



LCE N-Channel Enhancement Mode Power MOSFET

**Description**

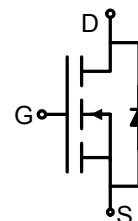
The LCE2304 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge .This device is suitable for use as a load switch or in PWM applications.

**General Features**

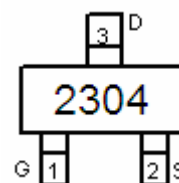
- $V_{DS} = 30V, I_D = 3.6A$   
 $R_{DS(ON)} < 73m\Omega @ V_{GS}=4.5V$   
 $R_{DS(ON)} < 58m\Omega @ V_{GS}=10V$
- High power and current handing capability
- Lead free product is acquired
- Surface mount package

**Application**

- Battery protection
- Load switch
- Power management



Schematic diagram



Marking and pin assignment



SOT-23 top view

**Package Marking and Ordering Information**

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
2304	LCE2304	SOT-23	Ø180mm	8 mm	3000 units

**Absolute Maximum Ratings ( $T_A=25^\circ C$  unless otherwise noted)**

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	30	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	3.6	A
Drain Current-Pulsed (Note 1)	$I_{DM}$	15	A
Maximum Power Dissipation	$P_D$	1.7	W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	$^\circ C$

**Thermal Characteristic**

Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	73.5	$^\circ C/W$
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**Electrical Characteristics ( $T_A=25^\circ C$  unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	30	33	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=30V, V_{GS}=0V$	-	-	1	$\mu A$



Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 100$	nA
<b>On Characteristics (Note 3)</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	1.2	1.5	2.2	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=4.5V, I_D=3.1A$	-	58	73	m $\Omega$
		$V_{GS}=10V, I_D=3.6A$	-	40	58	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=5V, I_D=3.6A$	-	11	-	S
<b>Dynamic Characteristics (Note4)</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=15V, V_{GS}=0V,$ $F=1.0MHz$	-	230	-	PF
Output Capacitance	$C_{OSS}$		-	40	-	PF
Reverse Transfer Capacitance	$C_{RSS}$		-	17	-	PF
<b>Switching Characteristics (Note 4)</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=10V, I_D=3.6A$ $V_{GS}=4.5V, R_{GEN}=6\Omega$	-	10	-	nS
Turn-on Rise Time	$t_r$		-	50	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	10	-	nS
Turn-Off Fall Time	$t_f$		-	20	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=15V, I_D=3.6A,$ $V_{GS}=10V$	-	4.0	-	nC
Gate-Source Charge	$Q_{GS}$		-	0.75	-	nC
Gate-Drain Charge	$Q_{gd}$		-	0.65	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	$V_{SD}$	$V_{GS}=0V, I_S=2.7A$	-	0.8	1.2	V
Diode Forward Current (Note 2)	$I_S$		-	-	1.6	A

**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

Typical Electrical and Thermal Characteristics

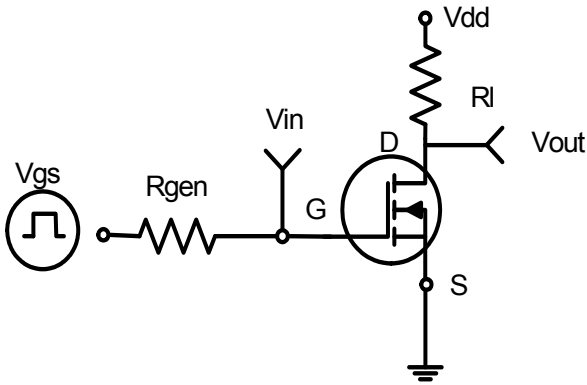


Figure 1: Switching Test Circuit

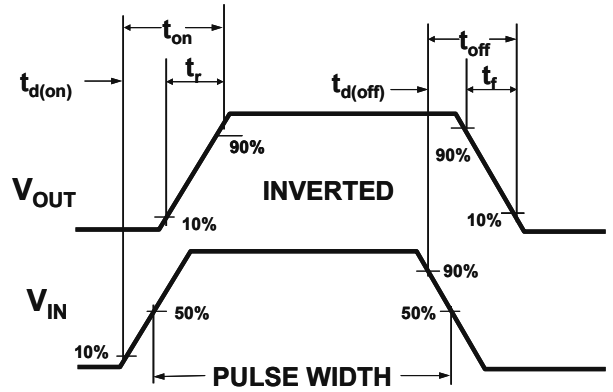
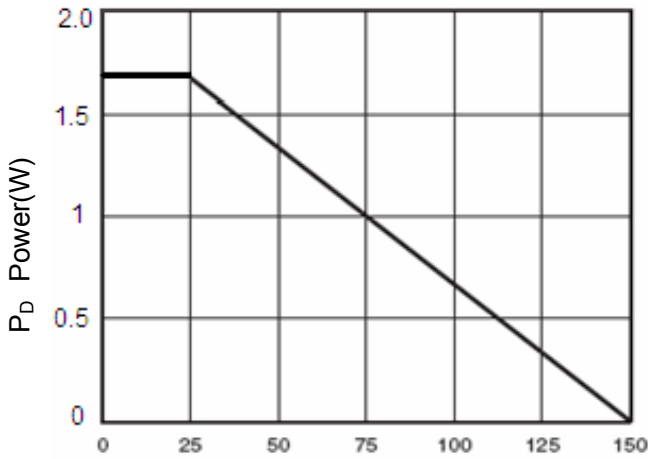
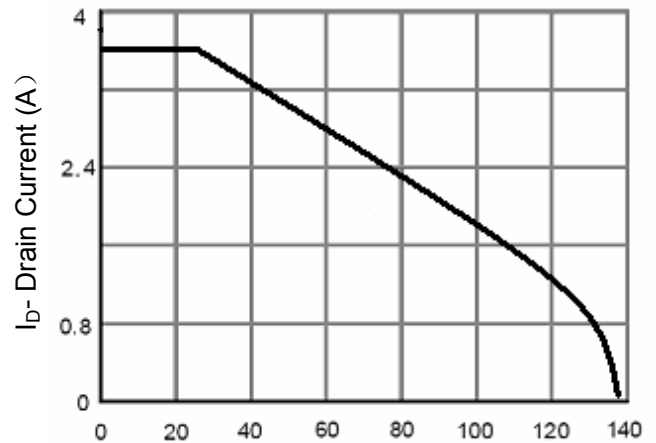


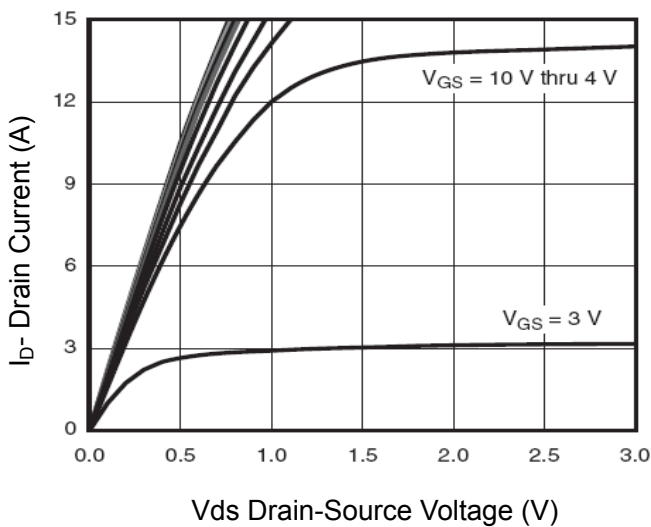
Figure 2: Switching Waveforms



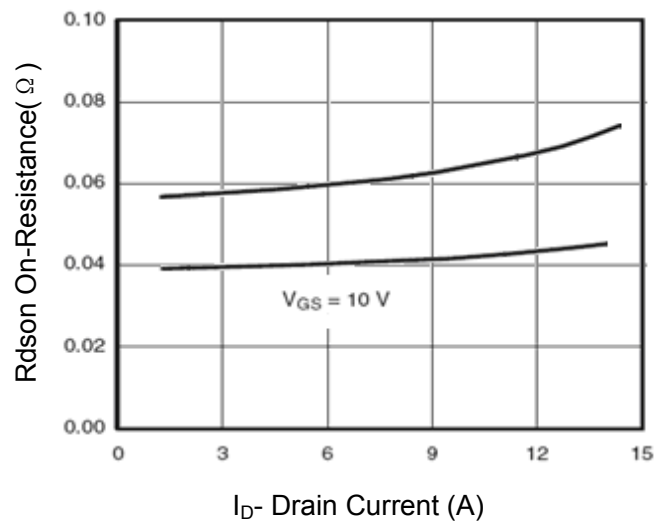
T<sub>J</sub>-Junction Temperature(°C)  
Figure 3 Power Dissipation



T<sub>J</sub>-Junction Temperature(°C)  
Figure 4 Drain Current



V<sub>ds</sub> Drain-Source Voltage (V)  
Figure 5 Output Characteristics



I<sub>D</sub>- Drain Current (A)  
Figure 6 Drain-Source On-Resistance

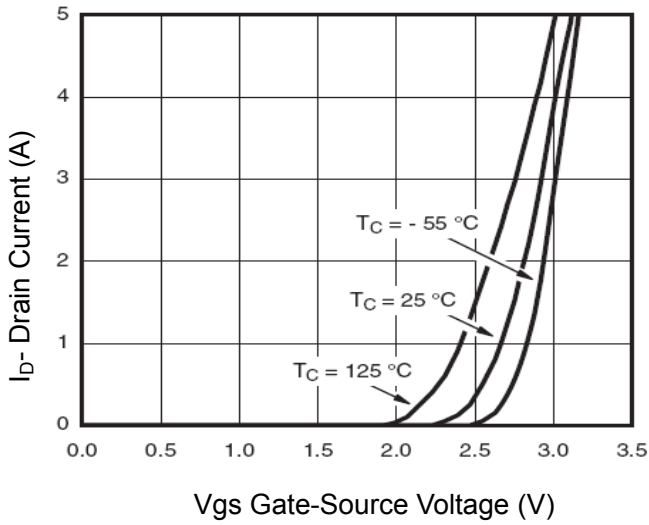


Figure 7 Transfer Characteristics

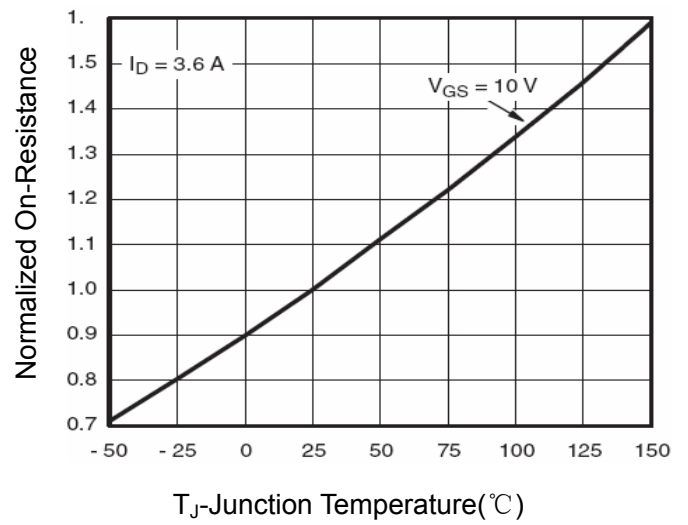


Figure 8 Drain-Source On-Resistance

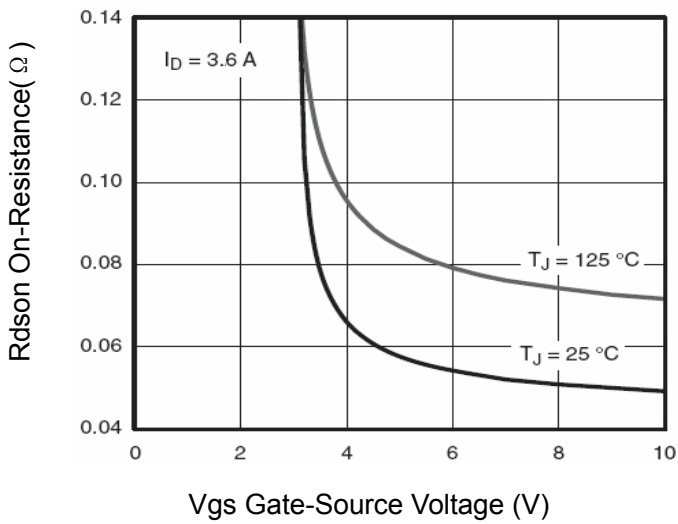


Figure 9 Rdson vs Vgs

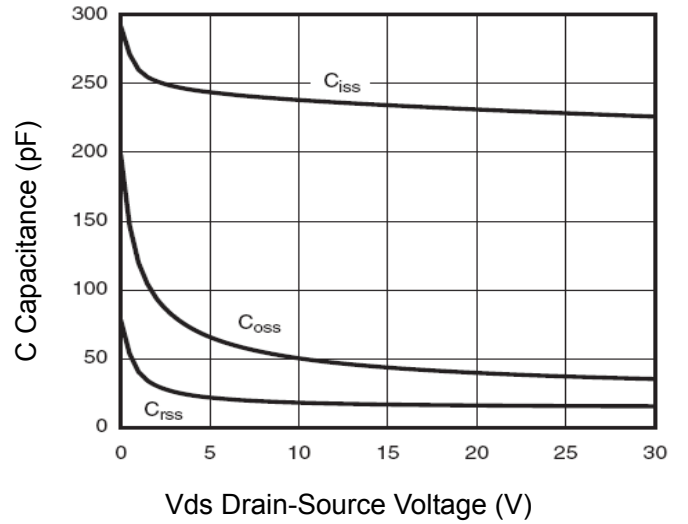


Figure 10 Capacitance vs Vds

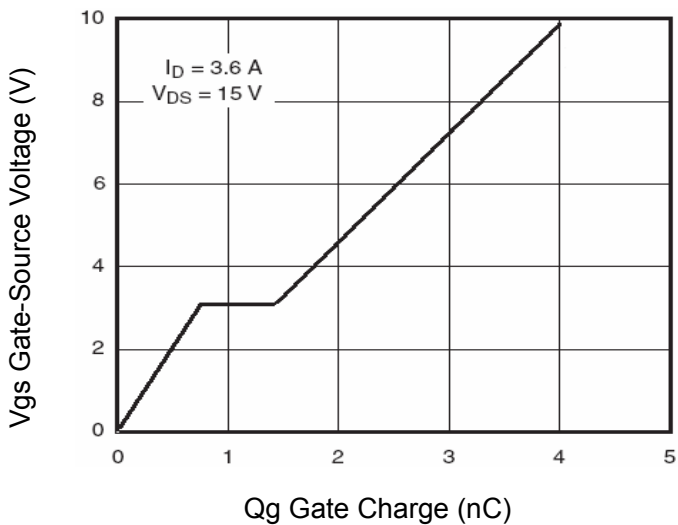


Figure 11 Gate Charge

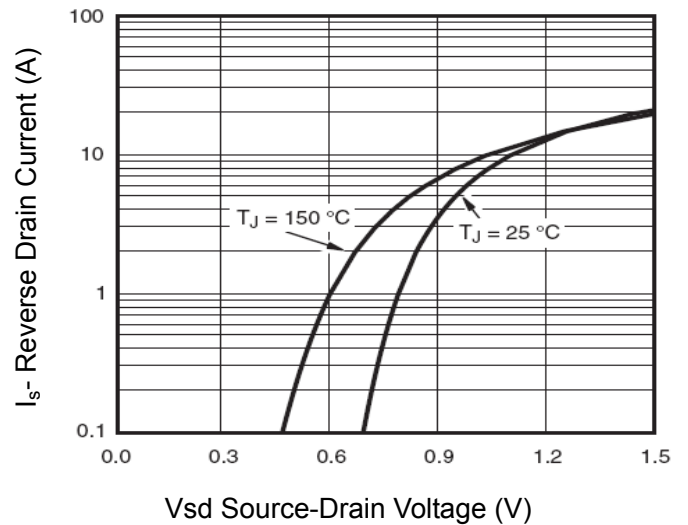
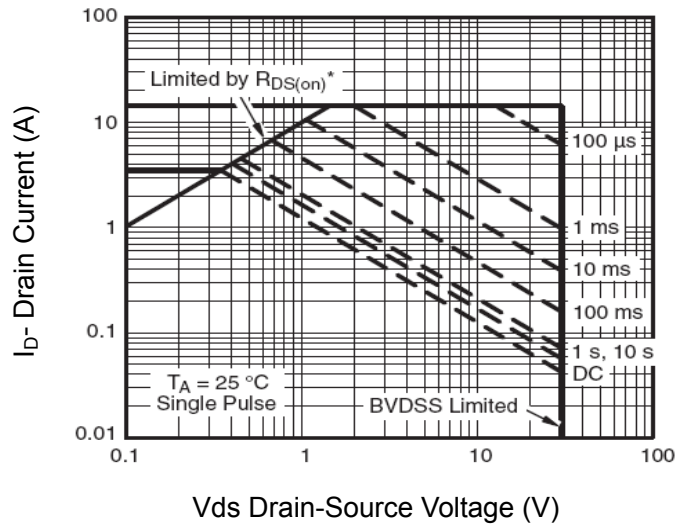
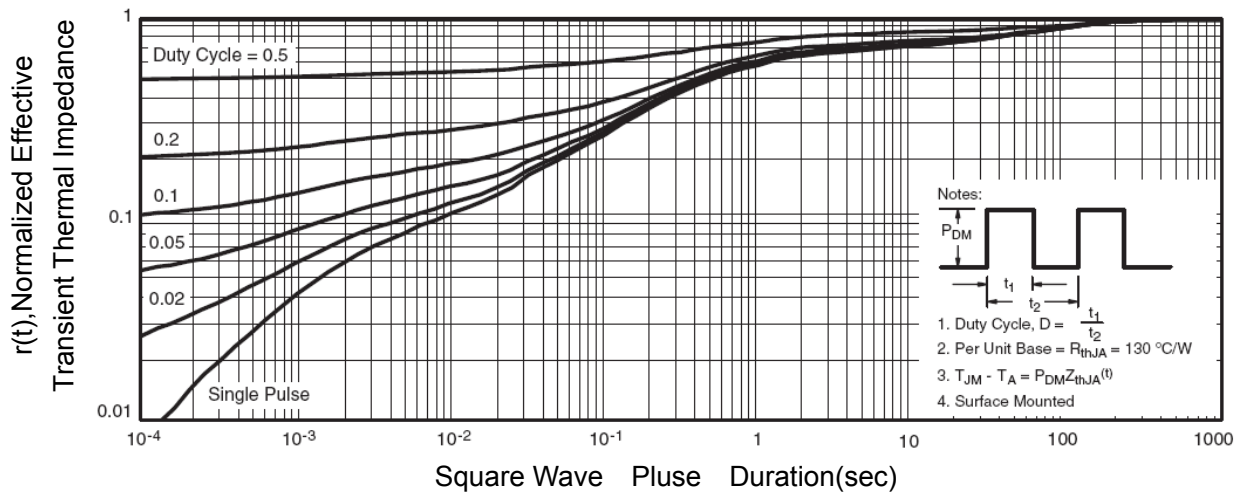


Figure 12 Source- Drain Diode Forward

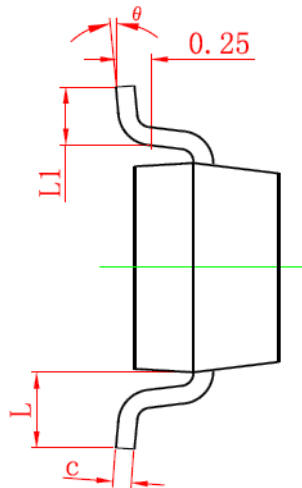
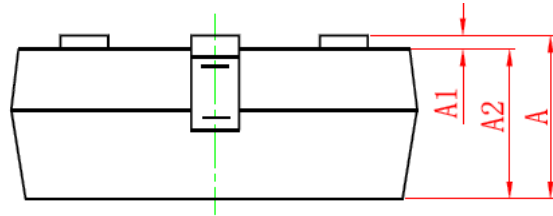
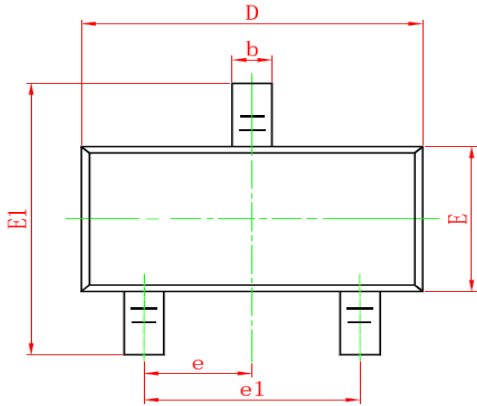


**Figure 13 Safe Operation Area**



**Figure 14 Normalized Maximum Transient Thermal Impedance**

## SOT-23 Package Information



Symbol	Dimensions in Millimeters	
	MIN.	MAX.
<b>A</b>	<b>0.900</b>	<b>1.150</b>
<b>A1</b>	<b>0.000</b>	<b>0.100</b>
<b>A2</b>	<b>0.900</b>	<b>1.050</b>
<b>b</b>	<b>0.300</b>	<b>0.500</b>
<b>c</b>	<b>0.080</b>	<b>0.150</b>
<b>D</b>	<b>2.800</b>	<b>3.000</b>
<b>E</b>	<b>1.200</b>	<b>1.400</b>
<b>E1</b>	<b>2.250</b>	<b>2.550</b>
<b>e</b>	<b>0.950TYP</b>	
<b>e1</b>	<b>1.800</b>	<b>2.000</b>
<b>L</b>	<b>0.550REF</b>	
<b>L1</b>	<b>0.300</b>	<b>0.500</b>
<b><math>\theta</math></b>	<b>0°</b>	<b>8°</b>

### Notes

1. All dimensions are in millimeters.
2. Tolerance  $\pm 0.10\text{mm}$  (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.