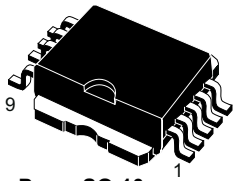
VN340SP-E

Quad high-side smart power solid state-relay

Datasheet - production data



PowerSO-10

Features

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

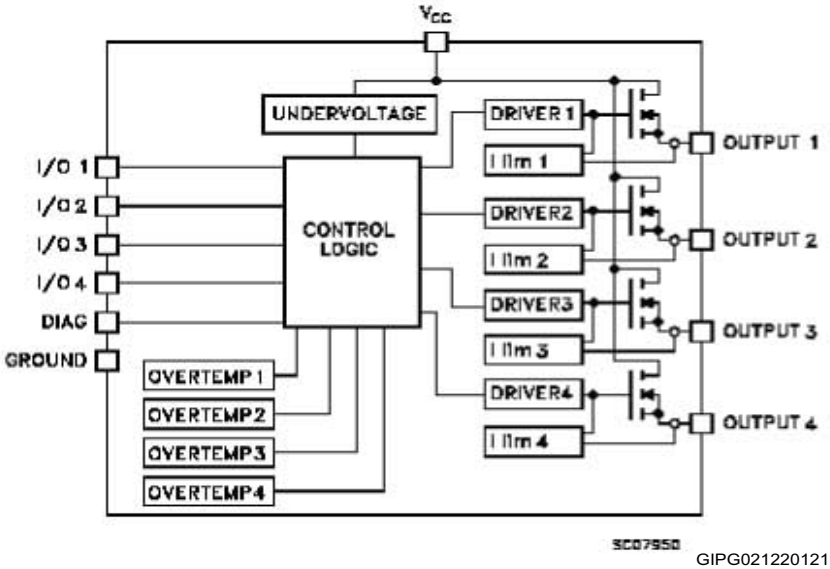
1. Per channel

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

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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Contents

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 kΩ; C = 100 pF)	2000	V
E_{AS}	Single pulse avalanche energy one channel active T_J = 125 °C, I_{LOAD} = 0.625 A	10	J
	Single pulse avalanche energy all channels active simultaneously T_J = 125 °C, I_{LOAD} = 0.625 A	2	
P_{TOT}	Power dissipation at T_C = 25 °C	Internally limited	W
T_J	Junction operating temperature		°C
T_{STG}	Storage temperature	-55 to 150	°C

Table 2. Thermal data

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

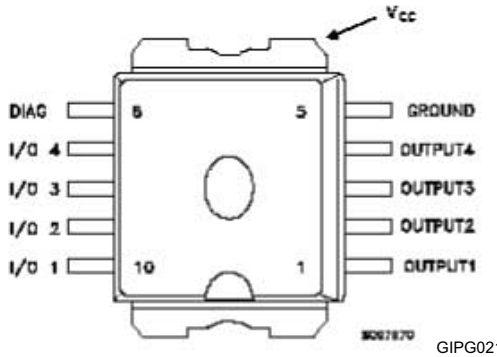

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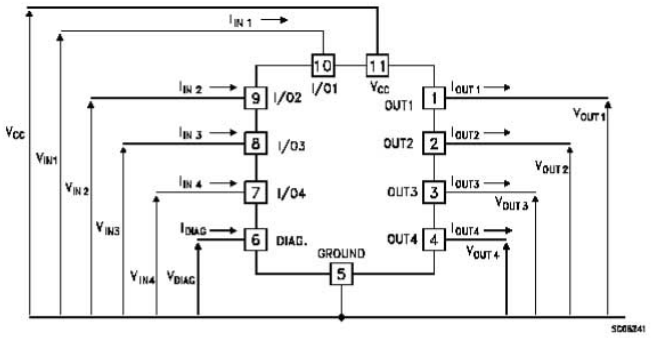
Figure 3. Current and voltage conventions



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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 A; T_J = 25 °C			0.2	Ω
		I_{OUT} = 0.5 A; T_J = 85 °C			0.32	
		I_{OUT} = 0.5 A; T_J = 125 °C			0.4	
I_S	Supply current	All channels OFF			1	mA
		On-state; V_{IN} = 30 V; I_{OUT} = 0 V (T_J = 125 °C)			6	
V_{OL}	Low-state output voltage	V_{IN} = V_{IL}, R_{LOAD} = 10 mΩ			1.5	V
V_{demag}	Output voltage at turn-off	I_{OUT} = 0.5 A; L_{LOAD} = 1 mH	V_{CC}-65	V_{CC}-55	V_{CC}-45	V
I_{LGND}	Output current at turn-off	V_{CC} = V_{INn} = V_{GND}= V_{STAT} = 18 to 30 V T_{amb} = 25 to 85 °C (see *Figure 6*)			2	mA

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time of output current	I_{OUT} = 0.5 A, resistive load input rise time < 0.1 µs T_J = 25 °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 V			25	µA
V_{ICL}	I/O input clamp voltage(1)	I_{IN} = 1 mA	32	36		V
		I_{IN} = -1 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 mA (fault condition)			1	V
V_{SCL}(1)	Status clamp voltage	I_{DIAG} = 1 mA I_{DIAG} = 1 mA	32	36 -0.7		V
V_{USD}	Undervoltage shutdown		5		8	V
I_{LIM}	DC short-circuit current	V_{CC} = 24 V; R_{LOAD} < 10 mΩ	0.7		2	A
I_{OVPK}	Peak short-circuit current	V_{CC} = 24V; V_{IN} = 30 V; R_{LOAD} < 10 mΩ			4	A
I_{DIAGH}	Leakage on DIAG pin in high-state	V_{DIAG} = 24 V			25	µA
I_{LOAD}	Output leakage current	V_{CC} = 10 to 36 V; V_{IN} = V_{IL}			50	µA
t_{SC}	Delay time of current limiter				100	µs
T_{TSD}	Thermal shutdown temperature		150	170		°C
T_R	Thermal reset temperature		135	155		°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

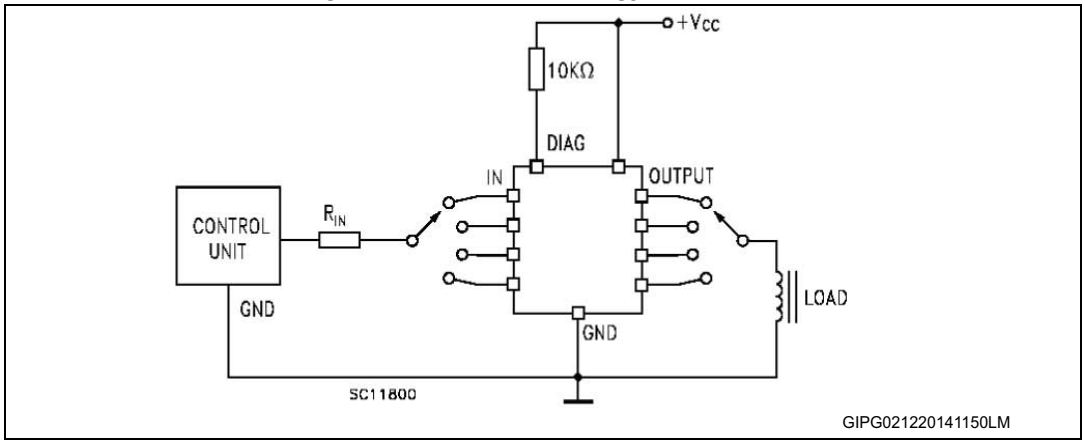


Figure 5. Peak short-circuit test diagram

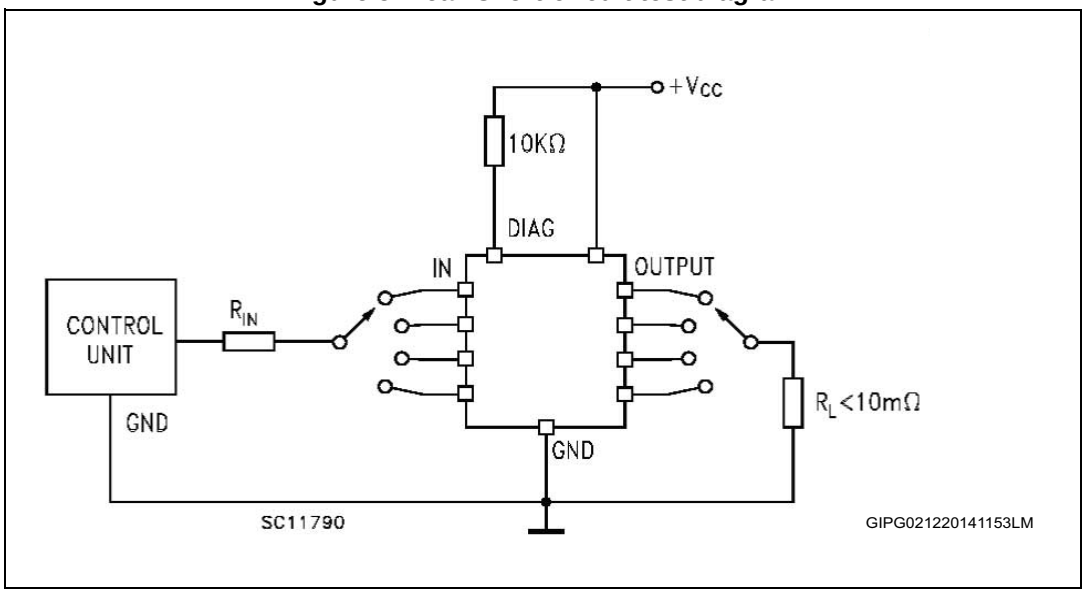
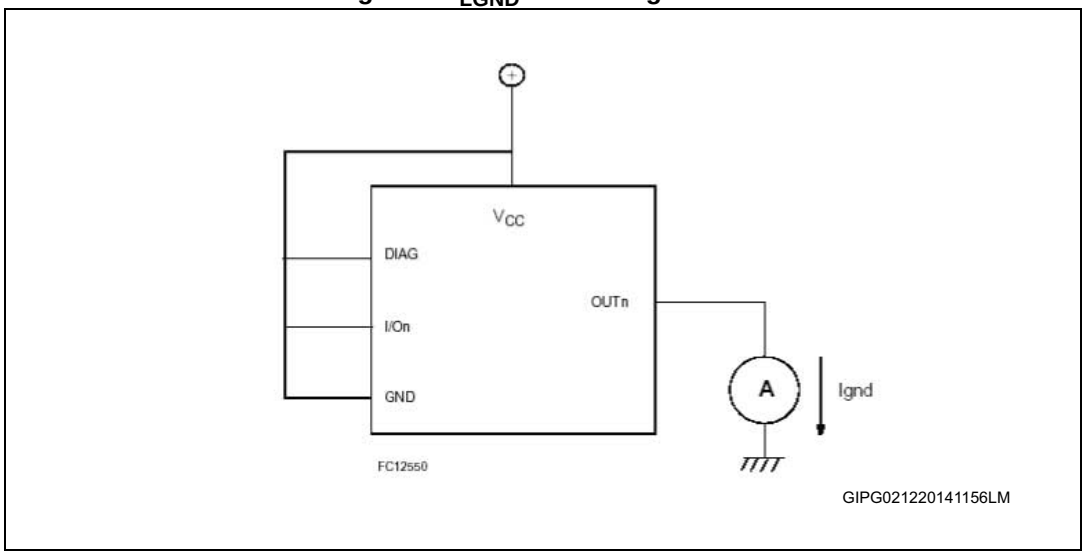


Figure 6. I_{LGND} test configuration



5 Switching time waveforms and truth table

Figure 7. Switching waveforms

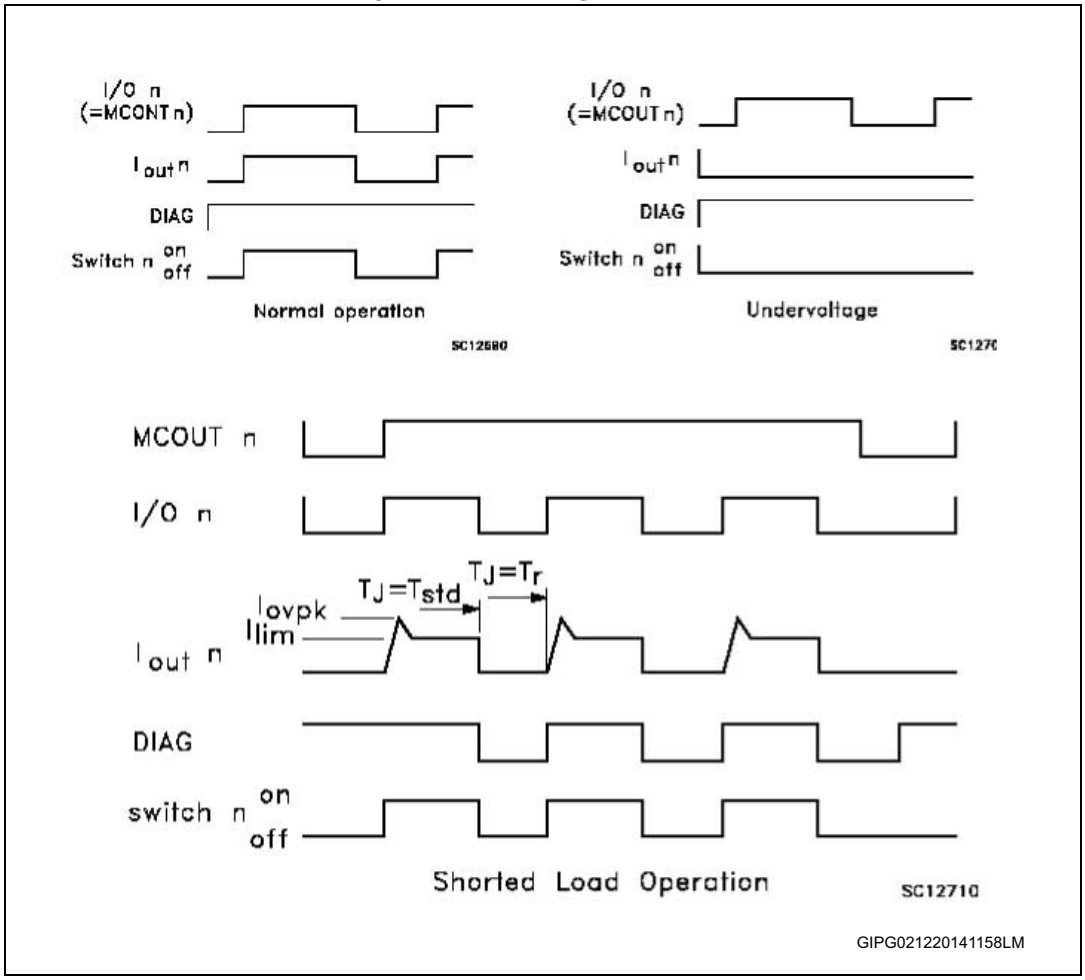


Figure 8. Switching parameter test conditions

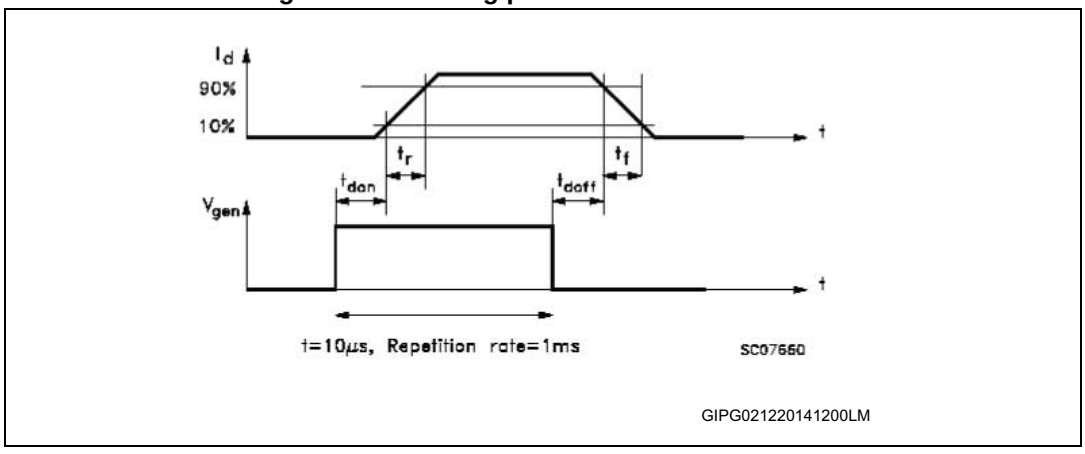
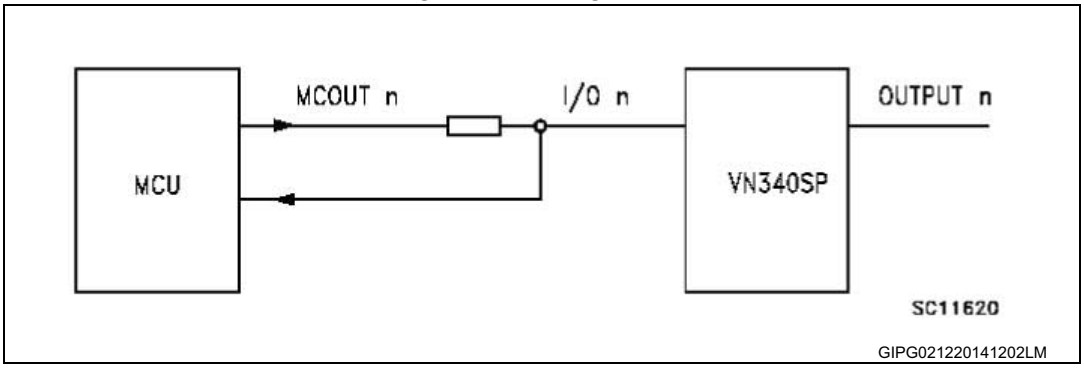


Table 7. Truth table

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

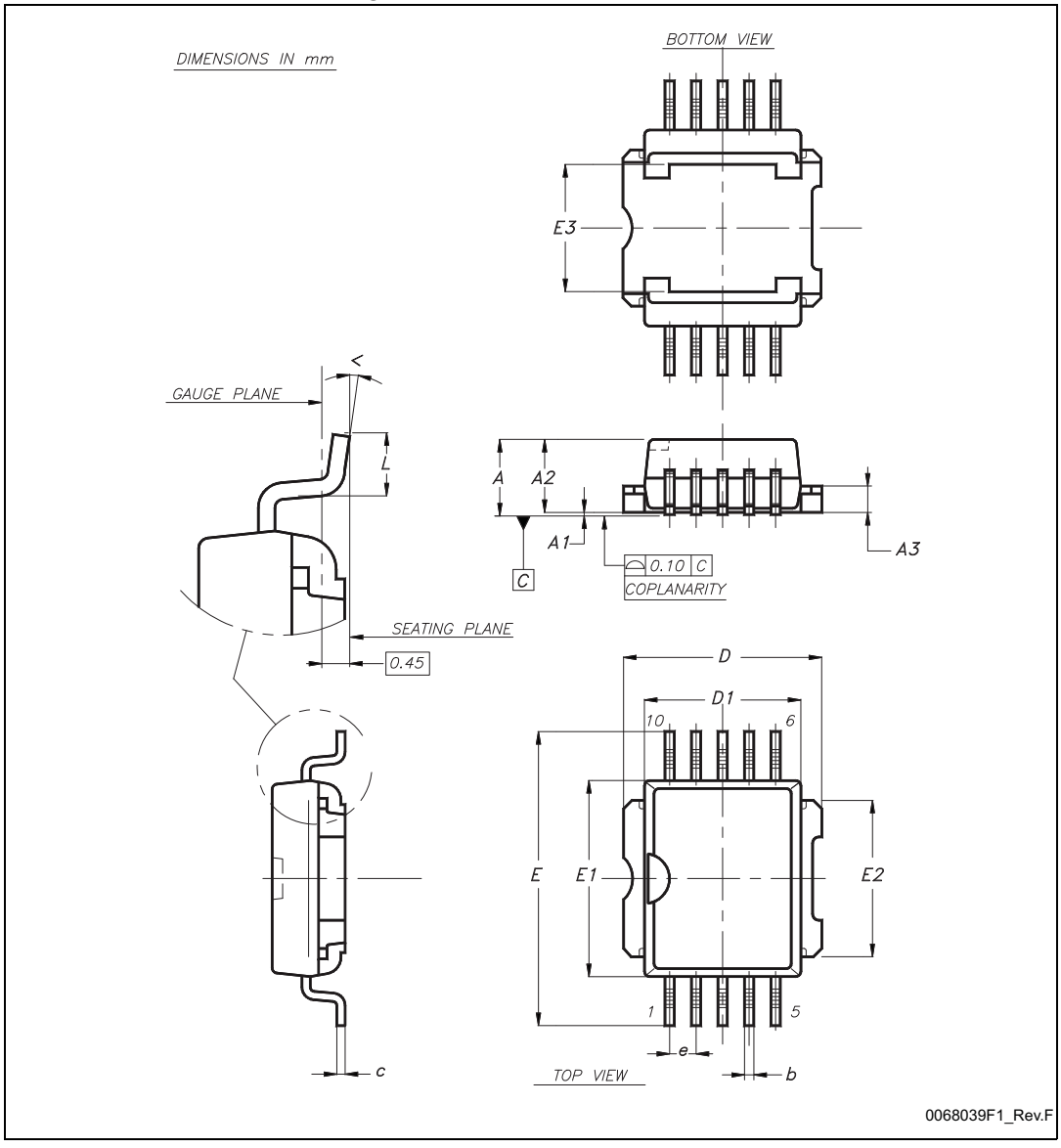


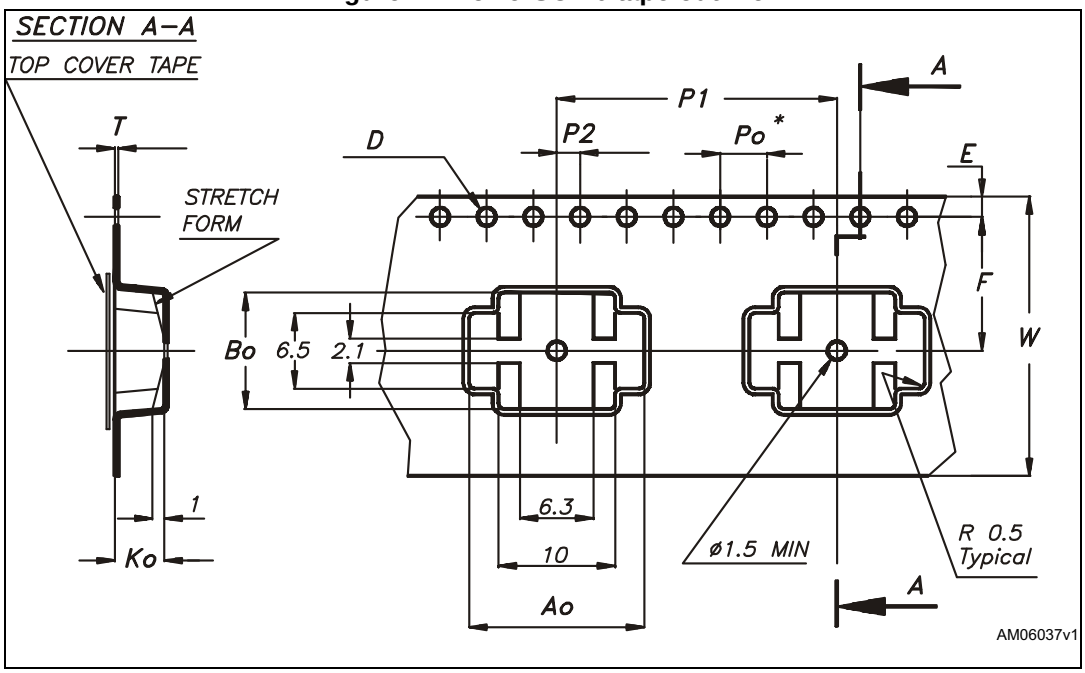
Table 8. PowerSO-10 mechanical data

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^o		8^o

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

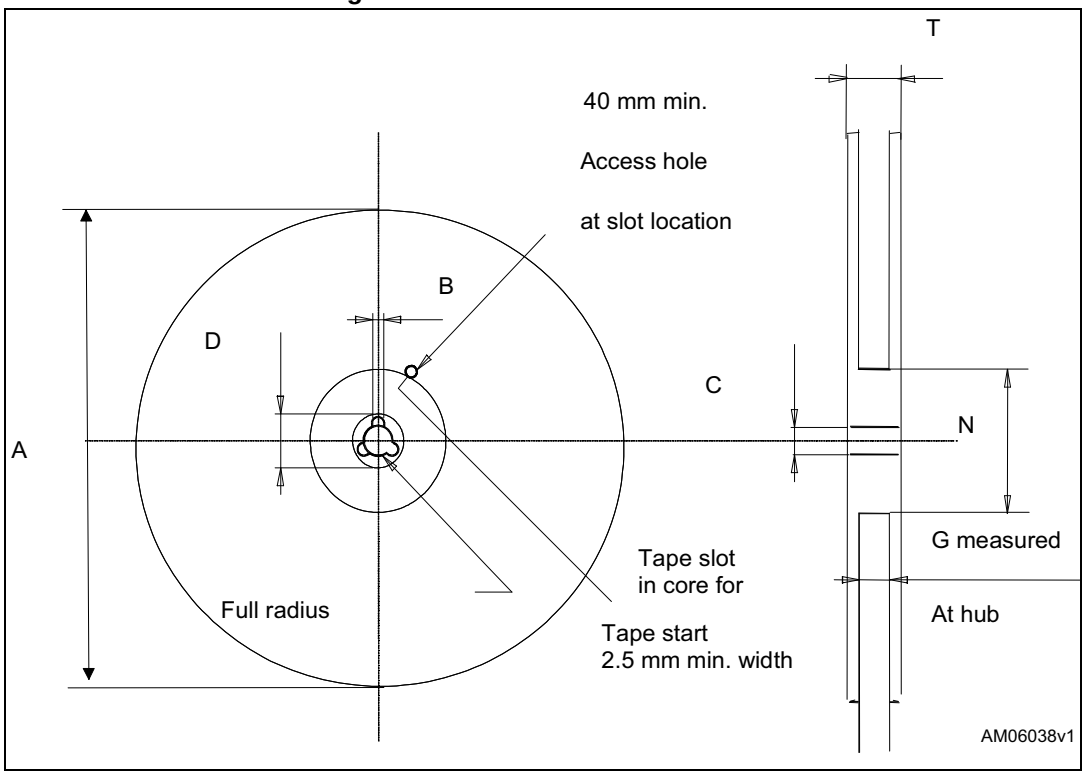


Table 9. PowerSO-10 tape and reel mechanical data

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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