NIB6404-5L

Preferred Device

HDPlus™
52 Amps, 40 Volts
Self Protected with Temperature Sense

N–Channel D²PAK

HDPlus devices are an advanced series of Power MOSFETs which utilize ON Semiconductor's latest MOSFET technology process to achieve the lowest possible on–resistance per silicon area while incorporating additional features such as clamp diodes. They are capable of withstanding high energy in the avalanche and commutation modes. The avalanche energy is specified to eliminate guesswork in designs where inductive loads are switched and offer additional safety margin against unexpected voltage transients.

This new HDPlus device features integrated Gate–to–Source diodes for ESD protection, and Gate–to–Drain clamp for overvoltage protection. Also, this device integrates a sense diode for temperature monitoring.

- Ultra Low $R_{DS(on)}$ Provides Higher Efficiency
- I_{DSS} Specified at Elevated Temperature
- Avalanche Energy Specified
- Overvoltage Protection
- FET ESD Human Body Model Discharge Sensitivity Class 3
- Temperature Sense Diode

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Drain–to–Source Voltage	V_{DSS}	40	Vdc
Drain–to–Gate Voltage	V_{DGR}	40	Vdc
Gate–to–Source Voltage	V_{GS}	±10	Vdc
Operating and Storage Temperature Range	T_J, T_{stg}	–55 to +175	°C
Single Pulse Drain–to–Source Avalanche Energy – Starting T_J = 25°C (Note 1) (V_{DD} = 25 Vdc, V_{GS} = 5.0 Vdc, $I_{L(pk)}$ = 25 A, L = 1.4 mH, R_G = 10 kΩ)	E_{AS}	450	mJ
Drain Current – Continuous @ T_A = 25°C – Continuous @ T_A = 140°C – Single Pulse ($t_p \le 10$ μs)	 I_D I_D I_{DM}	 52 25 200	Adc
Total Power Dissipation (t ≤ 10 seconds) Linear Derating Factor	P_D @ T_A = 25°C	115 0.76	W W/°C
Thermal Resistance – Junction–to–Case – Junction–to–Ambient (Note 1)	 $R_{\theta JC}$ $R_{\theta JA}$	 1.3 80	°C/W

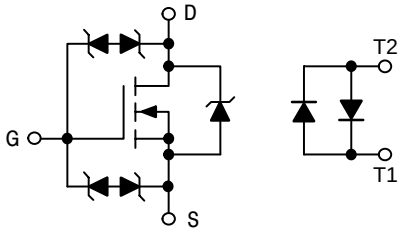
1. Measured while surface mounted to an FR4 board using the minimum recommended pad size. Typical value is 64°C/W.

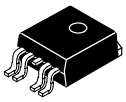
Observe the general handling precautions for electrostatic–discharge sensitive devices (ESD) to prevent damage.

ON Semiconductor™

http://onsemi.com

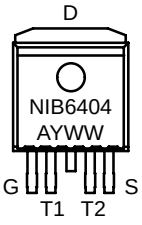
52 AMPERES
40 VOLTS
$R_{DS(on)}$ = 20 mΩ





D²PAK
CASE 936D
PLASTIC

MARKING DIAGRAM



NIB6404 = Device Code
A = Assembly Location
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
NIB6404–5L	D²PAK	800 Tape & Reel

Preferred devices are recommended choices for future use and best overall value.

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain–to–Source Breakdown Voltage (Note 2) (V_{GS} = 0 Vdc, I_D = 250 μAdc, –55°C < T_J < 175°C) Temperature Coefficient (Negative)		$V_{(BR)DSS}$	 40 –	 51 7.0	 55 –	Vdc mV/°C
Gate–to–Source Clamp Voltage (Note 2) (V_{GS} = 0 Vdc, I_G = 20 μAdc)		$V_{(BR)GSS}$	10	13	20	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 35 Vdc, V_{GS} = 0 Vdc) (V_{DS} = 15 Vdc, V_{GS} = 0 Vdc) (V_{DS} = 35 Vdc, V_{GS} = 0 Vdc, T_J = 125°C)		I_{DSS}	 – – –	 1.1 0.2 4.0	 100 2.0 20	μAdc
Gate–Body Leakage Current (V_{GS} = 5.0 Vdc, V_{DS} = 0 Vdc)		I_{GSS}	–	0.02	1.0	μAdc
ON CHARACTERISTICS (Note 2)						
Gate Threshold Voltage (Note 2) (V_{DS} = V_{GS}, I_D = 1.0 mAdc) Threshold Temperature Coefficient (Negative)		$V_{GS(th)}$	 1.0 –	 1.7 4.5	 2.0 –	Vdc mV/°C
Static Drain–to–Source On–Resistance (Note 2) (V_{GS} = 5.0 Vdc, I_D = 20 Adc)		$R_{DS(on)}$	–	18	20	mΩ
Forward Transconductance (V_{DS} = 15 Vdc, I_D = 10 Adc) (Note 2)		g_{FS}	TBD	34	–	mhos
DYNAMIC CHARACTERISTICS						
Input Capacitance	(V_{DS} = 25 Vdc, V_{GS} = 0 Vdc, f = 1.0 MHz)	C_{iss}	–	1720	–	pF
Output Capacitance		C_{oss}	–	525	–	
Transfer Capacitance		C_{rss}	–	120	–	
SWITCHING CHARACTERISTICS (Note 3)						
Turn–On Delay Time	(V_{DD} = 32 Vdc, I_D = 25 Adc, V_{GS} = 5.0 Vdc, R_G = 10 kΩ) (Note 2)	$t_{d(on)}$	–	11.2	–	μs
Rise Time		t_r	–	38.5	–	
Turn–Off Delay Time		$t_{d(off)}$	–	31.5	–	
Fall Time		t_f	–	29.5	–	
Gate Charge	(V_{DS} = 32 Vdc, I_D = 25 Adc, V_{GS} = 5.0 Vdc) (Note 2)	Q_T	–	29	–	nC
		Q_1	–	6.0	–	
		Q_2	–	16	–	
		Q_3	–	2.0	–	
SOURCE–DRAIN DIODE CHARACTERISTICS						
Forward On–Voltage	(I_S = 20 Adc, V_{GS} = 0 Vdc) (Note 2) (I_S = 20 Adc, V_{GS} = 0 Vdc, T_J = 125°C)	V_{SD}	 –	 0.876 0.746	 1.2 –	Vdc
Reverse Recovery Time	(I_S = 25 Adc, V_{GS} = 0 Vdc, dI_S/dt = 100 A/μs) (Note 2)	t_{rr}	–	60	–	ns
		t_a	–	29	–	
		t_b	–	32	–	
Reverse Recovery Stored Charge		Q_{RR}	–	80	–	pC
TEMPERATURE SENSE DIODE CHARACTERISTICS						
Forward (Reverse) On–Voltage	($I_{F(R)}$ = 250 μAdc) (Note 2) ($I_{F(R)}$ = 250 μAdc, T_J = 125°C)	$V_{AC(ACR)}$	715 –	743 570	775 –	mVdc
Temperature Coefficient (Negative)	$I_{F(R)}$ = 250 μAdc, T_J = 160°C	V_{FTC}	1.57	1.71	1.85	mV/°C
Forward Voltage Hysteresis	$I_{F(R)}$ = 125 μAdc to 250 μAdc	V_{hys}	25	37	50	mVdc

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
3. Switching characteristics are independent of operating junction temperatures.

TYPICAL ELECTRICAL CHARACTERISTICS

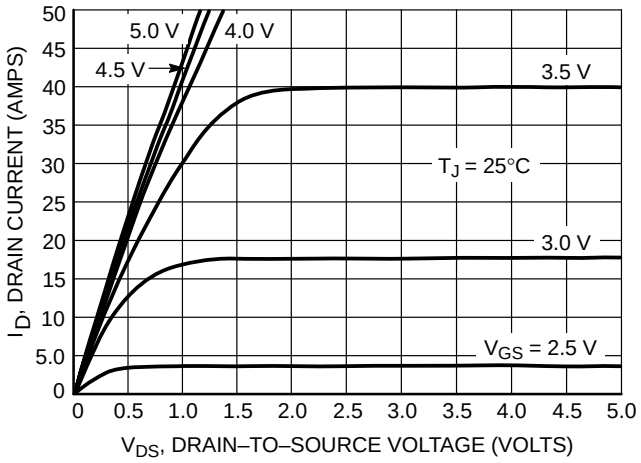


Figure 1. On–Region Characteristics

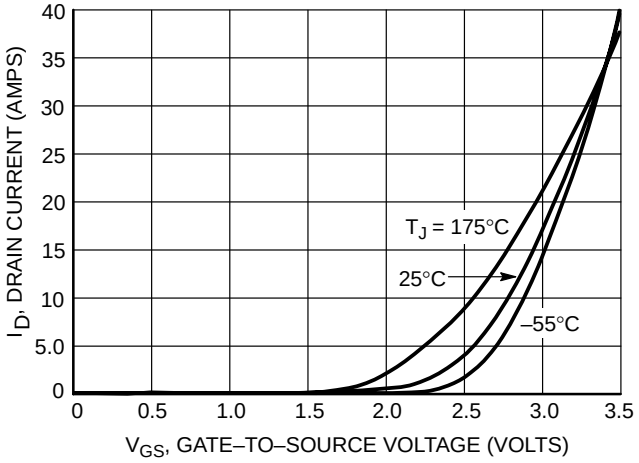


Figure 2. Transfer Characteristics

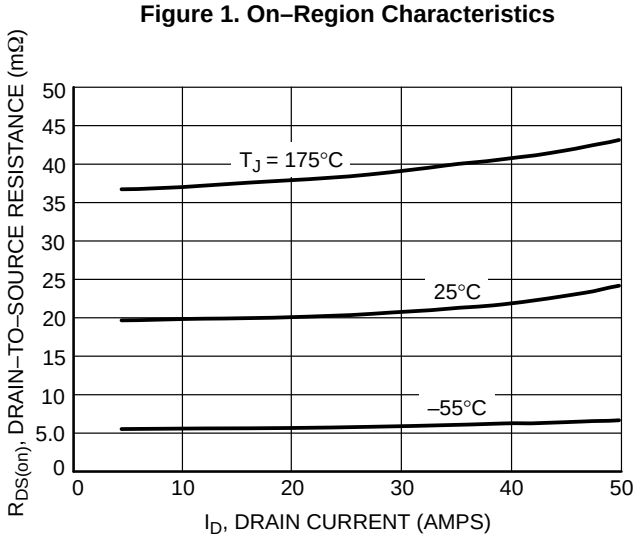


Figure 3. On–Resistance versus Drain Current and Temperature

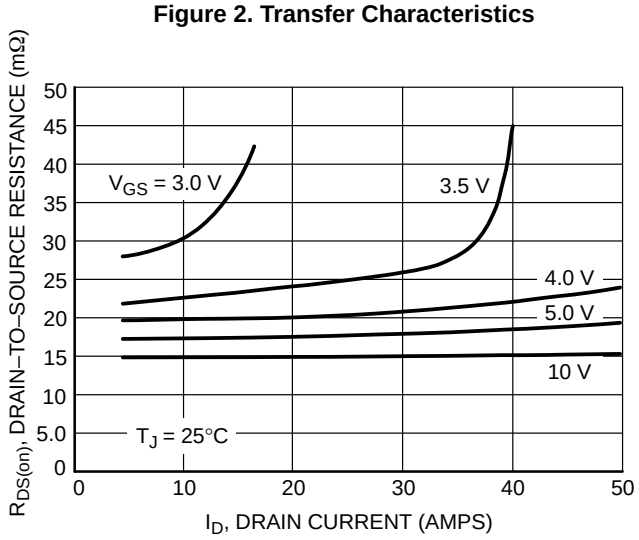


Figure 4. On–Resistance versus Drain Current and Gate Voltage

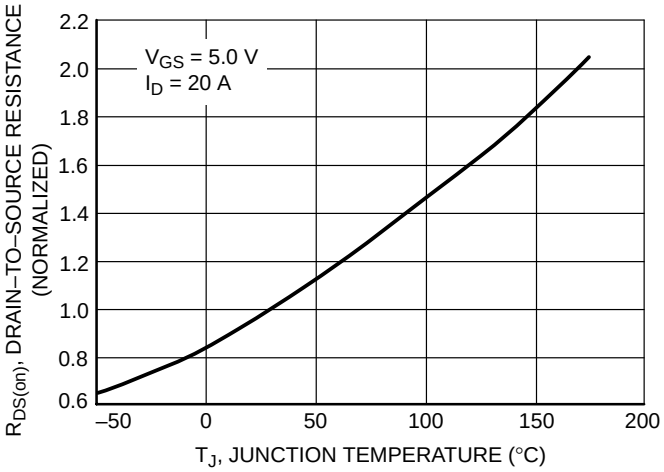


Figure 5. On–Resistance Variation with Temperature

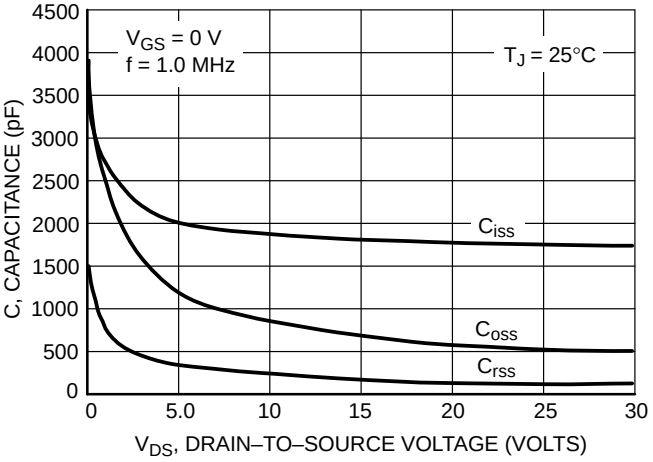


Figure 6. Capacitance Variation

TYPICAL ELECTRICAL CHARACTERISTICS

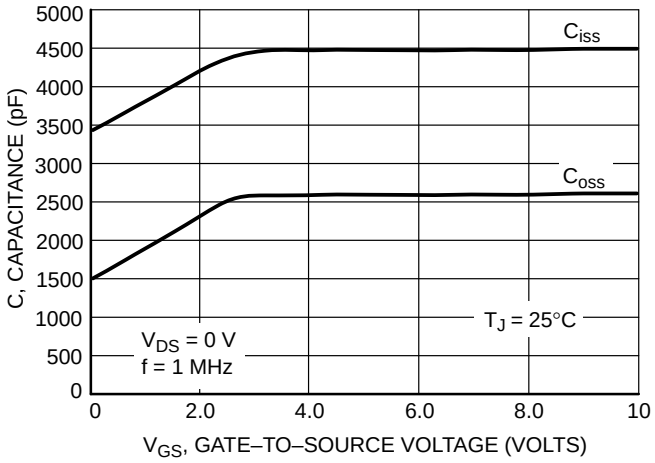


Figure 7. Capacitance Variation

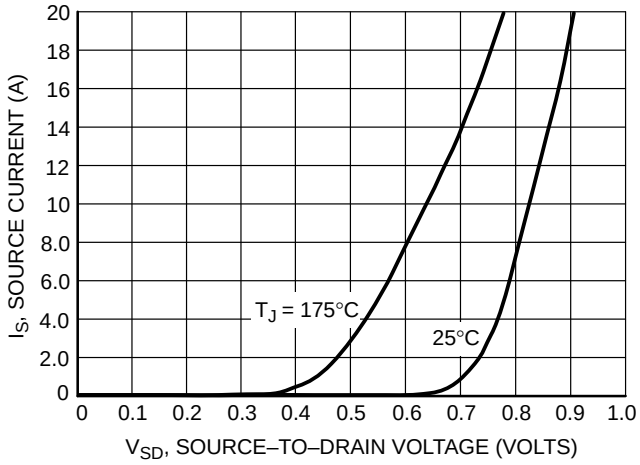


Figure 8. Diode Forward Voltage versus Current

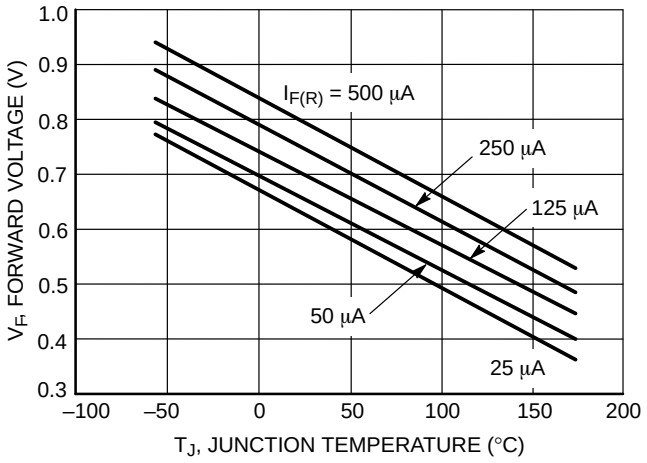


Figure 9. Sense Diode Forward Voltage Variation with Temperature

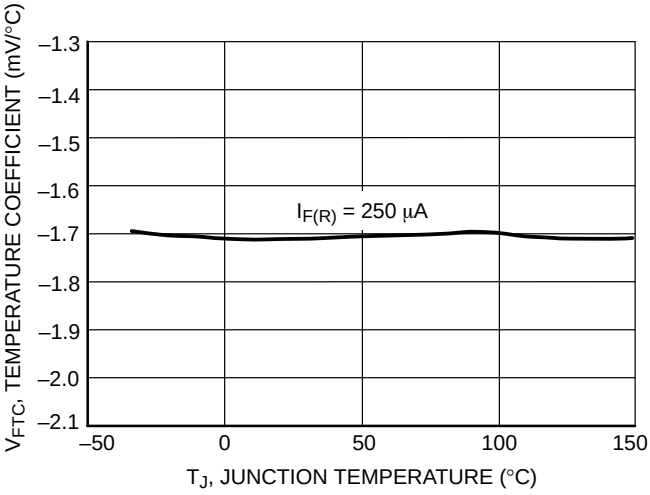
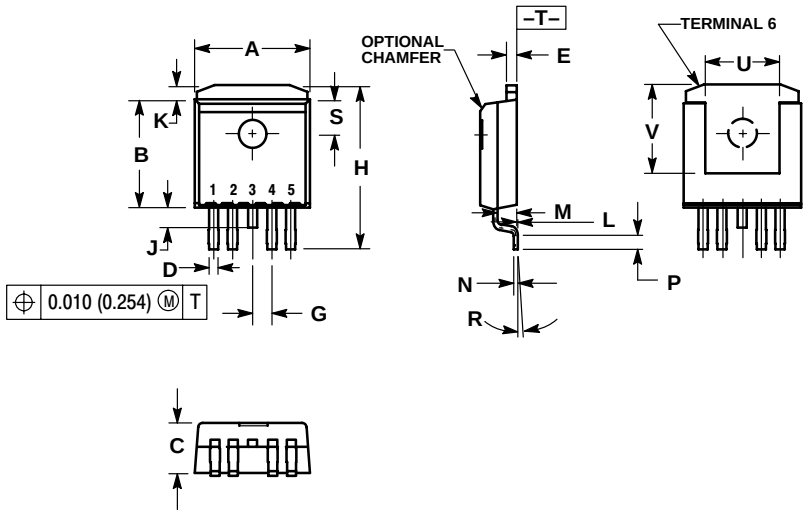


Figure 10. Sense Diode Temperature Coefficient Variation with Temperature

PACKAGE DIMENSIONS

D²PAK
CASE 936D–03
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. TAB CONTOUR OPTIONAL WITHIN DIMENSIONS A AND K.
4. DIMENSIONS U AND V ESTABLISH A MINIMUM MOUNTING SURFACE FOR TERMINAL 6.
5. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.025 (0.635) MAXIMUM.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.386	0.403	9.804	10.236
B	0.356	0.368	9.042	9.347
C	0.170	0.180	4.318	4.572
D	0.026	0.036	0.660	0.914
E	0.045	0.055	1.143	1.397
G	0.067 BSC		1.702 BSC	
H	0.539	0.579	13.691	14.707
J	0.125 MAX		3.175 MAX	
K	0.050 REF		1.270 REF	
L	0.000	0.010	0.000	0.254
M	0.088	0.102	2.235	2.591
N	0.018	0.026	0.457	0.660
P	0.058	0.078	1.473	1.981
R	5° REF		5° REF	
S	0.116 REF		2.946 REF	
U	0.200 MIN		5.080 MIN	
V	0.250 MIN		6.350 MIN	

Notes

Notes

HDPlus is a trademark of Semiconductor Components Industries, LLC (SCILLC).

PUBLICATION ORDERING INFORMATION

Literature Fulfillment:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303–675–2175 or 800–344–3860 Toll Free USA/Canada
Fax: 303–675–2176 or 800–344–3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com

N. American Technical Support: 800–282–9855 Toll Free USA/Canada

JAPAN: ON Semiconductor, Japan Customer Focus Center
4–32–1 Nishi–Gotanda, Shinagawa–ku, Tokyo, Japan 141–0031
Phone: 81–3–5740–2700
Email: r14525@onsemi.com

ON Semiconductor Website: http://onsemi.com

For additional information, please contact your local
Sales Representative.