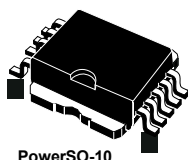


Quad high-side smart power solid-state relay



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

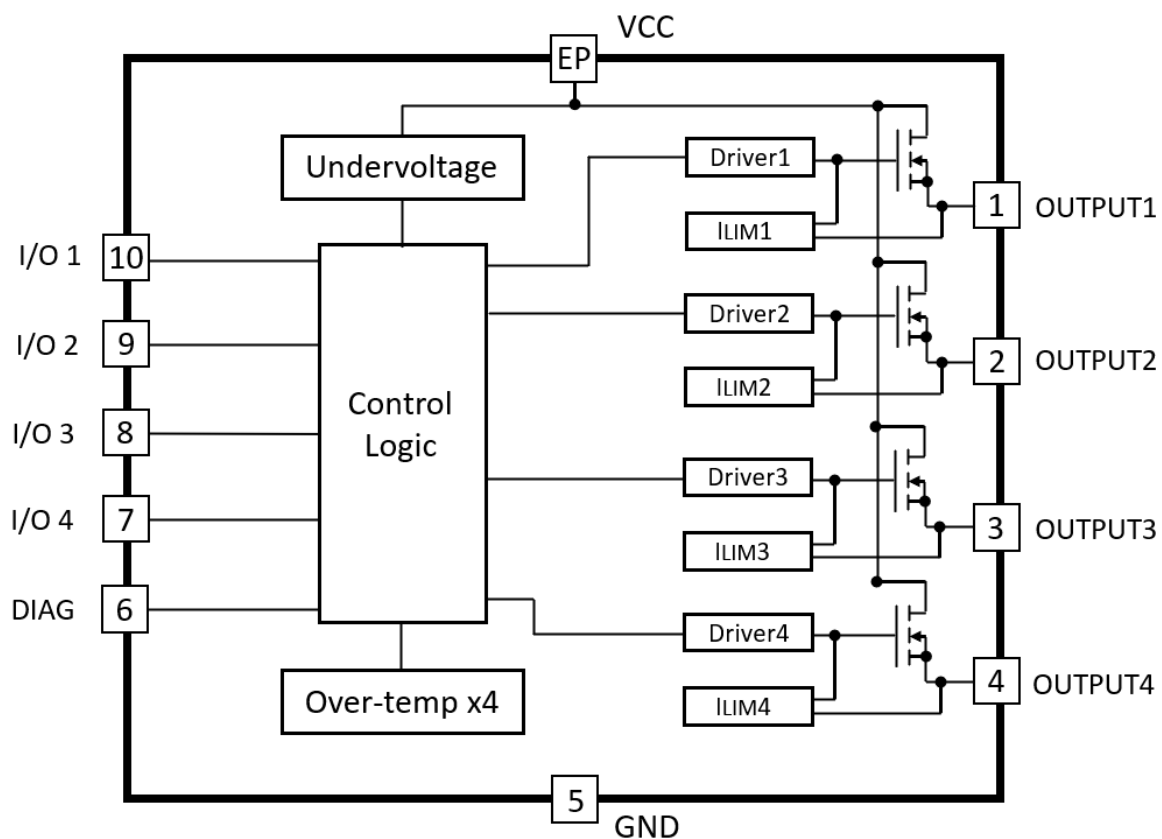
- Vending machines
- Industrial PC peripheral input/output
- Numerical control machines
- General high-side switch applications

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)

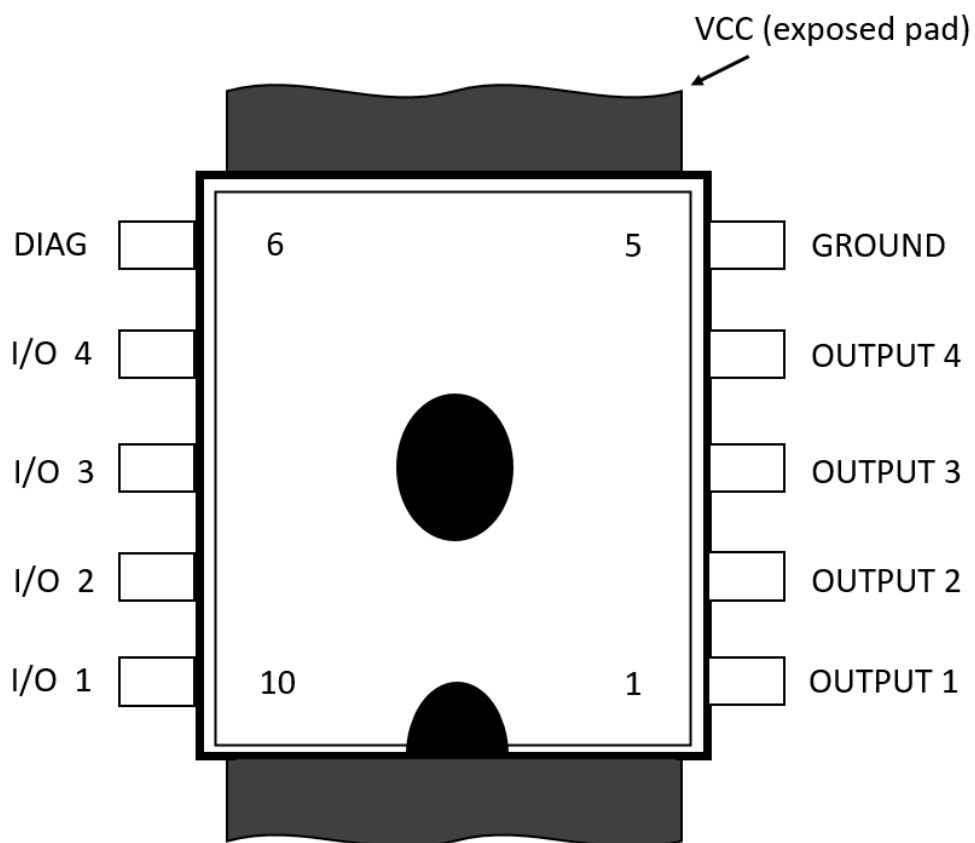
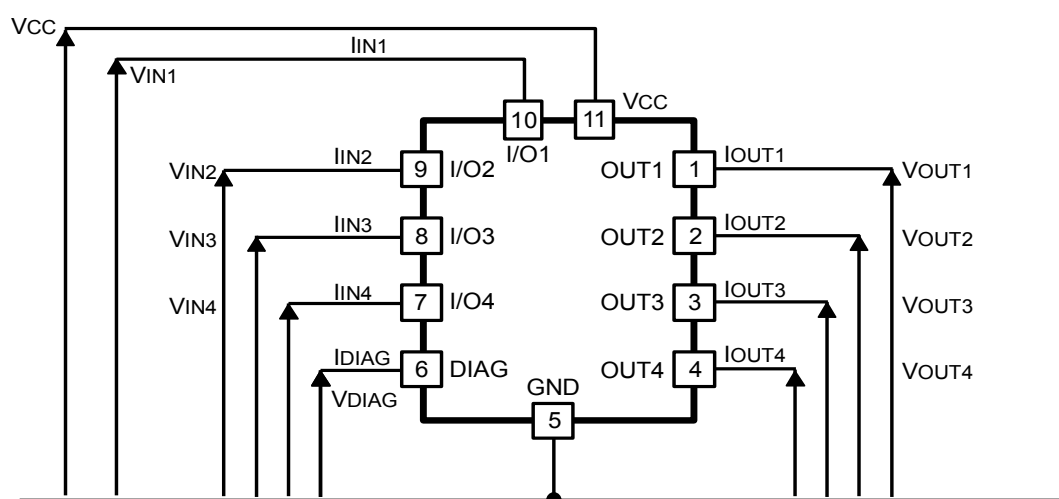


Figure 3. Current and voltage conventions



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

Table 2. Thermal data

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

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	$I_{DIAG} = 5 \text{ mA}$ (fault condition)			1	V
V_{SCL}	Status clamp voltage	$I_{DIAG} = 1 \text{ mA}$	32	36		V
		$I_{DIAG} = -1 \text{ mA}$		-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⁾		2	A
			1 ⁽³⁾			
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}	Junction shutdown temperature		150	170		$^{\circ}\text{C}$
T_R	Junction reset temperature		135	155		$^{\circ}\text{C}$

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

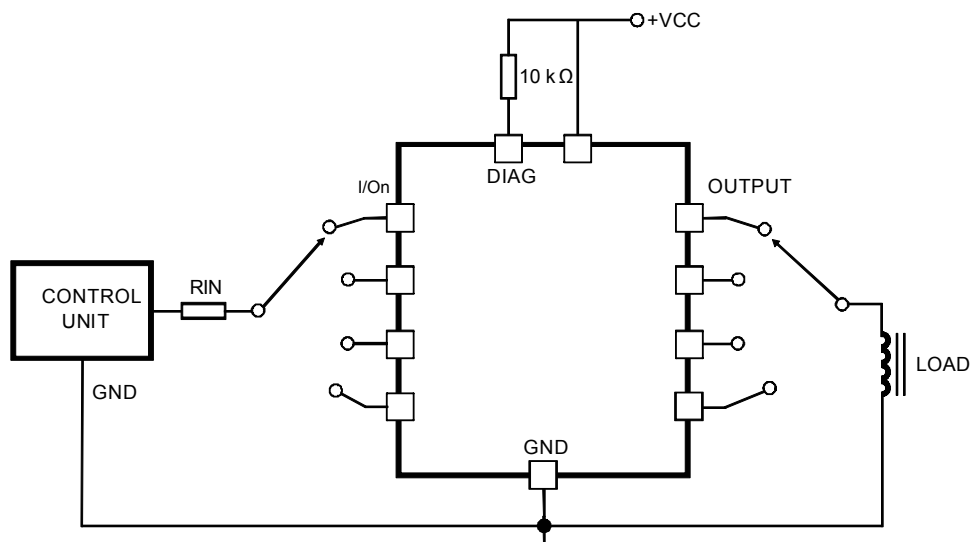


Figure 5. Peak short-circuit test diagram

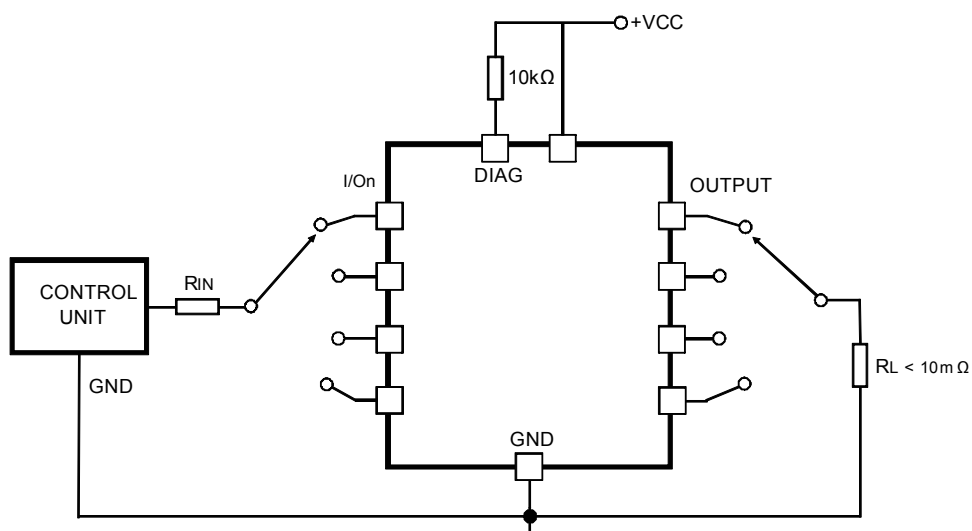
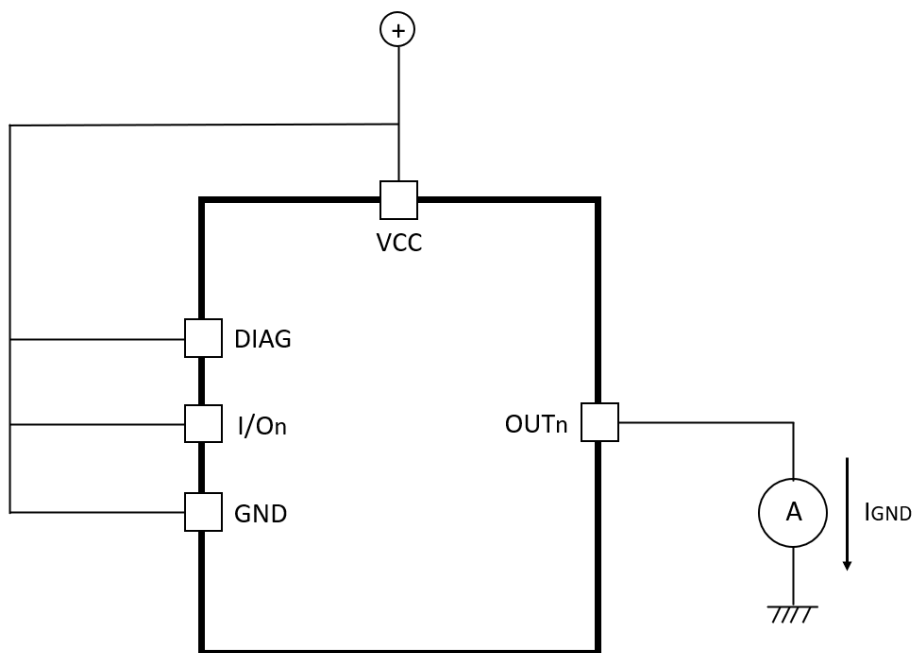


Figure 6. I_{LGND} test configuration


6 Switching time waveforms and truth table

Figure 7. Switching waveforms

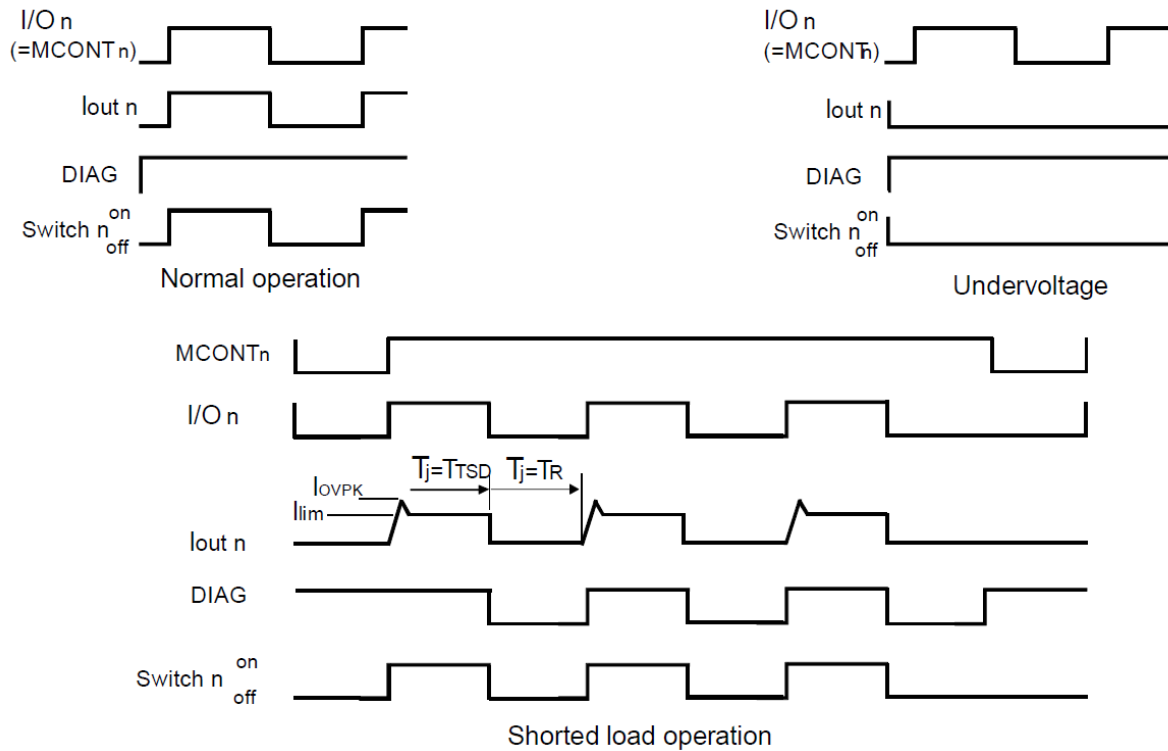


Figure 8. Switching parameter test conditions

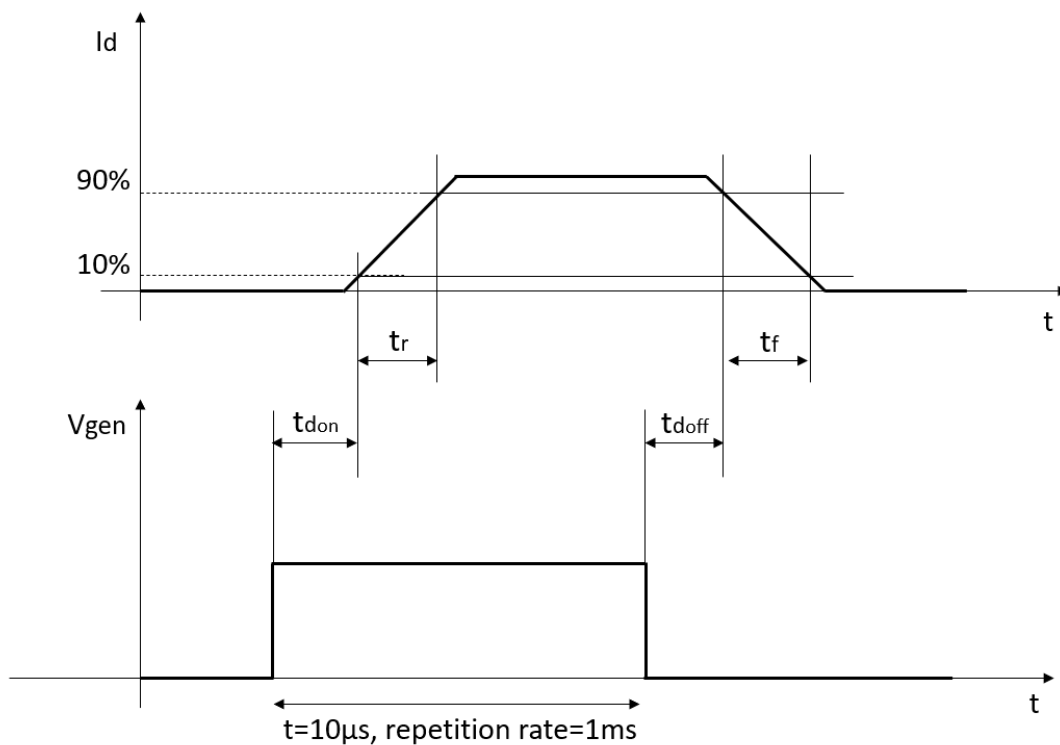
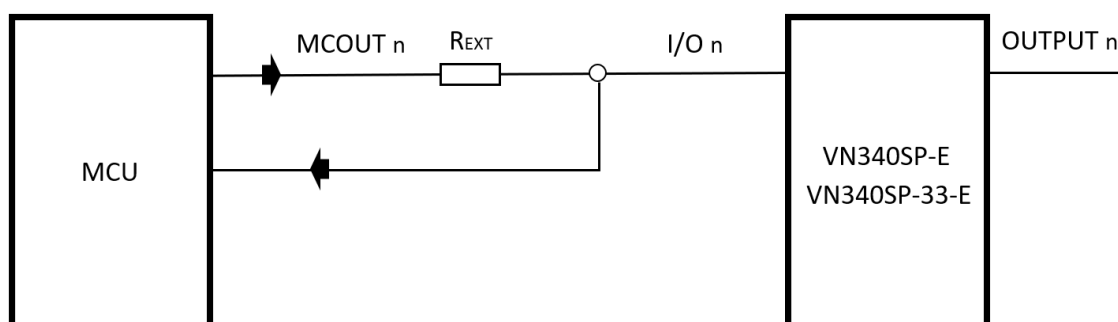


Table 7. Truth table

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/Os are internally pulled-down
- R_EXT is for enhancement of EMI robustness

7

7.1 PowerSO-10 package information

Technical drawing of a 16-pin D-subminiature connector, showing front, side, and detail views with dimensions and feature labels.

Front View (Top): Shows the connector body with 16 pins (8 on each side). Dimensions include $E3$ (body width), $E2$ (total width including pins), and $E1$ (pin pitch). Features include $R1$ (corner radius), $R2$ (pin base radius), and $R3$ (pin tip radius). A detail callout points to the pin base area.

Side View (Bottom): Shows the connector body with 16 pins. Dimensions include $A1$ (body height), $A2$ (pin height), $A3$ (pin base height), $A4$ (pin tip height), $T1$ (pin length), $T2$ (pin base length), and L (pin length). A detail callout points to the pin base area.

Detail View (Right): Shows a close-up of the pin base area. Dimensions include 0.35 (pin base width), T (pin base thickness), and R (pin base radius). A detail callout points to the pin base area.

Other Labels: $LEAD H10$, $LEAD H11$, $LEAD COPLANARITY$, $GAUGE PLANE$, $SEE DETAIL K$, $SEE DETAIL L$, $SEE DETAIL M$, $SEE DETAIL N$, $SEE DETAIL O$, $SEE DETAIL P$, $SEE DETAIL Q$, $SEE DETAIL R$, $SEE DETAIL S$, $SEE DETAIL T$, $SEE DETAIL U$, $SEE DETAIL V$, $SEE DETAIL W$, $SEE DETAIL X$, $SEE DETAIL Y$, $SEE DETAIL Z$, $SEE DETAIL AA$, $SEE DETAIL AB$, $SEE DETAIL AC$, $SEE DETAIL AD$, $SEE DETAIL AE$, $SEE DETAIL AF$, $SEE DETAIL AG$, $SEE DETAIL AH$, $SEE DETAIL AI$, $SEE DETAIL AJ$, $SEE DETAIL AK$, $SEE DETAIL AL$, $SEE DETAIL AM$, $SEE DETAIL AN$, $SEE DETAIL AO$, $SEE DETAIL AP$, $SEE DETAIL AQ$, $SEE DETAIL AR$, $SEE DETAIL AS$, $SEE DETAIL AT$, $SEE DETAIL AU$, $SEE DETAIL AV$, $SEE DETAIL AW$, $SEE DETAIL AX$, $SEE DETAIL AY$, $SEE DETAIL AZ$, $SEE DETAIL BA$, $SEE DETAIL BB$, $SEE DETAIL BC$, $SEE DETAIL BD$, $SEE DETAIL BE$, $SEE DETAIL BF$, $SEE DETAIL BG$, $SEE DETAIL BH$, $SEE DETAIL BI$, $SEE DETAIL BJ$, $SEE DETAIL BK$, $SEE DETAIL BL$, $SEE DETAIL BM$, $SEE 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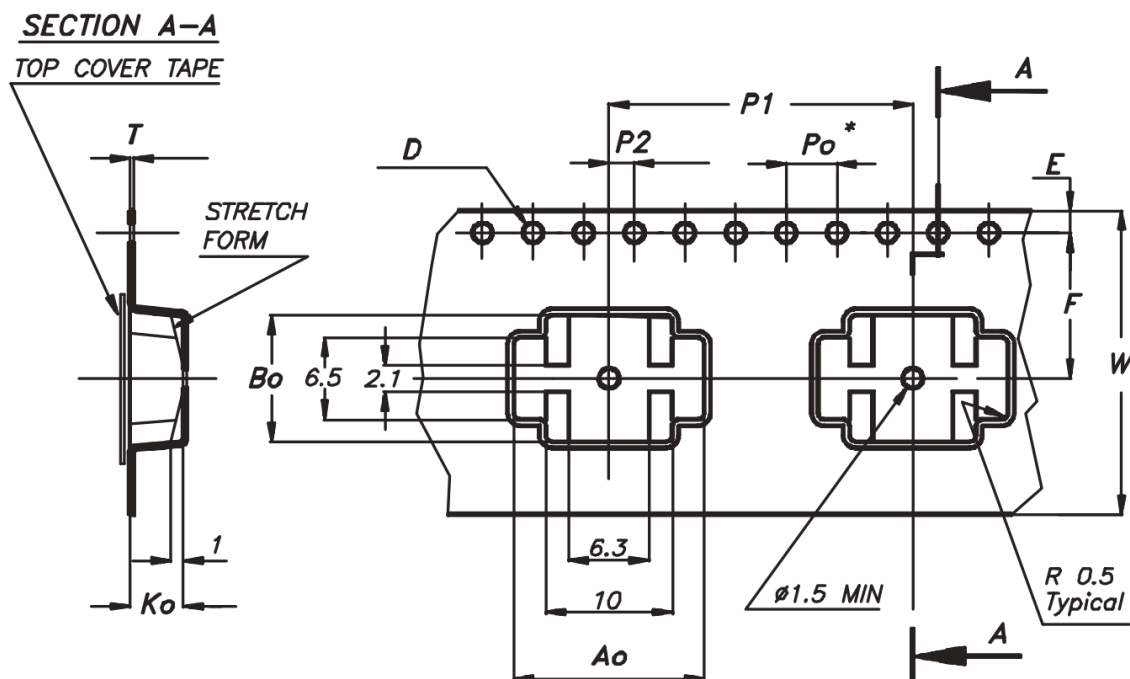
Table 8. PowerSO-10 package mechanical data

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

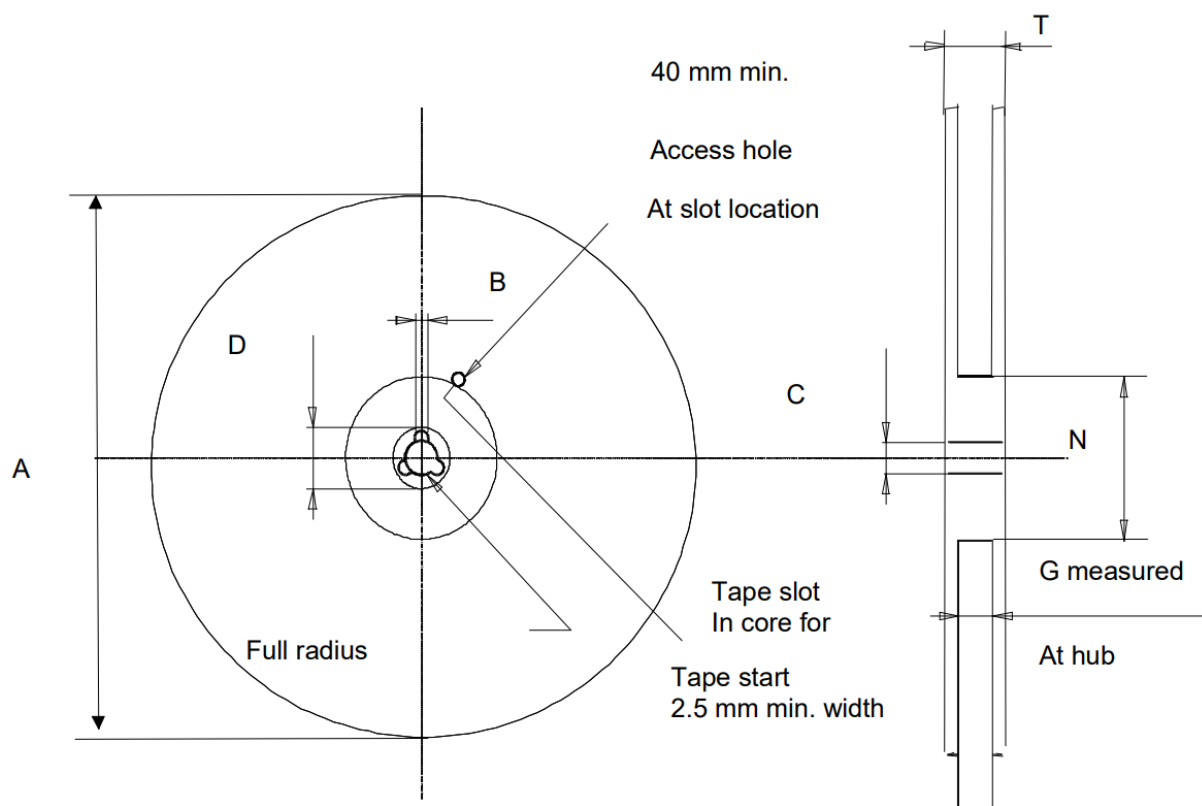


Note: Drawing is not in scale

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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