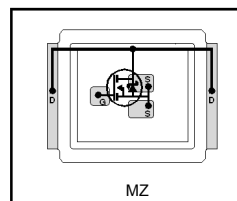


Features

- Latest MOSFET silicon technology
- 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 400 W per channel into 8Ω load in half-bridge configuration amplifier
- Dual sided cooling compatible
- Compatible with existing surface mount technologies
- RoHS compliant, halogen-free
- Lead-free (qualified up to 260°C reflow)

Key Parameters

V_{DS}	200	V
$R_{DS(on)}$ typ. @ $V_{GS} = 10V$	51	m Ω
Q_g typ.	34	nC
$R_{G(int)}$ typ.	1.0	Ω



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

SQ	SX	ST	SH	MQ	MX	MT	MN	MZ		
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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 IRF6641PbF 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.

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRF6641PbF	DirectFET Medium Can	Tape and Reel	4800	IRF6641TRPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{GS}	Gate-to-Source Voltage	± 20	V
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	26	A
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	4.6	
$I_D @ T_A = 70^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	3.7	
I_{DM}	Pulsed Drain Current ①	37	W
$P_D @ T_C = 25^\circ C$	Power Dissipation	89	
$P_D @ T_A = 25^\circ C$	Power Dissipation ③	2.8	
$P_D @ T_A = 70^\circ C$	Power Dissipation ③	1.8	mJ
E_{AS}	Single Pulse Avalanche Energy ②	46	
I_{AR}	Avalanche Current ①	11	A
	Linear Derating Factor	0.022	W/°C
T_J	Operating Junction and	-40 to + 150	°C
T_{STG}	Storage Temperature Range		

Notes ① through ③ are on page 9

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient ③	—	45	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑥	12.5	—	
$R_{\theta JA}$	Junction-to-Ambient ⑦	20	—	
$R_{\theta JC}$	Junction-to-Case ⑧⑨	—	1.4	
$R_{\theta J-PCB}$	Junction-to-PCB Mounted	1.0	—	

Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

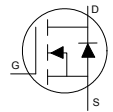
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	200	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.23	—	V/°C	Reference to 25°C , $I_D = 1.0\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	51	59.9	mΩ	$V_{GS} = 10V, I_D = 5.5A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	4.0	4.9	V	$V_{DS} = V_{GS}, I_D = 150\mu A$
$\Delta V_{GS(th)}$	Gate Threshold Voltage Coefficient	—	-11	—	mV/°C	
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 200V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 160V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$

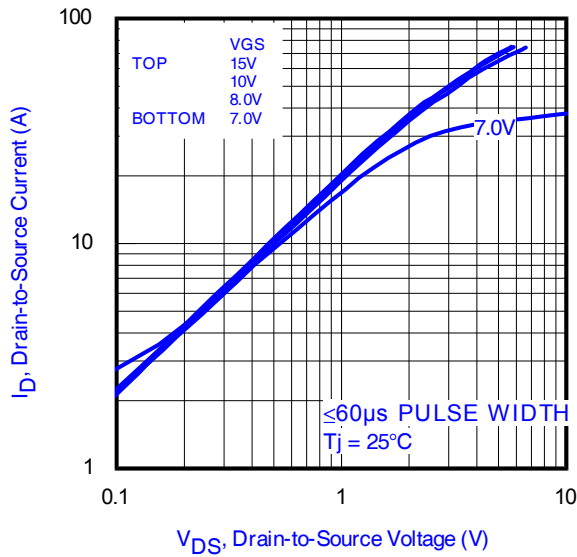
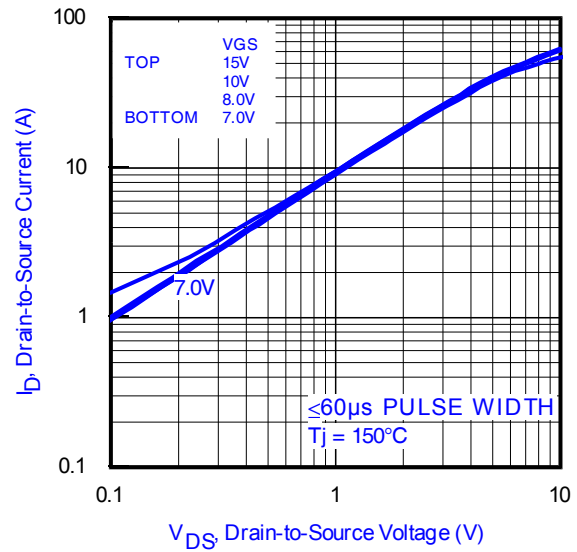
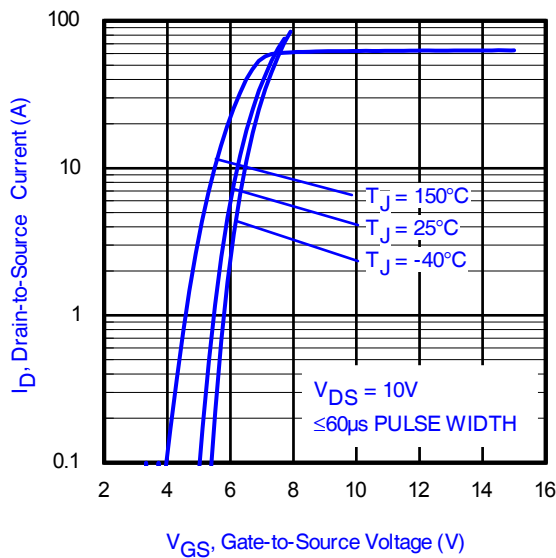
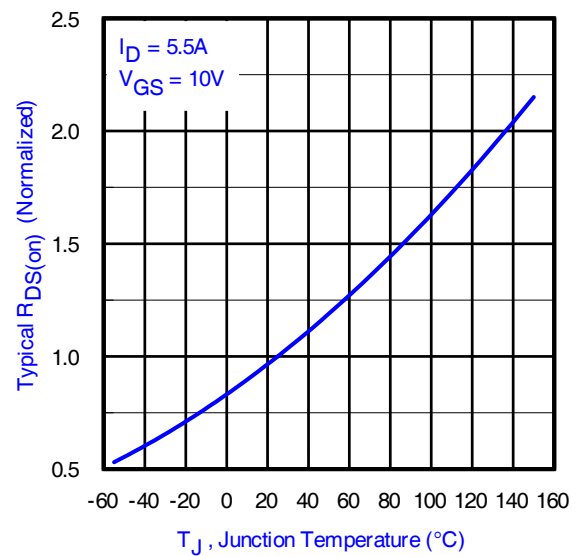
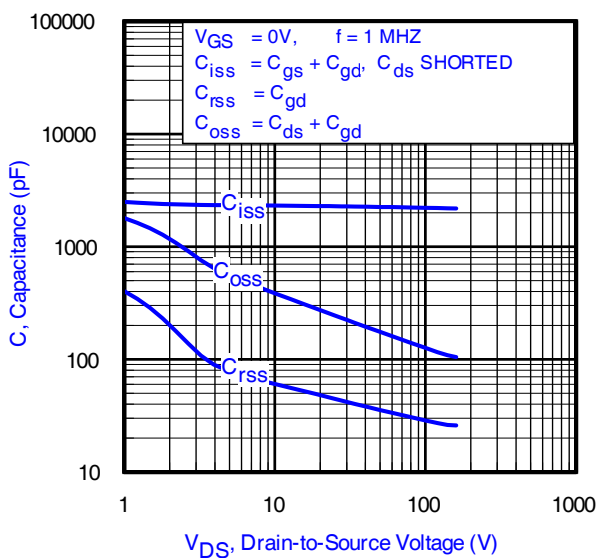
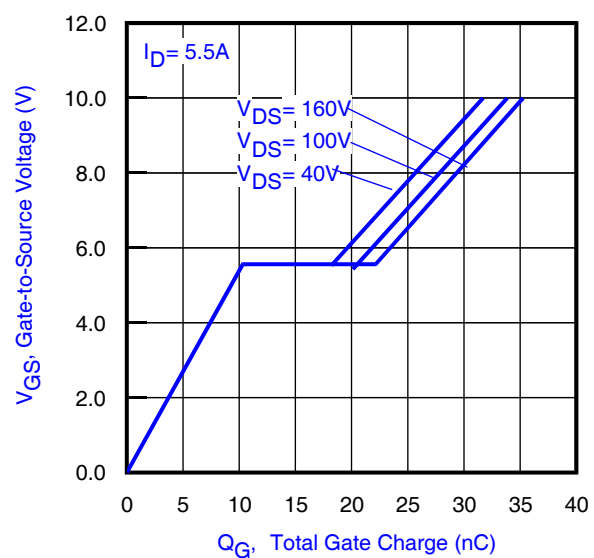
Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

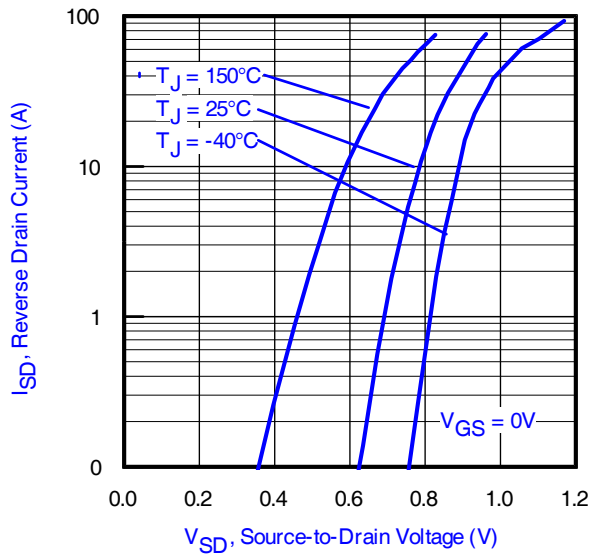
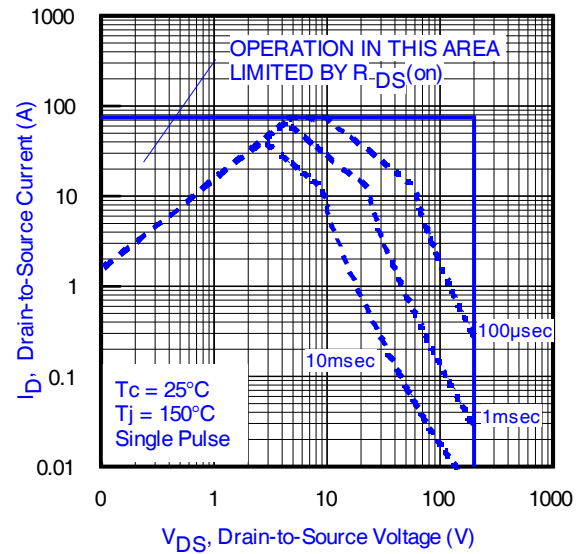
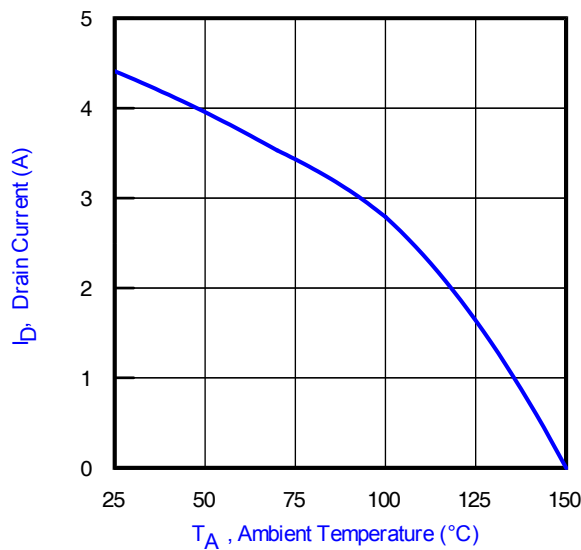
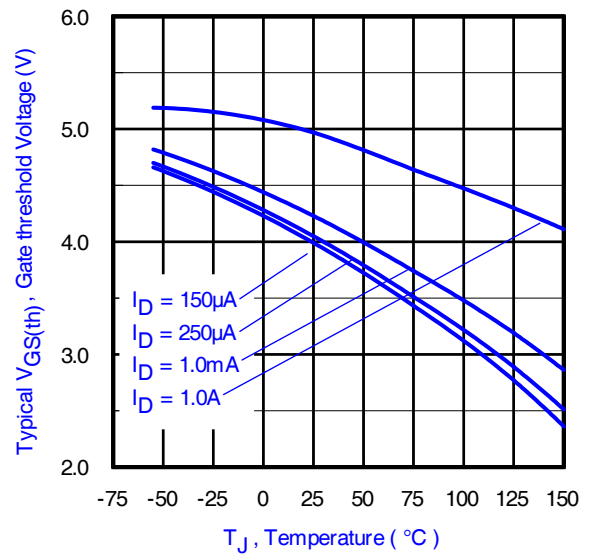
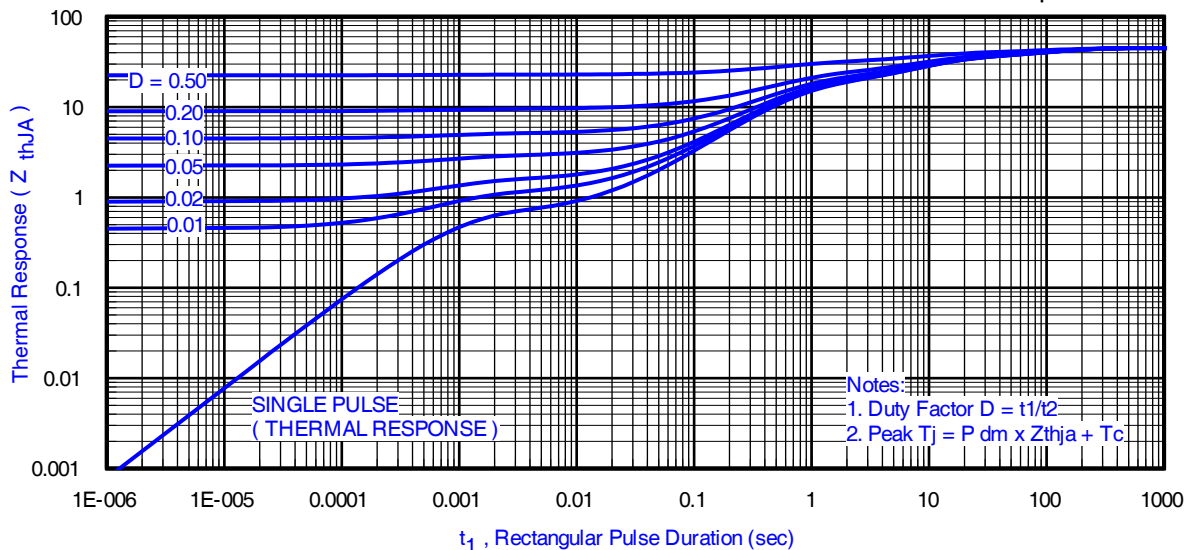
g_{fs}	Forward Transconductance	13	—	—	S	$V_{DS} = 10V, I_D = 5.5A$
Q_g	Total Gate Charge	—	34	48	nC	$V_{DS} = 100V$ $V_{GS} = 10V$ $I_D = 5.5A$
Q_{gs1}	Pre-V _{th} Gate-to-Source Charge	—	8.7	—		
Q_{gs2}	Post-V _{th} Gate-to-Source Charge	—	1.9	—		
Q_{gd}	Gate-to-Drain Charge	—	9.5	14		
Q_{godr}	Gate Charge Overdrive	—	14	—		
Q_{sw}	Switch Charge ($Q_{gs2} + Q_{gd}$)	—	11	—		$V_{DS} = 16V, V_{GS} = 0V$
$t_{d(on)}$	Turn-On Delay Time	—	16	—	ns	$V_{DD} = 100V, V_{GS} = 10V$ $I_D = 5.5A$ $R_G = 6.2\Omega$
t_r	Rise Time	—	11	—		
$t_{d(off)}$	Turn-Off Delay Time	—	31	—		
t_f	Fall Time	—	6.5	—		
C_{iss}	Input Capacitance	—	2290	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	240	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	46	—		$f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	1780	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	100	—		$V_{GS} = 0V, V_{DS} = 160V, f = 1.0\text{MHz}$

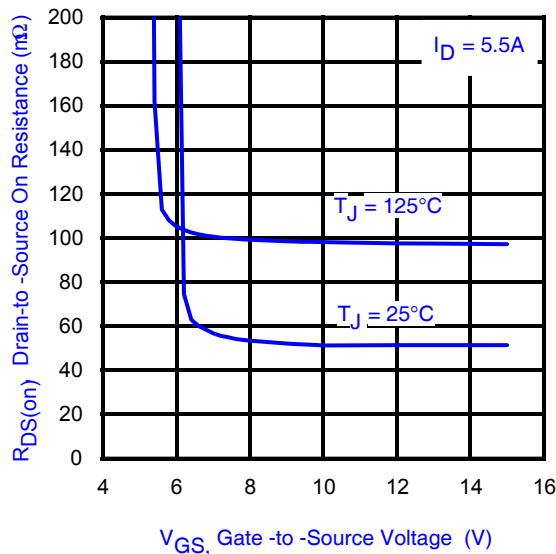
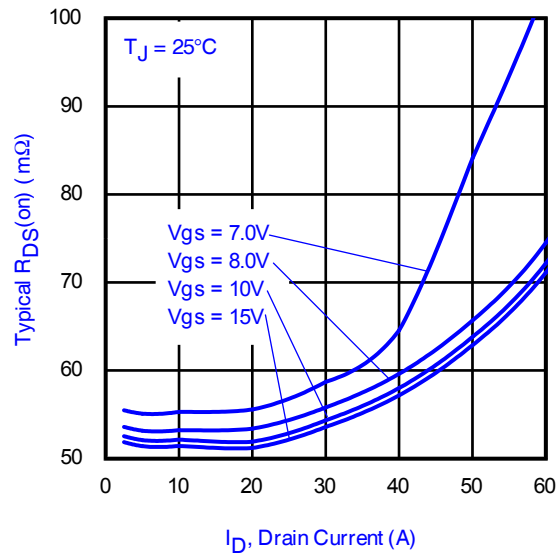
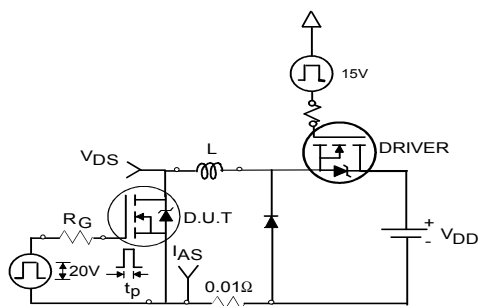
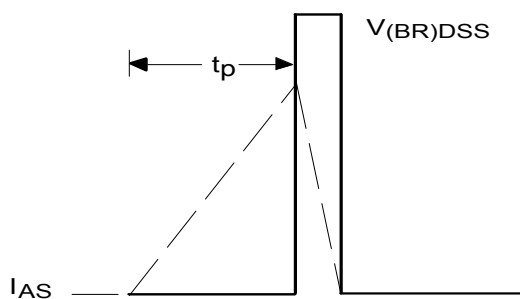
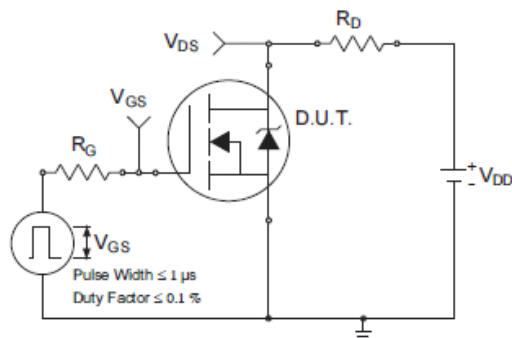
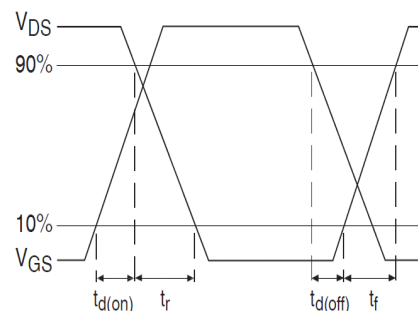
Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	26	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	37		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 5.5A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	85	130	ns	$T_J = 25^\circ\text{C}, I_F = 5.5A, V_{DD} = 100V$
Q_{rr}	Reverse Recovery Charge	—	320	480	nC	$di/dt = 100A/\mu s$ ④




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. Ambient Temperature

Fig 10. Typical Threshold Voltage vs. Junction Temperature

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


Fig 12. Typical On-Resistance vs. Gate Voltage

Fig 13. Typical On-Resistance vs. Drain Current

Fig 15a. Unclamped Inductive Test Circuit

Fig 15b. Unclamped Inductive Waveforms

Fig 16a. Switching Time Test Circuit

Fig 16b. Switching Time Waveforms

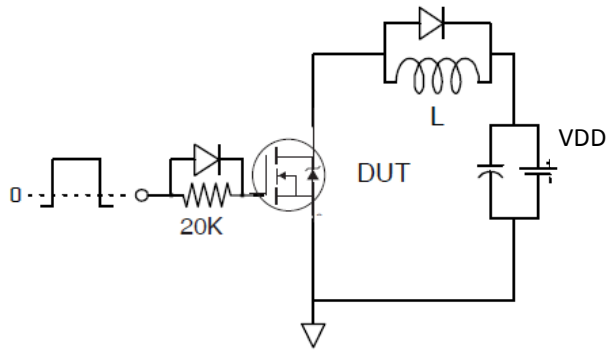


Fig 17a. Gate Charge Test Circuit

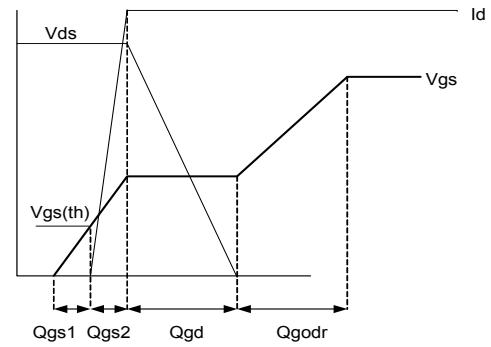


Fig 17b. Gate Charge Waveform

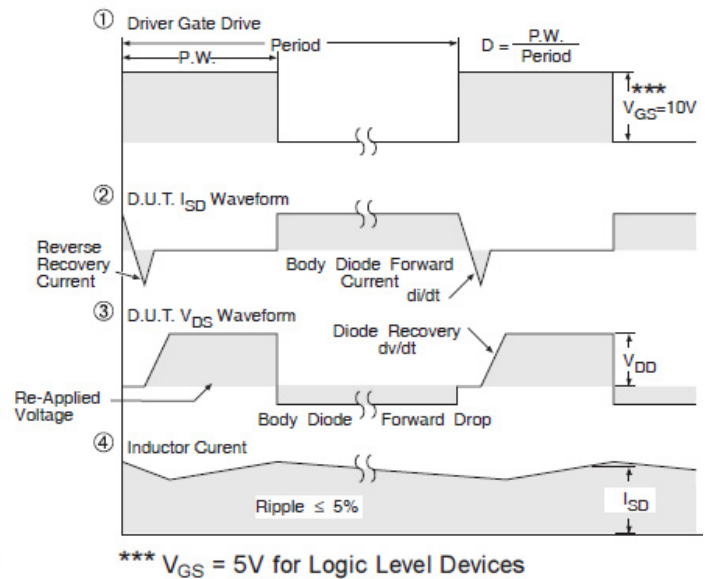
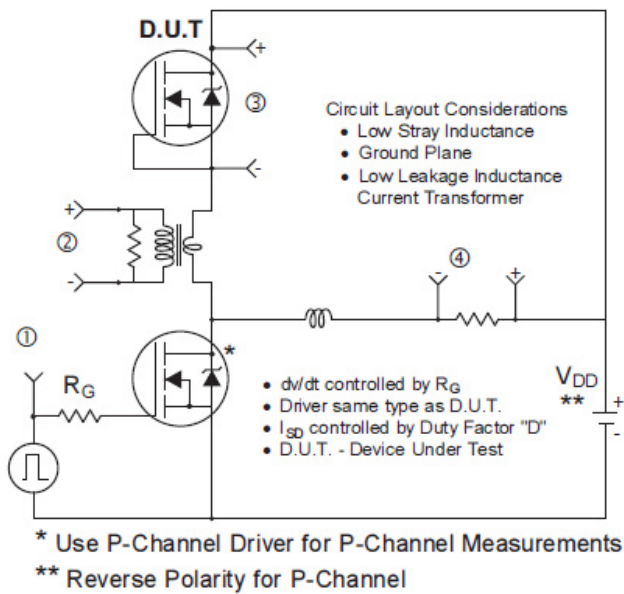
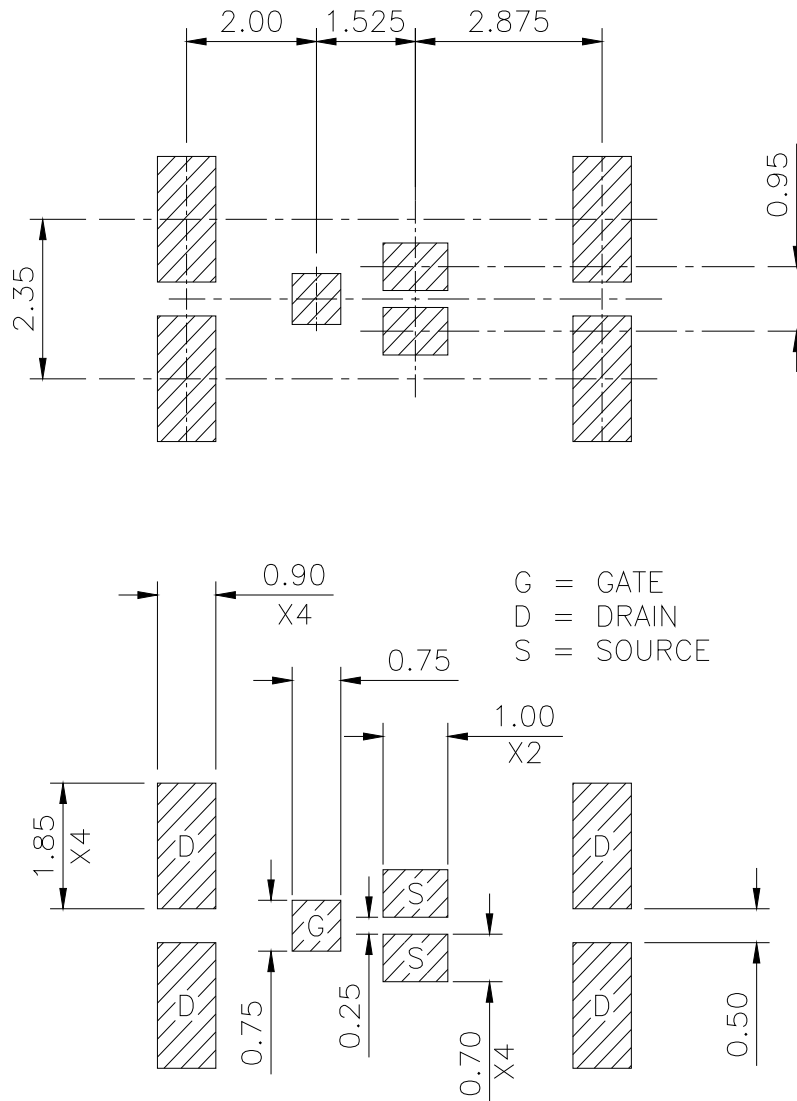


Fig 18. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

DirectFET® Substrate and PCB Layout, MZ Outline (Medium Size Can, Z-Designation).

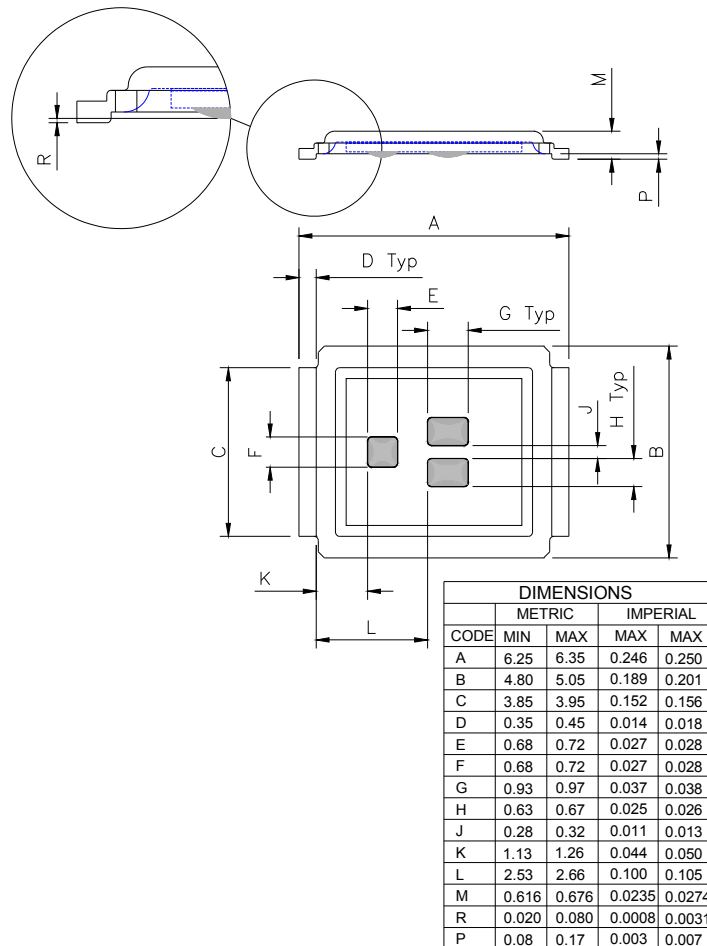
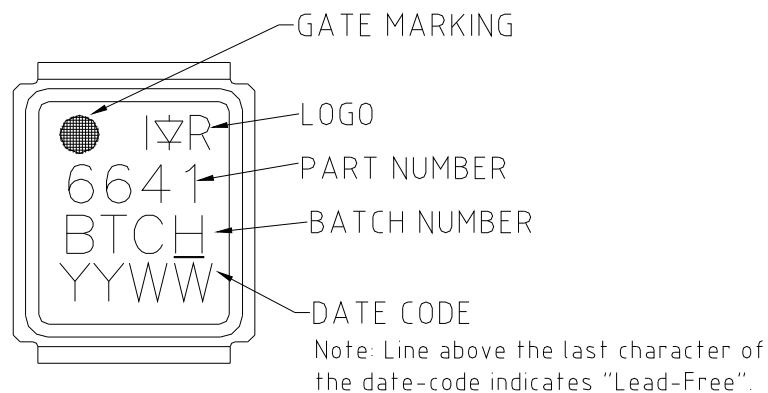
Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET. This includes all recommendations for stencil and substrate designs.



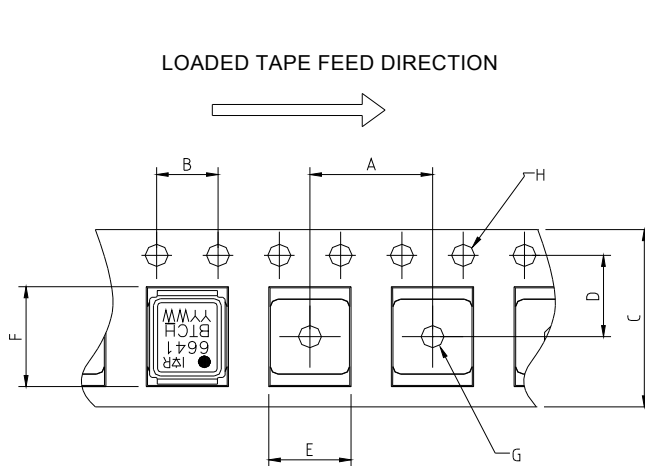
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

**DirectFET® Outline Dimension, MZ Outline
(Medium Size Can, D-Designation).**

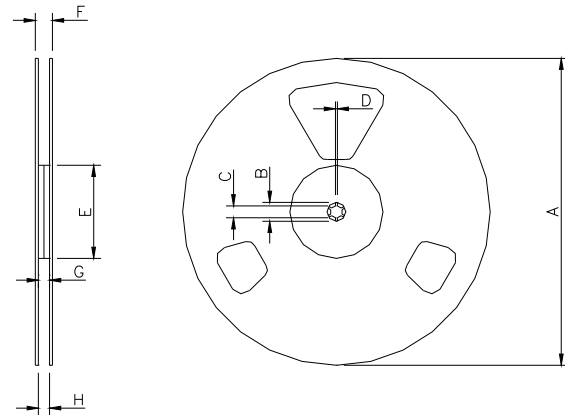
Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET. This includes all recommendations for stencil and substrate designs.


DirectFET® Part Marking


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

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


CODE	DIMENSIONS			
	METRIC		IMPERIAL	
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	5.10	5.30	0.201	0.209
F	6.50	6.70	0.256	0.264
G	1.50	N.C	0.059	N.C
H	1.50	1.60	0.059	0.063



NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6641TRPbF). For 1000 parts on 7" reel, order IRF6641TR1PbF

REEL DIMENSIONS								
STANDARD OPTION (QTY 4800)					TR1 OPTION (QTY 1000)			
CODE	METRIC		IMPERIAL		METRIC		IMPERIAL	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
A	330.0	N.C	12.992	N.C	177.77	N.C	6.9	N.C
B	20.2	N.C	0.795	N.C	19.06	N.C	0.75	N.C
C	12.8	13.2	0.504	0.520	13.5	12.8	0.53	0.50
D	1.5	N.C	0.059	N.C	1.5	N.C	0.059	N.C
E	100.0	N.C	3.937	N.C	58.72	N.C	2.31	N.C
F	N.C	18.4	N.C	0.724	N.C	13.50	N.C	0.53
G	12.4	14.4	0.488	0.567	11.9	12.01	0.47	N.C
H	11.9	15.4	0.469	0.606	11.9	12.01	0.47	N.C

Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

Qualification Information[†]

Qualification Level	Consumer ^{††} (per JEDEC JESD47F) ^{†††}	
Moisture Sensitivity Level	DirectFET	MSL1 (per JEDEC J-STD-020D ^{†††})
RoHS Compliant	Yes	

[†] Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/product-info/reliability/>

^{††} Higher qualification ratings may be available should the user have such requirements.

Please contact your International Rectifier sales representative for further information:

<http://www.irf.com/whoto-call/salesrep/>

^{†††} Applicable version of JEDEC standard at the time of product release.

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 0.77\text{mH}$, $R_G = 25\Omega$, $I_{AS} = 11\text{A}$.
- ③ Surface mounted on 1 in. square Cu board.
- ④ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- 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 with large heatsink.
- 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 .

International
 Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA

To contact International Rectifier, please visit <http://www.irf.com/whoto-call/>

Revision History

Date	Comments
06/28/2013	Added the Consumer qualification level information, on page 9.
05/17/2013	Converted the data sheet to Class-D Audio formatting template. No change in electrical parameters.