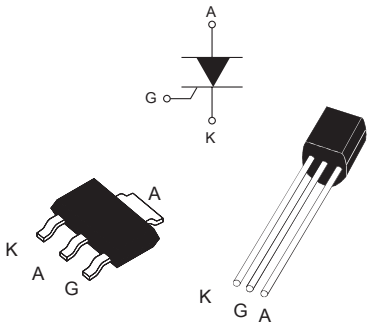
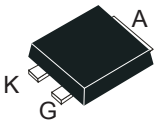
1.25 A sensitive gate SCR



SOT-223 **TO-92**



SMBflat-3L

Features

- On-state rms current, $I_{T(RMS)}$ 1.25 A
- Repetitive peak off-state voltage, $V_{DRM/VRRM}$ 600 or 800 V
- Triggering gate current, $I_{GT\ (Q1)}$ 50 to 200 µA

Applications

- Ground fault circuit interrupters
- Overvoltage crowbar protection in power supplies
- Capacitive ignition circuits

Description

The X02 SCR can be used as the on/off function in applications where topology does not offer high current for gate triggering.

This device is optimized in forward voltage drop and inrush current capabilities for reduced power losses and high reliability in harsh environments.

Product status link
X02

Product summary	
$I_{T(RMS)}$	1.25 A
V_{DRM}/V_{RRM}	600, 800 V
I_{GT} standard	50 to 200 µA

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)	SOT-223	T_{tab} = 99 °C	1.25	A
		TO-92	T_L = 63 °C		
		SMBflat-3L	T_{tab} = 111 °C		
$I_{T(AV)}$	Average on-state current (180 ° conduction angle)	SOT-223	T_{tab} = 99 °C	0.8	A
		TO-92	T_L = 63 °C		
		SMBflat-3L	T_{tab} = 111 °C		
I_{TSM}	Non repetitive surge peak on-state current	F = 50 Hz	t_p = 8.3 ms	25	A
		F = 60 Hz	t_p = 10 ms	22.5	
I^2t	I^2t value for fusing	t_p = 10 ms	T_j = 25 °C	2.5	A^2s
dI/dt	Critical rate of rise of on-state current I_G = 2 x I_{GT} , t_r ≤ 100 ns	F = 60 Hz	T_j = 125 °C	50	A/µs
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
			X0202	X0205	
I_{GT}(1)	V_D = 12 V, R_L = 140 Ω	Min.		20	µA
		Max.	200	50	
V_{GT}		Max.	0.8		V
V_{GD}	V_D = V_{DRM}, R_L = 3.3 kΩ, R_{GK} = 1 kΩ, T_j = 125 °C	Min.	0.1		V
V_{RG}	I_{RG} = 10 µA	Min.	8		
I_H(2)	I_T = 50 mA, R_{GK} = 1 kΩ	Max.	5		mA
I_L	I_G = 1 mA, R_{GK} = 1 kΩ	Max.	6		mA
dV/dt(2)	V_D = 67 % V_{DRM}, R_{GK} = 1 kΩ, T_j = 110 °C	Min.	10	15	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_T[1]	I_{TM} = 2.5 A, t_p = 380 µs	T_j = 25 °C	Max.	1.45	V
V_{TO}[1]	Threshold on-state voltage	T_j =125 °C	Max.	0.9	V
R_d	Dynamic resistance	T_j =125 °C	Max.	200	mΩ
I_{DRM} I_{RRM}	V_{DRM} = V_{RRM}	T_j =25 °C	Max.	5	µA
		T_j =125 °C		500	µA

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

Table 4. Thermal resistance

Symbol	Parameters		Max. value	Unit
$R_{th(j-t)}$	Junction to tab (AC)	SOT-223	25	°C/W
		SMBflat-3L	14	
$R_{th(j-l)}$	Junction to lead (AC)	TO-92	60	
$R_{th(j-a)}$	Junction to ambient (S[1] = 5 cm²)	SOT-223	60	
		SMBflat-3L	75	
	Junction to ambient	TO-92	150	

1. *Copper surface under tab.*

1.1 Characteristics (curves)

Figure 1. Maximum power dissipation versus on-state RMS current (full cycle)

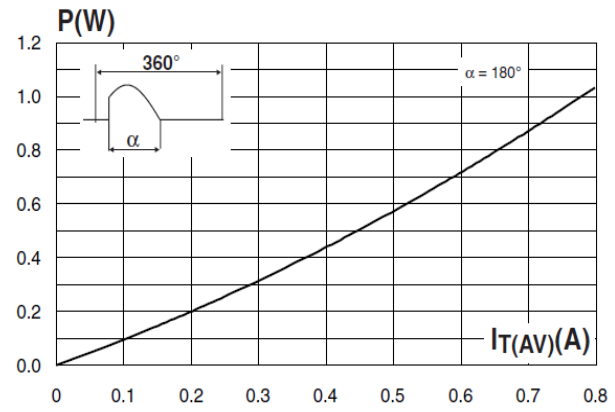


Figure 2. Average and DC on-state current versus tab (SOT-223, SMBflat-3L) or lead (TO-92) temperature

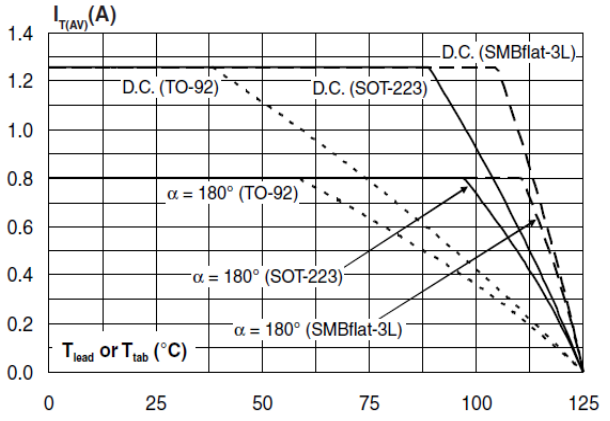


Figure 3. Average and DC on-state current versus ambient temperature

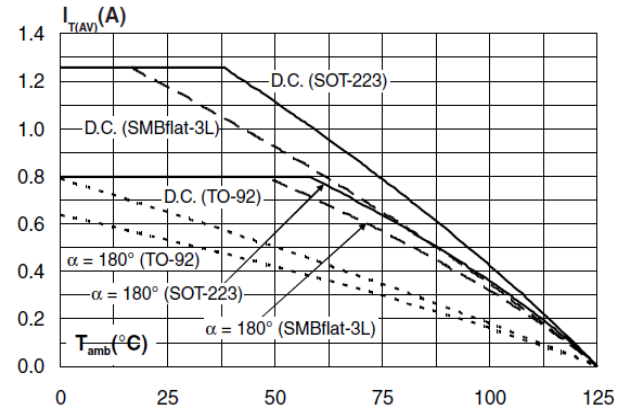


Figure 4. Relative variation of thermal impedance versus pulse duration

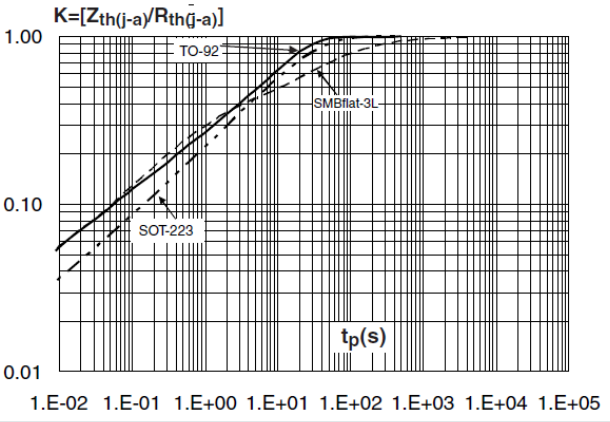


Figure 5. Relative variation of triggering, holding and latching current versus junction temperature

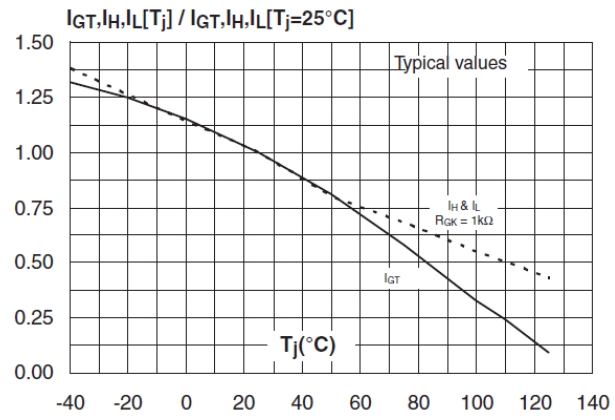


Figure 6. Relative variation of holding current versus gate-cathode resistance (typical values)

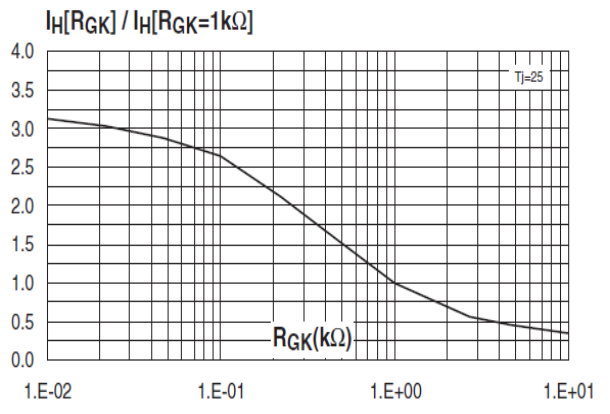


Figure 7. Relative variation of dV/dt immunity versus gate-cathode resistance (typical values)

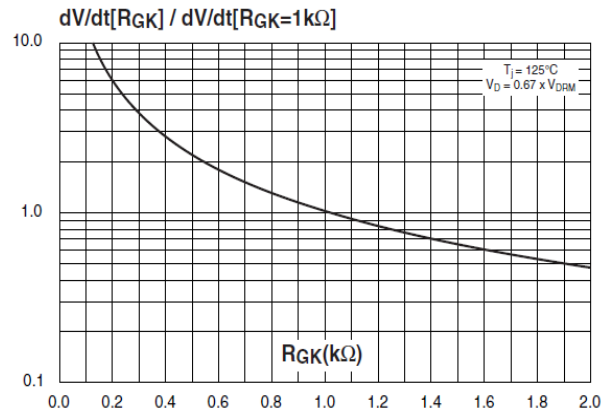


Figure 8. Relative variation of dV/dt immunity versus gate-cathode capacitance (typical values)

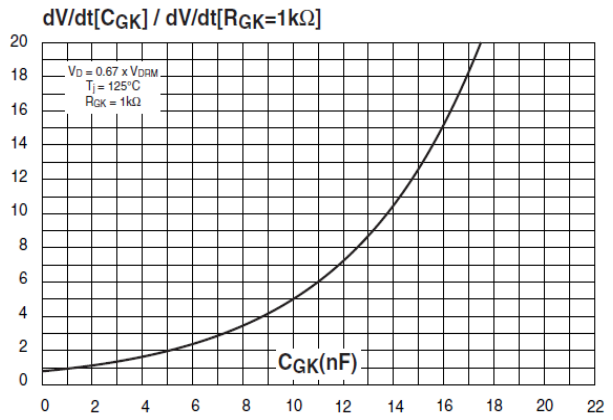


Figure 9. Surge peak on-state current versus number of cycles

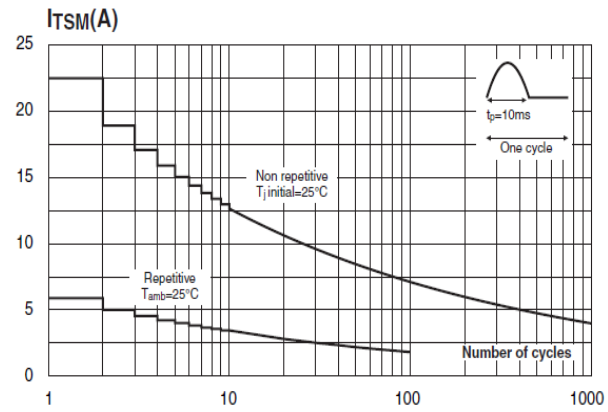


Figure 10. On-state characteristics (maximum values)

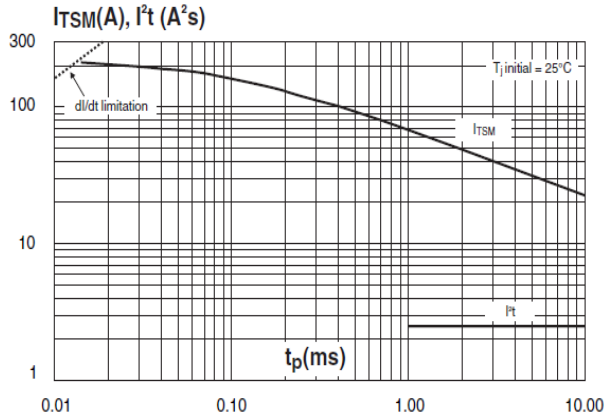


Figure 11. On-state characteristics (maximum values)

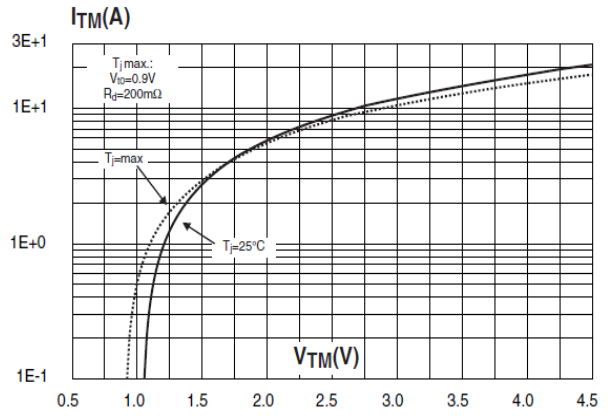
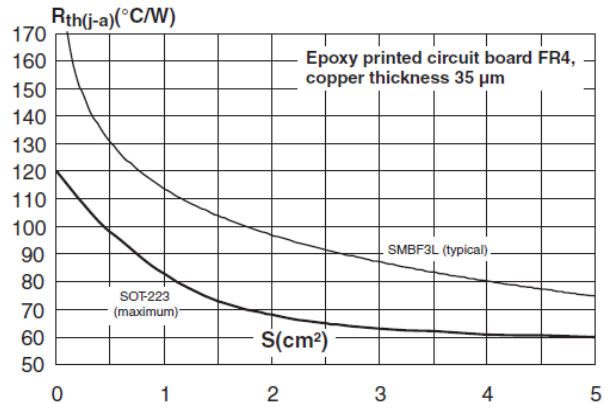


Figure 12. Thermal resistance junction to ambient versus copper surface under tab (SOT-223, SMBflat-3L)



2 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.

2.1 SOT-223 package information

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

Figure 13. SOT-223 package outline

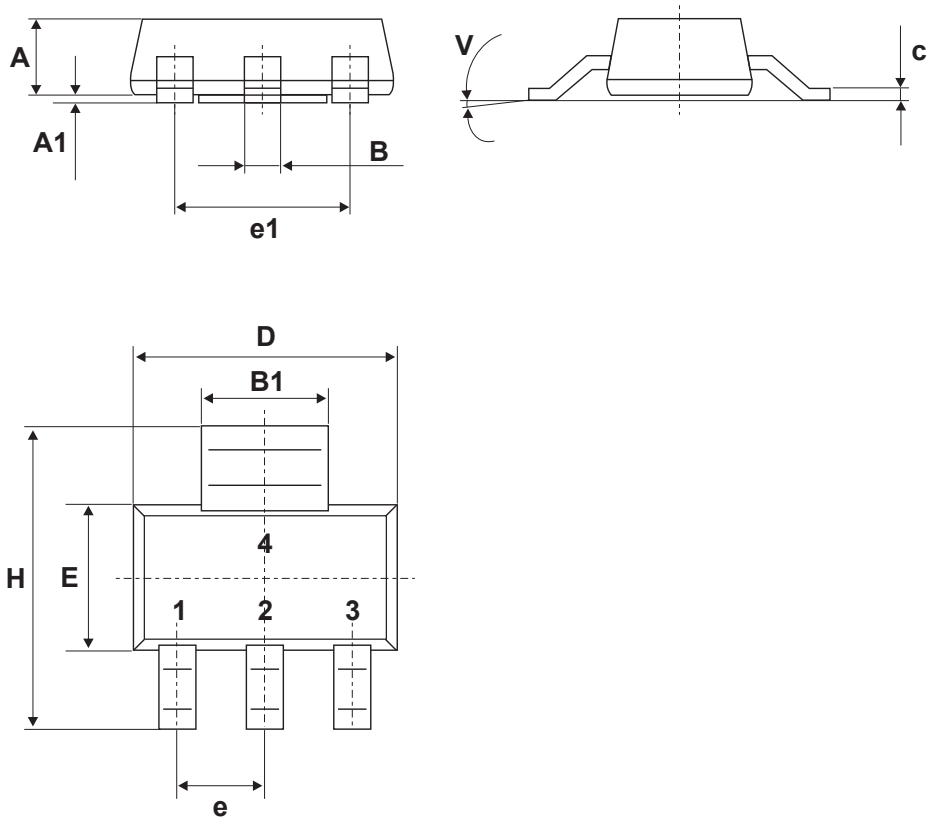
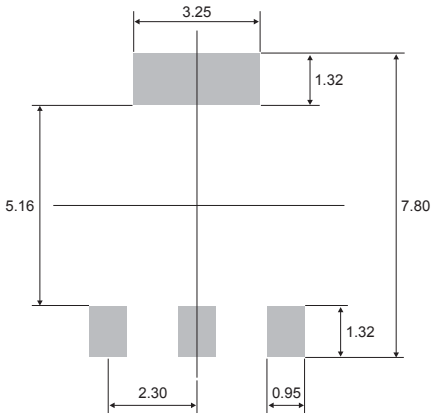


Table 5. SOT-223 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches[1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.80			0.0709
A1		0.02	0.10		0.0008	0.0039
B	0.60	0.70	0.85	0.024	0.0276	0.0335
B1	2.90	3.00	3.15	0.114	0.1181	0.1240
c	0.24	0.26	0.35	0.009	0.0102	0.0138
D	6.30	6.50	6.70	0.248	0.2559	0.2638
e		2.3			0.0906	
e1		4.6			0.1811	
E	3.30	3.50	3.70	0.130	0.1378	0.1457
H	6.70	7.00	7.30	0.264	0.2756	0.2874
V	10° max.					

1. *Inches only for reference*

Figure 14. SOT-223 footprint (dimensions in mm)



2.2 TO-92 package information

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

Figure 15. TO-92 package outline

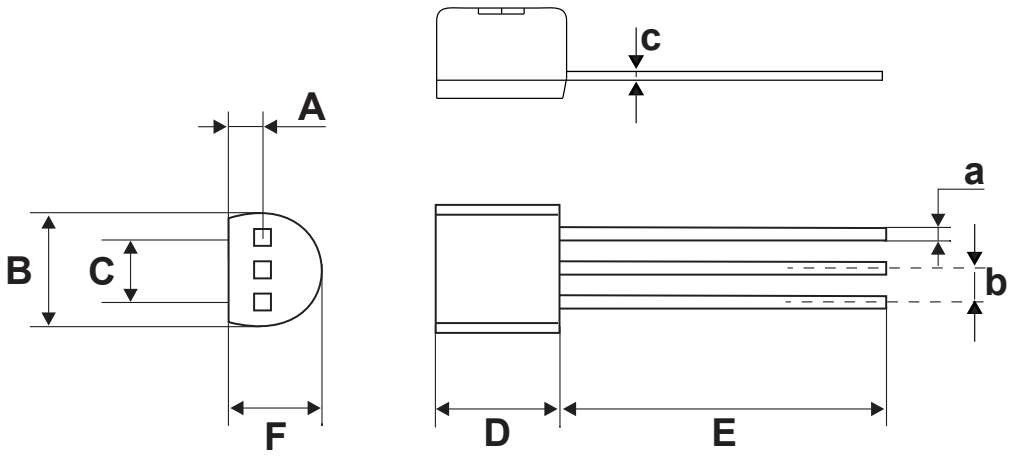


Table 6. TO-92 package mechanical data

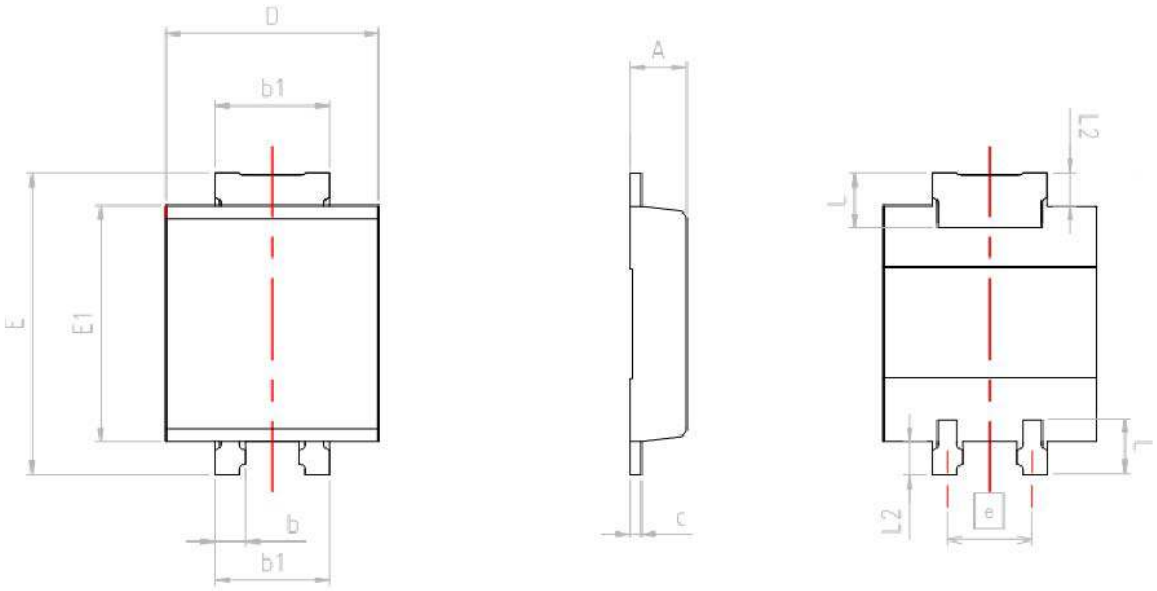
Ref.	Dimensions					
	Millimeters			Inches[1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		1.35			0.0531	
B			4.70			0.1850
C		2.54			0.1000	
D	4.40			0.1732		
E	12.70			0.5000		
F			3.70			0.1457
a			0.50			0.0197
b		1.27			0.0500	
c			0.48			0.0189

1. *Inches dimensions given for information*

2.3 SMBflat-3L package information

- Epoxy meets UL94, V0
- Lead-free package

Figure 16. SMBflat-3L package outline

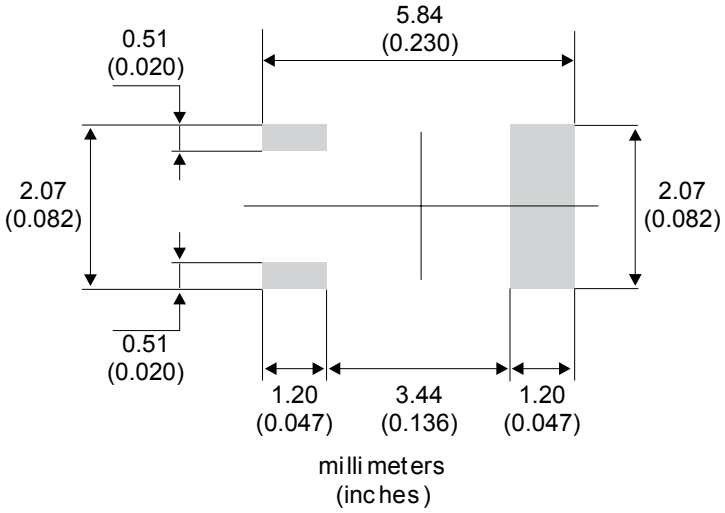


Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions in the following table are guaranteed.

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 17. **Footprint recommendations, dimensions in mm (inches)**



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

3 Ordering information

Figure 18. **Ordering information scheme**

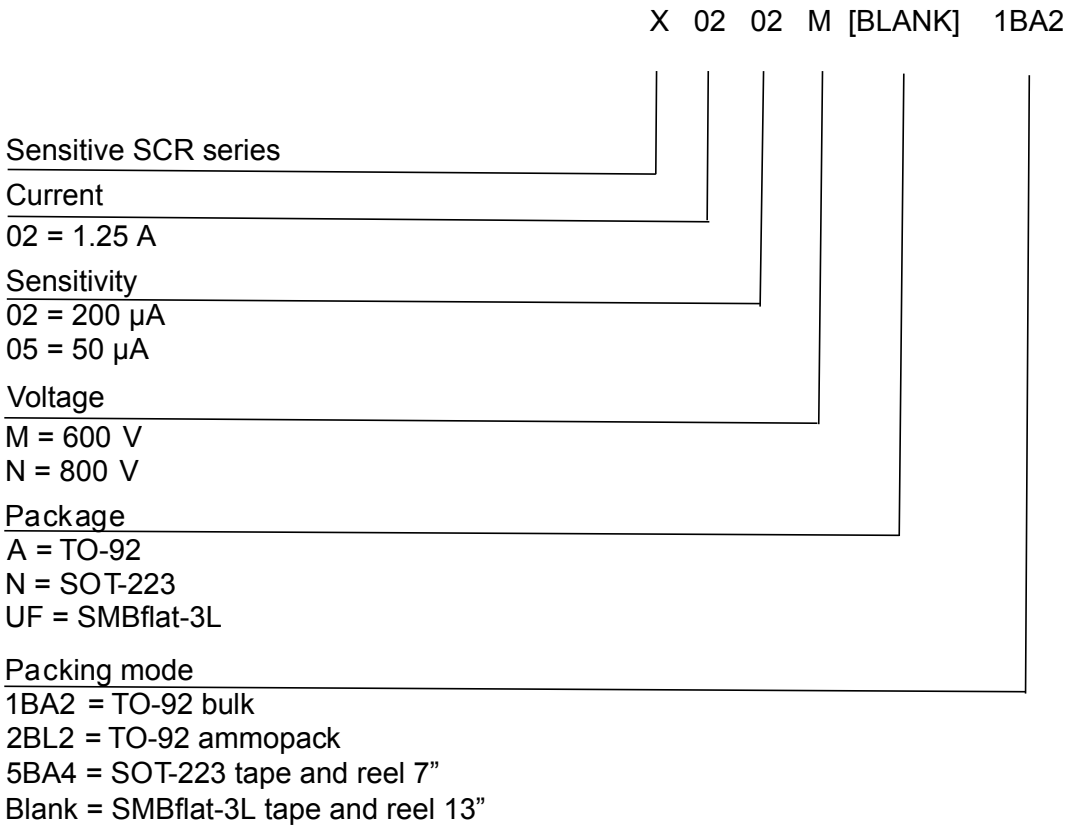


Table 8. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Delivery mode
X0202MA 1BA2	X0202 MA	TO-92	0.2 g	2500	Bulk
X0202MA 2BL2	X0202 MA			2000	Ammopack
X0202MN5BA4	X2M	SOT-223	0.12 g	1000	Tape and reel
X0202NA 1BA2	X0202 NA	TO-92	0.2 g	2500	Bulk
X0202NA 2BL2	X0202 NA			2000	Ammopack
X0202NN5BA4	X2N	SOT-223	0.12 g	1000	Tape and reel
X0205MA 1BA2	X0205 MA	TO-92	0.2 g	2500	Bulk
X0205MA 2BL2	X0205 MA			2000	Ammopack
X0205NA 1BA2	X0205 NA			2500	Bulk
X0202NUF	X2N	SMBflat-3L	47 mg	5000	Tape and reel

Table 9. Product selector

Part number	Voltage (xxx)		Sensitivity µA	Package
	600	800		
X0202MA	X		200	TO-92
X0202MN	X		200	SOT-323
X0202NA		X	200	TO-92
X0202NN		X	200	SOT-323
X0205MA	X		50	TO-92
X0205NA		X	50	TO-92
X0202NUF		X	200	SMBflat-3L

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
Sep-2000	3	Previous issue
14-Jan-2011	4	Added SMBflat-3L package and ECOPACK statement.
17-Apr-2023	5	Updated Figure 16 and Table 7. Minor text changes.
19-Jul-2023	6	Updated Table 8.

IMPORTANT NOTICE – READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.