PD - 96239

International
IOR Rectifier

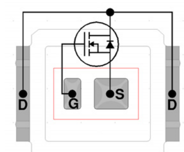
DIGITAL AUDIO MOSFET

IRF7665S2TRPbF
IRF7665S2TR1PbF

Features

- Key parameters optimized for Class-D audio amplifier applications
- Low $R_{DS(on)}$ for improved efficiency
- Low Q_g for better THD and improved efficiency
- Low Q_{rr} for better THD and lower EMI
- Low package stray inductance for reduced ringing and lower EMI
- Can deliver up to 100W per channel into 8Ω with no heatsink ⑩
- Dual sided cooling compatible
- Compatible with existing surface mount technologies
- RoHS compliant containing no lead or bromide
- Lead-Free (Qualified up to 260°C Reflow)
- Industrial Qualified

Key Parameters		
V_{DS}	100	V
$R_{DS(on)}$ typ. @ V_{GS} = 10V	51	mΩ
Q_g typ.	8.3	nC
$R_{G(int)}$ typ.	3.5	Ω



SB


DirectFET™ ISOMETRIC

Applicable DirectFET Outline and Substrate Outline (see p. 6, 7 for details)

SB	SC			M2	M4		L4	L6	L8	

Description

This Digital Audio MOSFET is specifically designed for Class-D audio amplifier applications. This MOSFET utilizes the latest processing techniques to achieve low on-resistance per silicon area. Furthermore, gate charge, body-diode reverse recovery and internal gate resistance are optimized to improve key Class-D audio amplifier performance factors such as efficiency, THD, and EMI.

The IRF7665S2TR/TR1PbF device utilizes DirectFET™ packaging technology. DirectFET™ packaging technology offers lower parasitic inductance and resistance when compared to conventional wirebonded SOIC packaging. Lower inductance improves EMI performance by reducing the voltage ringing that accompanies fast current transients. The DirectFET™ package is compatible with existing layout geometries used in power applications, PCB assembly equipment and vapor phase, infra-red or convection soldering techniques, when application note AN-1035 is followed regarding the manufacturing method and processes. The DirectFET™ package also allows dual sided cooling to maximize thermal transfer in power systems, improving thermal resistance and power dissipation. These features combine to make this MOSFET a highly efficient, robust and reliable device for Class-D audio amplifier applications.

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{DS}	Drain-to-Source Voltage	100	V
V_{GS}	Gate-to-Source Voltage	± 20	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	14.4	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	10.2	
I_D @ T_A = 25°C	Continuous Drain Current, V_{GS} @ 10V	4.1	
I_{DM}	Pulsed Drain Current ①	58	
P_D @T_C = 25°C	Maximum Power Dissipation	30	W
P_D @T_C = 100°C	Power Dissipation ⑧	15	
P_D @T_A = 25°C	Power Dissipation ⑧	2.4	
	Linear Derating Factor ⑧	0.2	W/°C
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ③	---	63	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑥	12.5	---	
$R_{\theta JA}$	Junction-to-Ambient ⑦	20	---	
$R_{\theta J\text{-}Can}$	Junction-to-Can ⑧⑨	---	5.0	
$R_{\theta J\text{-}PCB}$	Junction-to-PCB Mounted	1.4	---	

Notes ① through ⑩ are on page 2

Static @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	—	—	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.10	—	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	51	62	mΩ	V_{GS} = 10V, I_D = 8.9A ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	4.0	5.0	V	V_{DS} = V_{GS}, I_D = 25µA
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	µA	V_{DS} = 100V, V_{GS} = 0V
		—	—	250		V_{DS} = 80V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V_{GS} = -20V
$R_{G(int)}$	Internal Gate Resistance	—	3.5	5.0	Ω	

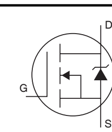
Dynamic @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
gfs	Forward Transconductance	8.8	—	—	S	V_{DS} = 25V, I_D = 8.9A
Q_g	Total Gate Charge	—	8.3	13	nC	V_{DS} = 50V
Q_{gs1}	Pre-Vth Gate-to-Source Charge	—	1.9	—		V_{GS} = 10V
Q_{gs2}	Post-Vth Gate-to-Source Charge	—	0.77	—		I_D = 8.9A
Q_{gd}	Gate-to-Drain Charge	—	3.2	—		See Fig. 6 and 17
Q_{godr}	Gate Charge Overdrive	—	2.4	—		
Q_{sw}	Switch Charge (Q_{gs2} + Q_{gd})	—	4.0	—		
$t_{d(on)}$	Turn-On Delay Time	—	3.8	—	ns	V_{DD} = 50V
t_r	Rise Time	—	6.4	—		I_D = 8.9A
$t_{d(off)}$	Turn-Off Delay Time	—	7.1	—		R_G = 6.8Ω
t_f	Fall Time	—	3.6	—		V_{GS} = 10V ④
C_{iss}	Input Capacitance	—	515	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	112	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	30	—		f = 1.0MHz
C_{oss}	Output Capacitance	—	533	—		V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz
C_{oss}	Output Capacitance	—	67	—		V_{GS} = 0V, V_{DS} = 80V, f = 1.0MHz
C_{oss} eff.	Effective Output Capacitance	—	115	—		V_{GS} = 0V, V_{DS} = 0V to 80V ⑤

Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	—	37	mJ
I_{AR}	Avalanche Current ①	—	8.9	A

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	14.4	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	58		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	T_J = 25°C, I_S = 8.9A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	33	—	ns	T_J = 25°C, I_F = 8.9A, V_{DD} = 25V
Q_{rr}	Reverse Recovery Charge	—	38	—	nC	di/dt = 100A/µs ④

Notes:

① Repetitive rating; pulse width limited by max. junction temperature.
② Starting T_J = 25°C, L = 0.944mH, R_G = 25Ω, I_{AS} = 8.9A.
③ Surface mounted on 1 in. square Cu board.
④ Pulse width ≤ 400µs; duty cycle ≤ 2%.
⑤ C_{oss} eff. is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.
⑥ Used double sided cooling , mounting pad.
⑦ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
⑧ T_C measured with thermal couple mounted to top (Drain) of part.
⑨ R_θ is measured at T_J of approximately 90°C.
⑩ Based on testing done using a typical device & evaluation board at Vbus=±45V, f_{SW}=400KHz, and T_A=25°C. The delta case temperature ΔT_C is 55°C.

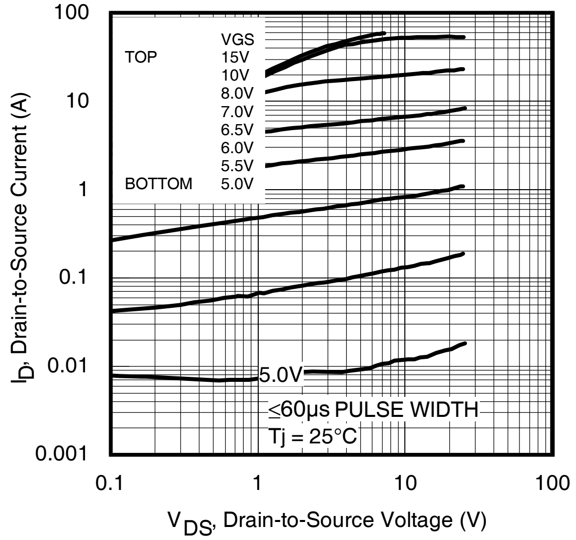


Fig 1. Typical Output Characteristics

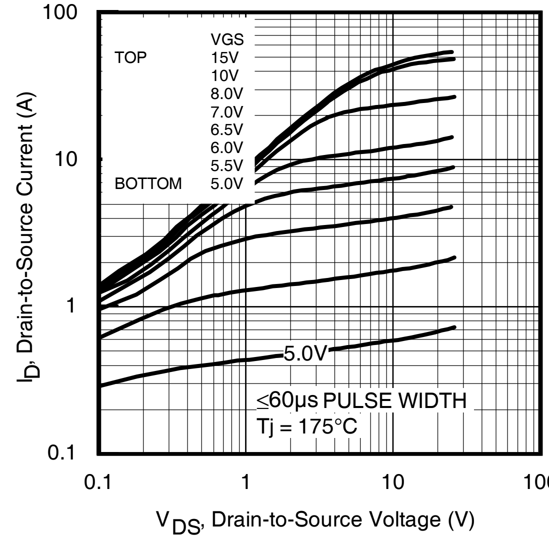


Fig 2. Typical Output Characteristics

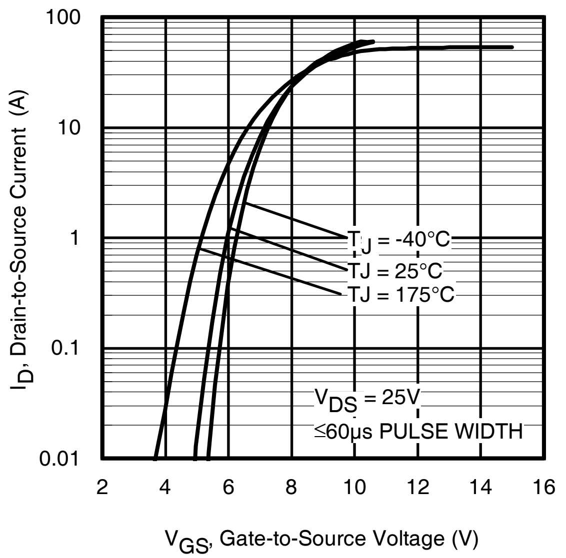


Fig 3. Typical Transfer Characteristics

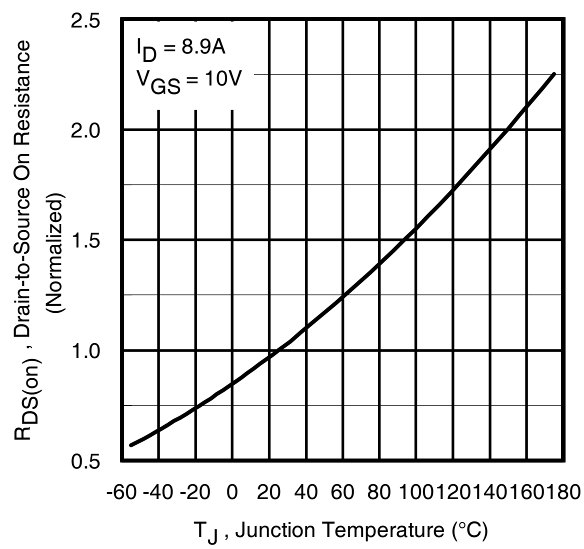


Fig 4. Normalized On-Resistance vs. Temperature

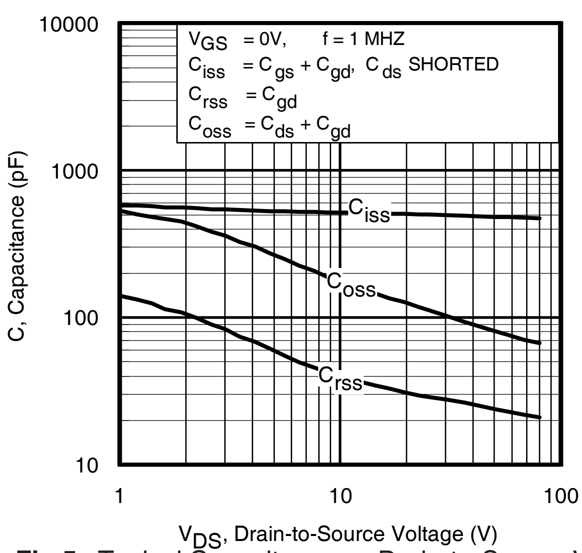


Fig 5. Typical Capacitance vs.Drain-to-Source Voltage

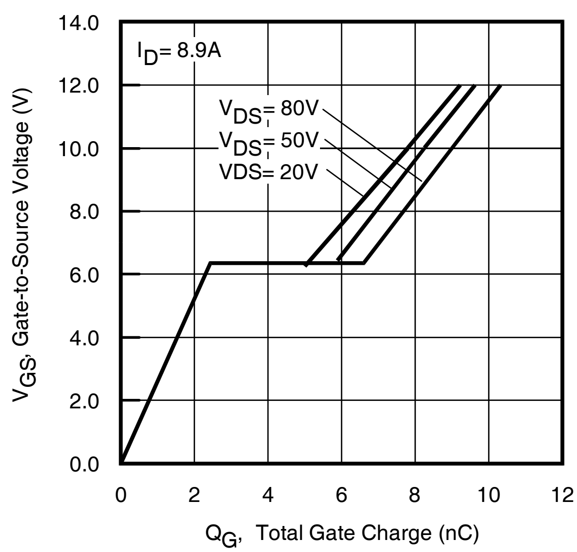


Fig 6. Typical Gate Charge vs.Gate-to-Source Voltage

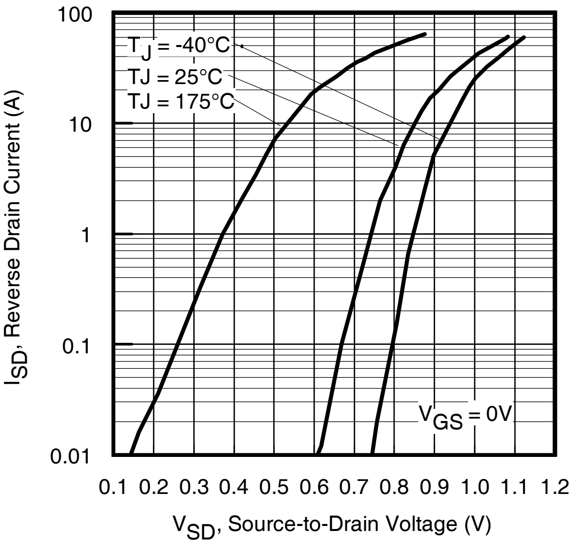


Fig 7. Typical Source-Drain Diode Forward Voltage

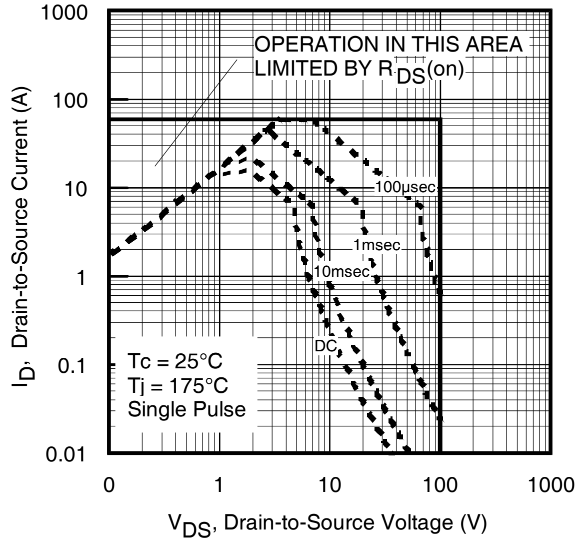


Fig 8. Maximum Safe Operating Area

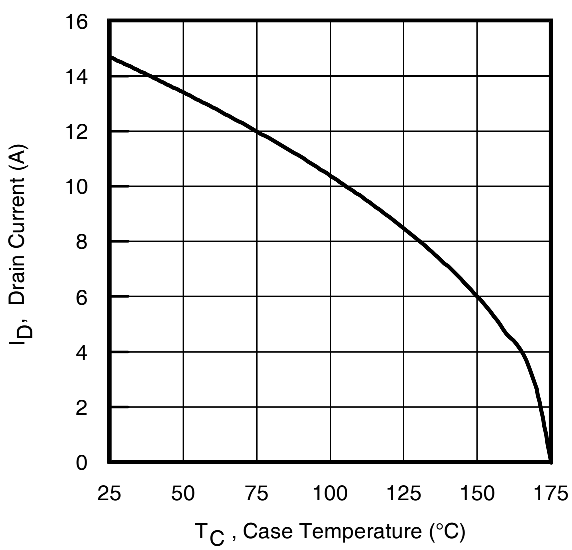


Fig 9. Maximum Drain Current vs. Case Temperature

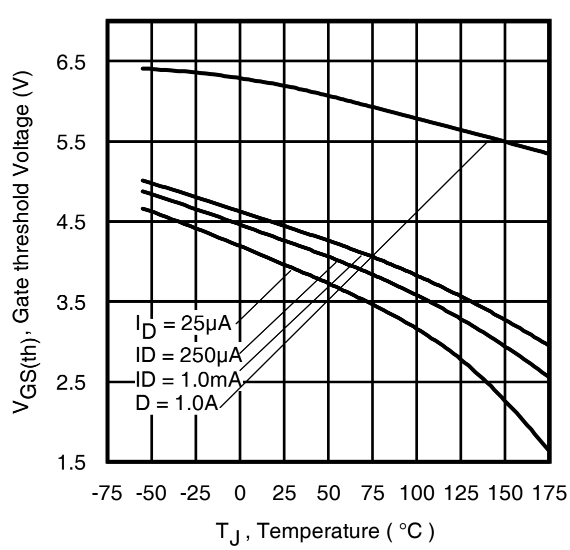


Fig 10. Threshold Voltage vs. Temperature

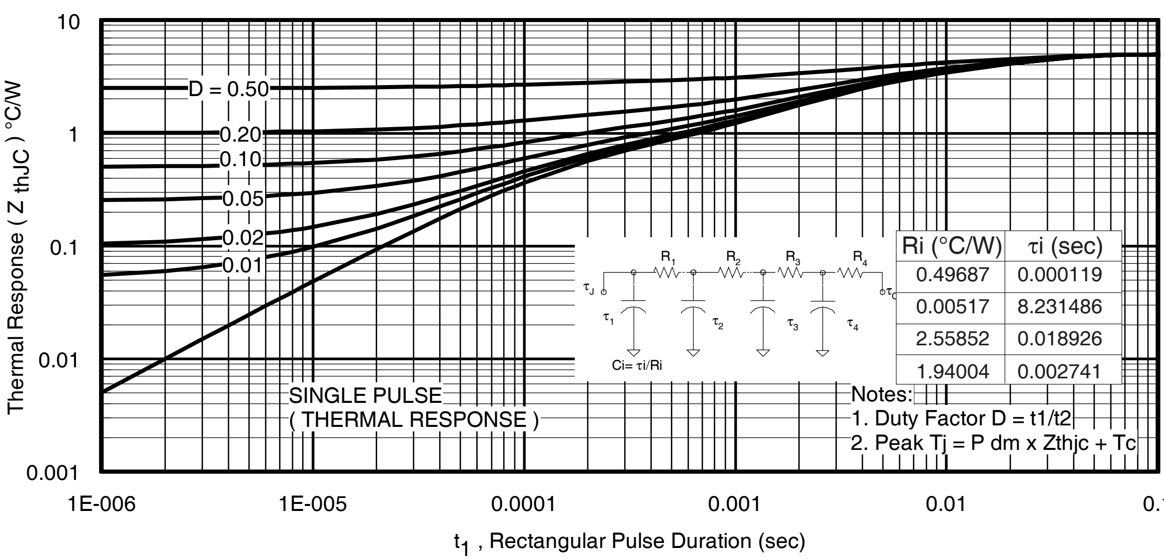


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient ③

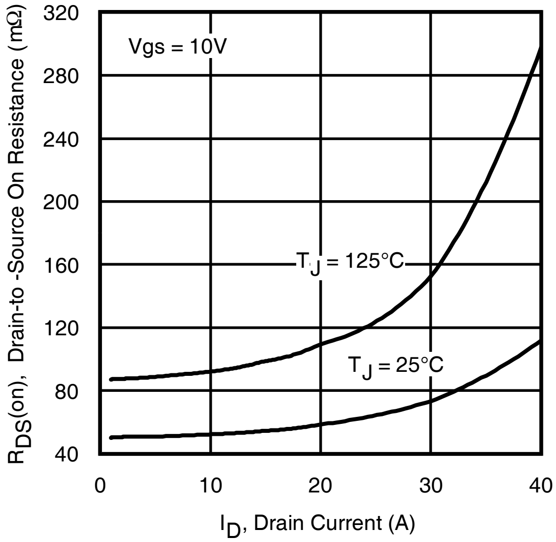


Fig 12. On-Resistance vs. Gate Voltage

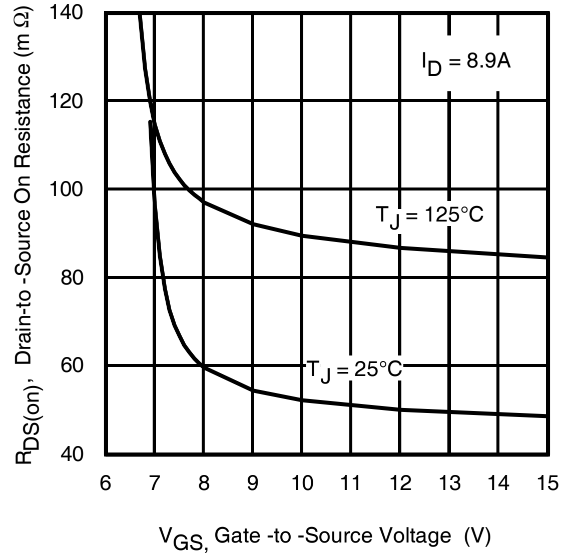


Fig 13. On-Resistance vs. Drain Current

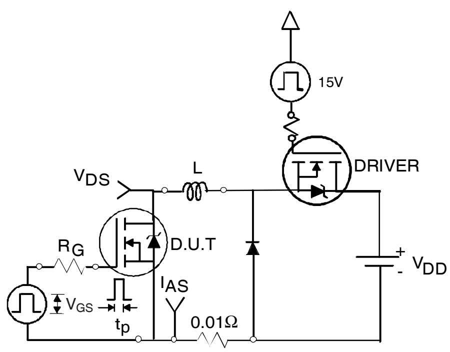


Fig 15a. Unclamped Inductive Test Circuit

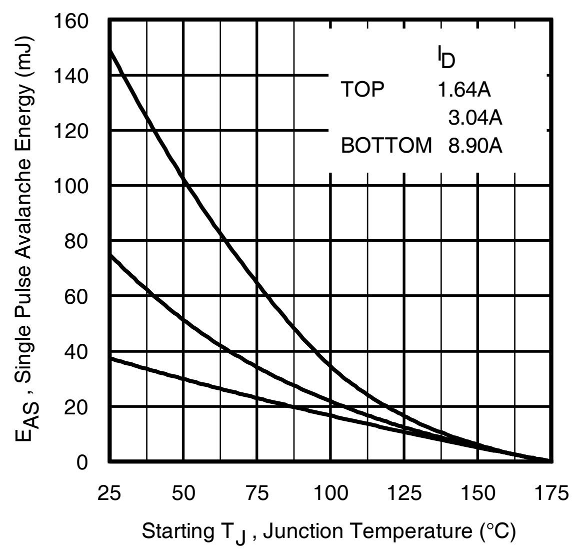


Fig 14. Maximum Avalanche Energy vs. Drain Current

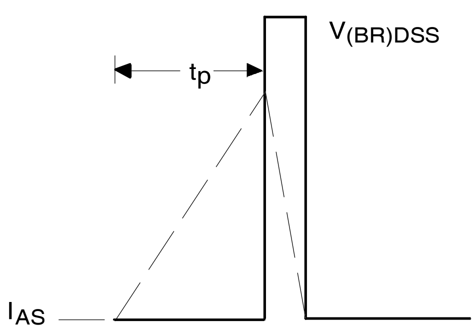


Fig 15b. Unclamped Inductive Waveforms

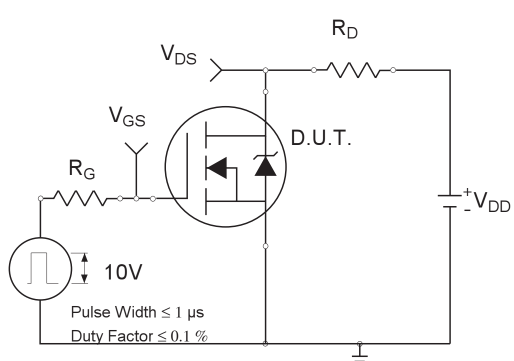


Fig 16a. Switching Time Test Circuit

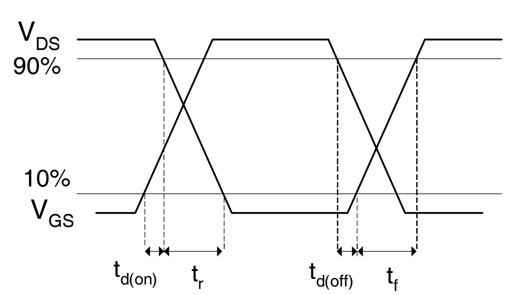


Fig 16b. Switching Time Waveforms

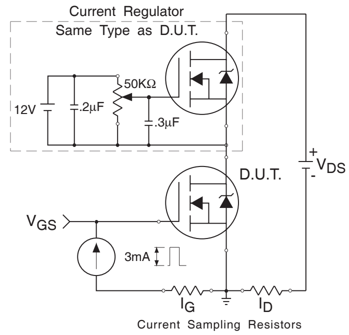


Fig 17a. Gate Charge Test Circuit

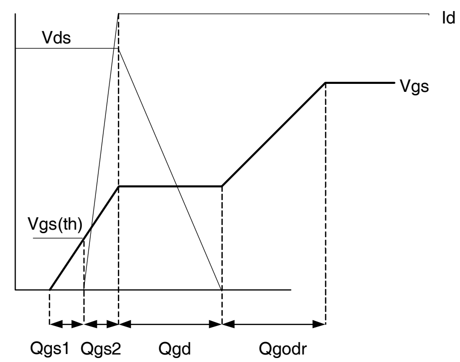
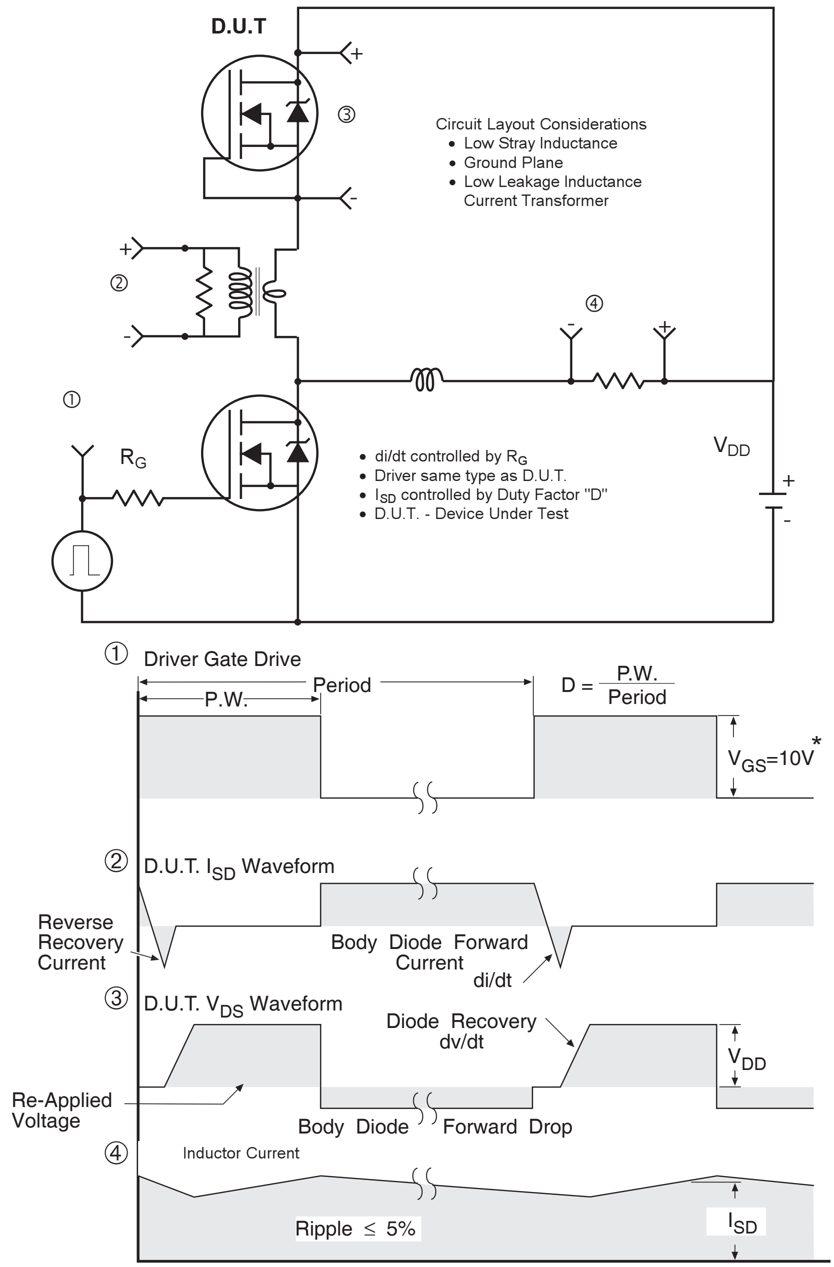


Fig 17b. Gate Charge Waveform

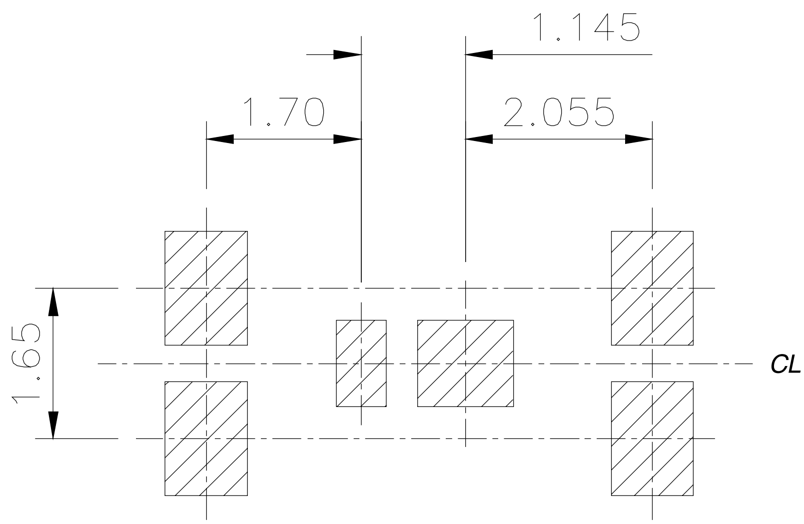


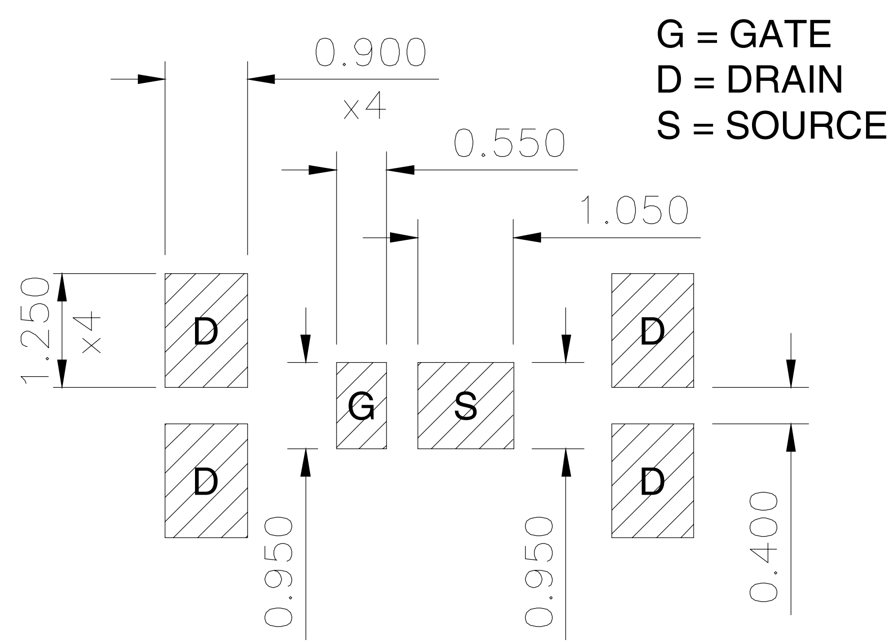
* V_{GS} = 5V for Logic Level Devices

Fig 18. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

DirectFET Auto™ Board Footprint, SB (Small Size Can).

Please see AN-1035 for DirectFET assembly details and stencil and substrate design recommendations

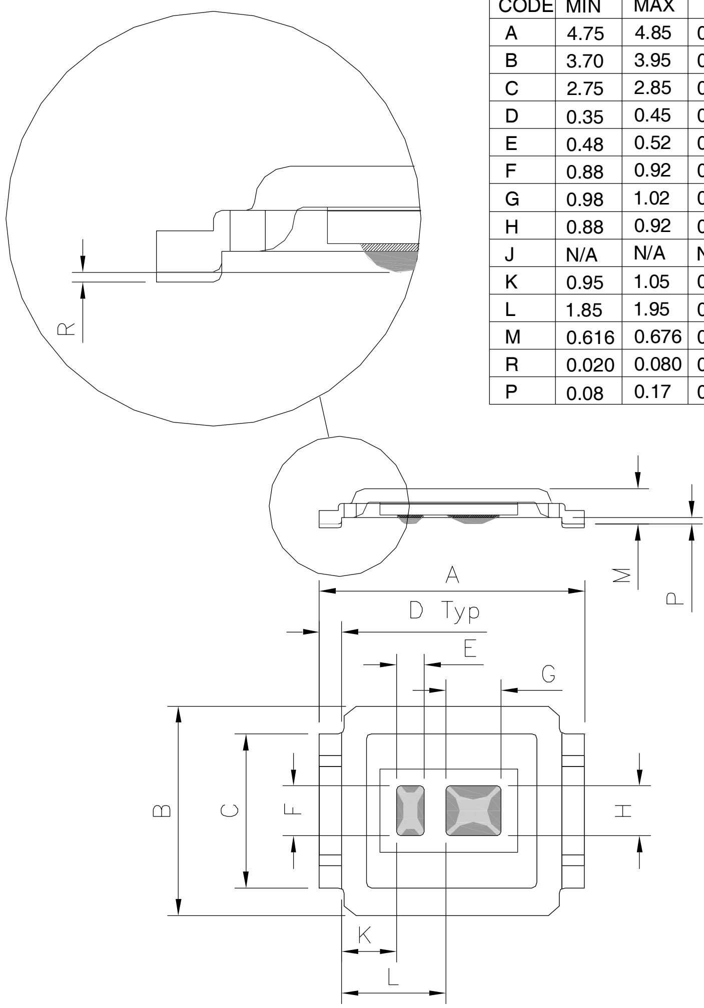




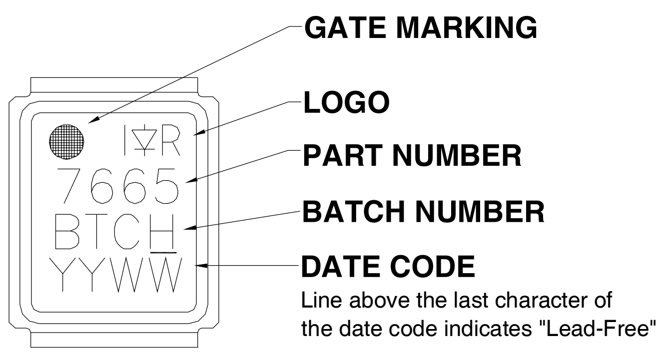
DirectFET Auto™ Outline Dimension, SB Outline (Small Size Can).

Please see AN-1035 for DirectFET assembly details and stencil and substrate design recommendations

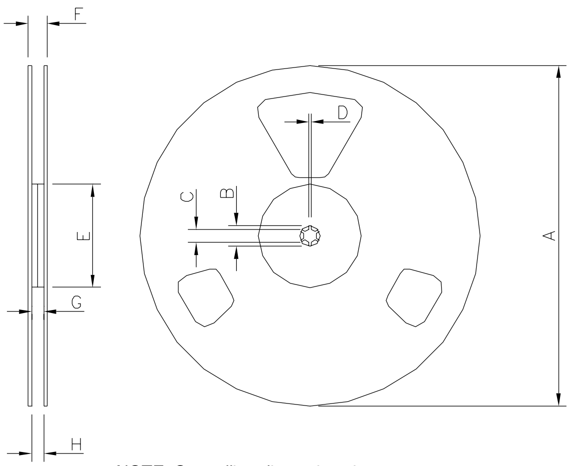
DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	4.75	4.85	0.187	0.191
B	3.70	3.95	0.146	0.156
C	2.75	2.85	0.108	0.112
D	0.35	0.45	0.014	0.018
E	0.48	0.52	0.019	0.020
F	0.88	0.92	0.035	0.036
G	0.98	1.02	0.039	0.040
H	0.88	0.92	0.035	0.036
J	N/A	N/A	N/A	N/A
K	0.95	1.05	0.037	0.041
L	1.85	1.95	0.073	0.073
M	0.616	0.676	0.0235	0.0274
R	0.020	0.080	0.0008	0.0031
P	0.08	0.17	0.003	0.007

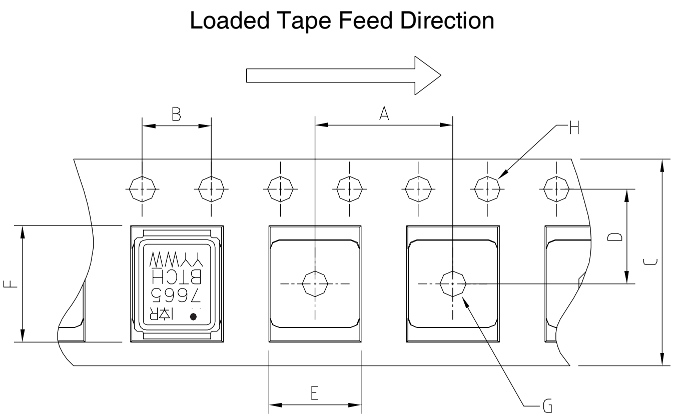


DirectFET™ Part Marking



DirectFET™ Tape & Reel Dimension (Showing component orientation).





NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts.IRF7665S2PbF

REEL DIMENSIONS				
STANDARD OPTION **(QTY 4800)**				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	330.0	N.C	12.992	N.C
B	20.2	N.C	0.795	N.C
C	12.8	13.2	0.504	0.520
D	1.5	N.C	0.059	N.C
E	100.0	N.C	3.937	N.C
F	N.C	18.4	N.C	0.724
G	12.4	14.4	0.488	0.567
H	11.9	15.4	0.469	0.606

NOTE: CONTROLLING DIMENSIONS IN MM

DIMENSIONS				
	METRIC		IMPERIAL	
CODE	MIN	MAX	MIN	MAX
A	7.90	8.10	0.311	0.319
B	3.90	4.10	0.154	0.161
C	11.90	12.30	0.469	0.484
D	5.45	5.55	0.215	0.219
E	4.00	4.20	0.158	0.165
F	5.00	5.20	0.197	0.205
G	1.50	N.C	0.059	N.C
H	1.50	1.60	0.059	0.063

Data and specifications subject to change without notice.
This product has been designed and qualified to MSL1 rating for the Industrial market.
Additional storage requirement details for DirectFET products can be found in application note AN1035 on IR’s Web site.
Qualification Standards can be found on IR’s Web site.

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