

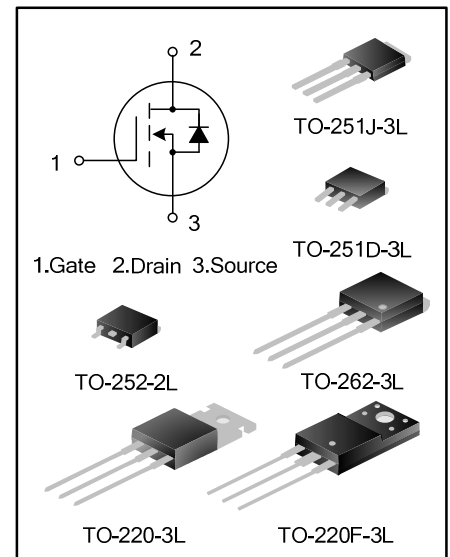
# 4A, 600V, N-Channel MOSFET

## General Description

The GGVF4N60D/F/FG/T/K/M/MJ is an N-channel enhancement mode power MOS field effect transistor. The improved planar stripe cell and the improved guard ring terminal have been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulses in the avalanche and commutation mode.

## Features

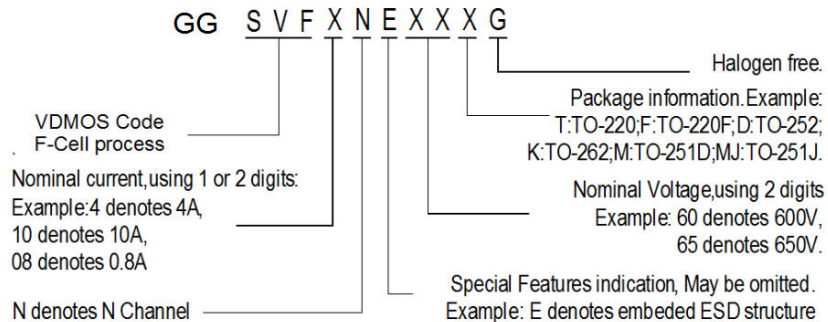
- 4A, 600V
- $R_{DS(on)(typ)}=2.0\Omega@V_{GS}=10V$
- Low gate charge
- Low Crss
- Fast switching
- Improved dv/dt capability



## Applications

- AC-DC power supplies
- DC-DC converters
- H-bridge PWM motor drivers

## Nomenclature

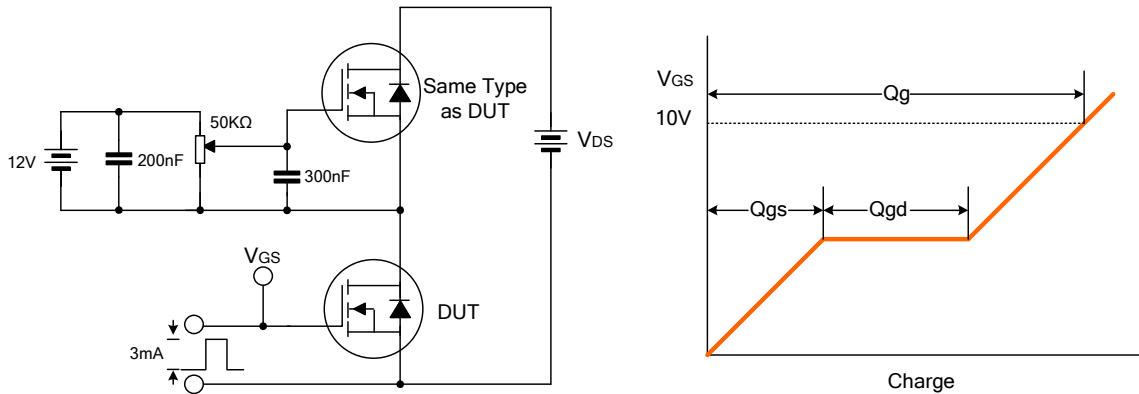


## Ordering Information

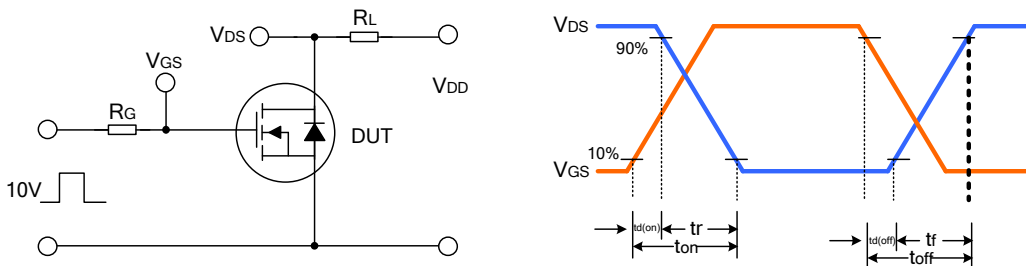
Part No.	Package	Marking	Material	Packing
GGVF4N60T	TO-220-3L	GGVF4N60T	Pb free	Tube
GGVF4N60F	TO-220F-3L	GGVF4N60F	Pb free	Tube
GGVF4N60FG	TO-220F-3L	GGVF4N60FG	Halogen free	Tube
GGVF4N60K	TO-262-3L	GGVF4N60K	Pb free	Tube
GGVF4N60D	TO-252-2L	GGVF4N60D	Pb free	Tube
GGVF4N60DTR	TO-252-2L	GGVF4N60D	Pb free	Tape & Reel
GGVF4N60MJ	TO-251J-3L	GGVF4N60MJ	Pb free	Tube
GGVF4N60M	TO-251D-3L	GGVF4N60M	Pb free	Tube

## Typical Test Circuits

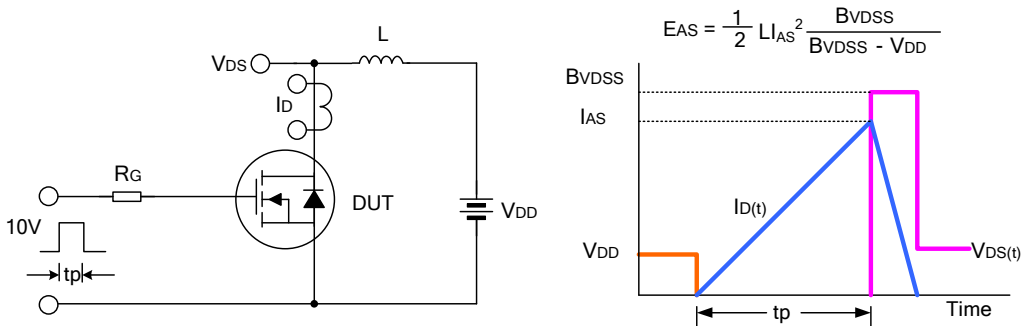
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveform



**Typical Characteristics**

Figure 1. On-Region Characteristics

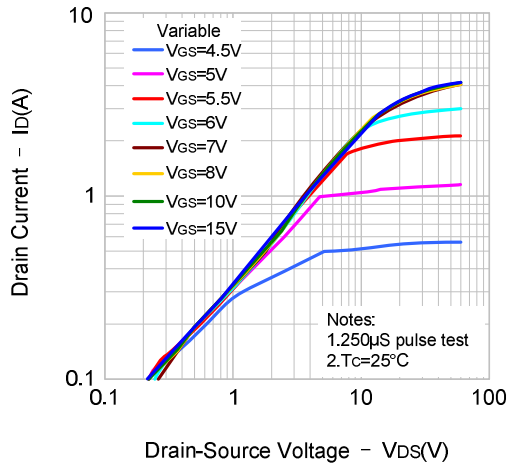


Figure 2. Transfer Characteristics

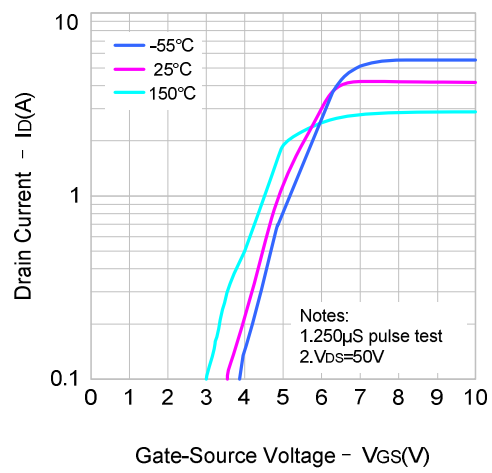


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

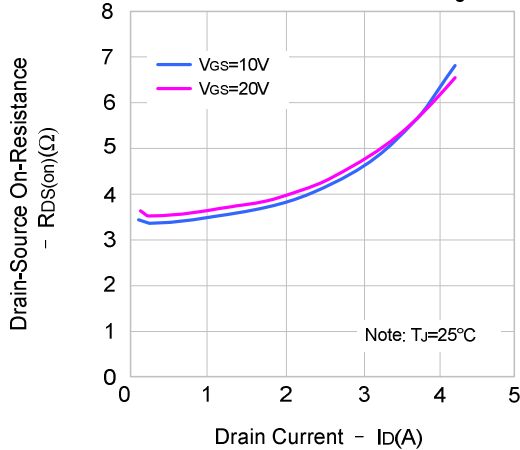
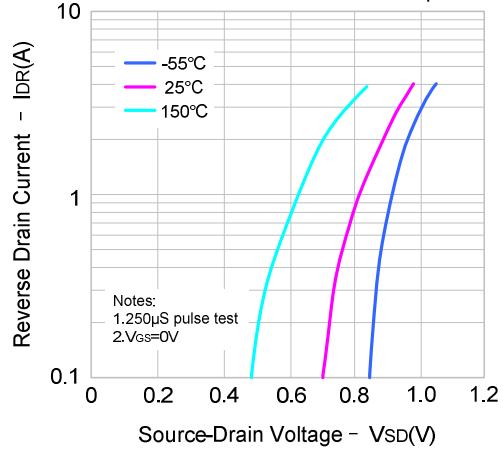
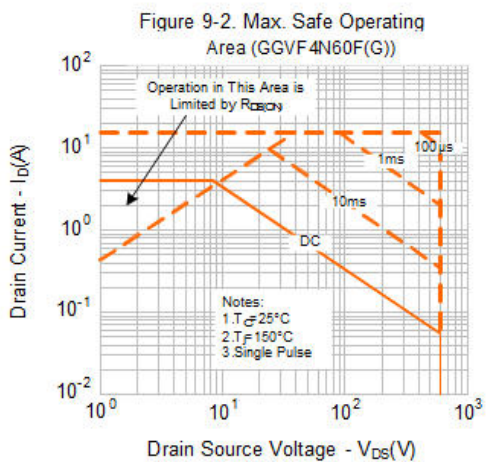
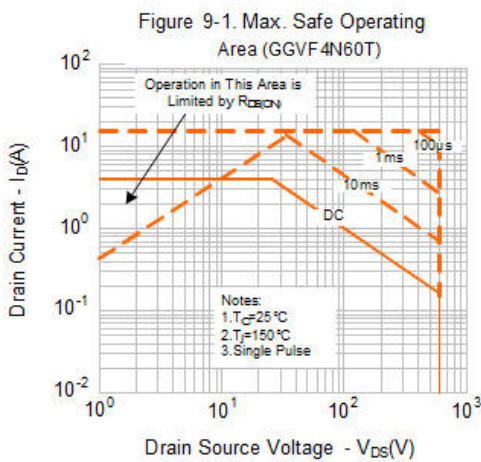
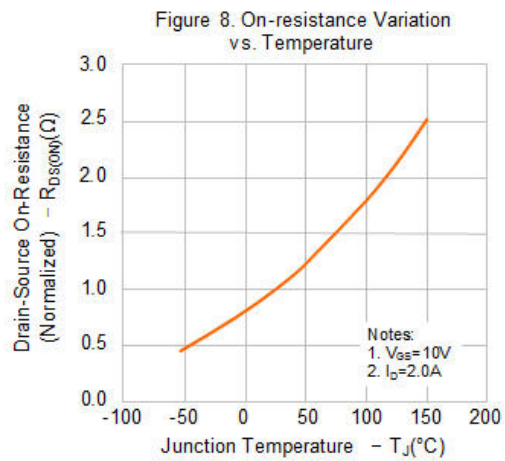
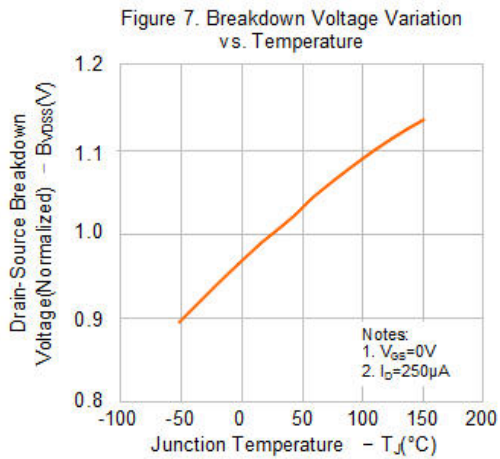
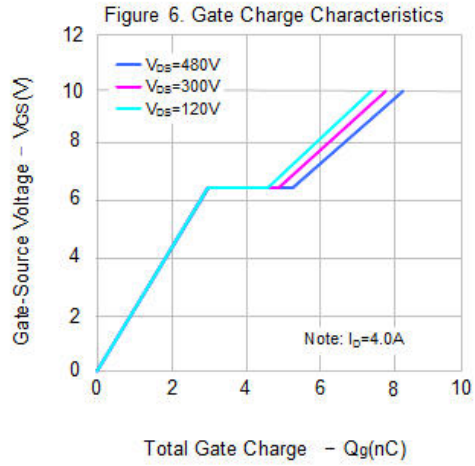
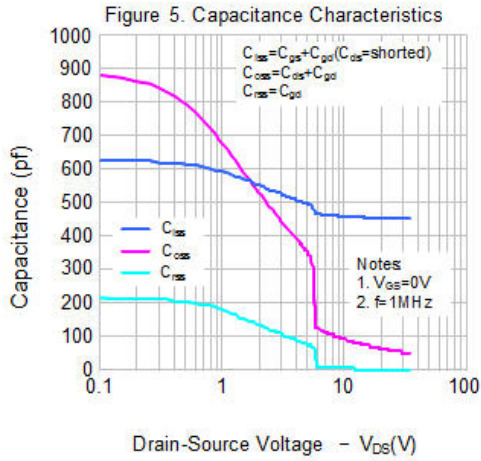


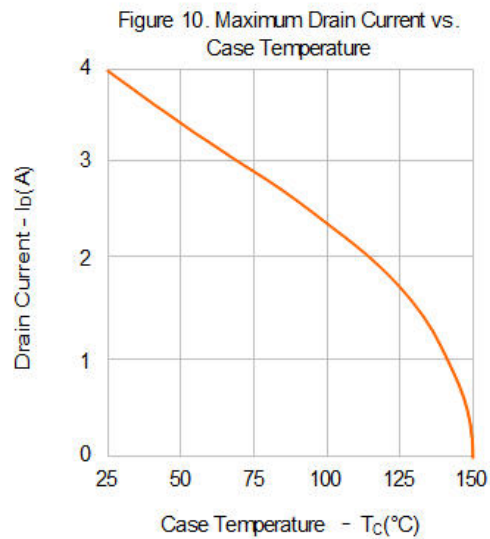
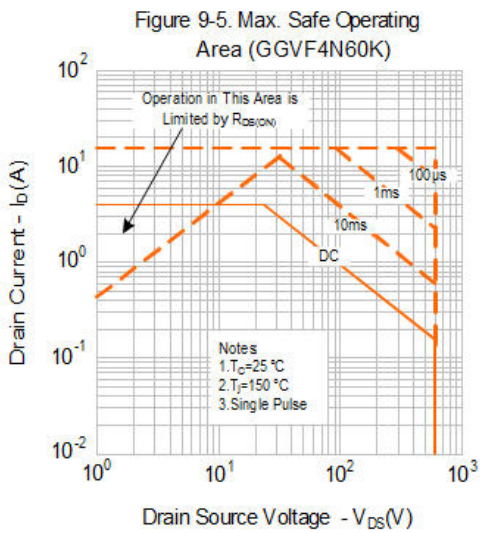
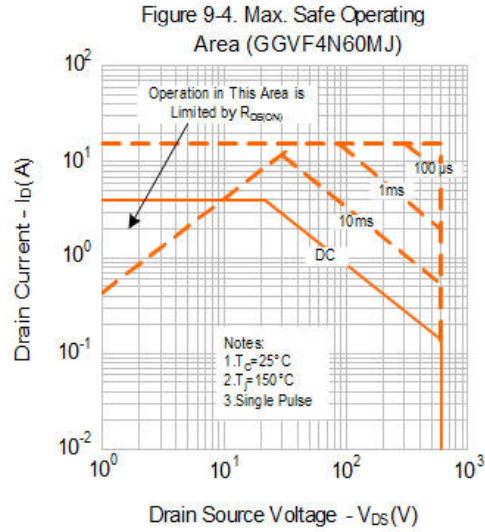
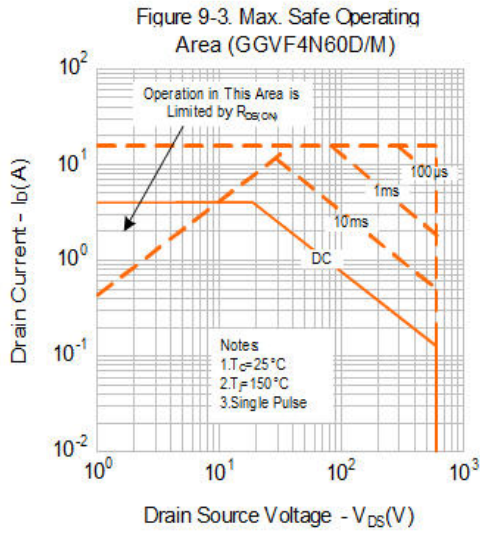
Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature



**Typical Characteristics (continued)**



**Typical Characteristics (continued)**



**Absolute Maximum Ratings** ( $T_C=25^\circ\text{C}$  unless otherwise noted)

Characteristics	Symbol	Ratings					Unit
		GGVF4N 60T	GGVF4N 60F(G)	GGVF4N 60D/M	GGVF4N 60MJ	GGVF4N 60K	
Drain-Source Voltage	$V_{DS}$	600					V
Gate-Source Voltage	$V_{GS}$	$\pm 30$					V
Drain Current	$I_D$	$T_C=25^\circ\text{C}$					A
		$T_C=100^\circ\text{C}$					
Drain Current Pulsed	$I_{DM}$	16					A
Power Dissipation( $T_C=25^\circ\text{C}$ ) -Derate above $25^\circ\text{C}$	$P_D$	100	33	77	86	95	W
		0.8	0.26	0.62	0.69	0.76	
Single Pulsed Avalanche Energy(Note 1)	$E_{AS}$	217					mJ
Operation Junction Temperature Range	$T_J$	$-55\sim+150$					$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	$-55\sim+150$					$^\circ\text{C}$

**Thermal Characteristics**

Characteristics	Symbol	Ratings					Unit
		GGVF4N 60T	GGVF4N 60F(G)	GGVF4N 60D/M	GGVF4 N 60MJ	GGVF4 N 60K	
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.25	3.85	1.61	1.45	1.32	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	120	110	110	62.5	$^\circ\text{C/W}$

**Electrical Characteristics** ( $T_C=25^\circ\text{C}$ , Unless Otherwise Specified)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Drain -Source Breakdown Voltage	$B_{V_{DS}}$	$V_{GS}=0V, I_D=250\mu\text{A}$	600	--	--	V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$	--	--	1.0	$\mu\text{A}$
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30V, V_{DS}=0V$	--	--	$\pm 100$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}, I_D=250\mu\text{A}$	2.0	--	4.0	V
Static Drain- Source On State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=2A$	--	2.0	2.4	$\Omega$
Input Capacitance	$C_{iss}$	$V_{DS}=25V, V_{GS}=0V,$ $f=1.0\text{MHZ}$	--	449.7	--	pF
Output Capacitance	$C_{oss}$		--	57	--	
Reverse Transfer Capacitance	$C_{rss}$		--	2.0	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=300V, I_D=4A,$ $R_G=25\Omega$	--	16.8	--	ns
Turn-on Rise Time	$t_r$		--	26.2	--	
Turn-off Delay Time	$t_{d(off)}$		--	37.4	--	
Turn-off Fall Time	$t_f$		(Note2,3)	--	20.2	
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=4A,$ $V_{GS}=10V$	--	8.16	--	nC
Gate-Source Charge	$Q_{gs}$		--	2.63	--	
Gate-Drain Charge	$Q_{gd}$		(Note 2,3)	--	3.01	

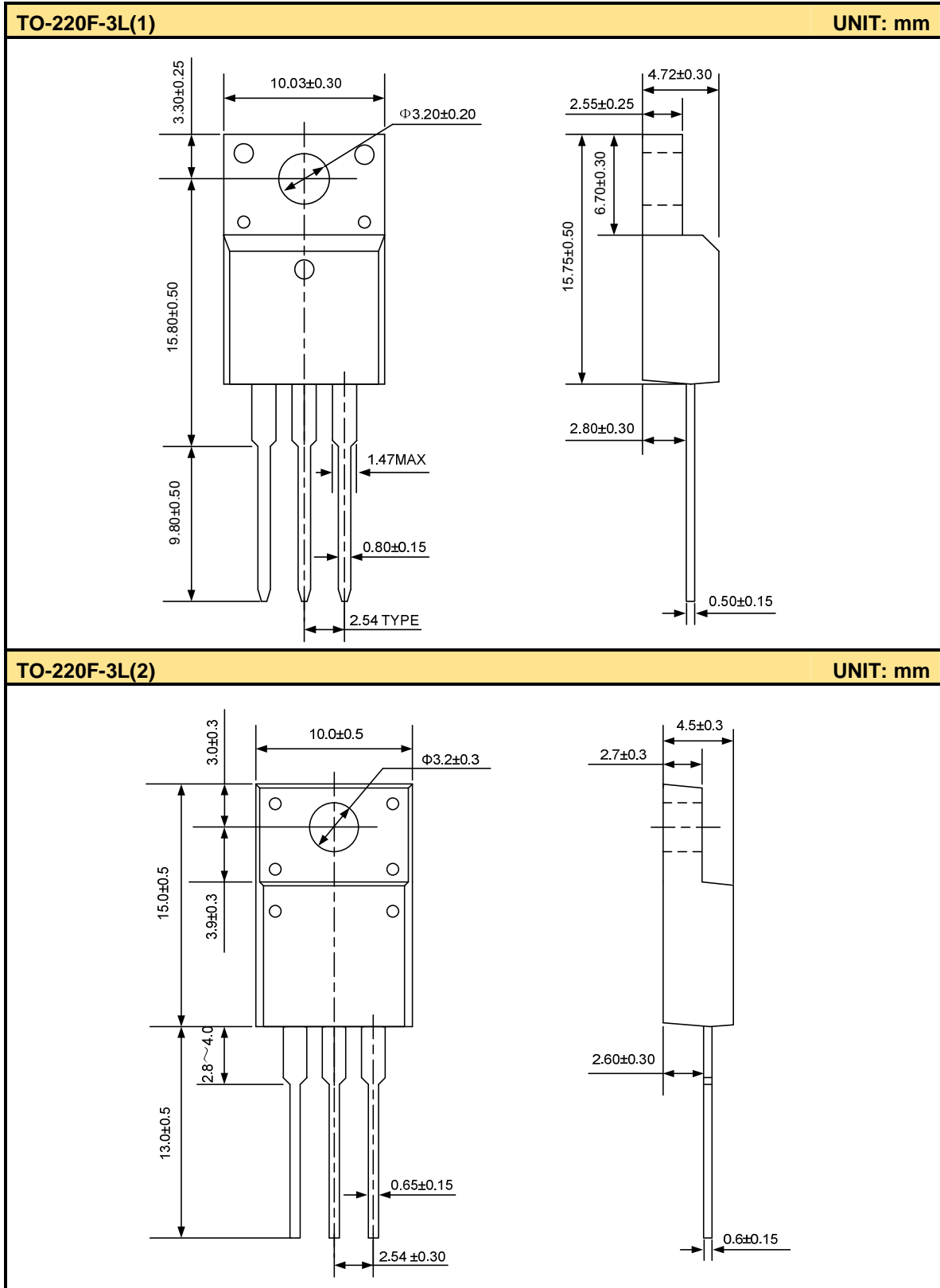
## Source-Drain Diode Ratings and Characteristics

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Continuous Source Current	$I_S$	Integral Reverse P-N Junction Diode in the MOSFET	--	--	4.0	A
Pulsed Source Current	$I_{SM}$		--	--	16	
Diode Forward Voltage	$V_{SD}$	$I_S=4.0A, V_{GS}=0V$	--	--	1.4	V
Reverse Recovery Time	$T_{rr}$	$I_S=4.0A, V_{GS}=0V,$ $dI_F/dt=100A/\mu s$ (Note 2)	--	441.5 3	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	1.98	--	$\mu C$

**Notes:**

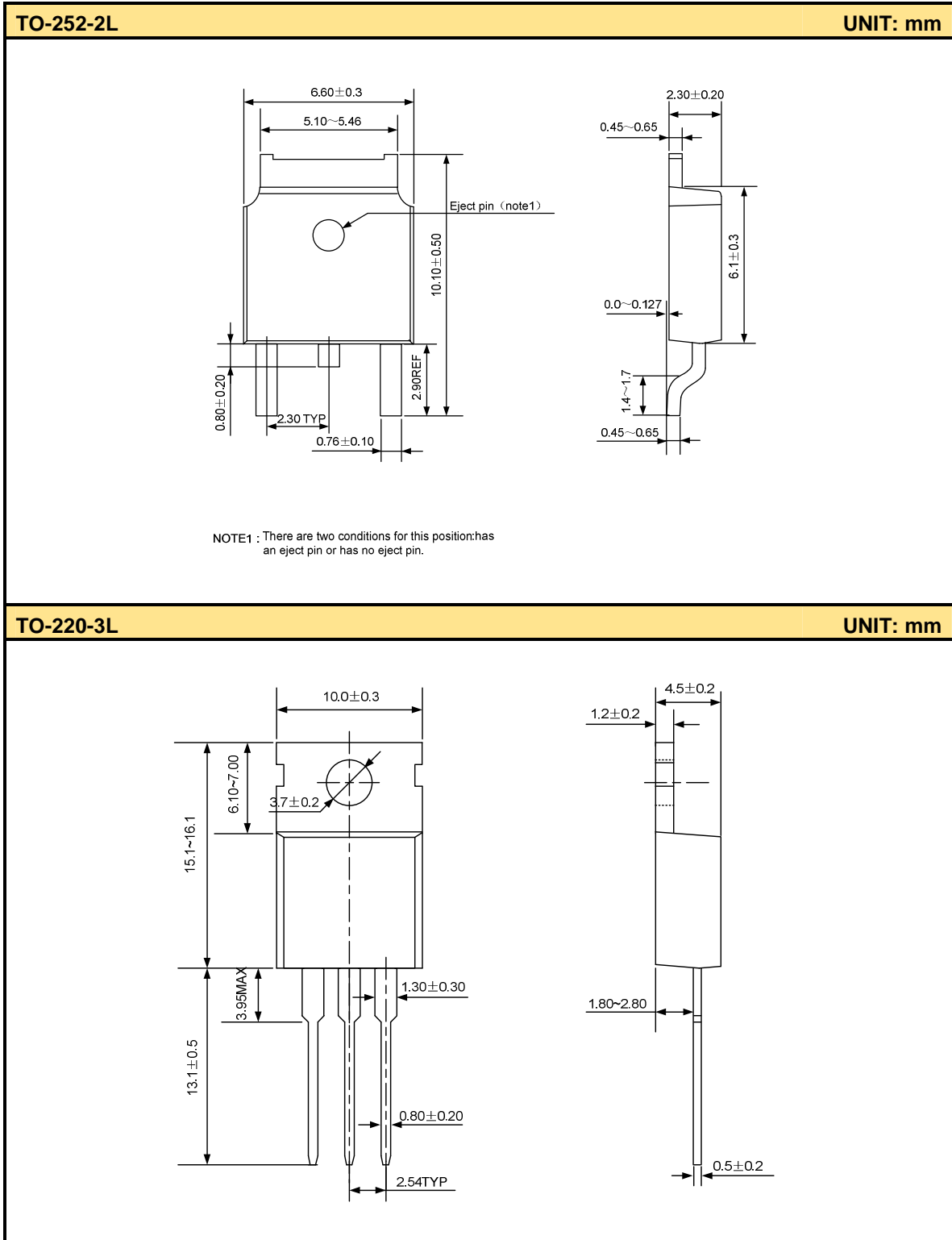
1.  $L=30mH, I_{AS}=3.45A, V_{DD}=155V, R_G=25\Omega,$  starting  $T_{BJB}=25^\circ C$ ;
2. Pulse Test: Pulse width  $\leq 300\mu s,$  Duty cycle  $\leq 2\%$ ;
3. Essentially independent of operating temperature.

**Package Outline**

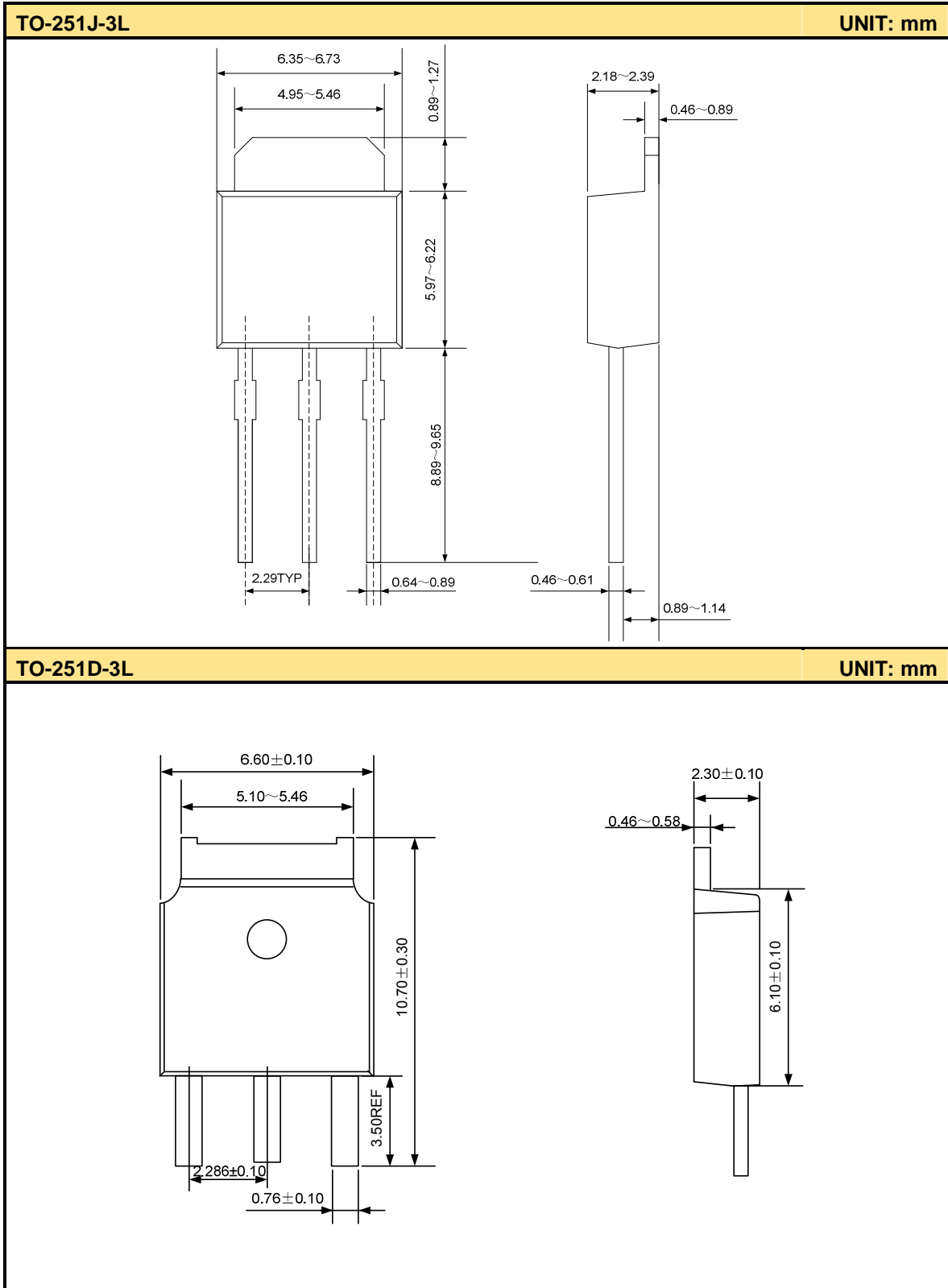




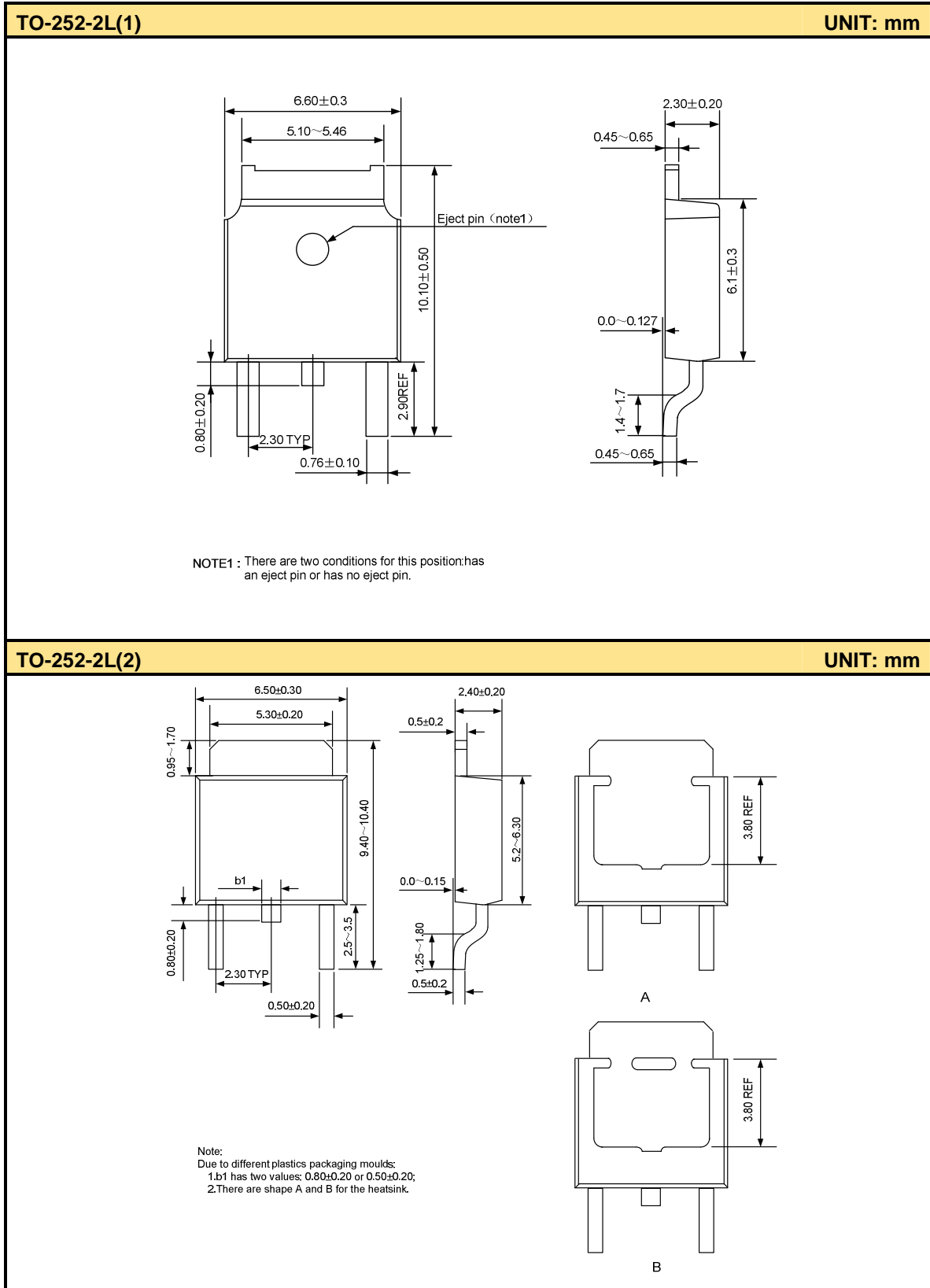
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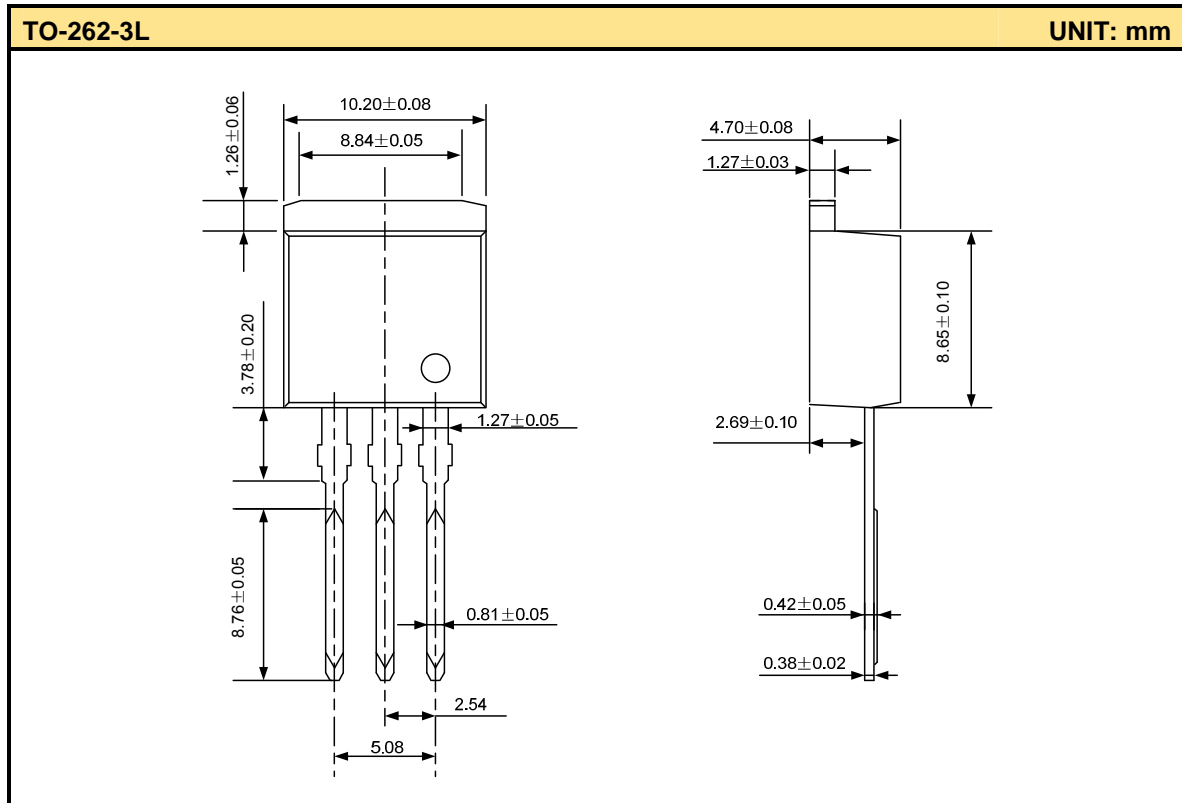
**Package Outline (continued)**



**Package Outline (continued)**



**Package Outline (continued)**



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