

1.Description

Features of this design are a 150°C junction operating temperature, fast switching speed and improved repetitive avalanche rating.

2.Features

- $V_{DS(V)} = -55V$
- $I_D = -42A (V_{GS} = -10V)$
- $R_{DS(ON)} < 20m\Omega (V_{GS} = -10V)$

3.Pinning information

Pin	Symbol	Description
1	G	GATE
2	D	DRAIN
3	S	SOURCE



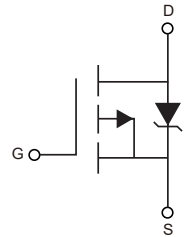
TO-263



TO-220



TO-252



4.Absolute Maximum Ratings

Parameter		Symbol	Rating	Units
Continuous Drain Current, $V_{GS}=10V$ (Silicon Limited)	$T_C=25^{\circ}C$	I_D	-70	A
Continuous Drain Current, $V_{GS}=10V$ (See Fig. 9)	$T_C=100^{\circ}C$		-44	A
Continuous Drain Current, $V_{GS}=10V$ (Package Limited)	$T_C=25^{\circ}C$		-42	A
Pulsed Drain Current ①		I_{DM}	-280	A
Maximum Power Dissipation	$T_C=25^{\circ}C$	P_D	170	W
Linear Derating Factor			1.3	W/°C
Gate-to-Source Voltage		V_{GS}	±20	V
Single Pulse Avalanche Energy ②		E_{AS}	140	mJ
Single Pulse Avalanche Energy Tested Value ⑥		$E_{AS(tested)}$	790	mJ
Avalanche Current ①		I_{AR}	See Fig.12a, 12b,15,16	A
Repetitive Avalanche Energy ⑤		E_{AR}		mJ
Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C
Soldering Temperature, for 10 seconds			300(1.6mm from case)	°C
Mounting torque, 6-32 or M3 screw ⑦			10 lbf•in (1.1N•m)	



5.Thermal resistance rating

Parameter	Symbol	Typ	Max	Units
Junction-to-Case ⑧	$R_{\theta JC}$		0.75	°C/W
Junction-to-Ambient (PCB Mount, steady state)⑦⑧	$R_{\theta JA}$		40	°C/W



6.SPECIFICATIONS (T_J= 25°C, unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$I_D = -250\mu A$, $V_{GS} = 0V$	-55			V
Breakdown Voltage Temp. Coefficient	$\Delta V_{(BR)DSS} / \Delta T_J$	Reference to 25°C, $I_D = -1mA$		-0.054		V/°C
Static Drain-to-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = -10V$, $I_D = -42A$ ③			-20	mΩ
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = -250\mu A$	-1.1	-1.8	-2.5	V
Forward Transconductance	g_{FS}	$V_{DS} = -25V$, $I_D = -42A$		19		S
Drain-to-Source Leakage Current	I_{DSS}	$V_{DS} = -55V$, $V_{GS} = 0V$			-25	μA
		$V_{DS} = -44V$, $V_{GS} = 0V$, $T_J = 125^\circ C$			-200	μA
Gate-to-Source Forward Leakage	I_{GSS}	$V_{GS} = -20V$			100	nA
Gate-to-Source Reverse Leakage		$V_{GS} = 20V$			-100	nA
Total Gate Charge	Q_g	$I_D = -42A$, $V_{DS} = -44V$ $V_{GS} = -10V$ ③		120	180	nC
Gate-to-Source Charge	Q_{gs}			32		nC
Gate-to-Drain ("Miller") Charge	Q_{gd}			53		nC
Turn-On Delay Time	$t_{D(on)}$	$V_{DD} = -28V$, $I_D = -42A$ $R_G = 2.6\Omega$, $V_{GS} = -10V$ ③		20		ns
Rise Time	t_r			99		ns
Turn-Off Delay Time	$t_{D(off)}$			51		ns
Fall Time	t_f			64		ns
Internal Source Inductance	L_S	Between lead, and center of die contact		7.5		nH
Input Capacitance	C_{iss}	$V_{GS} = 0V$, $V_{DS} = -25V$, $f = 1MHz$		3500		pF
Output Capacitance	C_{oss}			1250		pF
Reverse Transfer Capacitance	C_{rss}			450		pF
Output Capacitance	C_{oss}	$V_{GS} = 0V$, $V_{DS} = -1V$, $f = 1MHz$		4620		pF
Output Capacitance	C_{oss}	$V_{GS} = 0V$, $V_{DS} = -44V$, $f = 1MHz$		940		pF
Effective Output Capacitance	$C_{oss\text{eff.}}$	$V_{GS} = 0V$, $V_{DS} = 0V$ to $-44V$ ④		1530		pF



Diode Characteristics						
Continuous Source Current (Body Diode)	I_S	MOSFET symbol showing the integral reverse p-n junction diode.			-42	A
Pulsed Source Current (Body Diode) ①	I_{SM}				-280	A
Diode Forward Voltage	V_{SD}	$T_J=25^\circ\text{C}, I_S=-42\text{A}, V_{GS}=0\text{V}$ ③			-1.3	V
Reverse Recovery Time	t_{rr}	$T_J=25^\circ\text{C}, I_F=-42\text{A}, V_{DD}=-28\text{V}$		61	92	ns
Reverse Recovery Charge	Q_{rr}	$di/dt=-100\text{A}/\mu\text{s}$ ③		150	220	nC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by T_{Jmax} , starting $T_J=25^\circ\text{C}$, $L=0.16\text{mH}$, $R_G=25\Omega$, $I_{AS}=-42\text{A}$, $V_{GS}=-10\text{V}$. Part not recommended for use above this value.
- ③ Pulse width $\leq 1\text{ms}$; duty cycle $\leq 2\%$.
- ④ C_{oss} eff. is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .
- ⑤ Limited by T_{Jmax} , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population. 100% tested to this value in production.
- ⑦ This is applied to D2Pak, when mounted on 1" square PCB (FR-4 or G-10 Material).
- ⑧ R_θ is measured at T_J approximately 90°C .



7.1 Typical Characteristics

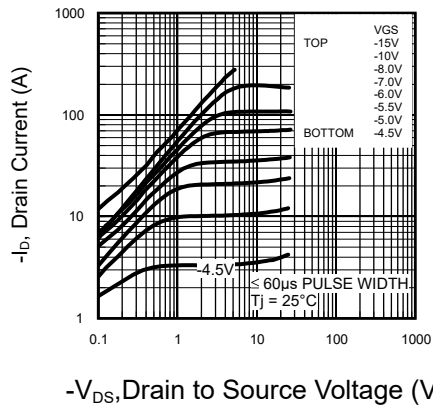


Figure 1: Typical Output Characteristics

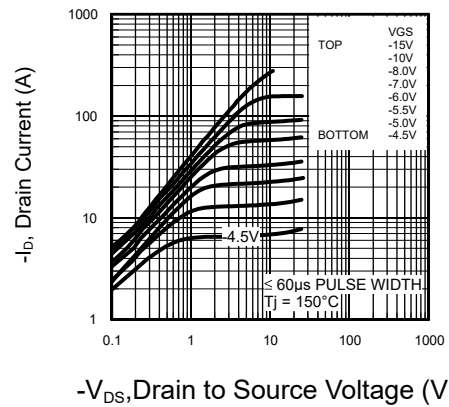


Figure 2: Typical Output Characteristics

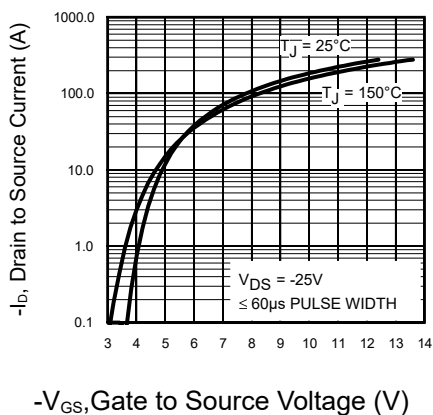


Figure 3: Typical Transfer Characteristics

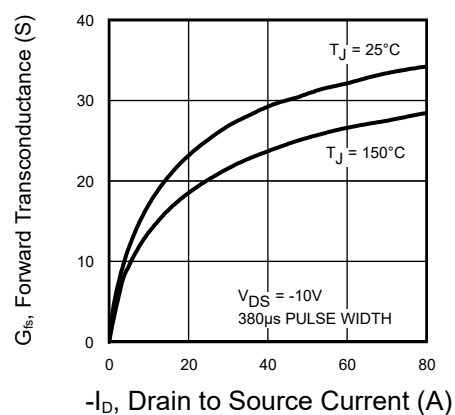


Figure 4: Typical Forward Transconductance vs. Drain Current

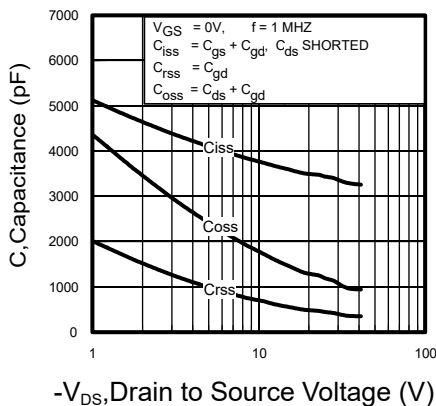


Figure 5: Typical Capacitance vs. Drain-to-Source Voltage

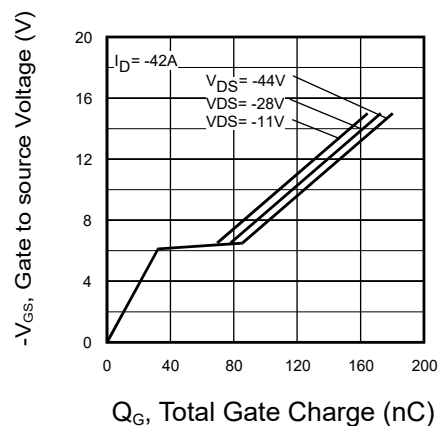


Figure 6: Typical Gate Charge vs. Gate-to-Source Voltage



7.2 Typical Characteristics

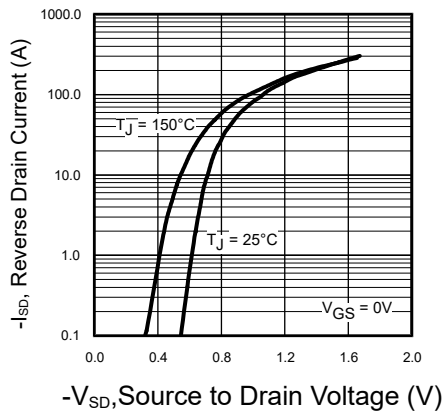


Figure 7: Typical Source-Drain Diode Forward Voltage

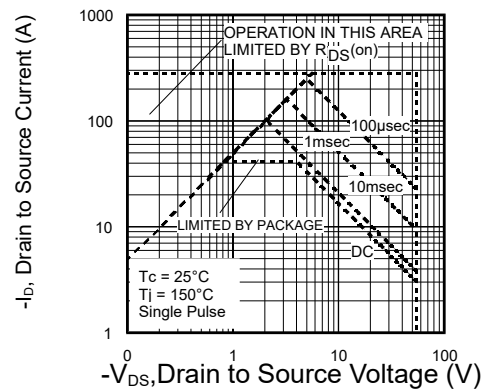


Figure 8: Maximum Safe Operating Area

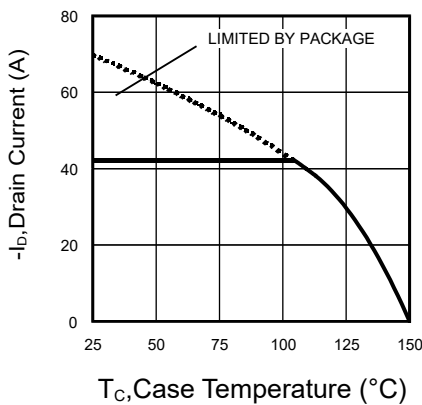


Figure 9: Maximum Drain Current vs. Case Temperature

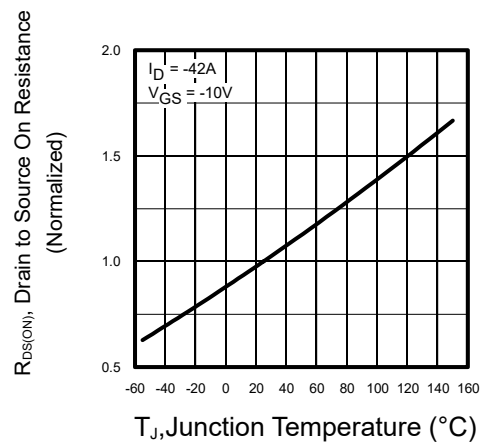


Figure 10: Drain-to-Source Breakdown Voltage

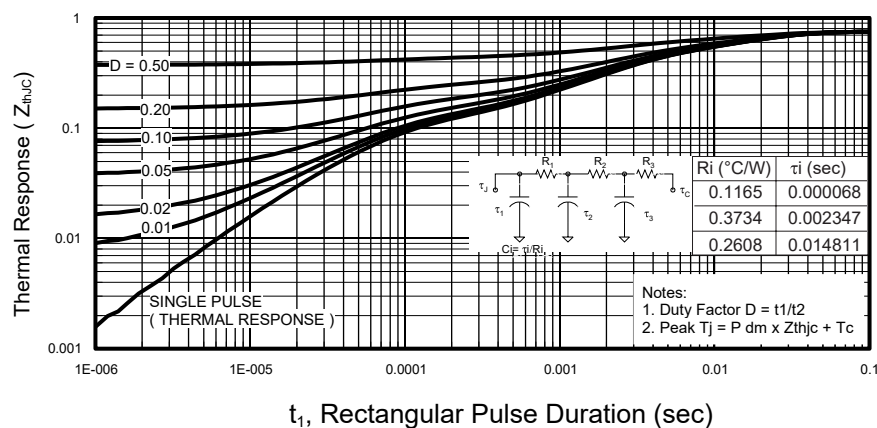


Figure 11: Maximum Effective Transient Thermal Impedance, Junction-to-Case



7.3 Typical Characteristics

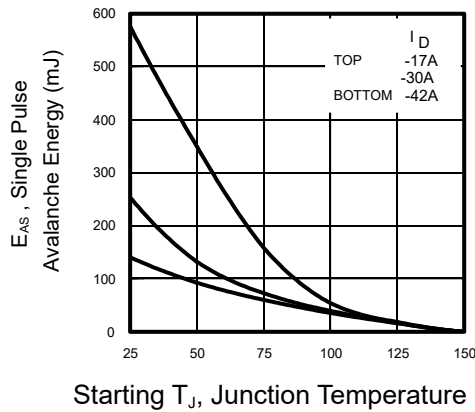


Figure 12c: Maximum Avalanche Energy vs. Drain Current

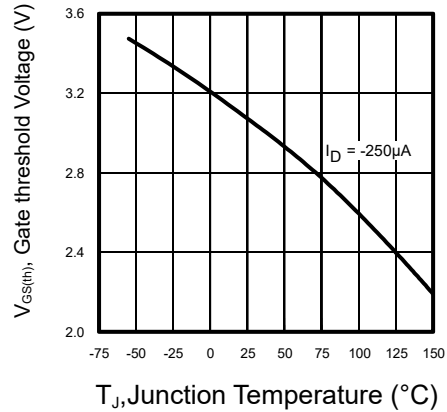


Figure 14: Threshold Voltage vs. Temperature

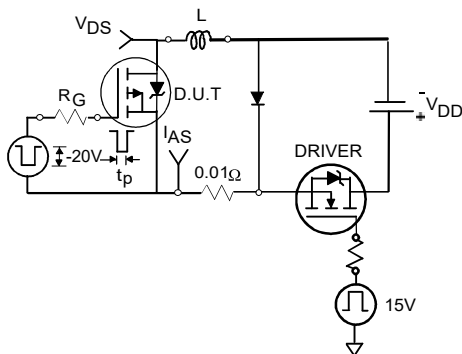


Figure 12a: Unclamped Inductive Test Circuit

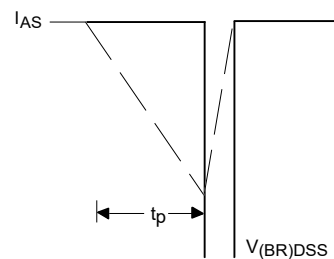


Figure 12b: Unclamped Inductive Waveforms

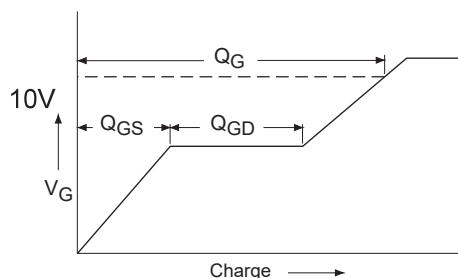


Figure 13a: Basic Gate Charge Waveform

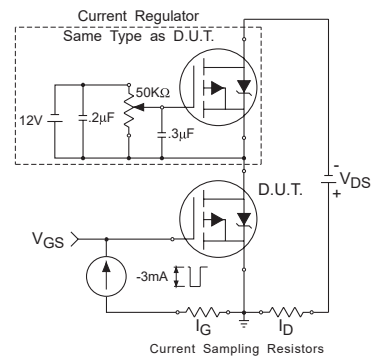


Figure 13b: Gate Charge Test Circuit



7.4Typical Characteristics

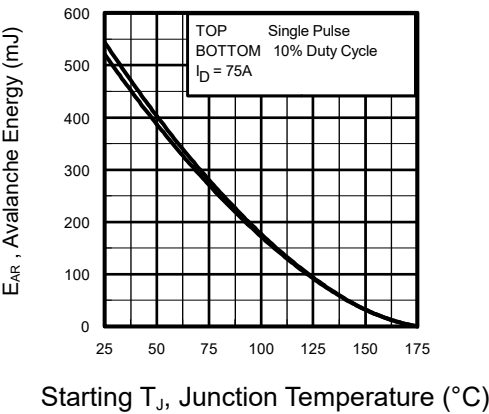


Figure 15: Maximum Avalanche Energy Vs. Temperature

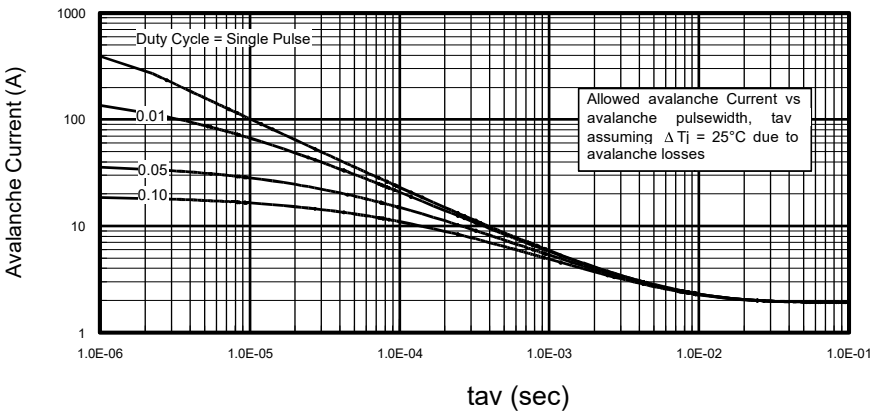


Figure 16: Typical Avalanche Current Vs.Pulsewidth



Notes on Repetitive Avalanche Curves , Figures 15, 16:

1. Avalanche failures assumption: Purely a thermal phenomenon and failure occurs at a temperature far in excess of T_{jmax} .

This is validated for every part type.

2. Safe operation in Avalanche is allowed as long as T_{jmax} is not exceeded.

3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.

4. $P_{D(ave)}$ = Average power dissipation per single avalanche pulse.

5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).

6. I_{av} = Allowable avalanche current.

7. ΔT = Allowable rise in junction temperature, not to exceed

T_{jmax} (assumed as 25°C in Figure 15,16).

t_{av} = Average time in avalanche.

D = Duty cycle in avalanche = $t_{av} \cdot f$

$Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11).

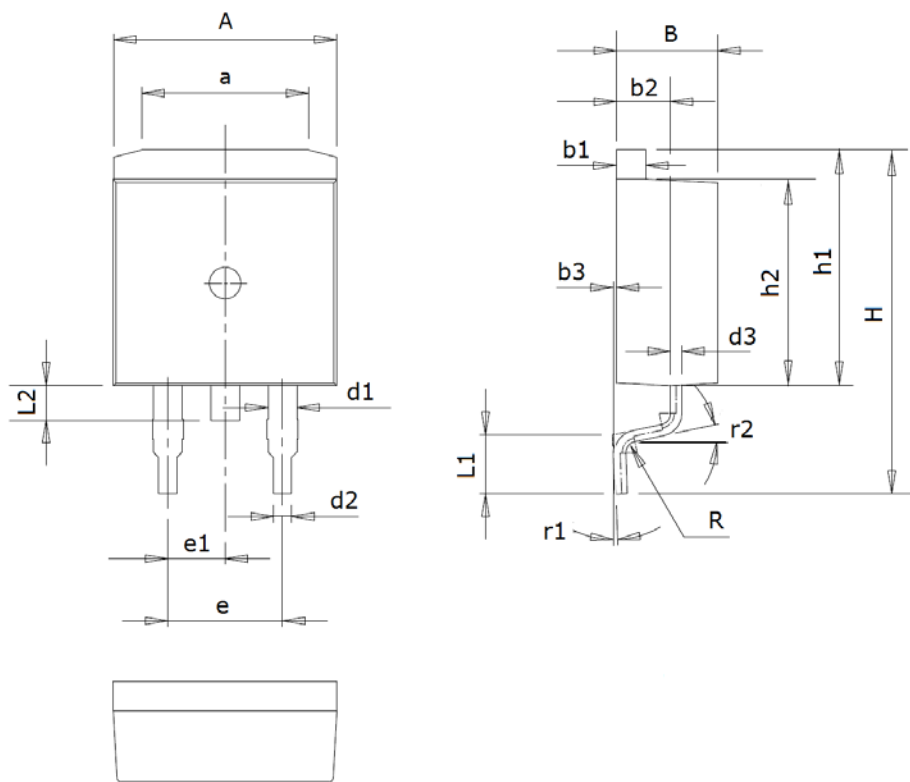
$$P_{D(ave)} = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



8.1TO-263 Package Outline Dimensions

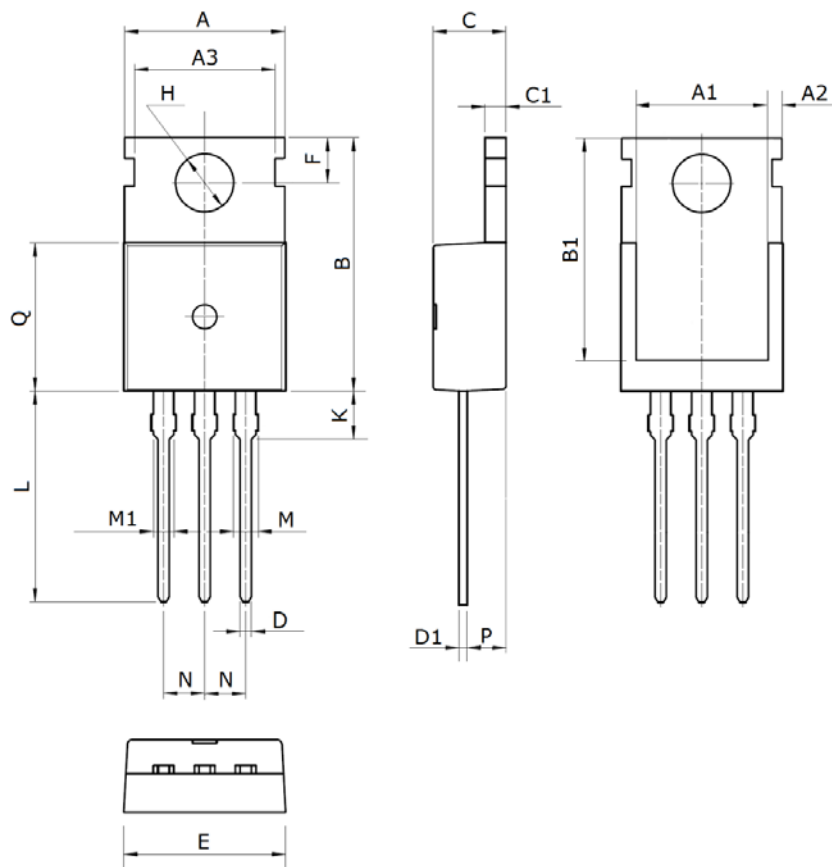


DIMENSIONS (mm are the original dimensions)

Symbol	Dimensions(mm)	Symbol	Dimensions(mm)	Symbol	Dimensions(mm)
A	9.7~10.3	d2	0.7~0.9	L1	2.4~2.9
a	7.0~7.8	d3	0.4~0.6	L2	1.3~1.8
B	4.3~4.7	e	5.08(typ)	R	0.5(typ)
b1	1.25~1.35	e1	2.54(typ)	r1	0~8°
b2	2.2~2.6	H	14.8~15.6	r2	12°(typ)
b3	0~0.2	h1	10.2~10.7		
d1	1.2~1.4	h2	8.9~9.4		



8.2Package Mechanical Data TO-220

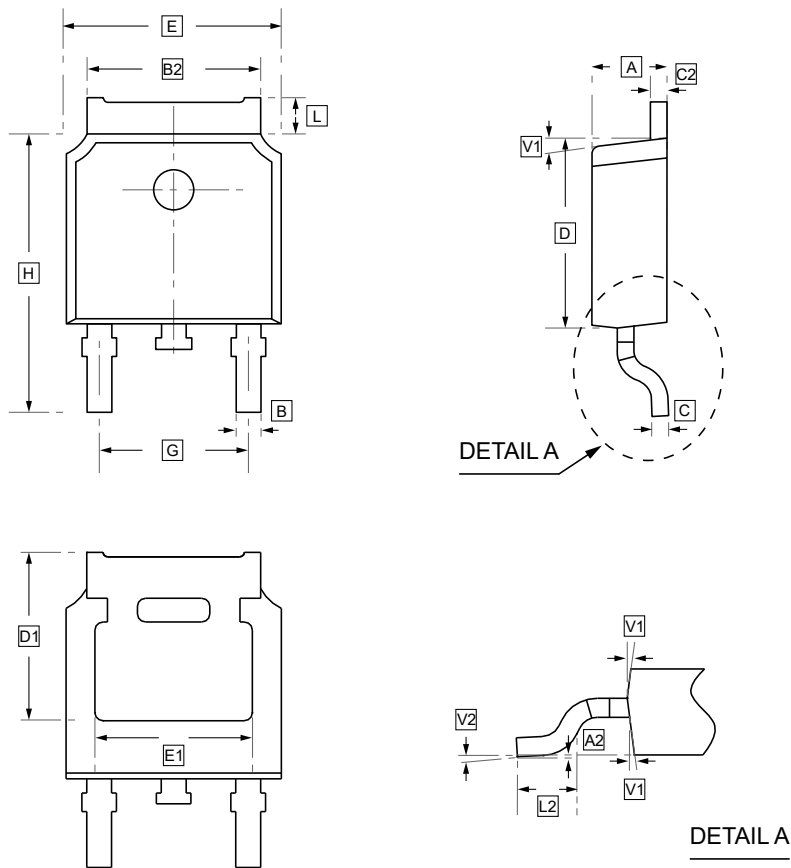


DIMENSIONS (mm are the original dimensions)

Symbol	Dimensions(mm)	Symbol	Dimensions(mm)	Symbol	Dimensions(mm)
A	10.0±0.3	C1	1.3±0.2	L	13.2±0.4
A1	8.0±0.2	D	0.8±0.2	M	1.38±0.1
A2	0.94±0.1	D1	0.5±0.1	M1	1.28±0.1
A3	8.7±0.1	E	10.0±0.3	N	2.54(typ)
B	15.6±0.4	F	2.8±0.1	P	2.4±0.3
B1	13.2±0.2	H	3.6±0.1	Q	9.15±0.25
C	4.5±0.2	K	3.1±0.2		



8.3TO-252 PACKAGE OUTLINE DIMENSIONS

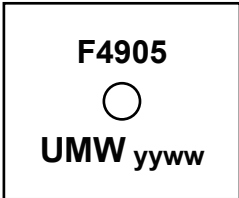
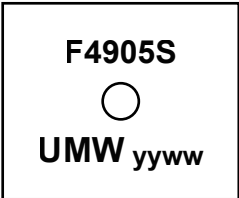
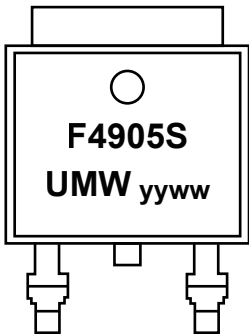


DIMENSIONS (mm are the original dimensions)

Symbol	A	A2	B	B2	C	C2	D	D1	E	E1	G	H	L	L2	V1	V2
Min	2.10	0	0.66	5.18	0.40	0.44	5.90	5.30	6.40	4.63	4.47	9.50	1.09	1.35		0°
Max	2.50	0.10	0.86	5.48	0.60	0.58	6.30	REF	6.80		4.67	10.70	1.21	1.65		6°



9.Ordering information



yy: Year Code
ww: Week Code

Order Code	Package	Base QTY	Delivery Mode
UMW IRF4905STRL	TO-252	2500	Tape and reel
UMW IRF4905STRLP	TO-263	800	Tape and reel
UMW IRF4905	TO-220	1000	Tube and Box



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