

40V(D-S) N-Channel Enhancement Mode Power MOS FET

General Features

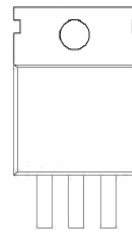
- $V_{DS} = 40V, I_D = 200A$
 $R_{DS(ON)} < 4m\Omega @ V_{GS}=10V$ (Typ:3.3m Ω)
- Special process technology for high ESD capability
- High density cell design for ultra low R_{ds(on)}
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high E_{AS}
- Excellent package for good heat dissipation



Lead Free

Application

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply

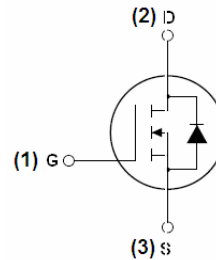


Marking and pin assignment

PIN Configuration



TO-220-3L top view



Schematic diagram

Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
MSN04C0K	MSN04C0K	TO-220-3L	-	-	-

Absolute Maximum Ratings (T_C=25°C unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V _{DS}	40	V
Gate-Source Voltage	V _{GS}	±20	V
Drain Current-Continuous	I _D	200	A
Drain Current-Continuous(T _C =100°C)	I _D (100°C)	140	A
Pulsed Drain Current	I _{DM}	790	A
Maximum Power Dissipation	P _D	260	W
Derating factor		1.73	W/°C
Single pulse avalanche energy ^(Note 5)	E _{AS}	1500	mJ
Operating Junction and Storage Temperature Range	T _J , T _{STG}	-55 To 175	°C

Thermal Characteristic

Thermal Resistance, Junction-to-Case ^(Note 2)	$R_{\theta jc}$	0.58	$^{\circ}C/W$
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Electrical Characteristics ($T_C=25^{\circ}C$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	40	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=40V, V_{GS}=0V$	-	-	1	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA
On Characteristics ^(Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2	3	4	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=40A$	-	3.3	4.0	m Ω
Forward Transconductance	g_{FS}	$V_{DS}=5V, I_D=40A$	60	-	-	S
Dynamic Characteristics ^(Note 4)						
Input Capacitance	C_{iss}	$V_{DS}=30V, V_{GS}=0V,$ $F=1.0MHz$	-	9600	-	PF
Output Capacitance	C_{oss}		-	890	-	PF
Reverse Transfer Capacitance	C_{rss}		-	530	-	PF
Switching Characteristics ^(Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=30V, I_D=1A$ $V_{GS}=10V, R_{GEN}=2.5\Omega$	-	21	-	nS
Turn-on Rise Time	t_r		-	37	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	75	-	nS
Turn-Off Fall Time	t_f		-	40	-	nS
Total Gate Charge	Q_g	$V_{DS}=30V, I_D=30A,$ $V_{GS}=10V$	-	170	-	nC
Gate-Source Charge	Q_{gs}		-	36	-	nC
Gate-Drain Charge	Q_{gd}		-	56	-	nC
Drain-Source Diode Characteristics						
Diode Forward Voltage ^(Note 3)	V_{SD}	$V_{GS}=0V, I_S=20A$	-	-	1.2	V
Diode Forward Current ^(Note 2)	I_S	-	-	-	200	A
Reverse Recovery Time	t_{rr}	$T_J = 25^{\circ}C, I_F = 40A$ $di/dt = 100A/\mu s$ ^(Note 3)	-	47.5	-	nS
Reverse Recovery Charge	Q_{rr}		-	66.3	-	nC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

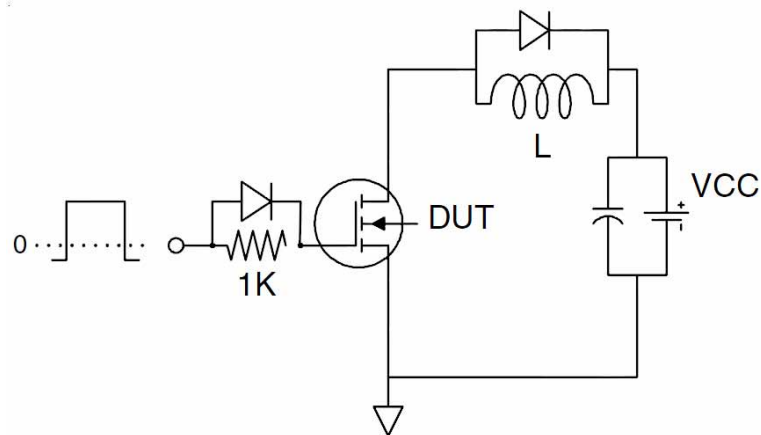
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production
5. EAS condition: $T_J=25^{\circ}C, V_{DD}=20V, V_G=10V, L=0.5mH, R_g=25\Omega$

Test circuit

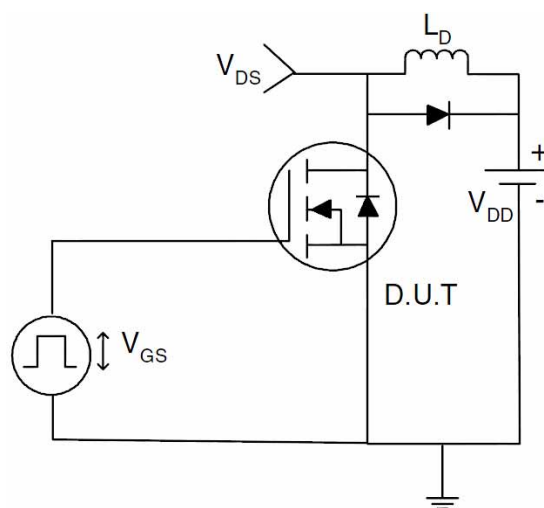
1) E_{AS} test Circuits



2) Gate charge test Circuit:



3) Switch Time Test Circuit:



Typical Electrical and Thermal Characteristics (Curves)

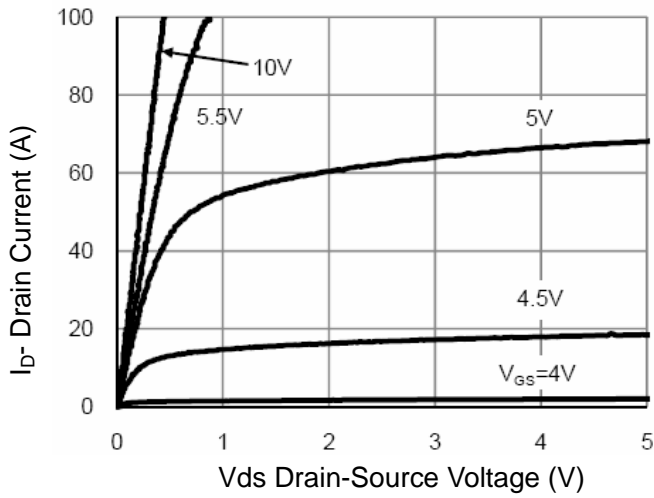


Figure 1 Output Characteristics

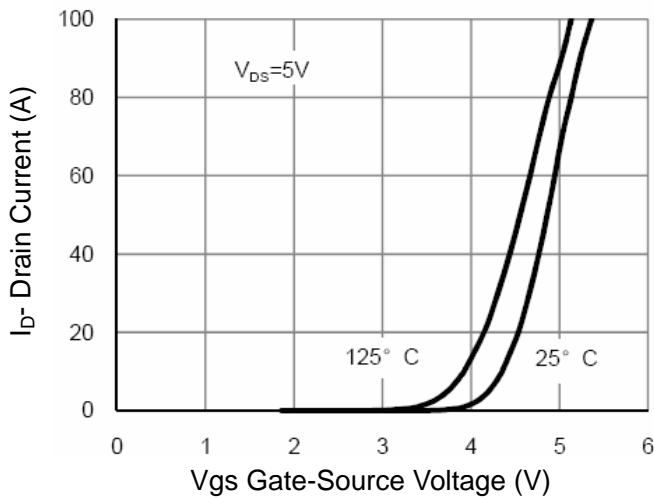


Figure 2 Transfer Characteristics

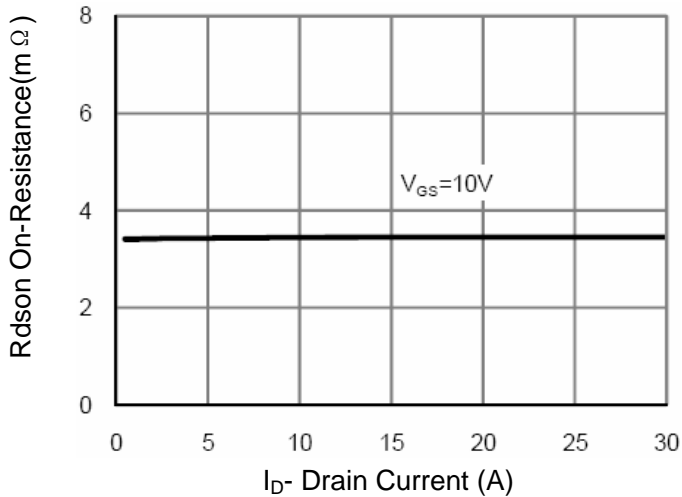


Figure 3 Rdson- Drain Current

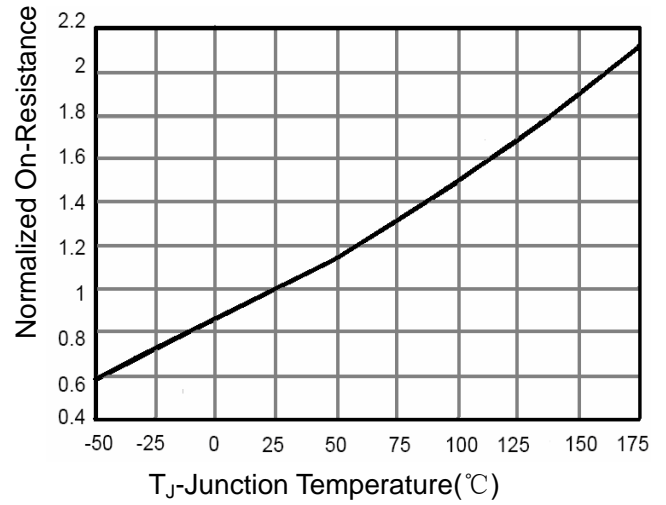


Figure 4 Rdson-Junction Temperature

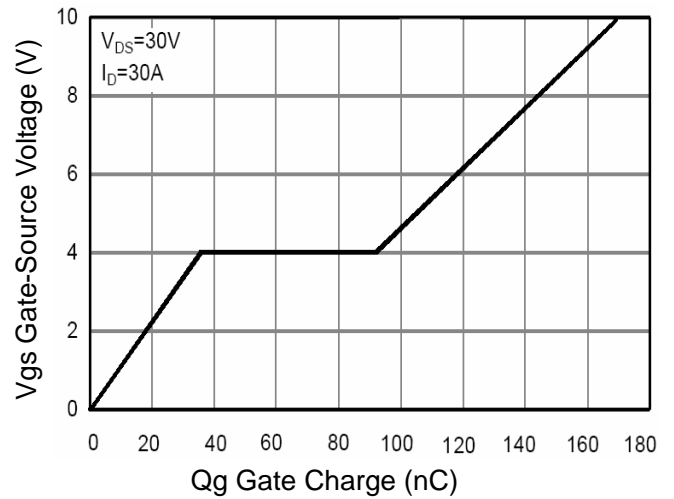


Figure 5 Gate Charge

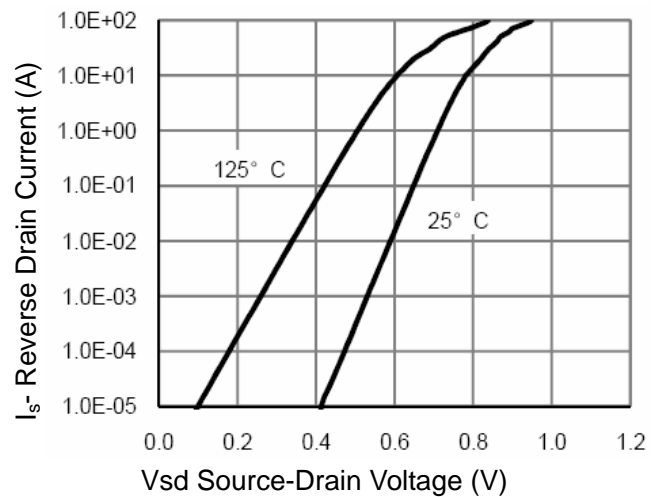


Figure 6 Source- Drain Diode Forward

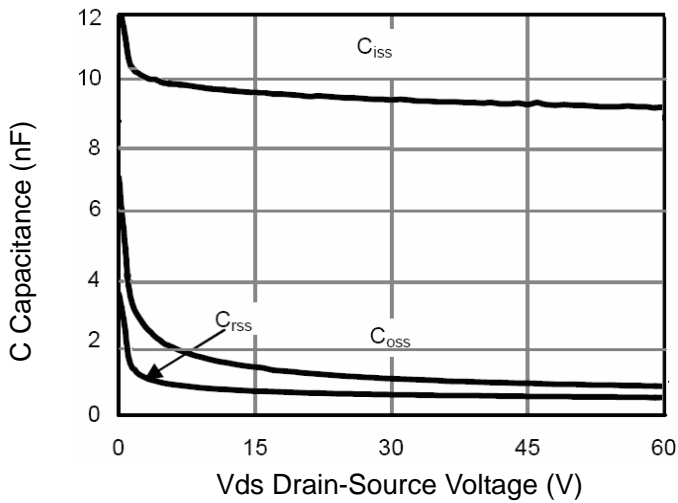


Figure 7 Capacitance vs Vds

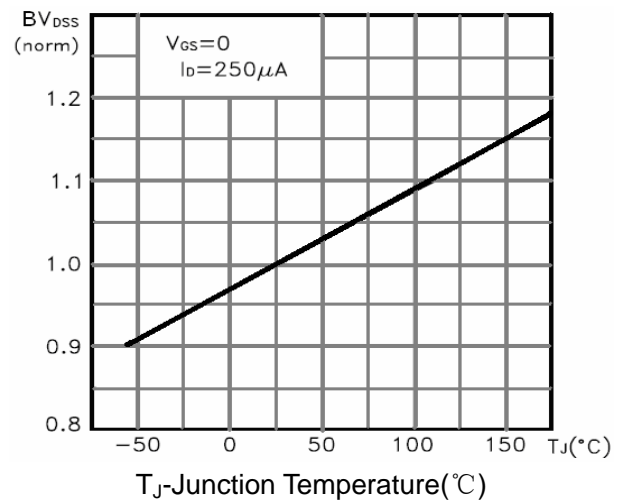


Figure 9 BV_{DSS} vs Junction Temperature

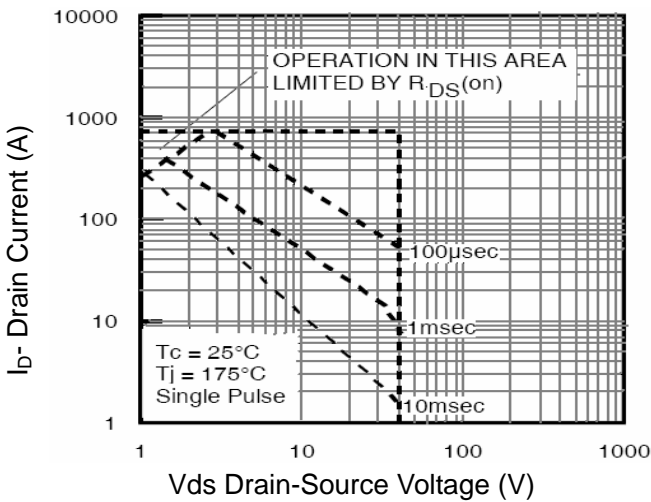


Figure 8 Safe Operation Area

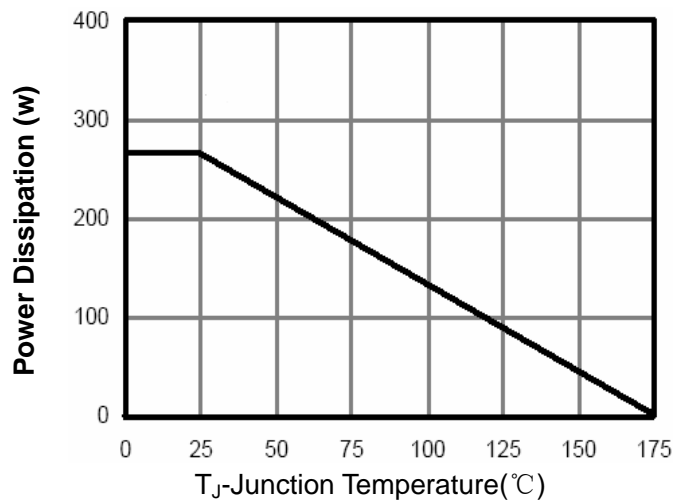


Figure 10 Power De-rating

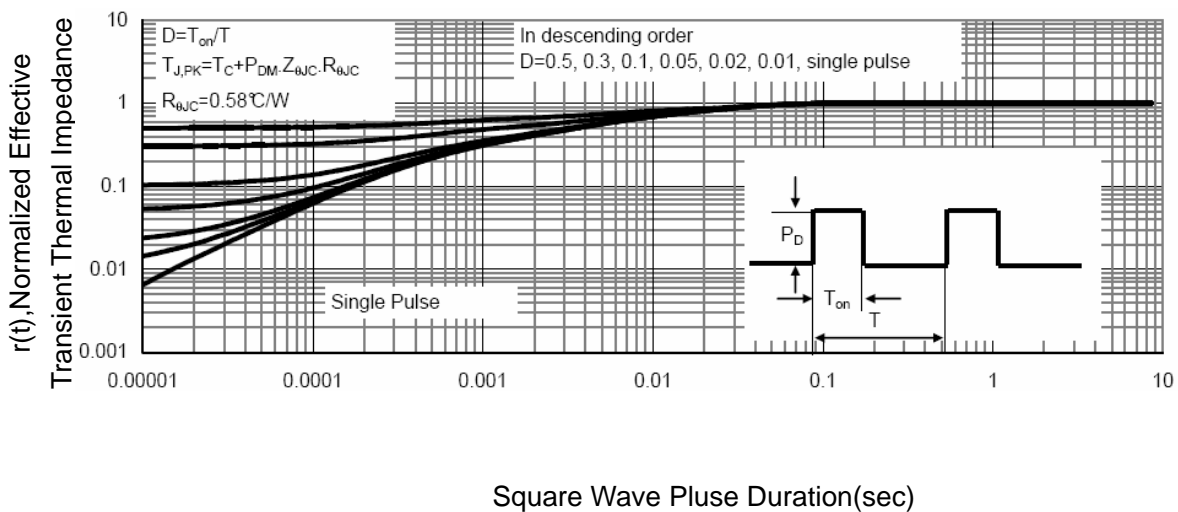
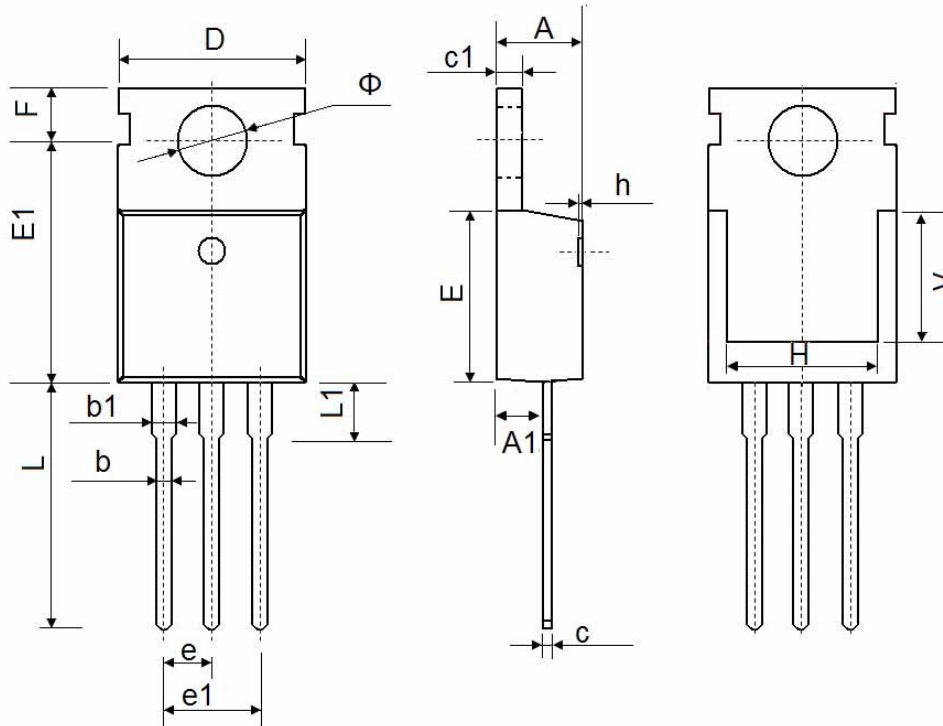


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-220-3L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	7.500 REF.		0.295 REF.	
Φ	3.400	3.800	0.134	0.150