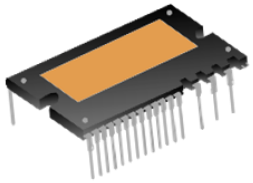
WGP15LF60H3A1D

600V 15A 3-phase Integrated Power Modules

Description

WGP15LF60H3A1D is an insulated type three-phase Intelligent Power Modules (IPM), highly integrated in a compact package. With the embedded HVIC and LVIC as the most compatible driver and protector for IGBTs, this series IPM offers an efficient power inverter solution with outstanding performance for PMSM motors such as low power fan or pump for home appliances and Industrial Instruments.



DIP-24HL

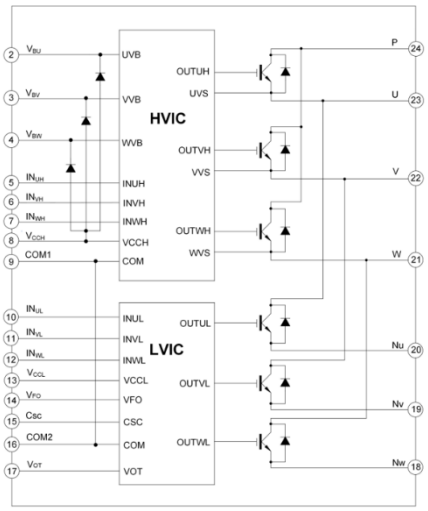
Features

- Integrated 6 low-loss IGBTs (600V/15A)
- Built-in Control supply under-voltage protection (UV)
- Built-in over-current protection (OCP)
- Built-in Over Temperature protection (OTP)
- Bootstrap diode integrated
- Insulation level :1500Vrms/min

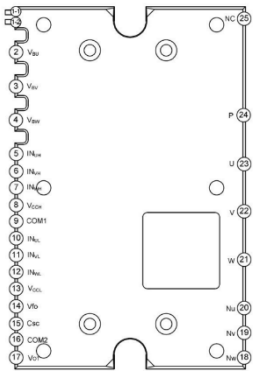
Applications

- Refrigerator compressors / Air cleaner
- Low-power frequency converter

Internal Electrical Schematic



Module Pin-Out Description



Pin No.	Pin Name	Pin Description	Pin No.	Pin Name	Pin Description
1-1	COM	Internal common ground terminal	13	VCCL	Low side gate drive supply voltage
1-2	NC	Internal power terminal, No Connection	14	VFO	Fault output
2	VBU	U-phase high side floating IC supply voltage	15	CSC	External capacitor, used for short-circuit current detection input and low-pass filtering
3	VBV	V-phase high side floating IC supply voltage	16	Com2	Module common ground
4	VBW	W-phase high side floating IC supply voltage	17	VOT	Temperature output terminal
5	INUH	U-phase high side gate driver input	18	NW	W phase DC negative
6	INVH	V-phase high side gate driver input	19	NV	V-phase DC negative
7	INWH	W-phase high side gate driver input	20	NU	U-phase DC negative
8	VCCH	High side gate drive supply voltage	21	W	W phase output
9	Com1	Module common ground	22	V	V phase output
10	INUL	U-phase low side gate driver input	23	U	U phase output
11	INVL	V-phase low side gate driver input	24	P	Positive DC−Link Input
12	INWL	W-phase low side gate driver input	25	NC	No Connection

Absolute Maximum Ratings (T_j=25℃, Unless otherwise Specified)

Inverter Part

Parameter	Symbol	Condition	Ratings	Unit
Supply voltage	V_{PN}	Applied between P-NU, NV, and NW	450	V
Supply voltage (Surge)	$V_{PN(Surge)}$	Applied between P-NU, NV, and NW	500	V
Collector-emitter voltage	V_{CES}	T_C = 25 °C	600	V
Each IGBT collector current	±I_C	T_C = 25 °C Note1	15	A
Each IGBT collector current (Peak)	±I_{CP}	T_c=25℃,T_J≤150℃ less than 1ms	30	A
Power dissipation per 1 chip	P_C	TC=25℃, per 1 chip	33	W
Junction temperature	T_J	Note2	-20 to +150	℃

Note1: Pulse width and period are limited due to junction temperature. Note2: The maximum rated junction temperature of the IPM power chip is 150℃. To ensure safe operation of the IPM, the junction temperature should be limited to $T_{J(av)}$≤125℃.

Control Part

Parameter	Symbol	Condition	Ratings	Unit
Control supply voltage	V_D	Applied between VCCH-COM1, VCCL-COM2	20	V
Control supply voltage(high side)	V_{DB}	Applied between VBU-U, VBV-V, VBW-W	20	V
Input signal voltage	V_{IN}	Applied between INUH, INVH,INWH,-COM1 INUL, INVL,INWL-COM2	-0.3~V_D+0.3	V
Fault output supply voltage	V_{FO}	Applied between FO-COM2	-0.3~V_D+0.3	V
Fault output current	I_{FO}	Sink current at FO terminal	1	mA
Current Sensing Input Voltage	V_{SC}	Applied between C_{SC}-COM2	-0.3~V_D+0.3	V
Short circuit withstand time	t_{SC}	VPN=400V, VGE=15V, VCES≤600V	5	us

Total system

Parameter	Symbol	Condition	Ratings	Unit
Self protection supply voltage limit (Short circuit protection capability)	$V_{CC(PORT)}$	V_{CC} = 13.5-16.5V, Inverter Part T_J= 125°C, non-repetitive, less than 2us	400	V
Module case operation temperature	T_C	Measurement point of T_c is described in Fig.1	-20 to +100	℃
Storage temperature	T_{STG}	-	-40 to +125	℃
Isolation voltage	V_{ISO}	60Hz,Sinusoidal,AC 1min, between connected all pins and heat sink plate	1500	V_{RMS}

Thermal Resistance

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Junction to case thermal resistance Note 3	$R_{th(j-c)Q}$	Single IGBT thermal resistance	-	-	3.0	K/W
	$R_{th(j-c)F}$	Single FRD thermal resistance	-	-	3.9	K/W

Note 3: Grease with good thermal conductivity and long-term endurance should be applied evenly with about +100um~+200um on the contacting surface of DIPIPM and heat sink. The contacting thermal resistance between DIPIPM case and heat sink Rth(c-f) is determined by the thickness and the thermal conductivity of the applied grease. For reference, Rth(c-f) is about 0.3K/w (per 1/6 module, grease thickness: 20um, thermal conductivity. 1.0W/m*k).

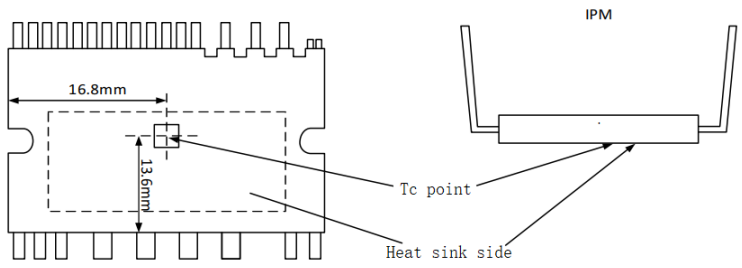


Figure 1: T_C Measurement Point

● Electrical Characteristics（(T_J=25℃,Unless otherwise Specified）

Inverter Part

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{CC} = V_{BS} = 15V V_{IN} = 5V, I_C =15A, T_J = 25°C	-	1.60	1.90	V
		V_{CC} = V_{BS} = 15V V_{IN} = 5V, I_C =15A, T_J = 125°C		1.70	2.0	V
Forward voltage	V_F	V_{CC} = V_{BS} = 15V V_{IN} = 0V, I_C =-15A, T_J = 25°C	-	1.5	1.9	V
Switching times (high side)	t_{ON}	V_{PN} = 400V, V_{CC} = V_{BS} = 15V I_C = 15A, VIN= 0↔5V Inductive Load (upper-arm)	-	650	-	ns
	$t_{C(ON)}$		-	130	-	ns
	t_{OFF}		-	1000	-	ns
	$t_{C(OFF)}$		-	150	-	ns
	t_{rr}		-	120	-	ns
Switching times (low side)	t_{ON}	V_{PN} = 400V, V_{CC} = V_{BS} = 15V I_C = 15A, VIN= 0↔5V Inductive Load (lower arm)	-	650	-	ns
	$t_{C(ON)}$		-	170	-	ns
	t_{OFF}		-	950	-	ns
	$t_{C(OFF)}$		-	170	-	ns
	t_{rr}		-	120	-	ns
Collector-emitter cut-off current	I_{CES}	V_{CE}= V_{CES}, V_{IN} = 0V, T_J = 25°C	-	-	1	mA
		V_{CE}= V_{CES}, V_{IN} = 0V, T_J = 125°C			10	mA

Control Part

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit
Quiescent circuit current	I_{QD}	Total of VCCH-COM1,VCCL-COM2	V_{CC} = 15 V_{IN} = 0V	-	-	0.8	mA
	I_{QDB}	Each part of VBU-U, VBV-V,VBW-W	V_{CC}=V_{BS} = 15V V_{IN} = 0V	-	-	0.1	mA
Short circuit trip level	$V_{SC(ref)}$	V_{CC} = 15V Note 4		0.45	0.5	0.55	V
HIGH-side Control supply under-voltage protection(UV)	UV_{DBT}	Trip level T_J ≤125°C		9.0	10.0	11.0	V
	UV_{DBR}	Reset level T_J ≤125°C		8.0	9.0	10.0	V
LOW-side Control supply under-voltage protection(UV)	UV_{DT}	Trip level T_J ≤125°C		10.0	11.0	12.0	V
	UV_{DR}	Reset level T_J ≤125°C		8.0	10.0	11.0	V
Temperature Output	VOT	LVIC Temperature=90℃ Note 5		2.63	2.77	2.91	V
		LVIC Temperature=25℃ Note 5		0.88	1.13	1.39	V
Over temperature protection	OT_t	V_{CC} = 15V,Trip level		120	130	140	℃
	OT_{rh}	V_{CC} = 15V,Hysteresis of trip-reset		-	10	-	℃
Fault output voltage	V_{FOH}	VSC = 0V, FO terminal pulled up to 5V by 10k		4.8	-	-	V
	V_{FOL}	VSC = 1V, IFO = 10mA		-	-	0.5	V
Fault output pulse width	t_{FO}	- Note 6		40	-	-	μs
Input current	I_{IN}	VIN = 5V		-	820	-	μA
ON threshold voltage	V_{IH}	Applied between INUH, INVH,INWH,-COM1 INUL, INVL,INWL-COM2		-	-	2.6	V
OFF threshold voltage	V_{IL}			0.8	-	-	V
Bootstrap Di forward voltage	V_F	IF=10mA including voltage drop by limiting resistor		-	1.5	-	V
Built-in limiting resistance	R	Included in bootstrap Di		-	90	-	Ω

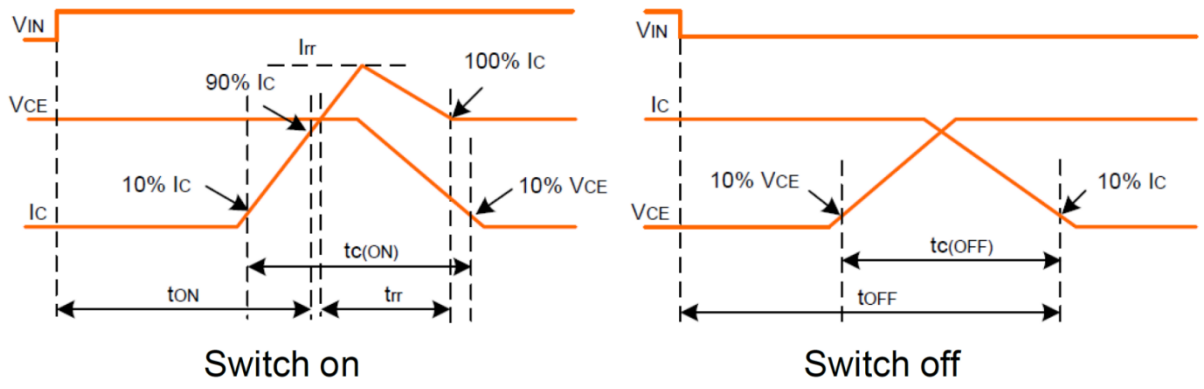


Figure 2: Switching Time Definition

Note 4: SC protection works only for N-side IGBT. Please select the external shunt resistance such that the SC trip-level is less than 1.7 times of the current rating.

Note 5: DIPIPM don't shutdown IGBTs and output fault signal automatically when temperature rises excessively. When temperature exceeds the protective level that user defined, controller(MCU) should stop the DIPIPM, Temperature of LVIC vs. VOT output characteristics is described in Figure 4.

Note 6: Fault signal Fo outputs when SC, UV or OT protection works. Fo pulse width is different for each protection modes at SC failure. Fo pulse width is a fixed width (minimum 40μs), but at UV or OT failure, Fo outputs continuously until recovering from UV or OT state. (But minimum Fo pulse width is 40μs.)

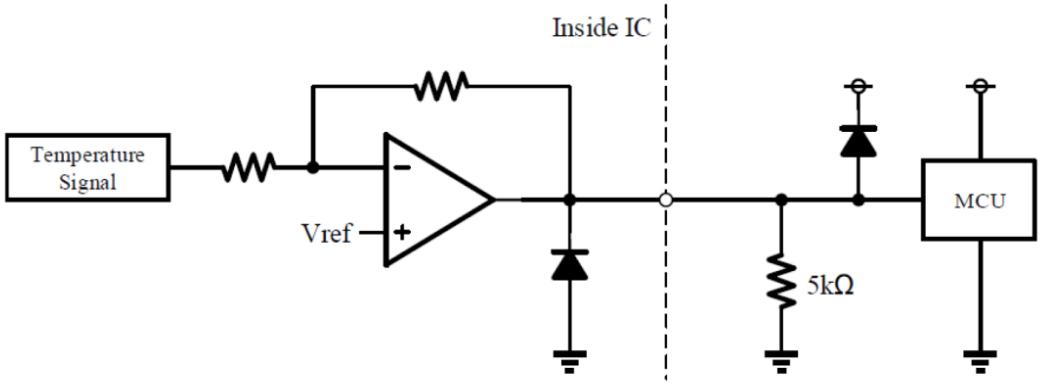


Figure 3: Pattern Wiring around the Analog Voltage Output Circuit [VOT terminal]

(1) When using the temperature monitoring function, the VOT pin needs to be connected with the pull-down 5kΩ resistor, and there is no internal OTP function; When keep the VOT pin open (no connection). The internal over temperature shutdown function can be used. The internal over temperature shutdown function is realized by detecting the temperature rise of LVIC, which can not effectively respond to the rapid temperature rise of power chip.

(2) When using VOT on low-voltage controllers such as 3.3V single chip microcomputer, the VOT output may exceed the control power supply voltage by 3.3V when the temperature rises too fast. If the system uses low-voltage controller, it is recommended to add clamping diode between the control power supply and VOT output to prevent overvoltage damage.

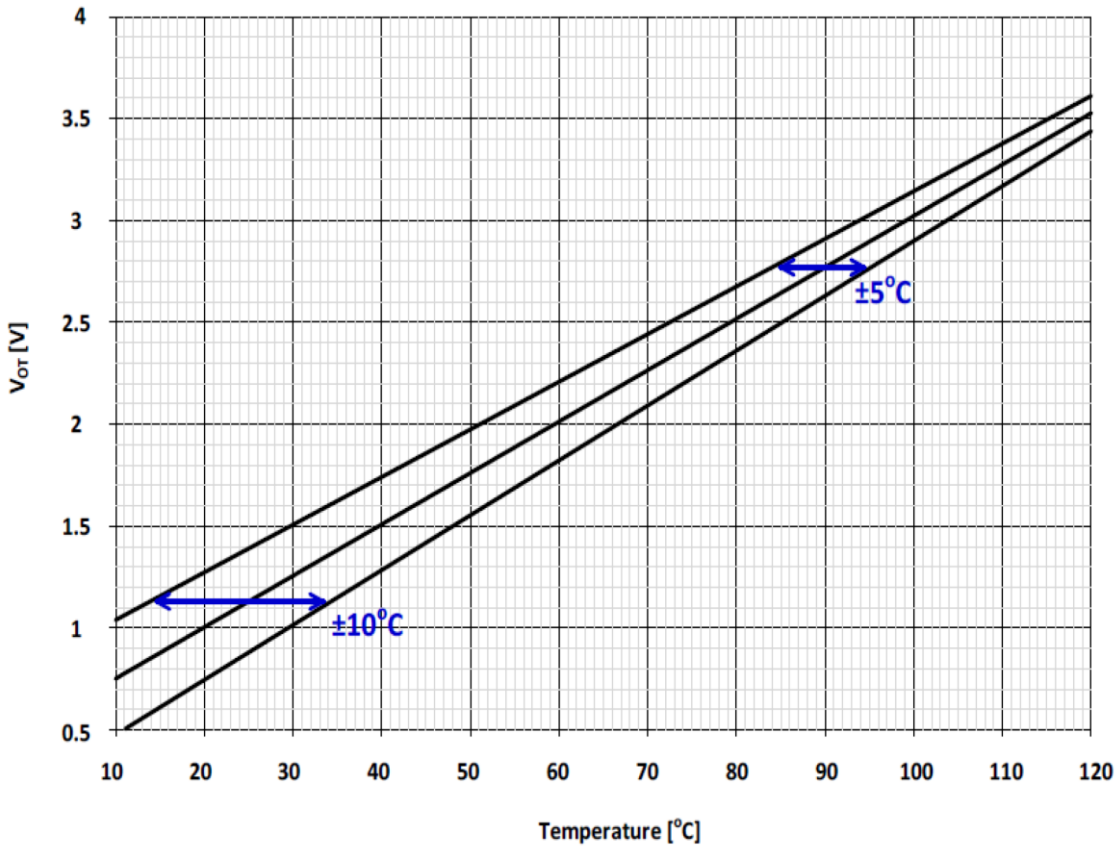


Figure 4: Temperature of LVIC vs. VOT Output Characteristics

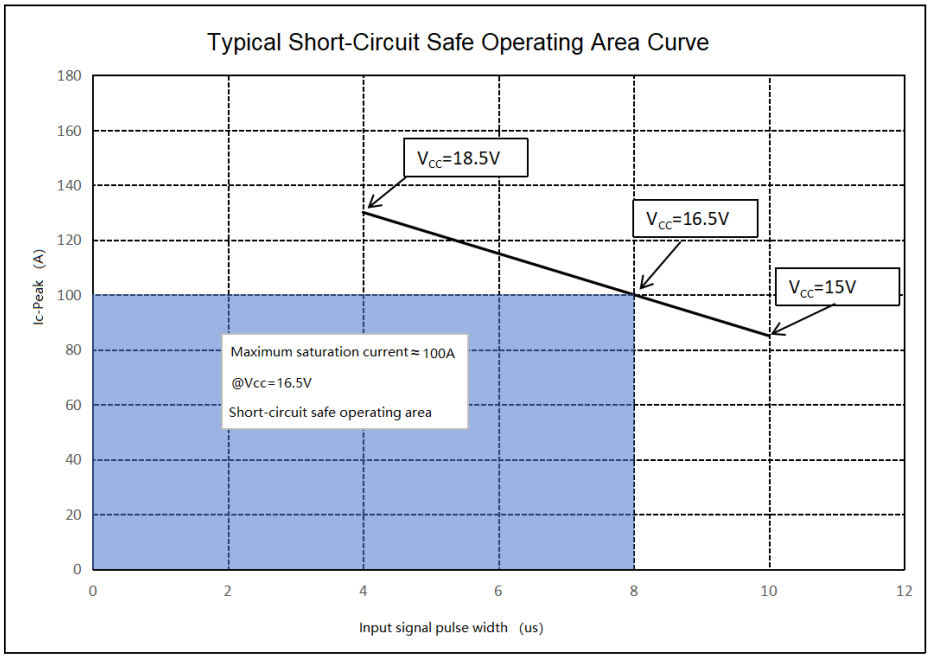


Figure 5: Typical Short-Circuit Safe Operating Area Curve

Mechanical Characteristics and Ratings

Parameter	Condition		Limits			Unit
			Min.	Typ.	Max.	
Mounting torque	Mounting screw: M3 (Note 7)	Recommended 0.62N-m	0.59	0.62	0.78	N*m
Terminal pulling strength	Control terminal: Load 4.9N Power terminal: Load 9.8N	JEITA-ED-4701	10	-	-	S
Terminal bending strength	Control terminal: Load 2.45N Power terminal: Load 4.9N 90deg. bend	JEITA-ED-4701	2	-	-	times
Weight	-		-	10	-	g
Heat-sink flatness	Note 8		-50	-	100	μm

Note 7: Plain washers (IS0 7089~7094) are recommended.

Note 8: Measurement point of heat sink flatness

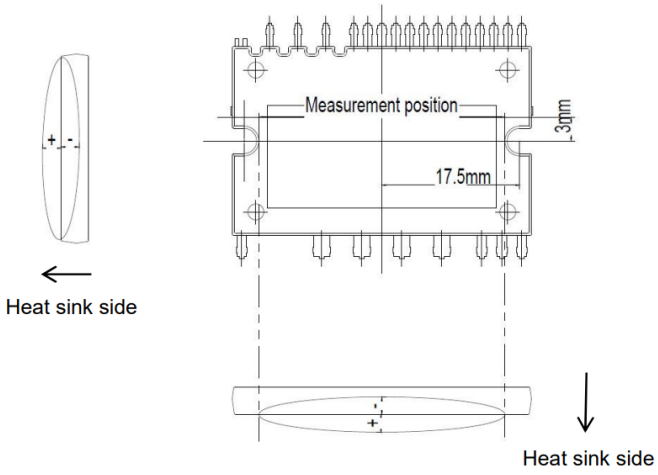


Figure 6: Flatness detection position

Recommended Operating Conditions

Parameter	Symbol	Condition		Limits			Unit
				Min.	Typ.	Max.	
Supply Voltage	V_{PN}	Applied between P-NU, NV, NW		-	300	400	V
Control Supply Voltage	V_D	Applied between VCCH-COM1, VCCL-COM2		13.5	15.0	16.5	V
Control supply voltage	V_{DB}	Applied between VBU-U, VBV-V,VBW-W		13.5	15.0	16.5	V
Control Supply Variation	dV_D/dt, dV_{DB}/dt	-		-1	-	1	V/μs
Arm shoot-through blocking time	t_{dead}	For each Input Signal		1.0	-	-	μs
PWM Input frequency	f_{PWM}	TC≤100℃, TJ≤125℃		-	-	20	KHZ
Minimum input pulse width	$P_{WIN(on)}$	- Note 9		0.7	-	-	μs
	$P_{WIN(off)}$	- Note 9		0.7	-	-	
Permissible effective current	I_O	VDC = 300V, V_{CC} = 15V, P.F = 0.8, PWM input,TC ≤ 100°C, Tj ≤ 125°C	f_{PWM} = 5kHz	-	-	7.5	Arms
			$_{PWM}$ = 15kHz	-	-	4.5	
Com variation	V_{NC}	Between COM2/COM1-NU、NV、NW (Including surge)		-5	-	+5	V
Junction temperature	T_J	-		-20	-	+125	℃

Note 9: DIPIPM might not make response if the input signal pulse width is less than $P_{WIN(on)}$, $P_{WIN(off)}$.

● Timing diagram

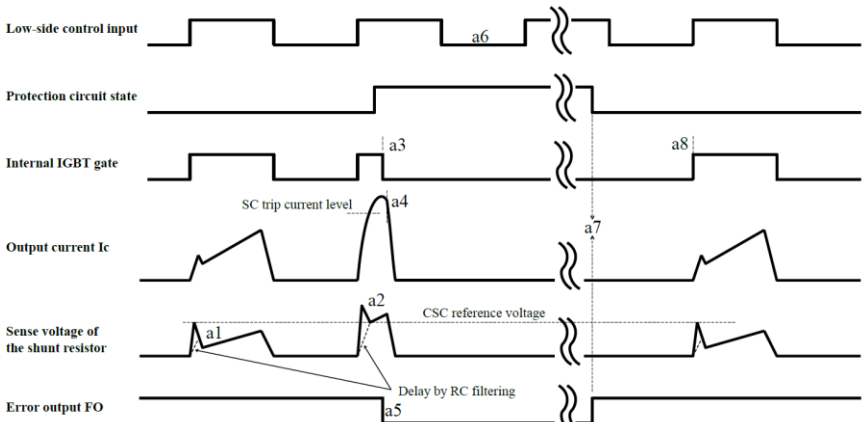


Figure 7: Short-circuit current protection (low side only)

NOTE:

a1: Normal operation: IGBT ON and outputs current.
a2: Short-circuit current detection (short-circuit triggering).
a3: All low-side IGBT's gate hard interrupts.
a4: All low-side IGBT's are turned off.
a5: The fault output pin outputs a fixed pulse width signal (tFO≥ 40μs).
a6: Input is "L": IGBT shutdown state.
a7: Input is "H": Although the input is "H", the IGBT is still in the off state during this time if there is a fault output signal.
a8: Normal operation: IGBT is ON, current is supplied to the load.

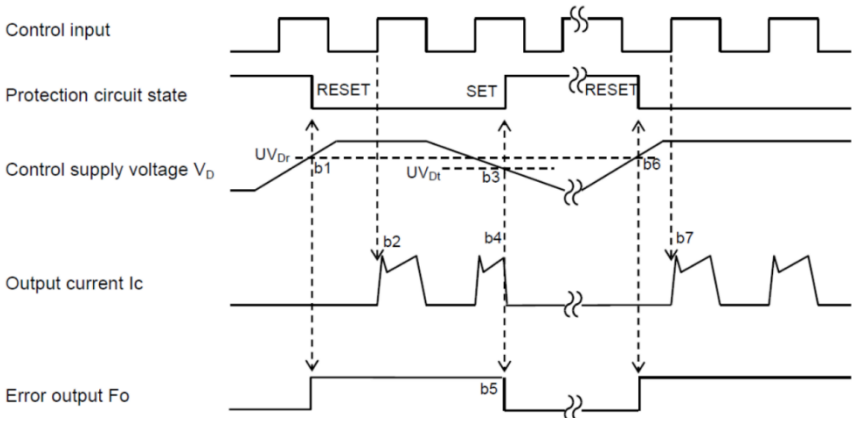


Figure 8: Under-voltage Protection (Low Side)

NOTE:

b1: Control supply voltage VD exceeds under voltage reset level UVDr, and the circuit starts to work when the next input waveform arrives.

b2: Normal operation: IGBT ON and outputs current.

b3: VD level drops under voltage trip level (UVDt).

b4: All low side IGBTs turn off in spite of control input condition.

b5: FO pin outputs fault signal (tFO ≥ 40μs, and continuously outputs fault signal during under voltage).

b6: VD level reaches UVDr

b7: Normal operation: IGBT ON and outputs current.

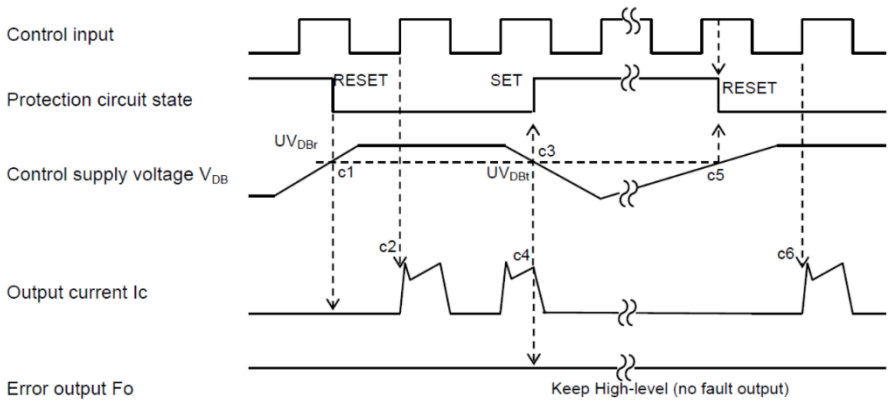


Figure 9: Under-voltage Protection (High Side)

NOTE:

c1: Control supply voltage VDB rises to UVDBR, and the circuit starts to work when the next input signal arrives.

c2: Normal operation: IGBT ON and outputs current.

c3: VDB level drops to under voltage trip level (UVDBt).

c4: No matter what signal input, IGBT is turned off, but there is no fault signal output.

c5: VDB level reaches UVDBr

c6: Normal operation: IGBT ON and outputs current.

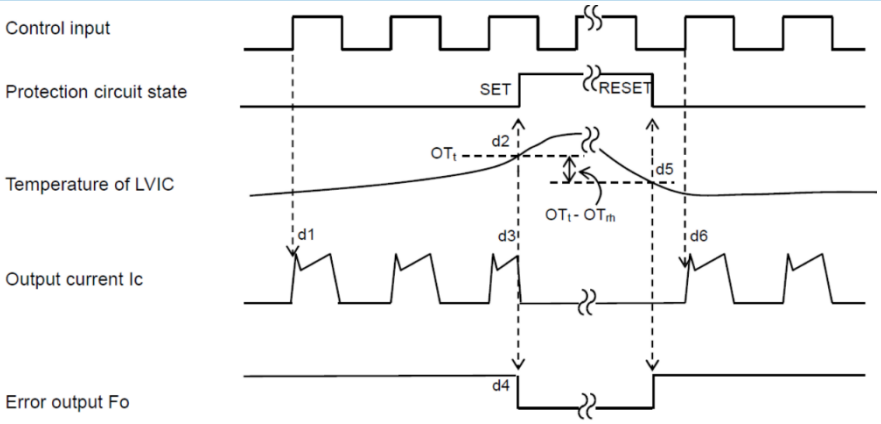


Figure 10: Over-temperature protection (low side only)

NOTES:

d1: Normal operation: IGBT ON and outputs current.

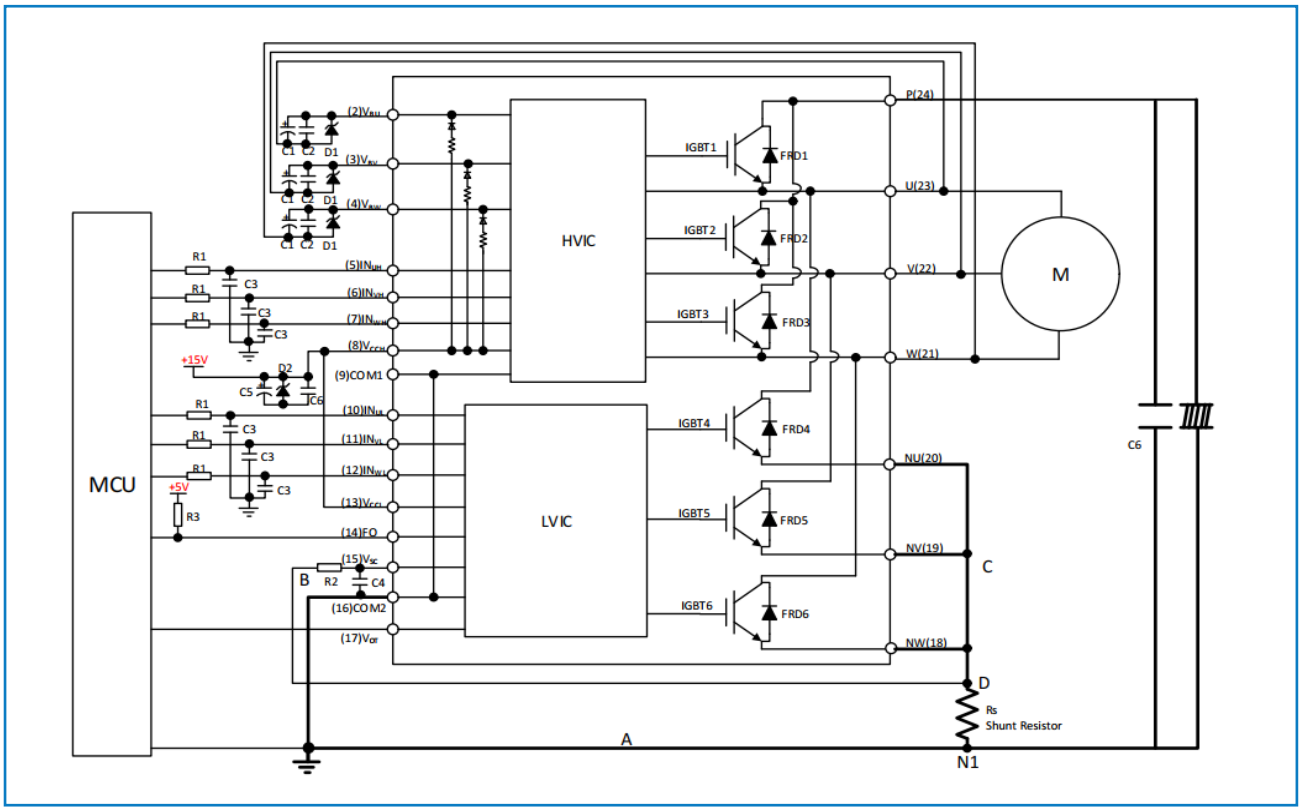
d2: LVIC temperature exceeds the over temperature protection trigger level (OTt).

d3: All low side IGBTs are turned off in spite of control input condition.

d4: Continuously output fault signal during over temperature, and the minimum pulse width is 40μs.d5: The LVIC will reset when the temperature is lower than the over temperature protection level.

d6: IGBT turns on when the next input signal control signal comes.

● Example of Application Circuit



NOTES:

(1) The control ground and the power ground should be grounded at a single point (N1).

(2) It is recommended to add a Zener diode D2 (24V/1W) between each pair of control power terminals of V_{CC}-COM and V_B-V_S to prevent damage caused by surges.

(3) To prevent damage caused by surges, it is recommended to add a high-frequency non-inductive buffer capacitor (0.1μF~0.22μF) between PN, and the connection wires of the capacitor should be as short as possible.

(4) For the short-circuit protection circuit, please select R2 and C4 with a time constant in the range of 1.5~2μs. At the same time, the wiring around R2 and C4 should be as short as possible. R2 should be close to the sampling resistor.

(5) The connection wire between the sampling resistor and the IPM should be as short as possible, otherwise the large surge voltage generated by stray inductance may cause damage.

(6) The overcurrent protection sampling point D should be as close as possible to the shunt resistor.

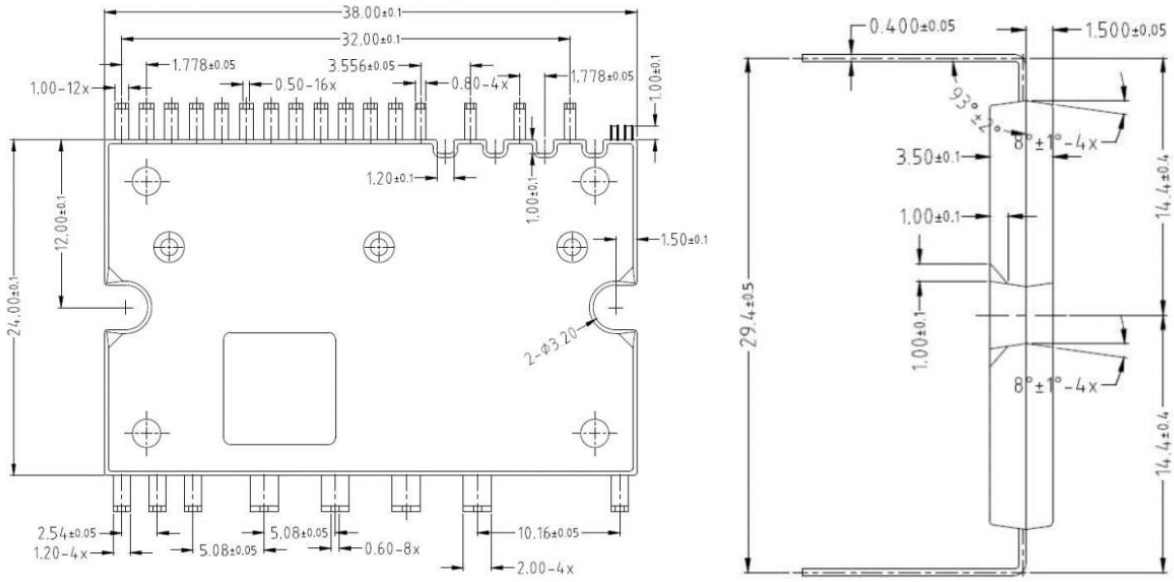
(7) All capacitors should be as close as possible to the corresponding pins of the IPM module.

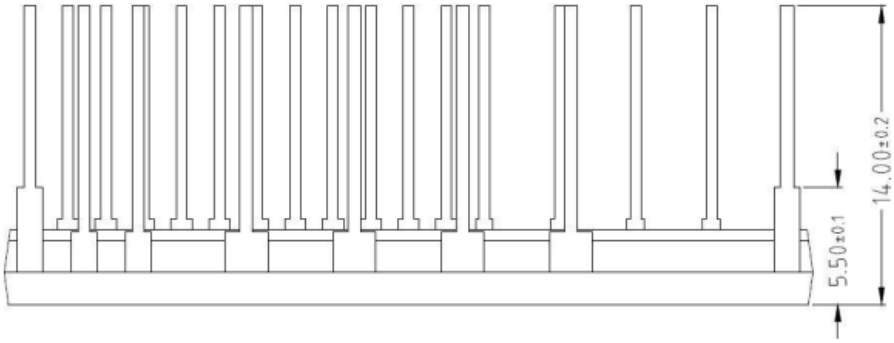
(8) The device is built-in with HVIC, compatible with 3.3V/5V signals of the microcontroller, and can be directly controlled by the microcontroller.

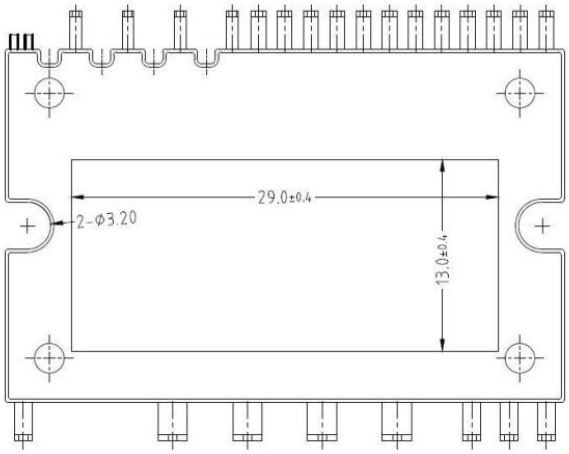
(9) The IPM has two COM terminals (pin 9 and pin 16). Please connect one of them to the logic ground in the circuit and leave the other floating.

(10) To avoid high-frequency noise being superimposed on the control power line, causing abnormal operation of the IPM, the ripple of the control power supply should be as small as possible. Generally, it is required that dV/dt ≤ +/-1V/μs and Vripple ≤ 2Vp-p.

Mechanical Dimensions for DIP-24HL







Ordering Information

Part	Package	Marking	QTY(PCS)	Packing method
WGP15LF60H3A1D	DIP-24HL	WGP15LF60H3A1D	TBD	Tube

Contact Information

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For additional information, please contact your local Sales Representative.
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1.The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

2.The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.

3.WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.

4.Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

5.The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.

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