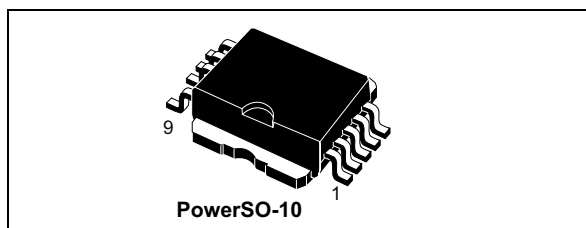


Quad high-side smart power solid state-relay

Datasheet - production data



- Built-in current limiter
- Undervoltage shutdown
- Open drain diagnostic output
- Fast demagnetization of inductive loads
- Conformity to IEC 61131-2

Features

Type	$V_{\text{demag}}^{(1)}$	$R_{\text{DS(on)}}^{(1)}$	$I_{\text{OUT}}^{(1)}$	$V_{\text{CC}}^{(1)}$
VN340SP-E	$V_{\text{CC}} - 55 \text{ V}$	0.2Ω	0.7 A	36 V

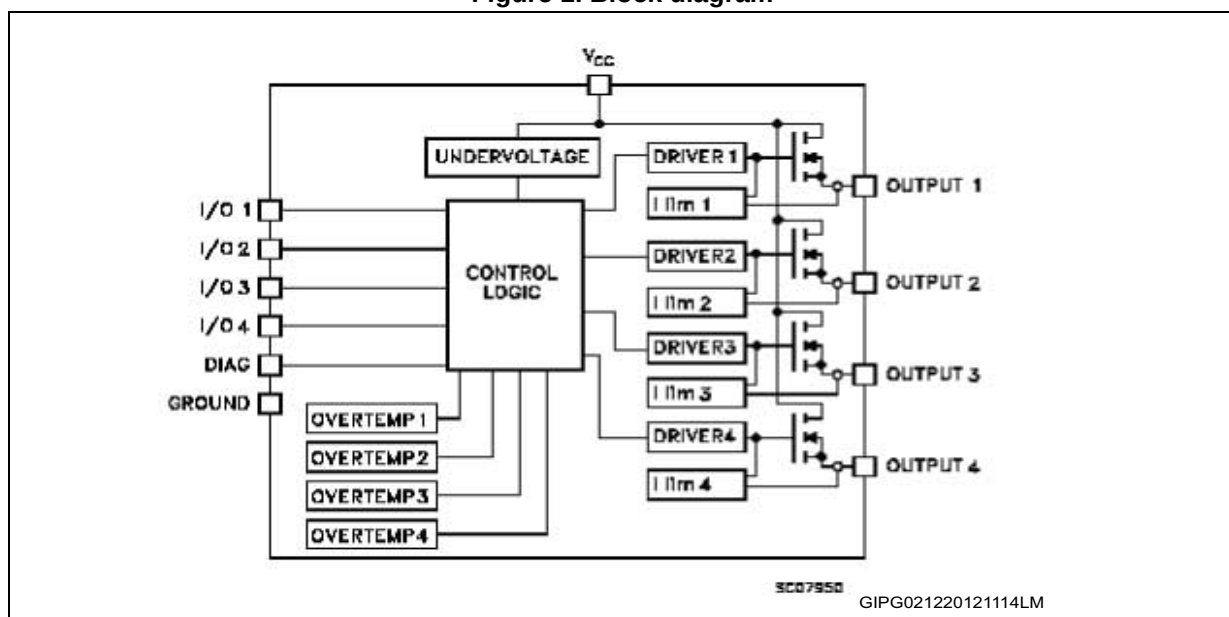
1. Per channel

- Output current: 0.7 A per channel
- Digital I/O clamped at 32 V minimum voltage
- Shorted load and overtemperature protections
- Protection against loss of ground

Description

The VN340SP-E is a monolithic device developed using ST VIPower™ technology, intended to drive four independent resistive or inductive loads with one side connected to ground. Active current limitation avoids dropping the system power supply in case of shorted load. Built-in thermal shutdown protects the chip from overtemperature and short-circuit. The open drain diagnostic output indicates overtemperature conditions. Each I/O is pulled down when the overtemperature condition of the relative channel is verified.

Figure 1. Block diagram



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1 Absolute maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Power supply voltage	45	V
$-V_{CC}$	Reverse supply voltage	-4	V
I_{OUT}	Output current (continuous)	Internally limited	A
I_R	Reverse output current (per channel)	-6	A
I_{IN}	Input current (per channel)	± 10	mA
I_{DIAG}	Diag pin current	± 10	mA
V_{ESD}	Electrostatic discharge ($R = 1.5\text{ k}\Omega$; $C = 100\text{ pF}$)	2000	V
E_{AS}	Single pulse avalanche energy one channel active $T_J = 125\text{ }^\circ\text{C}$, $I_{LOAD} = 0.625\text{ A}$	10	J
	Single pulse avalanche energy all channels active simultaneously $T_J = 125\text{ }^\circ\text{C}$, $I_{LOAD} = 0.625\text{ A}$	2	
P_{TOT}	Power dissipation at $T_C = 25\text{ }^\circ\text{C}$	Internally limited	W
T_J	Junction operating temperature		$^\circ\text{C}$
T_{STG}	Storage temperature	-55 to 150	$^\circ\text{C}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case ⁽¹⁾	3	$^\circ\text{C/W}$
R_{thJA}	Thermal resistance junction-ambient ⁽²⁾	50	$^\circ\text{C/W}$

1. Per channel

2. When mounted, minimum recommended pad size on FR-4 board

2 Pin connections

Figure 2. Connection diagram (top view)

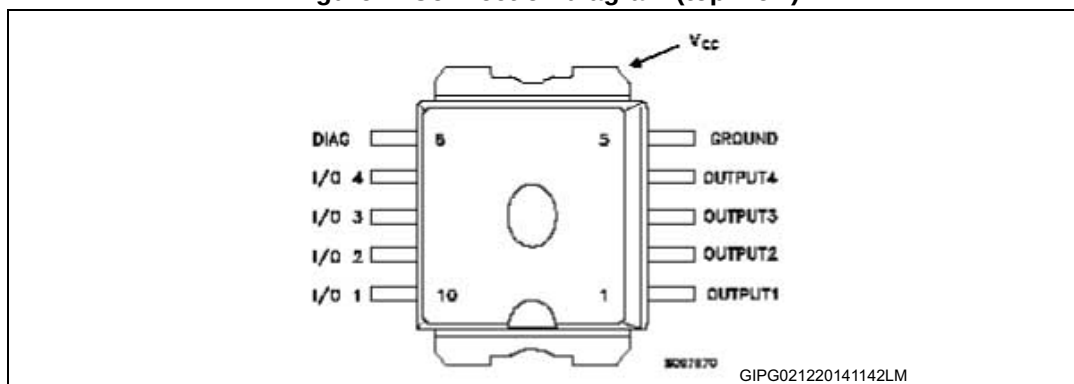
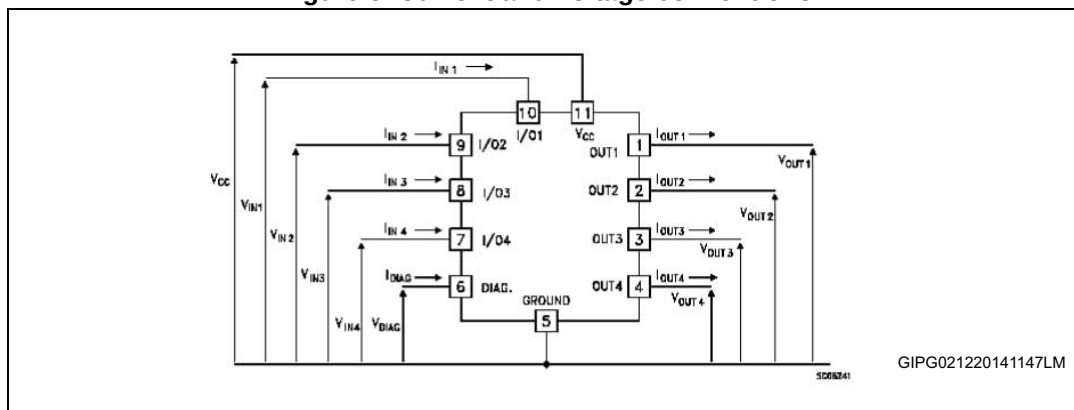


Figure 3. Current and voltage conventions



3 Electrical characteristics

10 V < V_{CC} < 36 V; -40 °C < T_J = 125 °C unless otherwise specified

Table 3. Power section

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		10		36	V
$R_{DS(on)}$	On-state resistance	$I_{OUT} = 0.5\text{ A}$; $T_J = 25\text{ °C}$			0.2	Ω
		$I_{OUT} = 0.5\text{ A}$; $T_J = 85\text{ °C}$			0.32	
		$I_{OUT} = 0.5\text{ A}$; $T_J = 125\text{ °C}$			0.4	
I_S	Supply current	All channels OFF			1	mA
		On-state; $V_{IN} = 30\text{ V}$; $I_{OUT} = 0\text{ V}$ ($T_J = 125\text{ °C}$)			6	
V_{OL}	Low-state output voltage	$V_{IN} = V_{IL}$, $R_{LOAD} = 10\text{ m}\Omega$			1.5	V
V_{demag}	Output voltage at turn-off	$I_{OUT} = 0.5\text{ A}$; $L_{LOAD} = 1\text{ mH}$	$V_{CC}-65$	$V_{CC}-55$	$V_{CC}-45$	V
I_{LGND}	Output current at turn-off	$V_{CC} = V_{INn} = V_{GNDn}$ $V_{STAT} = 18\text{ to }30\text{ V}$ $T_{amb} = 25\text{ to }85\text{ °C}$ (see Figure 6)			2	mA

Table 4. Switching ($V_{CC} = 24\text{ V}$)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time of output current	$I_{OUT} = 0.5\text{ A}$, resistive load input rise time < 0.1 μs $T_J = 25\text{ °C}$	-	52	100	μs
t_r	Rise time of output current			94	250	
$t_{d(off)}$	Turn-off delay time of output current			34	50	
t_f	Fall time of output current			8	20	

Table 5. Logic input

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IL}	I/O input low level voltage				2	V
V_{IH}	I/O input high level voltage		3.5			
$V_{I(HYST)}$	I/O input hysteresis voltage			0.5		
I_{IN}	I/O input current	$V_{IN} = 30\text{ V}$			25	μA
V_{ICL}	I/O input clamp voltage ⁽¹⁾	$I_{IN} = 1\text{ mA}$	32	36		V
		$I_{IN} = -1\text{ mA}$		-0.7		

1. The input voltage is internally clamped at 32 V minimum, the input pins can be connected to a higher voltage via the external resistor without exceeding 10 mA

Table 6. Protection and diagnostic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{DIAG}^{(1)}$	Status voltage output low	$I_{DIAG} = 5\text{ mA}$ (fault condition)			1	V
$V_{SCL}^{(1)}$	Status clamp voltage	$I_{DIAG} = 1\text{ mA}$ $I_{DIAG} = 1\text{ mA}$	32	36 -0.7		V
V_{USD}	Undervoltage shutdown		5		8	V
I_{LIM}	DC short-circuit current	$V_{CC} = 24\text{ V};$ $R_{LOAD} < 10\text{ m}\Omega$	0.7		2	A
I_{OVPK}	Peak short-circuit current	$V_{CC} = 24\text{ V}; V_{IN} = 30\text{ V};$ $R_{LOAD} < 10\text{ m}\Omega$			4	A
I_{DIAGH}	Leakage on DIAG pin in high-state	$V_{DIAG} = 24\text{ V}$			25	μA
I_{LOAD}	Output leakage current	$V_{CC} = 10\text{ to }36\text{ V};$ $V_{IN} = V_{IL}$			50	μA
t_{SC}	Delay time of current limiter				100	μs
T_{TSD}	Thermal shutdown temperature		150	170		$^{\circ}\text{C}$
T_R	Thermal reset temperature		135	155		$^{\circ}\text{C}$

1. Status determination > 100 μs after the switching edge

Note: If INPUT pin floats, the corresponding channel automatically switches OFF. If GND pin is disconnected, the channel switches OFF provided that V_{CC} doesn't exceed 36 V

4 Test circuits

Figure 4. Avalanche energy test circuit

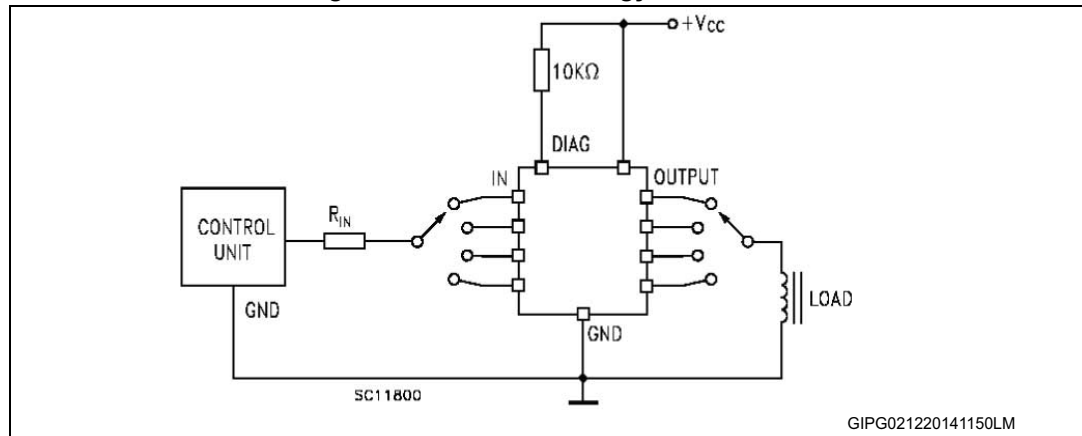


Figure 5. Peak short-circuit test diagram

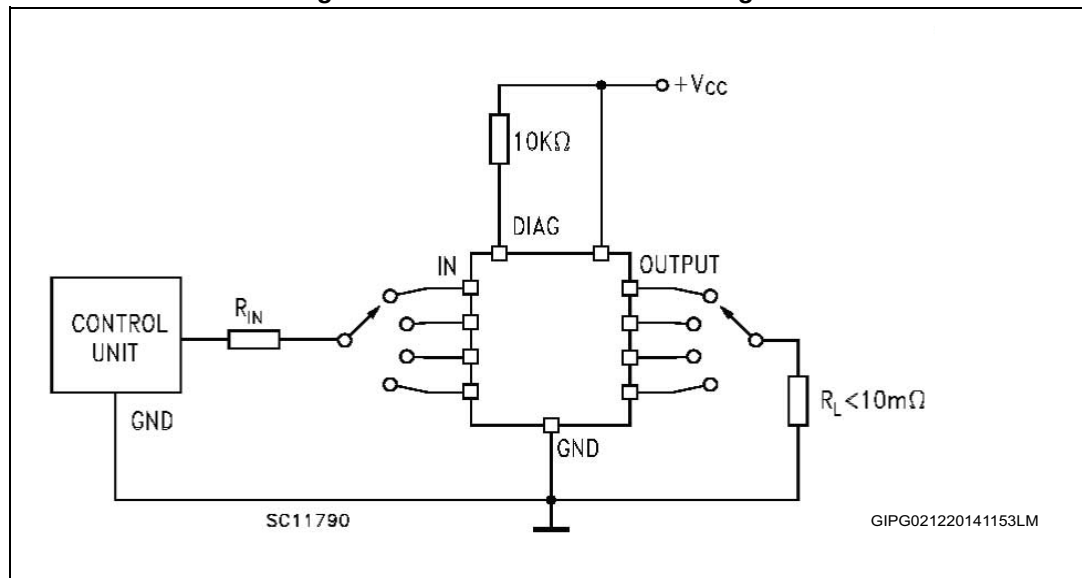
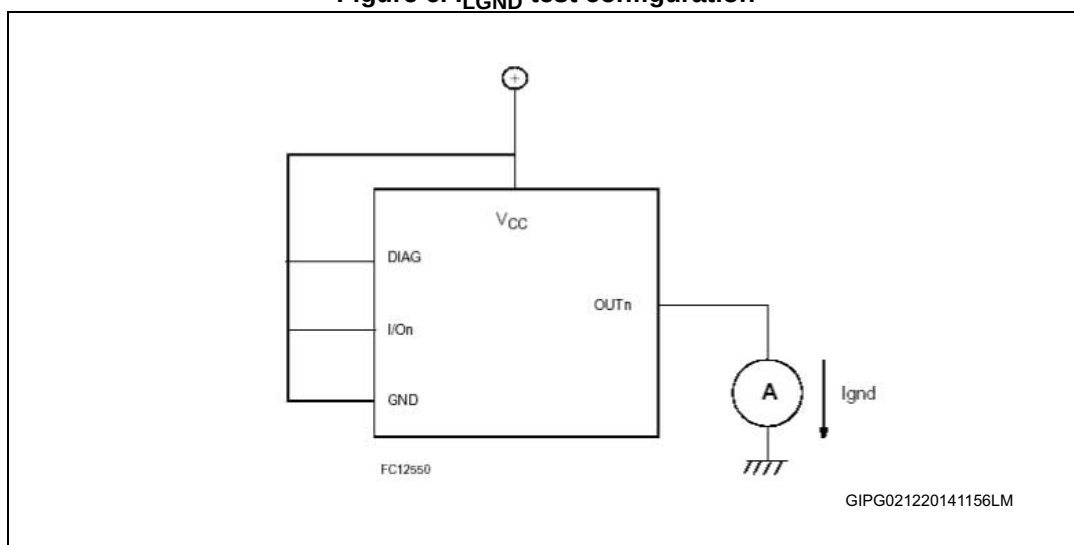


Figure 6. I_{LGND} test configuration

5 Switching time waveforms and truth table

Figure 7. Switching waveforms

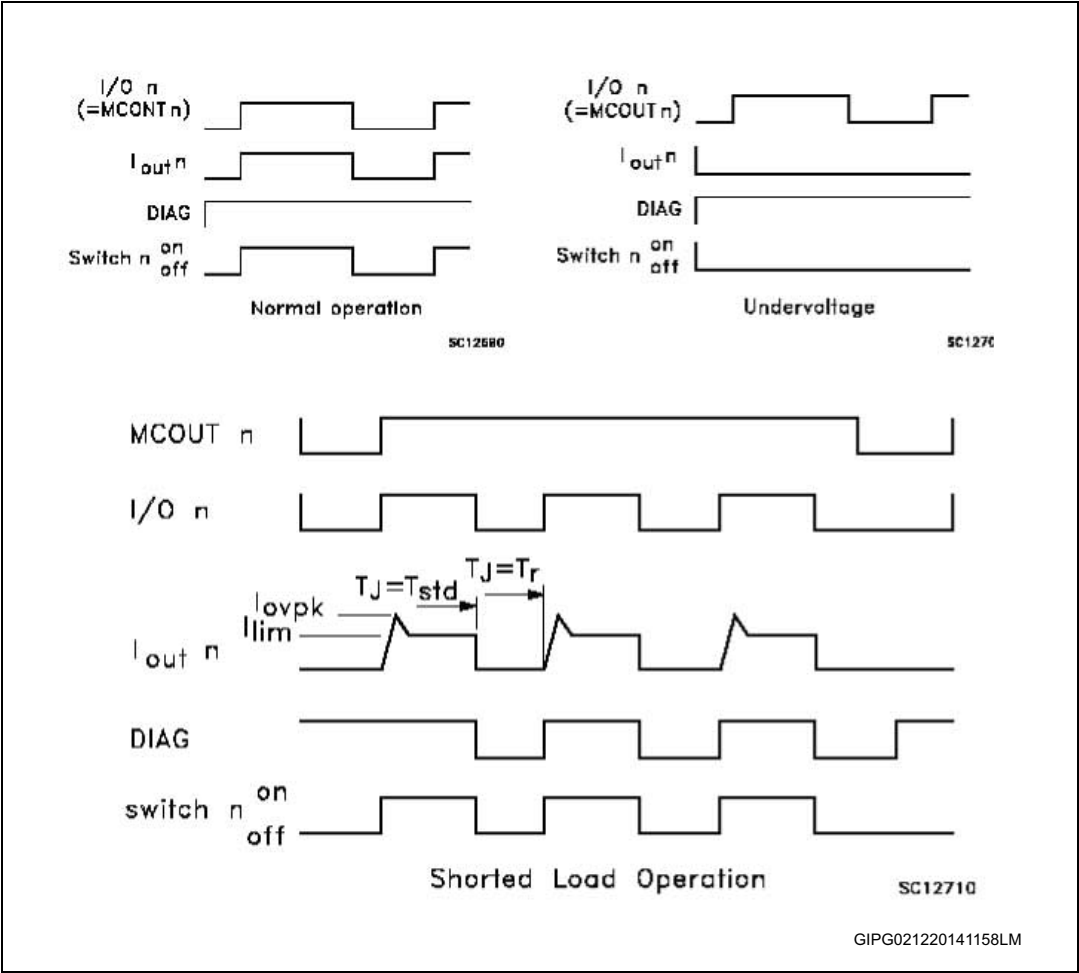


Figure 8. Switching parameter test conditions

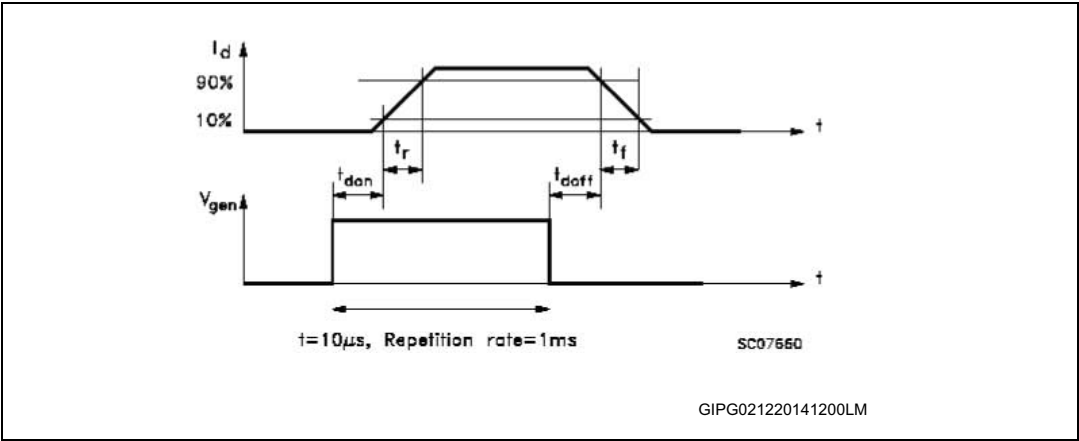
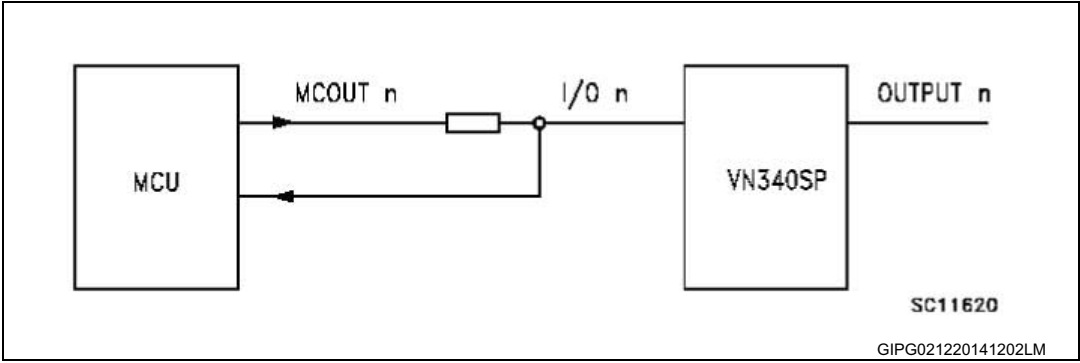


Table 7. Truth table

Conditions	MCOUTn	I/On	OUTPUTn	Diagnostic
Normal operation	L	L	L	H
	H	H	H	H
Overtemperature	L	L	L	H
	H	L	L	L
Undervoltage	L	L	L	H
	H	H	L	H
Short load (current limitation)	L	L	L	H
	H	H	H	H

Figure 9. Driving circuit



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 PowerSO-10 package information

Figure 10. PowerSO-10 outline

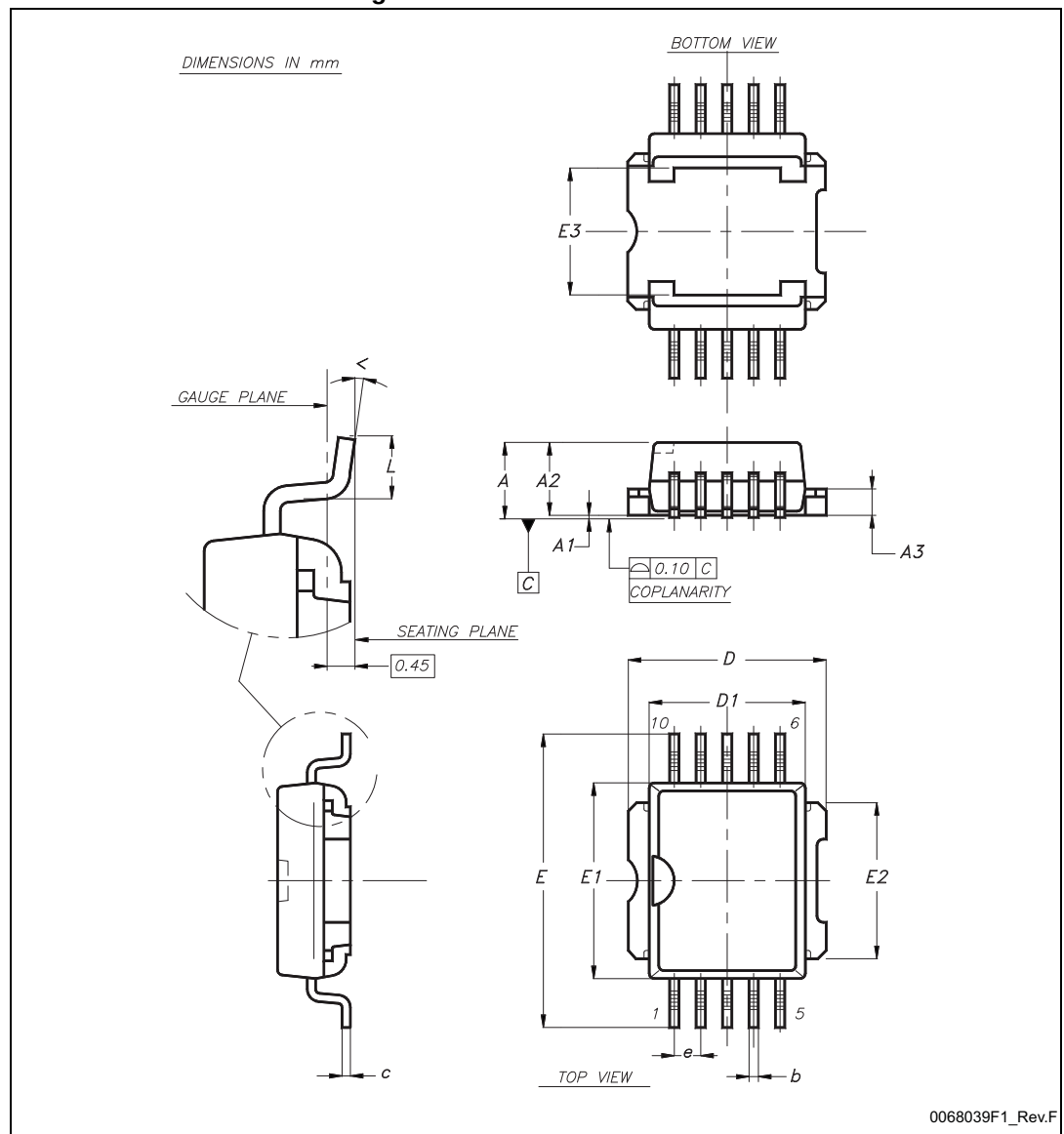


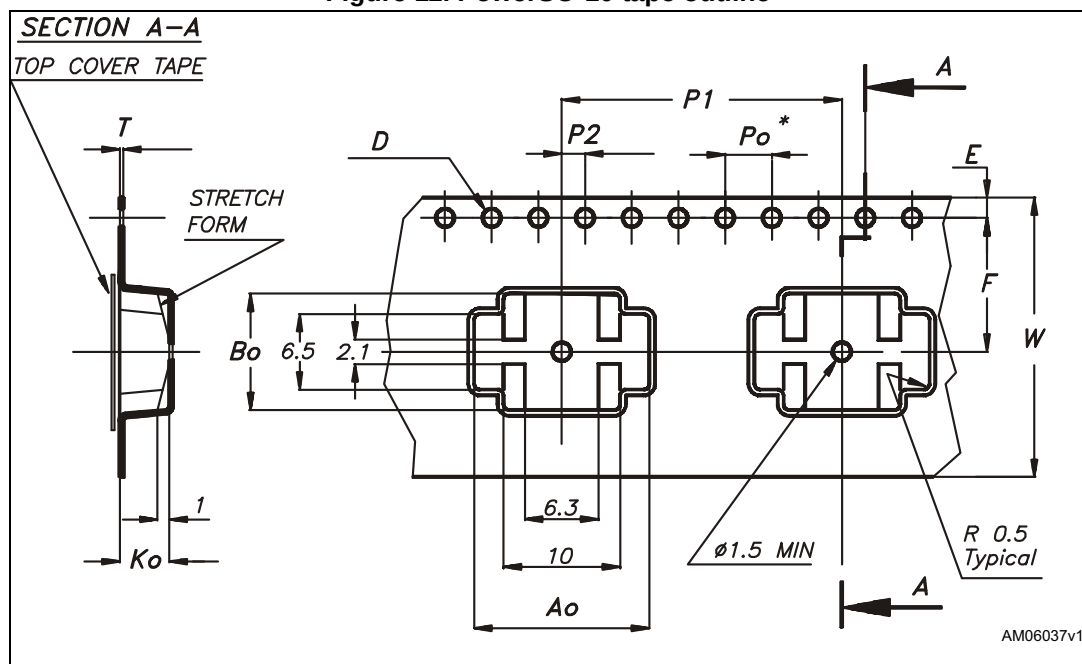
Table 8. PowerSO-10 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			3.70
A1	0.00		0.10
A2	3.40		3.60
A3	1.25		1.35
b	0.40		0.53
c	0.35		0.55
D	9.40		9.60
D1 ⁽¹⁾	7.40		7.60
E	13.80		14.40
E1 ⁽¹⁾	9.30		9.50
E2	7.20		7.60
E3	5.90		6.10
e		1.27	
L	0.95		1.65
<	0°		8°

1. Resin protrusion is not included (max. value 0.20 mm per side)

6.2 PowerSO-10 packing information

Figure 11. PowerSO-10 tape outline



Note: Drawing is not in scale

Figure 12. PowerSO-10 reel outline

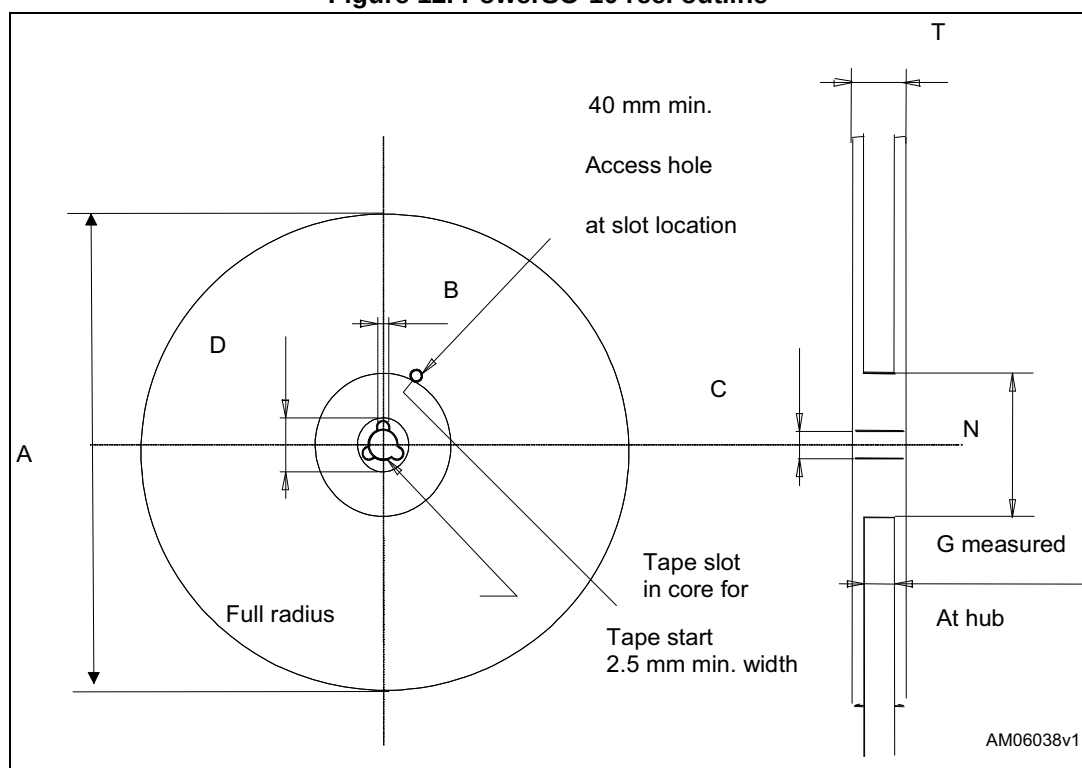


Table 9. PowerSO-10 tape and reel mechanical data

Ref.	mm		
	Min.	Typ.	Max.
A0	14.9	15.0	15.1
B0	9.9	10.0	10.1
K0	4.15	4.25	4.35
F	11.4	11.5	11.6
E	1.65	1.75	1.85
W	23.7	24.0	24.3
P2	1.9	2.0	2.1
P0	3.9	4.0	4.1
P1	23.9	24.0	24.1
T	0.025	0.30	0.35
D(Ø)	1.50	1.55	1.60

Note: 10 sprocket hole pitch cumulative tolerance ± 0.2 mm

7 Ordering information

Table 10. Ordering information

Order code	Package	Packing
VN340SP-E	PowerSO-10	Tube
VN340SPTR-E		Tape and reel

8 Revision history

Table 11. Document revision history

Date	Revision	Changes
05-Sep-2005	1	Initial release.
27-Jun-2006	2	Updated mechanical data.
18-Sep-2006	3	Updated mechanical data and added PowerSO-10 tape and reel.
31-Oct-2006	4	Updated typo in electrical characteristic temperature conditions.
05-Mar-2007	5	Document reformatted, typo in note 1.
04-Dec-2014	6	Updated the title. Updated E_{AS} parameter in Table 1 and updated Table 5 and Table 6 . Minor text changes.

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