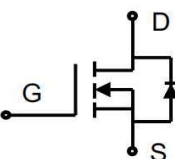




N- channel 650V, 12A Power MOSFET

Description The Power MOSFET is fabricated using the advanced planer VDMOS technology. The resulting device has low conduction resistance, superior switching performance and high avalanche energy. Features ◆ Low $R_{DS(on)}$ ◆ Low gate charge (typ. $Q_g = 41.9 \text{ nC}$) ◆ 100% UIS tested ◆ RoHS compliant Applications ◆ Power factor correction. ◆ Switched mode power supplies. ◆ LED driver.	Product Summary <table> <tr> <td>V_{DSS}</td><td>650V</td></tr> <tr> <td>I_D</td><td>12A</td></tr> <tr> <td>$R_{DS(on),max}$</td><td>0.8Ω</td></tr> <tr> <td>$Q_{g,typ}$</td><td>41.9 nC</td></tr> </table>  TO-252  TO-220F  N-Channel MOSFET	V_{DSS}	650V	I_D	12A	$R_{DS(on),max}$	0.8Ω	$Q_{g,typ}$	41.9 nC
V_{DSS}	650V								
I_D	12A								
$R_{DS(on),max}$	0.8Ω								
$Q_{g,typ}$	41.9 nC								

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	650	V
Continuous drain current ($T_c=25^\circ\text{C}$) ($T_c = 100^\circ\text{C}$)	I_D	12 7.5	A A
Pulsed drain current ¹⁾	I_{DM}	48	A
Gate-Source voltage	V_{GSS}	± 30	V
Avalanche energy, single pulse ²⁾	E_{AS}	500	mJ
Peak diode recovery dv/dt ³⁾	dv/dt	5	V/ns
Power Dissipation TO-220F/TO-220F Narrow Pin ($T_c=25^\circ\text{C}$) Derate above 25°C	P_D	42 0.34	W W/ $^\circ\text{C}$
Power Dissipation TO-252 ($T_c = 25^\circ\text{C}$) Derate above 25°C		150 1.2	W W/ $^\circ\text{C}$
Operating junction and storage temperature range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$
Continuous diode forward current	I_S	12	A
Diode pulse current	$I_{S,pulse}$	48	A

Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO-220F\TO-220F Narrow Pin	TO-252	
Thermal resistance, Junction-to-case	$R_{\theta JC}$	2.98	0.83	$^\circ\text{C/W}$



Thermal resistance, Junction-to-ambient	$R_{\theta JA}$	110	62.5	$^{\circ}\text{C/W}$
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Package Marking and Ordering Information

Device	Device Package	Marking	Units/Tube	Units/Real
BCT12N65	TO-220F	BCT12N65	50	
BCD12N65	TO-252	BCD12N65		2500

Electrical Characteristics $T_c = 25^{\circ}\text{C}$ unless otherwise noted

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static characteristics						
Drain-source breakdown voltage	BV _{DSS}	V _{GS} =0 V, I _D =0.25 mA	650	-	-	V
Gate threshold voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =0.25 mA	2	-	4	V
Drain cut-off current	I _{DSS}	V _{DS} =650 V, V _{GS} =0 V, T _j = 25°C T _j = 125°C	- -	-	1 100	μA
Gate leakage current, Forward	I _{GSSF}	V _{GS} =30 V, V _{DS} =0 V	-	-	100	nA
Gate leakage current, Reverse	I _{GSSR}	V _{GS} =-30 V, V _{DS} =0 V	-	-	-100	nA
Drain-source on-state resistance	R _{DS(on)}	V _{GS} =10 V, I _D =6A	-	0.64	0.8	Ω
Dynamic characteristics						
Input capacitance	C _{iss}	V _{DS} =25V, V _{GS} =0V, f = 1 MHz	-	2000	-	pF
Output capacitance	C _{oss}		-	164	-	
Reverse transfer capacitance	C _{rss}		-	7.4	-	
Turn-on delay time	t _{d(on)}	V _{DD} =325V, I _D =12A R _G = 10 Ω, V _{GS} =15 V	-	14.6	-	ns
Rise time	t _r		-	37.8	-	
Turn-off delay time	t _{d(off)}		-	69.3	-	
Fall time	t _f		-	15.8	-	
Gate charge characteristics						
Gate to source charge	Q _{gs}	V _{DD} =520 V, I _D =12 A, V _{GS} =0 to 10 V	-	10.8	-	nC
Gate to drain charge	Q _{gd}		-	15	-	
Gate charge total	Q _g		-	41.9	-	
Gate plateau voltage	V _{plateau}		-	5	-	V
Reverse diode characteristics						
Diode forward voltage	V _{SD}	V _{GS} =0 V, I _F =12 A	-	-	1.5	V
Reverse recovery time	t _{rr}	V _R =325 V, I _F =12 A, dI _F /dt=100 A/μs	-	450.4	-	ns
Reverse recovery charge	Q _{rr}		-	4.75	-	μC
Peak reverse recovery current	I _{rrm}		-	21.1	-	A

Notes:

1. Pulse width limited by maximum junction temperature.
2. $L=10\text{ mH}$, $I_{AS} = 10\text{ A}$, Starting $T_J = 25^{\circ}\text{C}$.
3. $I_{SD} = 12\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DD} \leq BV_{DS}$, Starting $T_J = 25^{\circ}\text{C}$.



Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

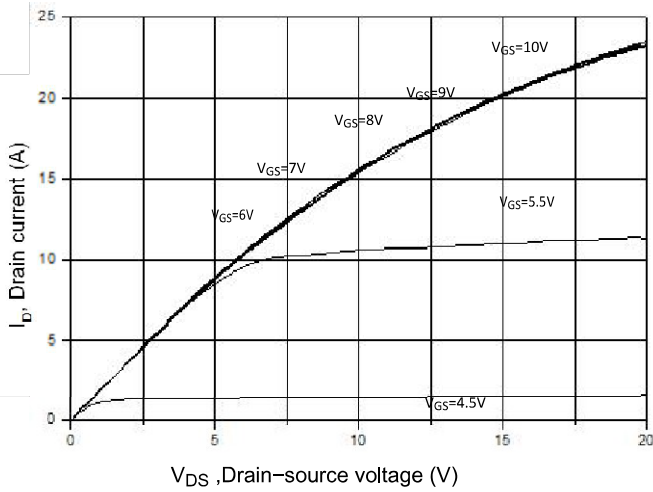


Figure 2. Transfer Characteristics

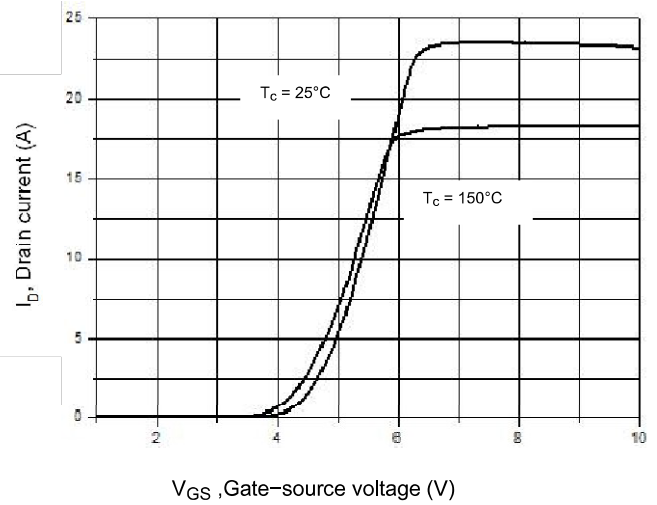


Figure 3. On-Resistance Variation vs. Drain Current

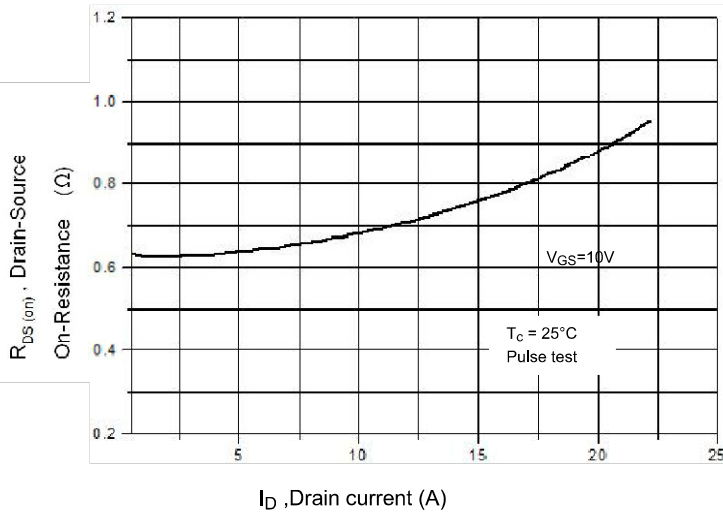


Figure 4. Threshold Voltage vs. Temperature

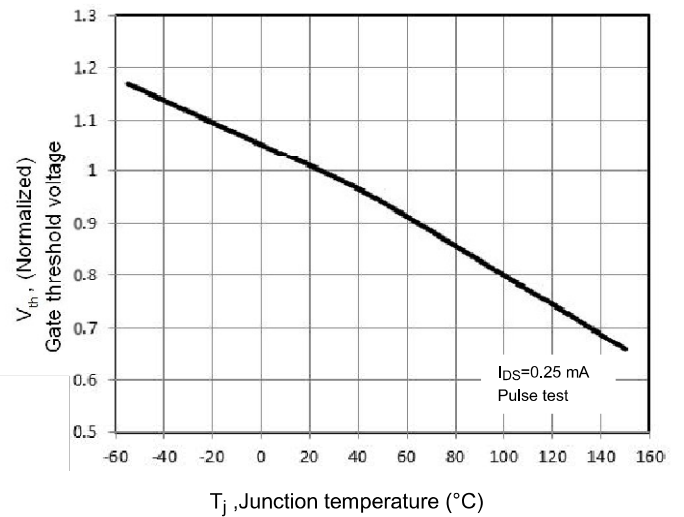


Figure 5. Breakdown Voltage vs. Temperature

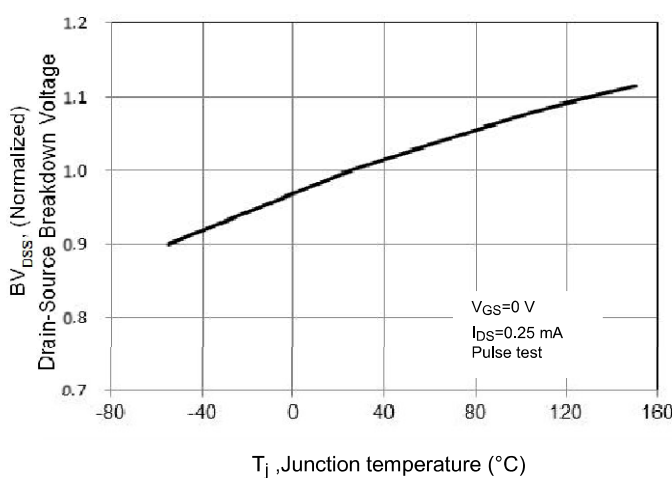


Figure 6. On-Resistance vs. Temperature

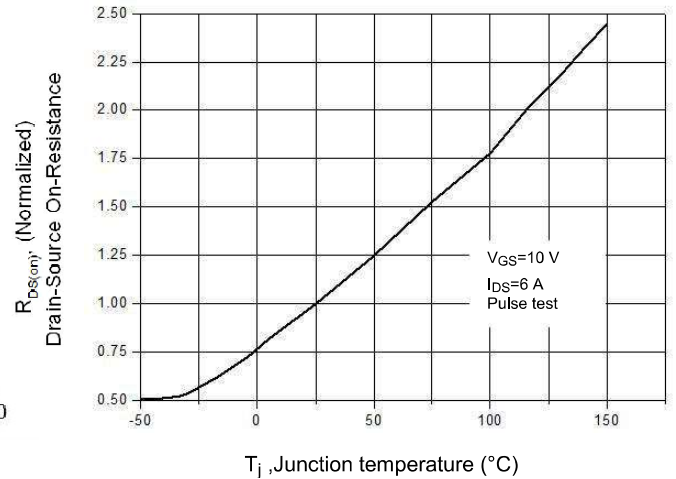




Figure 7. Capacitance Characteristics

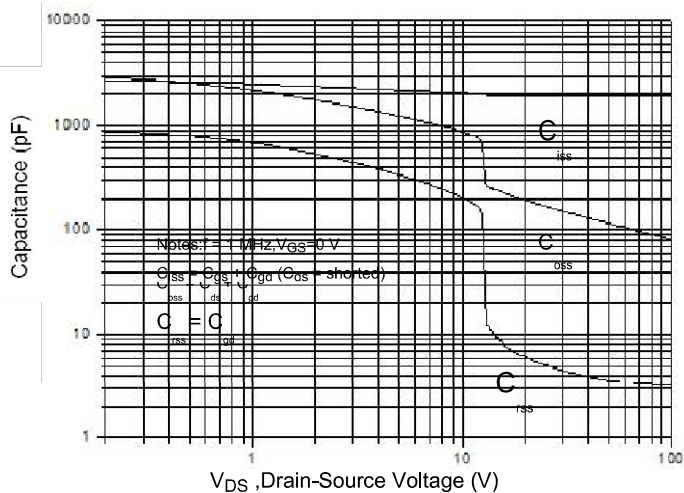


Figure 8. Gate Charge Characteristics

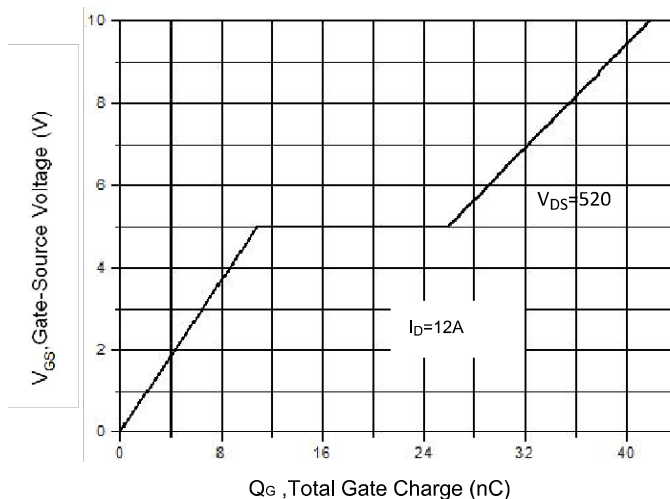


Figure 9. Maximum Safe Operating Area TO-220F/TO-220F Narrow Pin

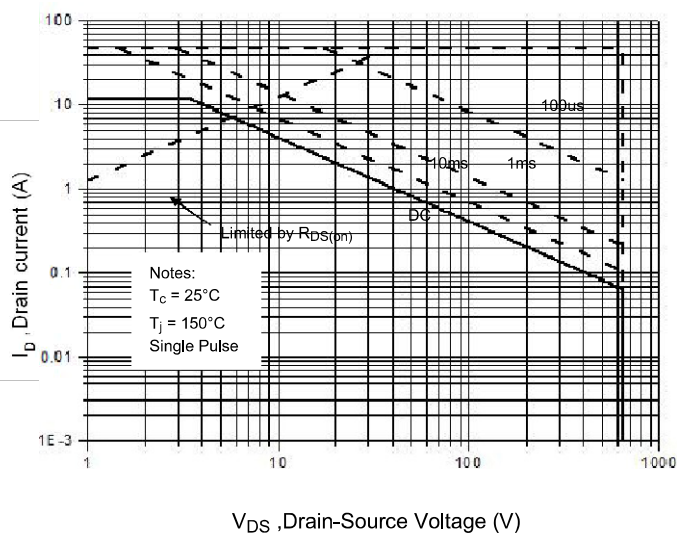


Figure 10. Maximum Safe Operating Area TO-252

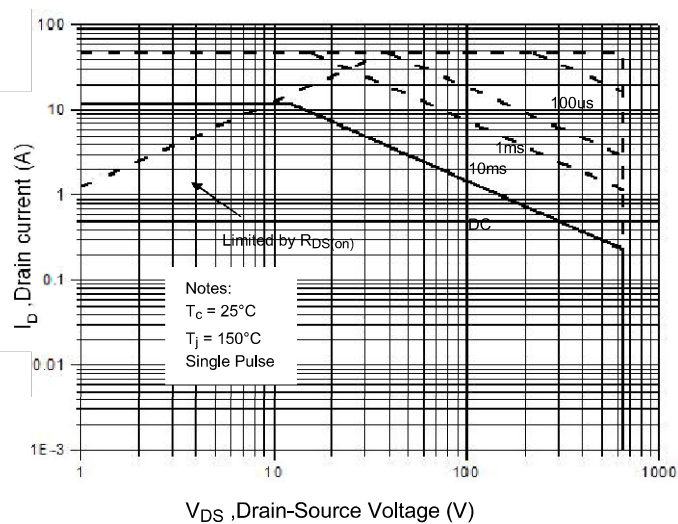


Figure 11. Power Dissipation vs. Temperature TO-220F/TO-220F Narrow Pin

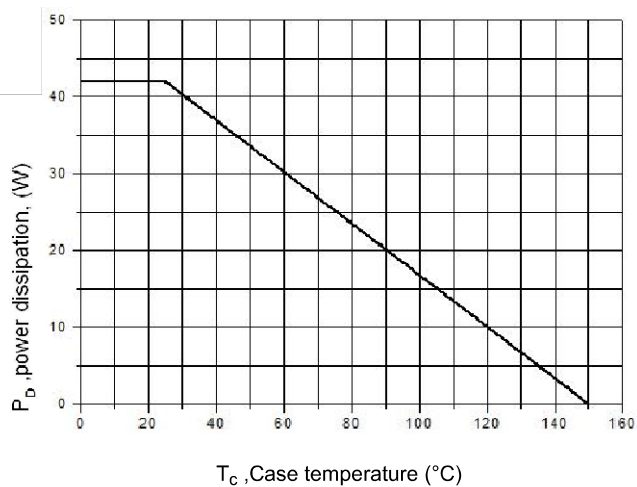


Figure 12. Power Dissipation vs. Temperature TO-252

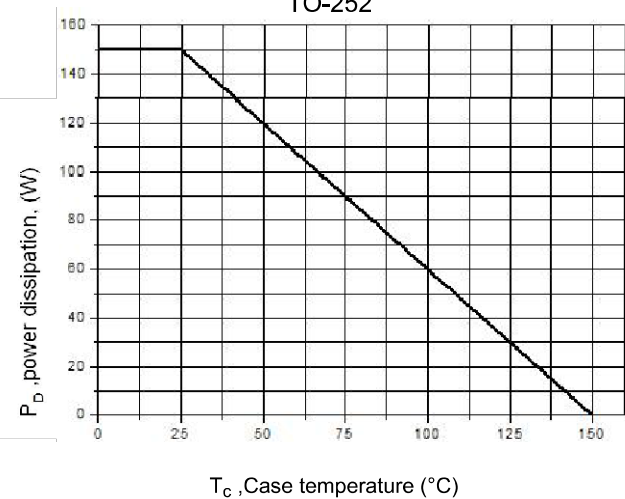




Figure 13. Continuous Drain Current vs. Temperature

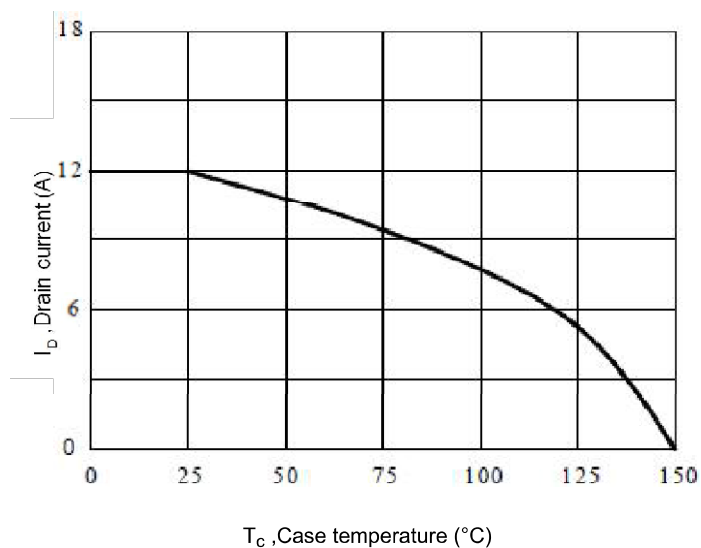


Figure 14. Body Diode Transfer Characteristics

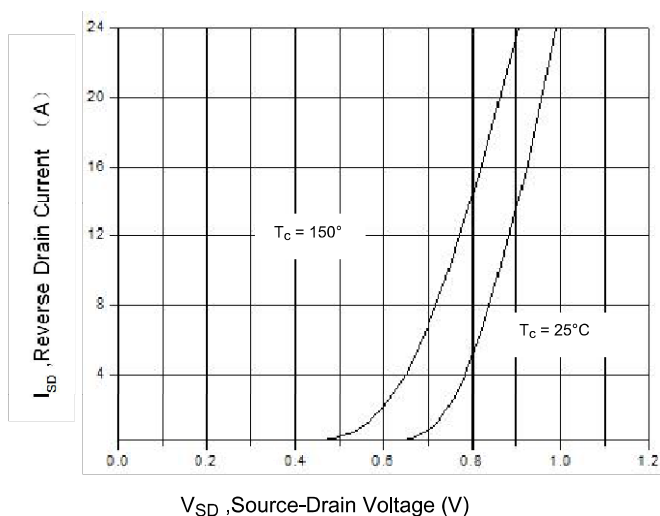


Figure 15 Transient Thermal Impedance, Junction to Case, TO-220F/TO-220F Narrow Pin

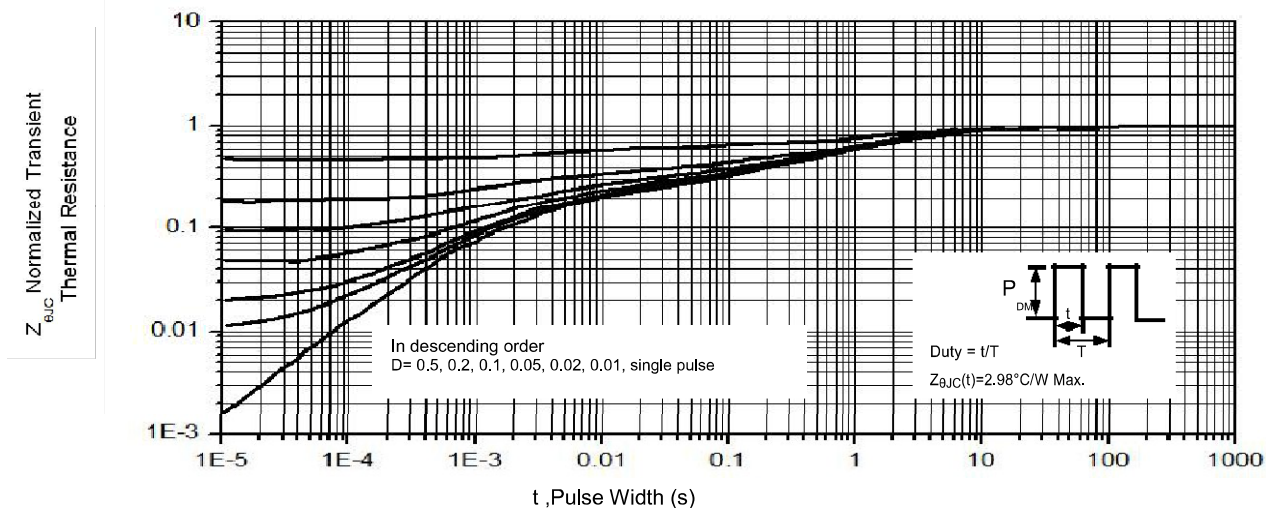
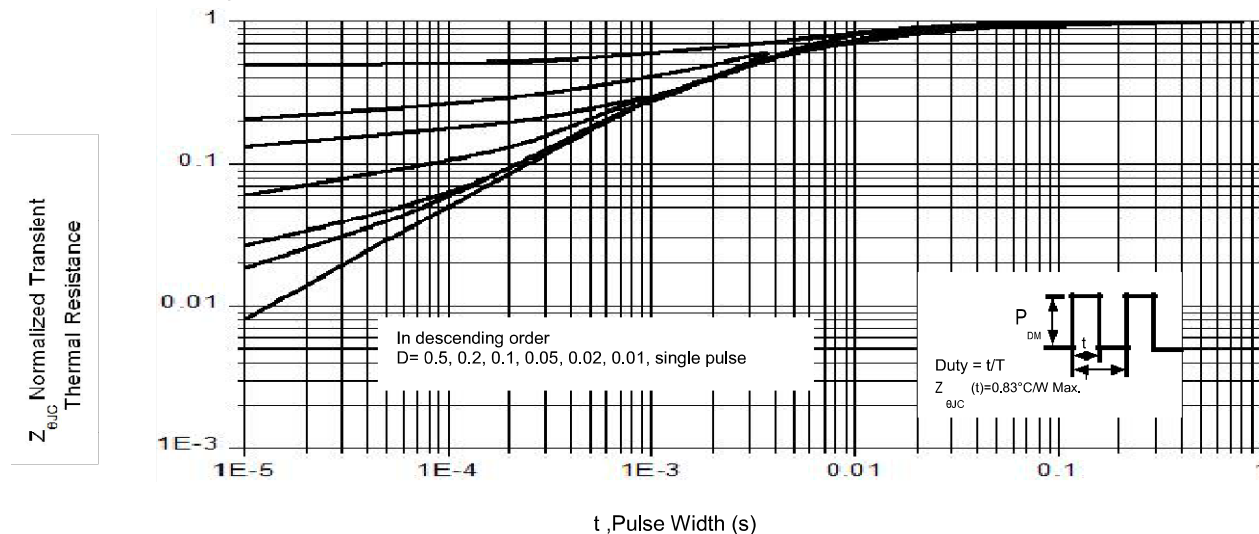
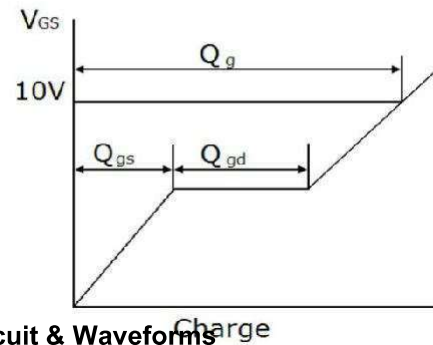
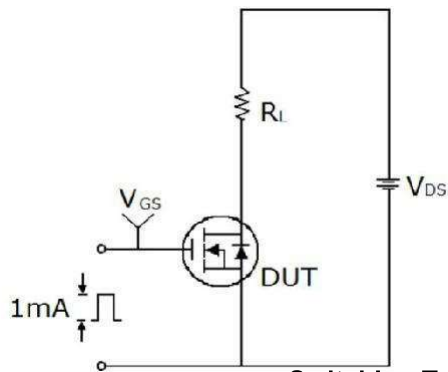


Figure 16. Transient Thermal Impedance, Junction to Case, TO-252

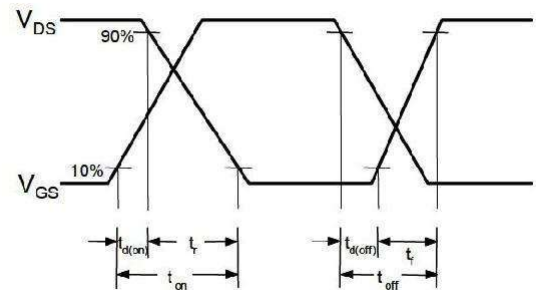
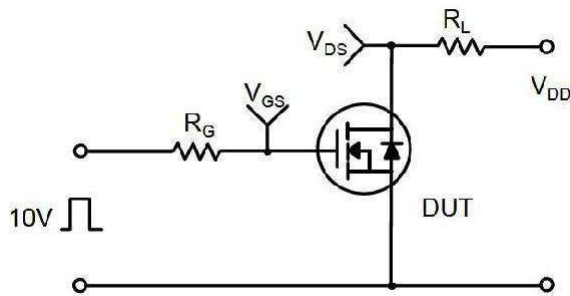




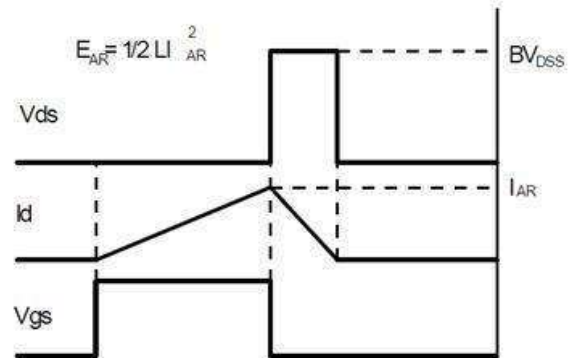
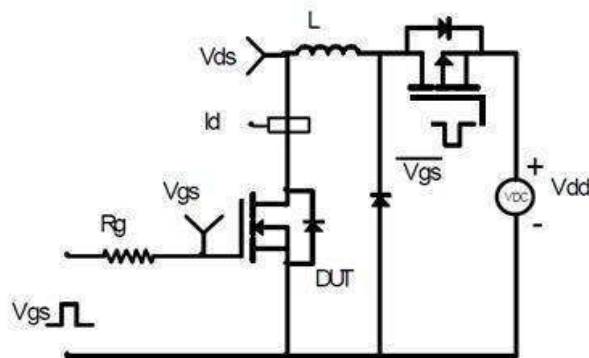
Gate Charge Test Circuit & Waveform



Switching Test Circuit & Waveforms

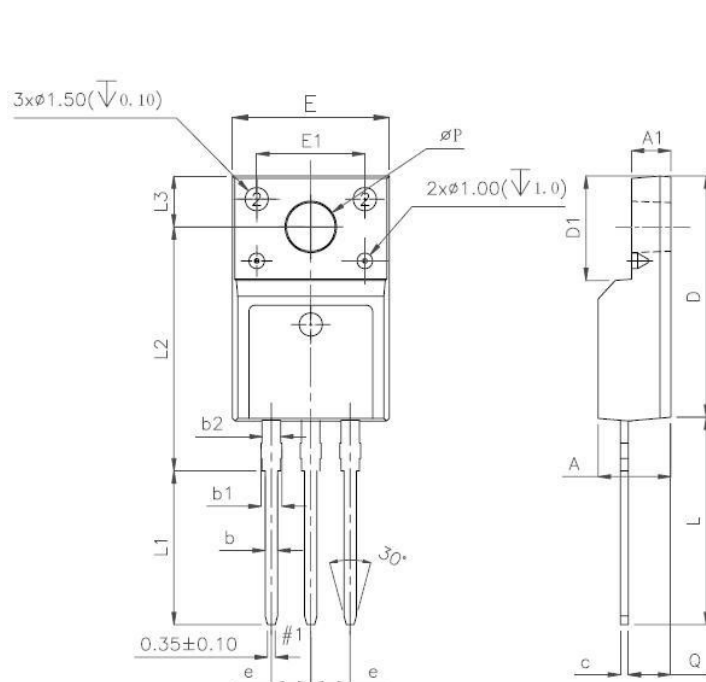


Unclamped Inductive Switching Test Circuit & Waveforms





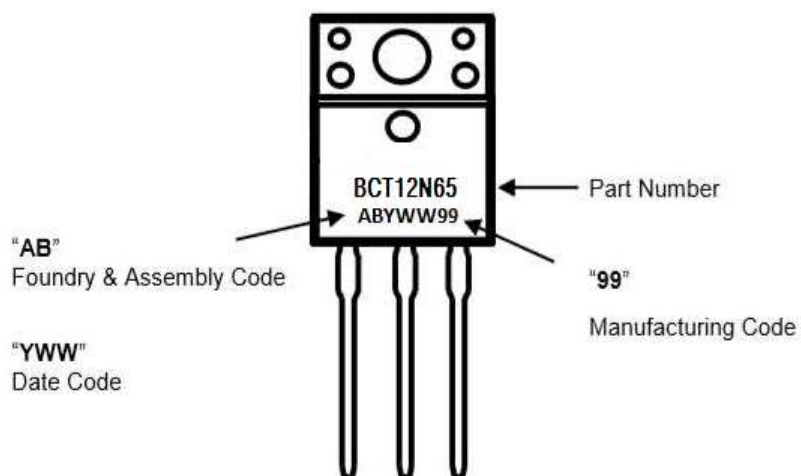
Mechanical Dimensions for TO-220F



UNIT: mm

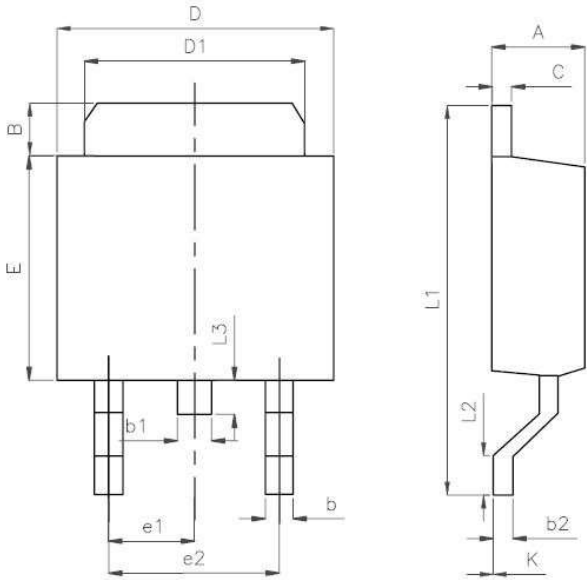
SYMBOL	MIN	NOM	MAX
A	4.5		4.9
A1	2.3		2.9
b	0.65		0.9
b1	1.1		1.7
b2	1.2		1.4
c	0.35		0.65
D	14.5		16.5
D1	6.1		6.9
E	9.6		10.3
E1	6.5	7	7.5
e	2.44	2.54	2.64
L	12.5		14.3
L1	9.45		10.05
L2	15		16
L3	3.2		4.4
ΦP	3		3.3
Q	2.5		2.9

TO-220F Part Marking Information





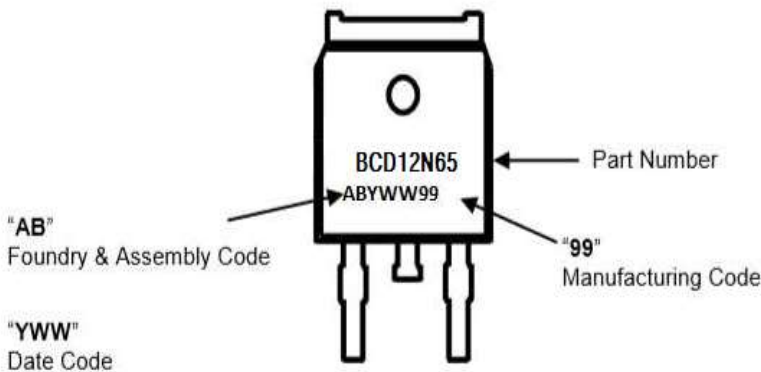
Mechanical Dimensions for TO-252



UNIT : mm

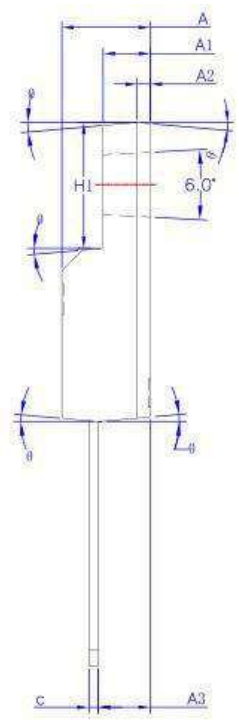
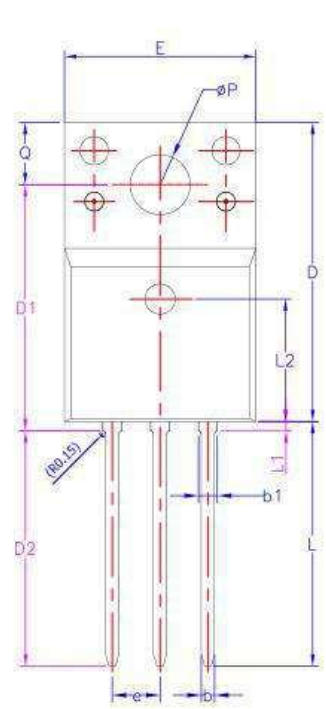
SYMBOL	MIN	NOM	MAX
A	2.10		2.50
B	0.80		1.25
b	0.50		0.85
b1	0.50		0.90
b2	0.45		0.60
C	0.45		0.60
D	6.35		6.75
D1	5.10		5.50
E	5.80		6.30
e1	2.25	2.30	2.35
e2	4.45		4.75
L1	9.50		10.20
L2	0.90		1.45
L3	0.60		1.10
K	-0.1		0.10

TO-252 Part Marking Information





Mechanical Dimensions for TO-220F Narrow Pin



(UNITS:mm)

SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.93
b	0.60	—	0.80
b1	0.90	—	1.10
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	12.87	13.07	13.27
D2	12.28	12.48	12.68
E	9.96	10.16	10.36
e	2.54BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	—	—	0.85
L2	6.50REF		
ϕP	3.08	3.18	3.28
Q	3.20	—	3.40
θ 1	1°	3°	5°

TO-220F Narrow Pin Part Marking Information

