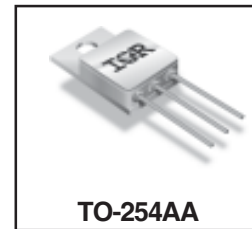


**RADIATION HARDENED
 POWER MOSFET
 THRU-HOLE (TO-254AA)**

**IRHM7054
 JANSR2N7394
 60V, N-CHANNEL
 REF: MIL-PRF-19500/603
 RAD Hard™ HEXFET® TECHNOLOGY**

Product Summary

Part Number	Radiation Level	RDS(on)	ID	QPL Part Number
IRHM7054	100K Rads (Si)	0.027Ω	35*A	JANSR2N7394
IRHM3054	300K Rads (Si)	0.027Ω	35*A	JANSF2N7394
IRHM4054	600K Rads (Si)	0.027Ω	35*A	JANSG2N7394
IRHM8054	1000K Rads (Si)	0.027Ω	35*A	JANSH2N7394



International Rectifier's RADHard HEXFET® technology provides high performance power MOSFETs for space applications. This technology has over a decade of proven performance and reliability in satellite applications. These devices have been characterized for both Total Dose and Single Event Effects (SEE). The combination of low Rds(on) and low gate charge reduces the power losses in switching applications such as DC to DC converters and motor control. These devices retain all of the well established advantages of MOSFETs such as voltage control, fast switching, ease of paralleling and temperature stability of electrical parameters.

Features:

- Single Event Effect (SEE) Hardened
- Low RDS(on)
- Low Total Gate Charge
- Proton Tolerant
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Ceramic Package
- Light Weight

Absolute Maximum Ratings

Pre-Irradiation

	Parameter		Units
ID @ VGS = 12V, TC = 25°C	Continuous Drain Current	35*	A
ID @ VGS = 12V, TC = 100°C	Continuous Drain Current	30	
IDM	Pulsed Drain Current ①	140	
PD @ TC = 25°C	Max. Power Dissipation	150	W
	Linear Derating Factor	1.2	W/°C
VGS	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	500	mJ
IAR	Avalanche Current ①	35	A
EAR	Repetitive Avalanche Energy ①	15	mJ
dv/dt	Peak Diode Recovery dv/dt ③	3.5	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Lead Temperature	300 (0.063 in.(1.6mm) from case for 10s)	
	Weight	9.3 (Typical)	g

For footnotes refer to the last page

*Current is limited by package

Electrical Characteristics @ T_j = 25°C (Unless Otherwise Specified)

	Parameter	Min	Typ	Max	Units	Test Conditions
BV _{DSS}	Drain-to-Source Breakdown Voltage	60	—	—	V	V _{GS} = 0V, I _D = 1.0mA
ΔBV _{DSS} /ΔT _J	Temperature Coefficient of Breakdown Voltage	—	0.053	—	V/°C	Reference to 25°C, I _D = 1.0mA
R _{DS(on)}	Static Drain-to-Source On-State Resistance	—	—	0.027	Ω	V _{GS} = 12V, I _D = 30A ④
		—	—	0.030		V _{GS} = 12V, I _D = 35A
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 1.0mA
g _{fs}	Forward Transconductance	12	—	—	S (r̄)	V _{DS} > 15V, I _{DS} = 30A ④
I _{DSS}	Zero Gate Voltage Drain Current	—	—	25	μA	V _{DS} = 48V, V _{GS} = 0V
		—	—	250		V _{DS} = 48V, V _{GS} = 0V, T _J = 125°C
I _{GSS}	Gate-to-Source Leakage Forward	—	—	100	nA	V _{GS} = 20V
I _{GSS}	Gate-to-Source Leakage Reverse	—	—	-100		V _{GS} = -20V
Q _g	Total Gate Charge	—	—	200	nC	V _{GS} = 12V, I _D = 35A
Q _{gs}	Gate-to-Source Charge	—	—	60		V _{DS} = 30V
Q _{gd}	Gate-to-Drain ('Miller') Charge	—	—	75		
t _{d(on)}	Turn-On Delay Time	—	—	27	ns	V _{DD} = 30V, I _D = 35A V _{GS} = 12V, R _G = 2.35Ω
t _r	Rise Time	—	—	100		
t _{d(off)}	Turn-Off Delay Time	—	—	75		
t _f	Fall Time	—	—	75		
L _S + L _D	Total Inductance	—	6.8	—	nH	Measured from Drain lead (6mm /0.25in from package) to Source lead (6mm /0.25in. from Package) with Source wires internally bonded from Source Pin to Drain Pad
C _{iss}	Input Capacitance	—	4100	—	pF	V _{GS} = 0V, V _{DS} = 25V f = 1.0MHz
C _{OSS}	Output Capacitance	—	2000	—		
C _{rSS}	Reverse Transfer Capacitance	—	560	—		

Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I _S	Continuous Source Current (Body Diode)	—	—	35*	A	
I _{SM}	Pulse Source Current (Body Diode) ①	—	—	140		
V _{SD}	Diode Forward Voltage	—	—	1.4	V	T _j = 25°C, I _S = 35A, V _{GS} = 0V ④
t _{rr}	Reverse Recovery Time	—	—	280	nS	T _j = 25°C, I _F = 35A, di/dt ≤ 100A/μs
Q _{RR}	Reverse Recovery Charge	—	—	2.2	μC	V _{DD} ≤ 50V ④
t _{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L _S + L _D .				

* Current is limited by package

Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R _{thJC}	Junction-to-Case	—	—	0.83	°C/W	Typical socket mount
R _{thJA}	Junction-to-Ambient	—	—	48		
R _{thCS}	Case-to-Sink	—	0.21	—		

Note: Corresponding Spice and Saber models are available on International Rectifier Website.

For footnotes refer to the last page

Radiation Characteristics

IRHM7054, JANSR2N7394

International Rectifier Radiation Hardened MOSFETs are tested to verify their radiation hardness capability. The hardness assurance program at International Rectifier is comprised of two radiation environments. Every manufacturing lot is tested for total ionizing dose (per notes 5 and 6) using the TO-3 package. Both pre- and post-irradiation performance are tested and specified using the same drive circuitry and test conditions in order to provide a direct comparison.

Table 1. Electrical Characteristics @ Tj = 25°C, Post Total Dose Irradiation ^{⑤⑥}

	Parameter	Up to 600K Rads(Si) ¹		1000K Rads (Si) ²		Units	Test Conditions
		Min	Max	Min	Max		
BVDSS	Drain-to-Source Breakdown Voltage	60	—	60	—	V	V _{GS} = 0V, I _D = 1.0mA
V _{GS(th)}	Gate Threshold Voltage	2.0	4.0	1.25	4.5		V _{GS} = V _{DS} , I _D = 1.0mA
I _{GSS}	Gate-to-Source Leakage Forward	—	100	—	100	nA	V _{GS} = 20V
I _{GSS}	Gate-to-Source Leakage Reverse	—	-100	—	-100		V _{GS} = -20 V
I _{DSS}	Zero Gate Voltage Drain Current	—	25	—	50	μA	V _{DS} = 48V, V _{GS} = 0V
R _{DS(on)}	Static Drain-to-Source ^④ On-State Resistance (TO-3)	—	0.027	—	0.04	Ω	V _{GS} = 12V, I _D = 30A
R _{DS(on)}	Static Drain-to-Source ^④ On-State Resistance (TO-254AA)	—	0.027	—	0.04	Ω	V _{GS} = 12V, I _D = 30A
V _{SD}	Diode Forward Voltage ^④	—	1.4	—	1.4	V	V _{GS} = 0V, I _S = 35A

1. Part numbers IRHM7054 (JANSR2N7394), IRHM3054 (JANSF2N7394), IRHM4054 (JANSG2N7394)
2. Part number IRHM8054 (JANSJ2N7394)

International Rectifier radiation hardened MOSFETs have been characterized in heavy ion environment for Single Event Effects (SEE). Single Event Effects characterization is illustrated in Fig. a and Table 2.

Table 2. Single Event Effect Safe Operating Area

Ion	LET MeV/(mg/cm ²)	Energy (MeV)	Range (μm)	V _{DS} (V)				
				@V _{GS} =0V	@V _{GS} =-5V	@V _{GS} =-10V	@V _{GS} =-15V	@V _{GS} =-20V
I	59.9	345	32.8	60	60	45	40	30
Br	36.8	305	39	40	35	30	25	20

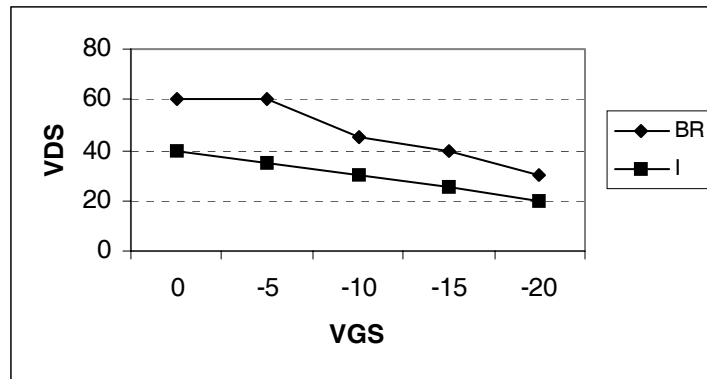


Fig a. Single Event Effect, Safe Operating Area

For footnotes refer to the last page

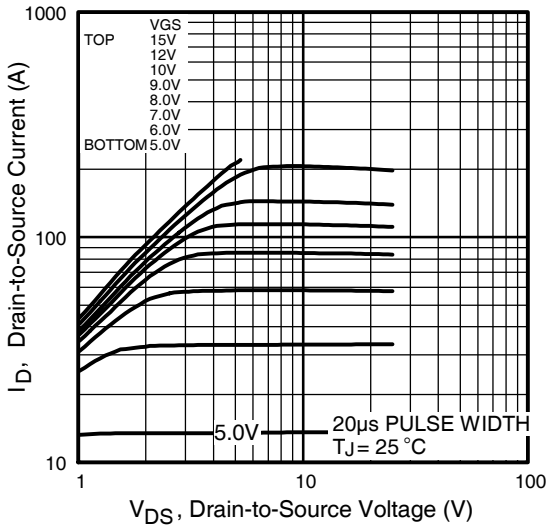


Fig 1. Typical Output Characteristics

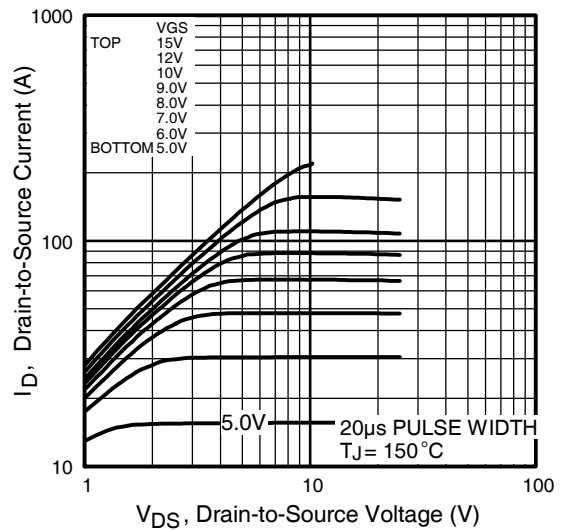


Fig 2. Typical Output Characteristics

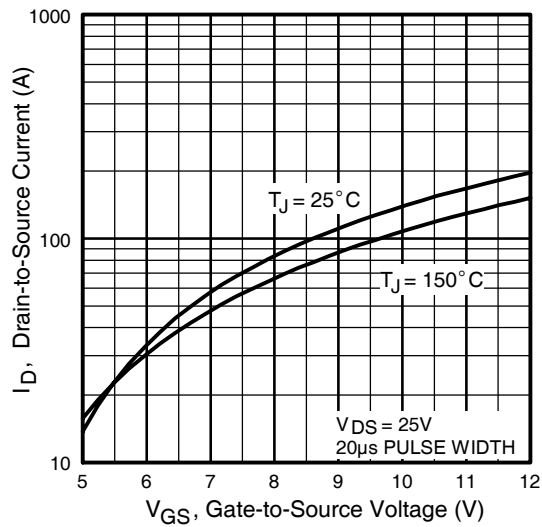


Fig 3. Typical Transfer Characteristics

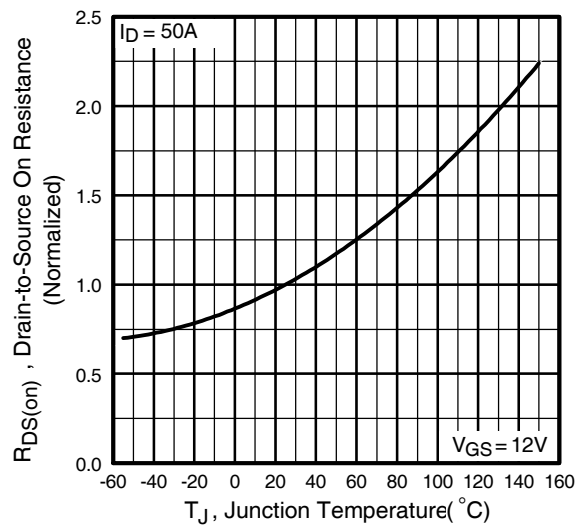


Fig 4. Normalized On-Resistance Vs. Temperature

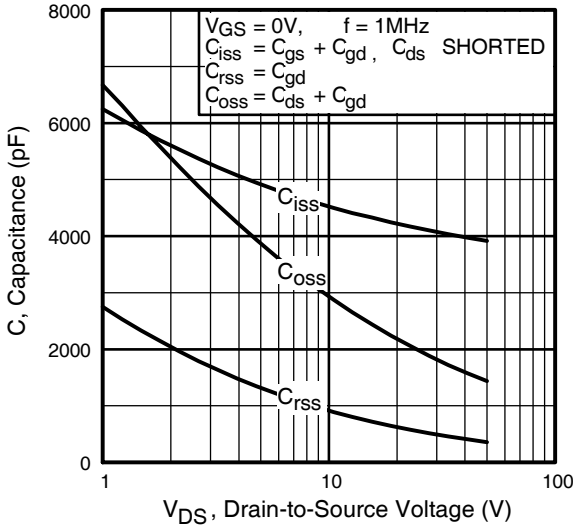


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

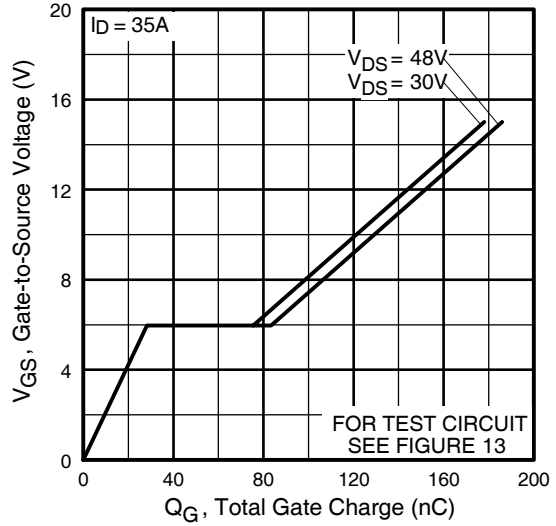


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

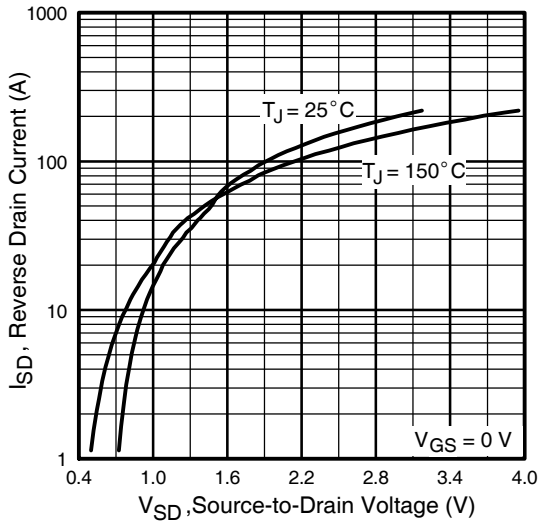


Fig 7. Typical Source-Drain Diode Forward Voltage

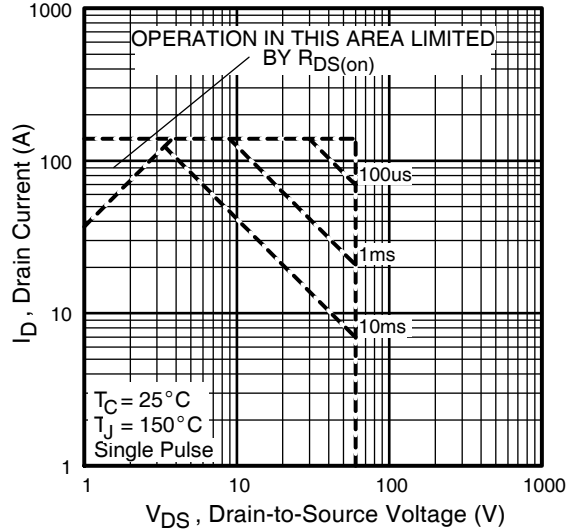
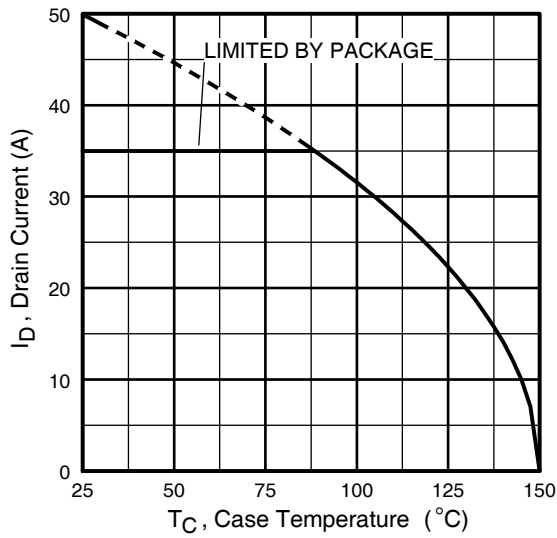


Fig 8. Maximum Safe Operating Area



Case Temperature

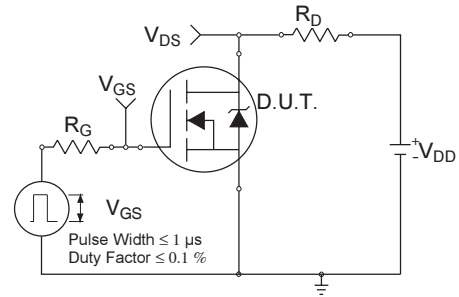


Fig 10a. Switching Time Test Circuit

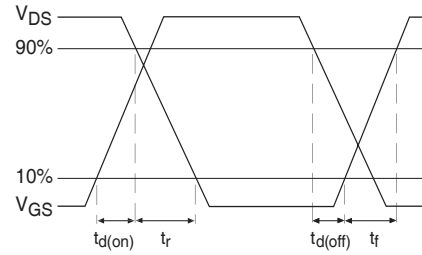


Fig 10b. Switching Time Waveforms

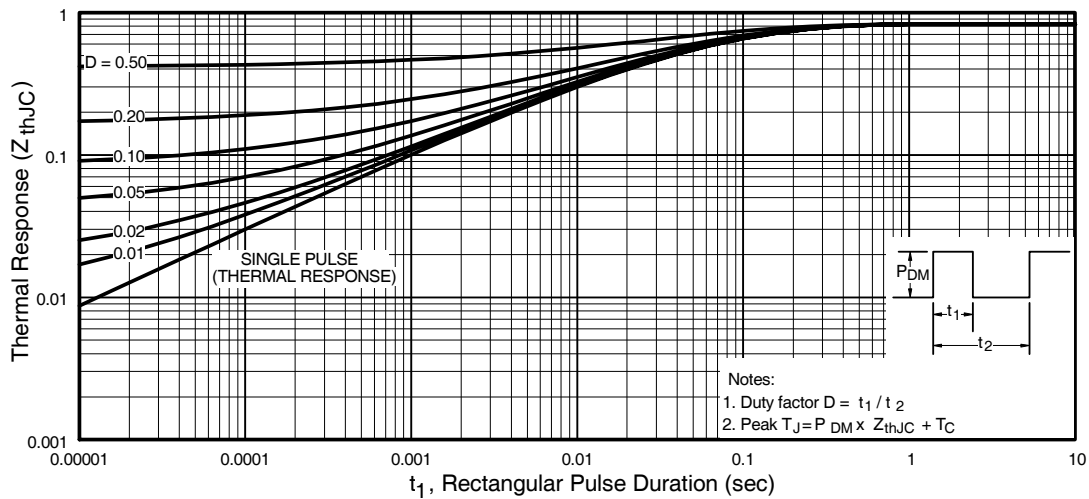


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

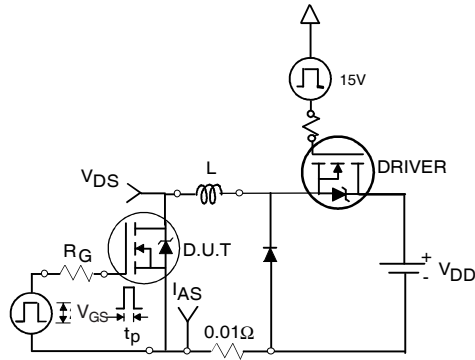


Fig 12a. Unclamped Inductive Test Circuit

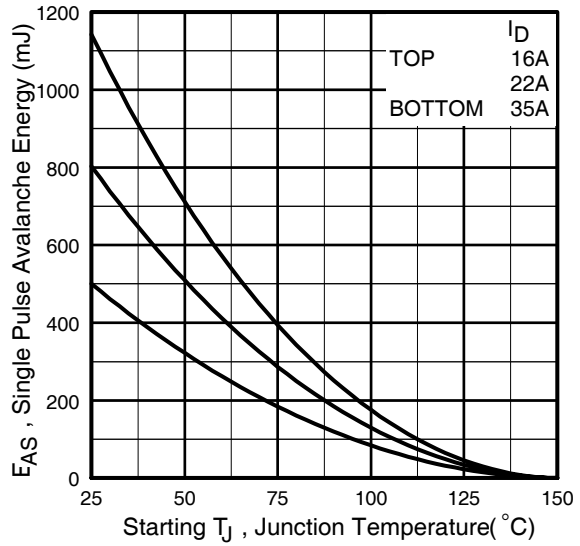


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

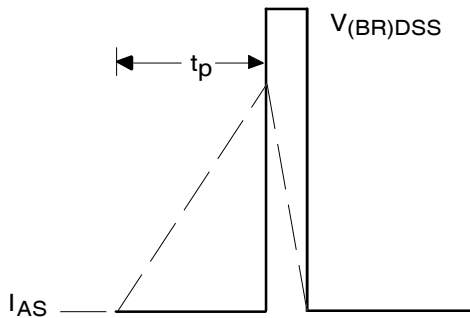


Fig 12b. Unclamped Inductive Waveforms

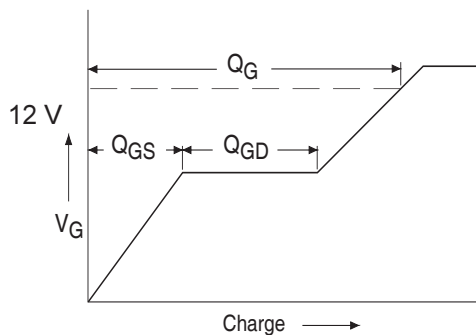


Fig 13a. Basic Gate Charge Waveform

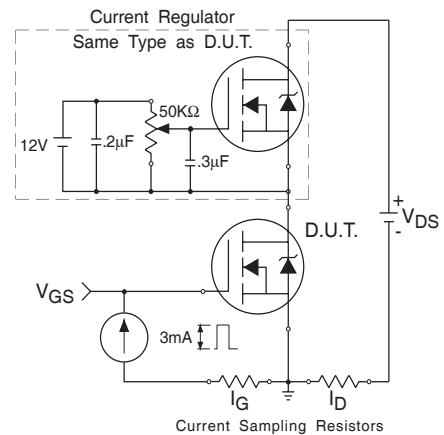


Fig 13b. Gate Charge Test Circuit

