

V_{DS} 60 V
 I_D 20 A
 $R_{DS(ON)}$ 4.5m Ω

Description

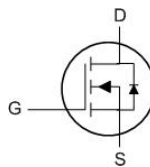
The 60N02 is the high cell density trench N-ch MOSFETs, which provide excellent R_{DS(ON)} and gate charge for most of the synchronous buck converter applications.

The 60N02 meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

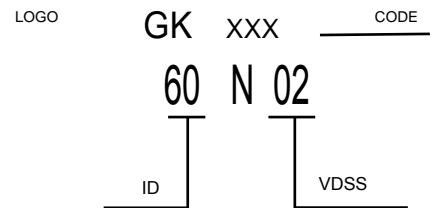
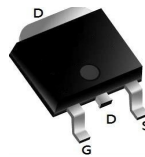
Features

- 100% EAS Guaranteed
- Green Device Available
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- Advanced high cell density Trench technology

Equivalent Circuit



TO-252



MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (T_c=25°C unless otherwise specified)

Symbol	Parameter	Rating	Units
V _{DS}	Drain-Source Voltage	20	V
V _{GS}	Gate-Source Voltage	±20	V
I _D @T _c =25°C	Continuous Drain Current, V _{GS} @ 10V ¹	60	A
I _D @T _c =100°C	Continuous Drain Current, V _{GS} @ 10V ¹	35	A
I _{DM}	Pulsed Drain Current ²	240	A
EAS	Single Pulse Avalanche Energy ³	48	mJ
I _{AS}	Avalanche Current	31	A
P _D @T _c =25°C	Total Power Dissipation ⁴	38	W
T _{STG}	Storage Temperature Range	-55 to 150	°C
T _J	Operating Junction Temperature Range	-55 to 150	°C

Thermal Data

Symbol	Parameter	Typ.	Max.	Unit
R _{θJC}	Thermal Resistance Junction-Case ¹	---	4.2	°C/W

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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
Off Characteristic						
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	20	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=20V, V_{GS}=0V,$	-	-	1.0	μA
I_{GSS}	Gate to Body Leakage Current	$V_{DS}=0V, V_{GS}=\pm 12V$	-	-	± 100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	0.4	0.7	1.0	V
$R_{DS(on)}$	Static Drain-Source on-Resistance <small>note3</small>	$V_{GS}=4.5V, I_D=25A$	-	4.5	6.5	m Ω
		$V_{GS}=2.5V, I_D=15A$	-	6.8	10	
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS}=10V, V_{GS}=0V,$ $f=1.0MHz$	-	1832	-	pF
C_{oss}	Output Capacitance		-	289	-	pF
C_{riss}	Reverse Transfer Capacitance		-	271	-	pF
Q_g	Total Gate Charge	$V_{DS}=10V, I_D=25A,$ $V_{GS}=4.5V$	-	23	-	nC
Q_{gs}	Gate-Source Charge		-	4.5	-	nC
Q_{gd}	Gate-Drain("Miller") Charge		-	7.3	-	nC
Switching Characteristics						
$t_{d(on)}$	Turn-on Delay Time	$V_{DS}=10V,$ $I_D=25A, R_{GEN}=3\Omega,$ $V_{GS}=4.5V$	-	15	-	ns
t_r	Turn-on Rise Time		-	37	-	ns
$t_{d(off)}$	Turn-off Delay Time		-	52	-	ns
t_f	Turn-off Fall Time		-	21	-	ns
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	60	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	240	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS}=0V, I_S=30A$	-	-	1.2	V
t_{rr}	Body Diode Reverse Recovery Time	$I_F=25A, di/dt=100A/\mu s$	-	25	-	ns
Q_{rr}	Body Diode Reverse Recovery Charge		-	21	-	nC

- Notes: 1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
 2. EAS condition: $T_J=25^{\circ}\text{C}$, $V_{DD}=10V$, $V_G=4.5V$, $L=0.5mH$, $R_G=25\Omega$, $I_{AS}=13.8A$
 3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 0.5\%$

RATING AND CHARACTERISTIC CURVES

Figure 1: Output Characteristics

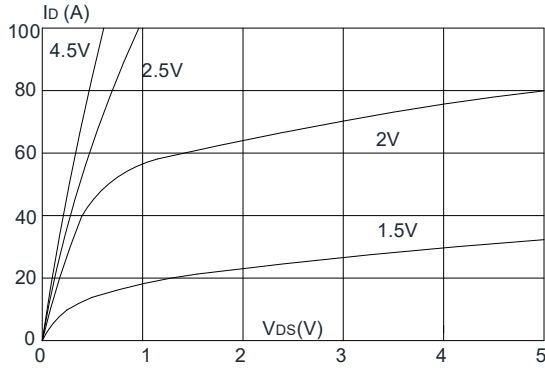


Figure 2: Typical Transfer Characteristics

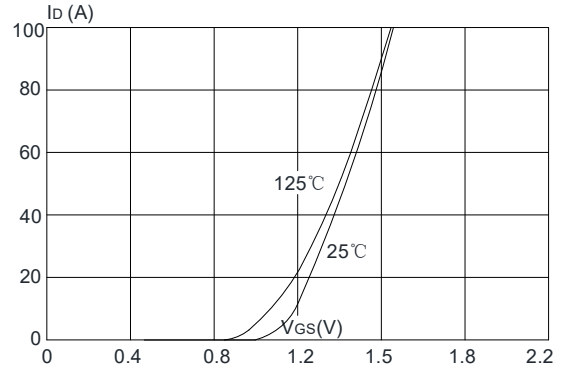


Figure 3: On-resistance vs. Drain Current

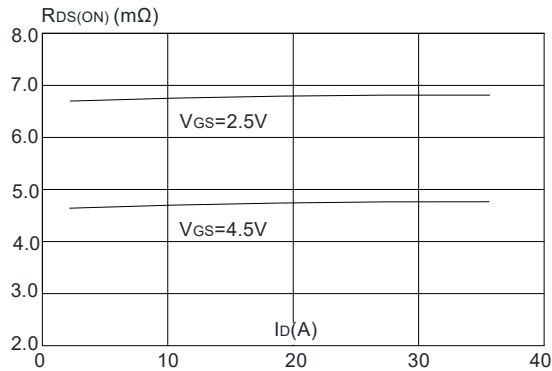


Figure 4: Body Diode Characteristics

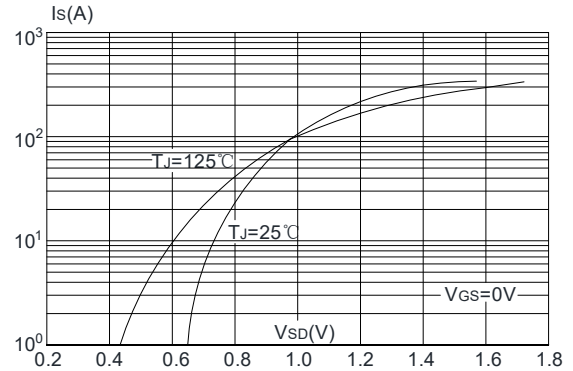


Figure 5: Gate Charge Characteristics

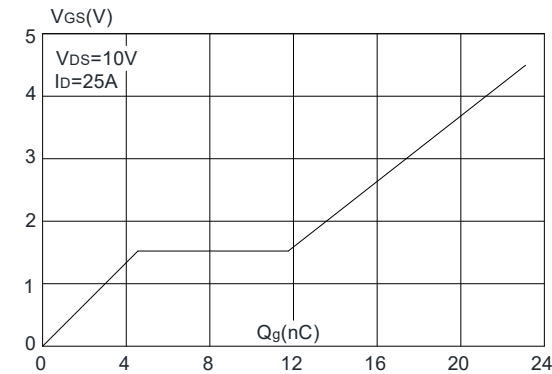
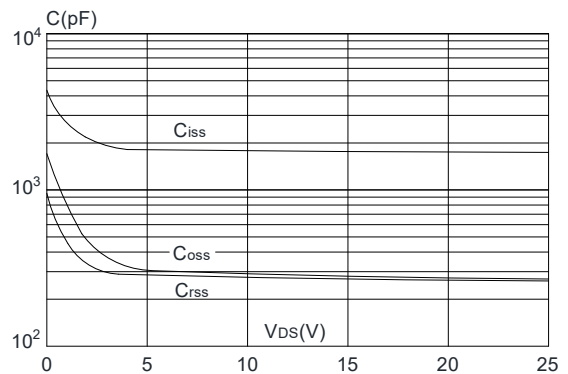


Figure 6: Capacitance Characteristics



RATING AND CHARACTERISTIC CURVES

Figure 7: Normalized Breakdown Voltage vs. Junction Temperature

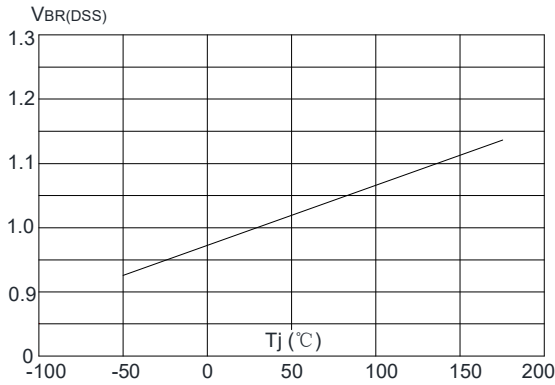


Figure 8: Normalized on Resistance vs. Junction Temperature

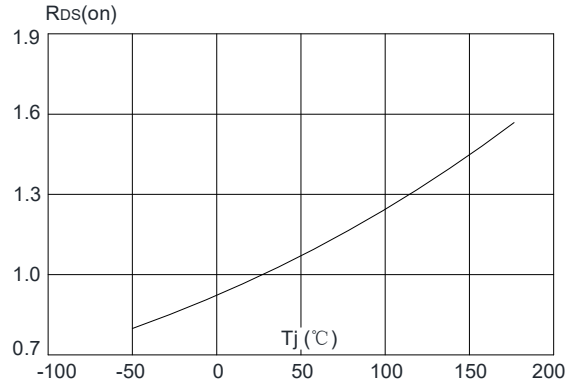


Figure 9: Maximum Safe Operating Area

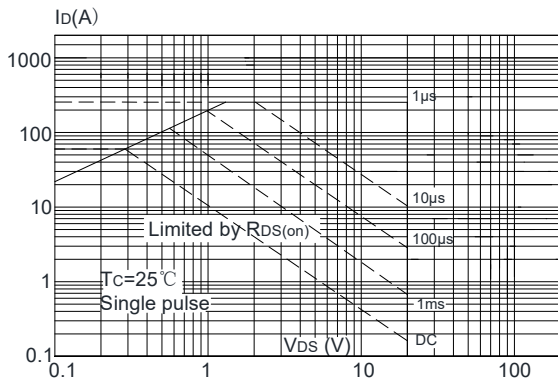


Figure 10: Maximum Continuous Drain Current vs. Case Temperature

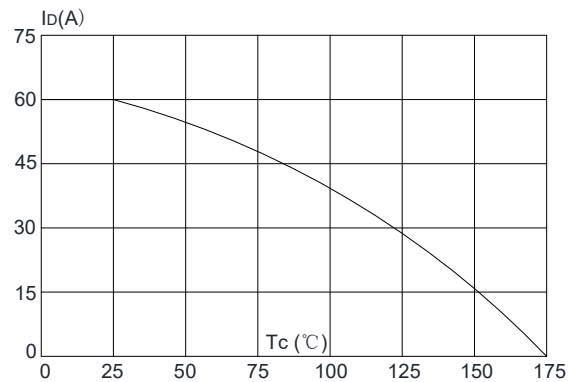
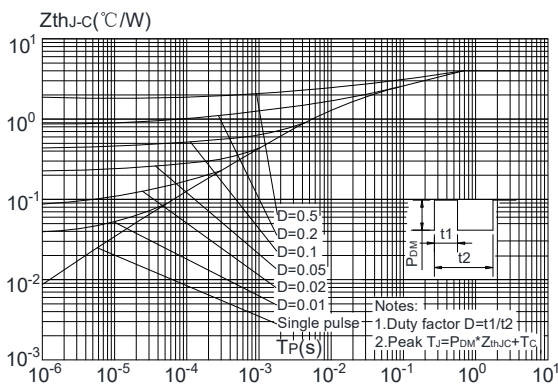


Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Case



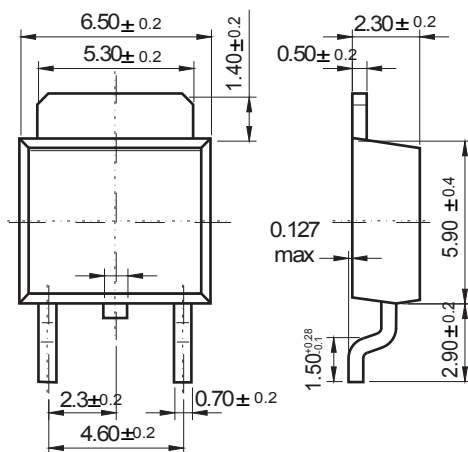
Soldering parameters

Reflow Condition		Pb-Free assembly (see as below)
Pre Heat	-Temperature Min ($T_{s(min)}$)	+150 °C
	-Temperature Max($T_{s(max)}$)	+200 °C
	-Time (Min to Max) (ts)	60-180 secs.
Average ramp up rate (Liquid us Temp (T_L) to peak)		3 °C/sec. Max
$T_{s(max)}$ to T_L - Ramp-up Rate		3 °C/sec. Max
Reflow	-Temperature(T_L)(Liquid us)	+217 °C
	-Temperature(t_L)	60-150 secs.
Peak Temp (T_P)		+260(+0/-5) °C
Time within 5 °C of actual Peak Temp (t_p)		30 secs. Max
Ramp-down Rate		6 °C/sec. Max
Time 25 °C to Peak Temp (T_P)		8 min. Max
Do not exceed		+260 °C

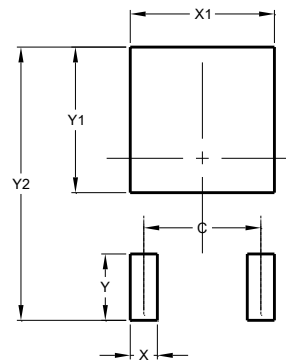


Package Dimensions & Suggested Pad Layout

TO-252



Dimensions in inches and (millimeters)



Dimensions	Value (in mm)
C	4.55
X	1.50
X1	5.80
Y	2.70
Y1	6.00
Y2	10.90

Tape & reel specification

Tape		Symbol	Dimension (mm)
		P0	4.00±0.20
		P1	8.00±0.20
		P2	2.00±0.20
		D0	1.55±0.15
		D1	1.55±0.20
		E	1.75±0.20
		F	7.50±0.20
		W	16.00±0.20
		A0	7.10±0.20
		B0	10.50±0.20
		K0	2.70±0.20
		T	0.30±0.10
		D2	330.0±5.0
		D3	100.0±4.0
W1	20.0±5.0		
W2	25.0±5.0		
I	13.0±2.0		
Quantity: 2500PCS			

