

# 650V, 7.0A, 350mΩ N-channel Power SuperJunction MOSFET

## JMH65R400MKFD

### Features

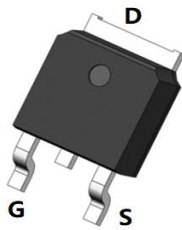
- Excellent  $R_{DS(ON)}$  and Low Gate Charge
- 100% UIS Tested
- 100%  $\Delta V_{ds}$  Tested
- Halogen-free; RoHS-compliant

### Applications

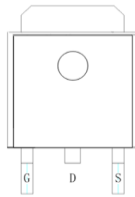
- SMPS with PFC
- Flyback and LLC topologies
- Silver ATX, adapter, TV, lighting, Telecom

### Product Summary

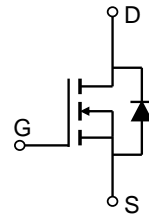
Parameters	Value	Unit
$V_{DSS}$	650	V
$V_{GS(th\_Typ)}$	4.0	V
$I_D(@V_{GS}=10V)$	7.0	A
$R_{DS(ON)\_Typ}(@V_{GS}=10V)$	350	mΩ



TO-252-3L



Pin Assignment



Schematic Diagram

### Ordering Information

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
JMH65R400MKFD-13	H65R400MF	3	Tape&Reel	TO-252-3L	2500	25000

### Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-to-Source Voltage	650	V
$V_{GS}$	Gate-to-Source Voltage	$\pm 30$	V
$I_D$	Continuous Drain Current	$T_C = 25^\circ\text{C}$	7.0
		$T_C = 100^\circ\text{C}$	4.4
$I_{DM}$	Pulsed Drain Current <sup>(1)</sup>	Refer to Fig.4	A
$E_{AS}$	Single Pulsed Avalanche Energy <sup>(2)</sup>	29	mJ
$P_D$	Power Dissipation	$T_C = 25^\circ\text{C}$	50
		$T_C = 100^\circ\text{C}$	20
$T_J, T_{STG}$	Junction & Storage Temperature Range	-55 to 150	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Max	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient <sup>(3)</sup>	39	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	2.5	

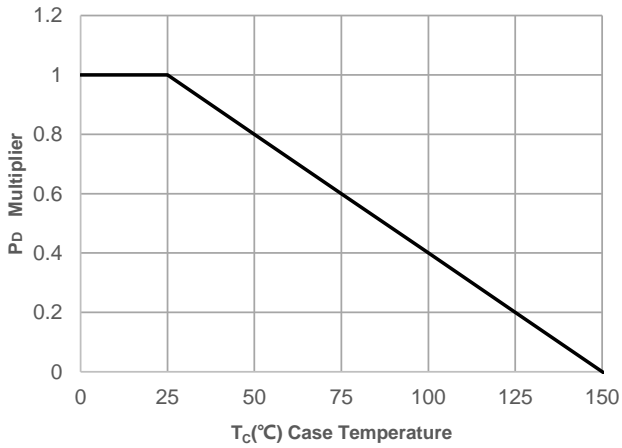
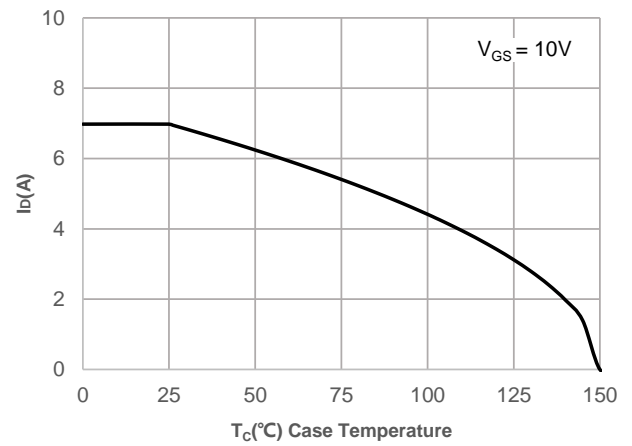
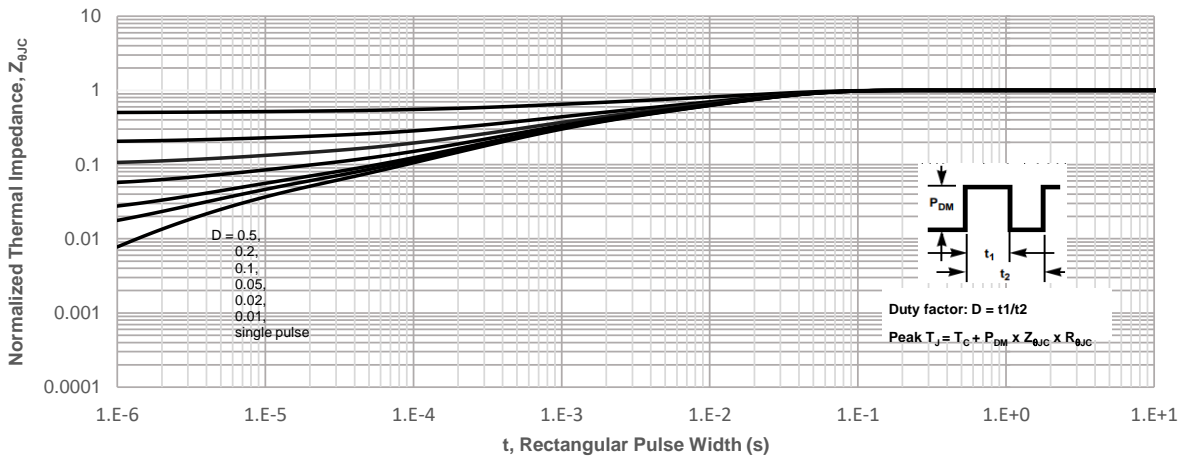
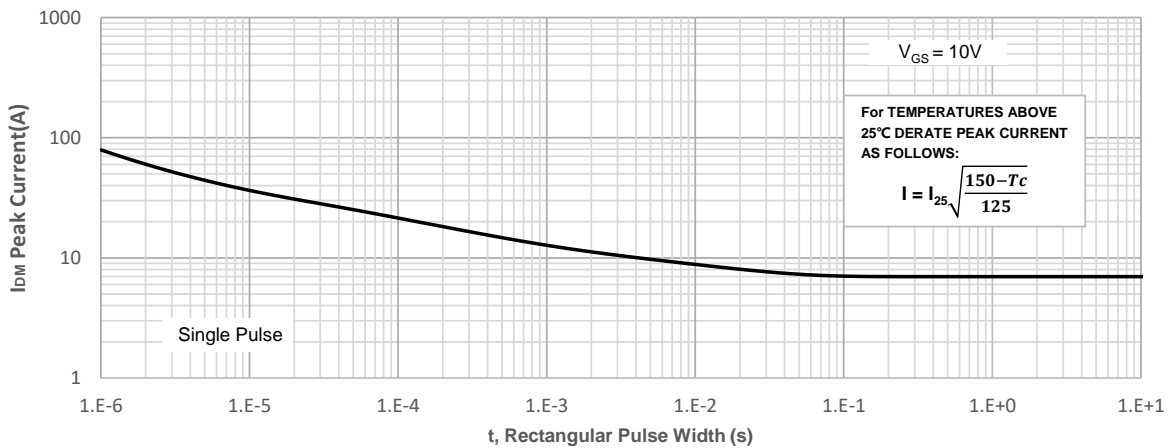
**Electrical Characteristics** ( $T_J = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$	650	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{V}$ , $V_{GS} = 0\text{V}$	-	-	1.0	$\mu\text{A}$
$I_{GSS}$	Gate-Body Leakage Current	$V_{DS} = 0\text{V}$ , $V_{GS} = \pm 30\text{V}$	-	-	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$	3.0	4.0	5.0	V
$R_{DS(ON)}$	Static Drain-Source ON-Resistance <sup>(4)</sup>	$V_{GS} = 10\text{V}$ , $I_D = 5.5\text{A}$	-	350	400	m $\Omega$
<b>Dynamic Characteristics</b>						
$R_g$	Gate Resistance	$f = 1\text{MHz}$	-	17	-	$\Omega$
$C_{iss}$	Input Capacitance	$V_{GS} = 0\text{V}$ , $V_{DS} = 325\text{V}$ , $f = 1\text{MHz}$	608	851	1149	pF
$C_{oss}$	Output Capacitance		20	29	39	pF
$C_{rss}$	Reverse Transfer Capacitance		-	4.8	-	pF
$Q_g$	Total Gate Charge	$V_{GS} = 0$ to $10\text{V}$ $V_{DS} = 325\text{V}$ , $I_D = 5.5\text{A}$	14	19	26	nC
$Q_{gs}$	Gate Source Charge		-	6	-	nC
$Q_{gd}$	Gate Drain ("Miller") Charge		-	6.7	-	nC
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{GS} = 10\text{V}$ , $V_{DD} = 325\text{V}$ $I_D = 5.5\text{A}$ , $R_{GEN} = 24\Omega$	-	30	-	ns
$t_r$	Turn-On Rise Time		-	33	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	84	-	ns
$t_f$	Turn-Off Fall Time		-	29	-	ns
<b>Body Diode Characteristics</b>						
$I_S$	Maximum Continuous Body Diode Forward Current		-	-	7	A
$I_{SM}$	Maximum Pulsed Body Diode Forward Current		-	-	28	A
$V_{SD}$	Body Diode Forward Voltage	$V_{GS} = 0\text{V}$ , $I_S = 5.5\text{A}$	-	-	1.2	V
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F = 5.5\text{A}$ , $di/dt = 100\text{A}/\mu\text{s}$	70	98	132	ns
$Q_{rr}$	Body Diode Reverse Recovery Charge		-	469	-	nC

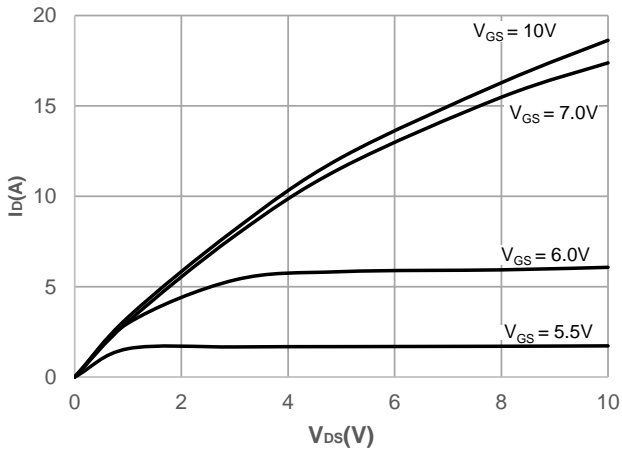
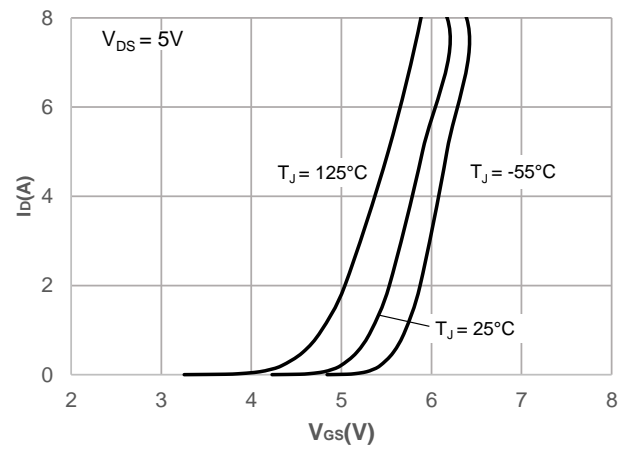
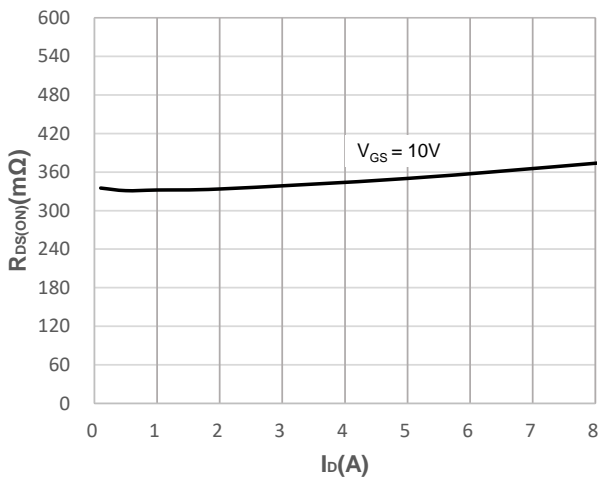
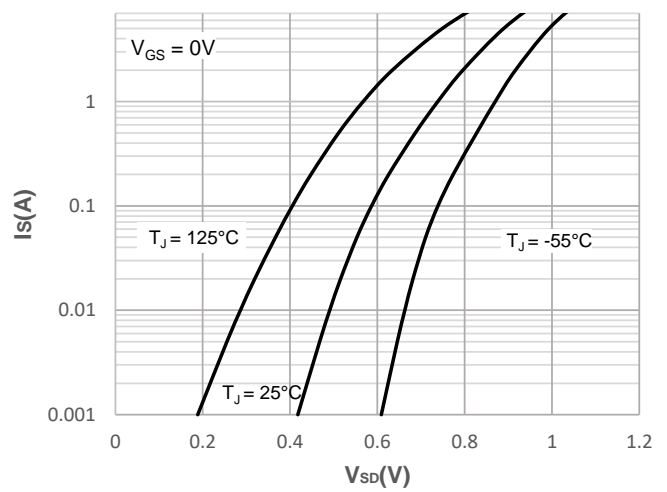
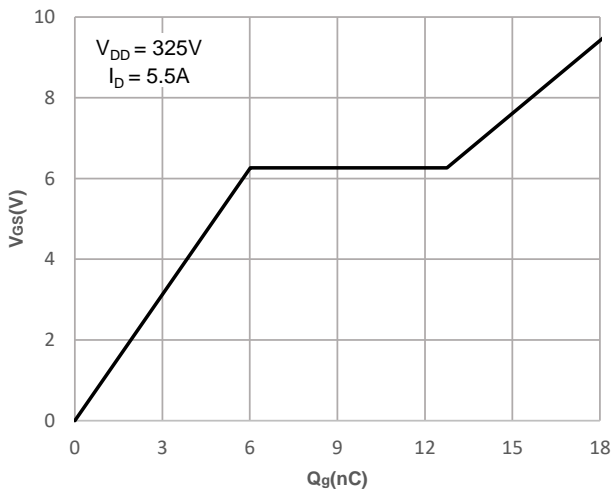
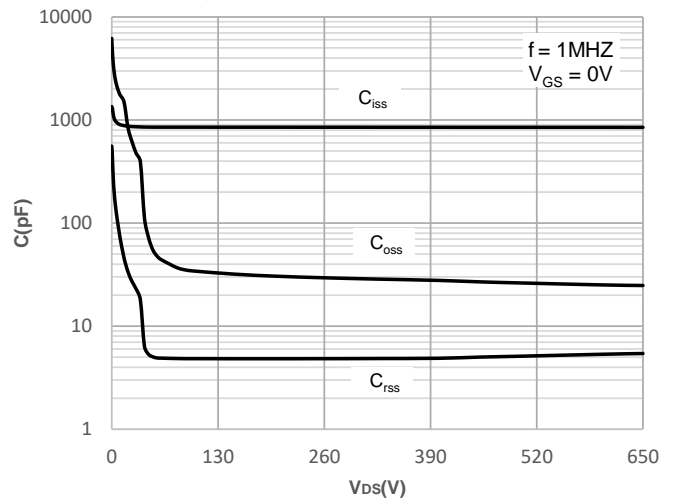
- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
  2.  $E_{AS}$  condition: Starting  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 75\text{V}$ ,  $V_{GS} = 10\text{V}$ ,  $R_G = 25\text{ohm}$ ,  $L = 10\text{mH}$ ,  $I_{AS} = 2.4\text{A}$ ,  $V_{DD} = 0\text{V}$  during time in avalanche.
  3.  $R_{\theta JA}$  is measured with the device mounted on a  $1\text{inch}^2$  pad of 2oz copper FR4 PCB.
  4. Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 0.5\%$ .



## Typical Performance Characteristics

**Figure 1: Power De-rating**

**Figure 2: Current De-rating**

**Figure 3: Normalized Maximum Transient Thermal Impedance**

**Figure 4: Peak Current Capacity**


## Typical Performance Characteristics

**Figure 5: Output Characteristics**

**Figure 6: Typical Transfer Characteristics**

**Figure 7: On-resistance vs. Drain Current**

**Figure 8: Body Diode Characteristics**

**Figure 9: Gate Charge Characteristics**

**Figure 10: Capacitance Characteristics**


## Typical Performance Characteristics

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

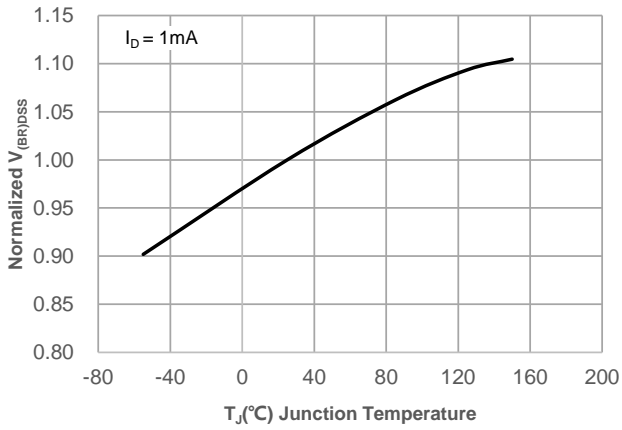


Figure 12: Normalized on Resistance vs. Junction Temperature

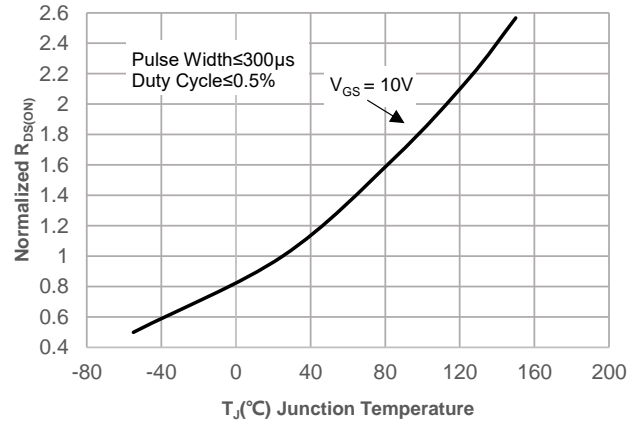


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

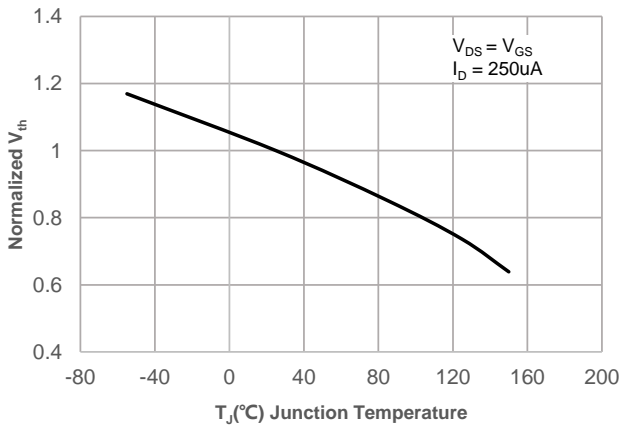


Figure 14:  $R_{DS(ON)}$  vs.  $V_{GS}$

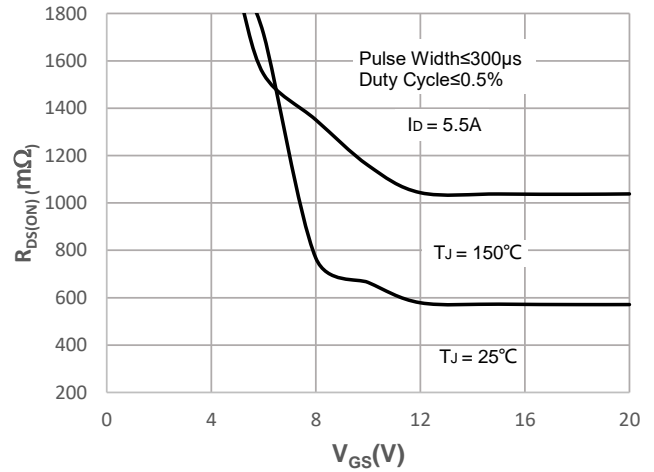
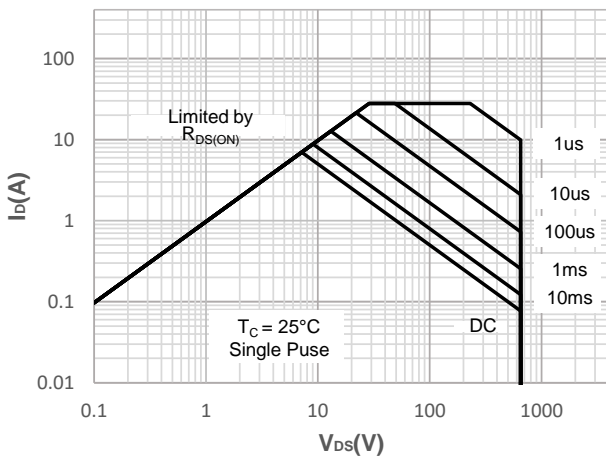
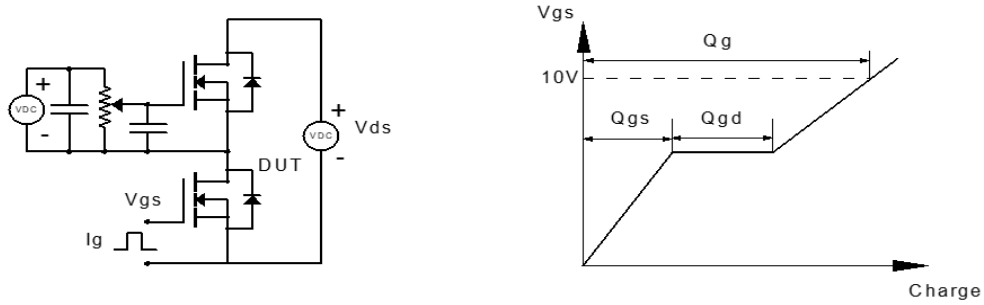


Figure 15: Maximum Safe Operating Area



**Test Circuit**

**Figure 1: Gate Charge Test Circuit & Waveform**

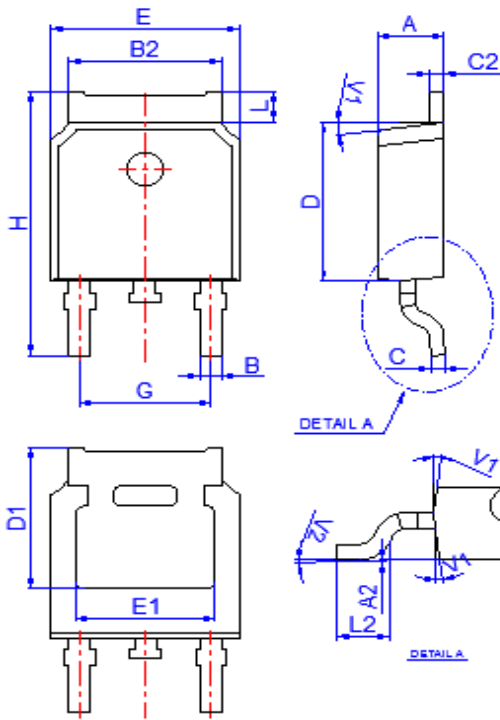
**Figure 2: Resistive Switching Test Circuit & Waveform**

**Figure 3: Unclamped Inductive Switching Test Circuit & Waveform**

**Figure 4: Diode Recovery Test Circuit & Waveform**

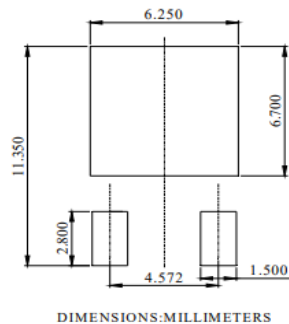
## Package Mechanical Data(TO-252-3L)

### Package Outline



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.10		2.50	0.083		0.098
A2	0		0.15	0		0.006
B	0.66		0.86	0.026		0.034
B2	5.18		5.48	0.202		0.216
C	0.40		0.60	0.016		0.024
C2	0.44		0.58	0.017		0.023
D	5.90		6.30	0.232		0.248
D1	5.30REF			0.209RE F		
E	6.40		6.80	0.252		0.268
E1	4.63			0.182		
G	4.47		4.67	0.176		0.184
H	9.50		10.70	0.374		0.421
L	1.09		1.21	0.043		0.048
L2	1.35		1.65	0.053		0.065
V1		7°			7°	
V2		0°	6°		0°	6°

### Recommended Soldering Footprint



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