



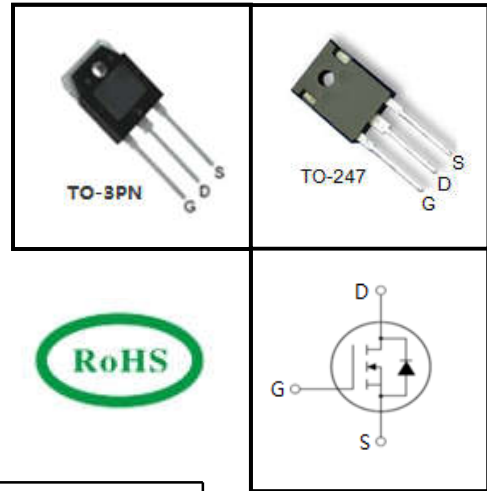
650V Super-Junction Power MOSFET

FEATURES

- Very low FOM $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- RoHS compliant

APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



Device Marking and Package Information

Device	TPV65R040M	TPW65R040M
Package	TO-3PN	TO-247
Marking	65R040M	65R040M

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

Parameter	Symbol	Value		Unit
		TO-3PN	TO-247	
Drain-Source Voltage ($V_{GS} = 0V$)	V_{DSS}	650		V
Continuous Drain Current	I_D	$T_C = 25^\circ\text{C}$	72	A
		$T_C = 100^\circ\text{C}$	43.2	
Pulsed Drain Current (note1)	I_{DM}	216		A
Gate-Source Voltage	V_{GSS}	± 30		V
Single Pulse Avalanche Energy (note2)	E_{AS}	2185		mJ
Avalanche Current (note1)	I_{AR}	13.7		A
Repetitive Avalanche Energy (note1)	E_{AR}	3.31		mJ
MOSFET dv/dt ruggedness, $V_{DS} = 0 \dots 480V$	dv/dt	50		V/ns
Reverse diode dv/dt, $V_{DS} = 0 \dots 480V$, $I_{SD} \leq I_D$	dv/dt	15		V/ns
Power Dissipation ($T_C = 25^\circ\text{C}$)	P_D	500		W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55~+150		$^\circ\text{C}$

Thermal Resistance

Parameter	Symbol	Value		Unit
		TO-3PN	TO-247	
Thermal Resistance, Junction-to-Case	R_{thJC}	0.25		$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62		



Specifications $T_J = 25^\circ\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	650	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 650V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	μA
		$V_{DS} = 650V, V_{GS} = 0V, T_J = 150^\circ\text{C}$	--	--	100	
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 30V$	--	--	± 100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5	--	4.5	V
Drain-Source On-Resistance (Note3)	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 25A$	--	0.035	0.04	Ω
Gate resistance	R_G	$f = 1.0\text{MHz}$ open drain	--	0.3	--	Ω
Dynamic						
Input Capacitance	C_{iss}	$V_{GS} = 0V,$ $V_{DS} = 100V,$ $f = 1.0\text{MHz}$	--	7551	--	μF
Output Capacitance	C_{oss}		--	265	--	
Reverse Transfer Capacitance	C_{rss}		--	28	--	
Total Gate Charge	Q_g	$V_{DD} = 520V, I_D = 50A,$ $V_{GS} = 10V$	--	160	--	nC
Gate-Source Charge	Q_{gs}		--	38	--	
Gate-Drain Charge	Q_{gd}		--	60	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V, I_D = 50A,$ $R_G = 25\Omega$	--	45	--	ns
Turn-on Rise Time	t_r		--	161	--	
Turn-off Delay Time	$t_{d(off)}$		--	287	--	
Turn-off Fall Time	t_f		--	87	--	
Drain-Source Body Diode Characteristics						
Continuous Body Diode Current	I_S	$T_C = 25^\circ\text{C}$	--	--	72	A
Pulsed Diode Forward Current	I_{SM}		--	--	216	
Body Diode Voltage	V_{SD}	$T_J = 25^\circ\text{C}, I_{SD} = 72A, V_{GS} = 0V$	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	$V_R = 400V, I_F = 30A,$ $di_F/dt = 100A/\mu s$	--	540	--	ns
Reverse Recovery Charge	Q_{rr}		--	13.5	--	μC
Peak Reverse Recovery Current	I_{rm}		--	50.4	--	A

Notes

1. Repetitive Rating: Pulse Width limited by maximum junction temperature
2. $I_{AS} = 13.7A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 1\%$



Typical Characteristics $T_J = 25^\circ\text{C}$, unless otherwise noted

Figure 1. Output Characteristics

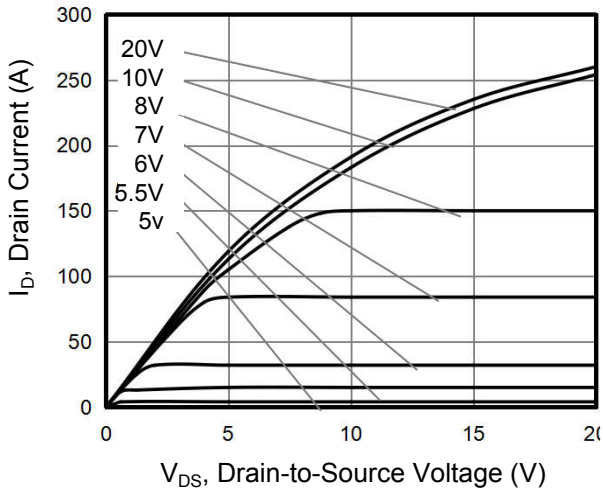


Figure 2. Transfer Characteristics

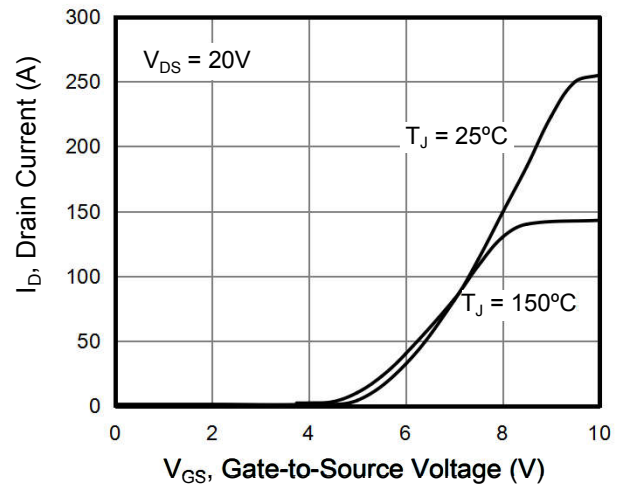


Figure 3. On-Resistance vs. Drain Current

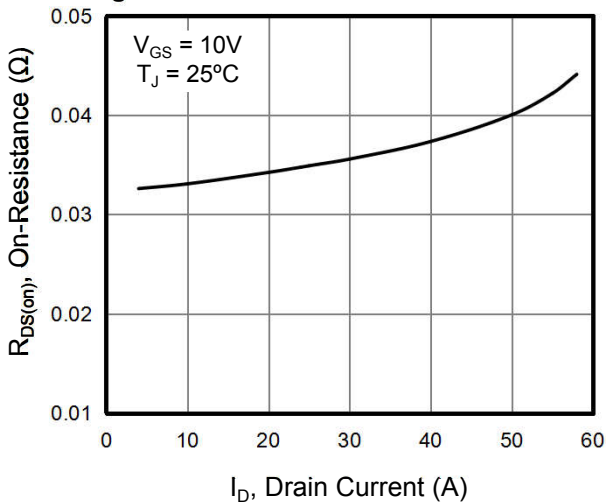


Figure 4. Capacitance

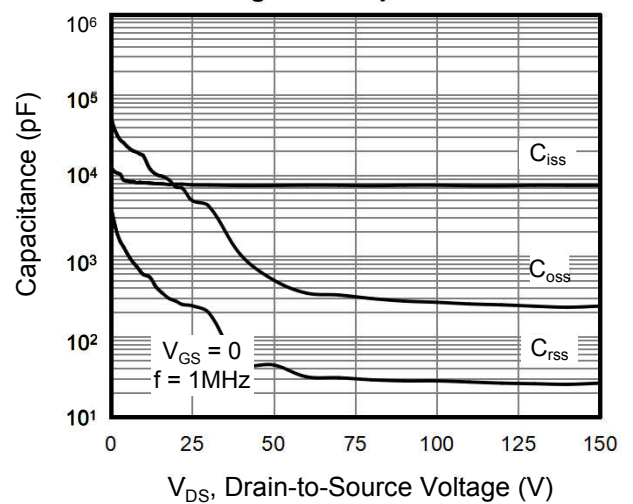


Figure 5. Gate Charge

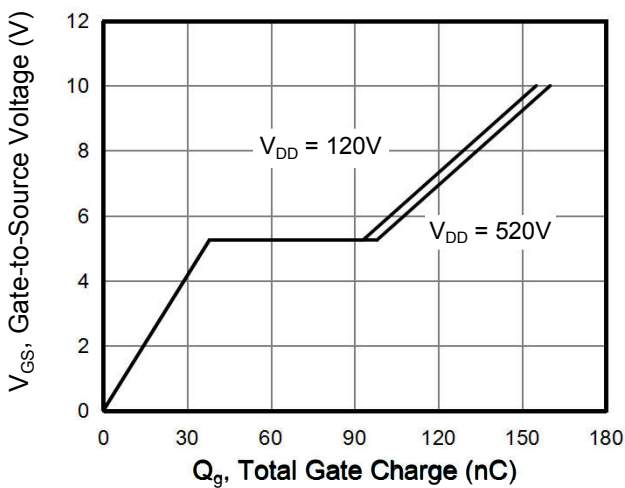
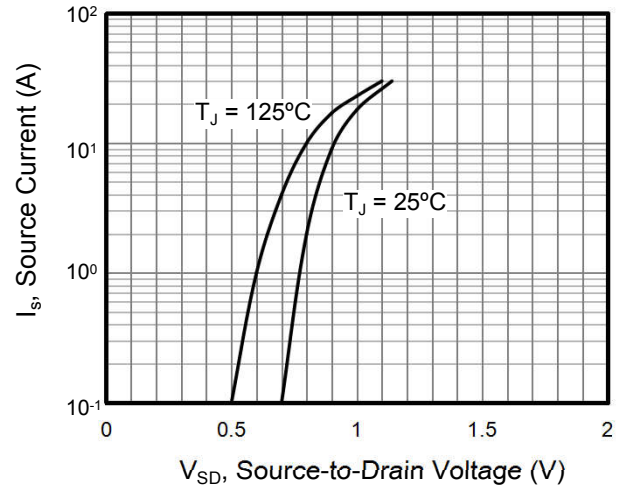


Figure 6. Body Diode Forward Voltage





Typical Characteristics $T_J = 25^\circ\text{C}$, unless otherwise noted

Figure 7. On-Resistance vs. Junction Temperature

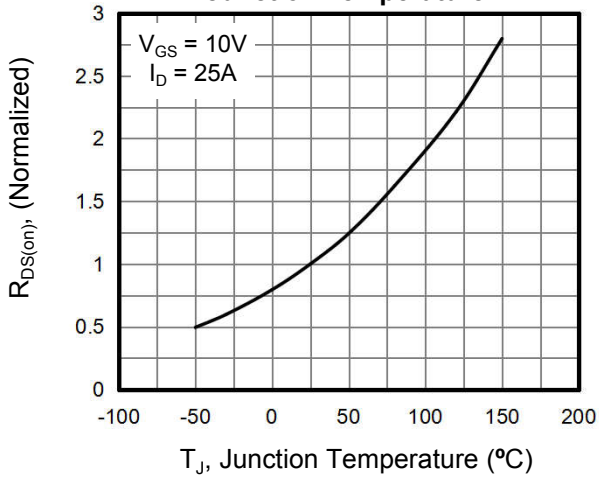


Figure 8. Threshold Voltage vs. Junction Temperature

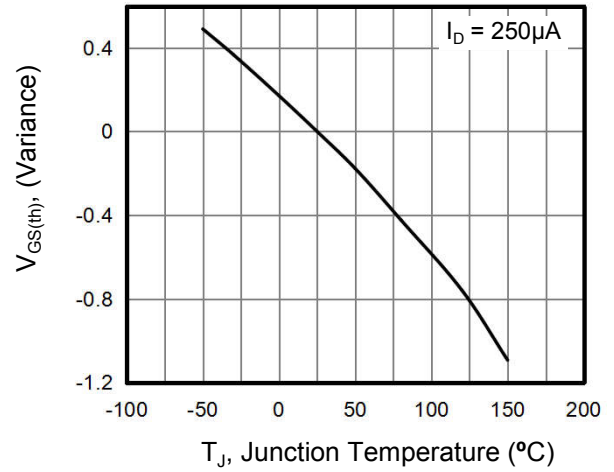


Figure 9. Transient Thermal Impedance TO-3PN/TO-247

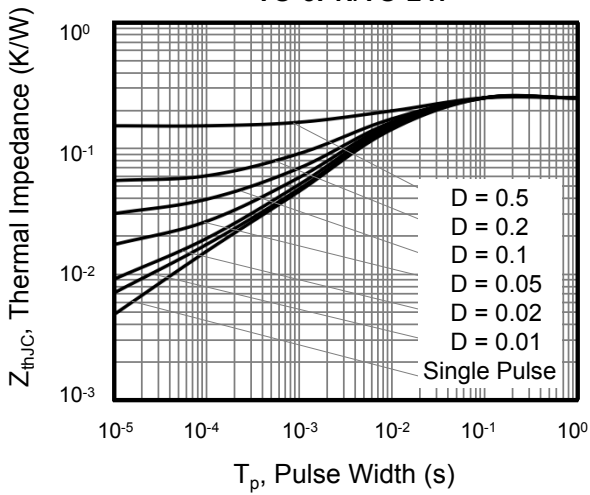


Figure 11. Safe operation area for TO-3PN/TO-247

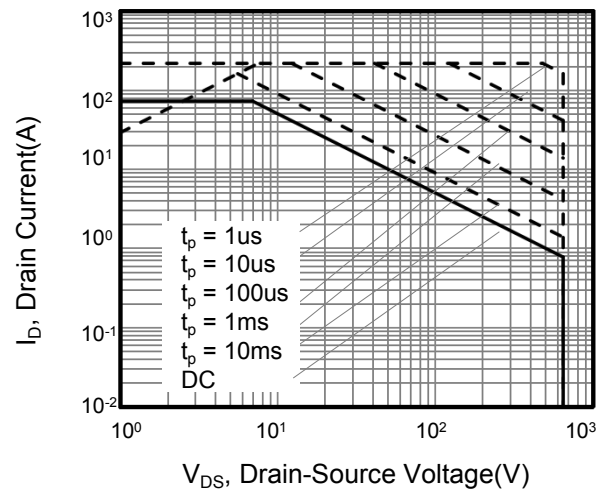




Figure A: Gate Charge Test Circuit and Waveform

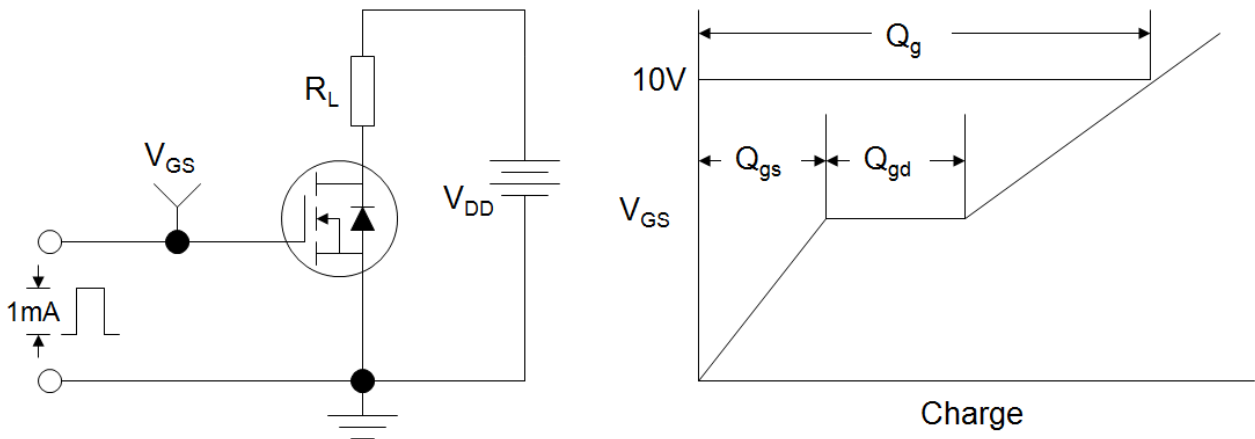


Figure B: Resistive Switching Test Circuit and Waveform

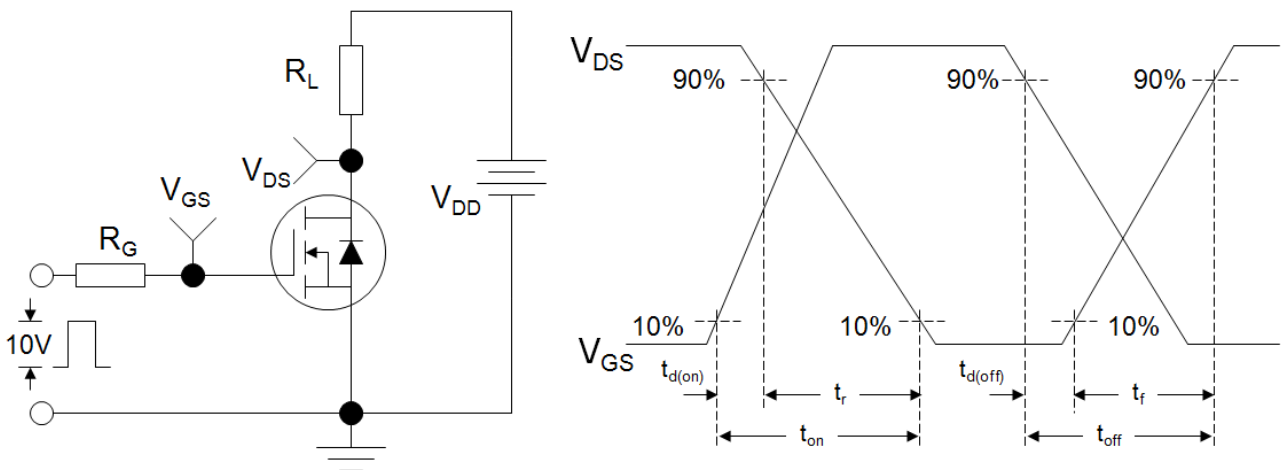
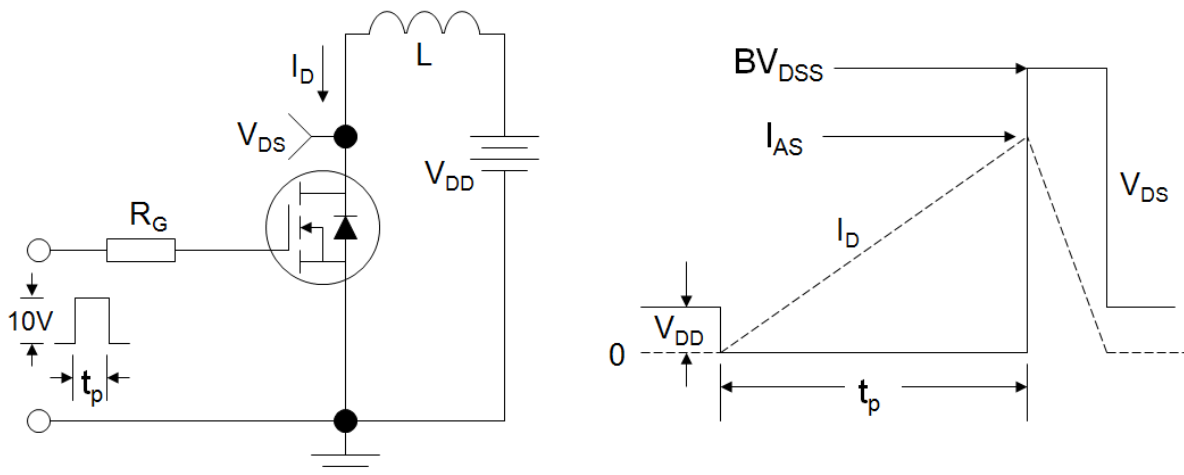
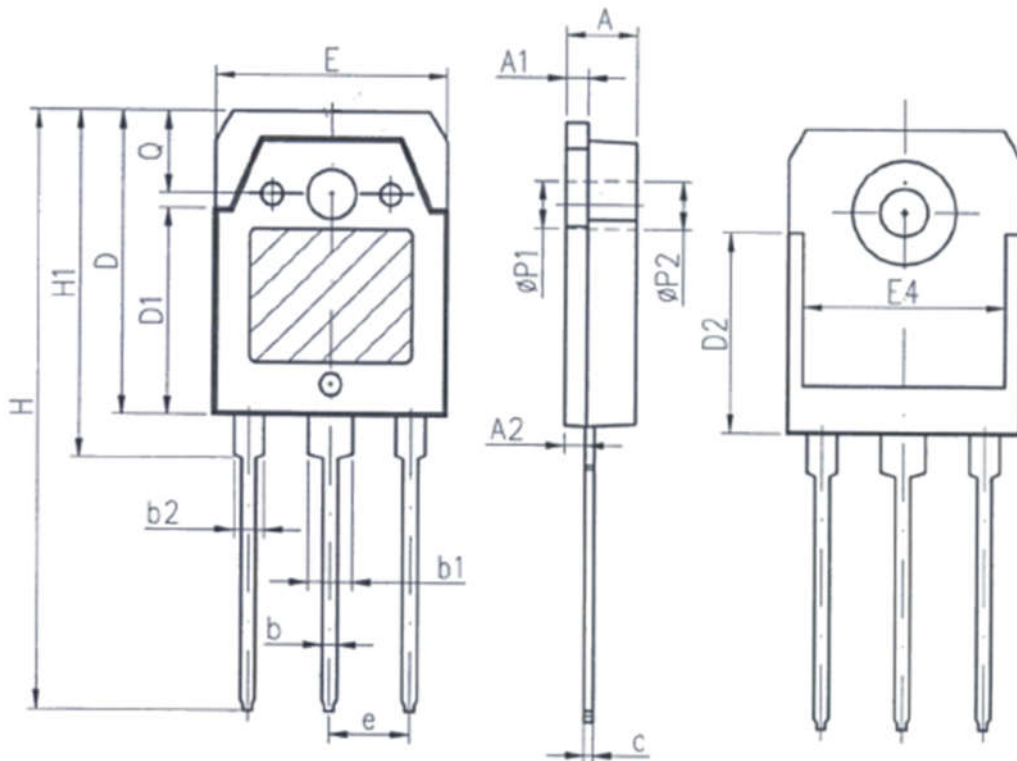


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





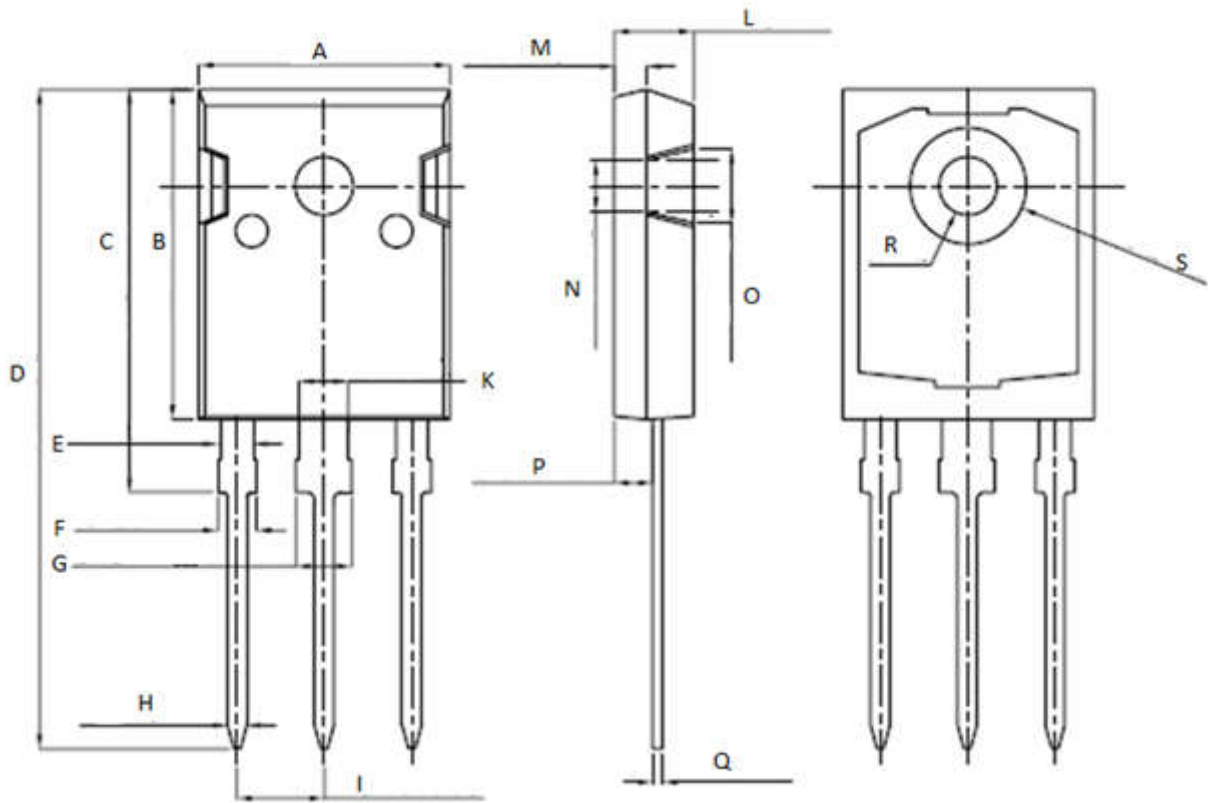
TO-3PN



Unit:mm		
Symbol	Min.	Max.
A	4.6	5
A1	1.4	1.65
A2	1.18	1.58
b	0.8	1.2
b1	2.8	3.2
b2	1.8	2.2
c	0.5	0.75
D	19.6	20.2
D1	13.55	14.25
D2	12.9REF	
E	15.35	15.85
E4	12.6	-
e	5.45TYP	
H	40.1	40.9
H1	23.15	23.65
P1	3.2REF	
P2	3.5REF	



TO-247



Unit: mm		
Symbol	Min.	Max.
A	15.95	16.25
B	20.85	21.25
C	20.95	21.35
D	40.5	40.9
E	1.9	2.1
F	2.1	2.25
G	3.1	3.25
H	1.1	1.3
I	5.40	5.50

Unit: mm		
Symbol	Min.	Max.
K	2.90	3.10
L	4.90	5.30
M	1.90	2.10
N	4.50	4.70
O	5.40	5.60
P	2.29	2.49
Q	0.51	0.71
R	φ 3.5	φ 3.7
S	φ 7.1	φ 7.3



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