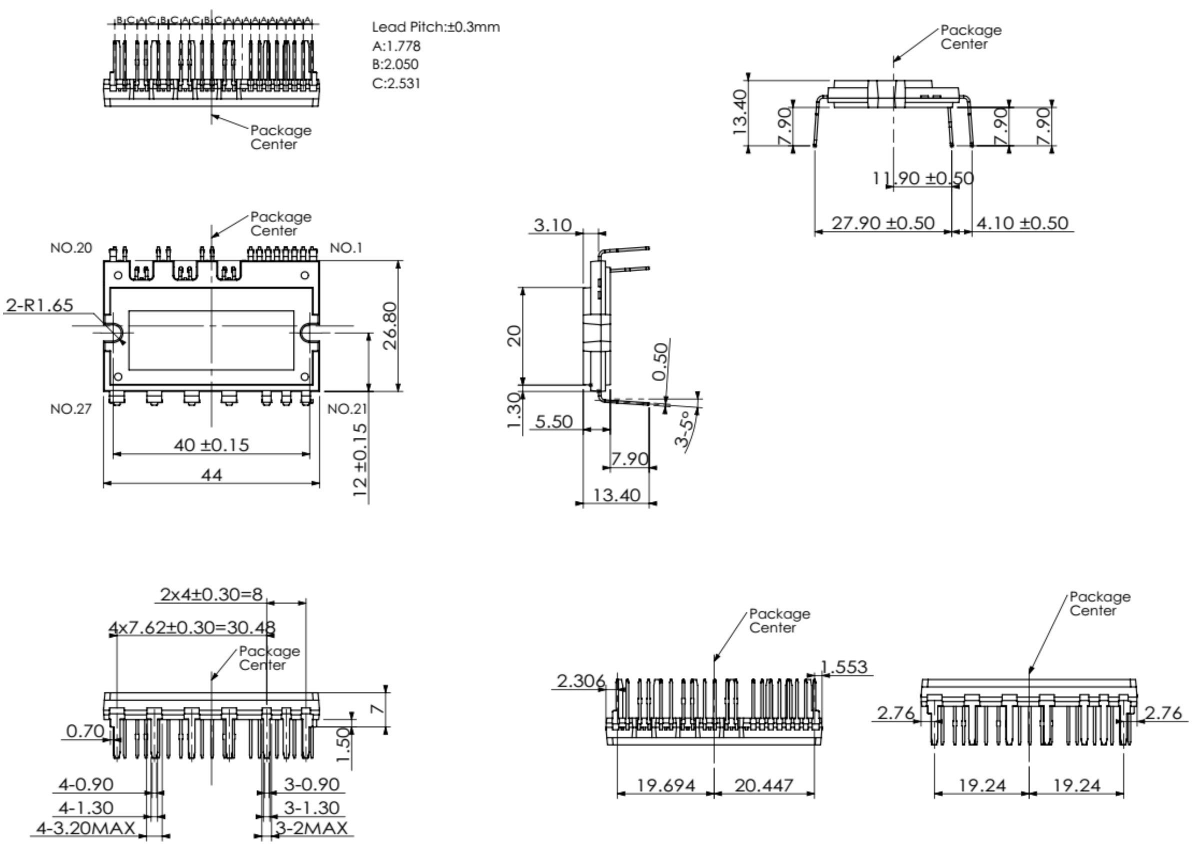
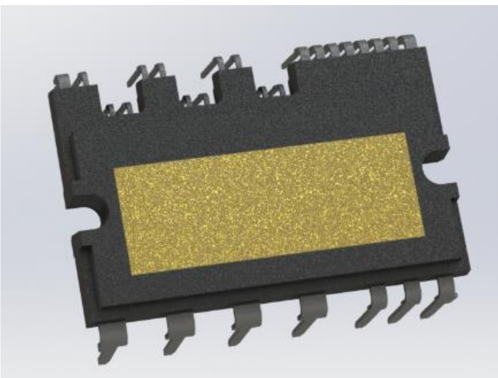
Compact - IPM ID20FFX60U3S

Features

- UL 1557 Certified.
- Adopt the latest trench IGBT technology to get a good overall loss trade-off.
- Open Emitter on N terminal for low cost current sensing application.
- Matched propagation delay and arm shooting through prevention.
- Built-in bootstrap diodes with current limiting resistor.
- Provide a fault signal (FO pin) and shut-off internal IGBT when suffer S.C. and under-voltage faulty event.
- RoHS compatible.





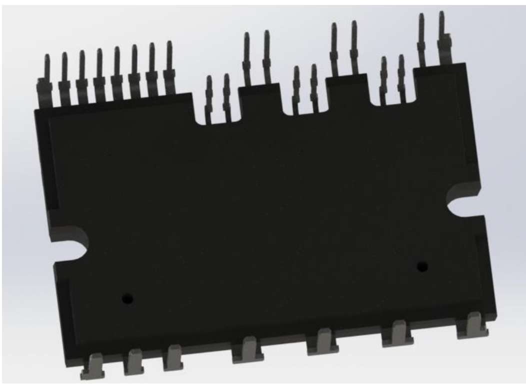


Table1: Pin Descriptions

No.	Symbol	Pin Description
1	V_{CCL}	Low-Side Common Bias Voltage for IC and IGBTS Driving
2	COM	Common Supply Ground
3	$IN_{(UL)}$	Signal Input Terminal for Low-side U Phase
4	$IN_{(VL)}$	Signal Input Terminal for Low-side V Phase
5	$IN_{(WL)}$	Signal Input Terminal for Low-side W Phase
6	V_{FO}	Fault Output Terminal
7	C_{FOD}	Capacitor for Fault Output Duration Selection
8	C_{SC}	Short-Current Detection Input
9	$IN_{(UH)}$	Signal Input Terminal for High-side U Phase
10	V_{CCH}	High-Side Common Bias Voltage for IC and IGBTS Driving
11	$V_{B(U)}$	High-Side Bias Voltage for U-Phase IGBT Driving
12	$V_{S(U)}$	High-Side Bias Voltage Ground for U-Phase IGBT Driving
13	$IN_{(VH)}$	Signal Input Terminal for High-side V Phase
14	V_{CCH}	High-Side Common Bias Voltage for IC and IGBTS Driving
15	$V_{B(V)}$	High-Side Bias Voltage for V-Phase IGBT Driving
16	$V_{S(V)}$	High-Side Bias Voltage Ground for V-Phase IGBT Driving
17	$IN_{(WH)}$	Signal Input Terminal for High-side V Phase
18	V_{CCH}	High-Side Common Bias Voltage for IC and IGBTS Driving
19	$V_{B(W)}$	High-Side Bias Voltage for W-Phase IGBT Driving
20	$V_{S(W)}$	High-Side Bias Voltage Ground for W-Phase IGBT Driving
21	Nu	Negative DC-Link Input Terminal for U Phase
22	Nv	Negative DC-Link Input Terminal for V Phase
23	Nw	Negative DC-Link Input Terminal for W Phase
24	U	Output Terminal for U Phase
25	V	Output Terminal for V Phase
26	W	Output Terminal for W Phase
27	P	Positive DC – Link Input

(see figure 2, next page)

Pin Configuration

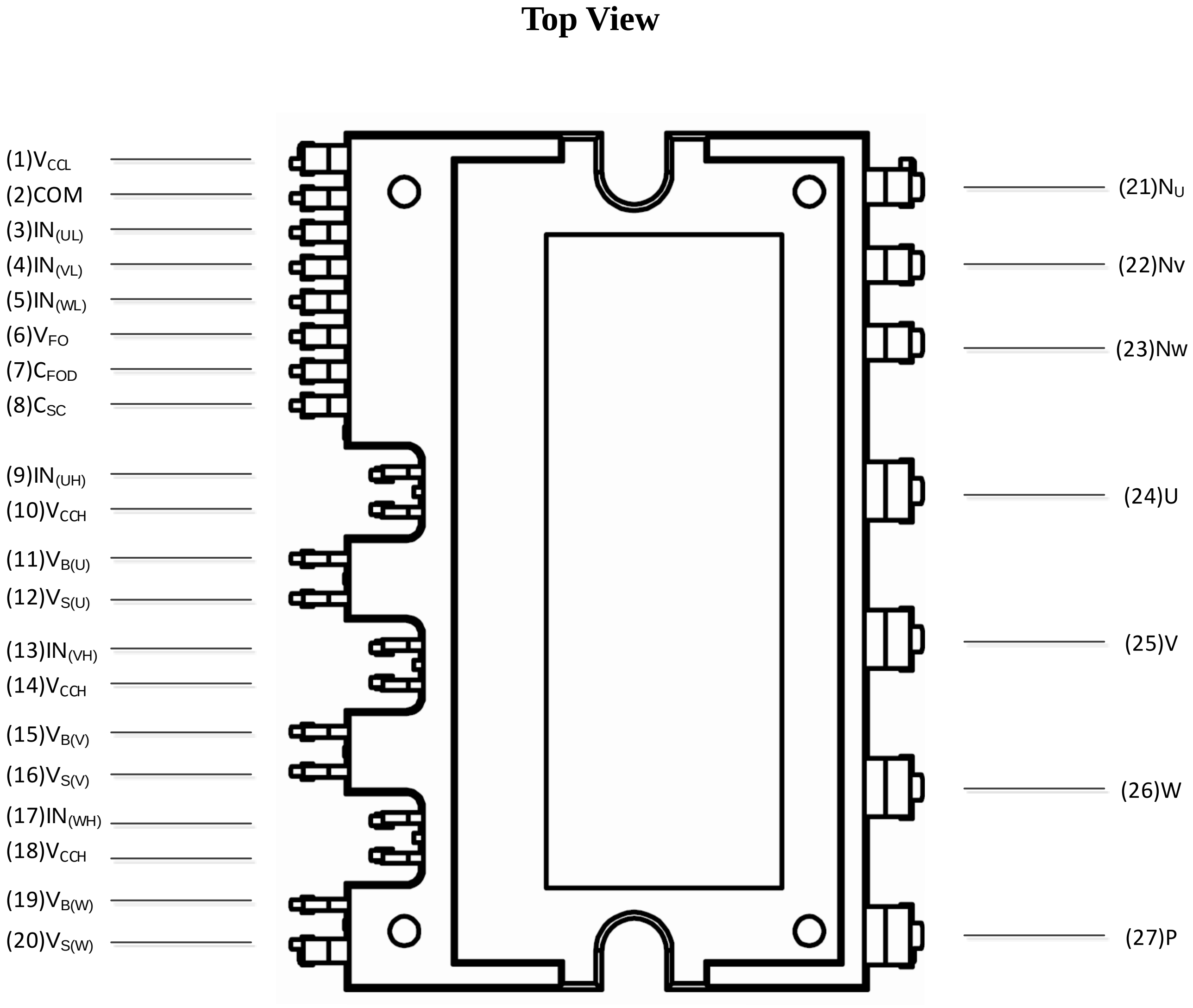


Figure 2. Pin Configuration

The IPM Internal Block Diagram

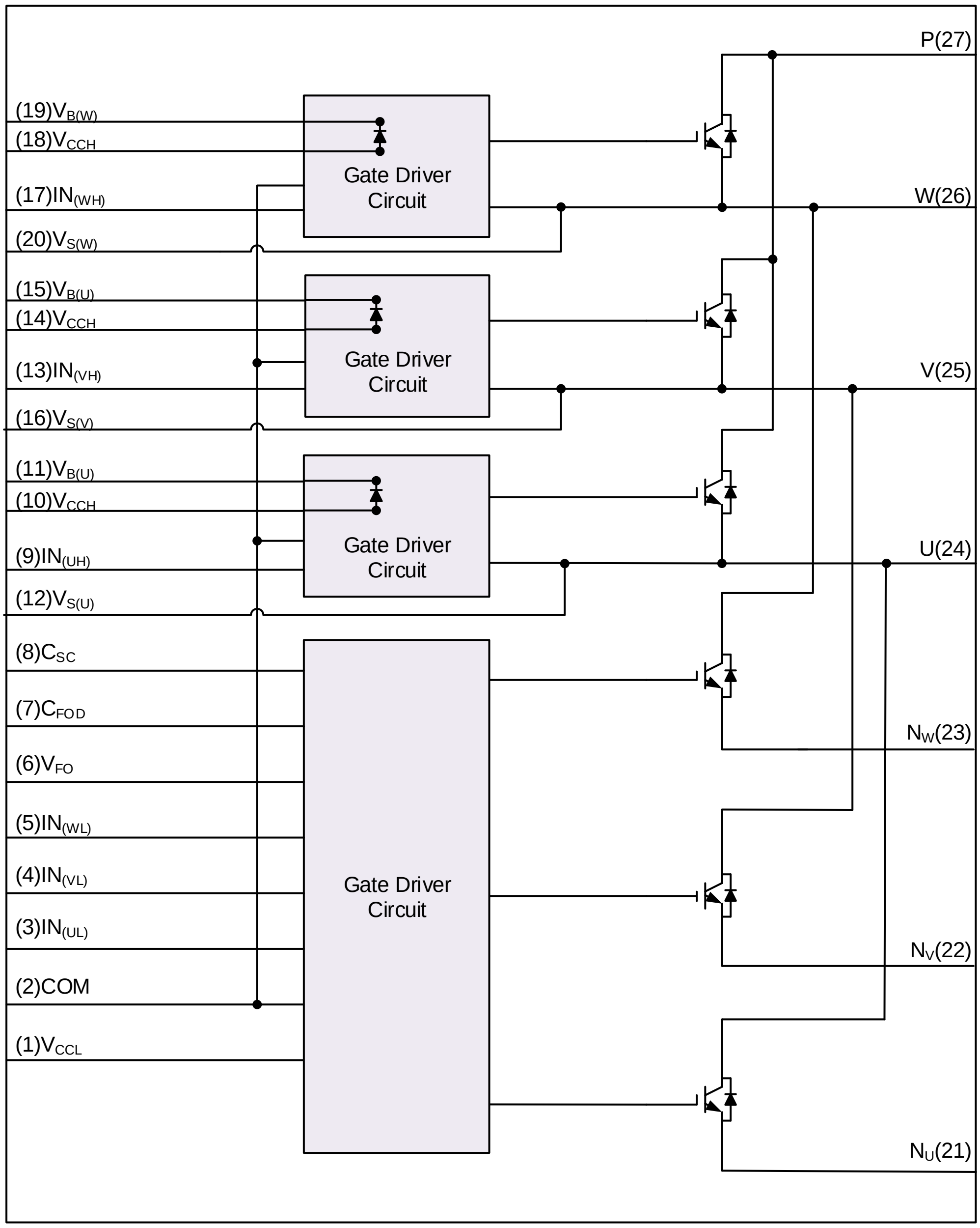


Figure 3. IPM Internal Block Diagram

Application:

- Short-circuit current protection AC 100~240Vrms class 3 phase output for low power motor control.
- Household electric appliances such as air conditioners, washing machines, refrigerators, etc..,
- Low power industrial servo drives applications such as sewing machine, treadmill, etc…

MAXIMUM RATINGS (T_j = 25℃)

INVERTER PART

Item	Symbol	Min.	Max.	Unit
Between collector to emitter voltage	V_{CES} (IGBT)	-	600	V
Supply voltage P-N	V_{PN}	-	450	V
Supply voltage (surge) P-N	$V_{PN (surge)}$	-	500	V
Each IGBT collector current	± I_C (Tc = 25℃)	-	20	A
Each IGBT collector current (peak)	± I_{CP} (Tc = 25℃, pulse)	-	40	A
Collector dissipation	P_C (Tc = 25℃, per one chip)	-	78	W
Junction temperature	T_j **(Note 1)**		+150	℃

Note 1: Power chip in IPM is qualified for 175°C operation. But overall junction temperature should be limited by T_j ≦ 125°C (@ Tc ≦ 100°C) to fit long term reliability requirement.

CONTROL PART

Item	Symbol	Min.	Max.	Unit
Driver IC supply voltage	V_{CC}	-0.3	20	V
P - side floating supply voltage	$V_{B(u)S(u), B(V)S(V), B(W)S(W)}$	-0.3	20	V
Current sensing input voltage	V_{SC}	-0.3	Vcc+0.3	V
Logic input voltage	$IN_{(UH)}$,$IN_{(VH)}$,$IN_{(WH)}$, $IN_{(UL)}$,$IN_{(VL)}$,$IN_{(WL)}$	-0.3	Vcc+0.3	V
Fault output voltage	V_{FO}	-0.3	Vcc+0.3	V
Fault output current	I_{FO}	-	1	mA

TOTAL SYSTEM

Item	Symbol	Min.	Max.	Unit
Module case operating temperature	T_C **(Note 2)**	-20	+125	℃
Storage temperature	T_{stg}	-40	+125	℃
Isolation voltage (60Hz Sinusoidal, AC 1 minute, pins to heat-sink plate)	V_{iso}	-	2500	Vrms

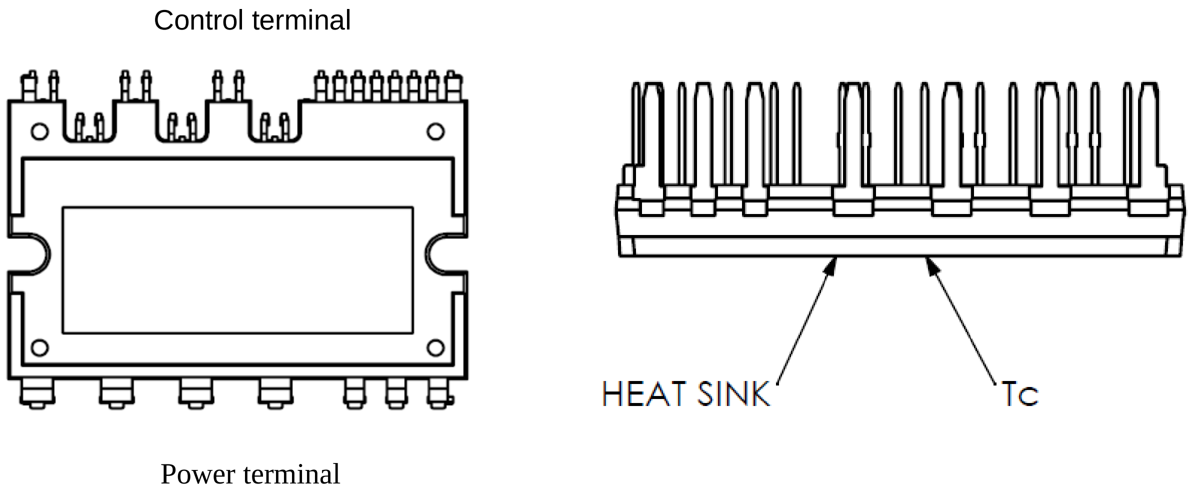


Figure 4. Tc Measurement Point

THERMAL RESISTANCE

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Junction to case thermal resistance	$R_{th(j-c)Q}$	IGBT part (1/6)	-	1.6	-	℃/W
	$R_{th(j-c)F}$	FWD part (1/6)	-	2.0	-	

ELECTRICAL CHARACTERISTICS (T_j = 25℃)

INVERTER PART

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	V_{CC} = $V_{B(U)S(U),\ B(V)S(V),\ B(W)S(W)}$ = 15V, I_C = 20A, V_{SC} = 0V	T_j=25℃	-	1.50	-	V
FWD forward voltage drop	V_F	T_j =25℃, - I_C = 20A		-	1.80	-	V
Switching times **(Fig. 5)**	T_{on}	V_D = 300V, V_{CC} = $V_{B(U),\ B(V),\ B(W)}$ = 15V, I_C = 20A, T_j =25℃, V_{IN} = 5V <–> 0V, V_{SC} = 0V, Inductive Load		-	0.80	-	μS
	$T_{c(on)}$			-	0.20	-	
	T_{off}			-	0.50	-	
	$T_{c(off)}$			-	0.15	-	
	T_{rr}			-	0.10	-	
Collector-emitter cut-off current	I_{CES}	V_{CE} =V_{CES}		-	-	1	mA

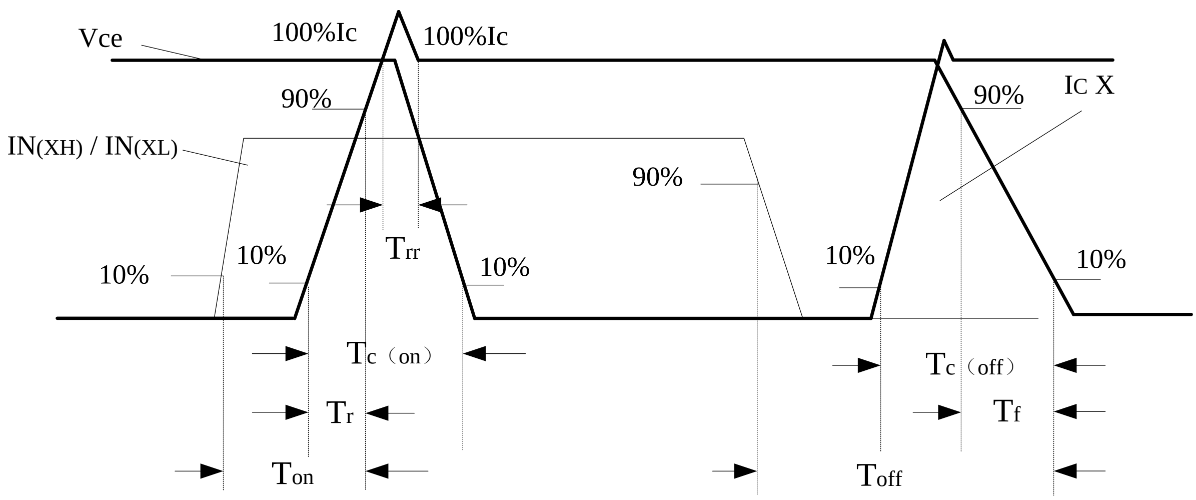


Figure 5. Switching Time Definition

CONTROL PART (T_j = 25℃)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
$IN_{(UH, VH, WH)}$, $IN_{(UL,VL,WL)}$ ON threshold voltage	$V_{th(on)}$		-	-	3.0	V
$IN_{(UH, VH, WH)}$,$IN_{(UL,VL,WL)}$ OFF threshold voltage	$V_{th(off)}$		0.8	-	-	V
$IN_{(UH, VH, WH)}$ input bias current	$I_{IN(UH, VH, WH)(HI)}$	$V_{IN(UH, VH, WH)}$ = 3.3V	-	-	660	μA
	$I_{IN(UH, VH, WH) (LO)}$	$V_{IN(UH, VH, WH)}$ = 0V	-1	-	-	
$IN_{(UL, VL, WL)}$ input bias current	$I_{IN(UL, VL, WL) (HI)}$	$V_{IN(UL, VL, WL)}$ = 3.3V	-	-	660	μA
	$I_{IN(UL, VL, WL) (LO)}$	$V_{IN(UL, VL, WL)}$ = 0V	-1	-	-	
Quiescent V_{BS} supply current	I_{QBS}	V_{BS}=15V, $I_{IN(UH, VH, WH)}$=0V	-	70	120	μA
Quiescent VCC supply current	I_{QCC}	V_{BS}=15V, I_{IN}=0V	-	2	3	mA
Driver IC supply voltage	V_{CC}		13.5	15.0	16.5	V
P - side floating supply voltage	$V_{B(U), B(V), B(W)}$		13.5	15.0	16.5	V
Fault output voltage	V_{FOH}	V_{SC} =0V **(Note 2)**	4.5	-	-	V
	V_{FOL}	V_{SC}=1V	-	-	0.8	V
Short circuit trip level	$V_{SC(ref)}$	V_{CC} =15V, T_j = 25℃	0.45	0.48	0.51	V
Fault output pulse width	t_{FOD}	C_{FOD}=33nF **(Note 3)**	60	-	-	μs
Supply Circuit Under-Voltage-Protection	UV_{CCD}	Trip level	-	11.0	-	V
	UV_{CCR}	Reset level	-	12.0	-	V
	UV_{BSD}	Trip level	-	10.5	-	V
	UV_{BSR}	Reset level	-	11.5	-	V
$IN_{(UL、VL、WL)}$ Input filter time	$t_{IN,FIL}$	VIN = 0 & 5V **(Note 4)**	200	300	510	ns
VF	Bootstrap diode forward voltage	If=10mA, T_j = 25℃	-	1.6	-	V
R	Limiting resistance	Individual resistor		80	-	Ohm

Note 2: V_{FO} output is open collector type, so this signal line should be pulled up to the +5V power supply with approximately 4.7KΩ

Note 3: Fault output pulse width is filter capacitor of S.C. depended.

Note 4: For high side PWM, IN(UH、VH、WH) pulse width must be ≧ 1 us.

Input Filter Function

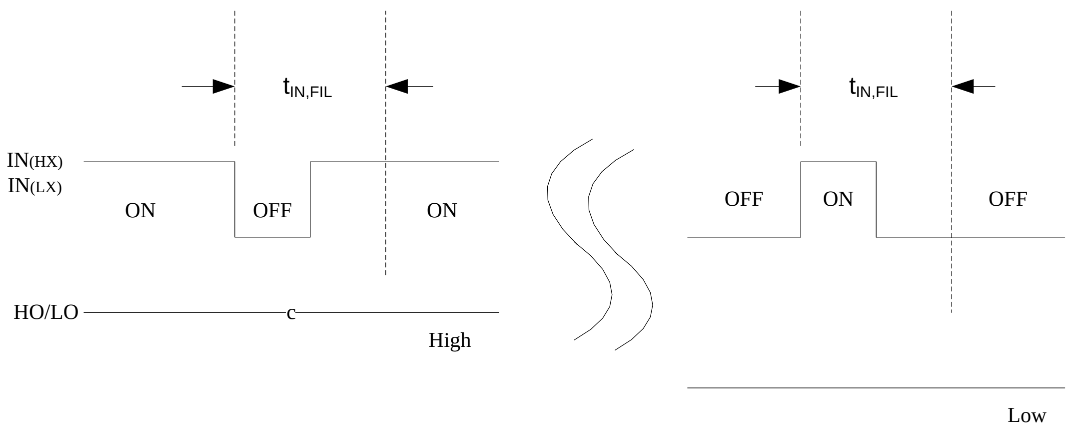


Figure 6. Input Filter Function

RECOMMENDED OPERATION CONDITIONS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
DC – Link Supply voltage	V_D	Applied between P-N	0	300	400	V
Driver IC supply voltage	V_{CC}	Applied between V_{CC} - COM	13.5	15.0	16.5	V
P - side floating supply voltage	V_{BS}	Applied between $V_{B(u、v、w)}$ – $V_{S(u、v、w)}$	13.5	15.0	16.5	V
Supply voltage ripple	ΔV_D , ΔV_{DB}		-1	-	1	V/μs
Arm shoot-through blocking time	t_{dead}		1	-	-	μs
PWM input frequency	f_{PWM}	T_C≦100℃, T_j≦125℃	-	0	20	kHz
Voltage for Current Sensing	V_{SEN}	Applied between N_U,N_V,N_W – COM (Including Surge Voltage)	-4	-	4	V

MECHANICAL CHARACTERISTICS AND RATINGS

Item	Condition		Min.	Typ.	Max.	Unit
Mounting torque	Mounting screw：M3	Recommended 0.7 N•m	0.6	0.7	0.8	N•m
Weight		--	-	15.00	-	g
Heat-sink flatness		--	0	-	150	μm

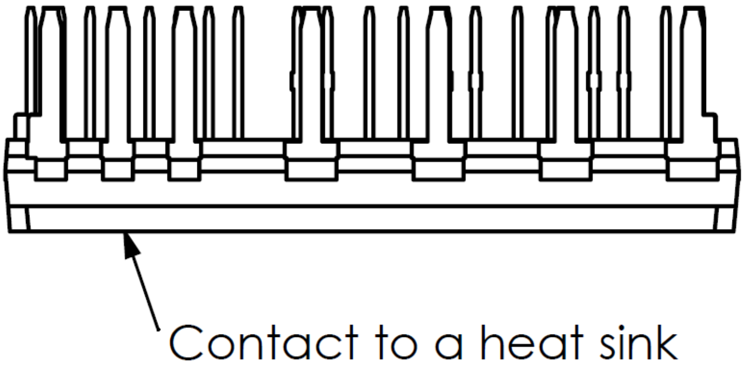


Figure 7 Measurement Location of Heat-sink Flatness

Input/Output Timing Diagram

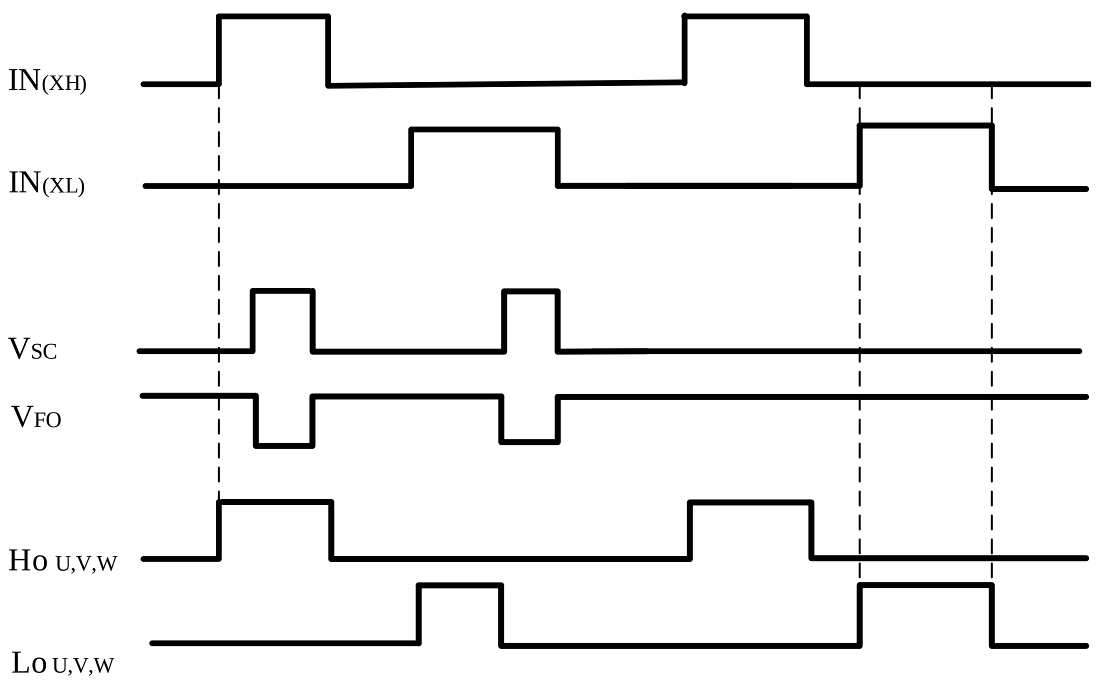
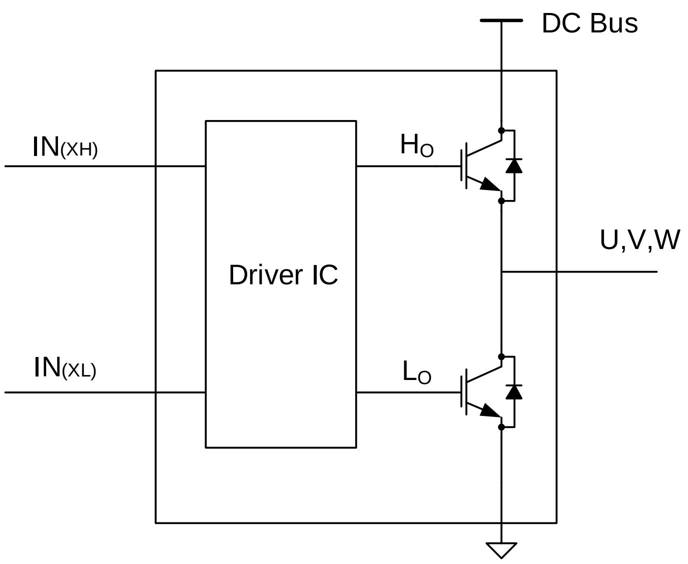


Figure 8 Input/Output Timing Diagram



Vsc	IN(XH)	IN(XL)	U,V,W
0	1	0	DC Bus
0	0	1	0
0	0	0	0
1	1	0	DC Bus
1	0	1	0

(X=U,V,W)

Figure 9 Input/Output Signal Circuit

IPM Short-Circuit Protection Function
(N-side only with the external shunt resistor and RC filter)

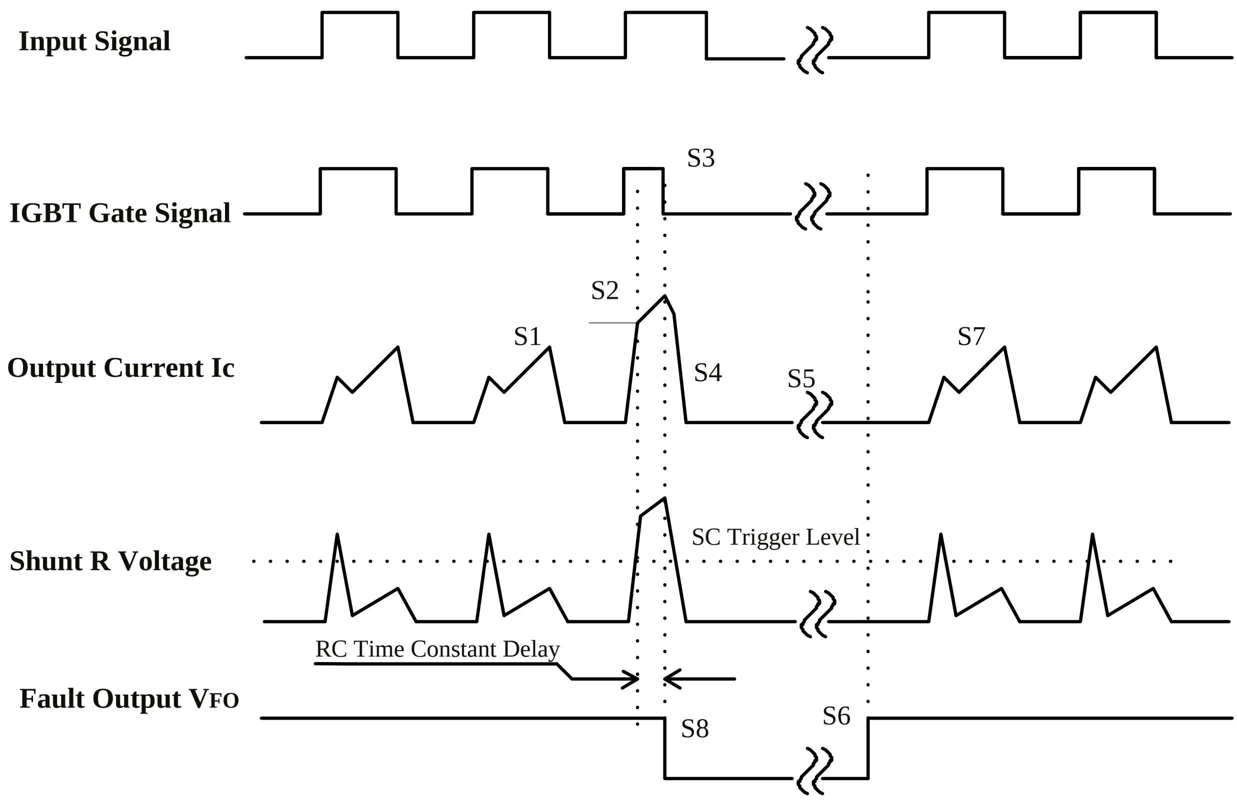


Figure 10 Timing Chart of SC Operation

S1. The Lower-side IGBT’s are controlled by input PWM signal.(Normal operation)
S2. Short circuit event occurs and reaches the limited level. (SC protection is trigger.)
S3. All N-side IGBT gate driving signals are disabled.
S4. Current is cut off caused by IGBT turns OFF.
S5. Disabled state.
S6. Fo finishes output, but IGBT of each phase returns to normal state until inputting next ON signal(L→H).
S7. IGBT returns for normal operation when fault state is reset.
S8. Fault output starts once SC protection is trigger.

IPM Under-Voltage Protection Function

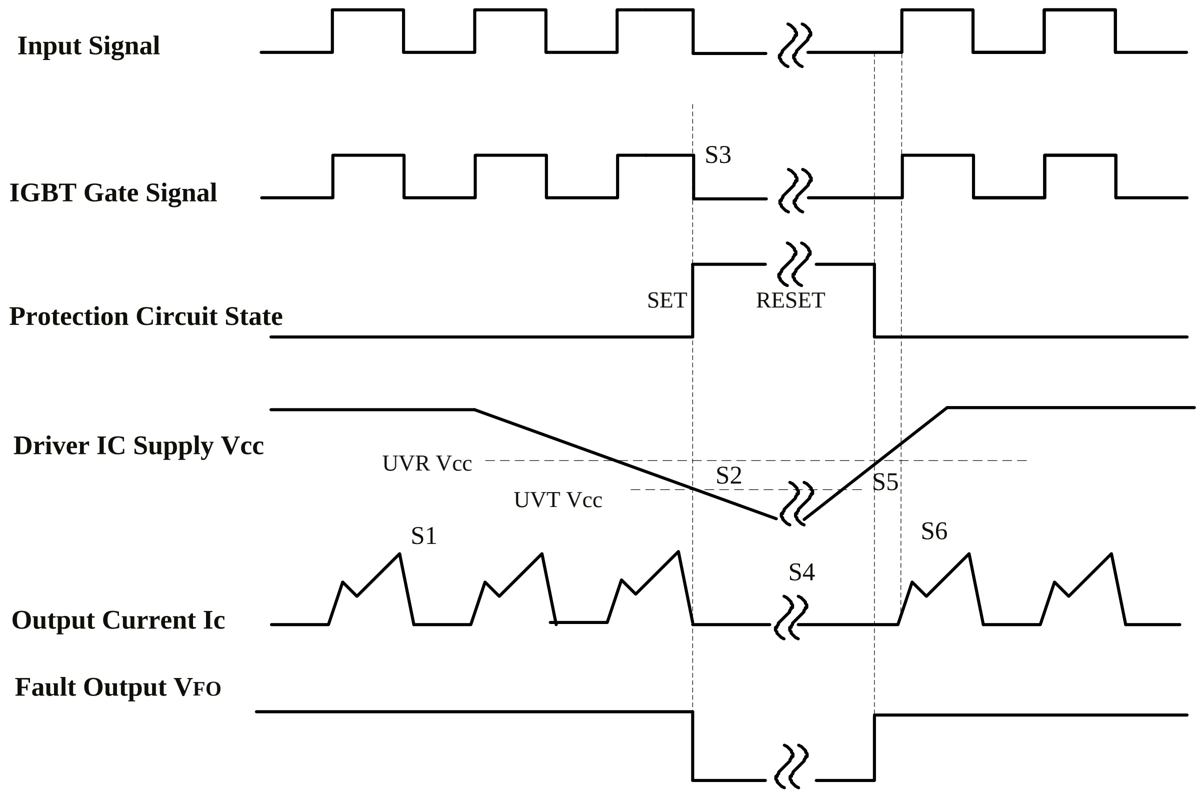


Figure 11 Timing Chart of Under-Voltage Operation

S1. The IGBT's are controlled by input PWM signal.(Normal operation).
S2. Under-voltage protection is trigger.
S3. IGBT driving signals are disabled when fault condition occur.
S4. Fault state and the period will be able to control by external capacitor value.
S5. Under-voltage event is recovered.
S6. IGBT returns for normal operation when fault state is reset.

Direct Input (without Photo Coupler) Interface Example

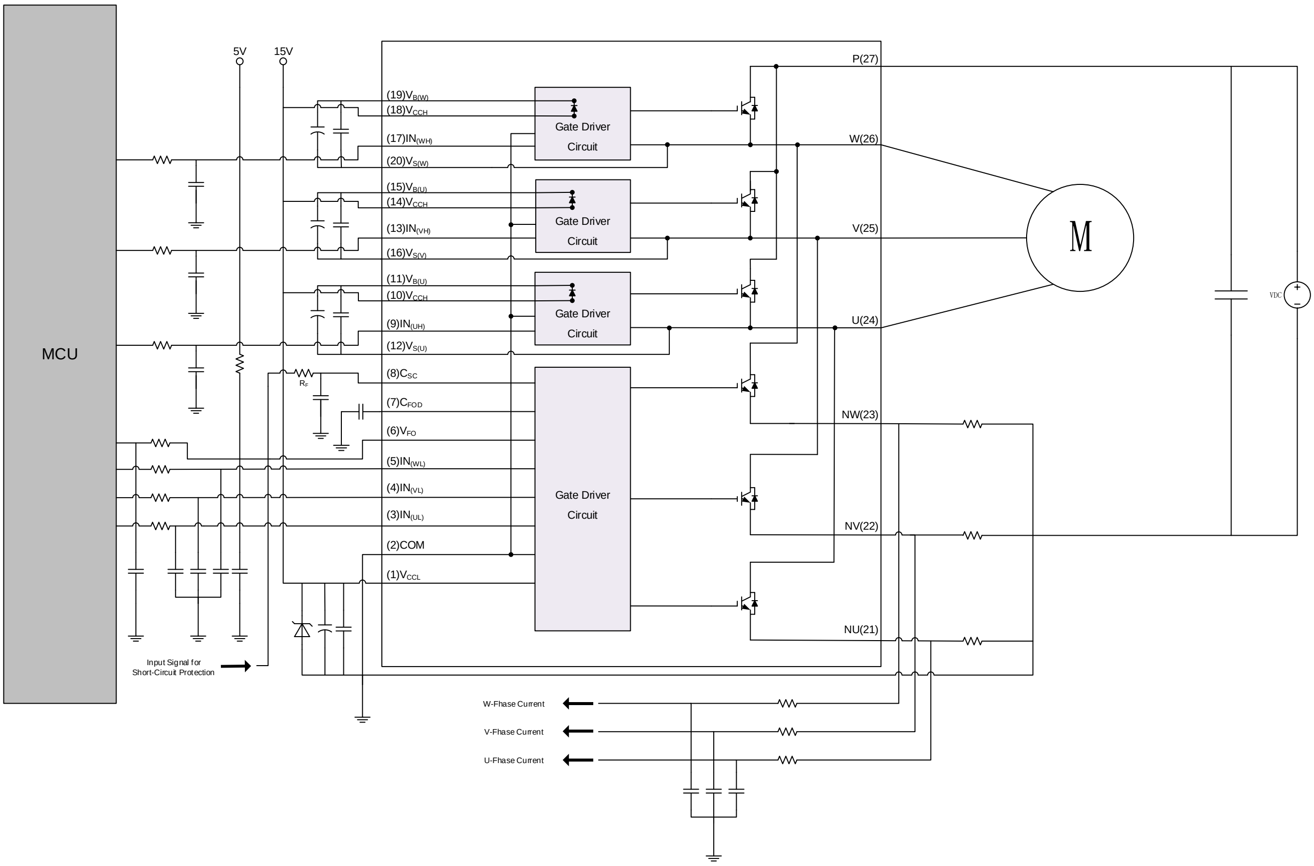


Figure 12 Typical Application Circuit Interface Example without Photo-Coupler

Current Sense Shceme

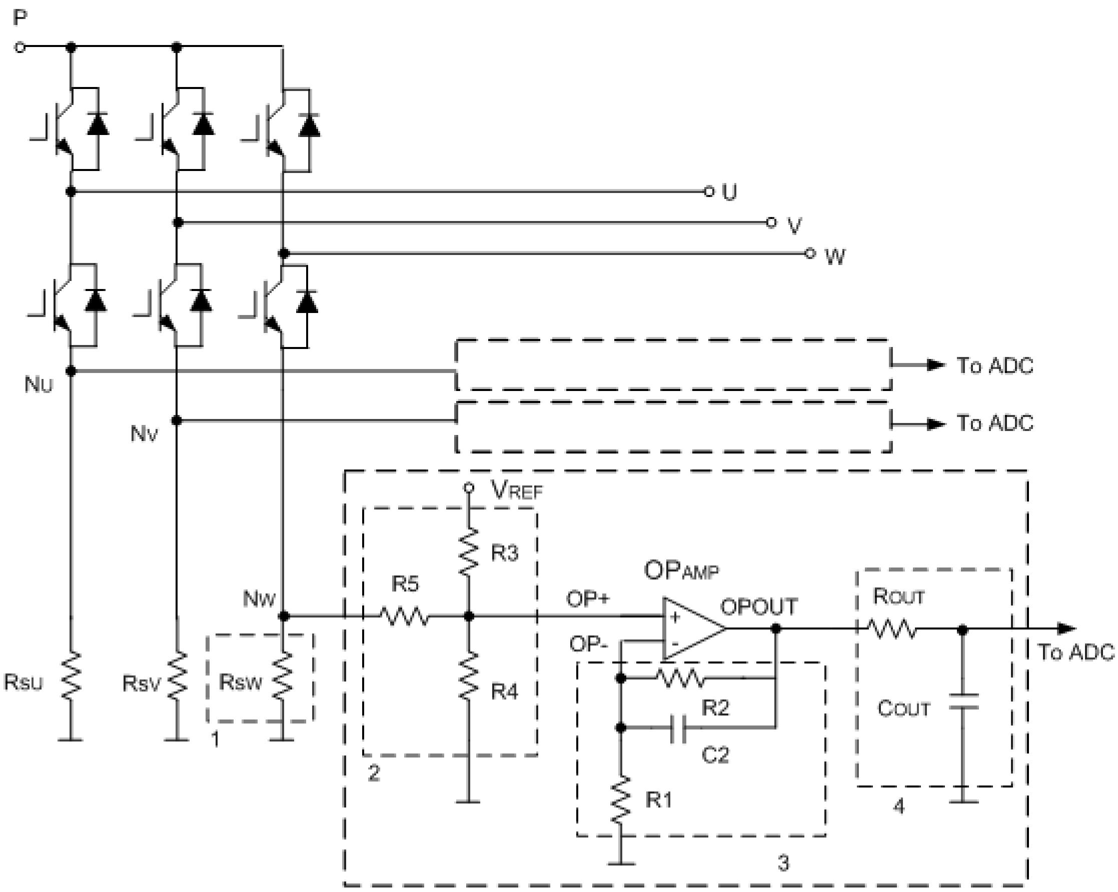


Figure 13 Current Sense Scheme

Precautions on Electrostatic Electricity

(1) Operators must wear anti-static clothing and conductive shoes (or a leg or heel strap).

(2) Operators must wear a wrist strap grounded to earth via a resistor of about 1 MΩ.

(3) Soldering irons must be grounded from iron tip to earth, and must be used only at low voltages.

(4) If the tweezers you use are likely to touch the device terminals, use anti-static tweezers and in particular avoid metallic tweezers. If a charged device touches a low-resistance tool, rapid discharge can occur. When using vacuum tweezers, attach a conductive chucking pat to the tip, and connect it to a dedicated ground used especially for anti-static purposes (suggested resistance value: 10^4 to 10^8Ω).

(5) Do not place devices or their containers near sources of strong electrical fields (such as above a CRT).

(6) When storing printed circuit boards which have devices mounted on them, use a board container or bag that’s protected against static charge. To avoid the occurrence of static charge or discharge due to friction, keep the boards separate from one other and do not stack them directly on top of one another.

(7) Ensure, if possible, that any articles (such as clipboards) which are brought to any location where the level of static electricity must be closely controlled are constructed of anti-static materials.

(8) In cases where the human body comes into direct contact with a device, be sure to wear anti-static finger covers or gloves (suggested resistance value: 10^8Ω or less).

(9) Equipment safety covers installed near devices should have resistance ratings of 10^9Ω or less.

(10) If a wrist strap cannot be used for some reason, and there is a possibility of imparting friction to devices, use an ionizer.

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