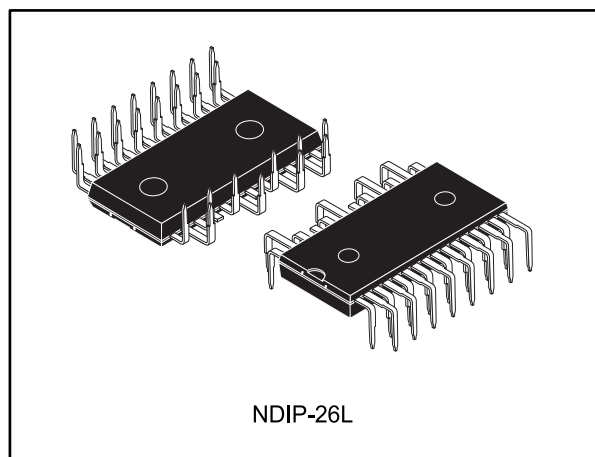


SLLIMM™-nano small low-loss intelligent molded module IPM, 3-phase inverter, 2 A, 1.7 Ω max., 500 V MOSFET

Datasheet - production data



Features

- IPM 2 A, 500 V, $R_{DS(on)} = 1.7 \Omega$, 3-phase MOSFET inverter bridge including control ICs for gate driving
- Optimized for low electromagnetic interference
- 3.3 V, 5 V, 15 V CMOS/TTL input comparators with hysteresis and pull-down/pull-up resistors
- Undervoltage lockout
- Internal bootstrap diode
- Interlocking function
- Smart shutdown function
- Comparator for fault protection against overtemperature and overcurrent
- Op-amp for advanced current sensing
- Optimized pinout for easy board layout
- NTC for temperature control (UL 1434 CA 2 and 4)
- Up to ± 2 kV ESD protection (HBM C = 100 pF, R = 1.5 kΩ)

Applications

- 3-phase inverters for small power motor drives
- Dish washers, refrigerator compressors, heating systems, air-conditioning fans, draining and recirculation pumps

Description

This SLLIMM (small low-loss intelligent molded module) nano provides a compact, high performance AC motor drive in a simple, rugged design. It is composed of six MOSFETs and three half-bridge HVICs for gate driving, providing low electromagnetic interference (EMI) characteristics with optimized switching speed. The package is optimized for thermal performance and compactness in built-in motor applications, or other low power applications where assembly space is limited. This IPM includes an operational amplifier, completely uncommitted, and a comparator that can be used to design a fast and efficient protection circuit. SLLIMM™ is a trademark of STMicroelectronics.

Table 1: Device summary

| Order code | Marking | Package | Packing |
|--------------|------------|----------|---------|
| STIPN2M50T-H | IPN2M50T-H | NDIP-26L | Tube |

Contents

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1 Internal schematic diagram and pin configuration

Figure 1: Internal schematic diagram

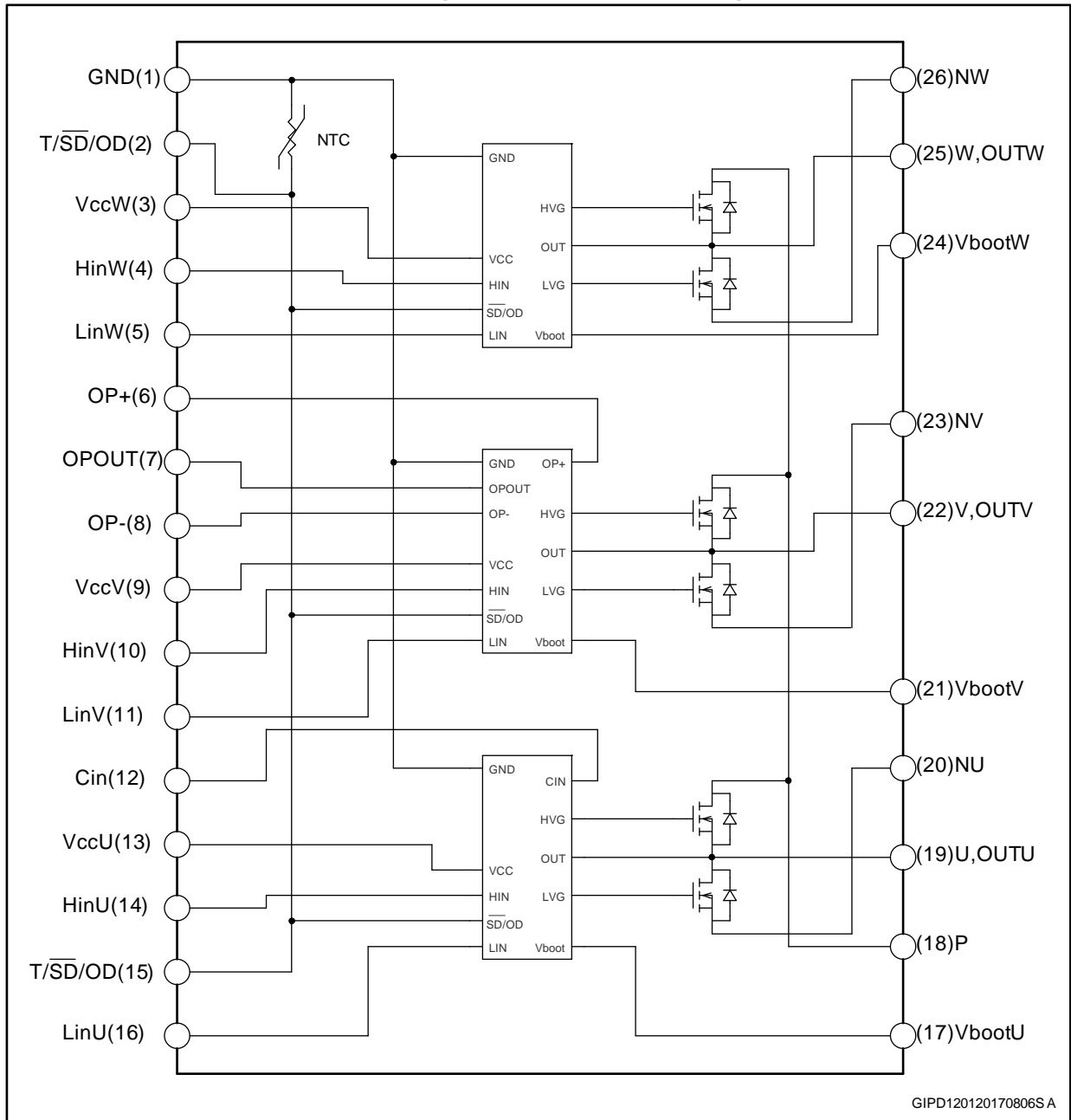
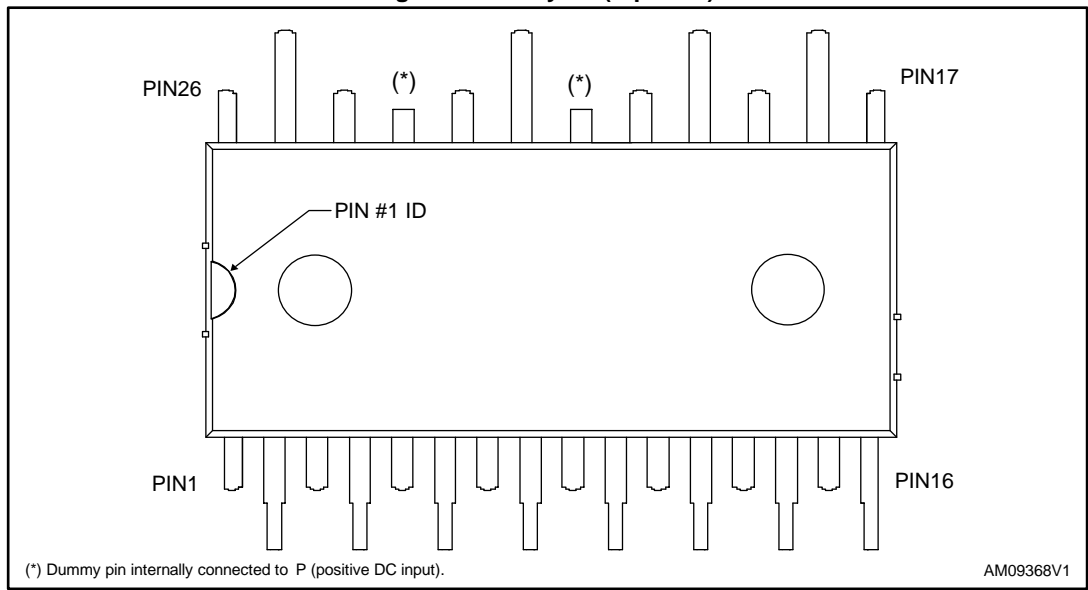


Table 2: Pin description

| Pin | Symbol | Description |
|-----|------------------------|--|
| 1 | GND | Ground |
| 2 | T/ \overline{SD} /OD | NTC thermistor terminal / shutdown logic input (active low) / open-drain (comparator output) |
| 3 | V _{CC} W | Low voltage power supply W phase |
| 4 | HIN W | High-side logic input for W phase |
| 5 | LIN W | Low-side logic input for W phase |
| 6 | OP+ | Op-amp non inverting input |
| 7 | OP _{OUT} | Op-amp output |
| 8 | OP- | Op-amp inverting input |
| 9 | V _{CC} V | Low voltage power supply V phase |
| 10 | HIN V | High-side logic input for V phase |
| 11 | LIN V | Low-side logic input for V phase |
| 12 | CIN | Comparator input |
| 13 | V _{CC} U | Low voltage power supply for U phase |
| 14 | HIN U | High-side logic input for U phase |
| 15 | T/ \overline{SD} /OD | NTC thermistor terminal / shutdown logic input (active low) / open-drain (comparator output) |
| 16 | LIN U | Low-side logic input for U phase |
| 17 | V _{BOOT} U | Bootstrap voltage for U phase |
| 18 | P | Positive DC input |
| 19 | U, OUT _U | U phase output |
| 20 | N _U | Negative DC input for U phase |
| 21 | V _{BOOT} V | Bootstrap voltage for V phase |
| 22 | V, OUT _V | V phase output |
| 23 | N _V | Negative DC input for V phase |
| 24 | V _{BOOT} W | Bootstrap voltage for W phase |
| 25 | W, OUT _W | W phase output |
| 26 | N _W | Negative DC input for W phase |

Figure 2: Pin layout (top view)



2 Electrical ratings

2.1 Absolute maximum ratings

Table 3: Inverter part

| Symbol | Parameter | Value | Unit |
|--------------------|--|-------|------|
| V_{DSS} | MOSFET blocking voltage (or drain-source voltage) for each MOSFET ($V_{IN}^{(1)} = 0$) | 500 | V |
| $\pm I_D$ | Continuous current each MOSFET | 2 | A |
| $\pm I_{DP}^{(2)}$ | Peak drain current each MOSFET (less than 1 ms) | 4 | A |
| P_{TOT} | Each MOSFET total dissipation at $T_C = 25\text{ °C}$ | 10.4 | W |

Notes:

(1) Applied among HINi, LINi and GND for $i = U, V, W$.

(2) Pulse width limited by max. junction temperature.

Table 4: Control part

| Symbol | Parameter | Min. | Max. | Unit |
|--------------------------|--|-----------------|------------------|------|
| V_{OUT} | Output voltage applied among $OUT_U, OUT_V, OUT_W - GND$ | $V_{boot} - 21$ | $V_{boot} + 0.3$ | V |
| V_{CC} | Low voltage power supply | -0.3 | 21 | V |
| V_{CIN} | Comparator input voltage | -0.3 | $V_{CC} + 0.3$ | V |
| V_{op+} | Op-amp non-inverting input | -0.3 | $V_{CC} + 0.3$ | V |
| V_{op-} | Op-amp inverting input | -0.3 | $V_{CC} + 0.3$ | V |
| V_{boot} | Bootstrap voltage | -0.3 | 620 | V |
| V_{IN} | Logic input voltage applied among HIN, LIN and GND | -0.3 | 15 | V |
| $V_{T/\overline{SD}/OD}$ | Open-drain voltage | -0.3 | 15 | V |
| $\Delta V_{OUT/dT}$ | Allowed output slew rate | | 50 | V/ns |

Table 5: Total system

| Symbol | Parameter | Value | Unit |
|-----------|--|------------|------|
| V_{ISO} | Isolation withstand voltage applied between each pin and heatsink plate (AC voltage, $t = 60\text{ s}$) | 1000 | V |
| T_j | Power chip operating junction temperature | -40 to 150 | °C |
| T_C | Module case operation temperature | -40 to 125 | °C |

2.2 Thermal data

Table 6: Thermal data

| Symbol | Parameter | Value | Unit |
|---------------|----------------------------------|-------|------|
| $R_{th(j-c)}$ | Thermal resistance junction-case | 12 | °C/W |

3 Electrical characteristics

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

3.1 Inverter part

Table 7: Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|------|------|----------|
| I_{DSS} | Zero-gate voltage drain current | $V_{DS} = 500\text{ V}$, $V_{CC} = 15\text{ V}$, $V_{Boot} = 15\text{ V}$ | | | 1 | mA |
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $V_{CC} = V_{boot} = 15\text{ V}$, $V_{IN}^{(1)} = 0\text{ V}$, $I_D = 1\text{ mA}$ | 500 | | | V |
| $R_{DS(on)}$ | Static drain-source turn-on resistance | $V_{CC} = V_{boot} = 15\text{ V}$, $V_{IN}^{(1)} = 0 - 5\text{ V}$, $I_D = 1.2\text{ A}$ | | 1.5 | 1.7 | Ω |
| V_{SD} | Drain-source diode forward voltage | $V_{IN}^{(1)} = 0$ "logic state", $I_D = 2\text{ A}$ | | 0.9 | 1.6 | V |

Notes:

(1) Applied among HINx, LINx and GND for x = U, V, W.

Table 8: Inductive load switching time and energy

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------------|---------------------------|---|------|------|------|---------------|
| $t_{on}^{(1)}$ | Turn-on time | $V_{DD} = 300\text{ V}$, $V_{CC} = V_{boot} = 15\text{ V}$, $V_{IN}^{(2)} = 0 - 5\text{ V}$, $I_C = 1.2\text{ A}$ (see Figure 4: "Switching time definition") | - | 267 | - | ns |
| $t_{c(on)}^{(1)}$ | Crossover time (on) | | - | 153 | - | |
| $t_{off}^{(1)}$ | Turn-off time | | - | 265 | - | |
| $t_{c(off)}^{(1)}$ | Crossover time (off) | | - | 46 | - | |
| t_{rr} | Reverse recovery time | | - | 192 | - | |
| E_{on} | Turn-on switching energy | | - | 61 | - | μJ |
| E_{off} | Turn-off switching energy | | - | 4 | - | |

Notes:

(1) t_{ON} and t_{OFF} include the propagation delay time of the internal drive. $t_{c(ON)}$ and $t_{c(OFF)}$ are the switching time of MOSFET itself under the internally given gate driving conditions.

(2) Applied among HINx, LINx and GND for x = U, V, W.

Figure 3: Switching time test circuit



Figure 4: Switching time definition

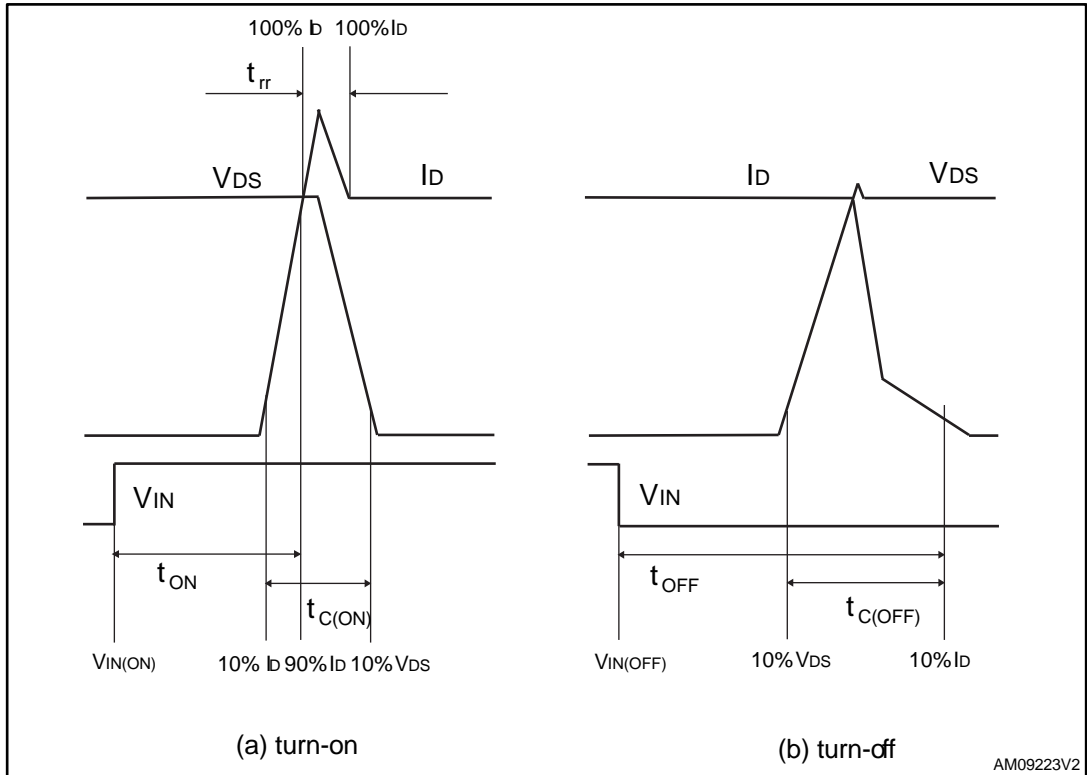


Figure 4: "Switching time definition" refers to HIN, LIN inputs (active high).

3.2 Control part

Table 9: Low voltage power supply ($V_{CC} = 15\text{ V}$ unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---|--|------|------|------|---------------|
| V_{CC_hys} | V_{CC} UV hysteresis | | 1.2 | 1.5 | 1.8 | V |
| V_{CC_thON} | V_{CC} UV turn-ON threshold | | 11.5 | 12 | 12.5 | V |
| V_{CC_thOFF} | V_{CC} UV turn-OFF threshold | | 10 | 10.5 | 11 | V |
| I_{qccu} | Undervoltage quiescent supply current | $V_{CC} = 10\text{ V}$, $T/\overline{SD}/OD = 5\text{ V}$; $LIN = 0\text{ V}$; $HIN = 0$, $CIN = 0$ | | | 150 | μA |
| I_{qcc} | Quiescent current | $V_{CC} = 15\text{ V}$, $T/\overline{SD}/OD = 5\text{ V}$; $LIN = 0\text{ V}$; $HIN = 0$, $CIN = 0$ | | | 1 | mA |
| V_{ref} | Internal comparator (CIN) reference voltage | | 0.5 | 0.54 | 0.58 | V |

Table 10: Bootstrapped voltage ($V_{CC} = 15\text{ V}$ unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---|--|------|------|------|---------------|
| V_{BS_hys} | V_{BS} UV hysteresis | | 1.2 | 1.5 | 1.8 | V |
| V_{BS_thON} | V_{BS} UV turn-ON threshold | | 11.1 | 11.5 | 12.1 | V |
| V_{BS_thOFF} | V_{BS} UV turn-OFF threshold | | 9.8 | 10 | 10.6 | V |
| I_{qBSU} | Undervoltage V_{BS} quiescent current | $V_{BS} < 9\text{ V}$ $T/\overline{SD}/OD = 5\text{ V}$; $LIN = 0\text{ V}$ and $HIN = 5\text{ V}$; $CIN = 0$ | | 70 | 110 | μA |
| I_{qBS} | V_{BS} quiescent current | $V_{BS} = 15\text{ V}$ $T/\overline{SD}/OD = 5\text{ V}$; $LIN = 0\text{ V}$ and $HIN = 5\text{ V}$; $CIN = 0$ | | 200 | 300 | μA |
| $R_{DS(on)}$ | Bootstrap driver on-resistance | LVG ON | | 120 | | Ω |

Table 11: Logic inputs ($V_{CC} = 15\text{ V}$ unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------|--|---|------|------|------|---------------|
| V_{il} | Low logic level voltage | | | | 0.8 | V |
| V_{ih} | High logic level voltage | | 2.25 | | | V |
| I_{HINh} | HIN logic "1" input bias current | $HIN = 15\text{ V}$ | 20 | 40 | 100 | μA |
| I_{HINl} | HIN logic "0" input bias current | $HIN = 0\text{ V}$ | | | 1 | μA |
| I_{LINl} | LIN logic "1" input bias current | $LIN = 15\text{ V}$ | 20 | 40 | 100 | μA |
| I_{LINh} | LIN logic "0" input bias current | $LIN = 0\text{ V}$ | | | 1 | μA |
| I_{SDh} | \overline{SD} logic "0" input bias current | $\overline{SD} = 15\text{ V}$ | 220 | 295 | 370 | μA |
| I_{SDl} | \overline{SD} logic "1" input bias current | $\overline{SD} = 0\text{ V}$ | | | 3 | μA |
| Dt | Dead time | See Figure 9: "Dead time and interlocking waveform definitions" | | 180 | | ns |

Table 12: Op-amp characteristics ($V_{CC} = 15\text{ V}$ unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------|-----------------------------------|--|------|------|------|------------------|
| V_{io} | Input offset voltage | $V_{ic} = 0\text{ V}$, $V_o = 7.5\text{ V}$ | | | 6 | mV |
| I_{io} | Input offset current | $V_{ic} = 0\text{ V}$, $V_o = 7.5\text{ V}$ | | 4 | 40 | nA |
| I_{ib} | Input bias current ⁽¹⁾ | | | 100 | 200 | nA |
| V_{OL} | Low level output voltage | $R_L = 10\text{ k}\Omega$ to V_{CC} | | 75 | 150 | mV |
| V_{OH} | High level output voltage | $R_L = 10\text{ k}\Omega$ to GND | 14 | 14.7 | | V |
| I_o | Output short-circuit current | Source, $V_{id} = +1\text{ V}$; $V_o = 0\text{ V}$ | 16 | 30 | | mA |
| | | Sink, $V_{id} = -1\text{ V}$; $V_o = V_{CC}$ | 50 | 80 | | mA |
| SR | Slew rate | $V_i = 1 - 4\text{ V}$; $C_L = 100\text{ pF}$; unity gain | 2.5 | 3.8 | | V/ μs |
| GBWP | Gain bandwidth product | $V_o = 7.5\text{ V}$ | 8 | 12 | | MHz |
| A_{vd} | Large signal voltage gain | $R_L = 2\text{ k}\Omega$ | 70 | 85 | | dB |
| SVR | Supply voltage rejection ratio | vs. V_{CC} | 60 | 75 | | dB |
| CMRR | Common mode rejection ratio | | 55 | 70 | | dB |

Notes:

⁽¹⁾The direction of the input current is out of the IC.

Table 13: Sense comparator characteristics ($V_{CC} = 15\text{ V}$ unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|------|------|------------------|
| I_{ib} | Input bias current | $V_{CIN} = 1\text{ V}$ | | | 3 | μA |
| V_{od} | Open-drain low level output voltage | $I_{od} = 3\text{ mA}$ | | | 0.5 | V |
| R_{ON_OD} | Open-drain low level output resistance | $I_{od} = 3\text{ mA}$ | | 166 | | Ω |
| R_{PD_SD} | \overline{SD} pull-down resistor ⁽¹⁾ | | | 125 | | k Ω |
| t_{d_comp} | Comparator delay | T/ \overline{SD} /OD pulled to 5 V through 100 k Ω resistor | | 90 | 130 | ns |
| SR | Slew rate | $C_L = 180\text{ pF}$; $R_{pu} = 5\text{ k}\Omega$ | | 60 | | V/ μs |
| t_{sd} | Shutdown to high / low-side driver propagation delay | $V_{OUT} = 0$, $V_{boot} = V_{CC}$, $V_{IN} = 0$ to 3.3 V | 50 | 125 | 200 | ns |
| t_{isd} | Comparator triggering to high / low-side driver turn-off propagation delay | Measured applying a voltage step from 0 V to 3.3 V to pin CIN | 50 | 200 | 250 | |

Notes:

⁽¹⁾Equivalent values are as a result of the resistances of three drivers in parallel.

Table 14: Truth table

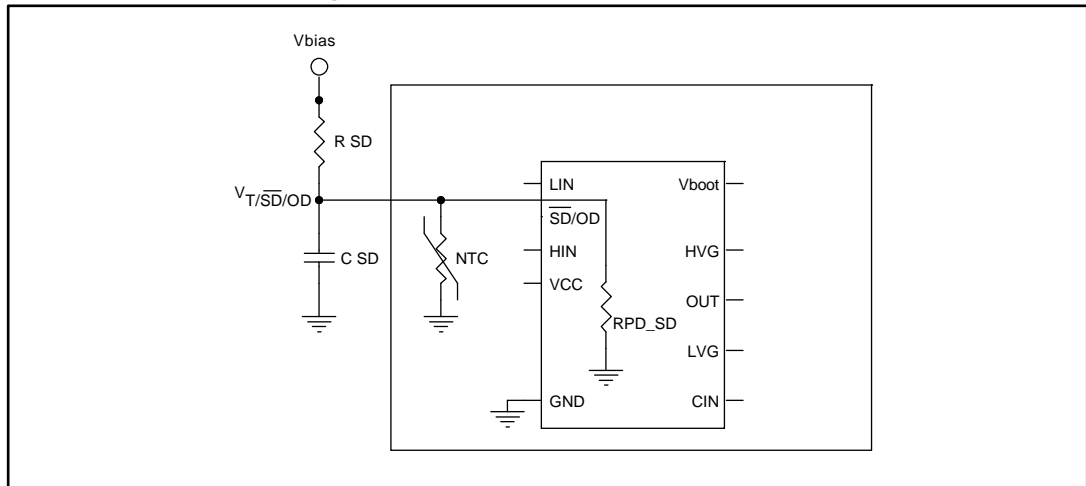
| Conditions | Logic input (Vi) | | | Output | |
|--|-------------------------------|------------------|------------------|--------|-----|
| | T/ $\overline{\text{SD}}$ /OD | LIN | HIN | LVG | HVG |
| Shutdown enable half-bridge tri-state | L | X ⁽¹⁾ | X ⁽¹⁾ | L | L |
| Interlocking half-bridge tri-state | H | H | H | L | L |
| 0 “logic state” half-bridge tri-state | H | L | L | L | L |
| 1 “logic state” low-side direct driving | H | H | L | H | L |
| 1 “logic state” high-side direct driving | H | L | H | L | H |

Notes:

⁽¹⁾X: do not care.

3.2.1 NTC thermistor

Figure 5: Internal structure of $\overline{\text{SD}}$ and NTC



RPD_SD: equivalent value as result of resistances of three drivers in parallel.

Figure 6: Equivalent resistance (NTC//RPD_SD)

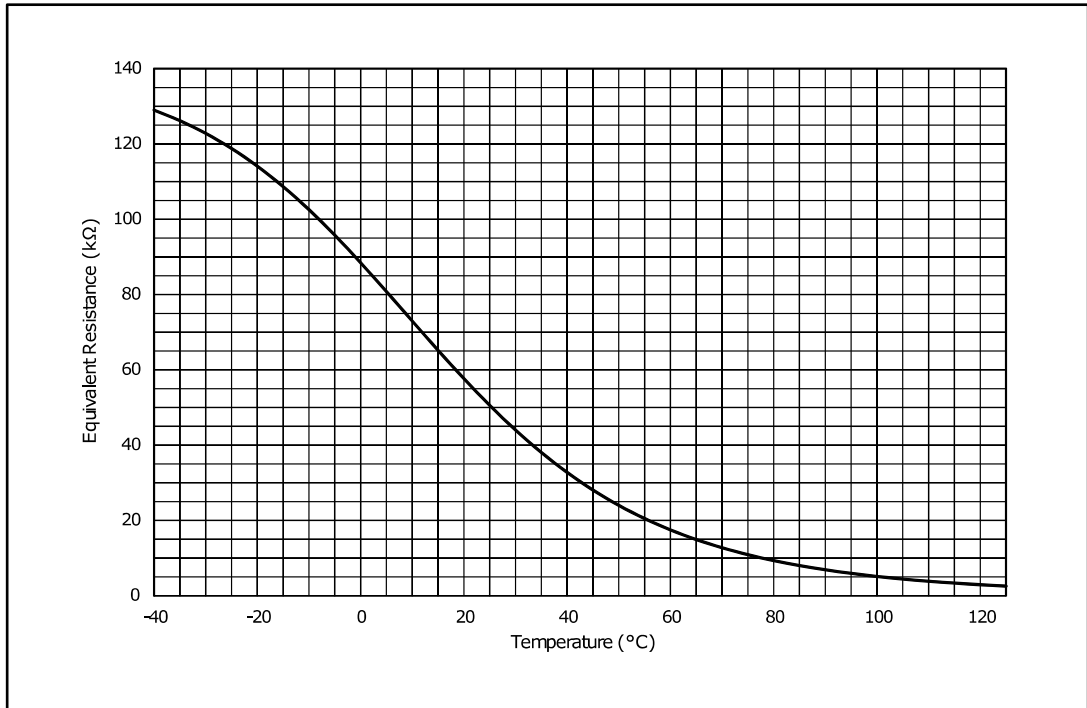


Figure 7: Equivalent resistance (NTC//RPD_SD) zoom

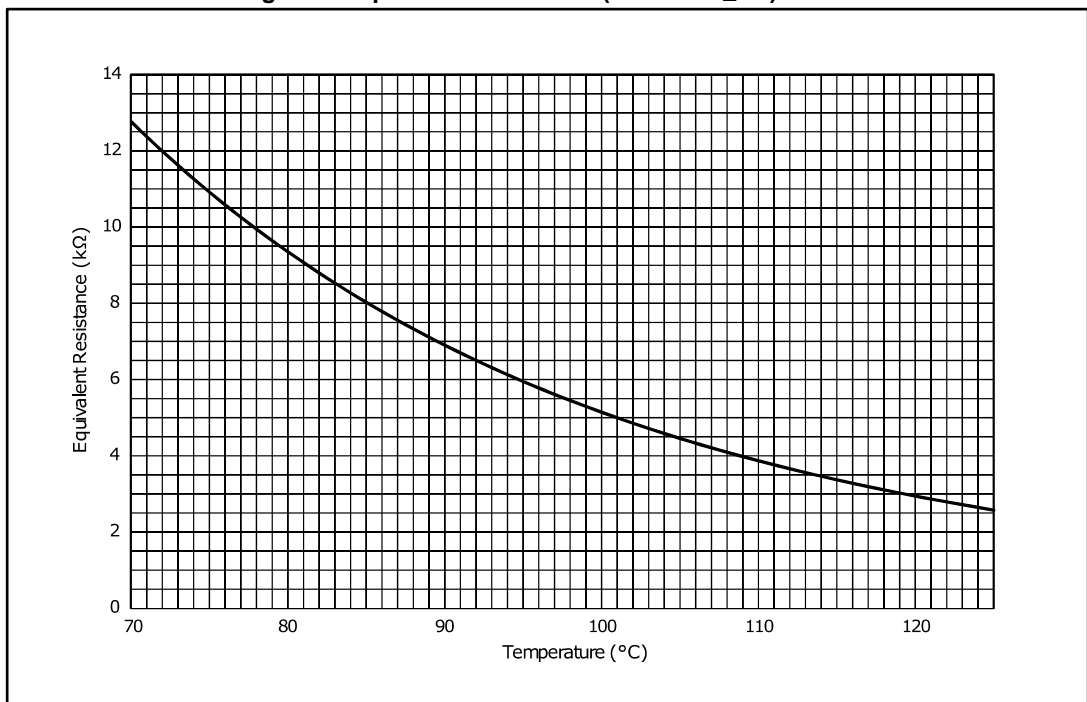
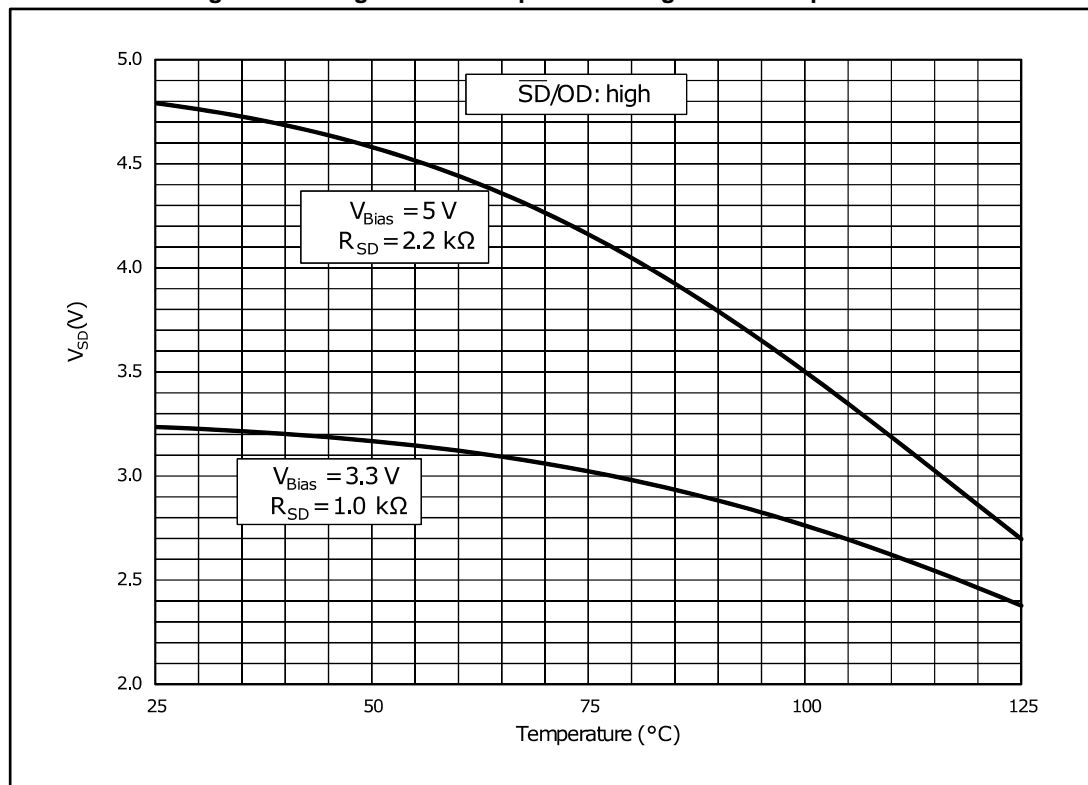
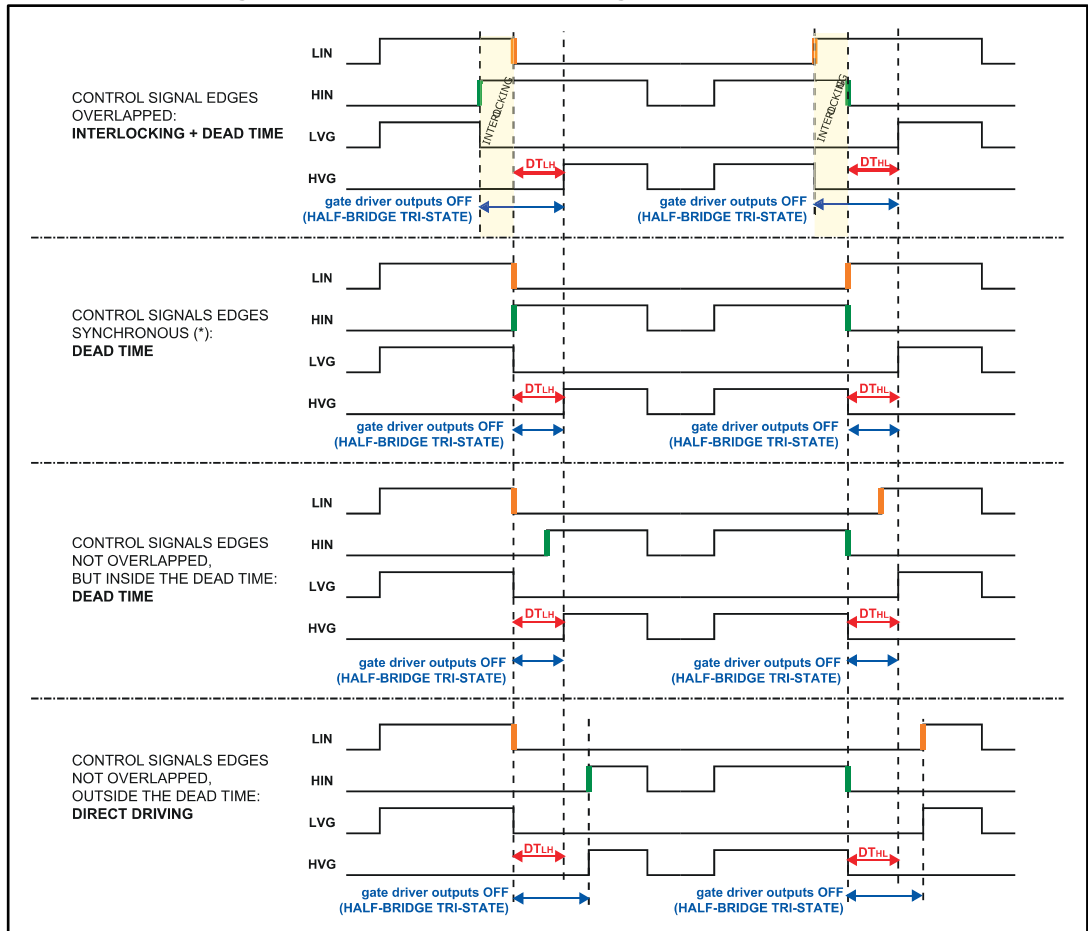


Figure 8: Voltage of T/SD/OD pin according to NTC temperature



3.3 Waveform definitions

Figure 9: Dead time and interlocking waveform definitions



4 Smart shutdown function

The device integrates a comparator for fault sensing purposes. The comparator has an internal voltage reference V_{REF} connected to the inverting input, while the non-inverting input on pin (CIN) can be connected to an external shunt resistor for the overcurrent protection.

When the comparator triggers, the device is set to the shutdown state and both of its outputs are set to low level, causing the half-bridge to enter a tri-state.

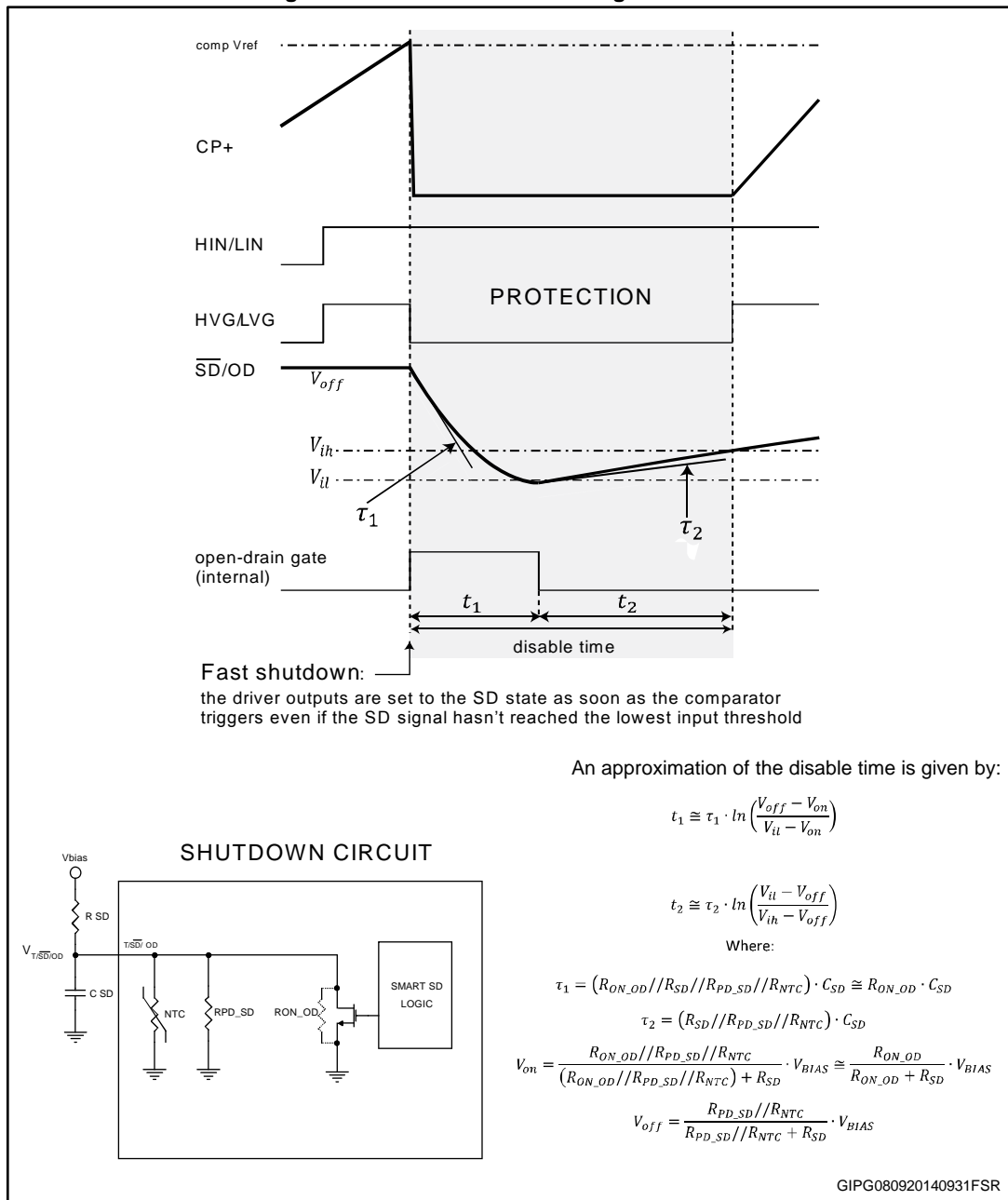
In common overcurrent protection architectures, the comparator output is usually connected to the shutdown input through an RC network so to provide a mono-stable circuit which implements a protection time following to a fault condition.

Our smart shutdown architecture immediately turns off the output gate driver in case of overcurrent through a preferential path for the fault signal which directly switches off the outputs. The time delay between the fault and output shutdown no longer depends on the RC values of the external network connected to the shutdown pin. At the same time, the DMOS connected to the open-drain output (pin T/ \overline{SD} /OD) is turned on by the internal logic, which holds it on until the shutdown voltage is well below the minimum value of logic input threshold (V_{il}).

Besides, the smart shutdown function allows the real disable time to be increased without rising the constant time of the external RC network.

An NTC thermistor for temperature monitoring is internally connected in parallel to the \overline{SD} pin. To avoid undesired shutdown, keep the voltage $V_{T/\overline{SD}/OD}$ higher than the high-level logic threshold by setting the pull-up resistor $R_{\overline{SD}}$ to 1 k Ω or 2.2 k Ω for 3.3 V or 5 V MCU power supplies, respectively.

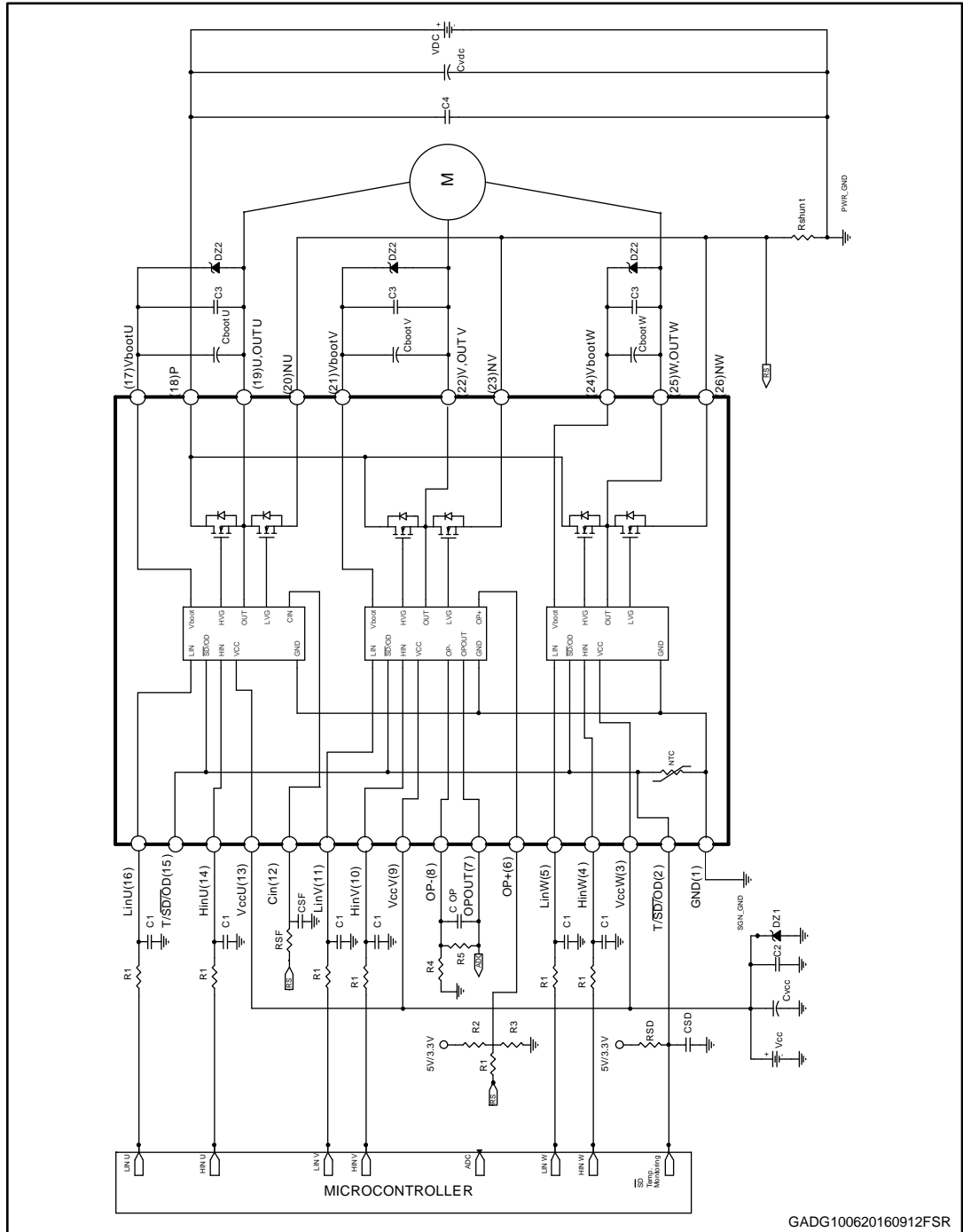
Figure 10: Smart shutdown timing waveforms



Please refer to [Table 13: "Sense comparator characteristics \(VCC = 15 V unless otherwise specified\)"](#) for internal propagation delay time details.

5 Application circuit example

Figure 11: Application circuit example



Application designers are free to use a different scheme according to the specifications of the device.

5.1 Guidelines

- Input signals HIN, LIN are active high logic. A 375 k Ω (typ.) pull-down resistor is built-in for each input. To prevent input signal oscillations, the wiring of each input should be as short as possible and the use of RC filters (R_1 , C_1) on each input signal is suggested. The filters should be with a time constant of about 100 ns and placed as close as possible to the IPM input pins.
- The use of a bypass capacitor CVCC (aluminum or tantalum) can help to reduce the transient circuit demand on the power supply. Besides, to reduce high frequency switching noise distributed on the power lines, a decoupling capacitor C_2 (100 to 220 nF, with low ESR and low ESL) should be placed as close as possible to V_{cc} pin and in parallel with the bypass capacitor.
- The use of RC filter (RSF, CSF) for circuit malfunction protection is recommended. The time constant ($RSF \times CSF$) should be set to 1 μ s and the filter must be placed as close as possible to the CIN pin.
- The \overline{SD} is an input/output pin (open-drain type if used as output). A built-in thermistor NTC is internally connected between the \overline{SD} pin and GND. The voltage VSD-GND decreases as the temperature increases, due to the pull-up resistor RSD. In order to keep the voltage always higher than the high level logic threshold, the pull-up resistor is suggested to be set to 1 k Ω or 2.2 k Ω for 3.3 V or 5 V MCU power supply, respectively. The CSD capacitor of the filter on \overline{SD} should be fixed no higher than 3.3 nF in order to assure a \overline{SD} activation time $T_1 \leq 500$ ns and the filter should be placed as close as possible to the \overline{SD} pin.
- The decoupling capacitor C_3 (from 100 to 220 nF, ceramic with low ESR and low ESL), in parallel with each C_{boot} , filters high frequency disturbance. Both C_{boot} and C_3 (if present) should be placed as close as possible to the U, V, W and V_{boot} pins. Bootstrap negative electrodes should be connected to U, V, W terminals directly and separated from the main output wires.
- To prevent the overvoltage on V_{cc} pin, a Zener diode (Dz1) can be used. Similarly on the V_{boot} pin, a Zener diode (Dz2) can be placed in parallel with each C_{boot} .
- The use of the decoupling capacitor C_4 (100 to 220 nF, with low ESR and low ESL) in parallel with the electrolytic capacitor C_{vdc} is useful to prevent surge destruction. Both capacitors C_4 and C_{vdc} should be placed as close as possible to the IPM (C_4 has priority over C_{vdc}).
- By integrating an application-specific type HVIC inside the module, direct coupling to the MCU terminals without an optocoupler is possible.
- Use low inductance shunt resistors for phase leg current sensing.
- In order to avoid malfunctions, the wiring on N pins, the shunt resistor and PWR_GND should be as short as possible.
- The connection of SGN_GND to PWR_GND to one point only (close to the shunt resistor terminal) can help to reduce the impact of power ground fluctuation.

These guidelines ensure the specifications of the device for application designs. For further details, please refer to the relevant application note.

Table 15: Recommended operating conditions

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|------------|------------------------------------|--|------|------|------|---------|
| V_{PN} | Supply voltage | Applied among P-Nu, Nv, Nw | | 300 | 400 | V |
| V_{CC} | Control supply voltage | Applied to V_{CC-GND} | 13.5 | 15 | 18 | V |
| V_{BS} | High-side bias voltage | Applied to $V_{BOOTi-OUTi}$ for $i = U, V, W$ | 13 | | 18 | V |
| t_{dead} | Blanking time to prevent arm-short | For each input signal | 1 | | | μs |
| f_{PWM} | PWM input signal | -40 °C < T_c < 100 °C -40 °C < T_j < 125 °C | | | 25 | kHz |
| T_c | Case operation temperature | | | | 100 | °C |

6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

6.1 NDIP-26L type C package information

Figure 12: NDIP-26L type C package outline

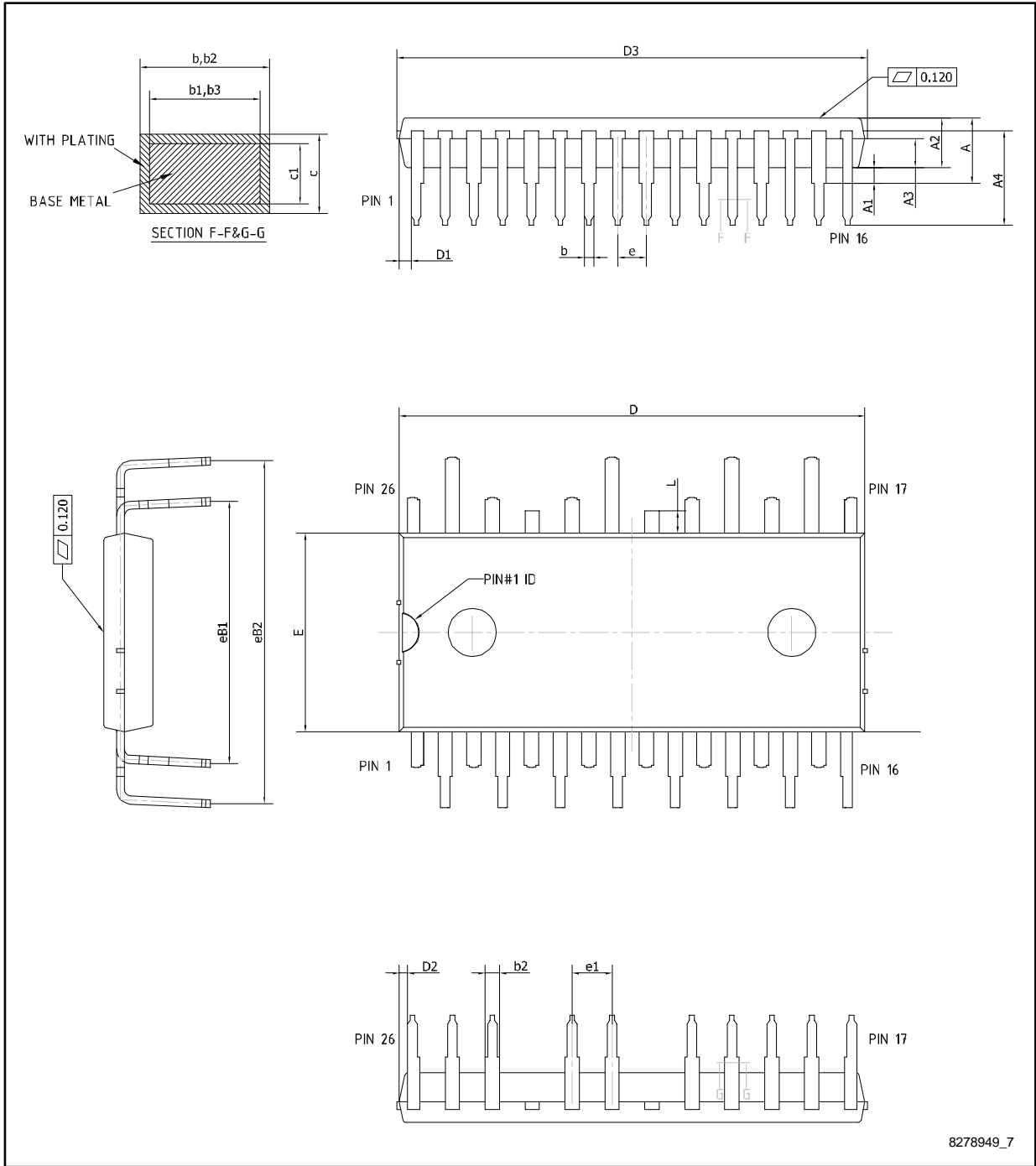


Table 16: NDIP-26L type C mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | | | 4.40 |
| A1 | 0.80 | 1.00 | 1.20 |
| A2 | 3.00 | 3.10 | 3.20 |
| A3 | 1.70 | 1.80 | 1.90 |
| A4 | 5.70 | 5.90 | 6.10 |
| b | 0.53 | | 0.72 |
| b1 | 0.52 | 0.60 | 0.68 |
| b2 | 0.83 | | 1.02 |
| b3 | 0.82 | 0.90 | 0.98 |
| c | 0.46 | | 0.59 |
| c1 | 0.45 | 0.50 | 0.55 |
| D | 29.05 | 29.15 | 29.25 |
| D1 | 0.50 | 0.77 | 1.00 |
| D2 | 0.35 | 0.53 | 0.70 |
| D3 | | | 29.55 |
| E | 12.35 | 12.45 | 12.55 |
| e | 1.70 | 1.80 | 1.90 |
| e1 | 2.40 | 2.50 | 2.60 |
| eB1 | 16.10 | 16.40 | 16.70 |
| eB2 | 21.18 | 21.48 | 21.78 |
| L | 1.24 | 1.39 | 1.54 |

6.2 NDIP-26L packing information

Figure 13: NDIP-26L tube (dimensions are in mm)

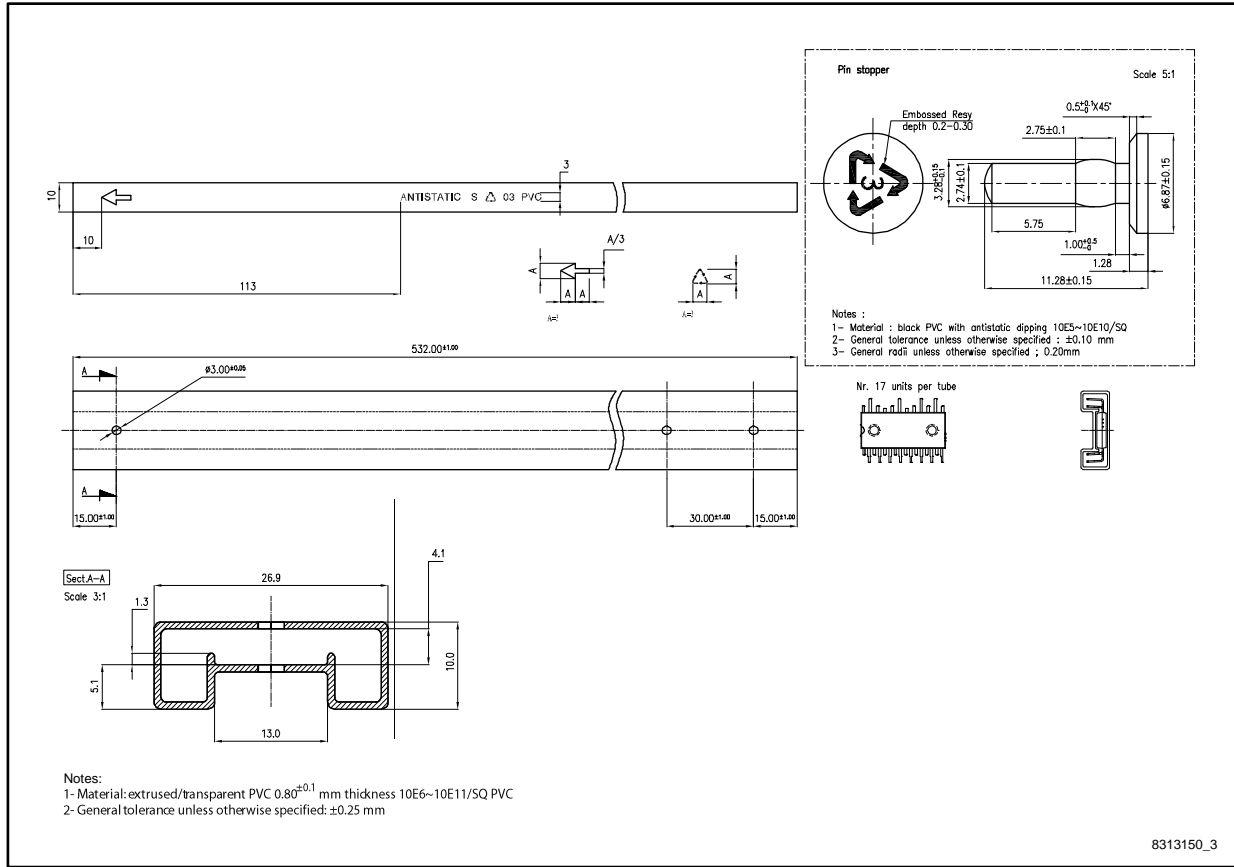


Table 17: Shipping details

| Parameter | Value |
|---------------|------------|
| Base quantity | 17 pieces |
| Bulk quantity | 476 pieces |

7 Revision history

Table 18: Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 19-Nov-2015 | 1 | Initial release. |
| 03-May-2016 | 2 | Updated <i>Figure 3: Switching time test circuit</i> and <i>Figure 4: Switching time definition</i> . Updated <i>Table 11: Logic inputs (VCC = 15 V unless otherwise specified)</i> and <i>Table 12: OP AMP characteristics (VCC = 15 V unless otherwise specified)</i> . Minor text changes. |
| 10-Jun-2016 | 3 | Updated title and features in cover page. Updated <i>Section 3: Electrical characteristics</i> , <i>Figure 11: Application circuit example</i> and <i>Section 5.1: Guidelines</i> . Updated <i>Section 6.1: NDIP-26L package information</i> . Document status changed from preliminary to production data. Minor text changes. |
| 10-Jan-2017 | 4 | Modified <i>Table 8: "Inductive load switching time and energy"</i> . Minor text changes. |
| 01-Feb-2017 | 5 | Modified description on cover page. |

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