

# FH1604D

# N-Channel Trench Power MOSFET

### Description

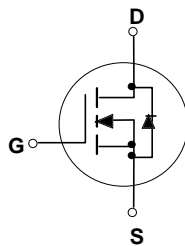
These N Channel enhancement mode power field effect transistors are using trench DMOS technology. This advanced technology has been especially tailored to minimize on state resistance, provide superior switching performance, and with stand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

### General Features

- ◆  $V_{DSS}=40V$  ,  $I_D=80A$   
 $R_{DS(ON)}=7.5m\Omega_{(MAX)}@V_{GS}=10V$
- ◆ Improved dv/dt capability
- ◆ Fast switching
- ◆ 100% EAS Guaranteed
- ◆ Green device available

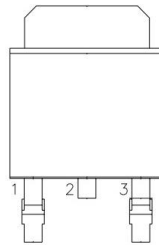
### Applications

- ◆ Motor Drives
- ◆ UPS
- ◆ DC DC Converter

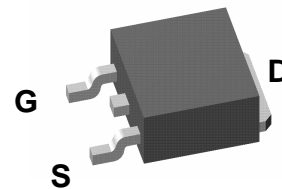


Schematic diagram

TO-252



Marking and pin assignment



TO-252 top view

### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	40	V
Continuous drain current ( $T_C = 25^\circ C$ )	$I_D$	80	A
Continuous drain current ( $T_C = 100^\circ C$ )		52	A
Pulsed drain current <sup>1)</sup>	$I_{DM}$	320	A
Gate Source voltage	$V_{GSS}$	$\pm 20$	V
Avalanche energy <sup>2)</sup>	$E_{AS}$	144	mJ
Power Dissipation ( $T_C = 25^\circ C$ )	$P_D$	83	W
Storage Temperature Range	$T_{STG}$	-55 to +150	°C
Operating Junction Temperature Range	$T_J$	-55 to +150	°C

### Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	15	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	76	°C/W

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

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
<b>Static characteristics</b>						
Drain source breakdown voltage	$BV_{DSS}$	$V_{GS}=0\text{ V}, I_D=250\mu\text{A}$	40			V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	1.0	---	2.0	V
Drain-source leakage current	$I_{DSS}$	$V_{DS}=40\text{ V}, V_{GS}=0\text{ V}, T_J=25^\circ\text{C}$	---	---	1	$\mu\text{A}$
		$V_{DS}=32\text{ V}, V_{GS}=0\text{ V}, T_J=125^\circ\text{C}$	---	---	10	$\mu\text{A}$
Gate leakage current, Forward	$I_{GSSF}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	---	---	100	nA
Gate leakage current, Reverse	$I_{GSSR}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$			100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=30\text{ A}$	---	5.6	7.5	m $\Omega$
		$V_{GS}=4.5\text{ V}, I_D=20\text{ A}$		7.1	9.5	m $\Omega$
Forward transconductance	$g_{fs}$	$V_{DS}=5\text{ V}, I_D=20\text{ A}$	---	63	---	S
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{DS}=20\text{ V}, V_{GS}=0\text{ V},$ $F=1\text{ MHz}$	---	2370	---	pF
Output capacitance	$C_{oss}$		---	316	---	
Reverse transfer capacitance	$C_{rss}$		---	212	---	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=32\text{ V}, V_{GS}=10\text{ V}, I_D=20\text{ A}$	---	6.6	---	ns
Rise time	$t_r$		---	110.6	---	
Turn off delay time	$t_{d(off)}$		---	285.4	---	
Fall time	$t_f$		---	121.1	---	
Gate resistance	$R_g$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}, F=1\text{ MHz}$	---	1.7	---	$\Omega$
<b>Gate charge characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DS}=32\text{ V}, I_D=20\text{ A},$ $V_{GS}=10\text{ V}$	---	9.2	---	nC
Gate to drain charge	$Q_{gd}$		---	9.6	---	
Gate charge total	$Q_g$		---	51.2	---	
<b>Drain-Source diode characteristics and Maximum Ratings</b>						
Continuous Source Current	$I_S$		---	---	80	A
Pulsed Source Current <sup>3)</sup>	$I_{SM}$		---	---	320	A
Diode Forward Voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_S=20\text{ A}, T_J=25^\circ\text{C}$	---	---	1.2	V
Reverse Recovery Time	$t_{rr}$	$I_S=20\text{ A}, di/dt=100\text{ A}/\mu\text{s}, T_J=25^\circ\text{C}$	---	22.4	---	ns
Reverse Recovery Charge	$Q_{rr}$		---	10.5	---	nC

**Notes:**

1 Repetitive Rating: Pulse width limited by maximum junction temperature.

2:  $V_{DD}=20\text{ V}, V_{GS}=10\text{ V}, L=0.5\text{ mH}, I_{AS}=24\text{ A}, R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$

3: Pulse Test: Pulse Width  $\leq 300\mu\text{ s}$ , Duty Cycle  $\leq 2\%$

Electrical Characteristics Diagrams

Figure 1. Typ. Output Characteristics

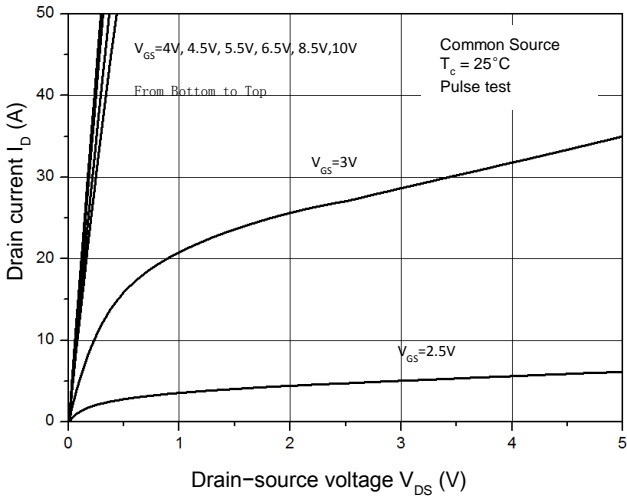


Figure 2. Transfer Characteristics

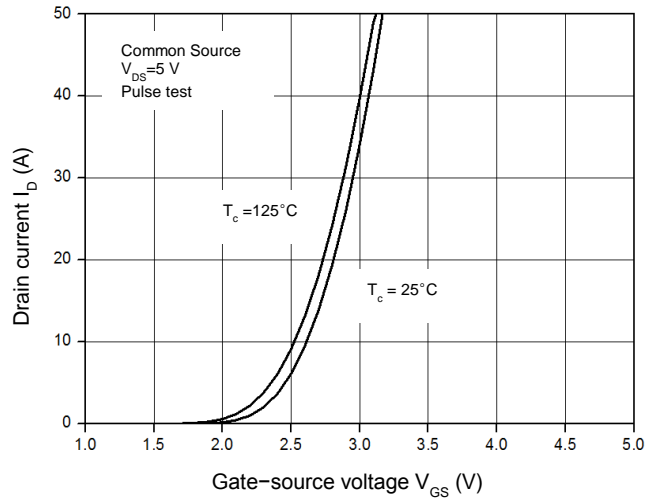


Figure 3. Capacitance Characteristics

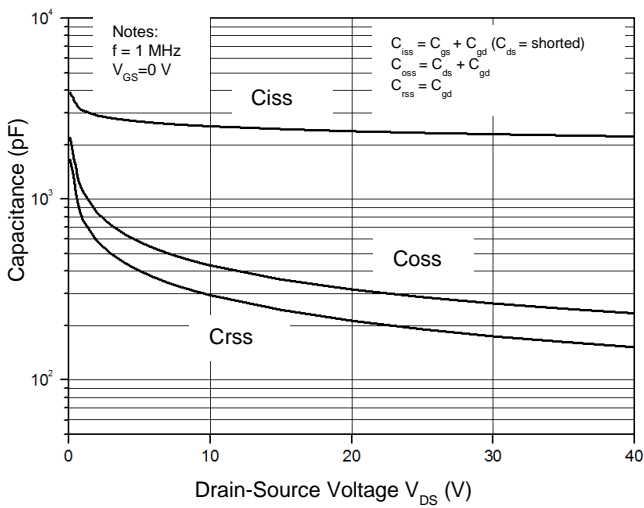


Figure 4. Gate Charge Waveform

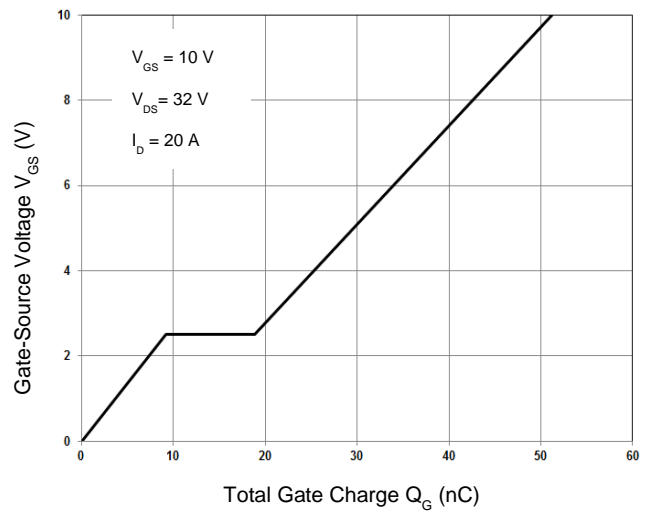


Figure 5. Body-Diode Characteristics

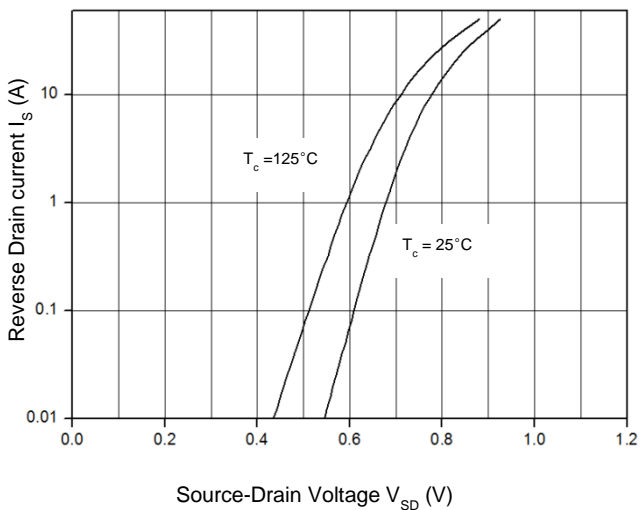


Figure 6. Rds(on)-Drain Current

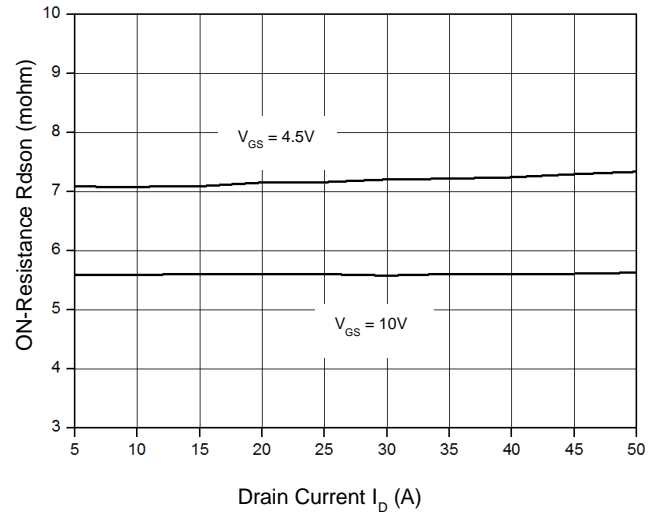


Figure 7. Rdson-Junction Temperature(°C)

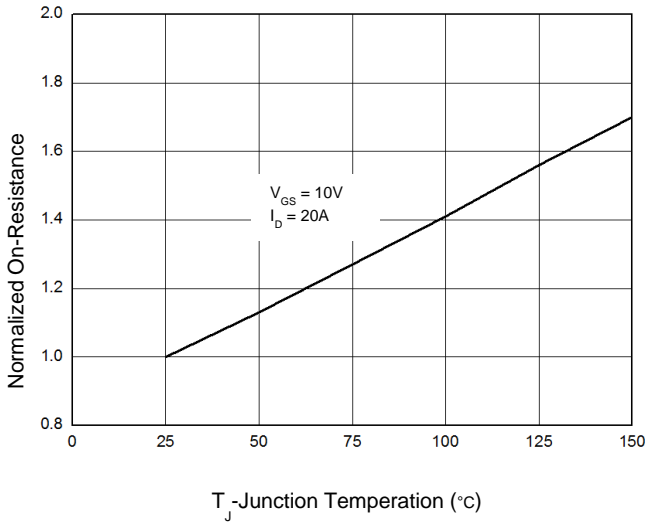


Figure 8. Maximum Safe Operating Area

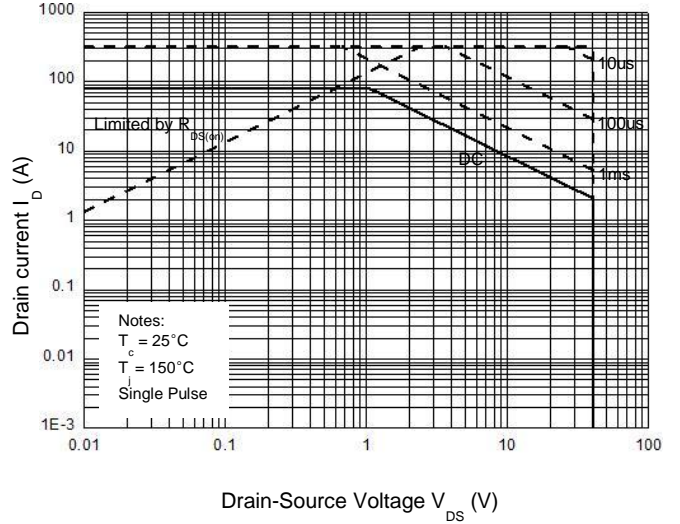
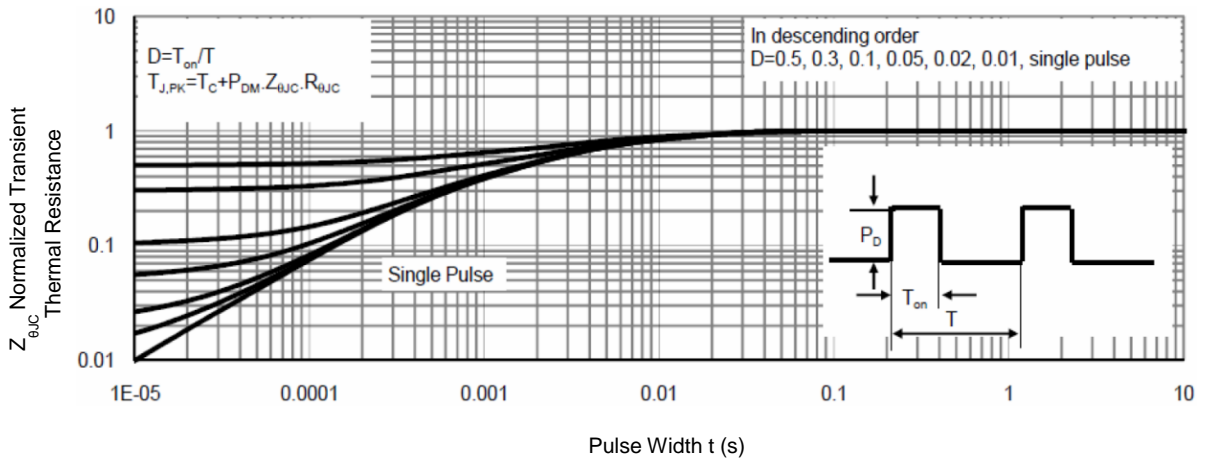


Figure 9. Normalized Maximum Transient Thermal Impedance (RthJC)



**Test Circuit & Waveform**

Figure 8. Gate Charge Test Circuit & Waveform

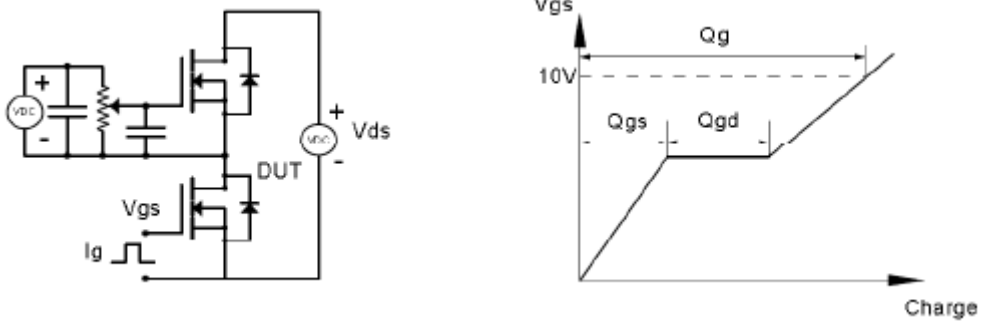


Figure 9. Resistive Switching Test Circuit & Waveforms

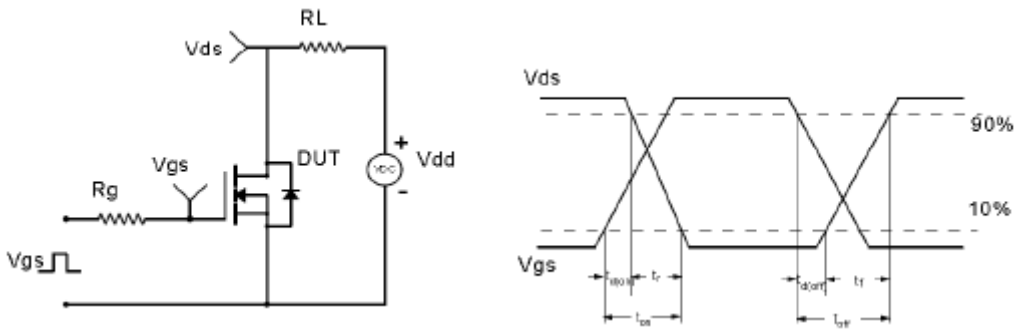


Figure 10. Unclamped Inductive Switching (UIS) Test Circuit & Waveform

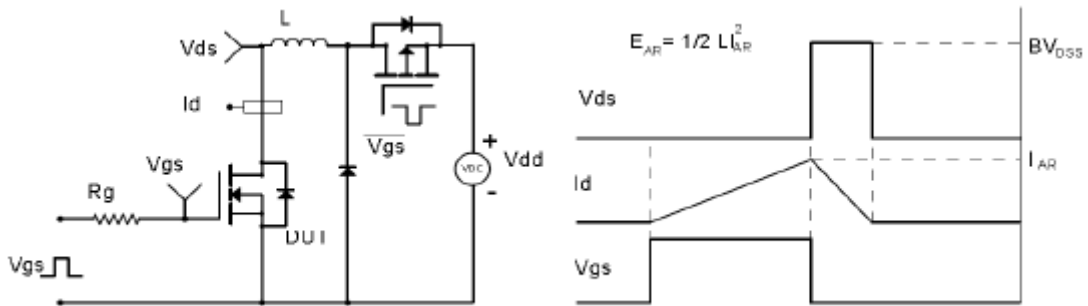
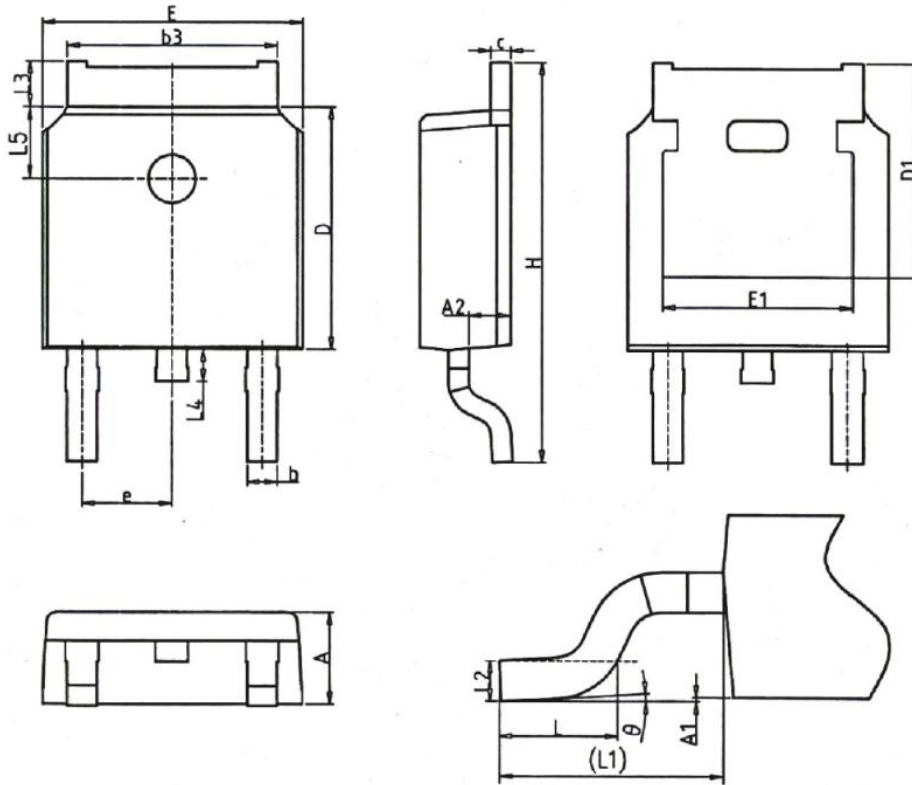


Figure 11. Diode Recovery Circuit & Waveform



Package Information : TO-252



COMMON DIMENSIONS						
SYMBOL	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.20	2.30	2.38	0.087	0.091	0.094
A1	0.00		0.20	0.000		0.008
A2	0.97	1.07	1.17	0.038	0.042	0.046
b	0.68	0.78	0.90	0.027	0.031	0.035
b3	5.20	5.33	5.46	0.205	0.210	0.215
c	0.43	0.53	0.61	0.017	0.021	0.024
D	5.98	6.10	6.22	0.235	0.240	0.245
D1	5.30REF			0.209REF		
E	6.40	6.60	6.73	0.252	0.260	0.265
E1	4.63	-	-	0.182	-	-
e	2.286BSC			0.090BSC		
H	9.40	10.10	10.50	0.370	0.398	0.413
L	1.38	1.50	1.75	0.054	0.059	0.069
L1	2.90REF			0.114REF		
L2	0.51BSC			0.020BSC		
L3	0.88		1.28	0.035		0.050
L4	0.50		1.00	0.020		0.039
L5	1.65	1.80	1.95	0.065	0.071	0.077
θ	0°		8°	0°		8°