

MOSFET – Single N-Channel, SUPERFET® III, FRFET® 650 V, 30 A, 110 mΩ

NVH4L110N65S3F

Features

- Ultra Low Gate Charge & Low Effective Output Capacitance
- Lower FOM ($R_{DS(on)}$ max. \times Q_g typ. & $R_{DS(on)}$ max. \times E_{OSS})
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	V_{DSS}	650	V
Gate-to-Source Voltage – DC	V_{GSS}	± 30	V
Gate-to-Source Voltage – AC ($f > 1$ Hz)	V_{GSS}	± 30	V
Drain Current – Continuous ($T_C = 25^\circ\text{C}$)	I_D	30	A
Drain Current – Continuous ($T_C = 100^\circ\text{C}$)	I_D	19.5	A
Drain Current – Pulsed (Note 3)	I_{DM}	69	A
Power Dissipation ($T_C = 25^\circ\text{C}$)	P_D	240	W
Power Dissipation – Derate Above 25°C	P_D	1.92	W/ $^\circ\text{C}$
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$
Single Pulsed Avalanche Energy (Note 4)	E_{AS}	380	mJ
Repetitive Avalanche Energy (Note 3)	E_{AR}	2.4	mJ
MOSFET dv/dt	dv/dt	100	V/ns
Peak Diode Recovery dv/dt (Note 5)	dv/dt	50	V/ns
Max. Lead Temperature for Soldering Purposes (1/8" from case for 5 s)	T_L	300	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case, Max. (Notes 1, 2)	$R_{\theta JC}$	0.52	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient, Max. (Notes 1, 2)	$R_{\theta JA}$	40	$^\circ\text{C}/\text{W}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

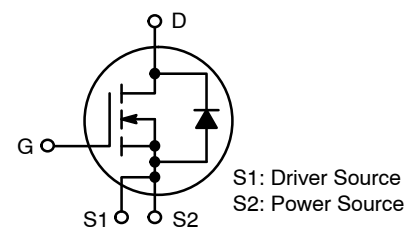
1. The entire application environment impacts the thermal resistance values shown. They are not constants and are only valid for the particular conditions noted.
2. Assembled to an infinite heatsink with perfect heat transfer from the case (assumes 0 K/W thermal interface).
3. Repetitive rating: pulse-width limited by maximum junction temperature.
4. $I_{AS} = 3.5$ A, $R_G = 25$ Ω , starting $T_J = 25^\circ\text{C}$.
5. $I_{SD} \leq 15$ A, $di/dt \leq 200$ A/ μs , $V_{DD} \leq 400$ V, starting $T_J = 25^\circ\text{C}$.



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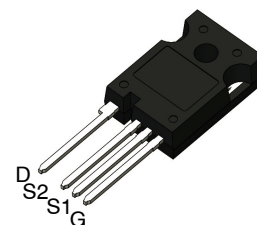
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V_{DSS}	$R_{DS(ON)}$ MAX	I_D MAX
650 V	110 mΩ @ 10 V	30 A

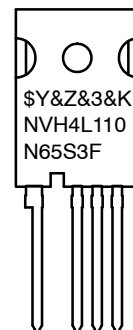


POWER MOSFET

MARKING DIAGRAM



TO-247-4LD
CASE 340CJ



\$Y = ON Semiconductor Logo
 &Z = Assembly Plant Code
 &3 = Data Code (Year & Week)
 &K = Lot
 NVH4L110N65S3F = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
NVH4L110N65S3F	TO-247-4LD (Pb-Free)	30 Units / Tube

NVH4L110N65S3F

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	BV _{DSS}	V _{GS} = 0 V, I _D = 1 mA, T _J = 25°C	650			V
Drain-to-Source Breakdown Voltage	BV _{DSS}	V _{GS} = 0 V, I _D = 10 mA, T _J = 150°C	700			V
Breakdown Voltage Temperature Coefficient	$\frac{\Delta BV_{DSS}}{\Delta T_J}$	I _D = 20 mA, Referenced to 25°C		610		mV/°C
Zero Gate Voltage Drain Current	I _{DSS}	V _{GS} = 0 V, V _{DS} = 650 V			10	μA
		V _{DS} = 520 V, T _C = 125°C		44		
Gate-to-Body Leakage Current	I _{GSS}	V _{GS} = ±30 V, V _{DS} = 0 V			±100	nA

ON CHARACTERISTICS

Gate Threshold Voltage	V _{GS(th)}	V _{GS} = V _{DS} , I _D = 0.74 mA	3.0		5.0	V
Threshold Temperature Coefficient	$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	V _{GS} = V _{DS} , I _D = 0.74 mA		-9.2		mV/°C
Static Drain-to-Source On Resistance	R _{DS(on)}	V _{GS} = 10 V, I _D = 15 A		93	110	mΩ
Forward Transconductance	g _{FS}	V _{DS} = 20 V, I _D = 15 A		17		S

DYNAMIC CHARACTERISTICS

Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 400 V, f = 1 MHz		2530		pF
Output Capacitance	C _{oss}			55.4		
Reverse Transfer Capacitance	C _{rss}			7.5		
Effective Output Capacitance	C _{oss(eff.)}	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		512		pF
Energy Related Output Capacitance	C _{oss(er.)}	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		96		pF
Total Gate Charge at 10 V	Q _{G(TOT)}	V _{GS} = 10 V, V _{DS} = 400 V, I _D = 15 A (Note 6)		59		nC
Threshold Gate Charge	Q _{G(TH)}			11		
Gate-to-Source Gate Charge	Q _{GS}			18		
Gate-to-Drain "Miller" Charge	Q _{GD}			24		
Equivalent Series Resistance	ESR	f = 1 MHz		1.6		Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	t _{d(on)}	V _{GS} = 10 V, V _{DD} = 400 V, I _D = 15 A, R _g = 4.7 Ω (Note 6)		24.6		ns
Turn-On Rise Time	t _r			16.4		ns
Turn-Off Delay Time	t _{d(off)}			59.5		ns
Turn-Off Fall Time	t _f			6.4		ns

SOURCE-DRAIN DIODE CHARACTERISTICS

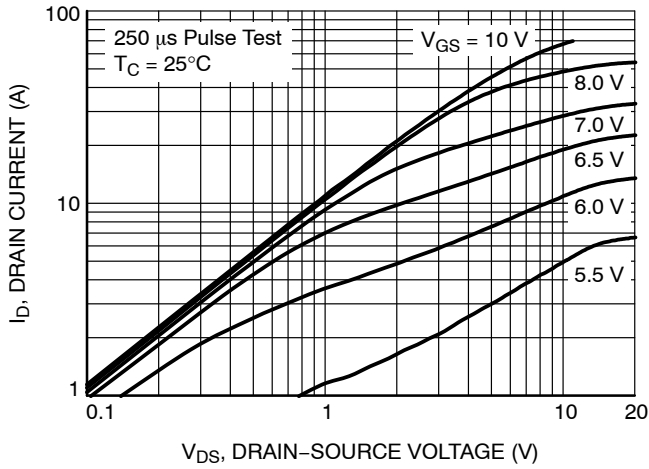
Maximum Continuous Source-to-Drain Diode Forward Current	I _S	V _{GS} = 0 V			30	A
Maximum Pulsed Source-to-Drain Diode Forward Current	I _{SM}	V _{GS} = 0 V			69	A
Source-to-Drain Diode Forward Voltage	V _{SD}	V _{GS} = 0 V, I _{SD} = 15 A			1.3	V
Reverse Recovery Time	t _{rr}	V _{GS} = 0 V, dI _F /dt = 100 A/μs, I _{SD} = 15 A		89.2		ns
Charge Time	t _a			78.2		
Discharge Time	t _b			11.5		
Reverse Recovery Charge	Q _{rr}			312		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

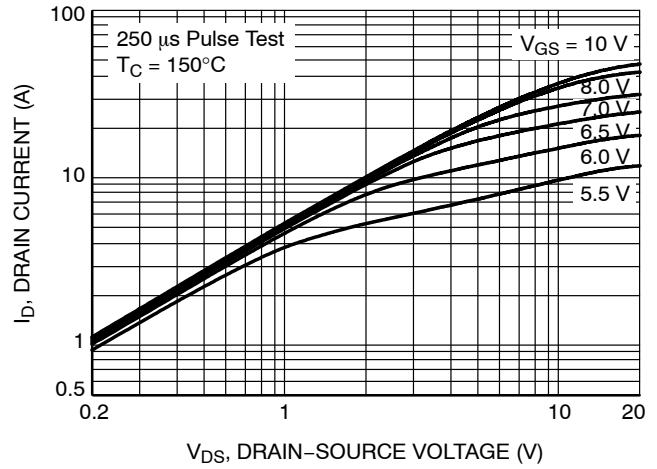
6. Essentially independent of operating temperature typical characteristics.

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TYPICAL CHARACTERISTICS



**Figure 1. On-Region Characteristics
25°C**



**Figure 2. On-Region Characteristics
150°C**

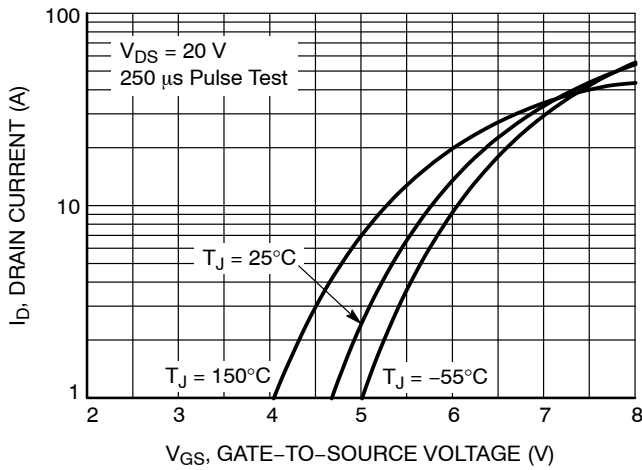
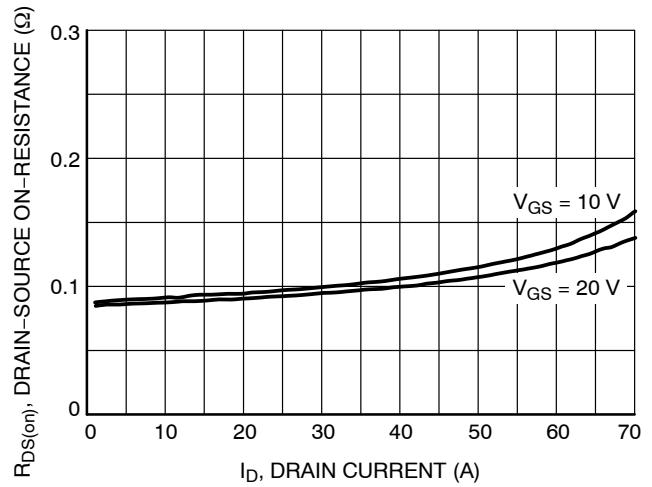
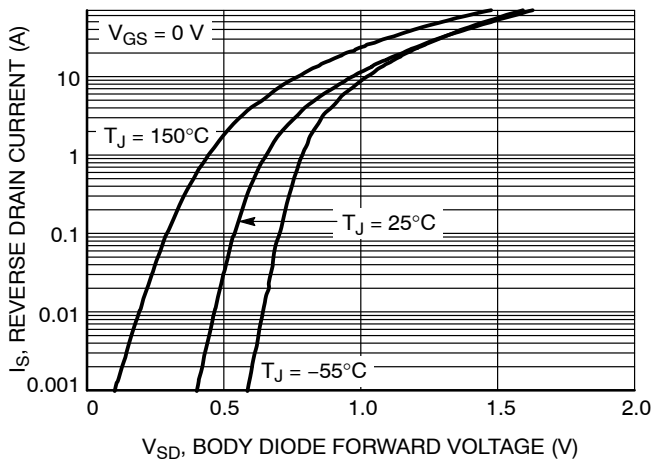


Figure 3. Transfer Characteristics



**Figure 4. On-Resistance Variation vs. Drain
Current and Gate Voltage**



**Figure 5. Body Diode Forward Voltage
Variation vs. Source Current and Temperature**

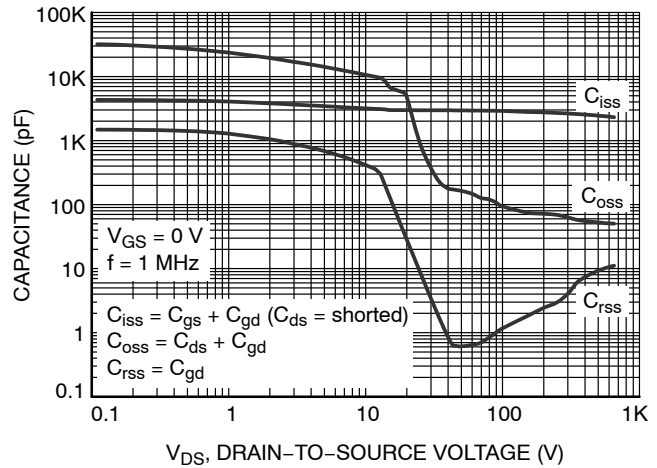


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS

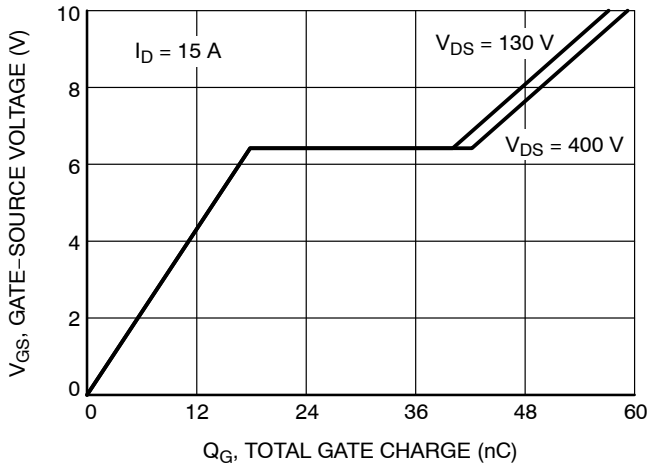


Figure 7. Gate Charge Characteristics

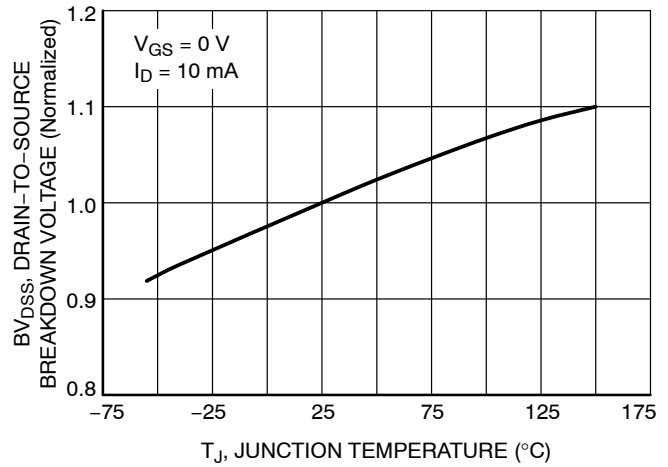


Figure 8. Breakdown Voltage Variation vs. Temperature

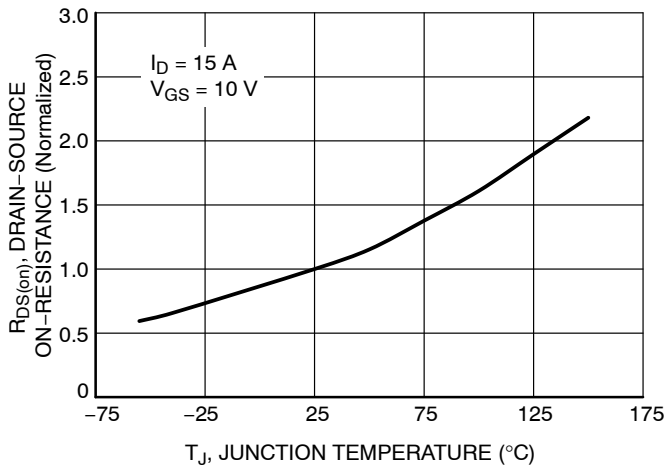


Figure 9. On-Resistance Variation vs. Temperature

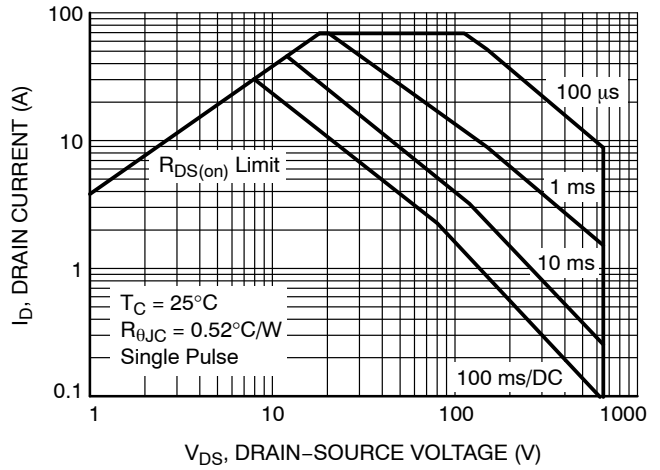


Figure 10. Maximum Safe Operating Area

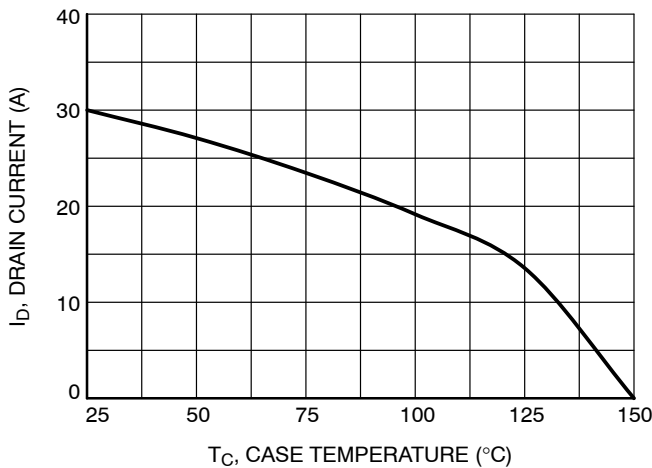


Figure 11. Maximum Drain Current vs. Case Temperature

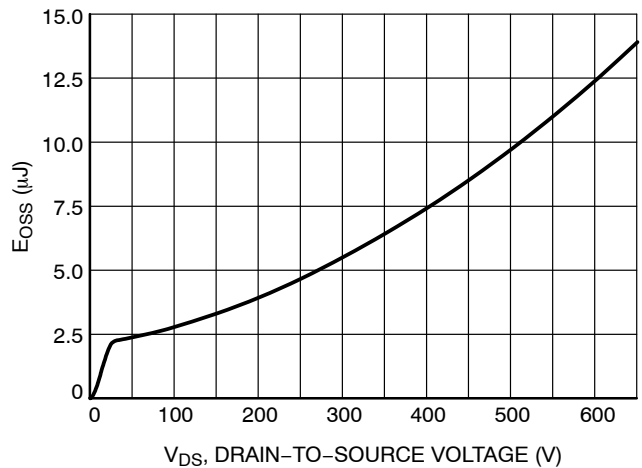


Figure 12. E_{OSS} vs. Drain-to-Source Voltage

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TYPICAL CHARACTERISTICS

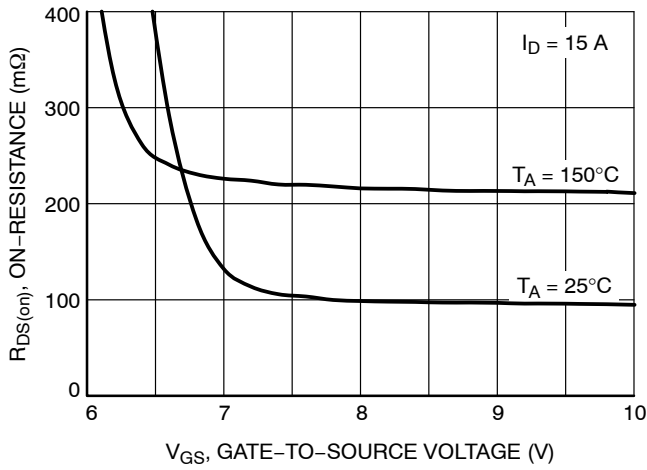


Figure 13. $R_{DS(on)}$ vs. Gate Voltage

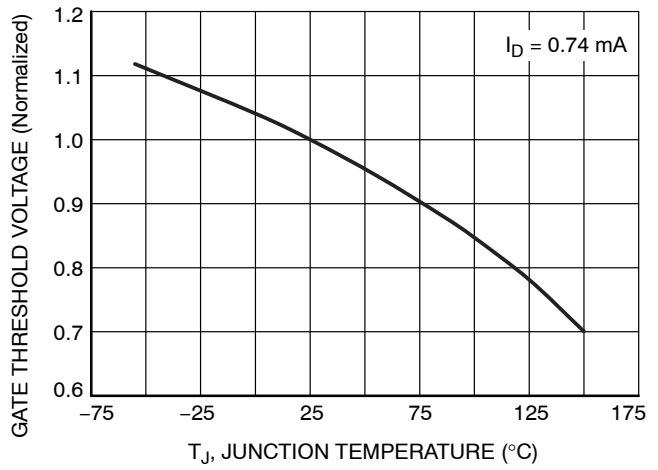
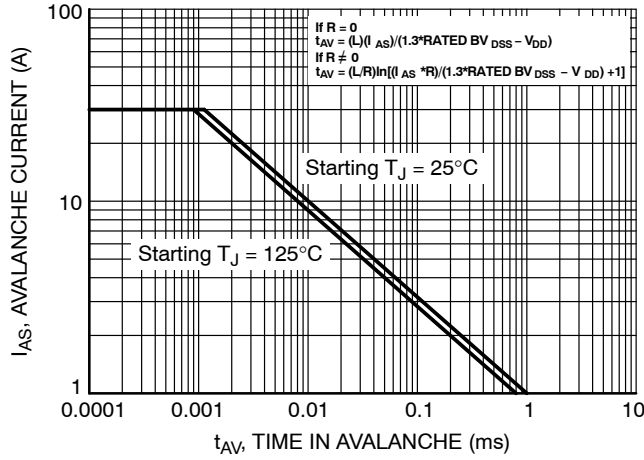


Figure 14. Normalized Gate Threshold Voltage vs. Temperature



NOTE: Refer to Application Notes AN7514 and AN7515

Figure 15. Unclamped Inductive Switching Capability

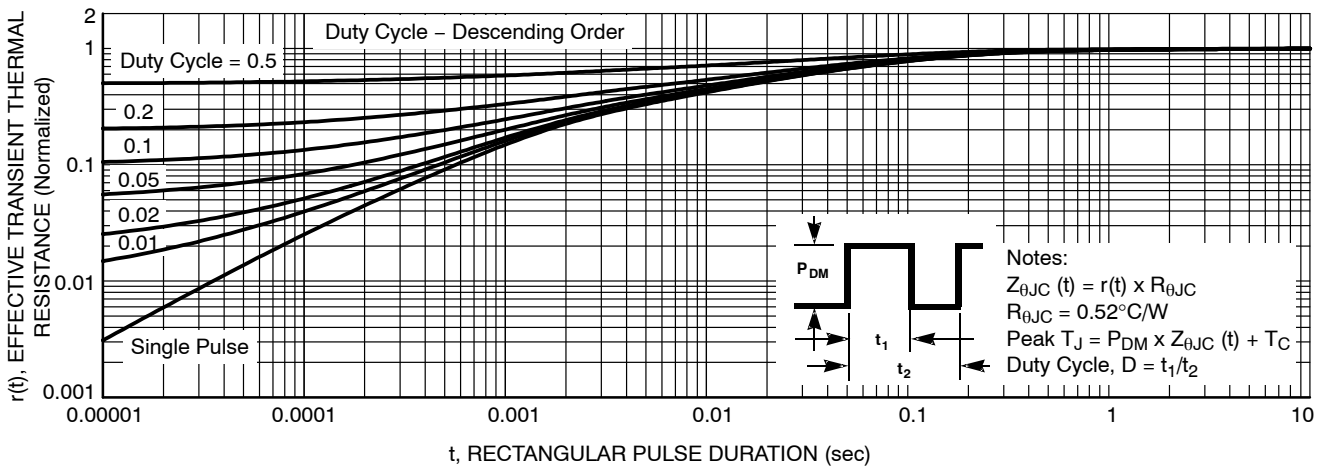


Figure 16. Transient Thermal Response

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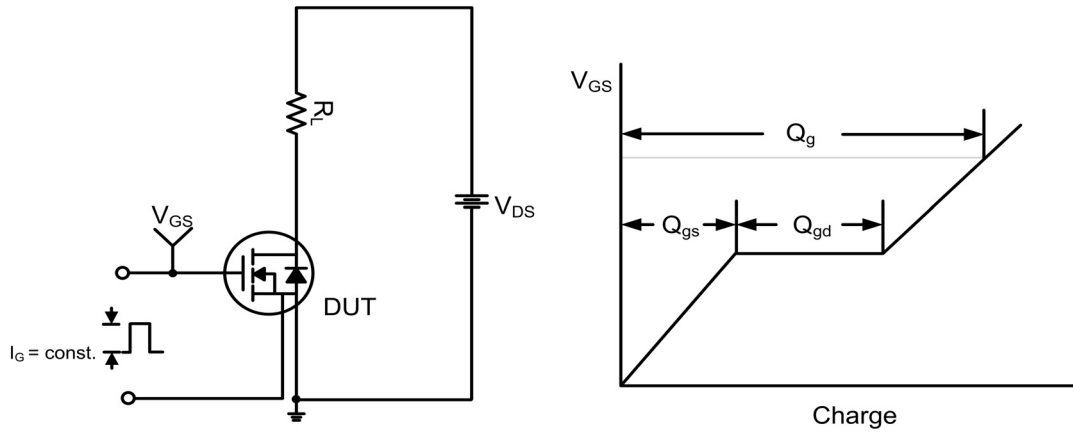


Figure 17. Gate Charge Test Circuit & Waveform

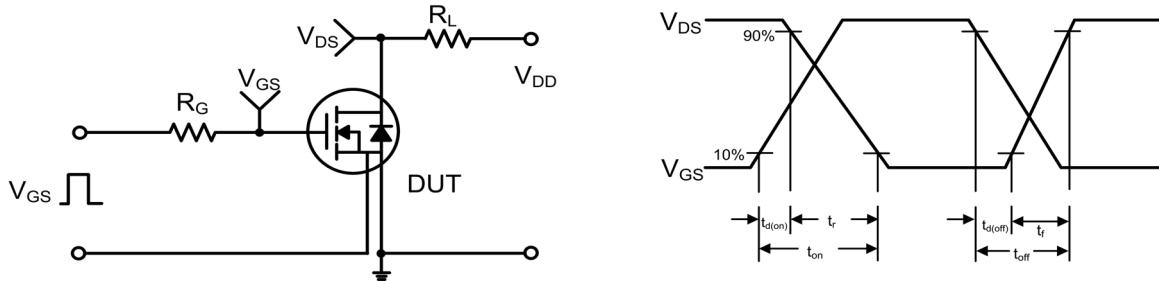


Figure 18. Resistive Switching Test Circuit & Waveforms

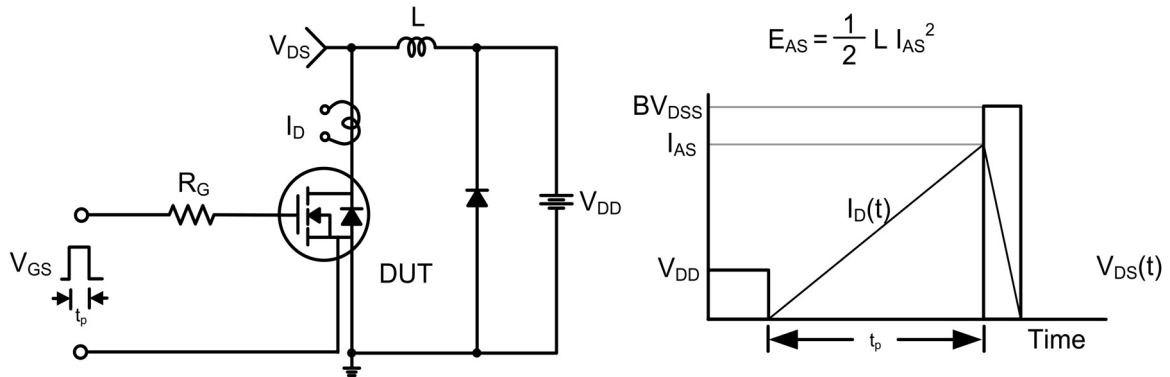


Figure 19. Unclamped Inductive Switching Test Circuit & Waveforms

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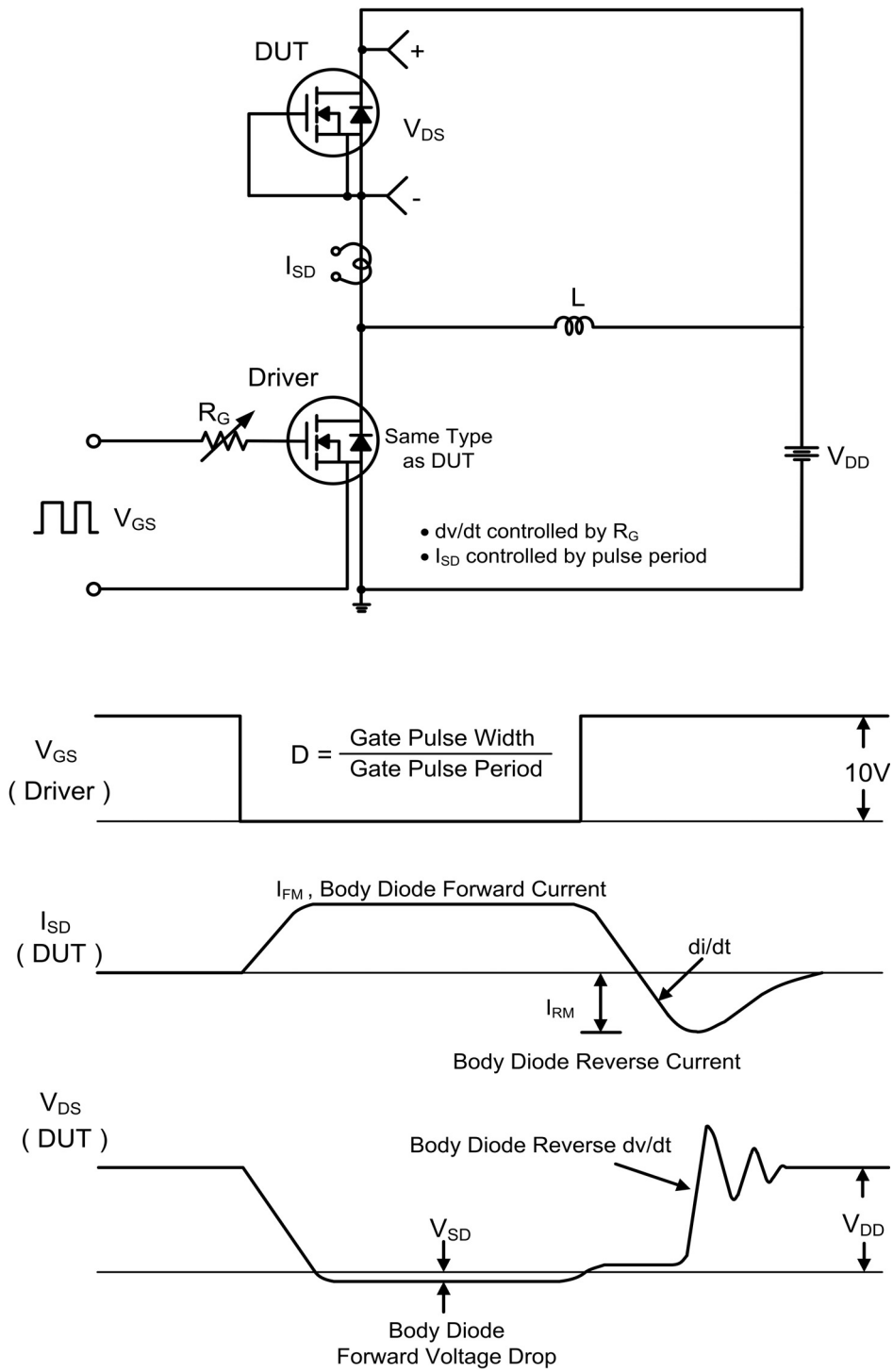
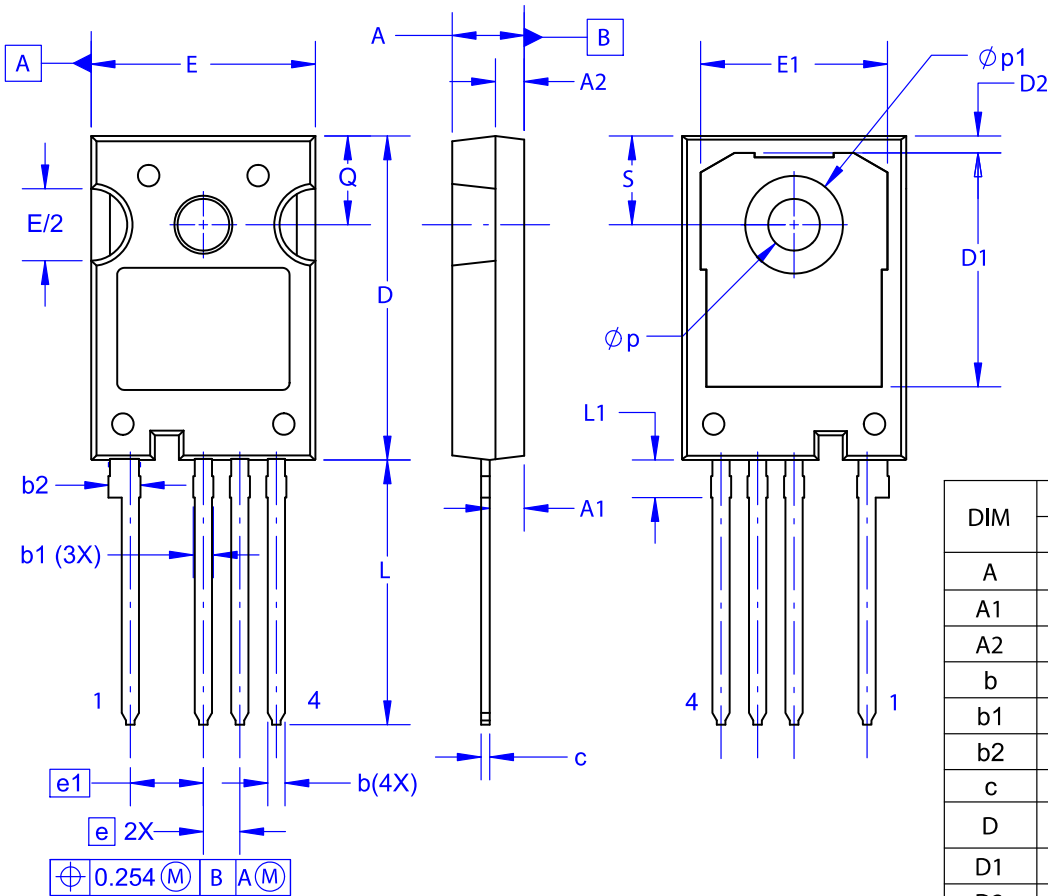


Figure 20. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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PACKAGE DIMENSIONS

TO-247-4LD
CASE 340CJ
ISSUE A




DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

NOTES:

- A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5-2009.

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