

MOSFET – Power, N-Channel, SUPERFET® III, FRFET®

650 V, 65 A, 40 mΩ

NTH4L040N65S3F

Description

SUPERFET III MOSFET is onsemi's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate.

Consequently, SUPERFET III MOSFET is very suitable for the various power system for miniaturization and higher efficiency.

SUPERFET III FRFET MOSFET's optimized reverse recovery performance of body diode can remove additional component and improve system reliability.

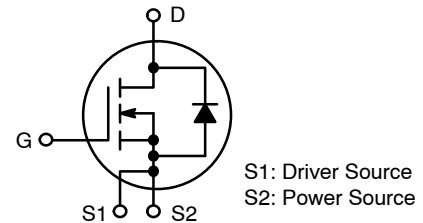
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 32\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 158\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 1366\text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

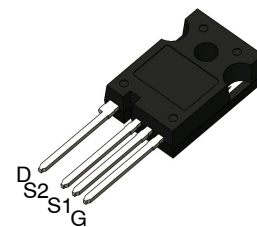
Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- EV Charger
- UPS / Solar

V_{DSS}	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	40 mΩ	65 A

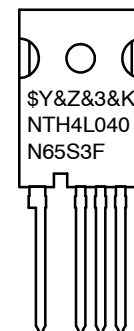


POWER MOSFET



**TO-247-4LD
CASE 340CJ**

MARKING DIAGRAM



&Z = Assembly Plant Code
 &3 = Data Code (Year & Week)
 &K = Lot
 NTH4L040N65S3F = Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

NTH4L040N65S3F

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

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		650	V
V_{GSS}	Gate to Source Voltage	– DC	± 30	V
		– AC ($f > 1\text{ Hz}$)	± 30	
I_D	Drain Current	– Continuous ($T_C = 25^\circ\text{C}$)	65	A
		– Continuous ($T_C = 100^\circ\text{C}$)	45	
I_{DM}	Drain Current	– Pulsed (Note 1)	162.5	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		1009	mJ
I_{AS}	Avalanche Current (Note 2)		9	A
E_{AR}	Repetitive Avalanche Energy (Note 1)		4.46	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		50	
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	446	W
		– Derate Above 25°C	3.57	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range		–55 to +150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 seconds		300	$^\circ\text{C}$

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. Repetitive rating: pulse-width limited by maximum junction temperature.

2. $I_{AS} = 9\text{ A}$, $R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$.

3. $I_{SD} \leq 32.5\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq 400\text{ V}$, starting $T_J = 25^\circ\text{C}$.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.28	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NTH4L040N65S3F	NTH4L040N65S3F	TO-247 – 4LD	Tube	N/A	N/A	30 Units

NTH4L040N65S3F

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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OFF CHARACTERISTICS

BV_{DSS}	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	650			V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$	700			V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 15\text{ mA}$, Referenced to 25°C		0.63		V/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$			10	μA
		$V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$		213		
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$			± 100	nA

ON CHARACTERISTICS

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 2.1\text{ mA}$	3.0		5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 32.5\text{ A}$		32	40	m Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 32.5\text{ A}$		48		S

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		5940		pF
C_{oss}	Output Capacitance			140		pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		1366		pF
$C_{oss(er.)}$	Energy Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		247		pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400\text{ V}, I_D = 32.5\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)		158		nC
Q_{gs}	Gate to Source Gate Charge			48		nC
Q_{gd}	Gate to Drain "Miller" Charge			60		nC
ESR	Equivalent Series Resistance	$f = 1\text{ MHz}$		1.1		Ω

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 32.5\text{ A},$ $V_{GS} = 10\text{ V}, R_g = 2.2\text{ }\Omega$ (Note 4)		44		ns
t_r	Turn-On Rise Time			23		ns
$t_{d(off)}$	Turn-Off Delay Time			96		ns
t_f	Turn-Off Fall Time			6		ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I_S	Maximum Continuous Source to Drain Diode Forward Current			65	A
I_{SM}	Maximum Pulsed Source to Drain Diode Forward Current			162.5	A
V_{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 32.5\text{ A}$		1.3	V
t_{rr}	Reverse Recovery Time	$V_{DD} = 400\text{ V}, I_{SD} = 32.5\text{ A},$ $dI_F/dt = 100\text{ A}/\mu\text{s}$		145	ns
Q_{rr}	Reverse Recovery Charge			737	nC

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.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS

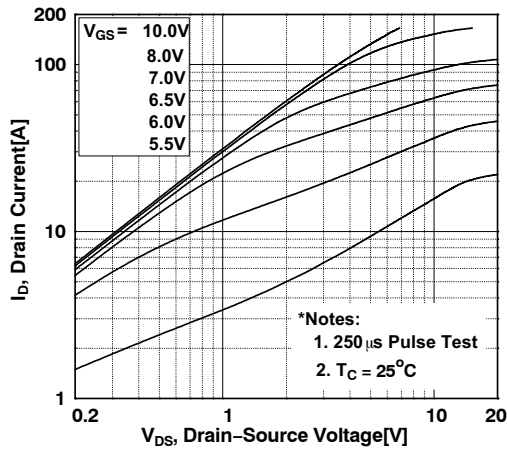


Figure 1. On-Region Characteristics

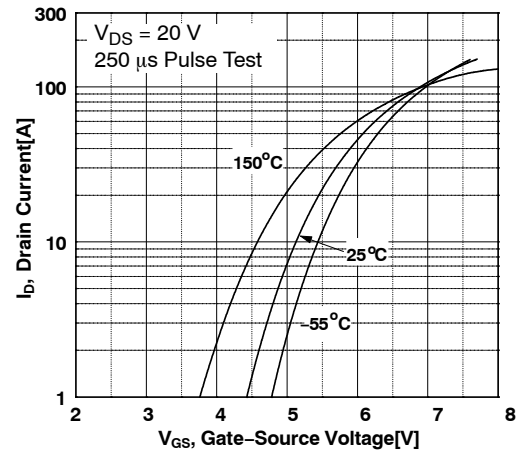


Figure 2. Transfer Characteristics

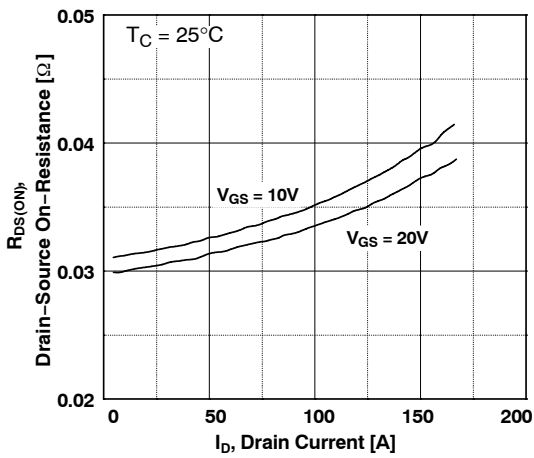


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

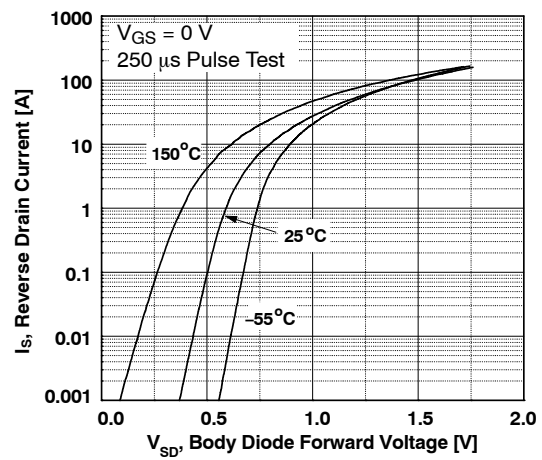


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

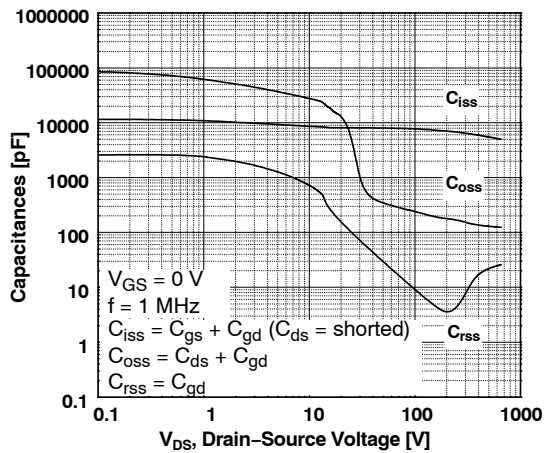


Figure 5. Capacitance Characteristics

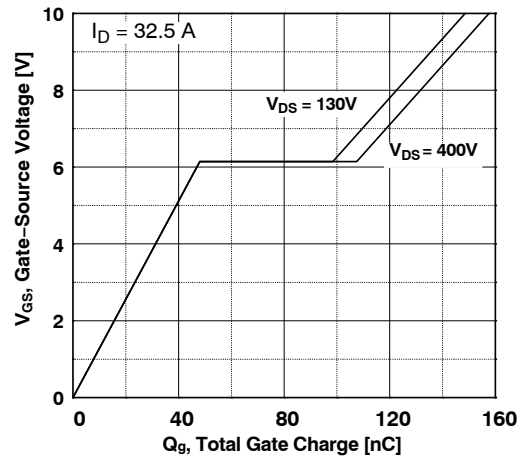


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

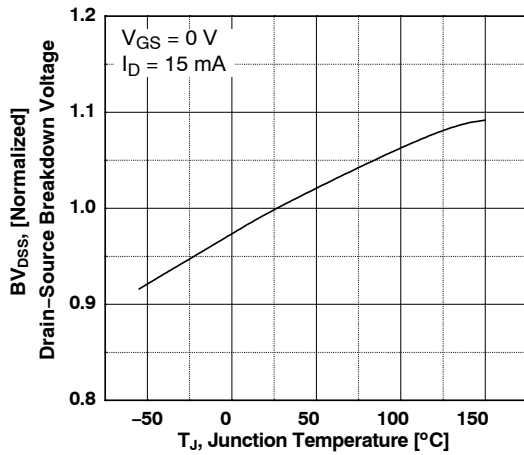


Figure 7. Breakdown Voltage Variation vs. Temperature

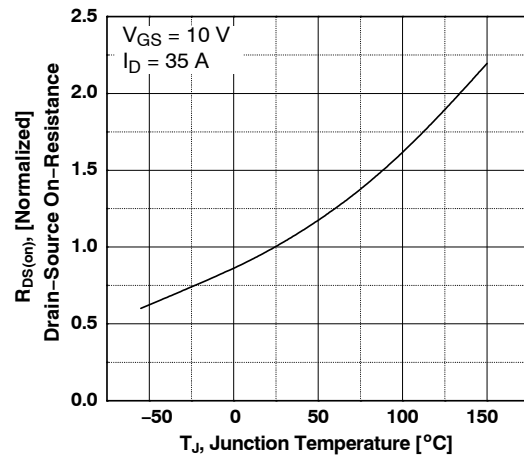


Figure 8. On-Resistance Variation vs. Temperature

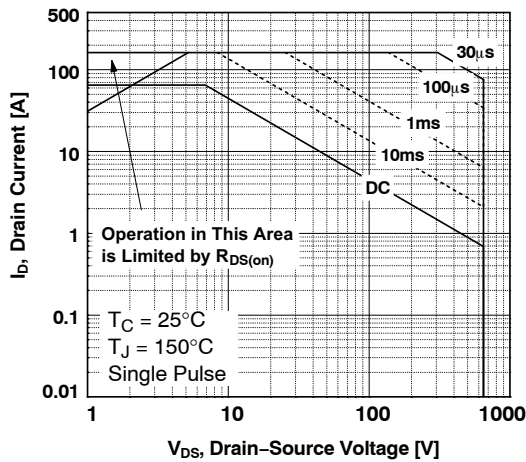


Figure 9. Maximum Safe Operating Area

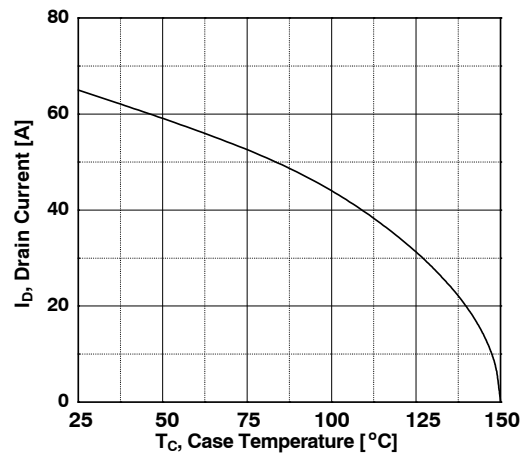


Figure 10. Maximum Drain Current vs. Case Temperature

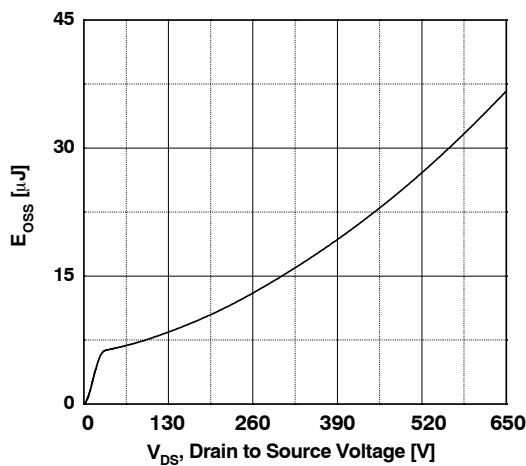


Figure 11. Eoss vs. Drain to Source Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

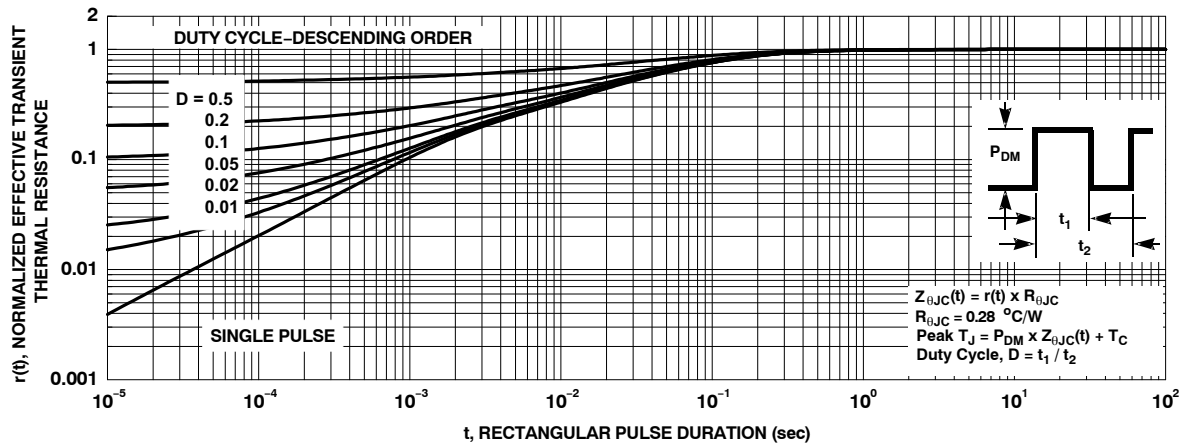
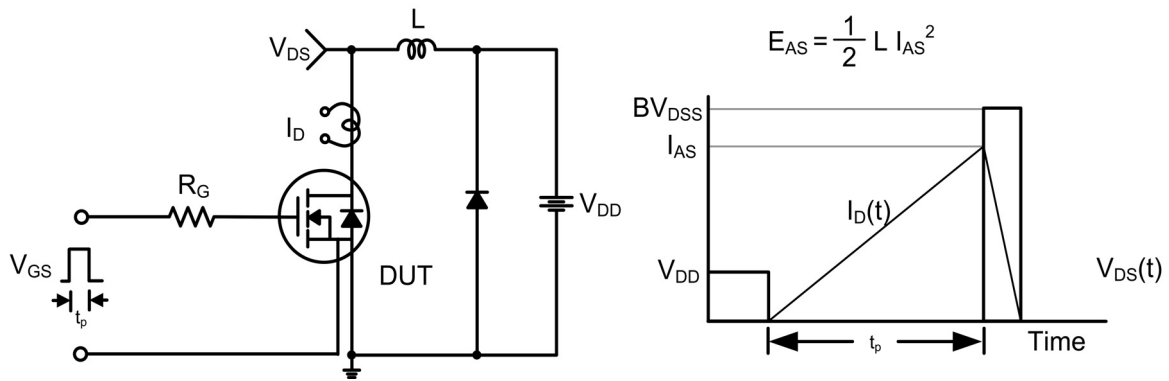
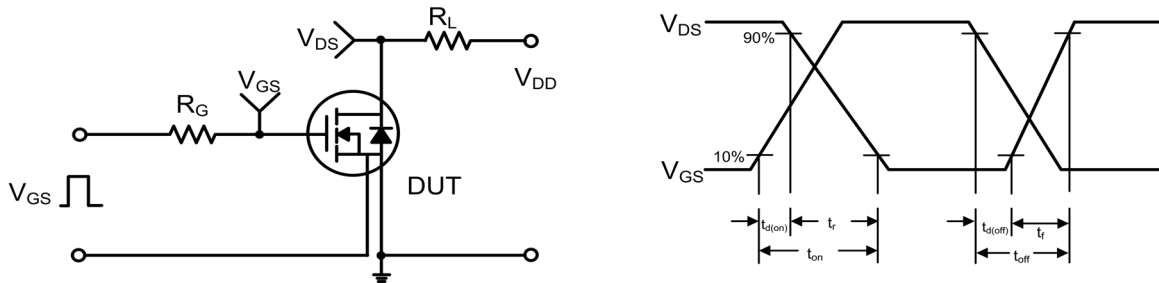
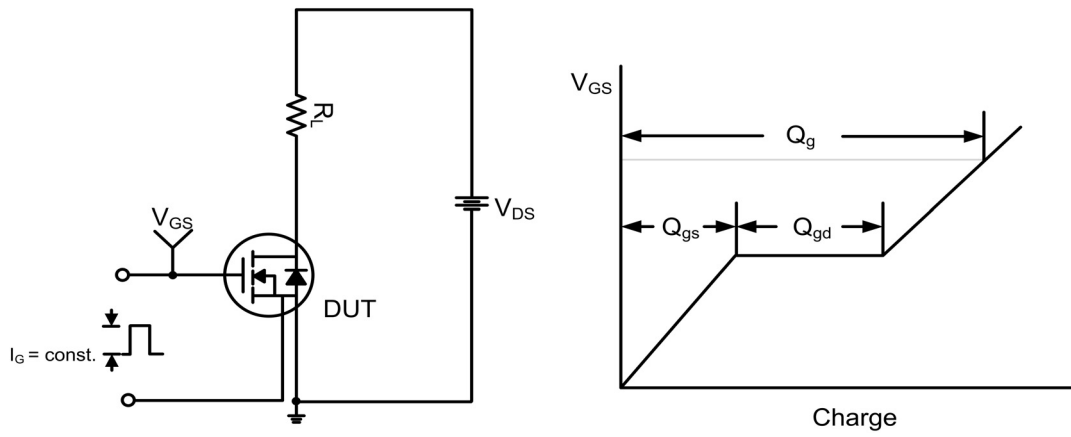


Figure 12. Transient Thermal Response Curve



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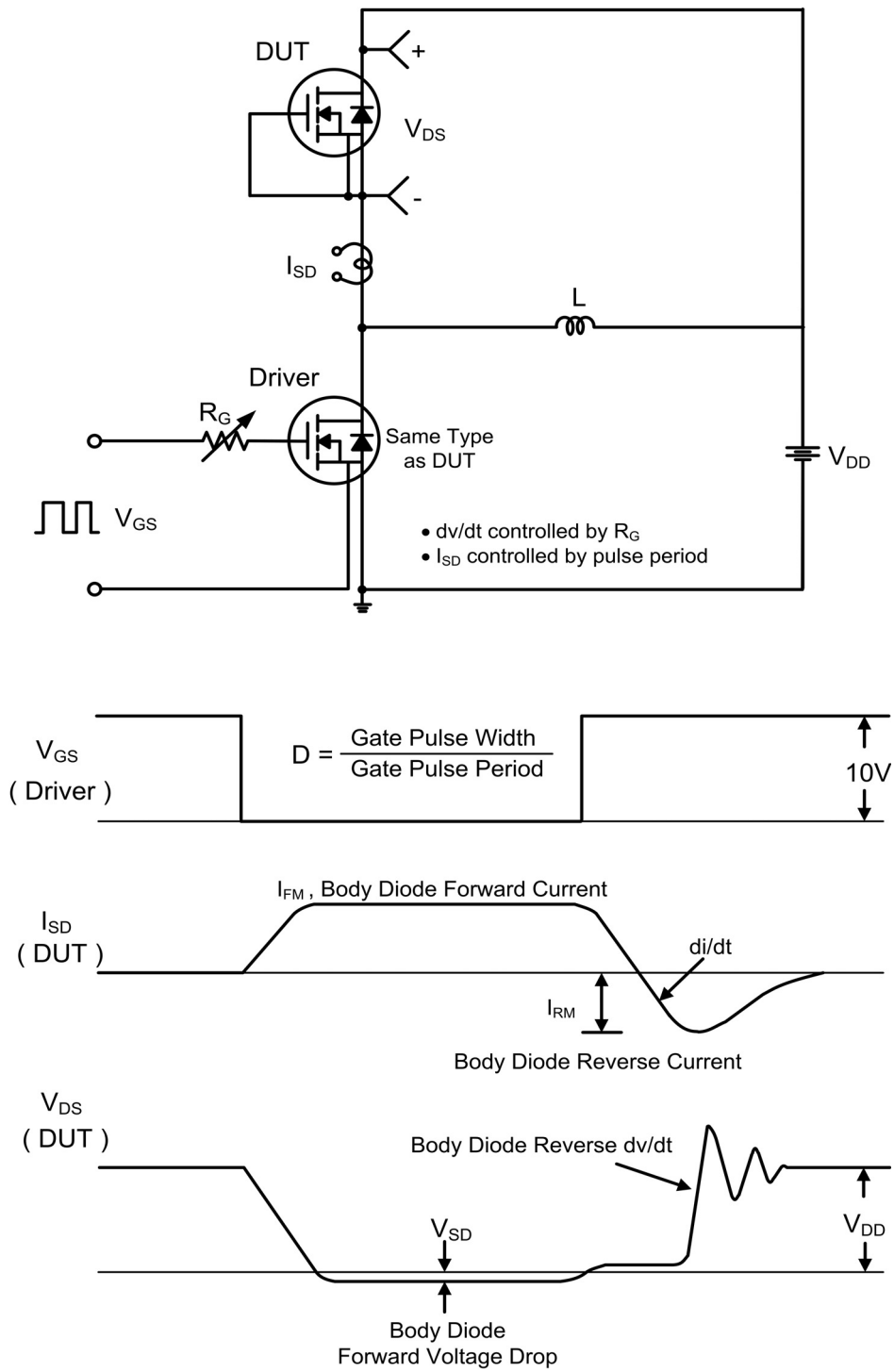
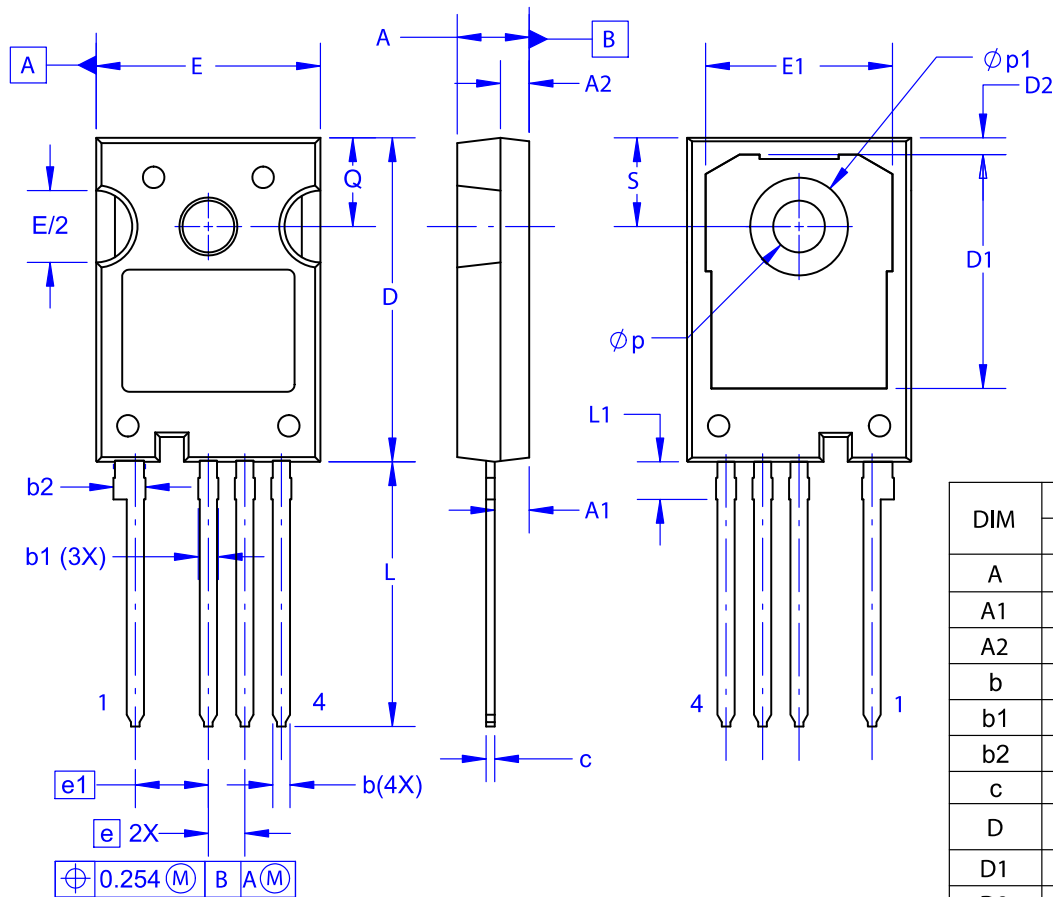


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

TO-247-4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019


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.

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

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