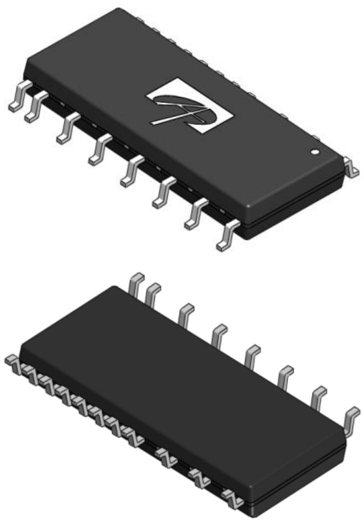
AIM704H50B

Intelligent Power Module

External View



Size: 18 x 7.5 x 2.5 mm

Green

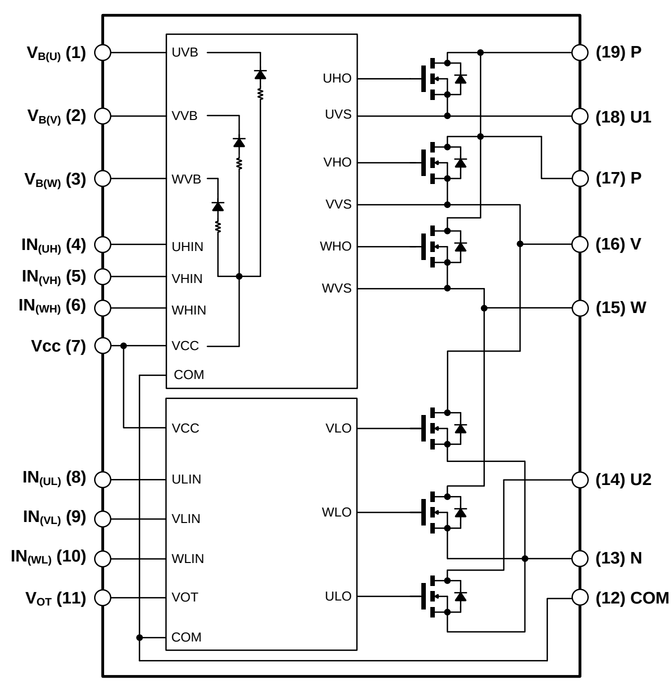
Features

- V_{DS} = 600V @ T_J=150°C
- $R_{DS(on)}$ = 2.4Ω (Max)
- Advanced MOSFET technology (αMOS2™) for motor drives
- Low loss and EMI
- 3-phase Inverter module including HVIC drivers
- Wide input interface (3-18V), Schmitt trigger receiver circuit (Active High)
- Built-in bootstrap diodes with integrated current-limiting resistor
- Control supply under-voltage lockout protection (UVLO)
- Over-temperature (OT) protection and temperature monitoring (V_{OT}) - pin open
- Temperature monitoring only (V_{OT}) - 10kΩ resistor connection
- Isolation ratings of 1500Vrms/min

Applications

- AC 100~240Vrms class low power motor drives
- Fan motors

Internal Equivalent Circuit / Pin Configuration



Ordering Information

Part Number	Temperature Range	Package	Description
AIM704H50B	-40°C to 150°C	IPM-7	N/A

Green

AOS Green Products use reduced levels of Halogens, and are also RoHS compliant.
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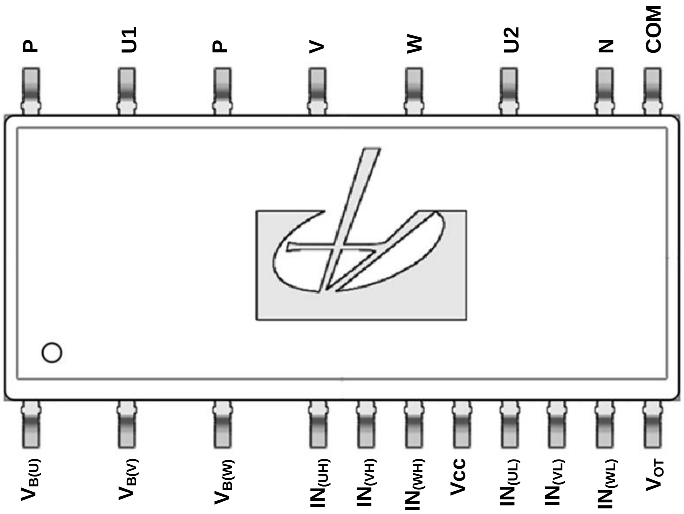


Figure 1. Pin Configuration

Pin Description

Pin Number	Pin Name	Pin Function
1	$V_{B(U)}$	High-Side Bias Voltage for U-phase MOSFET Driving
2	$V_{B(V)}$	High-Side Bias Voltage for V-phase MOSFET Driving
3	$V_{B(W)}$	High-Side Bias Voltage for W-phase MOSFET Driving
4	$IN_{(UH)}$	Signal Input for High-Side U-phase
5	$IN_{(VH)}$	Signal Input for High-Side V-phase
6	$IN_{(WH)}$	Signal Input for High-Side W-phase
7	V_{CC}	Control Supply Voltage
8	$IN_{(UL)}$	Signal Input for Low-Side U-phase
9	$IN_{(VL)}$	Signal Input for Low-Side V-phase
10	$IN_{(WL)}$	Signal Input for Low-Side W-phase
11	V_{OT}	Voltage Output of LVIC Temperature
12	COM	Common Supply Ground
13	N	Negative DC-Link Input
14	U2	Output for U-phase (connect to U1)
15	W	Output for W-phase
16	V	Output for V-phase
17	P	Positive DC-Link Input
18	U1	Output for U-phase (connect to U2)
19	P	Positive DC-Link Input

Absolute Maximum Ratings (T_J=25°C, unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Units
Inverter				
BV_{DSS}	MOSFET Breakdown Voltage		500	V
I_D	MOSFET Drain Current (Continuous)	T_C=25°C	2	A
		T_C=80°C	1.1	A
I_{DP}	MOSFET Drain Current (Pulsed)	T_C=25°C, <100µs pulse width	3	A
P_D	Maximum Power Dissipation	T_C=25°C	8	W
T_J	Operating Junction Temperature		-40 to 150	°C
Control (Protection)				
V_{CC}	Control Supply Voltage	Applied between V_{CC}-COM	20	V
V_{BS}	High-Side Control Bias Voltage	Applied between $V_{B(U)}$-U, $V_{B(V)}$-V, $V_{B(W)}$-W	20	V
V_{IN}	Input Voltage	Applied between $IN_{(UH)}$, $IN_{(VH)}$, $IN_{(WH)}$, $IN_{(UL)}$, $IN_{(VL)}$, $IN_{(WL)}$-COM	V_{CC}±0.5	V
V_{OT}	Temperature Output	Applied between V_{OT}-COM	5±0.5	V
Thermal Resistance				
$R_{th(j-c)}$	Junction to Case Thermal Resistance	All operating condition (per module)	12.5	°C/W
$R_{th(j-a)}$	Junction to ambient thermal resistance	All operating condition (per module)	39	°C/W
Total System				
T_C	Module Case Operation Temperature	Measurement point of T_C is provided in Figure 2	-30 to 125	°C
T_{STG}	Storage Temperature		-40 to 150	°C
V_{ISO}	Isolation Voltage	60Hz, sinusoidal, AC 1min, between connected all pins and heat sink plate	1500	V_{rms}

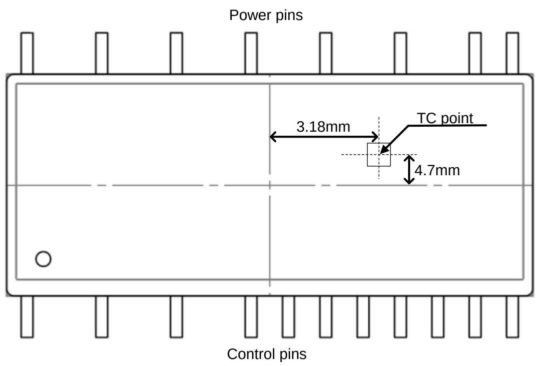


Figure 2. T_C Measurement Point

Recommended Operation Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max	Units
V_{PN}	Bus Supply Voltage	Applied between P-N	0	300	400	V
V_{CC}	Control Supply Voltage	Applied between V_{CC}-COM	13.5	15.0	16.5	V
V_{BS}	High-Side Bias Voltage	Applied between $V_{B(U)}$-U, $V_{B(V)}$-V, $V_{B(W)}$-W	13.5	15.0	16.5	V
dV_{CC}/dt, dV_{BS}/dt	Control Supply Variation		-1	-	1	V/us
t_{dead}	Arm Shoot-Through Blocking Time	For each input signal	1.5	-	-	µs
f_{PWM}	PWM Input Frequency	-40°C < T_J < 150°C	-	16	-	kHz
$PW_{IN(ON)}$	Minimum Input Pulse Width (1)		0.7	-	-	µs
$PW_{IN(OFF)}$			0.7	-	-	µs

Note:

1. IPM may not respond if the input pulse width is less than $PW_{IN(ON)}$, $PW_{IN(OFF)}$.

Electrical Characteristics (T_J=25°C, unless otherwise specified)

Symbol	Parameter	Conditions		Min.	Typ.	Max	Units
Inverter							
BV_{DSS}	MOSFET Breakdown Voltage	I_D=1mA, V_{IN}=0V, T_J=25°C		500	-	-	V
		I_D=1mA, V_{IN}=0V, T_J=150°C		-	600	-	
I_{DSS}	Drain-Source Leakage Current	V_{IN}=0V, V_{DS}=500V		-	-	100	µA
$R_{DS(on)}$	Drain-Source On-State Resistance	V_{CC}=V_{BS}=15V, V_{IN}=5V	I_D=1.25A	-	2.0	2.4	Ω
V_{SD}	MOSFET Body Diode Forward Voltage	V_{CC}=V_{BS}=15V, V_{IN}=0	I_{SD}=1.25A	-	0.8	1.2	V
t_{OFF}	Switching Times	V_{PN}=300V, V_{CC}=V_{BS}=15V I_D=1.25A, V_{IN}=0V↔5V Inductive load (high-side)		-	750	-	ns
t_f				-	120	-	ns
t_{ON}				-	850	-	ns
t_r				-	150	-	ns
t_{rr}				-	200	-	ns
Control (Protection)							
I_{QCC}	Quiescent V_{CC} Supply Current	V_{CC}=15V, $IN_{(UL, VL, WL)}$=0V	V_{CC}-COM	-	-	1.5	mA
I_{QBS}	Quiescent V_{BS} Supply Current	V_{BS}=15V, $IN_{(UH, VH, WH)}$=0V	$V_{B(U)}$-U, $V_{B(V)}$-V, $V_{B(W)}$-W	-	-	0.3	mA
UV_{CCT}	Supply Circuit Under-Voltage Protection	Trip Level		10.3	11.4	12.5	V
UV_{CCR}		Reset Level		10.8	11.9	13.0	V
UV_{BST}		Trip Level		9.0	10.0	11.0	V
UV_{BSR}		Reset Level		10.0	11.0	12.0	V
V_{OT}	Temperature Output	Pull-down R=10kΩ (2)	LVIC temperature=90°C	2.65	2.78	2.92	V
			LVIC temperature=25°C	0.80	1.05	1.30	V
OT_T	Over-Temperature Protection (3)	V_{CC}=15V, Detect LVIC Temperature	Trip Level	110	130	150	°C
OT_{HYS}			Hysteresis of Trip Reset	-	30	-	°C
I_{IN}	Input Current	V_{IN}=5V		-	650	850	µA
$V_{th(on)}$	ON Threshold Voltage	Applied between $IN_{(UH)}$, $IN_{(VH)}$, $IN_{(WH)}$, $IN_{(UL)}$, $IN_{(VL)}$, $IN_{(WL)}$ –COM		-	-	2.5	V
$V_{th(off)}$	OFF Threshold Voltage			0.8	-	-	V
Bootstrap Diode							
V_{RRM}	Maximum Repetitive Reverse Voltage			600	-	-	V
$V_{F(BSD)}$	Bootstrap Diode Forward Voltage	I_F=10mA including voltage drop by limiting resistor		-	5.0	-	V
R_{BSD}	Bootstrap Diode Equivalent Resistance			-	500	-	Ω

Note:

2. The IPM does not shutdown MOSFETs when temperature rises excessively. When temperature exceeds the protective level that the user defined, the controller (MCU) should stop the IPM. Temperature of LVIC vs. V_{OT} output characteristics is described in Figure 3.

VOT pin	V_{OT} output	OT protection
10kΩ	Enable	Disable
Open	Enable	Enable

3. When the LVIC temperature exceeds OT Trip temperature level (OT_T), OT protection is triggered and all low-side MOSFETs turn off.

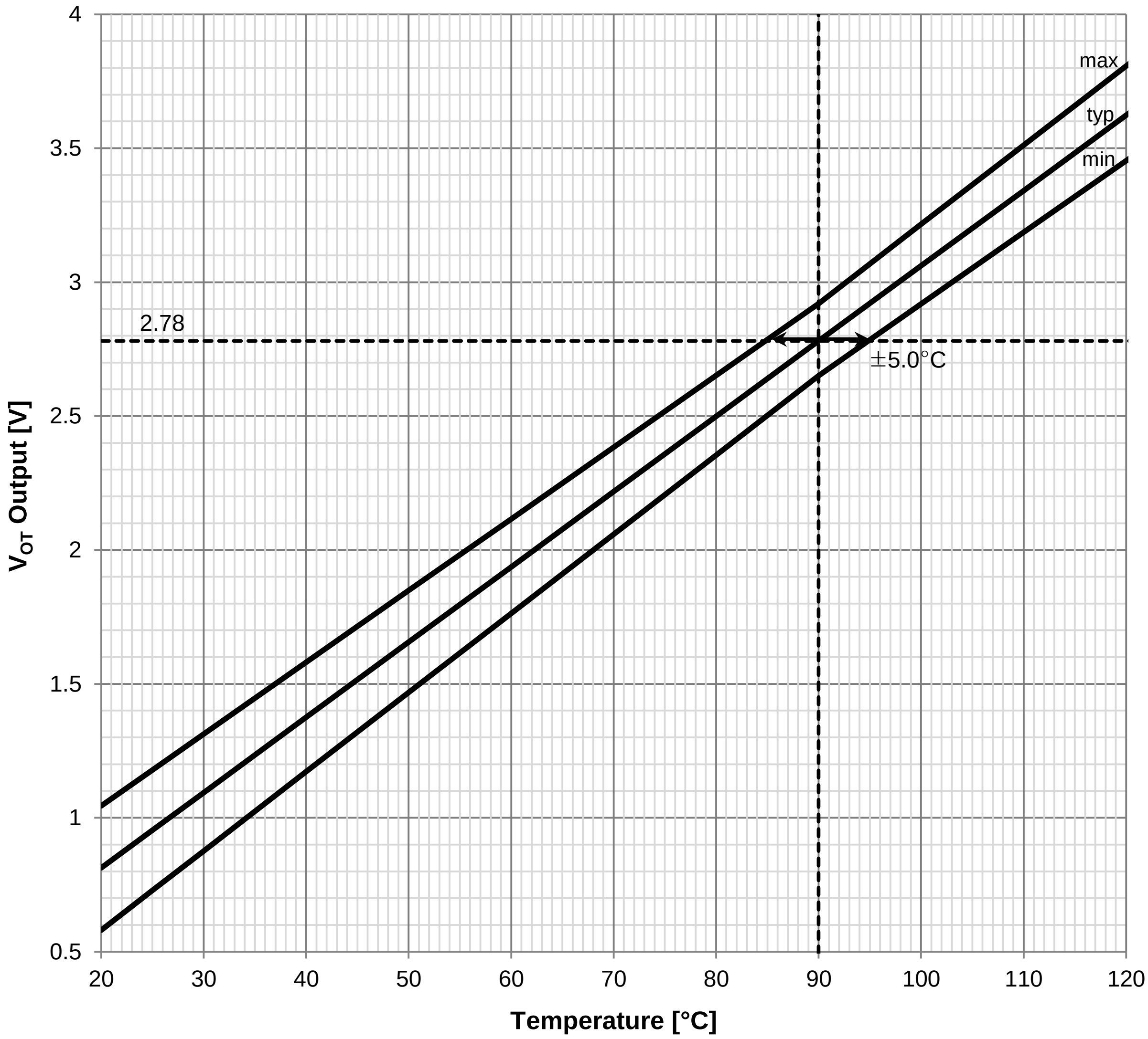
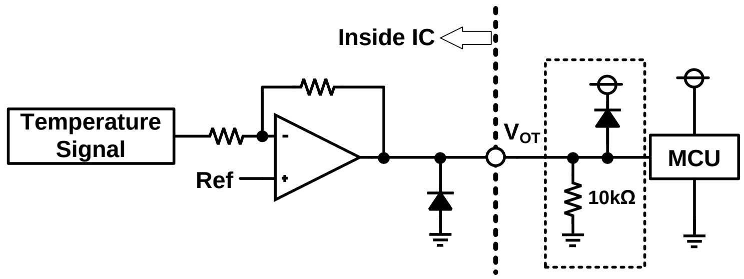


Figure 3. Temperature of LVIC vs. V_{OT} Output Characteristics



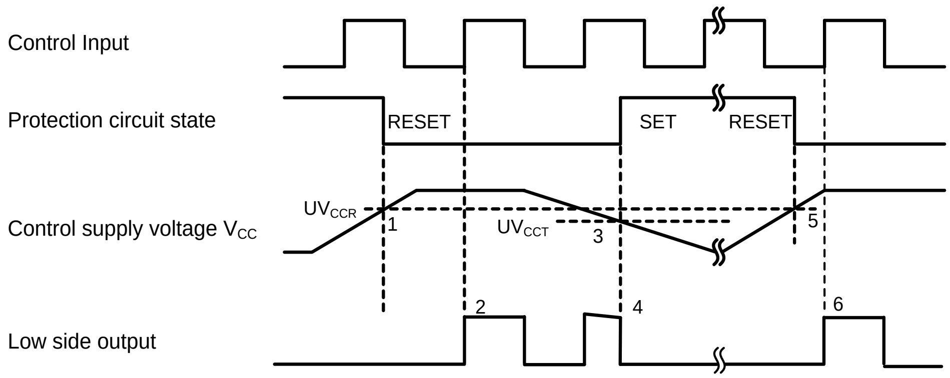
(1) If the V_{OT} pin is left unconnected, the internal over-temperature protection function and temperature monitoring function are used simultaneously.

(2) If pull-down resistor of 10kΩ connected to V_{OT} pin, the temperature monitoring function is only used.

(3) In the case of using V_{OT} with low voltage controller like 3.3V MCU, V_{OT} output might exceed control supply voltage 3.3V when temperature rises excessively. If system uses low voltage controller, it is recommended to insert a clamp diode between control supply of the controller and V_{OT} output for preventing over voltage destruction.

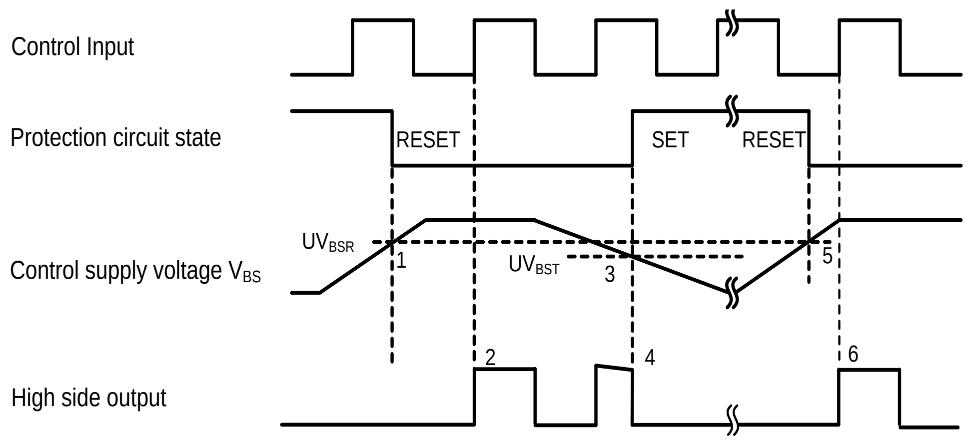
Figure 4. V_{OT} Output Circuit

Time Charts of the IPM Protective Function



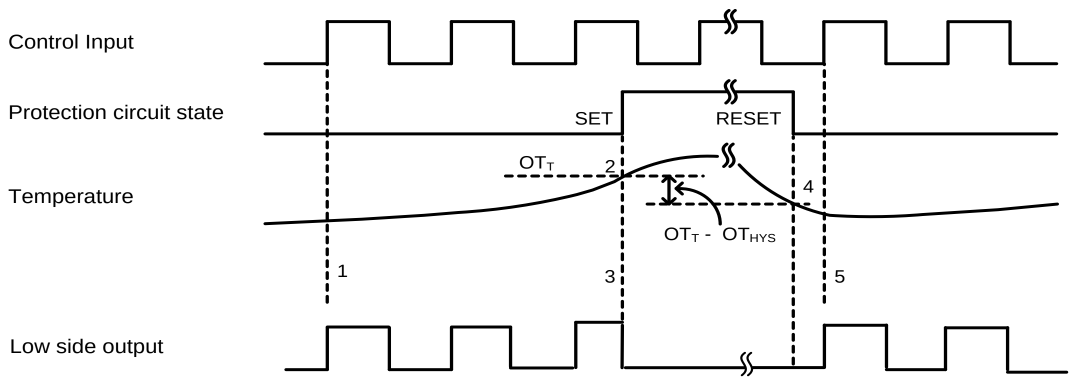
(1) Control supply voltage V_{CC} exceeds under-voltage reset level (UV_{CCR}), but MOSFETs turn on by next ON signal (L→H).
(2) Normal operation: MOSFETs turn-on and output current.
(3) V_{CC} level drops to under-voltage trip level (UV_{CCT}).
(4) All low-side MOSFETs turn off regardless of control input condition.
(5) V_{CC} level reaches UV_{CCR}.
(6) Normal operation: MOSFETs turn on and output current.

Figure 5. Under-Voltage Protection (Low-side, UV_{CC})



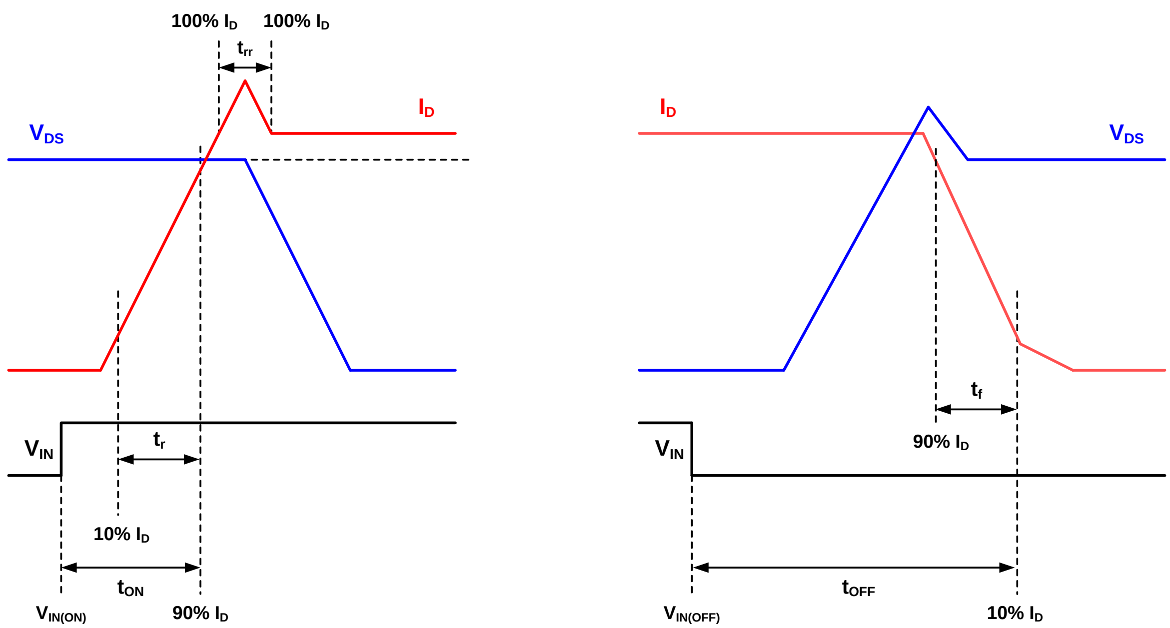
(1) Control supply voltage V_{BS} rises. After the voltage reaches under-voltage reset level (UV_{BSR}), MOSFETs turn on by next ON signal (L→H).
(2) Normal operation: MOSFETs turn on and output current.
(3) V_{BS} level drops to under-voltage trip level (UV_{BST}).
(4) All high-side MOSFETs turn off regardless of control input condition.
(5) V_{BS} level reaches UV_{BSR}.
(6) Normal operation: MOSFETs turn on and output current.

Figure 6. Under-Voltage Protection (High-side, UV_{BS})



(1) Normal operation: MOSFETs turn on and output current.
(2) LVIC temperature exceeds over-temperature trip level (OT_T).
(3) All low-side MOSFETs turn off regardless of control input condition.
(4) LVIC temperature drops to over-temperature reset level (OT_T-OT_{HYS}).
(5) Normal operation: MOSFETs turn on by the next ON signal (L→H).

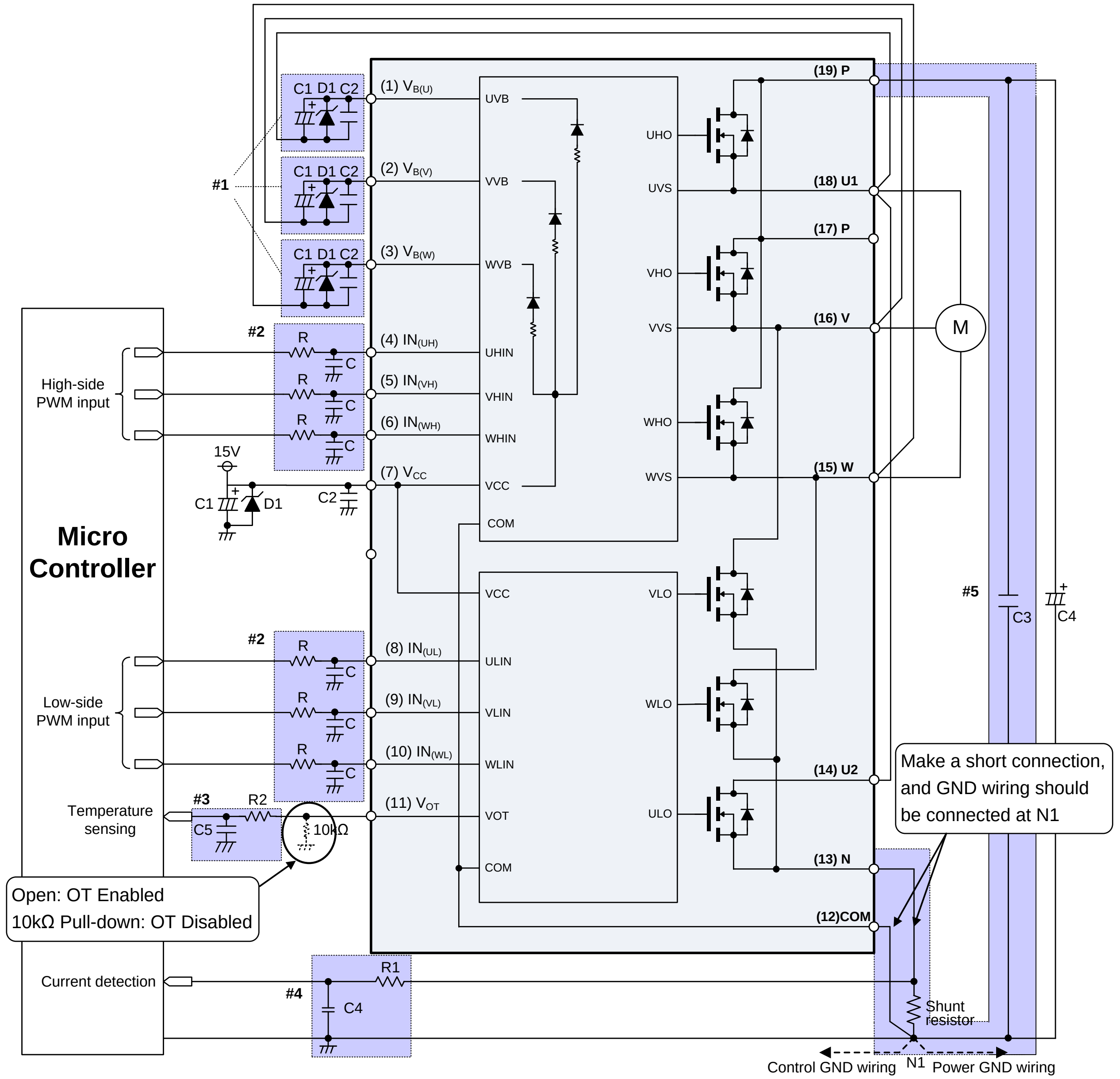
Figure 7. Over-Temperature Protection (Low-side, Detecting LVIC Temperature)



(a) Turn-on Waveform **(b) Turn-off Waveform**

Figure 8. Switching Times Definition

Example of Application Circuit



Recommended Component Values:

(#1) C1:1~3.3µF, C2:100nF, D1:20V (#2) R:100Ω, C:1nF (#3) R2:2kΩ, C5:10nF

(#4) R1:1kΩ, C4:2nF (#5) C3:0.1~0.22µF

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

(2) A zener diode D1 (20V/1W) is recommended between each pair of control supply pins to prevent surge destruction.

(3) Prevention of surge destruction can further be improved by placing the bus capacitor as close to pin P and N1 as possible. Generally a 0.1~0.22µF snubber capacitor C3 between the P-N1 terminals is recommended.

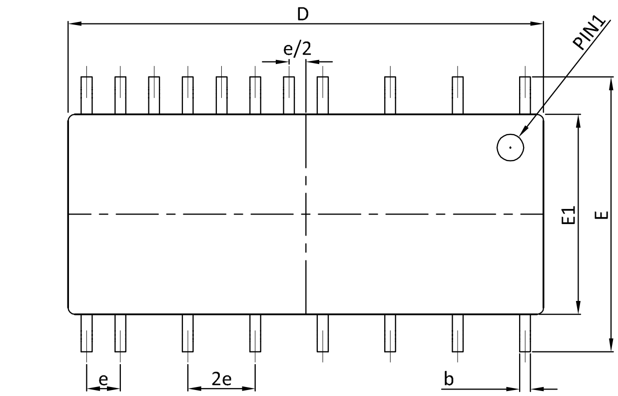
(4) When the current detection function is utilized by using the shunt resistor, the RC filter (R1 and C4) needs to be inserted to avoid the voltage spike noise in the current detection circuit. C4 should be placed as close to the controller as possible.

(5) Tight tolerance and temperature-compensated components are also recommended when selecting the R2*C5 filter for V_{OT}. The R2*C5 time constant should be set such that V_{OT} is immune to noise. Recommended values of R2 and C5 are 2kΩ and 10nF.

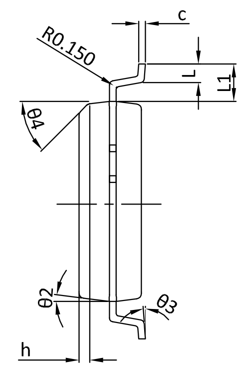
(6) It is recommended that all capacitors are mounted as close to the IPM as possible. (C1: electrolytic type with good temperature and frequency characteristics. C2: ceramic type with 0.1µF, good temperature, frequency and DC bias characteristics).

(7) To prevent malfunction, the layout to each input should be as short as possible. When using the RC coupling circuit (R: 100Ω, C: 1nF), place it as close to the IPM input pins as possible, and make sure the input signal levels meet the required turn-on and turn-off threshold voltages.

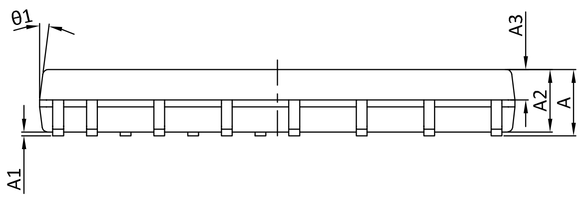
Package Dimensions, IPM-7



TOP VIEW

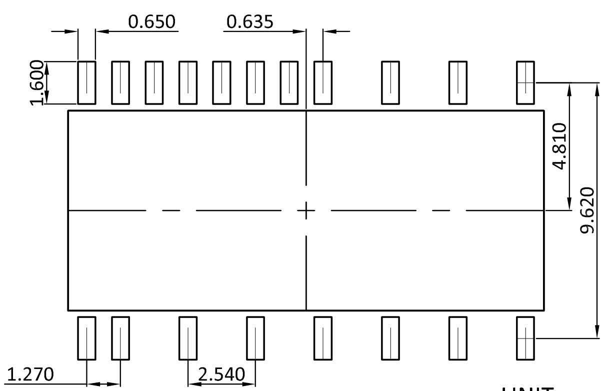


SIDE VIEW



SIDE VIEW

LAND PATTERN RECOMMENDATIONS



UNIT: mm

SYMBOLS	DIMENSION IN MILLIMETRES			DIMENSION IN INCHS		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	2.304	2.504	2.704	0.091	0.099	0.106
A1	0.050	0.150	0.250	0.002	0.006	0.010
A2	2.254	2.354	2.454	0.089	0.093	0.097
A3	1.050	1.150	1.250	0.041	0.045	0.049
D	17.800	17.900	18.000	0.701	0.705	0.709
E	10.140	10.340	10.540	0.399	0.407	0.415
E1	7.420	7.520	7.620	0.292	0.296	0.300
L	0.505	0.705	0.905	0.020	0.028	0.036
L1	1.210	1.410	1.610	0.048	0.056	0.063
e	1.270TYP.			0.050TYP.		
b	0.410TYP.			0.016TYP.		
c	0.254TYP.			0.010TYP.		
θ1	7°TYP.			7°TYP.		
θ2	7°TYP.			7°TYP.		
θ3	0°	---	8°	0°	---	8°
θ4	45°TYP.			45°TYP.		
h	0.381TYP.			0.015TYP.		

NOTES
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS, MOLD FLASH SHOULD BE LESS THAN 6 MIL.
2. TOLERANCE 0.100 MILLIMETERS UNLESS OTHERWISE SPECIFIED.
3. CONTROLLING DIMENSION IS MILLIMETER, CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.