# 2A, 600V N-CHANNEL MOSFET

GENERAL DESCRIPTION

SVF2N60CN/M/MJ/F/D is an N-channel enhancement mode power MOS field effect transistor which is produced using Silan proprietary F-Cell^{TM} high-voltage planar VDMOS technology. The improved process and cell structure have been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are widely used in AC-DC power supplies, DC-DC converters and H-bridge PWM motor drivers.

FEATURES

- 2A,600V,$R_{DS(on)(typ.)}$=3.7Ω@V_{GS}=10V
- Low gate charge
- Low Crss
- Fast switching
- Improved dv/dt capability

1.Gate 2.Drain 3.Source

TO-251D-3L
TO-251J-3L
TO-126-3L
TO-252-2L
TO-220F-3L
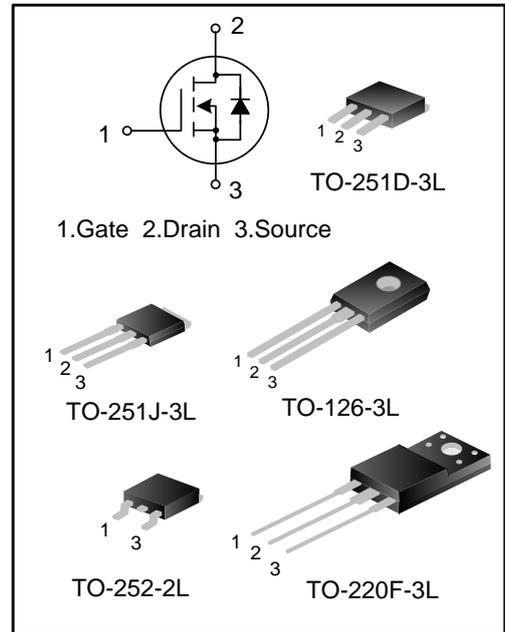
ORDERING INFORMATION

Part No.	Package Type	Marking	Hazardous substance control	Packing Type
SVF2N60CN	TO-126-3L	SVF2N60CN	Pb free	Tube
SVF2N60CM	TO-251D-3L	SVF2N60C	Halogen free	Tube
SVF2N60CMJ	TO-251J-3L	SVF2N60C	Halogen free	Tube
SVF2N60CF	TO-220F-3L	SVF2N60CF	Halogen free	Tube
SVF2N60CDTR	TO-252-2L	SVF2N60CD	Halogen free	Tape & Reel

ABSOLUTE MAXIMUM RATINGS (T$_C$=25°C UNLESS OTHERWISE NOTED)

Characteristics		Symbol	Ratings				Unit
			SVF2N 60CN	SVF2N 60CM/D	SVF2N 60CMJ	SVF2N 60CF	
Drain-Source Voltage		V$_{DS}$	600				V
Gate-Source Voltage		V$_{GS}$	±30				V
Drain Current	T$_C$=25°C	I$_D$	2.0				A
	T$_C$=100°C		1.3				
Drain Current Pulsed		I$_{DM}$	8				A
Power Dissipation(T$_C$=25°C)		P$_D$	30	34	35	23	W
-Derate above 25°C			0.24	0.27	0.28	0.18	W/°C
Single Pulsed Avalanche Energy(Note 1)		E$_{AS}$	115				mJ
Operation Junction Temperature Range		T$_J$	-55～+150				°C
Storage Temperature Range		T$_{stg}$	-55～+150				°C

THERMAL CHARACTERISTICS

Characteristics	Symbol	Ratings				Unit
		SVF2N 60CN	SVF2N 60CM/D	SVF2N 60CMJ	SVF2N 60CF	
Thermal Resistance, Junction-to-Case	R$_{θJC}$	4.17	3.7	3.57	5.56	°C/W
Thermal Resistance, Junction-to-Ambient	R$_{θJA}$	62.5	62.0	62.0	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T$_C$=25°C UNLESS OTHERWISE NOTED)

| Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Drain -Source Breakdown Voltage	BV$_{DSS}$	V$_{GS}$=0V, I$_D$=250µA	600	--	--	V
Drain-Source Leakage Current	I$_{DSS}$	V$_{DS}$=600V, V$_{GS}$=0V	--	--	1.0	µA
Gate-Source Leakage Current	I$_{GSS}$	V$_{GS}$=±30V, V$_{DS}$=0V	--	--	±100	nA
Gate Threshold Voltage	V$_{GS(th)}$	V$_{GS}$= V$_{DS}$, I$_D$=250µA	2.0	--	4.0	V
Static Drain- Source On State Resistance	R$_{DS(on)}$	V$_{GS}$=10V, I$_D$=1.0A	--	3.7	4.2	Ω
Input Capacitance	C$_{iss}$	V$_{DS}$=25V,V$_{GS}$=0V, f=1.0MHZ	179	233	303	pF
Output Capacitance	C$_{oss}$		--	32	--	
Reverse Transfer Capacitance	C$_{rss}$		--	2.8	--	
Turn-on Delay Time	t$_{d(on)}$	V$_{DD}$=300V,I$_D$=2.0A, R$_G$=25Ω (Note 2,3)	--	8.9	--	ns
Turn-on Rise Time	t$_r$		--	23.0	--	
Turn-off Delay Time	t$_{d(off)}$		--	23.4	--	
Turn-off Fall Time	t$_f$		--	24.9	--	
Total Gate Charge	Q$_g$	V$_{DS}$=480V,I$_D$=2.0A, V$_{GS}$=10V (Note 2,3)	--	8.24	--	nC
Gate-Source Charge	Q$_{gs}$		--	1.64	--	
Gate-Drain Charge	Q$_{gd}$		--	4.44	--	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Continuous Source Current	I_S	Integral Reverse P-N Junction Diode in the MOSFET	--	--	2.0	A
Pulsed Source Current	I_{SM}		--	--	8.0	
Diode Forward Voltage	V_{SD}	I_S=2.0A,V_{GS}=0V	--	--	1.4	V
Reverse Recovery Time	T_{rr}	I_S=2.0A,V_{GS}=0V,	--	326	--	ns
Reverse Recovery Charge	Q_{rr}	dI_F/dt=100A/µS	--	0.87	--	µC

Notes:

1. L=30mH, I_{AS}=2.52A, V_{DD}=100V, R_G=25Ω, starting T_J=25°C;

2. Pulse Test: Pulse width ≤300µs,Duty cycle≤2%;

3. Essentially independent of operating temperature.

TYPICAL CHARACTERISTICS

Figure 1. On-Region Characteristics

Figure 2. Transfer Characteristics

Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature
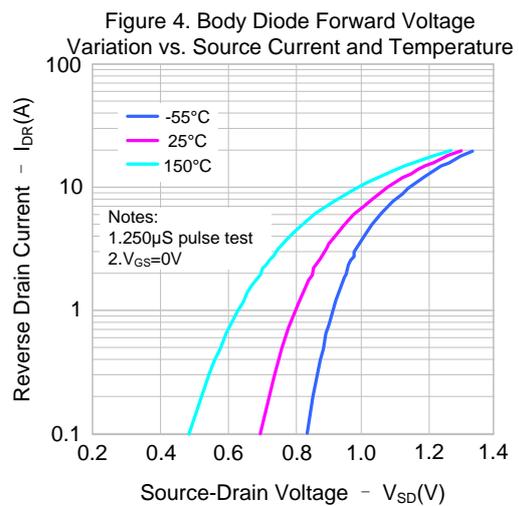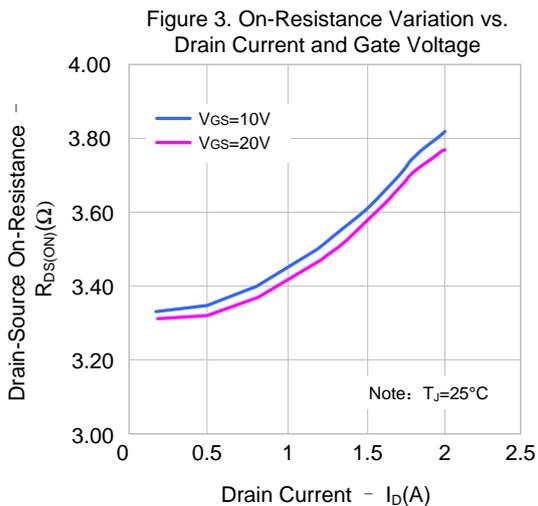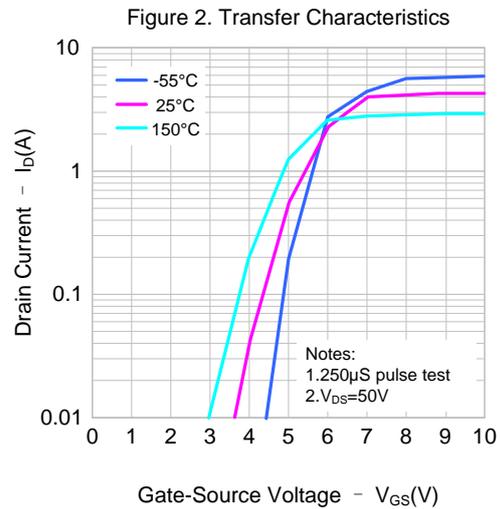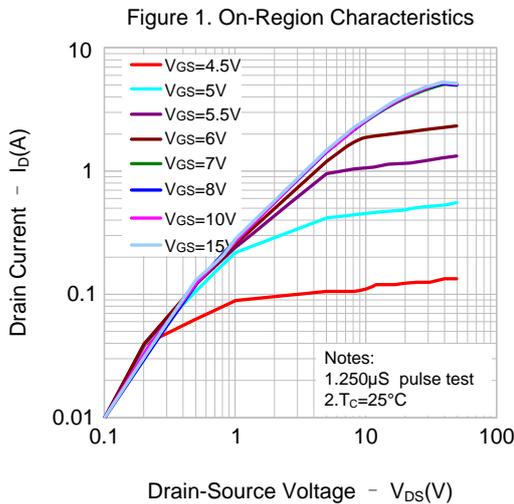
TYPICAL CHARACTERISTICS(CONTINUED)

Figure 5. Capacitance Characteristics

Ciss=Cgs+Cgd(Cds=shorted)
Coss=Cds+Cgd
Crss=Cgd

Notes:
1. $V_{GS}=0V$
2. $f=1MHz$

Capacitance (pF) vs. Drain-Source Voltage – $V_{DS}(V)$

Ciss, Coss, Crss
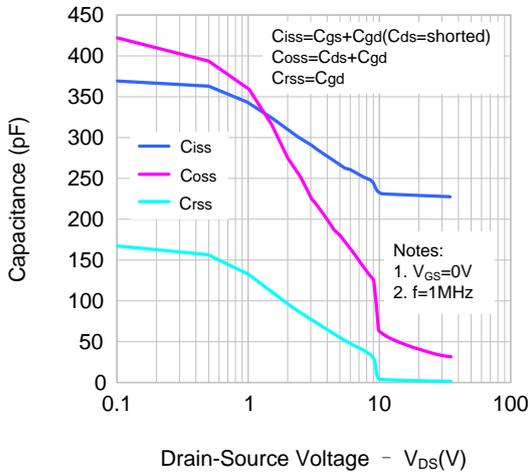
Figure 6. Gate Charge Characteristics

$V_{DS}=480V$
$V_{DS}=300V$
$V_{DS}=120V$

Note: $I_D=2.0A$

Gate-Source Voltage – $V_{GS}(V)$ vs. Total Gate Charge – $Qg(nC)$
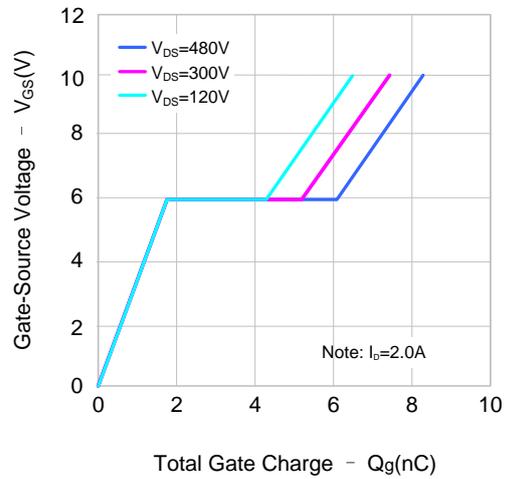
Figure 7. Breakdown Voltage Variation vs. Temperature

Notes:
1. $V_{GS}=0V$
2. $I_D=250\mu A$

Drain-Source Breakdown Voltage (Normalized) – BV_{DSS} vs. Junction Temperature – $T_J(°C)$
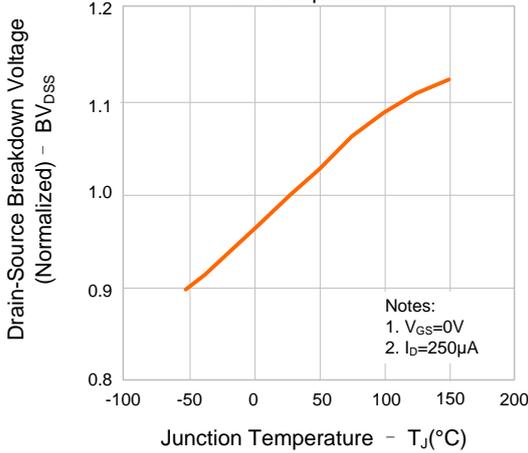
Figure 8. On-resistance vs. Temperature

Notes:
1. $V_{GS}=10V$
2. $I_D=1.0A$

Drain-Source On-Resistance (Normalized) – $R_{DS(ON)}$ vs. Junction Temperature – $T_J(°C)$
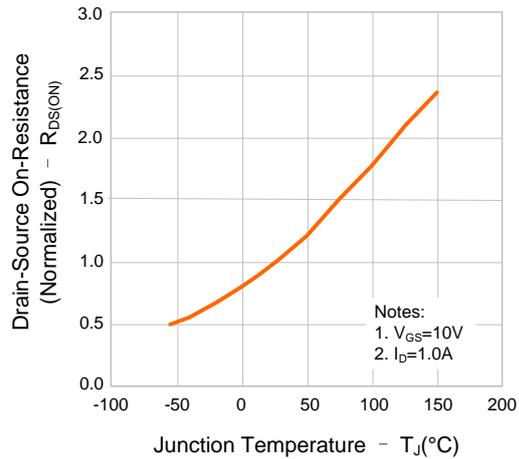
Figure 9-1. Max. Safe Operating Area(SVF2N60CN)

Operation in this area is limited by $R_{DS(ON)}$

100µs
1ms
10ms
DC

Notes:
1.$T_C=25°C$
2.$T_J=150°C$
3.$R_{DS(ON)}[max]=4.2\Omega$

Drain Current - $I_D(A)$ vs. Drain-Source Voltage - $V_{DS}(V)$
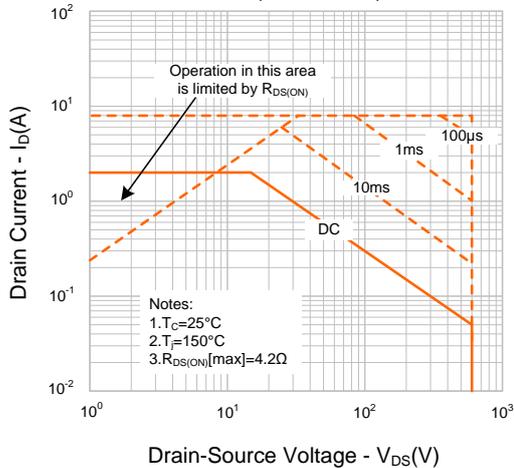
Figure 9-2. Max. Safe Operating Area(SVF2N60CM/D)

Operation in This Area is Limited by $R_{DS(ON)}$

100µs
1ms
10ms
DC

Notes:
1.$T_C=25°C$
2.$T_J=150°C$
3.$R_{DS(ON)}[max]=4.2\Omega$

Drain Current - $I_D(A)$ vs. Drain-Source Voltage - $V_{DS}(V)$
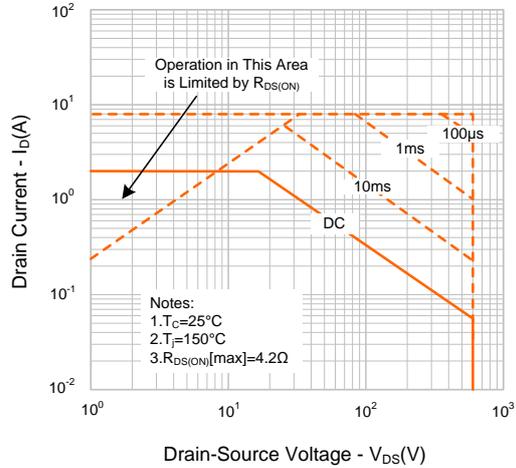
TYPICAL CHARACTERISTICS(CONTINUED)

Figure 9-3. Max. Safe Operating
Area(SVF2N60CMJ)
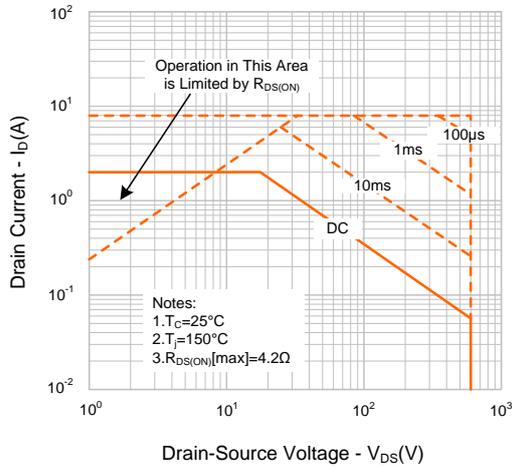

Figure 9-4. Max. Safe Operating
Area(SVF2N60CF)
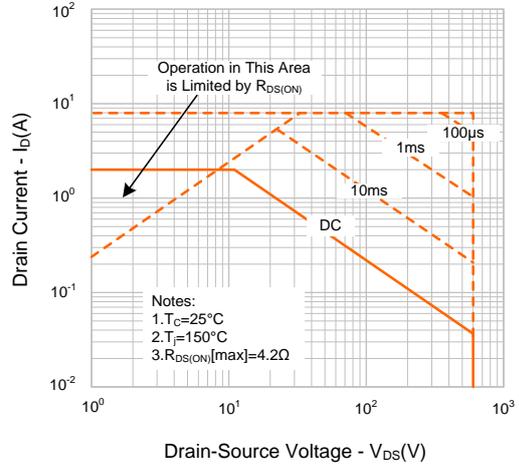
Figure 10. Max. Drain Current vs. Case
Temperature
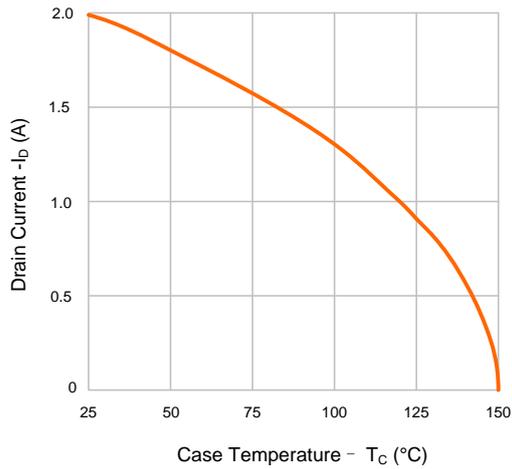
TYPICAL TEST CIRCUIT

Gate Charge Test Circuit & Waveform
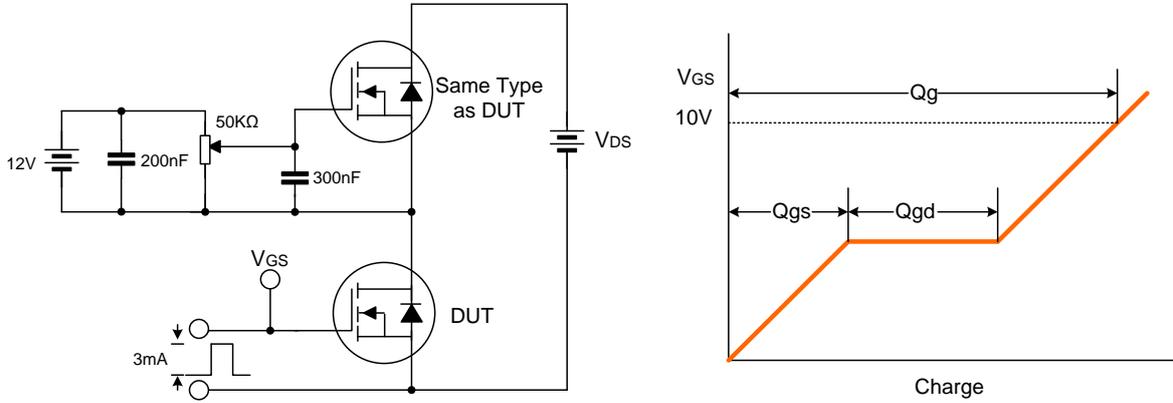

Resistive Switching Test Circuit & Waveform
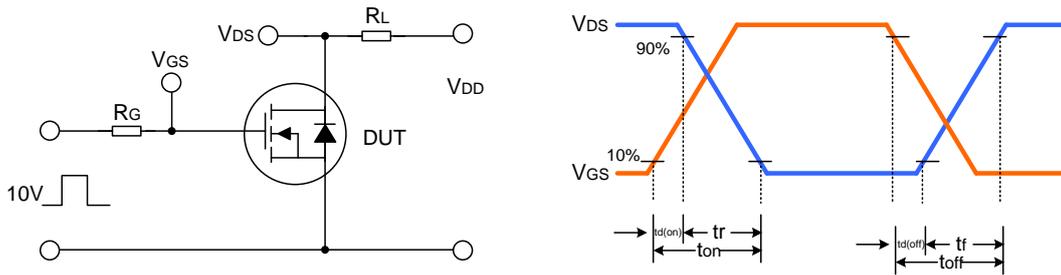

Unclamped Inductive Switching Test Circuit & Waveform

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$
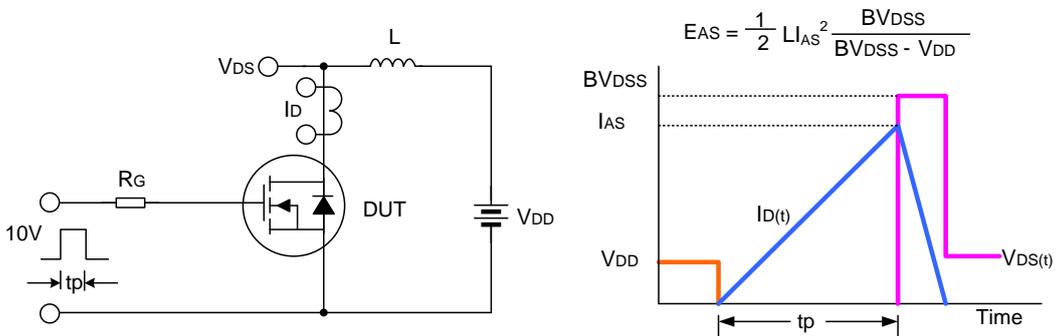
PACKAGE OUTLINE

TO-126-3L   UNIT: mm
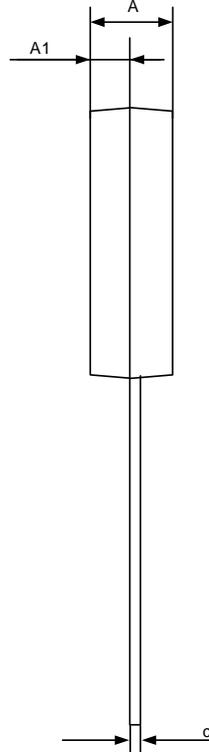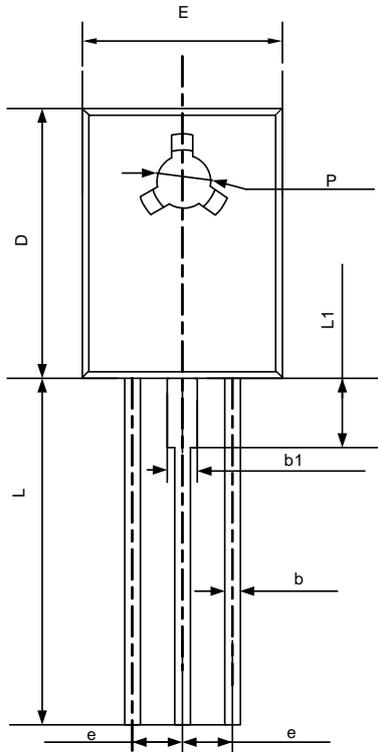
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.48	2.70	2.90
A1	1.00	—	1.50
b	0.66	0.76	0.86
b1	1.17	1.37	1.45
c	0.40	—	0.60
D	10.60	11.00	11.40
E	7.40	—	8.20
e	2.29TYP		
L	14.50	—	15.80
L1	2.10	—	2.35
P	2.90	3.10	3.30

TO-251D-3L   UNIT: mm
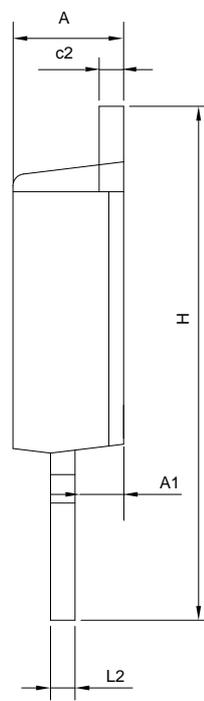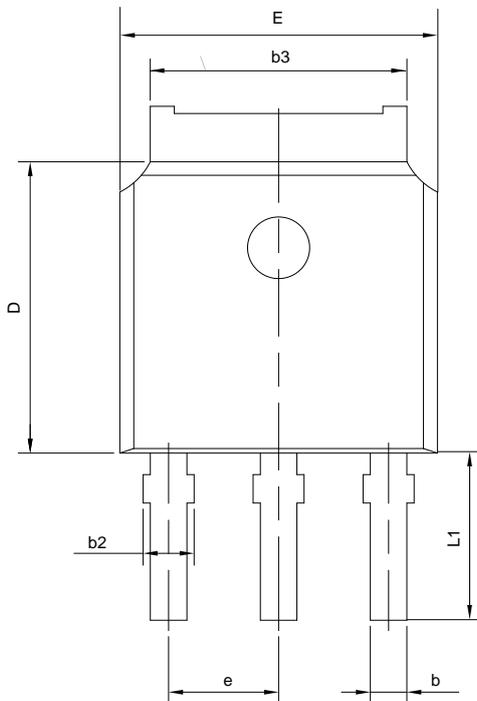
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.20	2.30	2.40
b	0.66	–	0.86
b2	0.72	–	0.90
b3	5.10	5.33	5.46
c2	0.46	–	0.60
D	6.00	6.10	6.20
E	6.50	6.60	6.70
e	2.186	2.286	2.386
H	10.40	10.70	11.00
L1	3.50 REF		
L2	0.508 BSC		

PACKAGE OUTLINE(CONTINUED)

TO-251J-3L   **UNIT: mm**
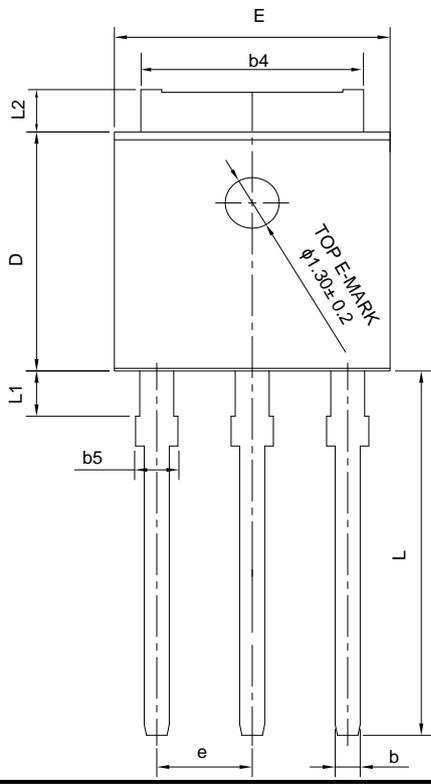
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.18	2.30	2.39
A1	0.89	1.00	1.14
b	0.56	—	0.89
b4	4.95	5.33	5.46
b5	—	—	1.05
c	0.46	—	0.61
D	5.97	6.10	6.27
E	6.35	6.60	6.73
e	2.29 BCS		
L	8.89	9.30	9.65
L1	0.95	—	1.50
L2	0.89	—	1.27

TOP E-MARK
φ1.30±0.2

TO-252-2L   **UNIT: mm**

Eject pin（note1）
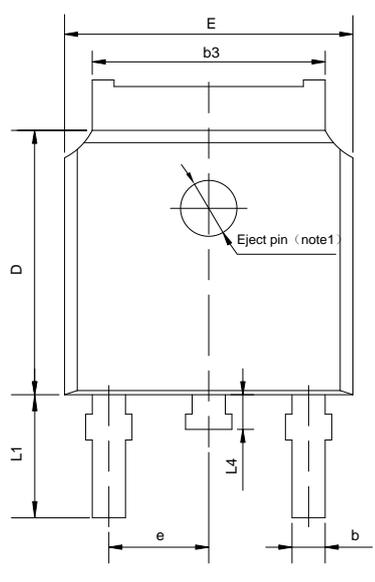
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.10	2.30	2.50
A1	0	—	0.127
b	0.66	0.76	0.89
b3	5.10	5.33	5.46
c	0.45	—	0.65
c2	0.45	—	0.65
D	5.80	6.10	6.40
E	6.30	6.60	6.90
e	2.30TYP		
H	9.60	10.10	10.60
L	1.40	1.50	1.70
L1	2.90REF		
L4	0.60	0.80	1.00

NOTE1 : There are two conditions for this position:has an eject pin or has no eject pin.

PACKAGE OUTLINE(CONTINUED)

TO-220F-3L | **UNIT: mm**

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.42	4.70	5.02
A1	2.30	2.54	2.80
A3	2.50	2.76	3.10
b	0.70	0.80	0.90
b2	–	–	1.47
c	0.35	0.50	0.65
D	15.25	15.87	16.25
D1	15.30	15.75	16.30
D2	9.30	9.80	10.30
E	9.73	10.16	10.36
e	2.54BSC		
H1	6.40	6.68	7.00
L	12.48	12.98	13.48
L1	–	–	3.50
φP	3.00	3.18	3.40
Q	3.05	3.30	3.55
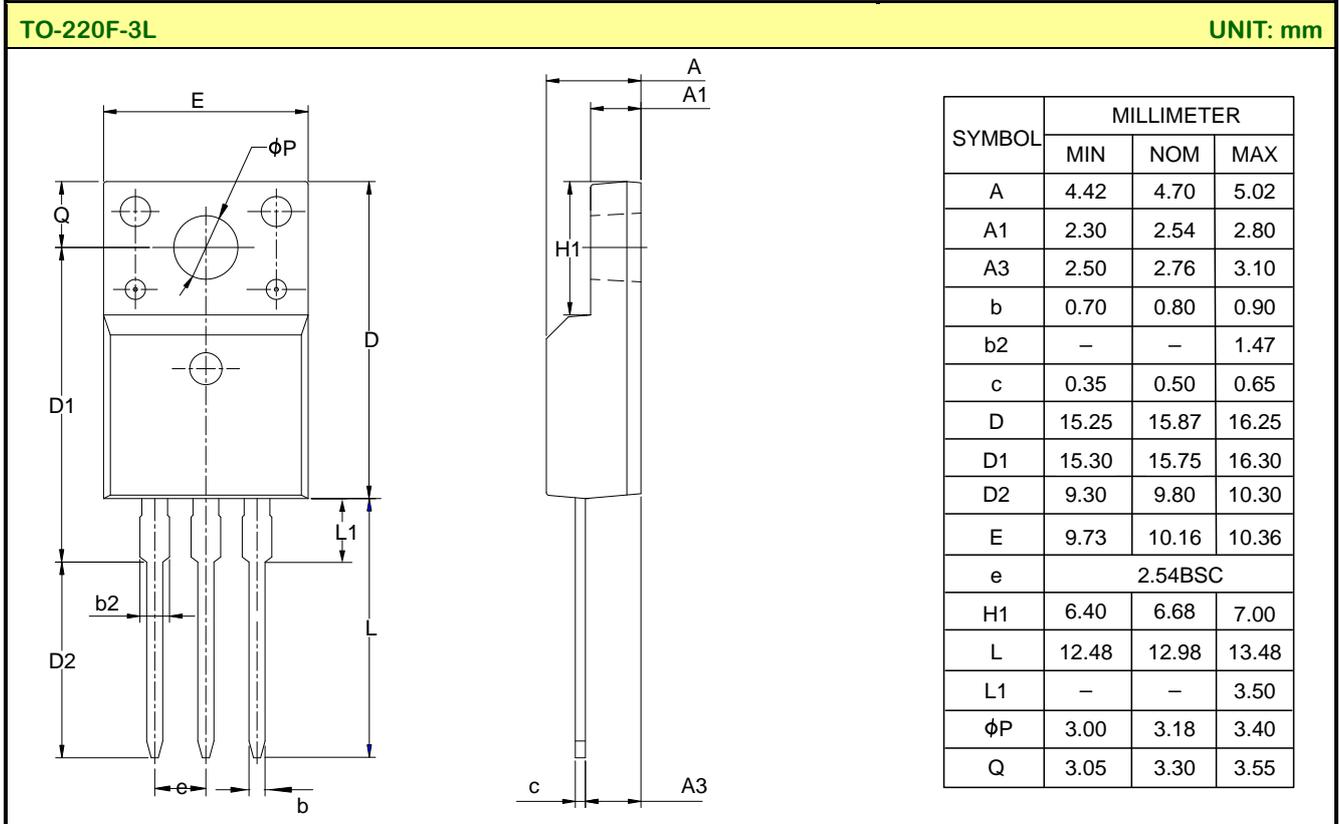
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Rev.: 2.1

Revision History:

1. Deleted NOMENCLATURE
2. Modify Important notice

Rev.: 2.0

Revision History:

1. Delete the package outline of TO-126F-3L

Rev.: 1.9

Revision History:

1. Modify ordering information

Rev.: 1.8

Revision History:

1. Update the package outline of TO-251J-3L
2. Delete the package outline of TO-220F-3L(2)

Rev.: 1.7

Revision History:

1. Modify the ordering information

Rev.: 1.6

Revision History:

1. Modify the package outline of TO-126-3L

Rev.: 1.5

Revision History:

1. Modify the figure 3
2. Modify the ordering information
3. Modify the package outline of TO-251D-3L

Rev.: 1.4

Revision History:

1. Modify the figure 6
2. Modify the ordering information

Rev.: 1.3

Revision History:

1. Modify the package information of TO-252-2L
2. Modify the ordering information

Rev.: 1.2

Revision History:

1. Modify the typical characteristics
2. Modify the package information
3. Modify the package outline

Rev.: 1.1

Revision History:

    1.   Modify the thermal characteristics

Rev.:   1.0

Revision History:

    1.   First release