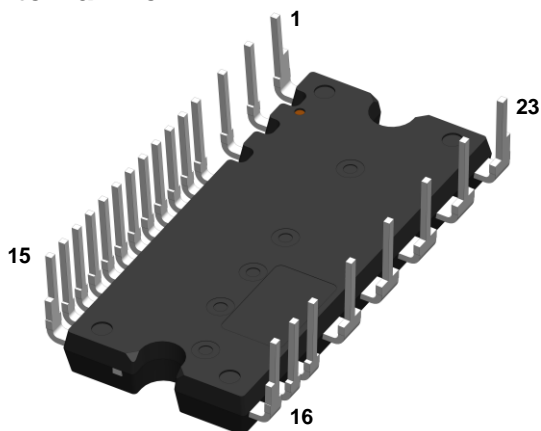


External View



Size: 33.4 x 15 x 3.6 mm

Features

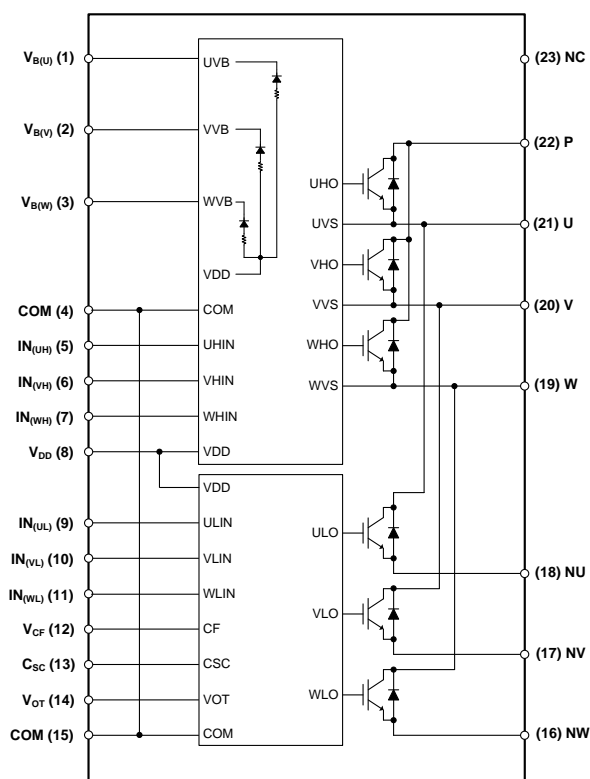
- UL Recognized:
- 600V-5A (Trench Shielded Planar Gate IGBT)
- 3 phase Inverter module including HVIC drivers
- Built-in bootstrap diodes with integrated current-limiting resistor
- Control supply under-voltage lockout protection (UVLO)
- Over-temperature (OT) protection and temperature monitoring (V_{OT}) - pin open
- Temperature monitoring only (V_{OT}) - 10k Ω resistor connection
- Short-circuit current protection (C_{SC})
- Controllable fault out signal (V_{CF}) corresponding to SC, UV and OT fault
- Wide input interface (3-18V), Schmitt trigger receiver circuit (Active High)
- Very good EMI behavior
- Isolation ratings of 2000Vrms/min

Applications

- AC 100-240Vrms class low power motor drives
- Washing Machines, Compressors, Fan Motors, Refrigerators and Dishwashers



Internal Equivalent Circuit / Pin Configuration



Ordering Information

| Part Number | Temperature Range | Package | Pin Length Description |
|----------------|-------------------|---------|------------------------|
| AIP5D05E060Q4 | -40°C to 150°C | IPM-5 | Normal |
| AIP5D05E060Q4S | -40°C to 150°C | IPM-5A | Short |



AOS Green Products use reduced levels of Halogens, and are also RoHS compliant. Please visit www.aosmd.com/media/AOSGreenPolicy.pdf for additional information.

Pin Description

| Pin Number | Pin Name | Pin Function |
|------------|--------------------|---|
| 1 | V _{B(U)} | High-Side Bias Voltage for U-Phase IGBT Driving |
| 2 | V _{B(V)} | High-Side Bias Voltage for V-Phase IGBT Driving |
| 3 | V _{B(W)} | High-Side Bias Voltage for W-Phase IGBT Driving |
| 4 | COM | Common Supply Ground |
| 5 | IN _(UH) | Signal Input for High-Side U-Phase |
| 6 | IN _(VH) | Signal Input for High-Side V-Phase |
| 7 | IN _(WH) | Signal Input for High-Side W-Phase |
| 8 | V _{DD} | Common Bias Voltage for IC and IGBTs Driving |
| 9 | IN _(UL) | Signal Input for Low-Side U-Phase |
| 10 | IN _(VL) | Signal Input for Low-Side V-Phase |
| 11 | IN _(WL) | Signal Input for Low-Side W-Phase |
| 12 | V _{CF} | Controllable Fault Output |
| 13 | C _{SC} | Capacitor (Low-Pass Filter) for Short-circuit Current Detection Input |
| 14 | V _{OT} | Voltage Output of LVIC Temperature |
| 15 | COM | Common Supply Ground |
| 16 | NW | Negative DC-Link Input for W-Phase |
| 17 | NV | Negative DC-Link Input for V-Phase |
| 18 | NU | Negative DC-Link Input for U-Phase |
| 19 | W | Output for W-Phase |
| 20 | V | Output for V-Phase |
| 21 | U | Output for U-Phase |
| 22 | P | Positive DC-Link Input |
| 23 | NC | No Connection |

Absolute Maximum Ratings

$T_J = 25^\circ\text{C}$, unless otherwise specified.

| Symbol | Parameter | Conditions | Ratings | Units |
|-----------------------------|--|--|-----------------|------------------|
| Inverter | | | | |
| V_{PN} | Supply Voltage | Applied between P - NU,NV,NW | 450 | V |
| $V_{PN(surge)}$ | Supply Voltage (surge) | Applied between P - NU,NV,NW | 500 | V |
| V_{CES} | Collector-Emitter Voltage | | 600 | V |
| I_C | Output Phase Current | $T_C=25^\circ\text{C}$, $T_J<150^\circ\text{C}$ | 5 | A |
| | | $T_C=100^\circ\text{C}$, $T_J<150^\circ\text{C}$ | 3 | A |
| $\pm I_{PK}$ | Output Peak Phase Current | $T_C=25^\circ\text{C}$, less than 1ms pulse width | 10 | A |
| t_{SC} | Short Circuit Withstand Time | $V_{PN}\leq 400\text{V}$, $T_J=150^\circ\text{C}$, $V_{DD}=15\text{V}$ | 5 | μs |
| P_C | Collector Dissipation | $T_C=25^\circ\text{C}$, per chip | 18.9 | W |
| T_J | Operating Junction Temperature | | -40 to 150 | $^\circ\text{C}$ |
| Control (Protection) | | | | |
| V_{DD} | Control Supply Voltage | Applied between V_{DD} -COM | 25 | V |
| V_{DB} | High-Side Control Bias Voltage | Applied between $V_{B(U)}$ -U, $V_{B(V)}$ -V, $V_{B(W)}$ -W | 25 | V |
| V_{IN} | Input Voltage | Applied between $IN_{(UH)}$, $IN_{(VH)}$, $IN_{(WH)}$, $IN_{(UL)}$, $IN_{(VL)}$, $IN_{(WL)}$ - COM | $V_{DD}\pm 0.5$ | V |
| V_{CF} | Fault Output Supply Voltage | Applied between V_{CF} -COM | 5 ± 0.5 | V |
| I_{CF} | Fault Output Current | Sink current at V_{CF} terminal | 1 | mA |
| V_{SC} | Current Sensing Input Voltage | Applied between C_{SC} -COM | 5 ± 0.5 | V |
| V_{OT} | Temperature Output | Applied between V_{OT} -COM | 5 ± 0.5 | V |
| Total System | | | | |
| $V_{PN(PROT)}$ | Self Protection Supply Voltage Limit (Short-Circuit Protection Capability) | $V_{DD}=13.5\text{-}16.5\text{V}$, Inverter part $T_J=150^\circ\text{C}$, Non-repetitive, less than $2\mu\text{s}$ | 400 | V |
| T_C | Module Case Operation Temperature | Measurement point of T_C is provided in Figure 1 | -30 to 125 | $^\circ\text{C}$ |
| T_{STG} | Storage Temperature | | -40 to 150 | $^\circ\text{C}$ |
| V_{ISO} | Isolation Voltage | 60Hz, sinusoidal, AC 1min, between connected all pins and heat sink plate | 2000 | V_{rms} |

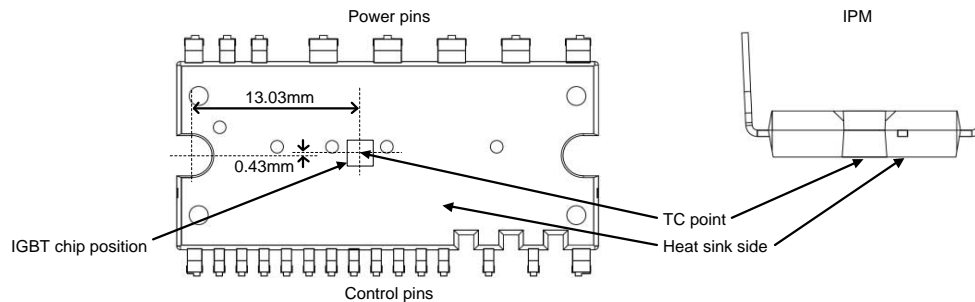


Figure 1. T_C Measurement Point

Thermal Resistance

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|----------------|--|--------------------------------|------|------|------|-------|
| $R_{th(j-c)Q}$ | Junction to Case Thermal Resistance ⁽¹⁾ | Inverter IGBT (per 1/6 module) | - | - | 6.6 | K/W |
| $R_{th(j-c)F}$ | | Inverter FWD (per 1/6 module) | - | - | 8.5 | K/W |

Note:

1. For the measurement point of case temperature (T_C), please refer to Figure 1.

Electrical Characteristics

T_J = 25°C, unless otherwise specified.

| Symbol | Parameter | Conditions | | Min. | Typ. | Max. | Units |
|----------------------|--|--|--|------|------|------|-------|
| Inverter | | | | | | | |
| V _{CE(SAT)} | Collector-Emitter Saturation Voltage | V _{DD} =V _{DB} =15V, V _{IN} =5V | I _C =2.5A, T _J =25°C | - | 1.48 | 1.85 | V |
| | | | I _C =2.5A, T _J =125°C | - | 1.69 | - | V |
| V _F | FWD Forward Voltage | V _{IN} =0 | I _F =2.5A, T _J =25°C | - | 1.75 | 2.15 | V |
| t _{ON} | Switching Times | V _{PN} =300V, V _{DD} =V _{DB} =15V I _C =2.5A, T _J =25°C, V _{IN} =0V ↔ 5V Inductive load (high-side) | | 0.40 | 0.80 | 1.40 | μs |
| t _{C(ON)} | | | | - | 0.25 | 0.50 | μs |
| t _{OFF} | | | | - | 1.00 | 1.60 | μs |
| t _{C(OFF)} | | | | - | 0.14 | 0.40 | μs |
| t _{rr} | | | | - | 0.20 | - | μs |
| I _{CES} | Collector-Emitter Leakage Current | V _{CE} =V _{CES} | T _J =25°C | - | - | 1 | mA |
| | | | T _J =125°C | - | - | 10 | mA |
| Control (Protection) | | | | | | | |
| I _{QDD} | Quiescent V _{DD} Supply Current | V _{DD} =15V, I _{N(UH,VH,WH,UL,VL,WL)} =0V | V _{DD} -COM | - | - | 1.5 | mA |
| I _{QDB} | Quiescent V _{DB} Supply Current | V _{DB} =15V, I _{N(UH, VH, WH)} =0V | V _{B(U)} -U, V _{B(V)} -V, V _{B(W)} -W | - | - | 0.3 | mA |
| V _{SC(ref)} | Short-Circuit Trip Level | V _{DD} =15V ⁽²⁾ | | 0.45 | 0.48 | 0.51 | V |
| UV _{DT} | Supply Circuit Under-Voltage Protection | Trip Level | | 10.3 | 11.4 | 12.5 | V |
| UV _{DR} | | Reset Level | | 10.8 | 11.9 | 13.0 | V |
| UV _{DBT} | | Trip Level | | 9.0 | 10.0 | 11.0 | V |
| UV _{DBR} | | Reset Level | | 10.0 | 11.0 | 12.0 | V |
| V _{OT} | Temperature Output | Pull-down R=10kΩ ⁽³⁾ | LVIC Temperature=80°C | 2.36 | 2.45 | 2.55 | V |
| | | | LVIC Temperature=25°C | 0.77 | 1.00 | 1.25 | V |
| OT _T | Over-Temperature Protection ⁽⁴⁾ | V _{DD} =15V, Detect LVIC Temperature | Trip Level | 110 | 130 | 150 | °C |
| OT _{HYS} | | | Hysteresis of Trip Reset | - | 30 | - | °C |
| V _{CFH} | Fault Output Voltage | V _{SC} =0V, V _{CF} Circuit: 10kΩ to 5V pull-up | | 4.9 | - | - | V |
| V _{CFL} | | V _{SC} =1V, V _{CF} Circuit: 10kΩ to 5V pull-up | | - | - | 0.5 | V |
| V _{CF+} | CF positive going threshold | | | - | 1.9 | 2.2 | V |
| V _{CF-} | CF negative going threshold | | | 0.8 | 1.1 | - | V |
| t _{FO} | Fault Output Pulse Width ⁽⁵⁾ | | | 20 | - | - | μs |
| I _{IN} | Input Current | V _{IN} =5V | | - | 1.0 | - | mA |
| V _{th(on)} | ON Threshold Voltage | Applied between I _{N(UH)} , I _{N(VH)} , I _{N(WH)} , I _{N(UL)} , I _{N(VL)} , I _{N(WL)} -COM | | | 2.3 | 2.6 | V |
| V _{th(off)} | OFF Threshold Voltage | | | 0.8 | 1.2 | | V |
| V _{th(hys)} | ON/OFF Threshold Hysteresis Voltage | | | - | 1.1 | - | V |
| V _{F(BSD)} | Bootstrap Diode Forward Voltage | I _F =10mA Including Voltage Drop by Limiting Resistor ⁽⁶⁾ | | - | 5.0 | - | V |
| R _{BSD} | Built-in Limiting Resistance | Included in Bootstrap Diode | | - | 500 | - | Ω |

Notes:

- Short-circuit protection works only for low sides.
- The IPM does not shutdown IGBTs and output fault signal automatically 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.
- When the LVIC temperature exceeds OT Trip temperature level (OT_T), OT protection is triggered and fault outputs.
- Fault signal (F_O) outputs when SC, UV or OT protection is triggered. F_O pulse width is different for each protection mode. At SC failure, F_O pulse width is a fixed width (minimum 20μs), but at UV or OT failure, F_O outputs continuously until recovering from UV or OT state. (But minimum F_O pulse width is 20μs).
- The characteristics of bootstrap diodes are described in Figure 2.

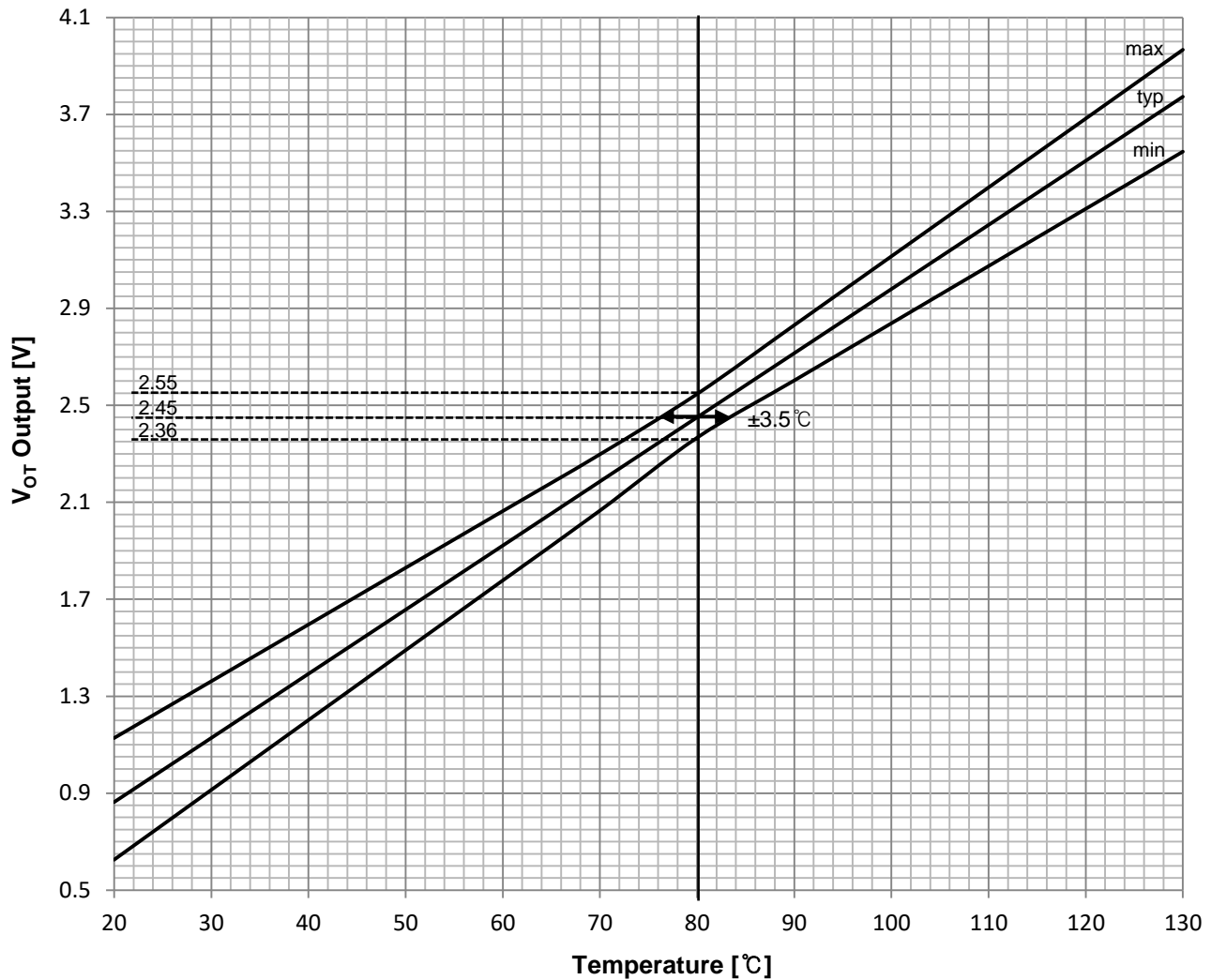


Figure 3. Temperature of LVIC vs. V_{OT} Output Characteristics

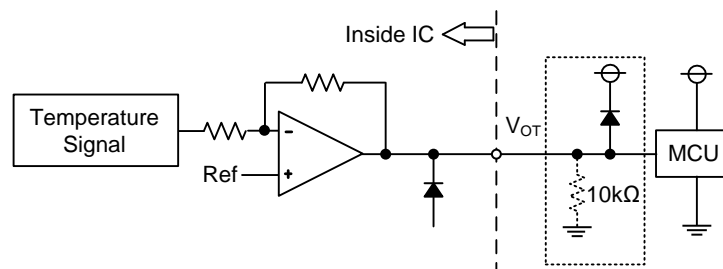


Figure 4. V_{OT} Output Circuit

- (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.

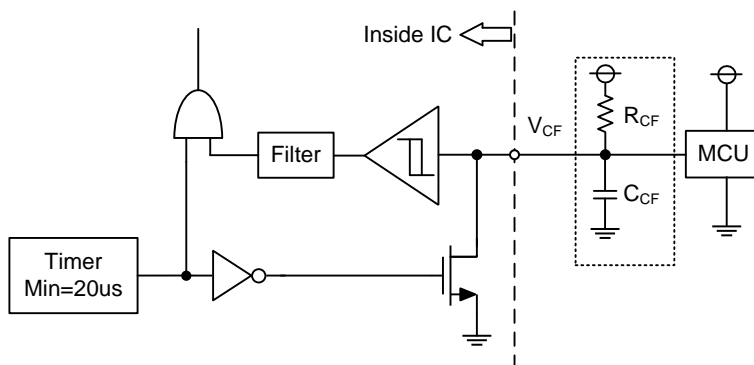


Figure 5. V_{CF} Output Circuit

- (1) The V_{CF} pin provides an enable functionality that allows it to shut down the all low-side IGBTs. When the V_{CF} pin is in the high state the IPM is able to operate normally. If the V_{CF} pin is in a low state, the low-side IGBTs are turned off until the enable condition is restored. In addition, the V_{CF} pin can provide the fault output signal with the fixed or controlled fault out pulse width.
- (2) If only a pull-up resistor of 10kΩ connected to the V_{CF} pin, the fault output pulse width is fixed at minimum 20us.
- (3) If a capacitor is connected with a pull-up resistor together, the fault output pulse width can be controlled according to the resistor and the capacitor values. The length of fault output pulse width is determined by the following formula ;
 - $t_{FO} = -(R_{CF} \cdot C_{CF}) \cdot \ln(1 - V_{CF}/V_{DD}) + 20\text{us}(\text{min.})$
 - ex) $V_{DD}=5\text{V}$, $R_{CF}=2.2\text{M}\Omega$, $C_{CF}=1\text{nF}$, $t_{FO}\approx 1.07\text{ms}$. Recommended parameters in the design are C_{CF} of $\leq 1\text{nF}$ and R_{CF} of 0.1M to 2.2MΩ.

Mechanical Characteristics and Ratings

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|-----------------|-----------------------------------|------------|------|------|------|-------|
| Mounting Torque | Mounting Screw: M3 ⁽⁷⁾ | | 0.59 | 0.69 | 0.78 | N m |
| Weight | | | - | 5.25 | - | g |
| Flatness | Refer to Figure 6 | | -50 | - | 100 | μm |

Note:

7. Plain washers (ISO 7089-7094) are recommended.

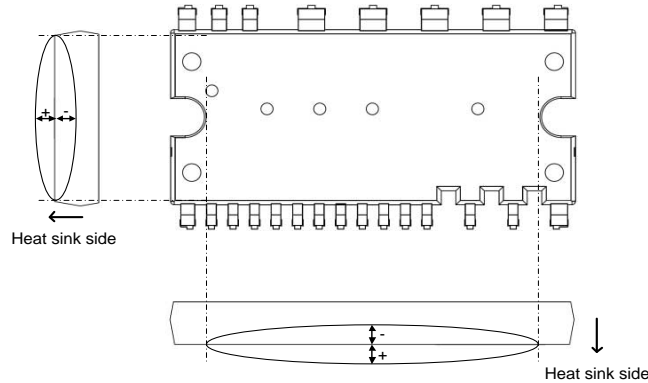


Figure 6. Flatness Measurement Positions

Recommended Operation Conditions

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|-----------------------------|--|---|------|------|------|-------|
| V_{PN} | Supply Voltage | Applied between P-NU, NV, NW | 0 | 300 | 400 | V |
| V_{DD} | Control Supply Voltage | Applied between V_{DD} -COM | 13.5 | 15.0 | 16.5 | V |
| V_{DB} | High-Side Bias Voltage | Applied between $V_{B(U)}$ -U, $V_{B(V)}$ -V, $V_{B(W)}$ -W | 13.5 | 15.0 | 18.5 | V |
| dV_{DD}/dt , dV_{DB}/dt | Control Supply Variation | | -1 | - | 1 | V/μs |
| t_{dead} | Arm Shoot-Through Blocking Time | For each input signal | 1.0 | - | - | μs |
| f_{PWM} | PWM Input Frequency | $-40^{\circ}\text{C} < T_J < 150^{\circ}\text{C}$ | - | - | 20 | kHz |
| $PW_{IN(ON)}$ | Minimum Input Pulse Width ⁽⁸⁾ | | 0.5 | - | - | μs |
| $PW_{IN(OFF)}$ | | | 0.5 | - | - | μs |
| COM | COM Variation | Between COM-NU, NV, NW (including surge) | -5.0 | - | 5.0 | V |

Note:

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

Time Charts of the IPM Protective Function

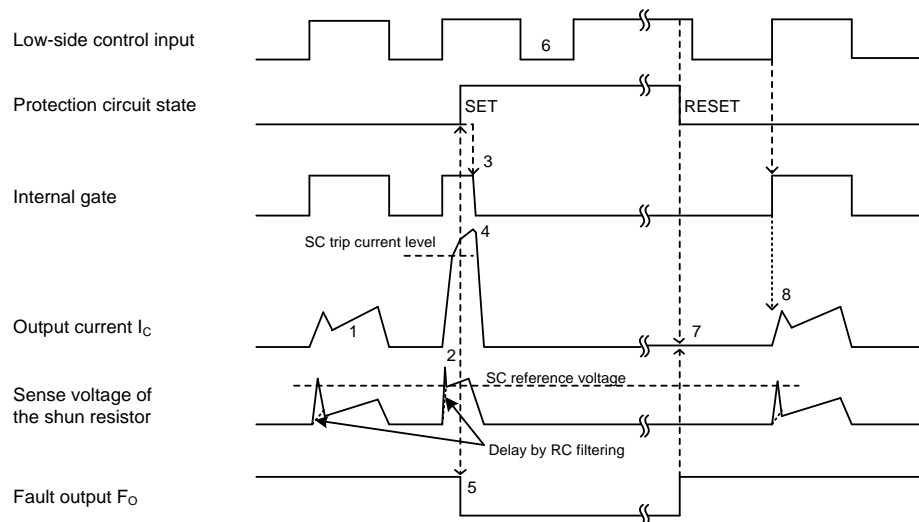


Figure 7. Short-Circuit Protection
(Low-side Operation Only with the External Shunt Resistor and RC Filter)

- (1) Normal operation: IGBT turns on and outputs current.
- (2) Short-circuit current detection (SC triggered).
- (3) All low-side IGBTs' gates are hard interrupted.
- (4) All low-side IGBTs turn OFF.
- (5) F_O output time (t_{FO})=minimum 20 μ s.
- (6) Input = "L" : IGBT OFF.
- (7) Fault output finishes, but output current will not turn on until next ON signal (L→H).
- (8) Normal operation: IGBT turns on and outputs current.

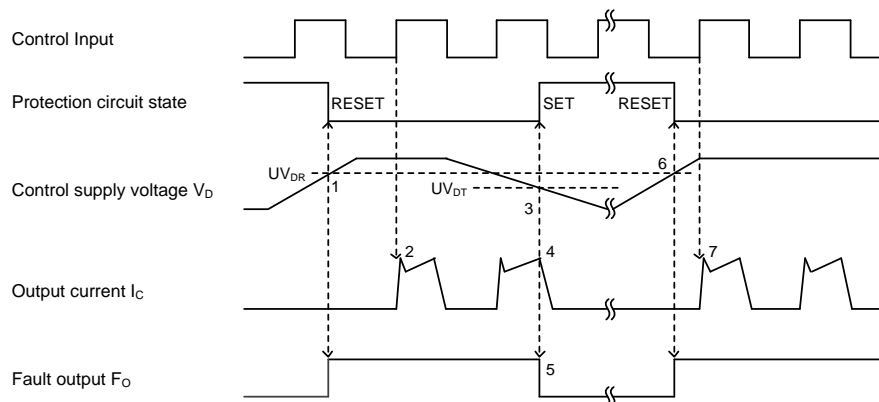


Figure 8. Under-Voltage Protection (Low-side, UV_D)

- (1) Control supply voltage V_{DD} exceeds under voltage reset level (UV_{DR}), but IGBT turns on by next ON signal (L→H).
- (2) Normal operation: IGBT turns on and outputs current.
- (3) V_{DD} level drops to under voltage trip level (UV_{DT}).
- (4) All low-side IGBTs turn OFF regardless of control input condition.
- (5) F_O output time (t_{FO})=minimum 20 μ s, and F_O stays low as long as V_{DD} is below UV_{DR} .
- (6) V_{DD} level reaches UV_{DR} .
- (7) Normal operation: IGBT turns on and outputs current.

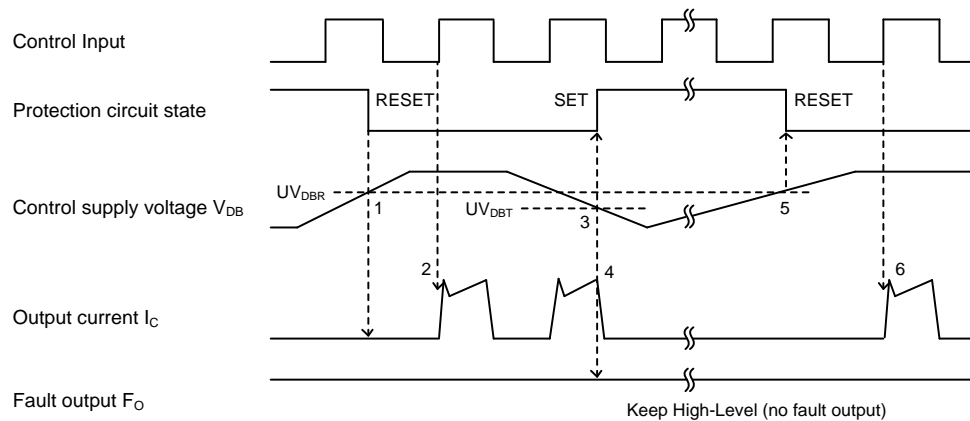


Figure 9. Under-Voltage Protection (High-side, UV_{DB})

- (1) Control supply voltage V_{DB} rises. After the voltage reaches under voltage reset level UV_{DBR} , IGBT turns on by next ON signal (L→H).
- (2) Normal operation: IGBT turns on and outputs current.
- (3) V_{DB} level drops to under voltage trip level (UV_{DBT}).
- (4) All high-side IGBTs turn OFF regardless of control input condition, but there is no F_O signal output.
- (5) V_{DB} level reaches UV_{DBR} .
- (6) Normal operation: IGBT turns on and outputs current.

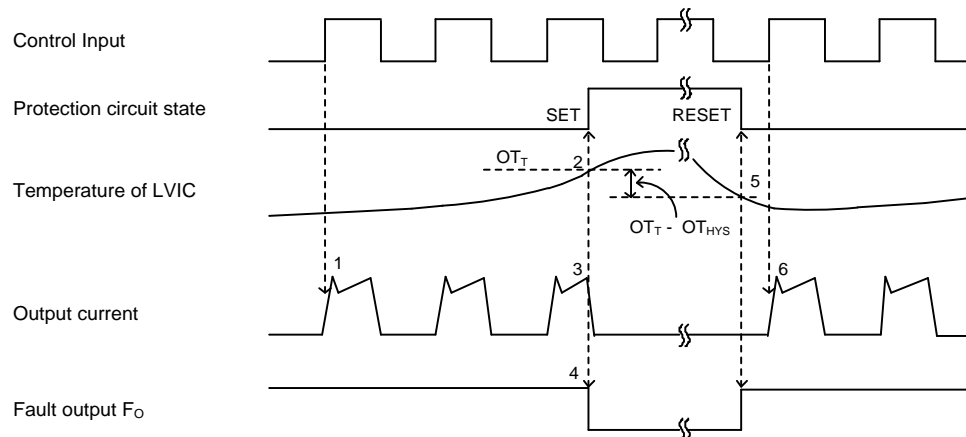
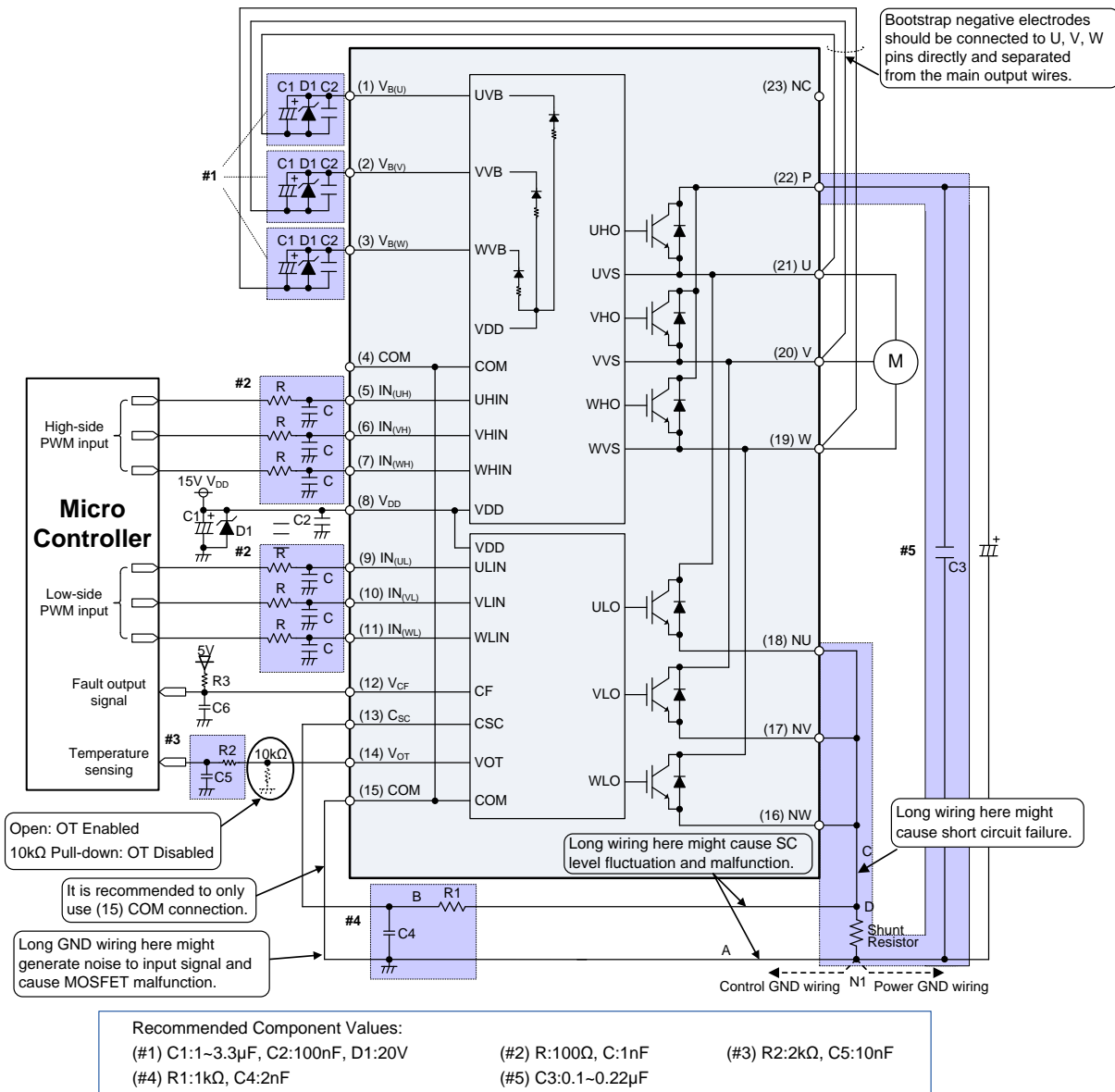


Figure 10. Over-Temperature Protection (Low-side, Detecting LVIC Temperature)

- (1) Normal operation: IGBT turns on and outputs current.
- (2) LVIC temperature exceeds over-temperature trip level (OT_T).
- (3) All low-side IGBTs turn off regardless of control input condition.
- (4) F_O output time (t_{FO})=minimum 20 μ s, and F_O stays low as long as LVIC temperature is over OT_T .
- (5) LVIC temperature drops to over-temperature reset level ($OT_T - OT_{HYS}$).
- (6) Normal operation: IGBT turns on by the next ON signal (L→H).

Example of Application Circuit



- (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 single point (N1), near the terminal of the shunt resistor.
- (2) There are two COM pins in the IPM but it is recommended to only use the (15) COM pin to minimize SC detection noise.
- (3) A zener diode D1 (24V/1W) is recommended between each pair of control supply pins to prevent surge destruction.
- (4) 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.
- (5) Selection of the R1*C4 filter components for short-circuit protection is recommended to have tight tolerance, and is temperature-compensated type. The R1*C4 time constant should be set such that SC current is shut down within 2μs; (typically 1.5-2μs). R1 and C4 should be placed as close as possible to the C_{SC} pin. SC interrupting time may vary with layout patterns and components selection, therefore thorough evaluation in the system is necessary.
- (6) 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.
- (7) To prevent malfunction, traces A, B, and C should be as short as possible.
- (8) 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 0.1-2μF, good temperature, frequency and DC bias characteristics.)

- (9) Input drives are active-high. There is a minimum 3.5k Ω pull-down resistor in the input circuit of IC. To prevent malfunction, the layout to each input should be as short as possible. When using RC coupling circuit, make sure the input signal levels meet the required turn-on and turn-off threshold voltages.
- (10) V_{CF} output is open drain type. It should be pulled up to MCU or control power supply (max= 5 \pm 0.5V), limiting the current (I_{CF}) to no more than 1mA. I_{CF} is estimated roughly by the formula of control power supply voltage divided by the pull-up resistor R3. For example, if control supply is 5V, a 10k Ω (over 5k Ω) pull-up resistor R3 is recommended.
- (11) If only a pull-up resistor R3 of 10k Ω connected to V_{CF} pin, the fault output pulse width is fixed at minimum 20 μ s. If a capacitor C6 is connected with a pull-up resistor R3, the fault output pulse width can be controlled according to the resistor value and capacitor value. For the design guide, please refer to the Figure 5.
- (12) Direct drive of the IPM from the MCU is possible without having to use opto-coupler or isolation transformer.
- (13) The IPM may malfunction and erroneous operations may occur if high frequency noise is superimposed to the supply line. To avoid such problems, line ripple voltage is recommended to have $dV/dt \leq \pm 1V/\mu s$, and $V_{ripple} \leq 2V_{p-p}$.
- (14) It is not recommended to use the IPM to drive the same load in parallel with another IPM or inverter types.

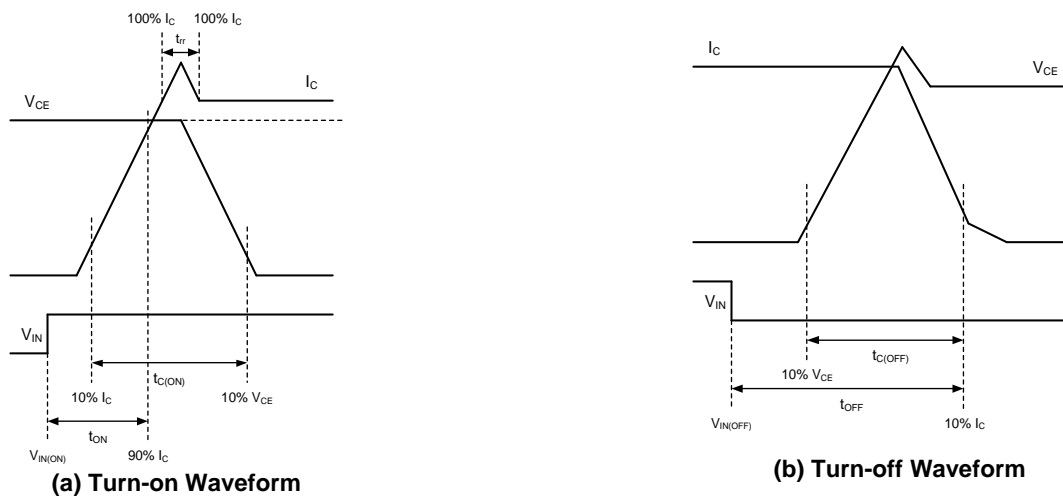
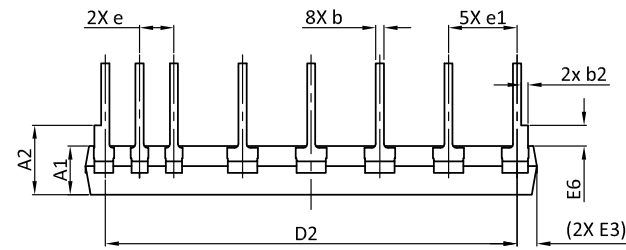
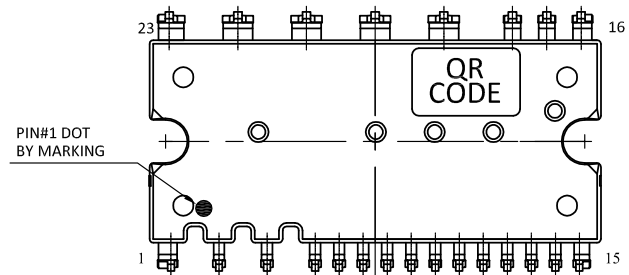


Figure 11. Switching Times Definition

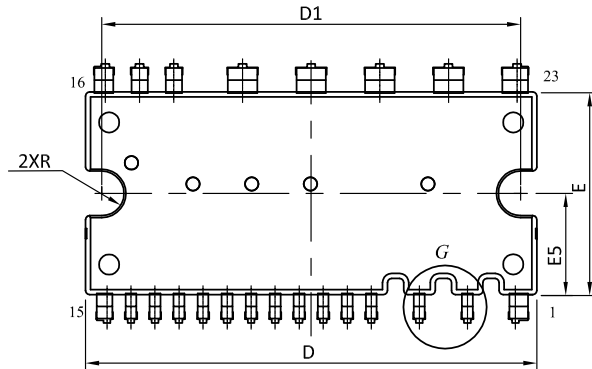
Package Dimensions, IPM-5



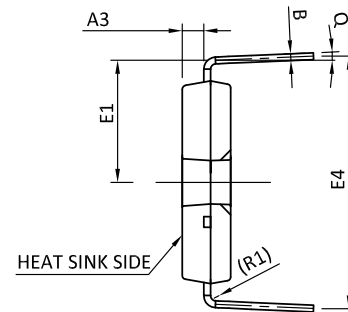
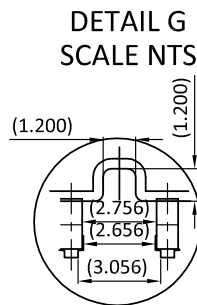
SIDE VIEW



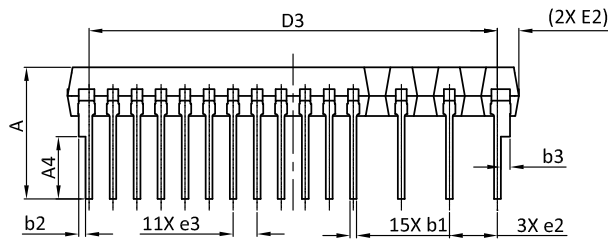
BOTTOM VIEW



TOP VIEW

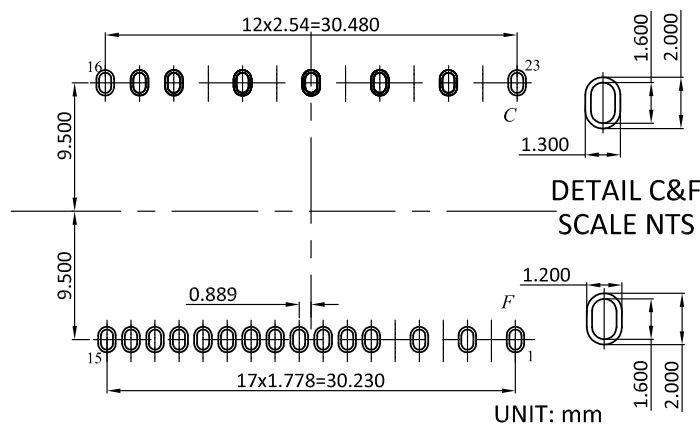


SIDE VIEW



SIDE VIEW

LAND PATTERN RECOMMENDATIONS



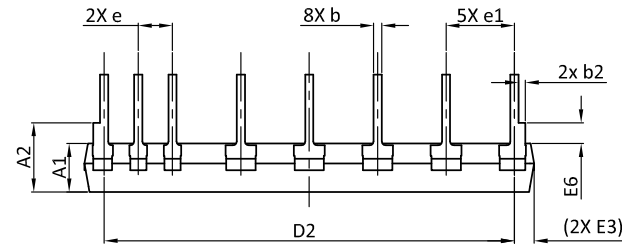
**DETAIL C&F
SCALE NTS**

| SYMBOLS | DIMENSION IN MILLIMETRES | | | DIMENSION IN INCHS | | |
|---------|--------------------------|--------|--------|--------------------|-------|-------|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 9.300 | 9.700 | 10.100 | 0.366 | 0.382 | 0.398 |
| A1 | 3.300 | 3.600 | 3.900 | 0.130 | 0.142 | 0.154 |
| A2 | 4.700 | 5.100 | 5.500 | 0.185 | 0.201 | 0.217 |
| A3 | 1.500 | 1.600 | 1.700 | 0.059 | 0.063 | 0.067 |
| A4 | 4.200 | 4.600 | 5.000 | 0.165 | 0.181 | 0.197 |
| B | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| b | 0.500 | 0.600 | 0.700 | 0.020 | 0.024 | 0.028 |
| b1 | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| b2 | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| b3 | 0.600 | 0.700 | 0.800 | 0.024 | 0.028 | 0.031 |
| D | 33.100 | 33.400 | 33.700 | 1.303 | 1.315 | 1.327 |
| D1 | 30.800 | 31.000 | 31.200 | 1.213 | 1.220 | 1.228 |
| D2 | 30.180 | 30.480 | 30.780 | 1.188 | 1.200 | 1.212 |
| D3 | 29.930 | 30.230 | 30.530 | 1.178 | 1.190 | 1.202 |
| E | 14.700 | 15.000 | 15.300 | 0.579 | 0.591 | 0.602 |
| E1 | 8.600 | 9.000 | 9.400 | 0.339 | 0.354 | 0.370 |
| E2 | 1.600REF | | | 0.063REF | | |
| E3 | 1.500REF | | | 0.059REF | | |
| E4 | 18.300 | 18.700 | 19.100 | 0.720 | 0.736 | 0.752 |
| E5 | 7.300 | 7.500 | 7.700 | 0.287 | 0.295 | 0.303 |
| E6 | 1.100 | 1.500 | 1.900 | 0.043 | 0.059 | 0.075 |
| e | 2.340 | 2.540 | 2.740 | 0.092 | 0.100 | 0.108 |
| e1 | 4.880 | 5.080 | 5.280 | 0.192 | 0.200 | 0.208 |
| e2 | 3.356 | 3.556 | 3.756 | 0.132 | 0.140 | 0.148 |
| e3 | 1.578 | 1.778 | 1.978 | 0.062 | 0.070 | 0.078 |
| R | 1.500 | 1.600 | 1.700 | 0.059 | 0.063 | 0.067 |
| R1 | 0.400REF | | | 0.016REF | | |
| Q | 2° - 6° | | | 2° - 6° | | |

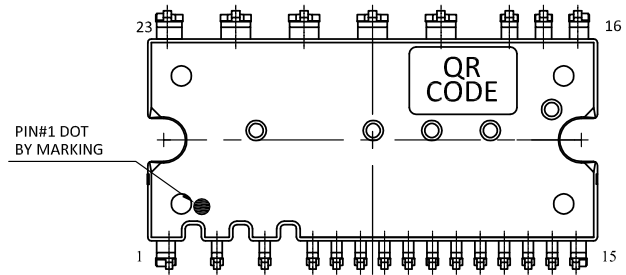
NOTES

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.
4. () IS REFERENCE.

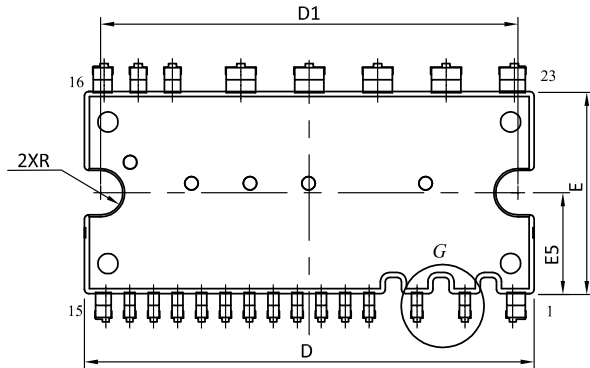
Package Dimensions, IPM-5A



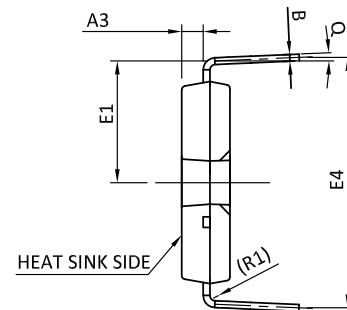
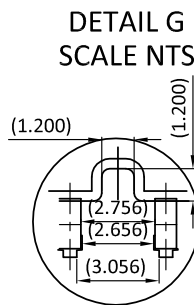
SIDE VIEW



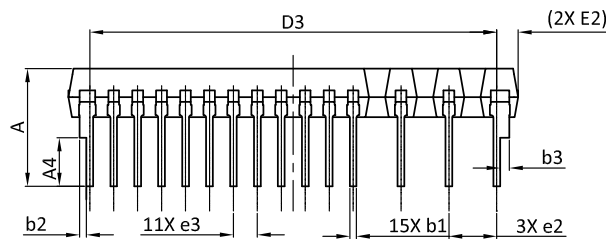
BOTTOM VIEW



TOP VIEW

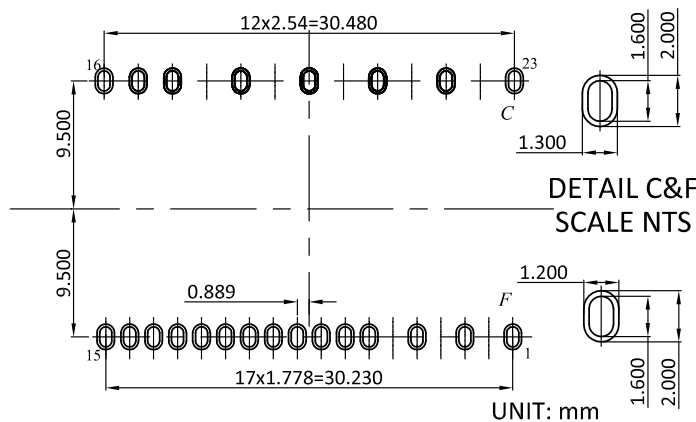


SIDE VIEW



SIDE VIEW

LAND PATTERN RECOMMENDATIONS



**DETAIL C&F
SCALE NTS**

| SYMBOLS | DIMENSION IN MILLIMETRES | | | DIMENSION IN INCHES | | |
|---------|--------------------------|--------|--------|---------------------|-------|-------|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 8.300 | 8.700 | 9.100 | 0.327 | 0.343 | 0.358 |
| A1 | 3.300 | 3.600 | 3.900 | 0.130 | 0.142 | 0.154 |
| A2 | 4.700 | 5.100 | 5.500 | 0.185 | 0.201 | 0.217 |
| A3 | 1.500 | 1.600 | 1.700 | 0.059 | 0.063 | 0.067 |
| A4 | 3.200 | 3.600 | 4.000 | 0.126 | 0.142 | 0.157 |
| B | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| b | 0.500 | 0.600 | 0.700 | 0.020 | 0.024 | 0.028 |
| b1 | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| b2 | 0.400 | 0.500 | 0.600 | 0.016 | 0.020 | 0.024 |
| b3 | 0.600 | 0.700 | 0.800 | 0.024 | 0.028 | 0.031 |
| D | 33.100 | 33.400 | 33.700 | 1.303 | 1.315 | 1.327 |
| D1 | 30.800 | 31.000 | 31.200 | 1.213 | 1.220 | 1.228 |
| D2 | 30.180 | 30.480 | 30.780 | 1.188 | 1.200 | 1.212 |
| D3 | 29.930 | 30.230 | 30.530 | 1.178 | 1.190 | 1.202 |
| E | 14.700 | 15.000 | 15.300 | 0.579 | 0.591 | 0.602 |
| E1 | 8.600 | 9.000 | 9.400 | 0.339 | 0.354 | 0.370 |
| E2 | 1.600REF | | | 0.063REF | | |
| E3 | 1.500REF | | | 0.059REF | | |
| E4 | 18.200 | 18.600 | 19.000 | 0.717 | 0.732 | 0.748 |
| E5 | 7.300 | 7.500 | 7.700 | 0.287 | 0.295 | 0.303 |
| E6 | 1.100 | 1.500 | 1.900 | 0.043 | 0.059 | 0.075 |
| e | 2.340 | 2.540 | 2.740 | 0.092 | 0.100 | 0.108 |
| e1 | 4.880 | 5.080 | 5.280 | 0.192 | 0.200 | 0.208 |
| e2 | 3.356 | 3.556 | 3.756 | 0.132 | 0.140 | 0.148 |
| e3 | 1.578 | 1.778 | 1.978 | 0.062 | 0.070 | 0.078 |
| R | 1.500 | 1.600 | 1.700 | 0.059 | 0.063 | 0.067 |
| R1 | 0.400REF | | | 0.016REF | | |
| Q | 2° - 6° | | | 2° - 6° | | |

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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.