

## SLLIMM™-nano (small low-loss intelligent molded module) IPM, 3 A - 600 V 3-phase IGBT inverter bridge

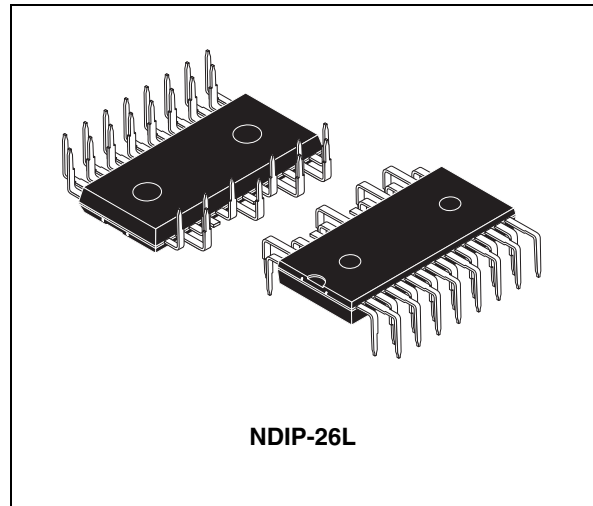
Datasheet – production data

### Features

- IPM 3 A, 600 V, 3-phase IGBT inverter bridge including control ICs for gate driving and freewheeling diodes
- Optimized for low electromagnetic interference
- $V_{CE(sat)}$  negative temperature coefficient
- 3.3 V, 5 V, 15 V CMOS/TTL input comparators with hysteresis and pull-down resistor
- Undervoltage lockout
- Internal bootstrap diode
- Interlocking function
- Optimized pinout for easy board layout

### Applications

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



### Description

This intelligent power module implements a compact, high-performance AC motor drive in a simple, rugged design. It is composed of six IGBTs with freewheeling diodes 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. SLLIMM™ is a trademark of STMicroelectronics.

**Table 1. Device summary**

Order code	Marking	Package	Packaging
STGIPN3H60A	GIPN3H60A	NDIP-26L	Tube

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# 1 Internal schematic diagram and pin configuration

Figure 1. Internal schematic diagram

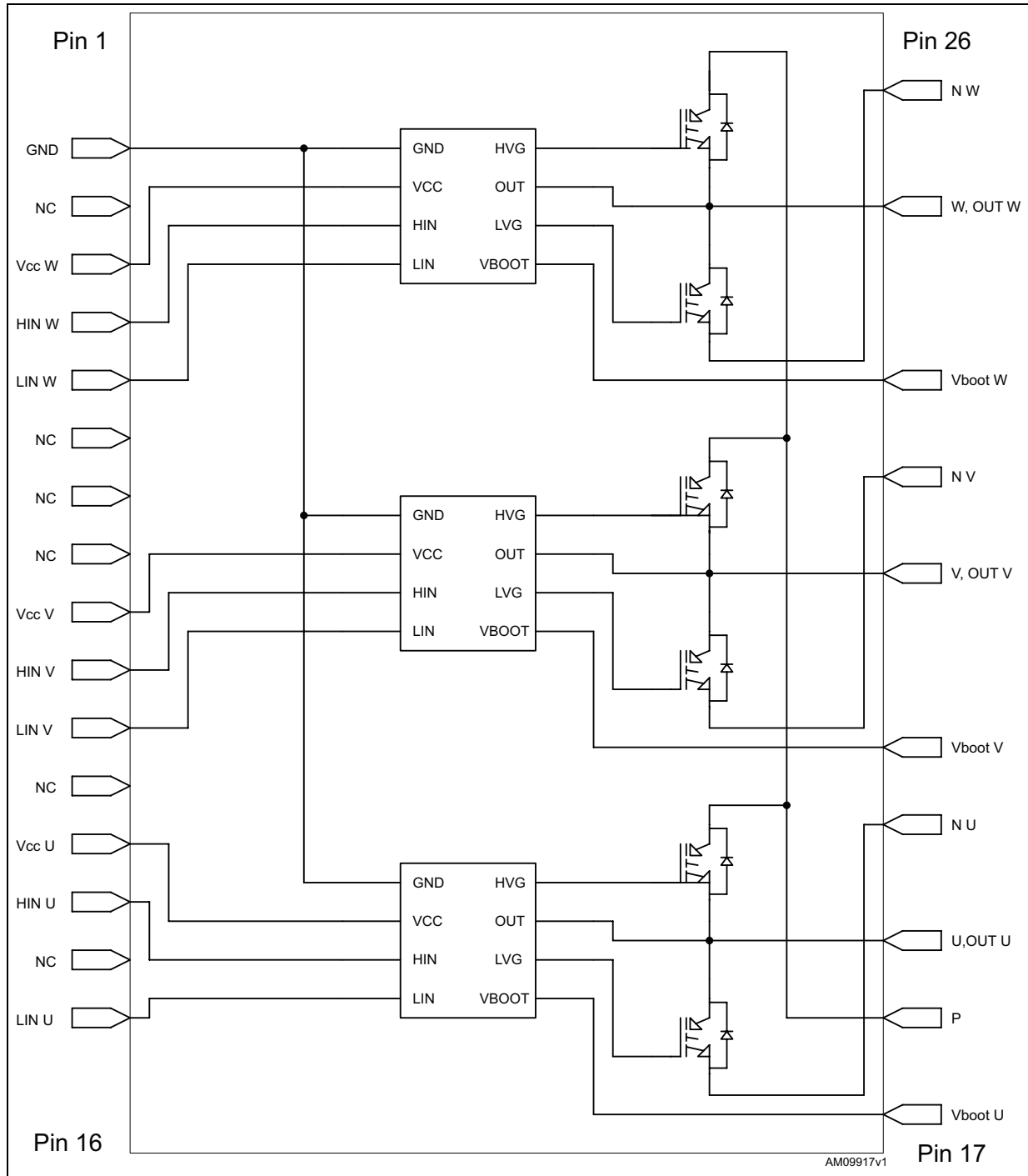
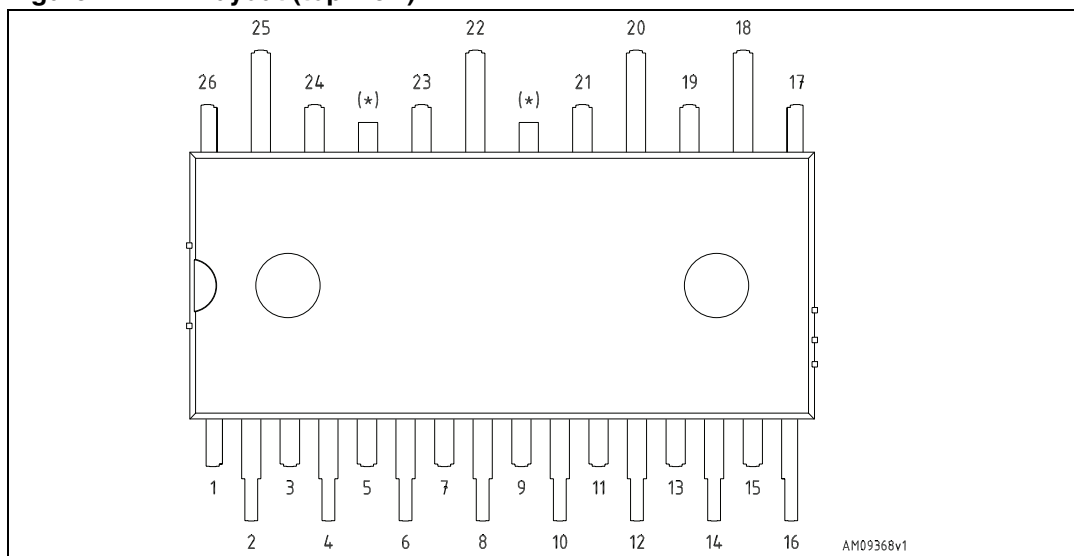


Table 2. Pin description

Pin	Symbol	Description
1	GND	Ground
2	NC	Not connected
3	V <sub>CC</sub> 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	NC	Not connected
7	NC	Not connected
8	NC	Not connected
9	V <sub>CC</sub> 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	NC	Not connected
13	V <sub>CC</sub> U	Low voltage power supply for U phase
14	HIN U	High side logic input for U phase
15	NC	Not connected
16	LIN U	Low side logic input for U phase
17	V <sub>boot</sub> U	Bootstrap voltage for U phase
18	P	Positive DC input
19	U	U phase output
20	N <sub>U</sub>	Negative DC input for U phase
21	V <sub>boot</sub> V	Bootstrap voltage for V phase
22	V	V phase output
23	N <sub>V</sub>	Negative DC input for V phase
24	V <sub>boot</sub> W	Bootstrap voltage for W phase
25	W	W phase output
26	N <sub>W</sub>	Negative DC input for W phase

Figure 2. Pin layout (top view)



(\*) Dummy pin internally connected to P (positive DC input).

## 2 Electrical ratings

### 2.1 Absolute maximum ratings

**Table 3. Inverter part**

Symbol	Parameter	Value	Unit
$V_{CES}$	Each IGBT collector emitter voltage ( $V_{IN}^{(1)} = 0$ )	600	V
$\pm I_C^{(2)}$	Each IGBT continuous collector current at $T_C = 25\text{ °C}$	3	A
$\pm I_{CP}^{(3)}$	Each IGBT pulsed collector current	18	A
$P_{TOT}$	Each IGBT total dissipation at $T_C = 25\text{ °C}$	8	W

1. Applied between  $HIN_i$ ,  $LIN_i$  and GND for  $i = U, V, W$ .
2. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

3. Pulse width limited by max junction temperature.

**Table 4. Control part**

Symbol	Parameter	Min.	Max.	Unit
$V_{OUT}$	Output voltage applied between $OUT_U$ , $OUT_V$ , $OUT_W$ - GND	$V_{boot} - 18$	$V_{boot} + 0.3$	V
$V_{CC}$	Low voltage power supply	- 0.3	18	V
$V_{boot}$	Bootstrap voltage	- 0.3	618	V
$V_{IN}$	Logic input voltage applied between $HIN_i$ , $LIN_i$ and GND for $i = U, V, W$	- 0.3	$V_{CC} + 0.3$	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, $t = 60$ sec.)	1000	V
$T_J$	Power chips operating junction temperature	-40 to 150	°C
$T_C$	Module case operating temperature	-40 to 125	°C

## 2.2 Thermal data

Table 6. Thermal data

Symbol	Parameter	Value	Unit
$R_{thJA}$	Thermal resistance junction-ambient	50	°C/W

### 3 Electrical characteristics

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

**Table 7. Inverter part**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{CC} = V_{boot} = 15\text{ V}$ , $V_{IN}^{(1)} = 0 - 5\text{ V}$ , $I_C = 1\text{ A}$	-	2.15	2.6	V
		$V_{CC} = V_{boot} = 15\text{ V}$ , $V_{IN}^{(1)} = 0 - 5\text{ V}$ , $I_C = 1\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$	-	1.65		
$I_{CES}$	Collector-cut off current ( $V_{IN}^{(1)} = 0$ "logic state")	$V_{CE} = 550\text{ V}$ , $V_{CC} = V_{Boot} = 15\text{ V}$	-		250	$\mu\text{A}$
$V_F$	Diode forward voltage	$V_{IN}^{(1)} = 0$ "logic state", $I_C = 1\text{ A}$	-		1.7	V
<b>Inductive load switching time and energy</b>						
$t_{on}$	Turn-on time	$V_{DD} = 300\text{ V}$ , $V_{CC} = V_{boot} = 15\text{ V}$ , $V_{IN}^{(1)} = 0 - 5\text{ V}$ , $I_C = 1\text{ A}$ (see <a href="#">Figure 4</a> )	-	275		ns
$t_{c(on)}$	Crossover time (on)		-	90		
$t_{off}$	Turn-off time		-	890		
$t_{c(off)}$	Crossover time (off)		-	125		
$t_{rr}$	Reverse recovery time		-	50		$\mu\text{J}$
$E_{on}$	Turn-on switching losses		-	18		
$E_{off}$	Turn-off switching losses	-	13			

1. Applied between  $HIN_i$ ,  $\overline{LIN}_i$  and GND for  $i = U, V, W$  ( $\overline{LIN}$  inputs are active-low).

*Note:*  $t_{ON}$  and  $t_{OFF}$  include the propagation delay time of the internal drive.  $t_{C(ON)}$  and  $t_{C(OFF)}$  are the switching time of IGBT itself under the internally given gate driving condition.

**Figure 3. Switching time test circuit**

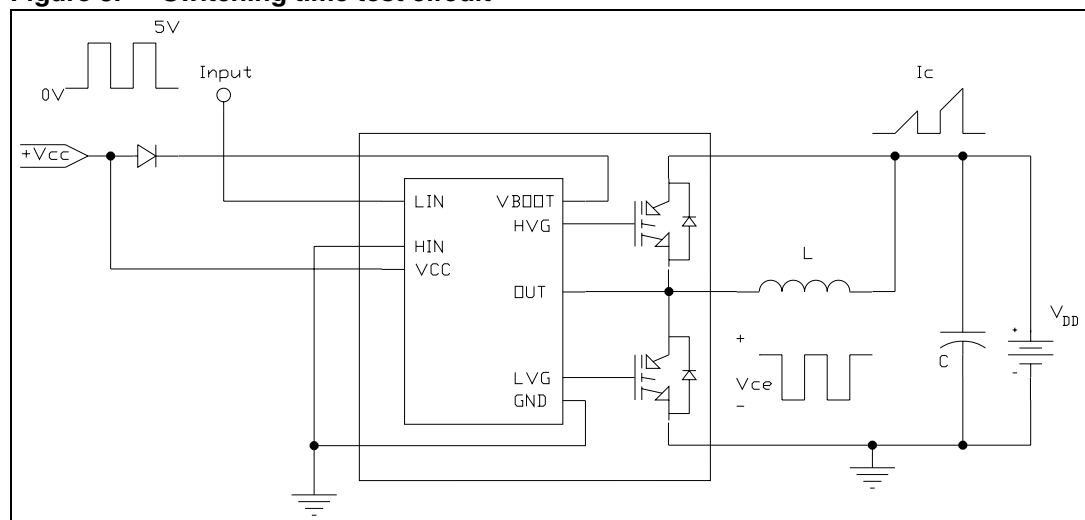
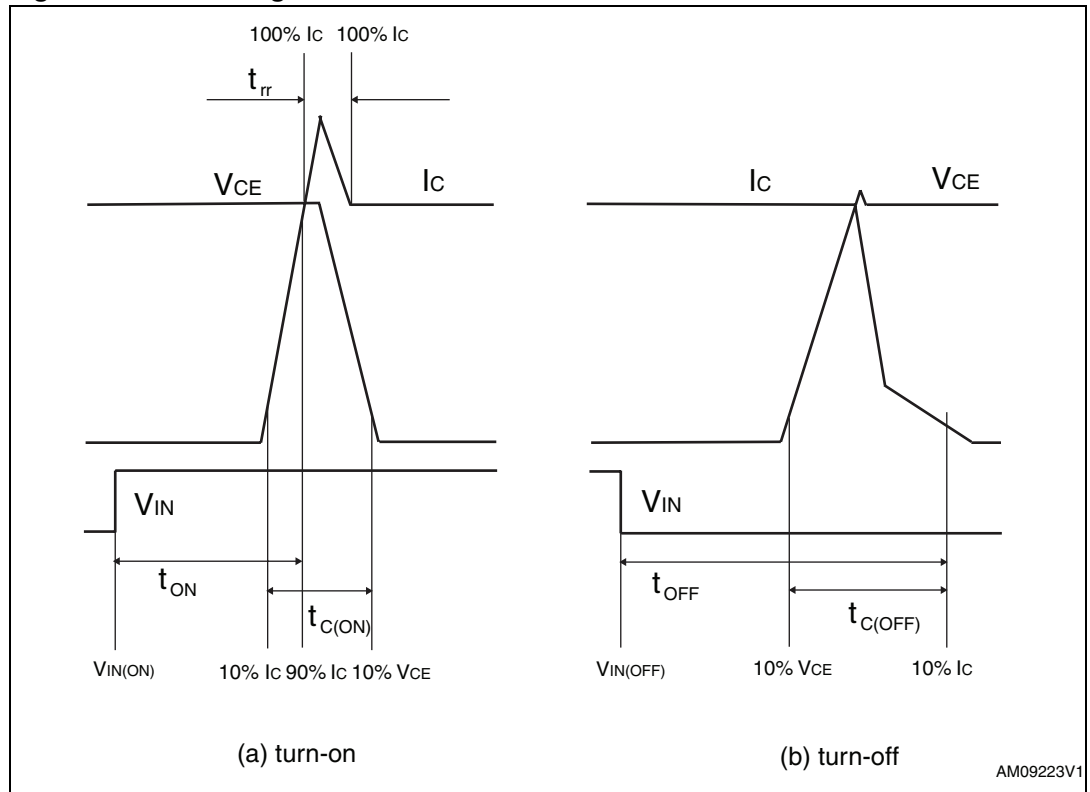




Figure 4. Switching time definition



### 3.1 Control part

Table 8. Low voltage power supply ( $V_{CC} = 15\text{ V}$  unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CCthON}$	Undervoltage turn-on threshold		9.1	9.6	10.1	V
$V_{CCthOFF}$	Undervoltage turn-off threshold		7.9	8.3	8.8	V
$V_{CChys}$	Undervoltage hystereses		0.9			V
$I_{qccu}$	Undervoltage quiescent supply current	$V_{CC} < 7.9\text{ V}$		250	330	$\mu\text{A}$
$I_{qcc}$	Quiescent current	$V_{CC} = 15\text{ V}$		350	450	$\mu\text{A}$

Table 9. Bootstrapped voltage ( $V_{CC} = 15\text{ V}$  unless otherwise specified)

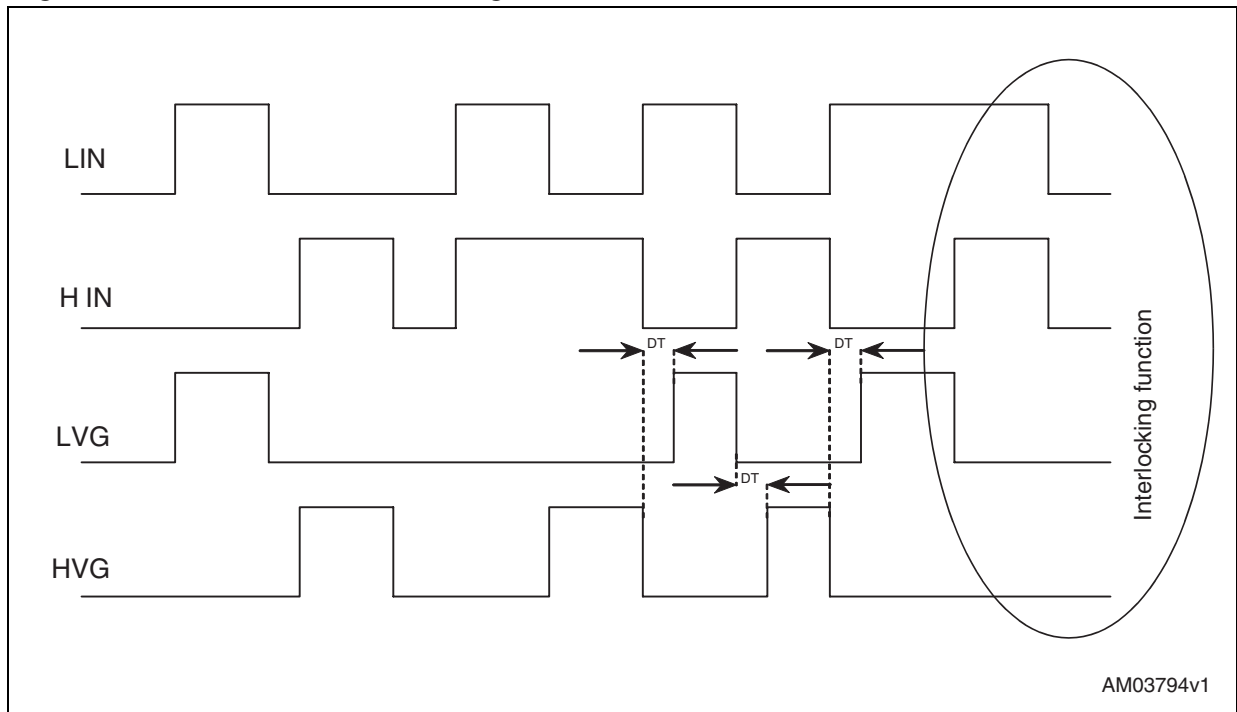
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{boot\_thON}$	Undervoltage turn-on threshold		8.5	9.5	10.5	V
$V_{boot\_thOFF}$	Undervoltage turn-off threshold		7.2	8.3	9.2	V
$V_{boot\_hys}$	Undervoltage hystereses		0.9			V
$I_{qboot}$	Quiescent current				250	$\mu\text{A}$
$R_{DS(on)}$	Bootstrap driver on-resistance	$V_{CC} > 12.5\text{ V}$		125		$\Omega$

**Table 10. Logic inputs ( $V_{CC} = 15\text{ V}$  unless otherwise specified) <sup>(1)</sup>**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{il}$	Low level logic input voltage				1.1	V
$V_{ih}$	High level logic input voltage		1.8			V
$I_{il}$	Low level logic input current	$V_{IN}^{(2)} = 0$	-1			$\mu\text{A}$
$I_{ih}$	High level logic input current	$V_{IN}^{(1)} = 15\text{ V}$		20	70	$\mu\text{A}$
Dt	Dead time			320		ns

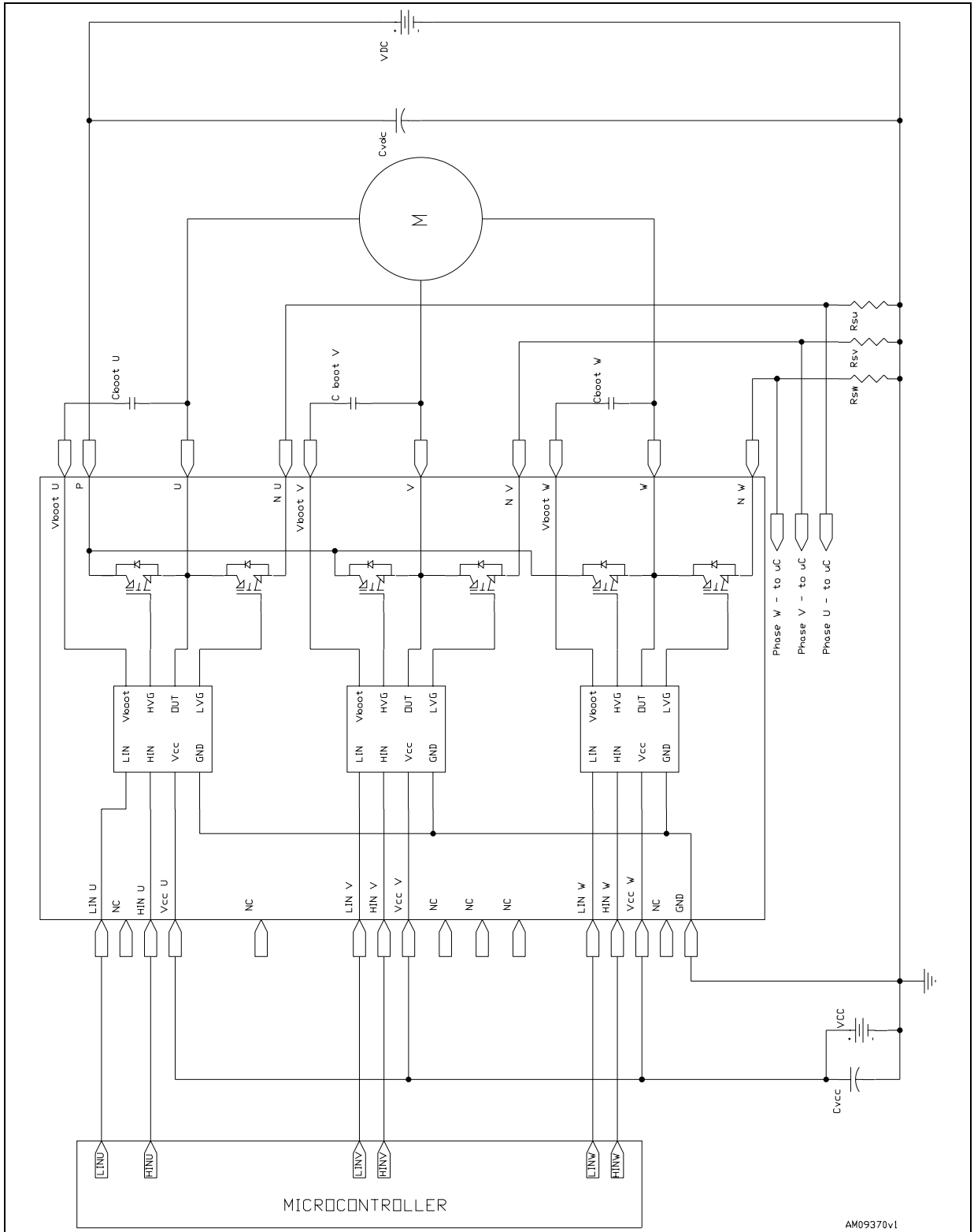
1. See [Figure 5: Dead time and interlocking definition](#).
2. Applied between  $HIN_i$ ,  $LIN_i$  and GND for  $i = U, V, W$

**Figure 5. Dead time and interlocking definition**



# 4 Application information

Figure 6. Typical application circuit



## 4.1 Recommendations

- Input signals HIN, LIN are active-high logic. A 500 k $\Omega$  (typ.) pull-down resistor is built-in for each high side input. If an external RC filter is used for noise immunity, attention should be given to the variation of the input signal level.
- To prevent input signal oscillation, the wiring of each input should be as short as possible.
- By integrating an application-specific type HVIC inside the module, direct coupling to the MCU terminals without an opto-coupler is possible.
- Each capacitor should be located as close as possible to the pins of the IPM.
- Low inductance shunt resistors should be used for phase leg current sensing.
- Electrolytic bus capacitors should be mounted as close to the module bus terminals as possible. Additional high frequency ceramic capacitors mounted close to the module pins will further improve performance.

**Table 11. Recommended operating conditions**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>PN</sub>	Supply voltage	Applied between P-Nu, Nv, Nw		300	500	V
V <sub>CC</sub>	Control supply voltage	Applied between V <sub>CC</sub> -GND	12	15	17	V
V <sub>BS</sub>	High side bias voltage	Applied between V <sub>BOOTi</sub> -OUT <sub>i</sub> for i = U, V, W	11.5		17	V
t <sub>dead</sub>	Blanking time to prevent Arm-short	For each input signal	1.5			$\mu$ s
f <sub>PWM</sub>	PWM input signal	-40°C < T <sub>c</sub> < 100°C -40°C < T <sub>j</sub> < 125°C			25	kHz
T <sub>C</sub>	Case operation temperature				100	°C

*Note:* For further details refer to AN4043.

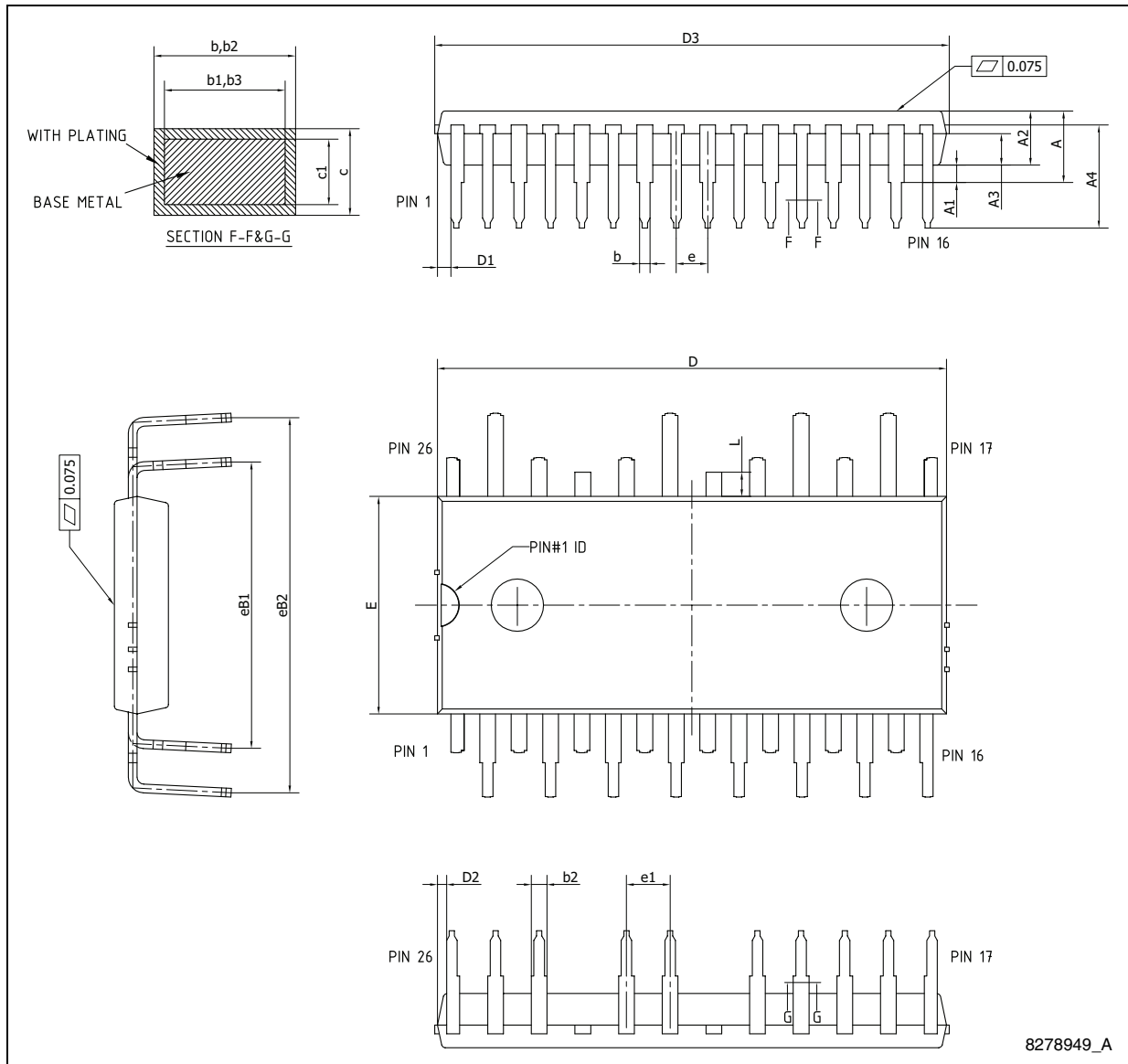
## 5 Package mechanical data

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

**Table 12. NDIP-26L mechanical data**

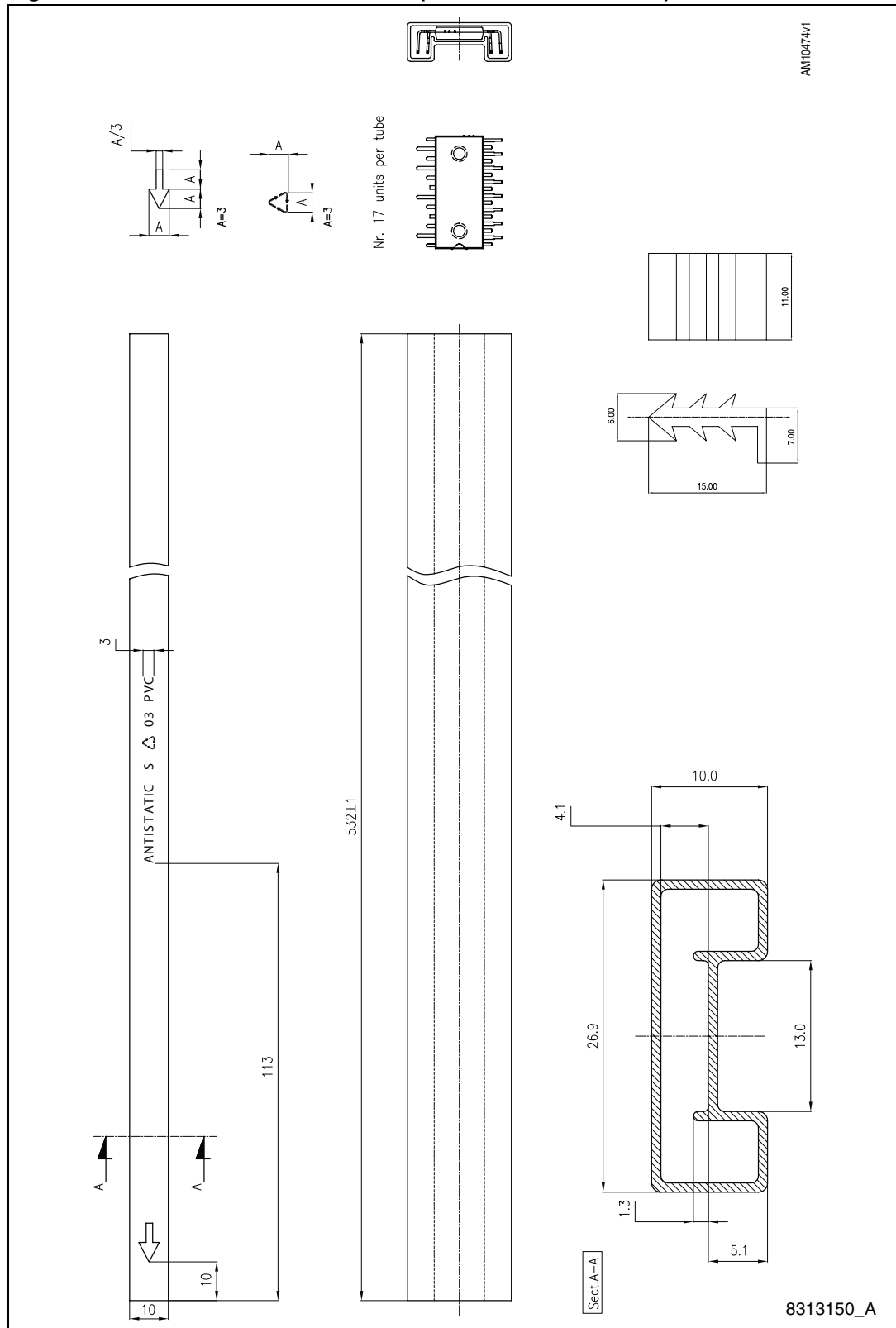
Dim.	mm.		
	Min.	Typ.	Max.
A			4.40
A1	0.80	1.00	1.20
A2	3.00	3.10	3.20
A3	1.70	1.80	1.90
A4	5.70	5.90	6.10
b	0.53		0.72
b1	0.52	0.60	0.68
b2	0.83		1.02
b3	0.82	0.90	0.98
c	0.46		0.59
c1	0.45	0.50	0.55
D	29.05	29.15	29.25
D1	0.50		
D2	0.35		
D3			29.55
E	12.35	12.45	12.55
e	1.70	1.80	1.90
e1	2.40	2.50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

Figure 7. NDIP-26L package dimensions



8278949\_A

Figure 8. NDIP-26L tube dimensions (dimensions are in mm.)



Note: Base quantity 17 pcs, bulk quantity 476 pcs.

## 6 Revision history

**Table 13. Document revision history**

Date	Revision	Changes
23-Jun-2011	1	Initial release.
09-Jan-2012	2	Document status promoted from preliminary data to datasheet. Added <a href="#">Figure 8 on page 15</a> .
02-May-2012	3	Modified: Min. and Max. value <a href="#">Table 4 on page 6</a> . Added: <a href="#">Table 11 on page 12</a> .



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