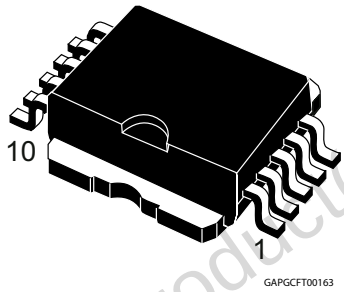
VBG15NB22T5SP-E

Ignition coil driver

Type	V_{cl}	I_{cl}	V_{CEsat}
VBG15NB22T5SP-E	250 V(1)	21 A(1)	1.7 V(1)

1. Typical value



PowerSO-10

Features

- ECOPACK®: lead free and RoHS compliant
- Automotive Grade: compliance with AEC guidelines
- Low threshold voltage
- Low on-voltage drop
- Coil current limit internally set
- High voltage clamping feature
- ESD protection
- Timing function externally set with
- Soft switch-off

Description

The VBG15NB22T5SP-E is an ignition coil driver made by using the latest high voltage Powermesh™ technology based on patented strip lay-out.

The device is particularly suitable in high performance car ignition, where coil current limitation and precise voltage clamping are required with no external component. ESD is an additional inherent features.

Table 1. Device summary

Package	Order code	
	Tube	Tape and reel
PowerSO-10	VBG15NB22T5SP-E	VBG15NB22T5TR-E

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1 Block diagram and pins connection

Figure 1. Block diagram

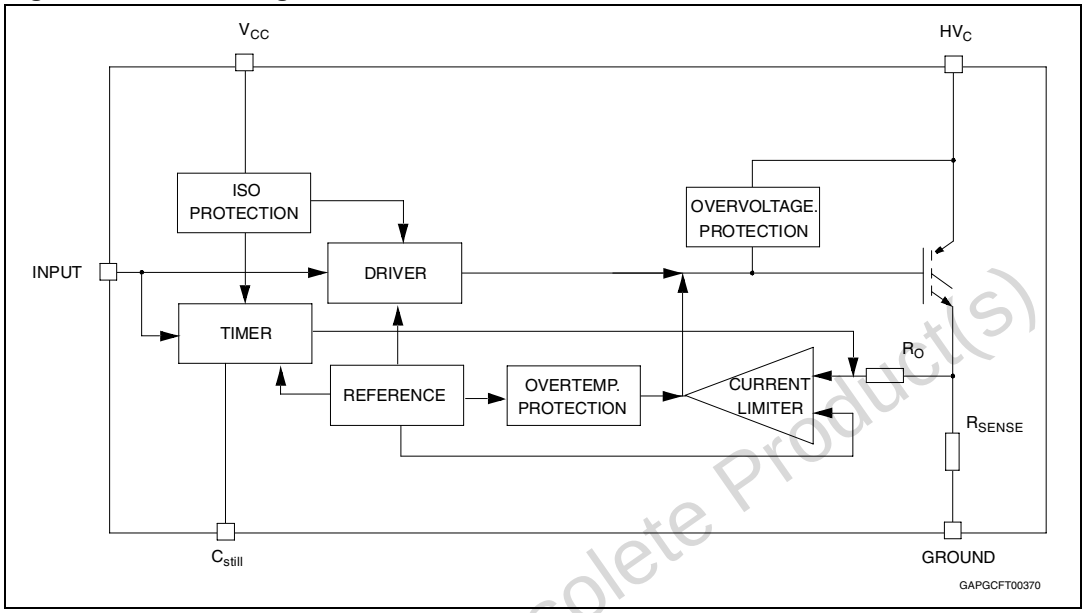
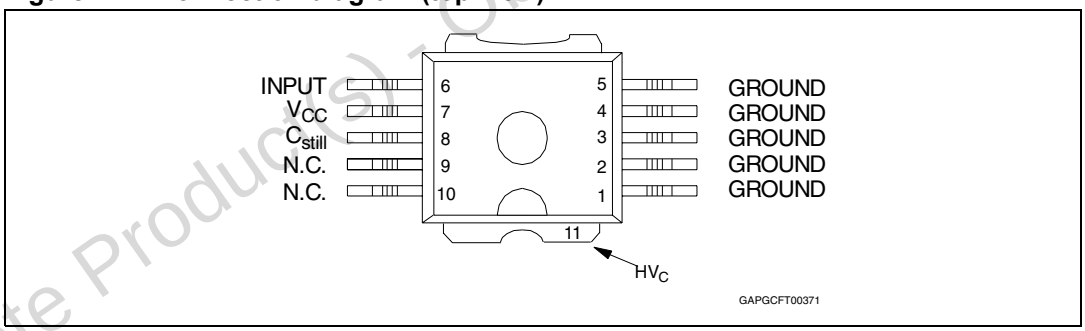


Figure 2. Connection diagram (top view)



2 Electrical specifications

2.1 Absolute maximum ratings

Stressing the device above the rating listed in the *Table 2: Absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE program and other relevant quality documents.

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-Emitter voltage	Clamped	V
V_{IN}	Input voltage	-16 to 18	V
V_{CC}	Maximum supply voltage	24	V
I_C	Collector current (continuous)	Internally limited	A
P_{tot}	Total dissipation at T_{case} = 25 °C	125	W
V_{ESD}	Electrostatic discharge (R = 1.5 KΩ; C = 100 pF)	2000	V
T_j	Operating junction temperature	-40 to 175	°C
T_{stg}	Storage temperature	-40 to 175	°C
V_{CC-GND}	Pulsed V_{CC} to ground voltage (t_p = 50 µs; V_{CC} - GND)	40	V
V_{CC-HVc}	Pulsed V_{CC} to HV_C voltage (t_p = 50 µs; V_{CC} - HV_C)	40	V

2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case (MAX)	1	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient (MAX)	50	°C/W

2.3 Functional characteristics

Table 4. Functional characteristics

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
E_{as}	Avalanche energy	T_j = 150 °C			250	mJ
V_{CC}	DC supply voltage		5.2		24	V

2.4 Electrical characteristics

T_j = 25 °C; V_{CC} = 14 V; L = 1 mH; R_L = 100 mΩ unless otherwise specified.

Table 5. Electrical characteristics

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
OFF						
V_{cl}	Clamp voltage	I_C = 15 A; V_{IN} = 0 V; T_j = -40 to 150 °C	225	250	275	V
I_S	Supply current (V_{CC})	V_{bat} = 16 V; V_{IN} = 0 V; T_j = -40 to 150 °C (see *Figure 3*)			10	mA
I_{CES}	Collector-emitter leakage current	V_{CE} = 175 V; V_{IN} = 0 V; V_{CC} = 0 V			40	µA
		V_{CE} = 175 V; V_{IN} = 0 V; T_j = 150 °C; V_{CC} = 0 V			200	µA
ON(1)						
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{IN} = 3 V; I_C = 15 A; -40 °C < T_j < 150 °C			2.5	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{IN} = 3V; I_C = 10A; -40 °C < T_j < 150 °C; V_{bat} = 6 V (See figure 1)			2.2	V
V_{IN}	Input voltage	I_{IN} = 5 mA; -40 °C < T_j < 150 °C	3			V
		I_{IN} = 10 mA; -40 °C < T_j < 150 °C			4.2	V
$V_{IN(on)}$	Input voltage on	-40 °C < T_j < 150 °C	3			V
$V_{IN(off)}$	Input voltage off	-40 °C < T_j < 150 °C			1.5	V
Dynamic						
C_{OES}	Output capacitance	V_{CE} = 25 V; f = 1 MHz		125		pF
Switching on						
$t_{d(on)}$	Turn-on delay time	From input signal to $V_{CE(sat)}$ = 3 V		2.7		µs
E_{on}	Turn-on switching losses			180		µJ
Switching off						
$t_{d(off)}$	Off voltage delay time	I_C = 15 A; V_{CE} = 100 V; T_{case} = 25 °C	5		15	µs
E_{off}(2)	Turn-off switching losses			7.5		mJ
$t_{d(off)}$	Off voltage delay time	I_C = 15A; V_{CE} = 100 V: T_{case} = 125 °C	5		15	µs
E_{off}(2)	Turn-off switching losses			10		mJ
t_r	Voltage rise time	From V_{CE} = 50 V to V_{CE} = 150 V			3	µs
Protection						
I_{cl}	Coil current limit	V_{IN} = 3 V; 10 V < V_{CC} < 24 V	17		25	A

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
Timing function						
t_{still}	Capacitor charging time	C_{still} = 100 nF; 100 < T_j < 175 °C	(3)(see *Figure 3*, *Figure 4*, *Figure 5*)			ms
dI_c/dt	Turn-off current slope	C_{still} = 100 nF	0.1		2	A/ms

1. Pulsed: pulse duration = 300 µs; duty cycle = 1.5 %
2. Losses include also the tail (Jedec Standardization)
3. The function is guaranteed by design to be operative in full temperature range.

Figure 3. Typical application circuit

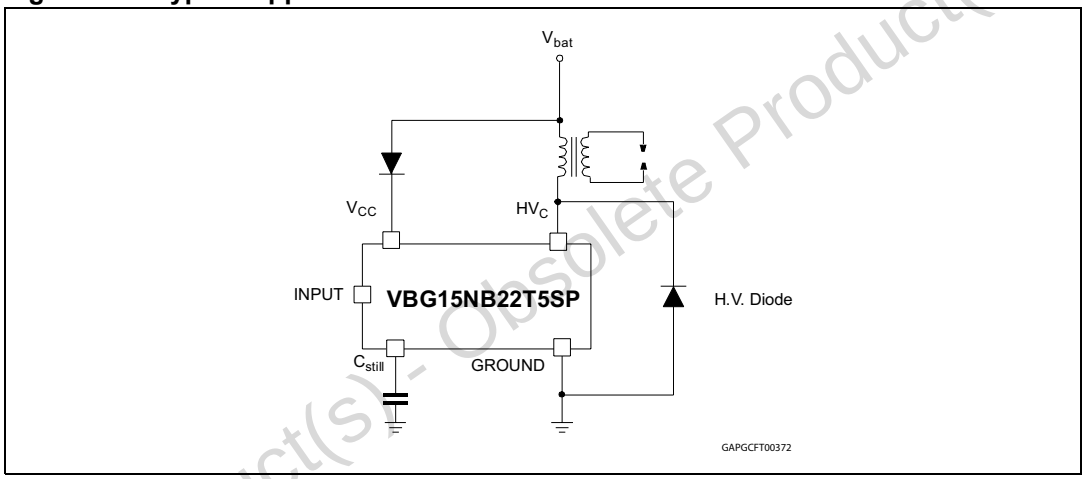


Figure 4. t_{still} definition

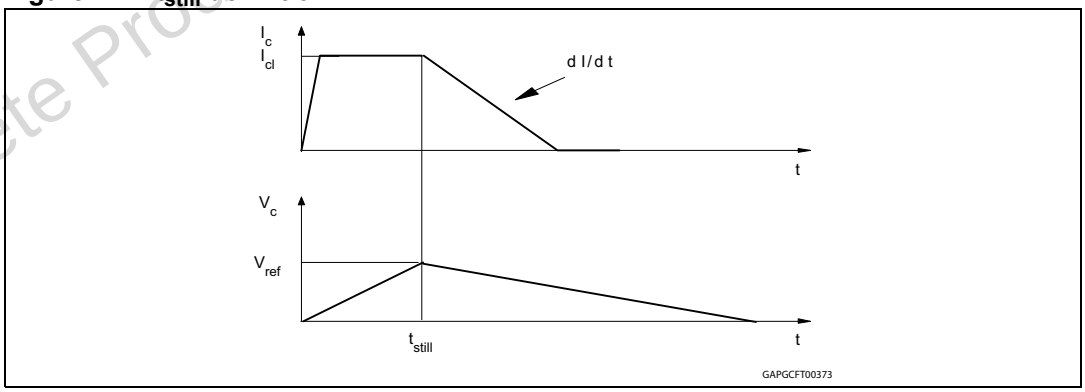


Figure 5. t_{still} specification

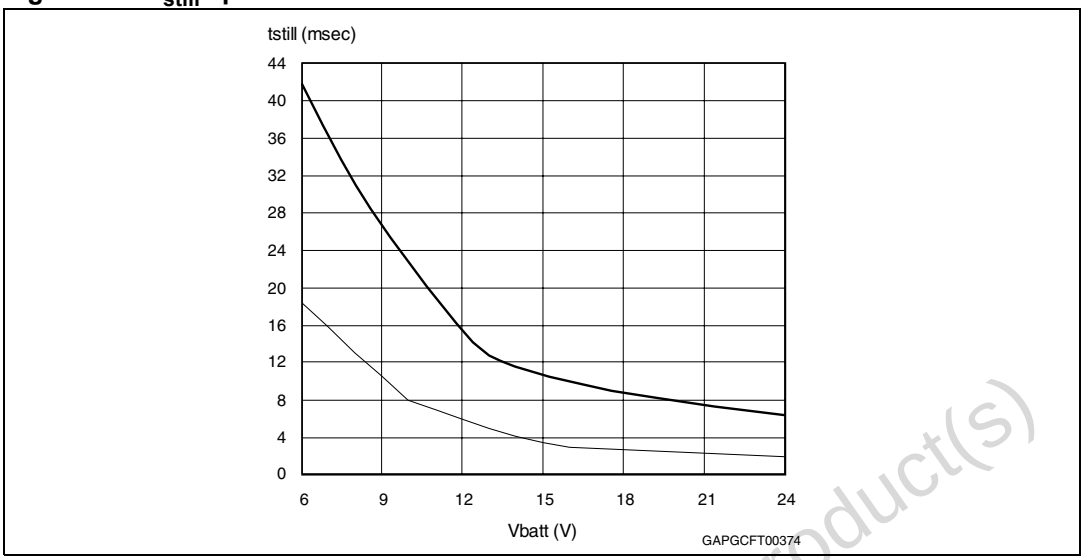


Table 6. Electrical transient requirements on V_{CC} pin(1) (part 1/3)

ISO T/R 7637/1 Test pulse	Test levels				
	I	II	III	IV	Delay and impedance
1	-25V	-50V	-75V	-100V	2ms, 10Ω
2	25V	50V	75V	100V	0.2ms, 10Ω
3a	-25V	-50V	-100V	-150V	0.1µs, 50Ω
3b	25V	50V	75V	100V	0.1µs, 50Ω
4	-4V	-5V	-6V	-7V	100ms, 0.01Ω
5	26.5V	46.5V	66.5V	86.5V	400ms, 2Ω

1. See *Figure 6*, V_{bat} = 12 V.

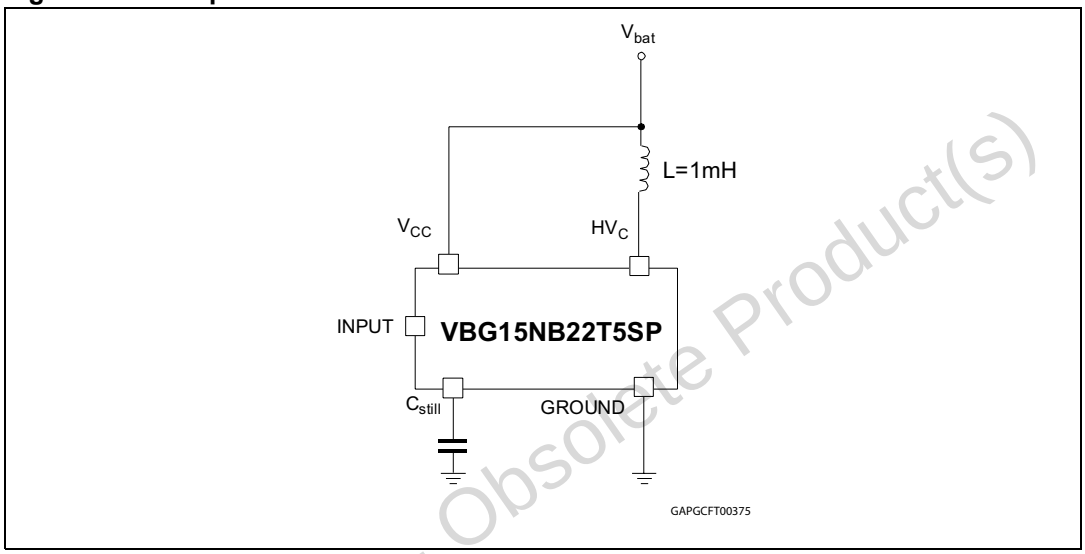
Table 7. Electrical transient requirements on V_{CC} pin (part 2/3)

ISO T/R 7637/1 Test pulse	Test level results				
	I	II	III	IV	Delay and impedance
1	C	C	E	E	2ms, 10Ω
2	C	E	E	E	0.2ms, 10Ω
3a	C	C	C	C	0.1µs, 50Ω
3b	C	C	C	C	0.1µs, 50Ω
4	C	E	C	C	100ms, 0.01Ω
5	C	C	E	E	400ms, 2Ω

Table 8. Electrical transient requirements on V_{CC} pin (part 3/3)

Class	Contents
C	All functions of the device performed as designed after exposure to disturbance.
E	One or more functions of the device did not perform as designed after exposure to disturbance and cannot be returned to proper operation without replacing the device.

Figure 6. ISO pulses test circuit



2.5 Timer block function

The VBG15NB22T5SP-E has a timer block built-in (see *Figure 8*), in order to have a soft switch-off of the device. When an input signal is provided to the device (see *Figure 7*, case a), the external capacitor starts its charging through the Switch1 (with a slope depending on V_{CC}) and goes on until it reaches the V_{ref} voltage (see *Figure 7*, case b). As soon as it happens, the voltage comparator gives an enable signal (see *Figure 7*, case c) that develops different functions:

- It opens Switch1 and closes Switch2, so that the external capacitor discharges.
- It provides power to the transconductance inverting amplifier, the input of which is theexternal capacitor voltage.

It means that while V_C decreases, I_{timer} (see *Figure 7*, case d) increases proportionally. The increasing drop voltage on R_O, due to I_{timer}, has to be compensated by a reducing drop voltage on R_{SENSE}, so to maintain the A input voltage equal to the B one. Since the R_{SENSE} drop depends on the coil current, it means that a soft decreasing of it occurs (see *Figure 7*, case e).

Figure 7. Typical waveforms

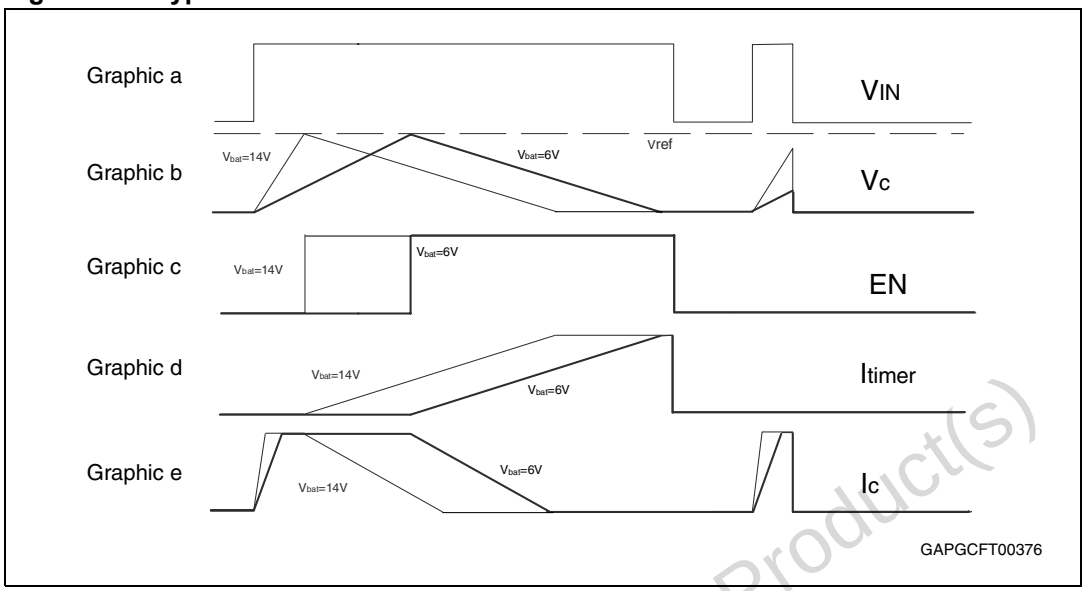
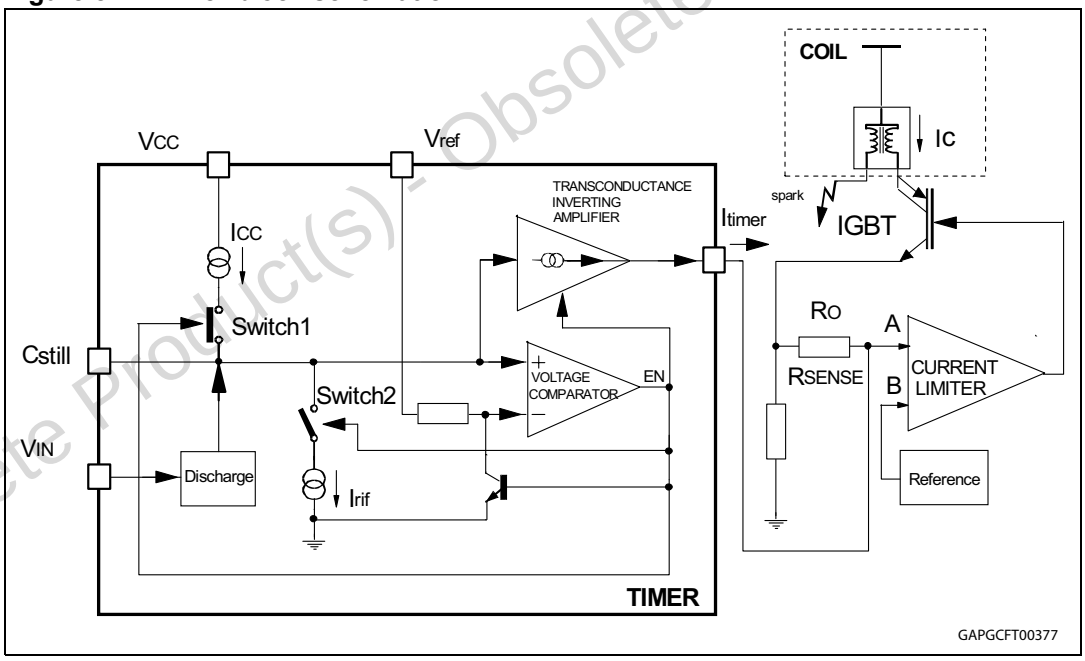


Figure 8. Timer block schematic



3 Package and packing information

3.1 ECOPACK®

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.

3.2 PowerSO-10 mechanical data

Figure 9. PowerSO-10 package dimensions

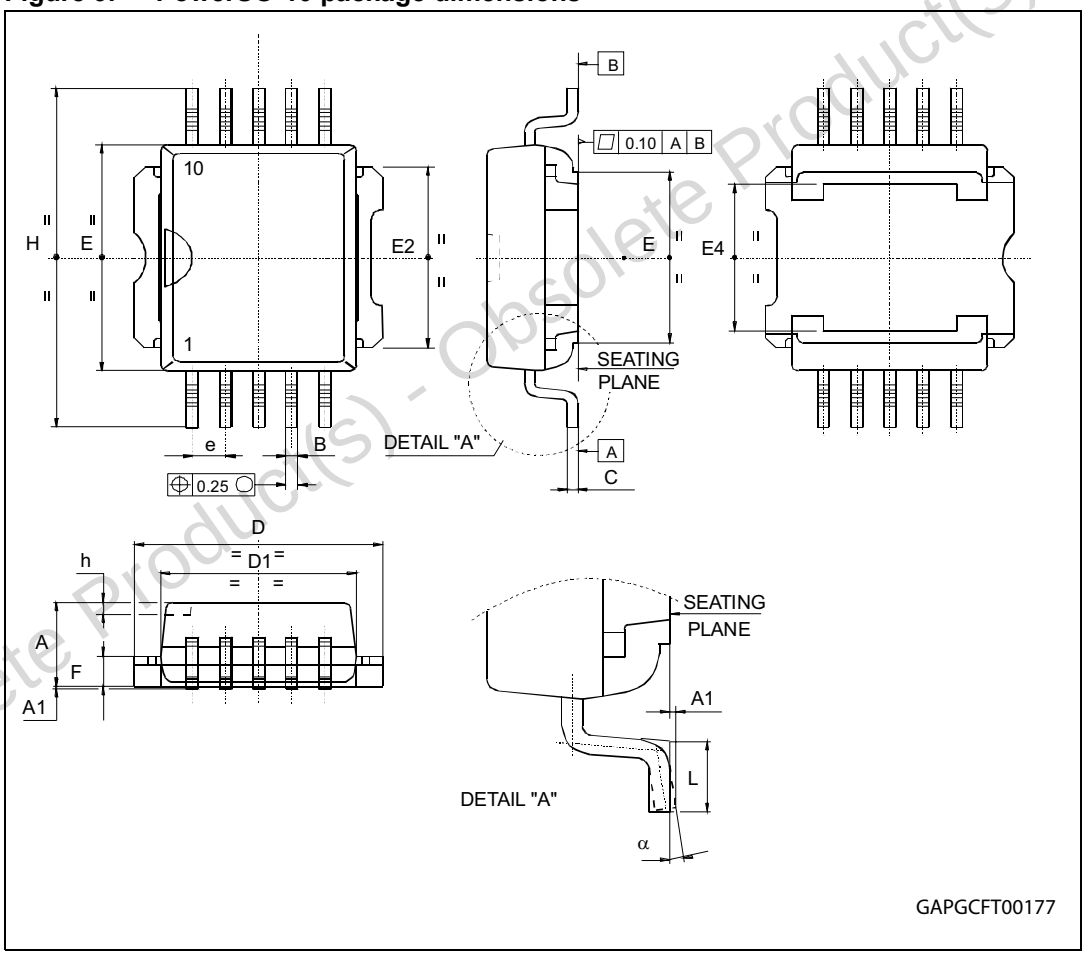


Table 9. PowerSO-10 mechanical data

Dim.	mm.			inch		
	Min.	Typ	Max.	Min.	Typ.	Max.
A	3.35		3.65	0.132		0.144
A(1)	3.4		3.6	0.134		0.142
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
B(1)	0.37		0.53	0.014		0.021
C	0.35		0.55	0.013		0.022
C(1)	0.23		0.32	0.009		0.0126
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E2	7.20		7.60	0.283		0.299
E2(1)	7.30		7.50	0.287		0.295
E4	5.90		6.10	0.232		0.240
E4(1)	5.90		6.30	0.232		0.248
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
F(1)	1.20		1.40	0.047		0.055
H	13.80		14.40	0.543		0.567
H(1)	13.85		14.35	0.545		0.565
h		0.50			0.002	
L	1.20		1.80	0.047		0.070
L(1)	0.80		1.10	0.031		0.043
α	0°		8°	0°		8°
α(1)	2°		8°	2°		8°

1. Muar only POA P013P.

3.3 PowerSO-10 packing information

Figure 10. PowerSO-10 suggested PAD layout

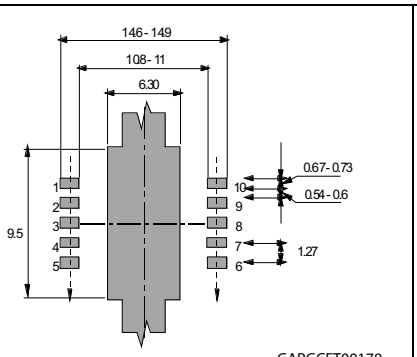
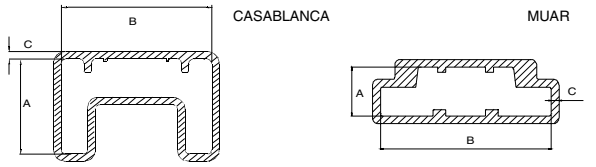


Figure 11. PowerSO-10 tube shipment (no suffix)



All dimensions are in mm.

	Base Q.ty	Bulk Q.ty	Tube length (± 0.5)	A	B	C (± 0.1)
Casablanca	50	1000	532	10.4	16.4	0.8
Muar	50	1000	532	4.9	17.2	0.8

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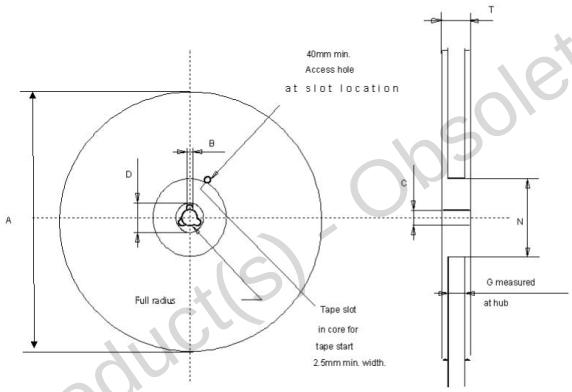
Figure 12. PowerSO-10 tape and reel shipment (suffix "13TR")



REEL DIMENSIONS

Base Q.ty	600
Bulk Q.ty	600
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	24.4
N (min)	60
T (max)	30.4

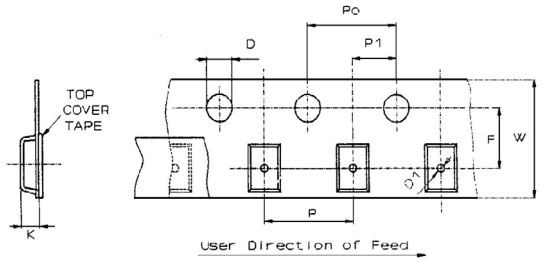
All dimensions are in mm.

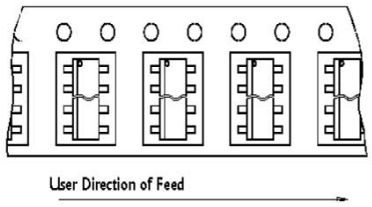
TAPE DIMENSIONS

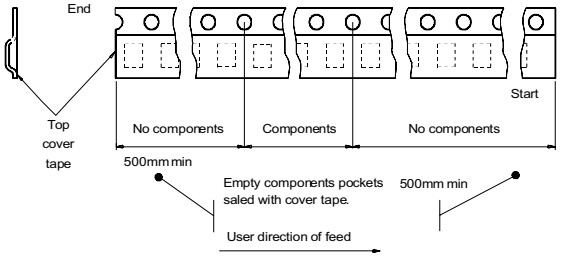
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	24
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	24
Hole Diameter	**D (± 0.1/-0)**	1.5
Hole Diameter	**D1 (min)**	1.5
Hole Position	**F (± 0.05)**	11.5
Compartment Depth	**K (max)**	6.5
Hole Spacing	**P1 (± 0.1)**	2

All dimensions are in mm.







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4 Revision history

Table 10. Document revision history

Date	Revision	Changes
20-May-2011	1	Initial release.

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