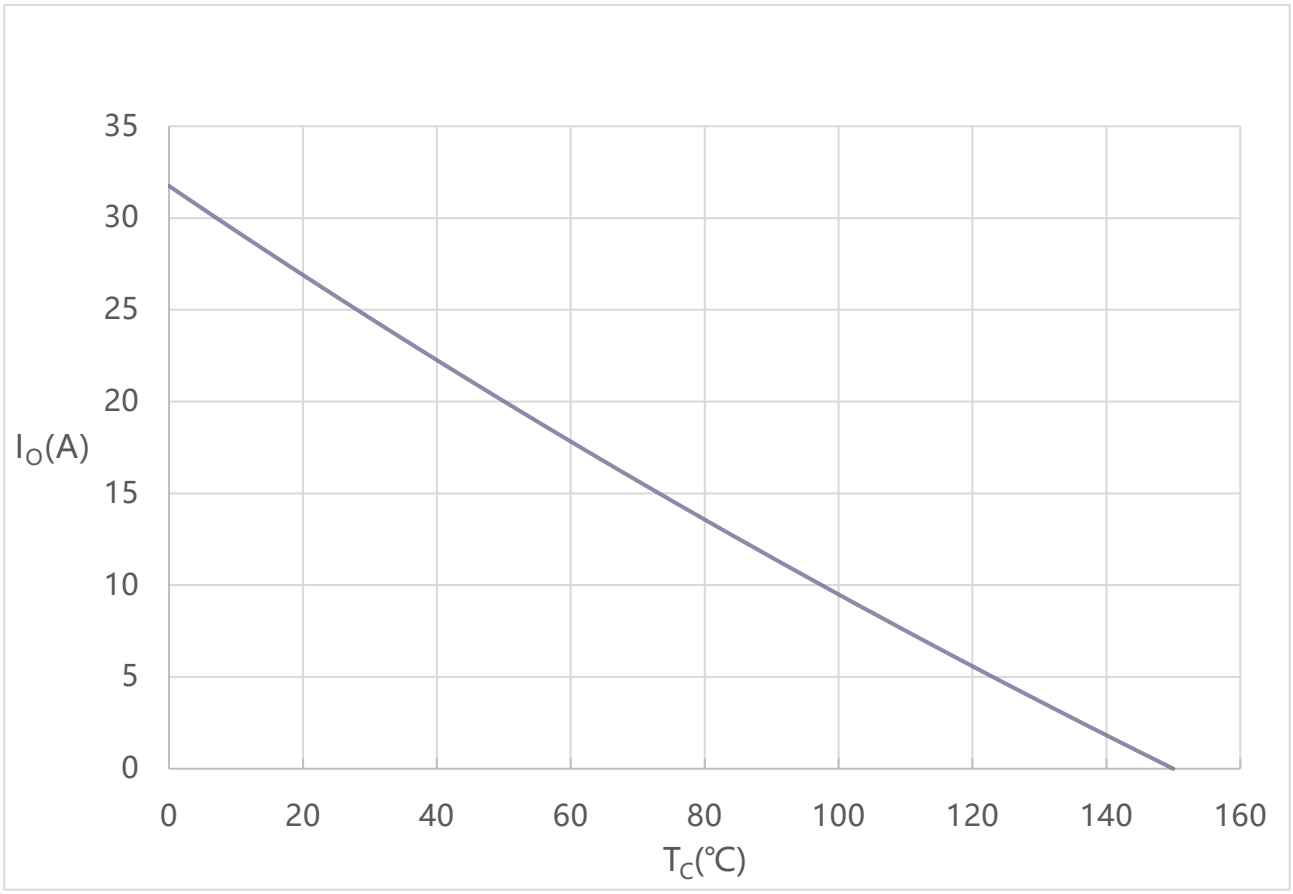


Figure 11　Maximum operating current SOA（Inverter Section）

Circuit of a Typical Application

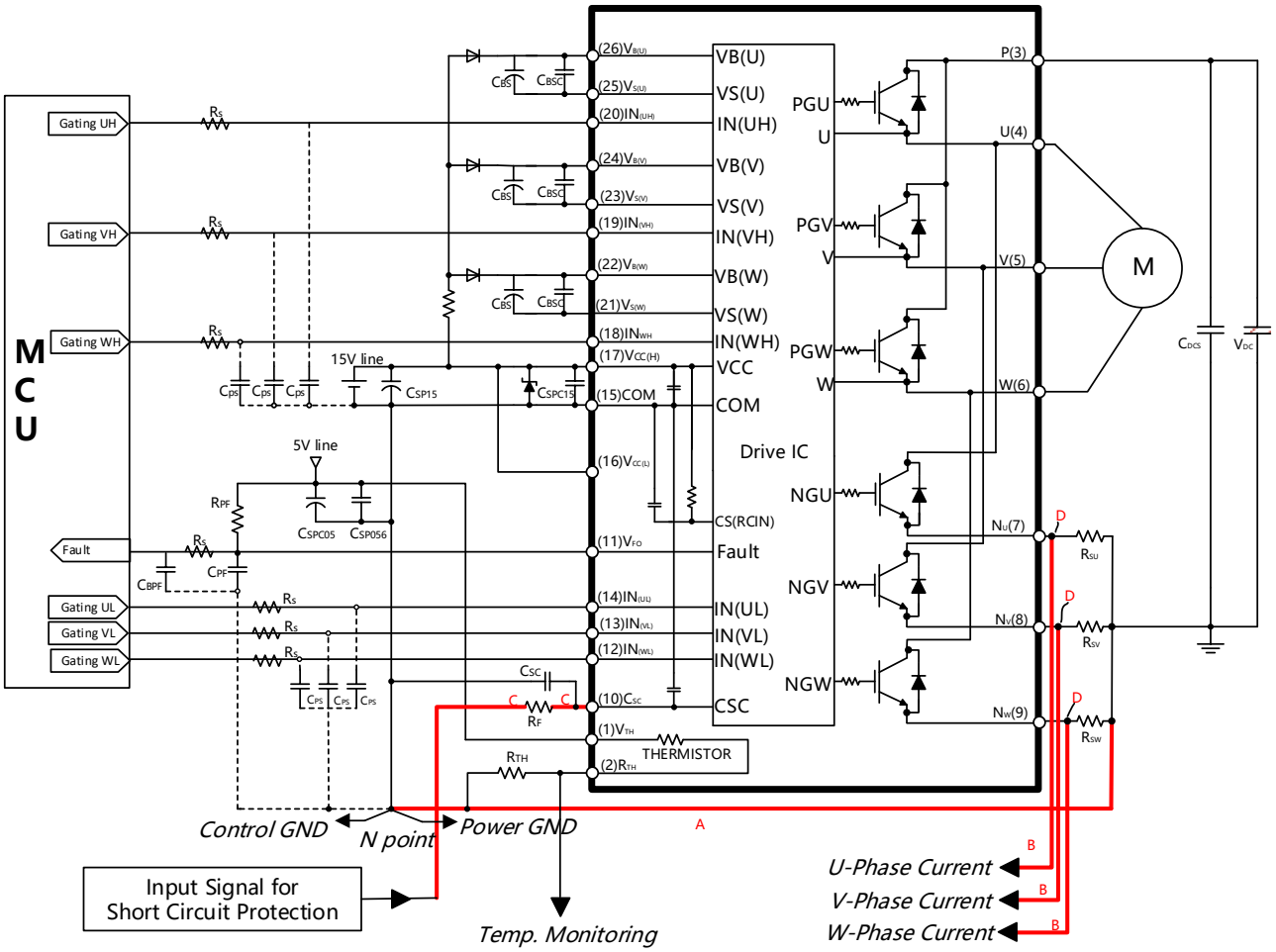


Figure 12 Application circuit

1. Input circuit

- Input signal is active-HIGH type. There is a 42kΩ resistor inside the HVIC to pull down each input signal line to GND.
- RC coupling circuits is recommanded 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=100Ω, C_{PS}=1nF).
- The capacitors should be located close to MIPS terminals (to COM terminal especially).

2. CSC circuit

- R_F, Ccsc of RC filter for preventing protection circuit malfunction is recommended to select tight tolerance, temp-compensated type.
- The capacitor must be located close to CSC and COM terminals.
- The time constant $R_F \cdot C_{csc}$ 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 CSC 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. 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.

4. VTH/RTH circuit (SYIM676-DGT)

- 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.

5. VB-VS circuit

- Capacitors for high side floating supply voltage should be placed close to VB and VS terminals.
- Additional high frequency capacitors, typically 0.1μF, are strongly recommended.
- In application design, it is strongly recommended to add a bootstrap circuit. When the bootstrap circuit is not used, each upper-side pre-driver needs an external independent power supply to ensure that the upper bridge is normally turned on.
- 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).

6. 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 0.1~1μF between the P and GND pins is recommended.

7. Shunt resistor

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

8. 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).

9. 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 ≤+/-1V/μs, Vripple≤2Vp-p.

Package Outline

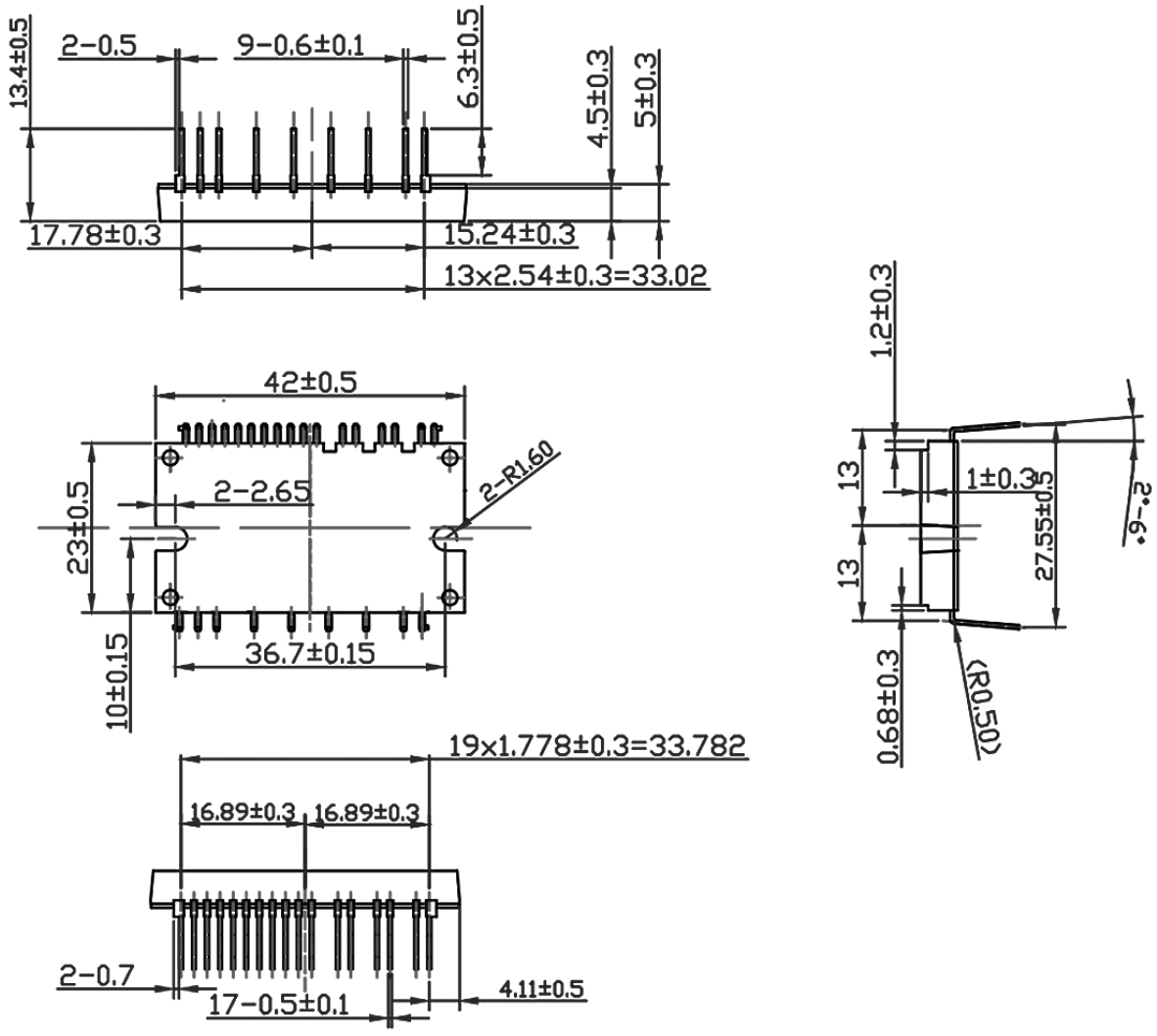


Figure 13 Package Outline

Note 1：All structural dimensions are in mm.