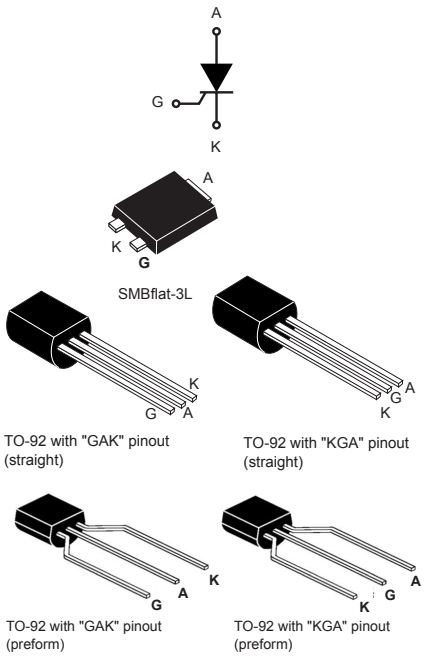
TS110-8S

Datasheet

High surge voltage 1.25 A SCR for circuit breaker



Features

- On-state rms current, $I_{T(RMS)}$ 1.25 A
- Repetitive peak off-state voltage, $V_{DRM/VRRM}$, 800 V
- Non-repetitive direct surge peak off-state voltage, 1250 V
- Non-repetitive reverse surge peak off-state voltage, 900 V
- Triggering gate current, $I_{GT\ (Q1)}$ 100 µA
- High off-state immunity: 200 V/µs
- ECOPACK2 compliant component

Applications

- GFCI (ground fault circuit interrupters)
- AFCI (arc fault circuit interrupters)
- RCD (residual current device)
- RCBO (residual current circuit breaker with overload protection)
- AFDD (arc fault detection device)

Description

Thanks to highly sensitive triggering levels, the TS110-8S series is suitable for circuit breaker applications where the available gate current is limited.

The 1250 V direct surge voltage capability of the TS110-8S enables high robustness of the whole circuit breaker. The low leakage current of the TS110-8S reduces power consumption over the entire lifetime of the circuit breaker. The high off-state immunity (200 V/µs) insures the non tripping of the breaker in case of electrical fast transient (EFT) on the mains.

The TS110-8S is available in through-hole TO-92 package with GAK and KGA pinout and in SMBflat-3L.

Product status
Custom

Product summary	
$I_{T(RMS)}$	1.25 A
V_{DRM} / V_{RRM}	800 V
V_{DSM} / V_{RSM}	1250 V, 900 V
I_{GT} standard	100 µA
T_j	125 °C

1 Characteristics

Table 1. Absolute ratings (limiting values, T_J = 25 °C unless otherwise specified)

Symbol	Parameters			Value	Unit
$I_{T(RMS)}$	RMS on-state current (180 ° conduction angle)	TO-92	T_L = 53 °C	1.25	A
		SMBflat-3L	T_{tab} = 109 °C		
$I_{T(AV)}$	Average on-state current (180 ° conduction angle)	TO-92	T_L = 53 °C	0.8	A
		SMBflat-3L	T_{tab} = 109 °C		
I_{TSM}	Non repetitive surge peak on-state current	t_p = 8.3 ms	T_j initial = 25 °C	21	A
		t_p = 10 ms		20	
	1st step: one surge every 5 seconds, 25 surges	tp = 10 ms	T_{amb} = 90 °C	25 times 12 A	
	2nd step: one surge every 5 seconds, 25 surges			25 times 16 A	
I^2t	I^2t value for fusing	t_p = 10 ms	T_j = 25 °C	2	A^2s
dI/dt	Critical rate of rise of on-state current I_G = 2 x I_{GT} , t_r ≤ 100 ns	F = 50 Hz	T_j = 125 °C	100	A/µs
	Non repetitive critical current rate of rise at break-over, see Figure 2, V_D > V_{DSM}			200	
V_{DRM}, V_{RRM}	Repetitive peak off-state AC voltage, R_{GK} = 220 Ω		T_j = 125 °C	800	V
V_{DSM}	Non-repetitive direct surge peak off-state voltage, R_{GK} = 220 Ω	t_p = 10 ms	T_j = 25 °C	1250	V
V_{RSM}	Non-repetitive reverse surge peak off-state voltage, R_{GK} = 220 Ω	t_p = 10 ms	T_j = 25 °C	900	V
I_{GM}	Peak gate current	t_p = 20 µs	T_j = 125 °C	1.2	A
$P_{G(AV)}$	Average gate power dissipation		T_j = 125 °C	0.2	W
T_{stg}	Storage junction temperature range			-40 to +150	°C
T_j	Operating junction temperature range			-40 to +125	°C

Table 2. Electrical characteristics (T_j = 25 °C, unless otherwise specified)

Symbol	Parameters			Value	Unit
I_{GT}(1)	V_D = 12 V, R_L = 140 Ω	T_j = 25 °C	Min.	1	µA
			Max.	100	
V_{GT}		T_j = 125 °C	Max.	0.8	V
I_{GT}	V_D = 280 V, R_L = 4 kΩ	T_j = -25 °C	Max.	160	µA
		T_j = -40 °C	Max.	290	µA
V_{GD}	V_D = V_{DRM}, R_L = 33 kΩ, R_{GK} = 220 Ω	T_j = 125 °C	Min.	0.1	V
V_{RG}	I_{RG} = 2 mA	T_j = 25 °C	Min.	7.5	V
I_H(2)	I_T = 50 mA, R_{GK} = 220 Ω	T_j = 25 °C	Max.	12	mA
I_L	I_G = 5 mA, R_{GK} = 220 Ω	T_j = 25 °C	Max.	12	mA
dV/dt(2)	V_D = 67 % V_{DRM}, R_{GK} = 220 Ω	T_j = 125 °C	Min.	200	V/µs

1. *Minimum I_{GT} is guaranteed at 5 % of I_{GT} max.*
2. *For both polarities of A2 referenced to A1*

Table 3. Static electrical characteristics

Symbol	Test conditions			Value	Unit
V_{TM}(1)	I_{TM} = 2.5 A, t_p = 380 µs	T_j = 25 °C	Max.	1.6	V
V_{TO}(1)	Threshold on-state voltage	T_j =125 °C	Max.	0.95	V
R_d	Dynamic resistance	T_j =125 °C	Max.	220	mΩ
I_{DRM},I_{RRM}	V_{DRM} = V_{RRM}, R_{GK} = 220 Ω	T_j =25 °C	Max.	1	µA
		T_j =125 °C		100	µA

1. *For both polarities of A2 referenced to A1*

Table 4. Thermal resistance

Symbol	Parameters		Max. value	Unit
$R_{th(j-l)}$	Junction to lead (DC)	TO-92	65	°C/W
$R_{th(j-a)}$	Junction to ambient (DC)	TO-92	160	
		SMBflat-3L	75	
$R_{th(j-c)}$	Junction to case (S(1) = 5 cm²)	SMBflat-3L	14	

1. *Copper surface under tab.*

1.1 Characteristics (curves)

Figure 1. Maximum average power dissipation versus average on-state current

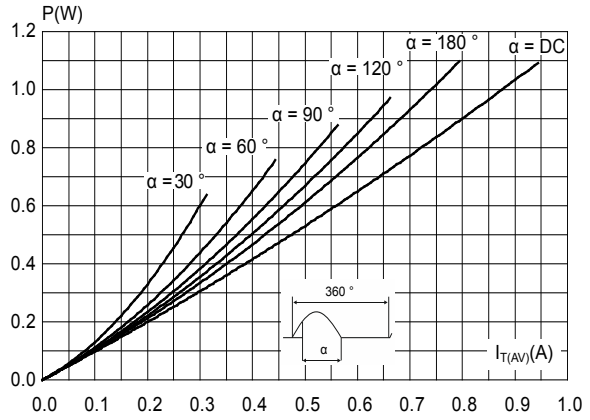


Figure 2. Average and DC on-state current versus lead temperature (TO-92)

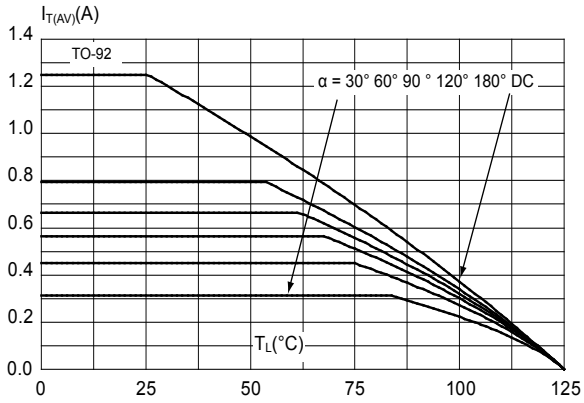


Figure 3. Average and DC on-state current versus case temperature (SMBflat-3L)

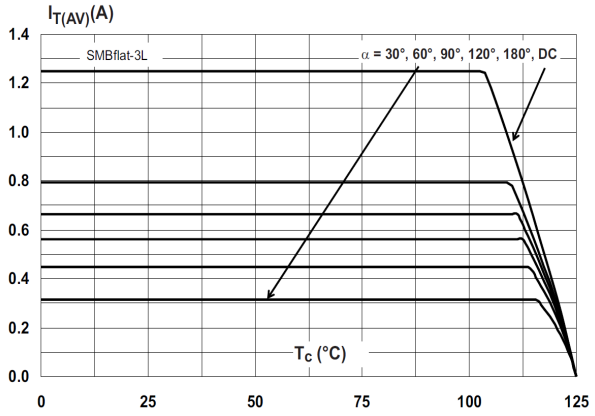


Figure 4. Average and DC on-state current versus ambient temperature

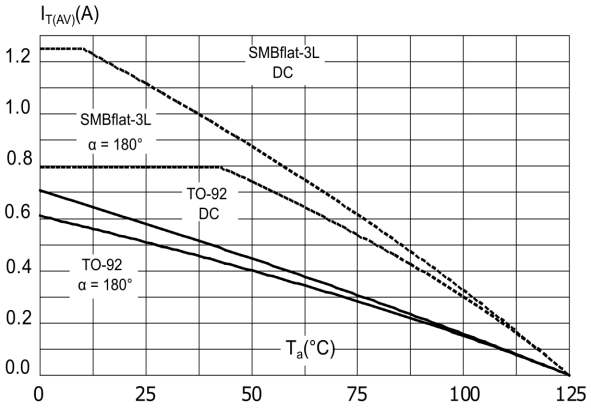


Figure 5. Relative variation of thermal impedance junction to ambient versus pulse duration

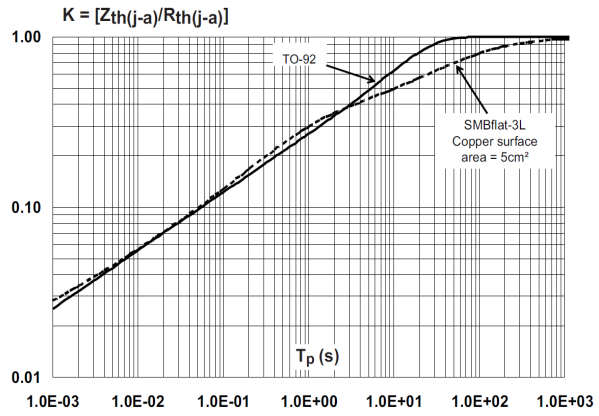


Figure 6. Relative variation of gate trigger current and trigger voltage versus junction temperature (typical values)

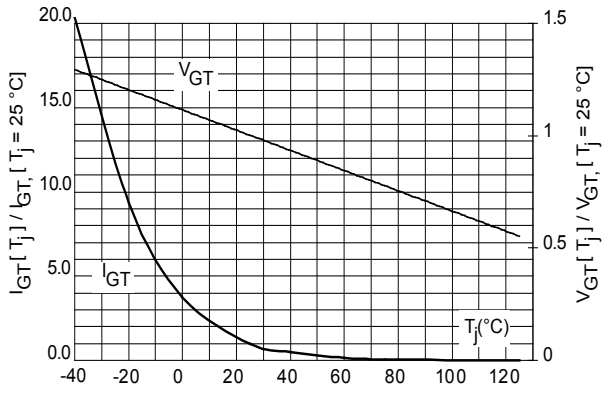


Figure 7. Relative variation of latching and holding current versus junction temperature (typical values)

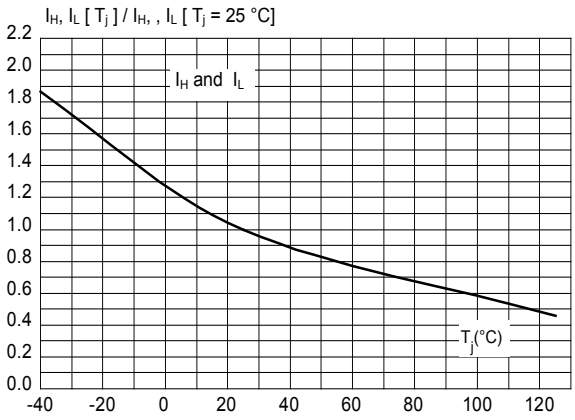


Figure 8. Relative variation of holding current versus gate-cathode resistance (typical values)

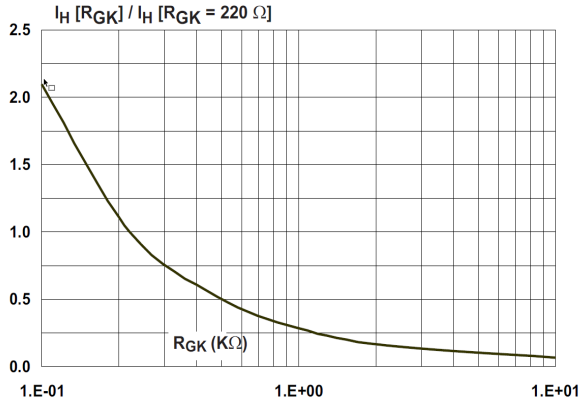


Figure 9. Relative variation of dV/dt immunity versus junction temperature (typical values)

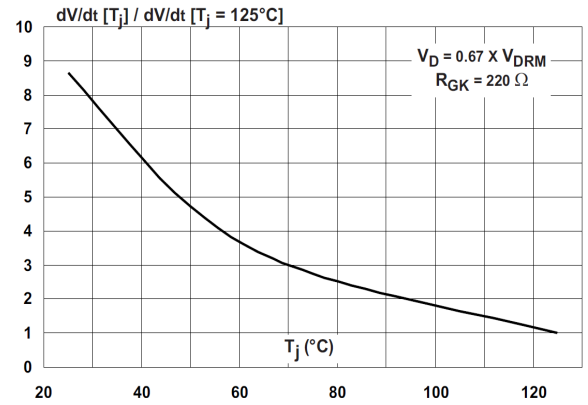


Figure 10. Relative variation of dV/dt immunity versus gate-cathode resistance (typical values)

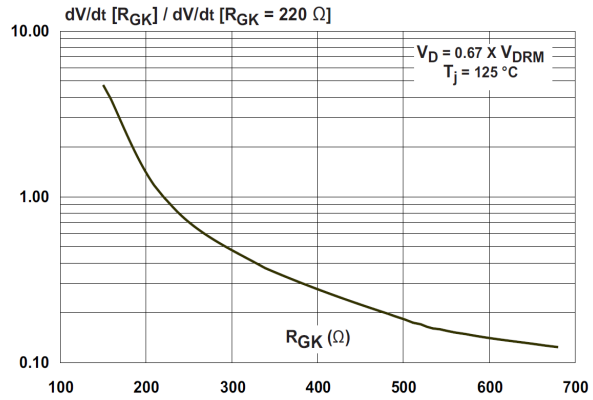


Figure 11. Relative variation of dV/dt immunity versus gate-cathode capacitor (typical values)

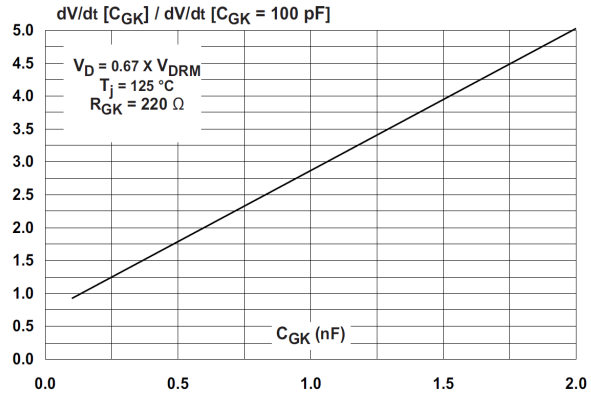


Figure 12. On-state characteristics (maximum values)

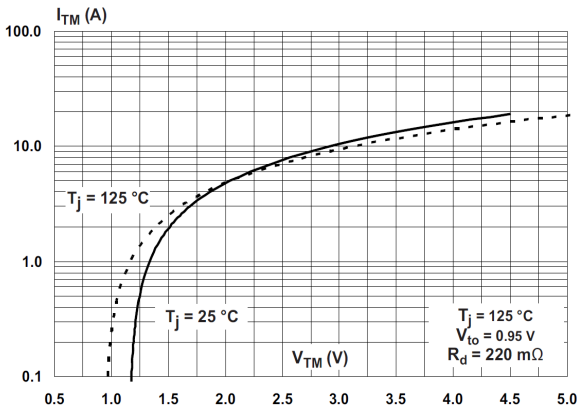


Figure 13. Surge peak on-state current versus number of cycles

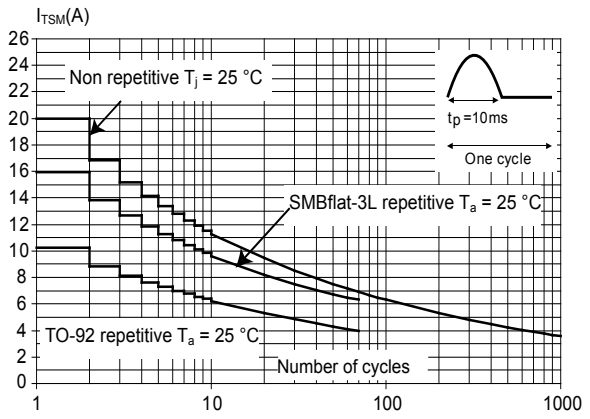


Figure 14. Non-repetitive surge peak on-state current

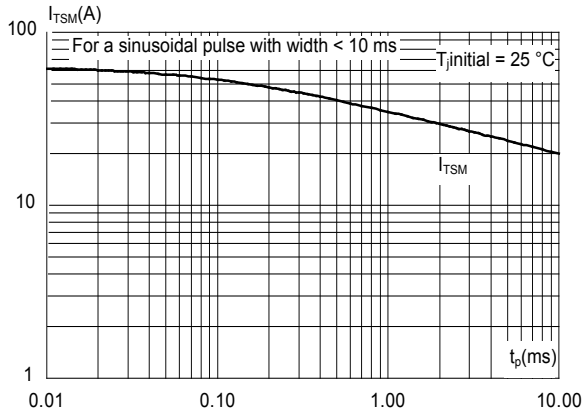
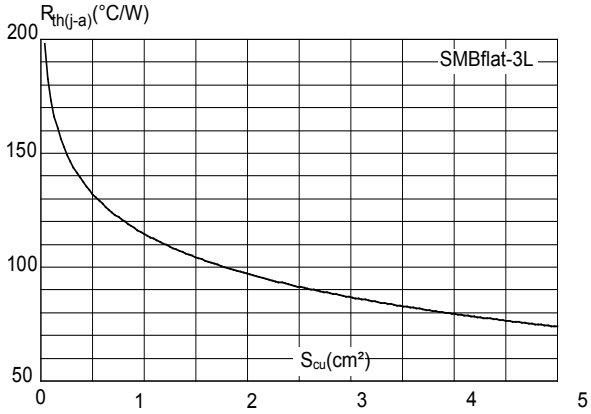


Figure 15. Thermal resistance junction to ambient versus copper surface under anode (epoxy FR4, Cu_{th} = 35 µm)



2 AC line transient voltage ruggedness

In comparison with standard SCRs, the TS110-8S is self-protected against over-voltage. The TS110-8S switch can safely withstand AC line surge voltages by switching to the on state (for less than 10 ms on 50 Hz mains) to dissipate energy shocks through the load. The load limits the current through the TS110-8S. The self-protection against over-voltage is based on an overvoltage crowbar technology. This safety feature works even with high turn-on current ramp up.

The Figure 16 represents the TS110-8S in a test environment. It is used to stress the TS110-8S switch according to the IEC 61000-4-5 standard conditions. The TS110-8S folds back safely to the on state as shown in the Figure 17.

The TS110-8S recovers its blocking voltage capability after the surge and the next zero current crossing. Such a non repetitive test can be done at least 10 times.

Figure 16. Overvoltage ruggedness test circuit for IEC 61000-4-5 standards

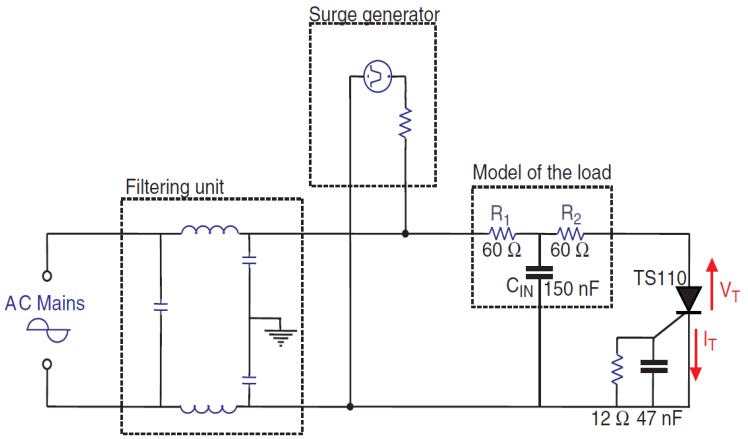
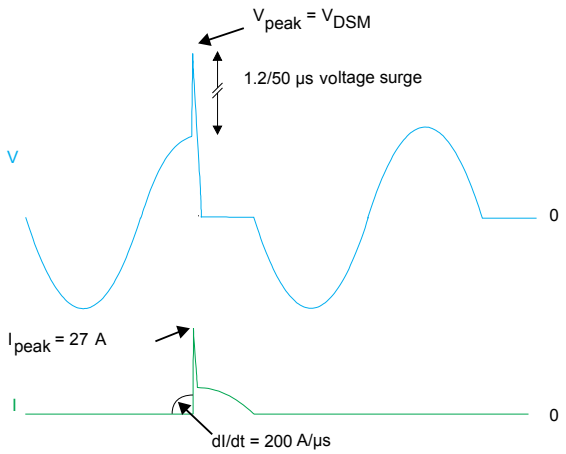


Figure 17. Typical current and voltage waveforms across the TS110-8S during IEC 61000-4-5 standard test



3 Package information

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.

3.1 TO-92 package information

- Lead free plating + halogen-free molding resin
- Epoxy meets UL94, V0

Figure 18. TO-92 package outline

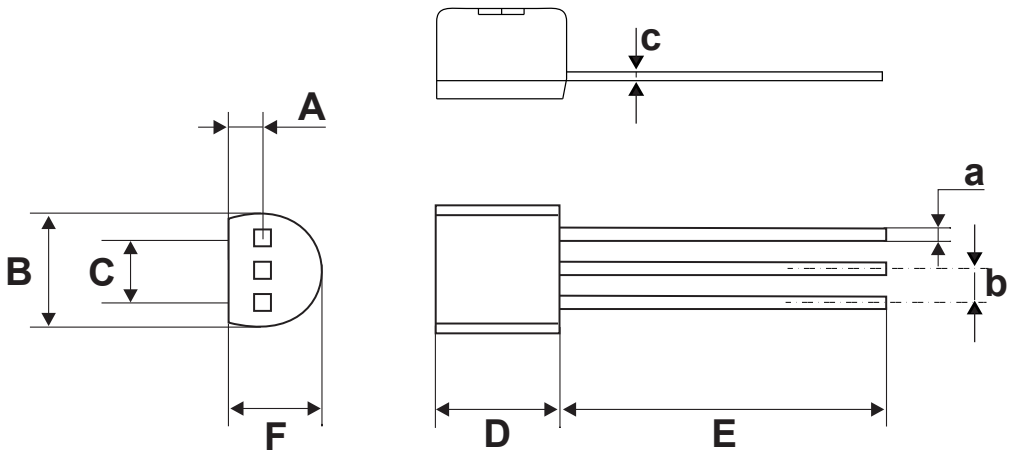


Table 5. TO-92 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches(1)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		1.35			0.0531	
B			4.70			0.1850
C		2.54			0.1000	
D	4.40			0.1732		
E	12.70			0.5000		
F			3.70			0.1457
a			0.50			0.0197
b		1.27			0.0500	
c			0.48			0.0189

1. *Inches dimensions given for information*

3.2 TO-92 with leads preform (plastic) package information

- Lead free plating + halogen-free molding resin
- Epoxy meets UL94, V0

Figure 19. TO-92 with leads preform (plastic) package outline

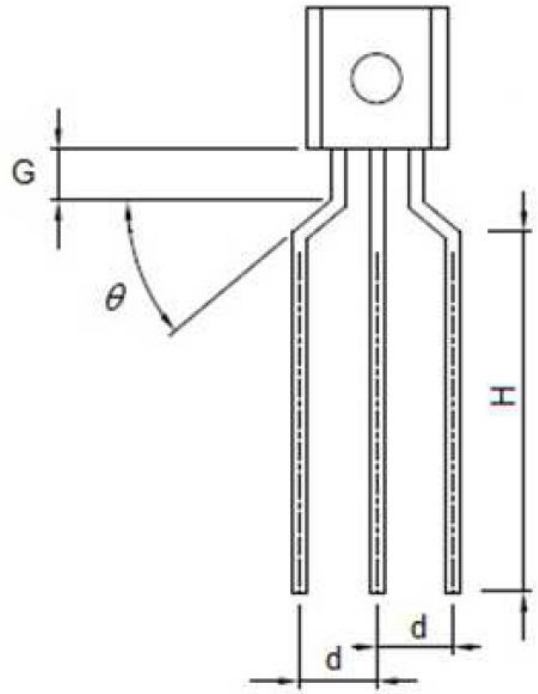


Table 6. TO-92 with leads preform (plastic) package mechanical data

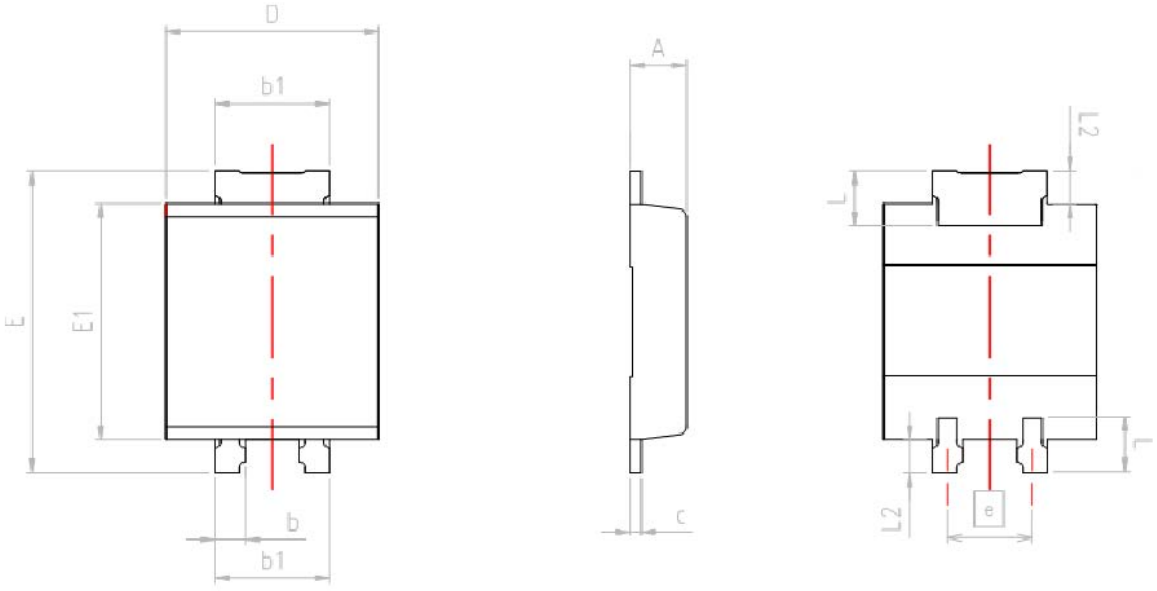
Ref.	Dimensions					
	Millimeters			Inches(1)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
G	1.30	1.70	2.00	0.051	0.067	0.079
H	7.69		9.69	0.303		0.381
d	2.40		2.90	0.094		0.114
θ	30°	40°	50°	30°	40°	50°

1. *Inches dimensions given for information*

3.3 SMBflat-3L package information

- Epoxy meets UL94, V0
- Lead-free package

Figure 20. SMBflat-3L package outline

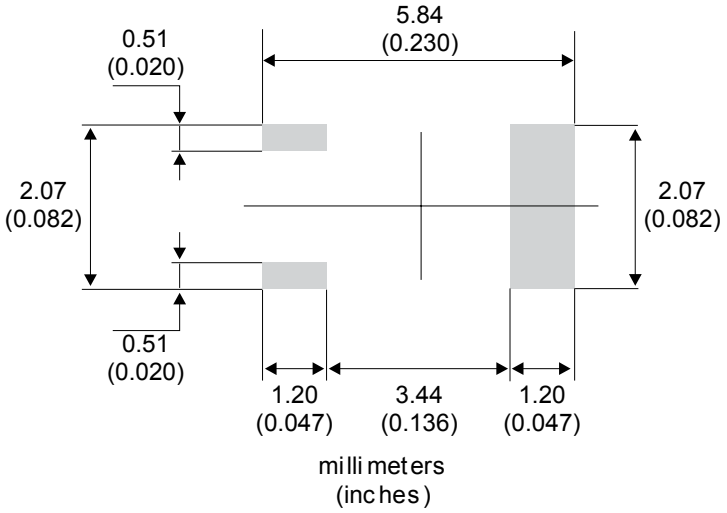


Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions in the following table are guaranteed.

Table 7. SMBflat-3L mechanical data

Ref.	Dimensions					
	Millimeters			Inches (dimensions are for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90		1.10	0.0354		0.0433
b	0.35		0.65	0.0138		0.0256
b1	1.95		2.20	0.0768		0.0866
c	0.15		0.40	0.0059		0.0157
D	3.30		3.95	0.1299		0.1555
E	5.10		5.60	0.2008		0.2205
E1	4.05		4.60	0.1594		0.1811
L	0.75		1.50	0.0295		0.0591
L2		0.60			0.0236	
e		1.60			0.0630	

Figure 21. **Footprint recommendations, dimensions in mm (inches)**



Note: This drawing may not be in scale; however, all the specified dimensions are guaranteed.

4 Ordering information

Figure 22. **Ordering information scheme**

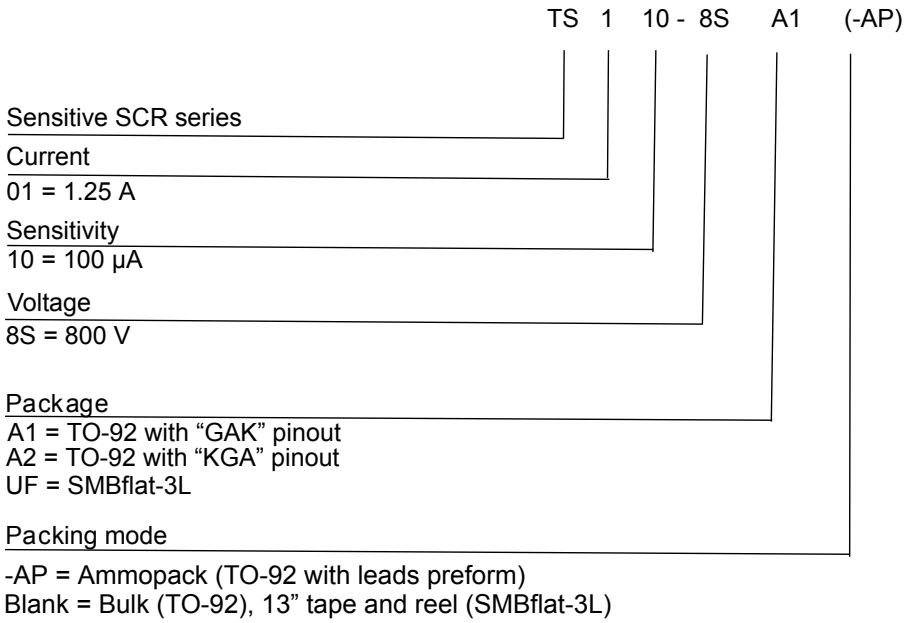


Table 8. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Delivery mode
TS110-8SA1	TS110-8S	TO-92	200 mg	2500	Bulk
TS110-8SA1-AP				2000	Ammopack(1)
TS110-8SA2				2500	Bulk
TS110-8A2-AP				2000	Ammopack(1)
TS110-8SUF		SMBflat-3L	47 mg	5000	Tape and reel 13"

1. *With this packing mode the pin are preform unless in bulk mode, see TN1173 which define the TO-92 in Ammopack.*

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
19-Jul-2023	1	Initial release.
12-Feb-2024	2	Updated *Table 2*.
10-Jul-2024	3	Updated *Cover image*, and *Table 8* for Ammopack packing. Inserted *Section 3.2: TO-92 with leads preform (plastic) package information*.
28-May-2025	4	Document classification changed from restricted to public.