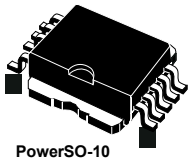
VN340SP-E & VN340SP-33-E

Datasheet

Quad high-side smart power solid-state relay



PowerSO-10

Product status link

VN340SP-E & VN340SP-33-E

Product label

Features

- Operating output current: 0.7 A (VN340SP-E) or 1 A (VN340SP-33-E)
- 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
- Conforms to IEC 61131-2

Applications

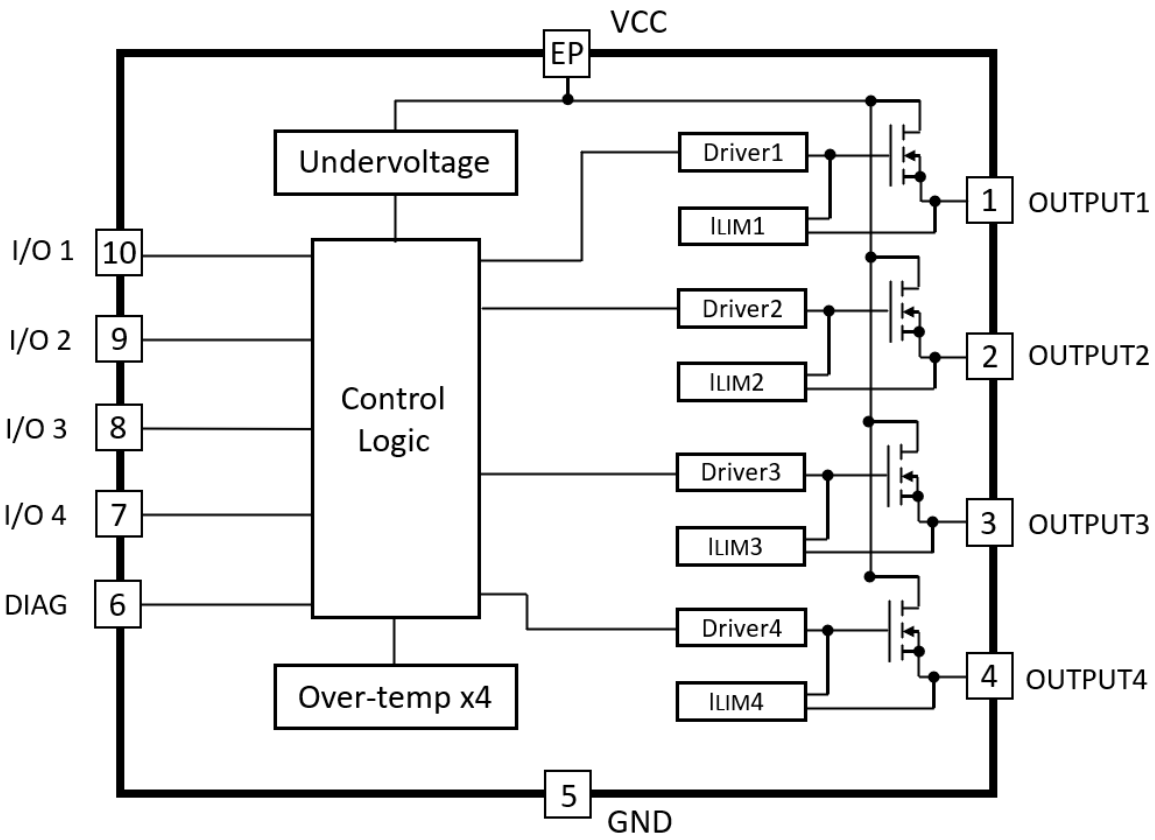
- Vending machines
- Industrial PC peripheral input/output
- Numerical control machines
- General high-side switch applications

Description

VN340SP-E & VN340SP-33-E are monolithic devices developed using STMicroelectronics' VIPower technology, intended to drive four independent resistive or inductive loads with one side connected to ground. Active current limitation prevents dropping of 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.

1 Block diagram

Figure 1. **Block diagram**



2 Pin connection

Figure 2. **Connection diagram (top view)**

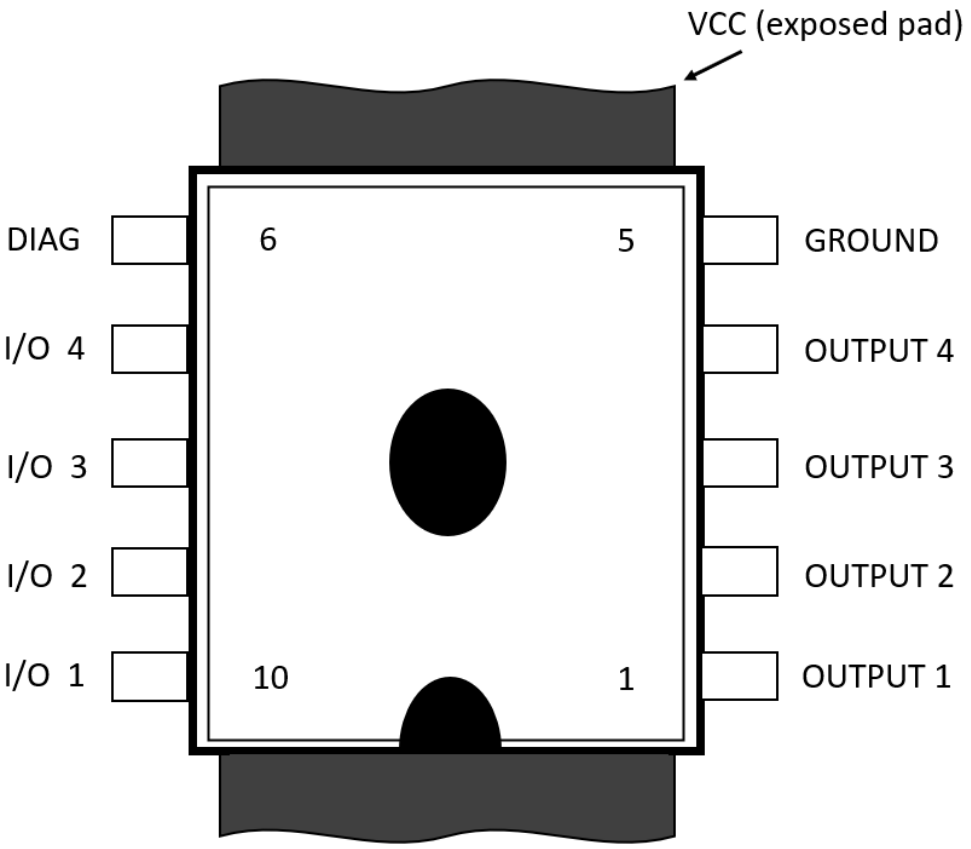
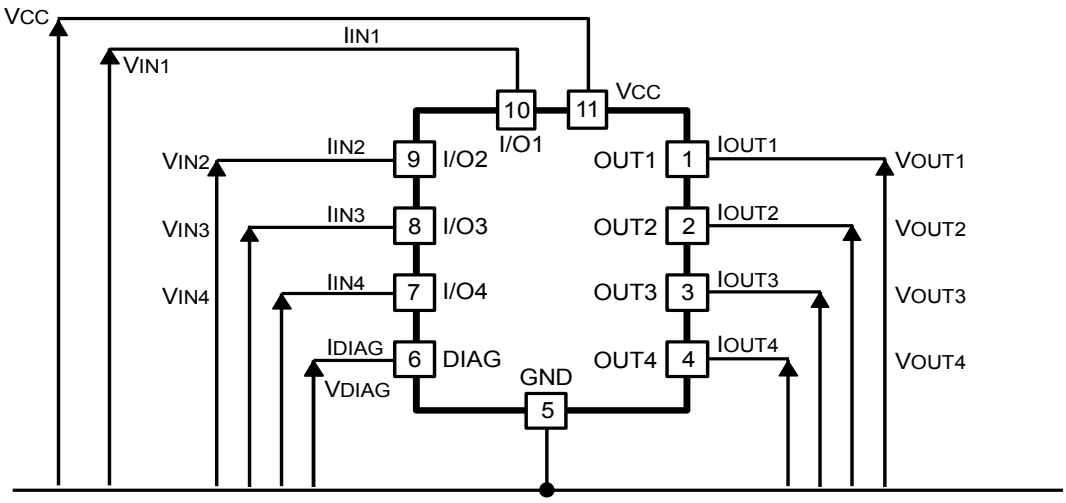


Figure 3. **Current and voltage conventions**



3 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	Internally limited	A
I_R	Reverse output current (per channel)	-6	A
I_{IN}	Input current range	-1 to +10	mA
I_{DIAG}	Diag pin current	-1 to +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	J
P_{TOT}	Power dissipation at T_C = 25 °C	Internally limited	W
T_J	Junction operating temperature	Internally limited	°C
T_{STG}	Storage temperature	-55 to 150	°C

Table 2. Thermal data

Symbol	Parameter	Max Value	Unit
$R_{th(JC)}$	Thermal resistance junction-case (1)	3	°C/W
$R_{th(JA)}$	Thermal resistance junction-ambient (2)	50	°C/W

1. *Per channel.*
2. *When mounted on a four-layer FR4, with the minimum recommended pad size.*

4 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 in OFF-state			1	mA
		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
I_{LGND}	Output current at turn-off	V_{CC} = V_{IN} = V_{GND} = V_{STAT} = 18 to 30 V, T_A = - 25 °C to 85 °C			2	mA
V_{demag}	Demagnetization voltage	I_{OUT} = 0.5 A; L_{LOAD} >= 1 mH	V_{CC}-65	V_{CC}-55	V_{CC}-45	V

Table 4. Switching (V_{CC} = 24 V, T_J = 25 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(ON)}$	Turn-on delay time	I_{OUT} = 0.5 A, resistive load, input rise time < 0.1 µs		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			8	20	

Table 5. Logic inputs

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
$V_{I(HYST)}$	I/O input hysteresis voltage			0.5		V
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 by an external resistor, which cannot exceed 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}	Status clamp voltage	I_{DIAG} = 1 mA	32	36		V
		I_{DIAG} = -1 mA		-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)		2	A
			1(3)			
I_{OVPK}	Peak short-circuit current	V_{CC} = 24 V; 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}	Junction shutdown temperature		150	170		°C
T_R	Junction reset temperature		135	155		°C

1. *Status determination > 100 µs after the switching edge.*
2. *VN340SP-E*
3. *VN340SP-33-E*

Note: If the INPUT pin is left floating the corresponding channel automatically switches off. If GND pin is disconnected the channel switches off provided that V_{CC} does not exceed 36 V.

5 Test circuits

Figure 4. **Avalanche energy test circuit**

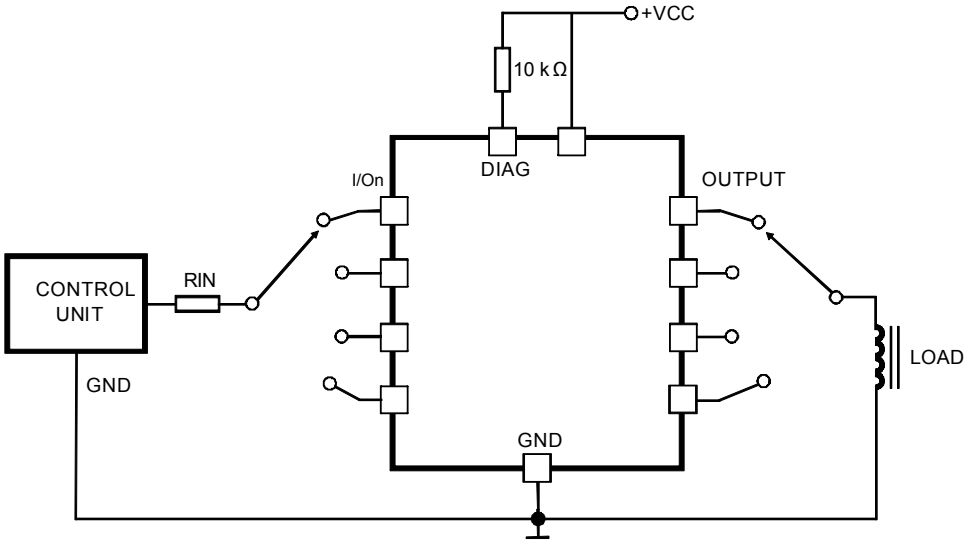


Figure 5. **Peak short-circuit test diagram**

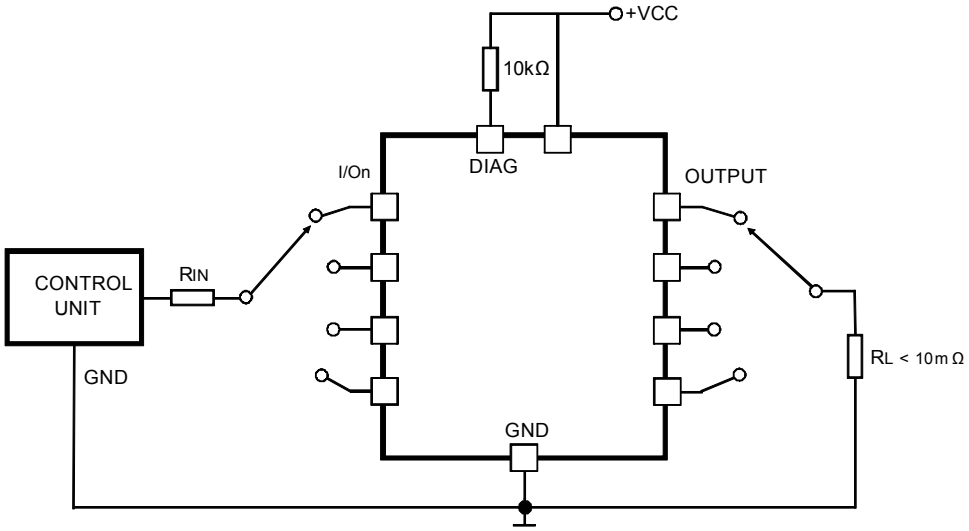
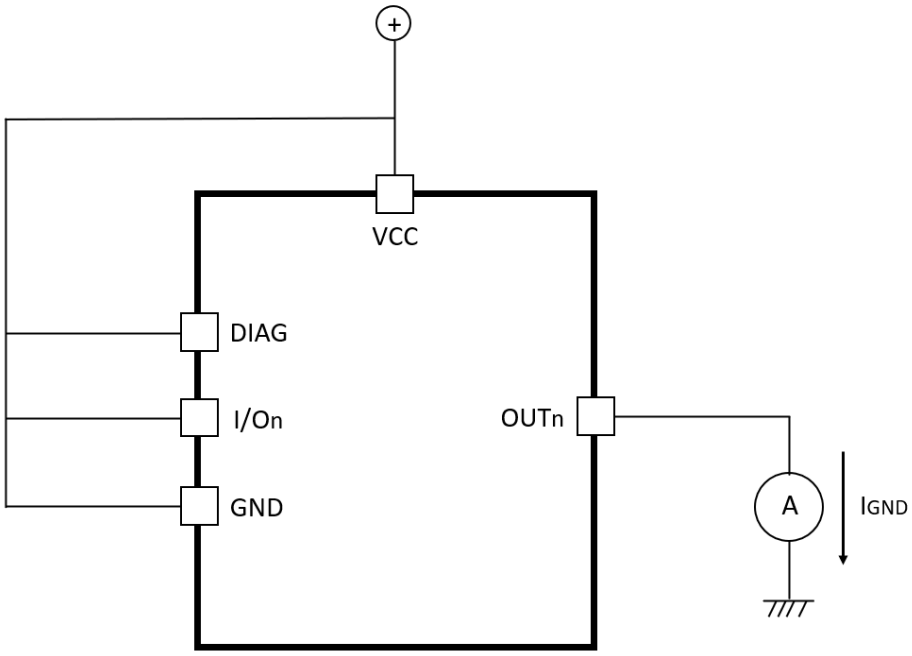


Figure 6. I_{LGND} test configuration



6 Switching time waveforms and truth table

Figure 7. **Switching waveforms**

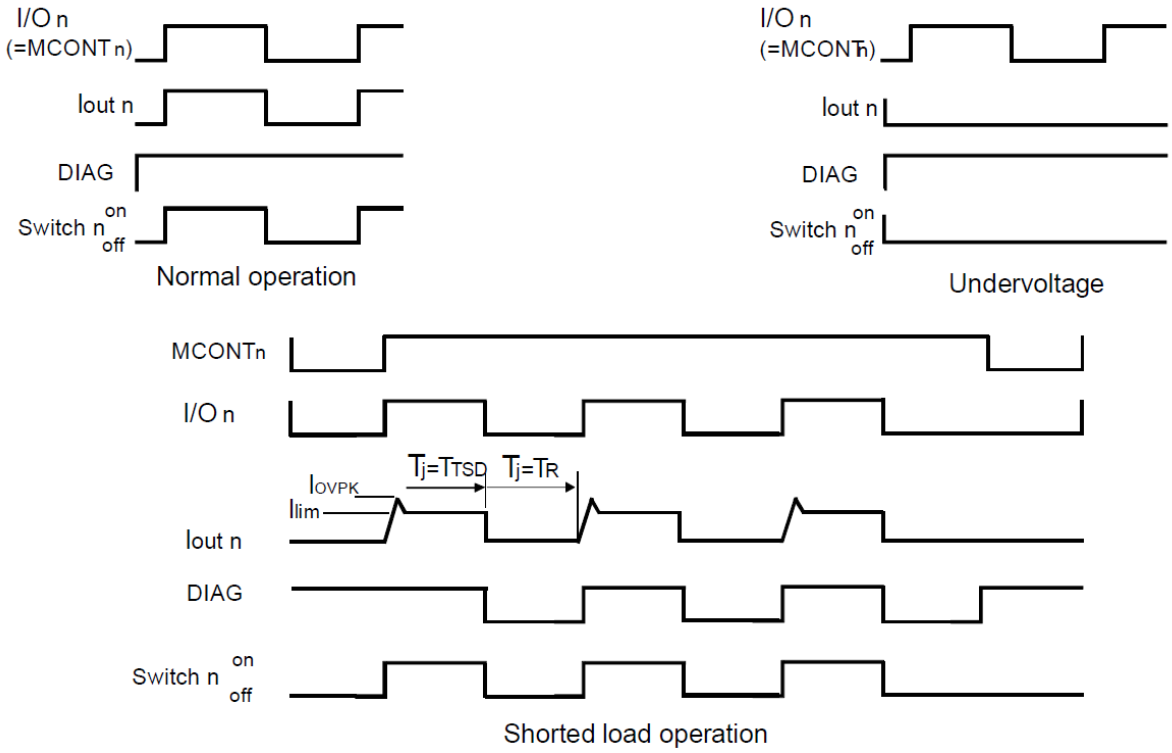


Figure 8. **Switching parameter test conditions**

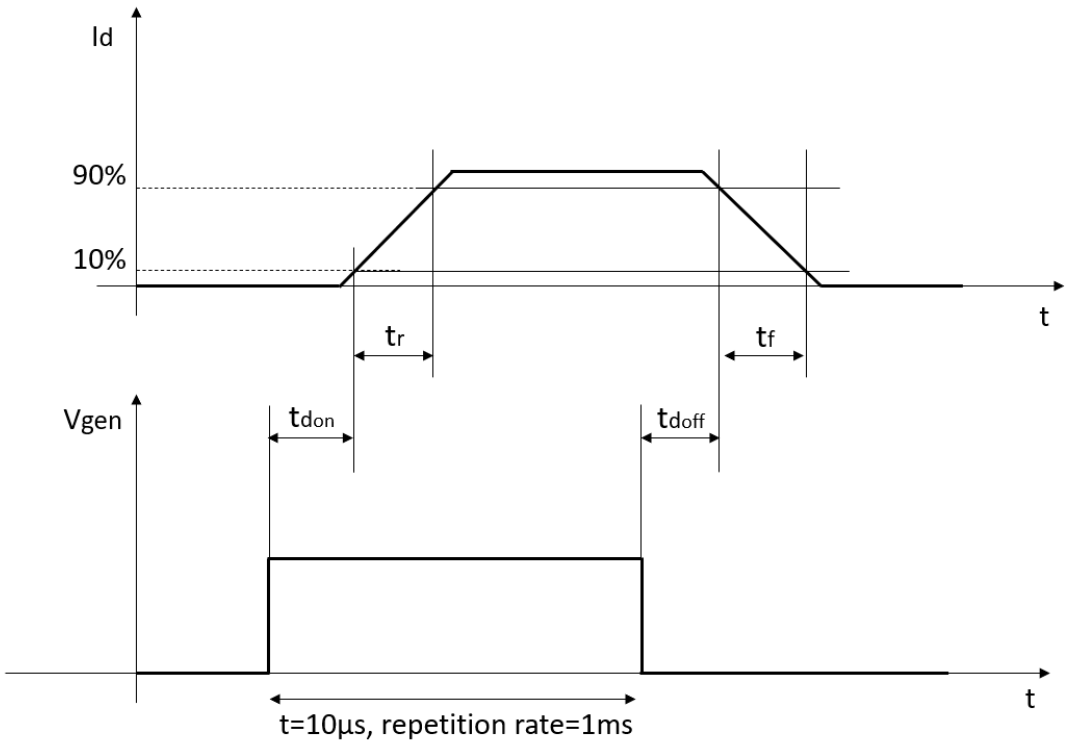
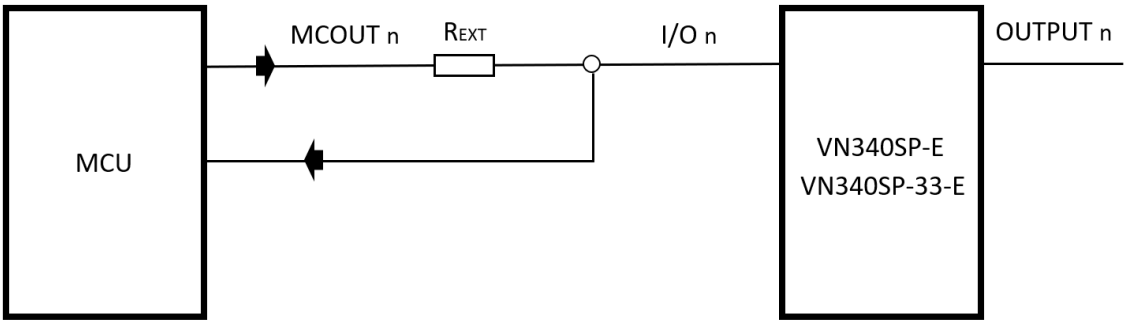


Table 7. Truth table

Conditions	MCOUTn	I/On	OUTPUTn	Diagnostic
Normal operation	L	L	L	H
	H	H	H	H
Junction overtemperature	L	L	L	H
	H	L	L	L
Undervoltage	L	L	L	H(1)
	H	H	L	H(1)
Shorted load (current limitation)	L	L	L	H
	H	H	H(2)	H

1. *DIAG pin is considered pulled-up at application voltage level*
2. $V_{OUT} = R_{LOAD} \times I_{LIM}$

Figure 9. Driving circuit



Notes:

- The I/O_S are internally pulled-down
- R_{EXT} is for enhancement of EMI robustness

7 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.

7.1 PowerSO-10 package information

Figure 10. PowerSO-10 package outline

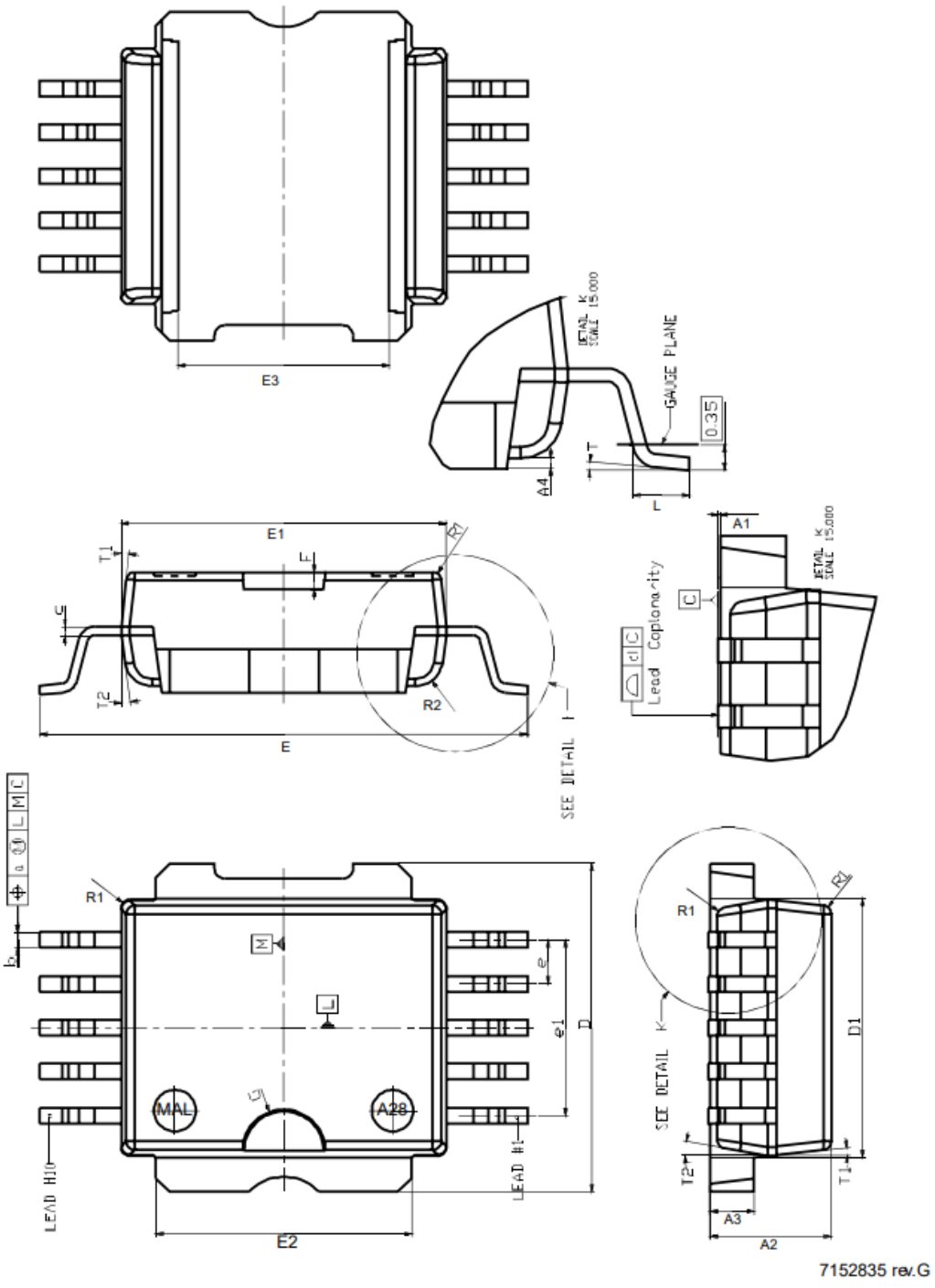


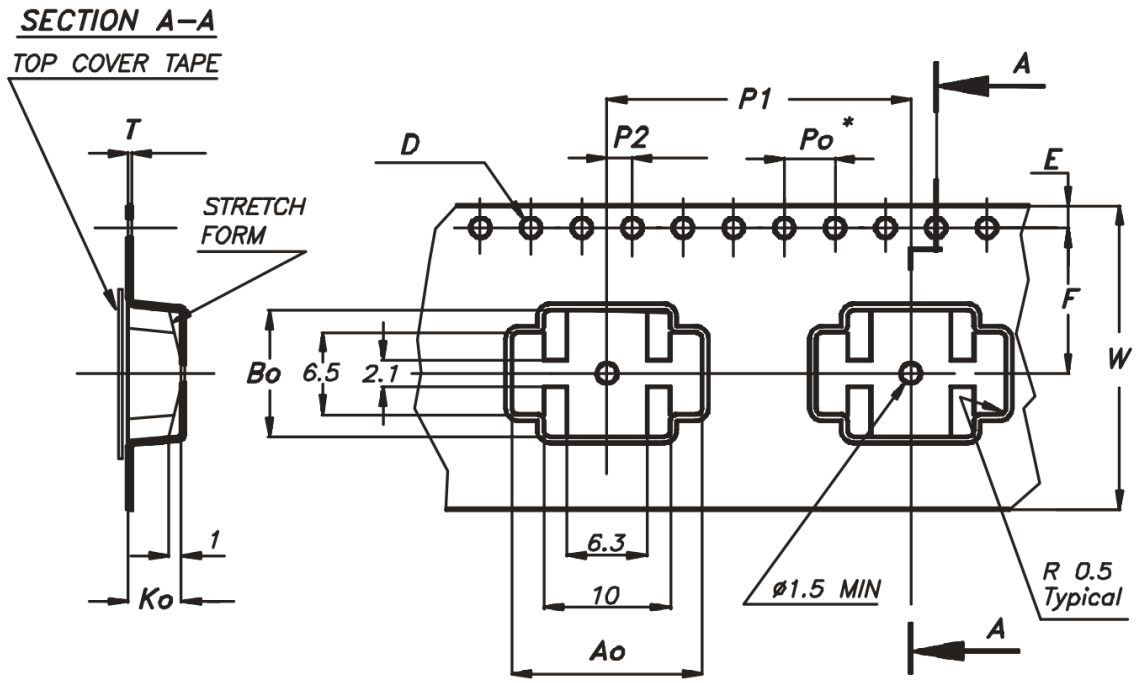
Table 8. PowerSO-10 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A1	0	0.05	0.08
A2	3.45	3.5	3.55
A3	1.24	1.28	1.32
A4	0.15	0.2	0.25
a		0.2	
b	0.4	0.45	0.5
c	0.24	0.27	0.3
D	9.45	9.52	9.59
D1	7.42	7.5	7.58
d	0	0.04	0.09
E	13.9	14.1	14.3
E1(1)	9.33	9.4	9.47
E2	7.4	7.42	7.5
E3	5.95	6.1	6.25
e	1.22	1.27	1.32
e1		5.08	
F		0.5	
G		1.2	
L	0.85	1	1.1
R1			0.25
R2		0.8	
T	3 deg	5 deg	7 deg
T1		6 deg	
T2		10 deg	

1. *Resin protrusions are not included (max. value 0.15 mm per side)*

7.2 PowerSO-10 packing information

Figure 11. **PowerSO-10 career tape outline**



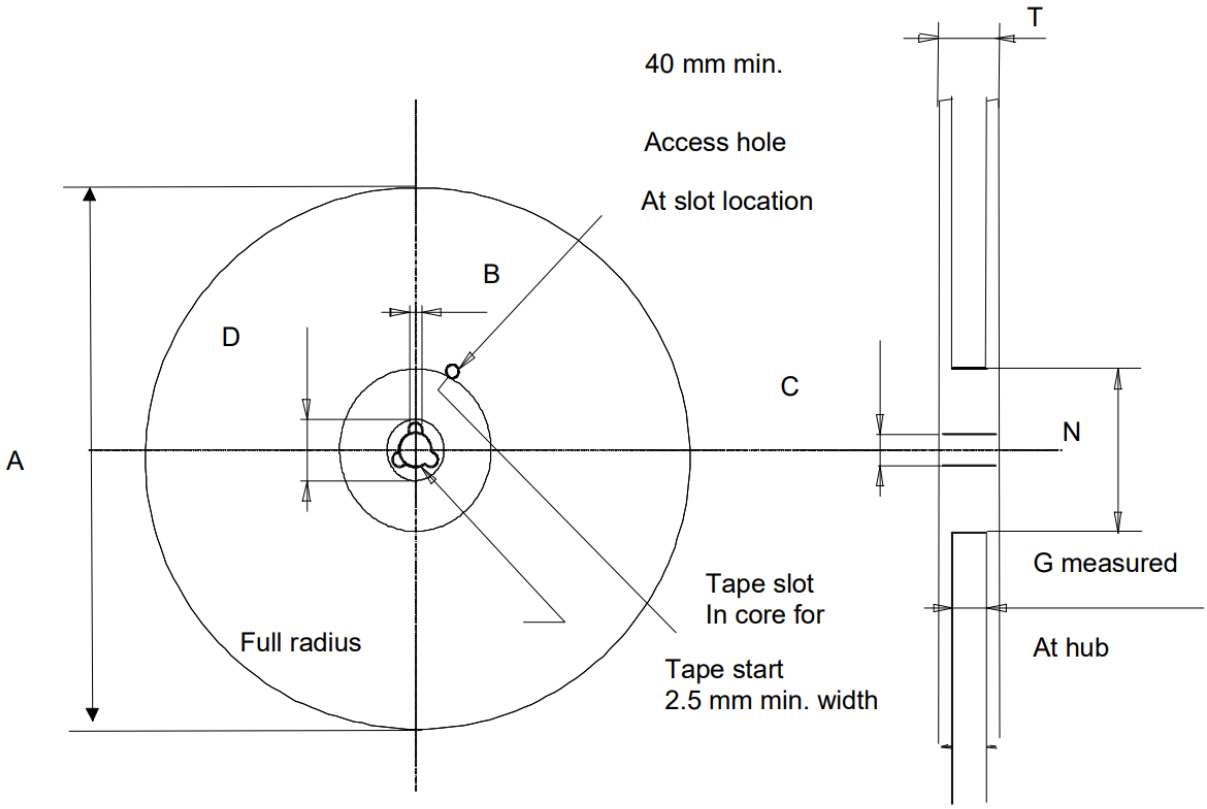
Note: Drawing is not in scale

Table 9. **PowerSO-10 career tape dimension mechanical data**

Dim.	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

Figure 12. **PowerSO-10 reel outline**



Note: Drawing is not in scale

Table 10. **PowerSO-10 reel dimension mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A			330
B	1.5		
C	12.8	13	13.2
D	20.2		
N	60		
G	23.7	24.4	
T			30.4

Note: 10 sprocket hole pitch cumulative tolerance ±0.2 mm

Table 11. **PowerSO-10 base and bulk quantity**

Base quantity	Bulk quantity
600	600

8 Ordering information

Table 12. **Ordering information**

Part Number	Package	Packaging
VN340SP-E	PowerSO-10	Tube
VN340SPTR-E		Tape and reel
VN340SP-33-E		Tube
VN340SPTR-33-E		Tape and reel

Revision history

Table 13. **Document revision history**

Date	Revision	Changes
05-Sep-2005	1	Initial release.
19-Mar-2007	2	Document reformatted, typo in note 1.
22-Aug-2008	3	Updated table 9.
07-Sep-2015	4	Updated the table of absolute maximum ratings.
1-Sep-2022	5	Merged VN340SP-33 and VN340SP DS; some minor changes

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