

## NCE Automotive N-Channel Super Trench Power MOSFET

### Description

The NCEAP40ND40AG uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of  $R_{DS(ON)}$  and  $Q_g$ . This device is ideal for high-frequency switching and synchronous rectification

### Application

- Automotive application
- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

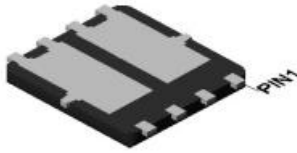
### General Features

- $V_{DS} = 40V, I_D = 43A$   
 $R_{DS(ON)} = 9.3m\Omega$  (typical) @  $V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175°C operating temperature
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- 100% UIS tested
- 100%  $\Delta V_{ds}$  tested
- **AEC-Q101 qualified**

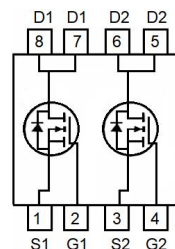
### PDFN5X6-8L



Top View



Bottom View



Schematic Diagram

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
AP40ND40AG	NCEAP40ND40AG	DFN5X6-8L	Ø330mm	12mm	5000units

### Absolute Maximum Ratings ( $T_c = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	40	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	43	A
Drain Current-Continuous( $T_c = 100^\circ C$ )	$I_D(100^\circ C)$	30.7	A
Pulsed Drain Current	$I_{DM}$	200	A
Maximum Power Dissipation	$P_D$	33	W
Derating factor		0.23	W/ $^\circ C$
Single pulse avalanche energy (Note 1)	$E_{AS}$	70	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175	$^\circ C$

### Thermal Characteristic

Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	4.5	$^\circ C/W$
Thermal Resistance, Junction-to-Ambient (Note 4)	$R_{\theta JA}$	50	$^\circ C/W$

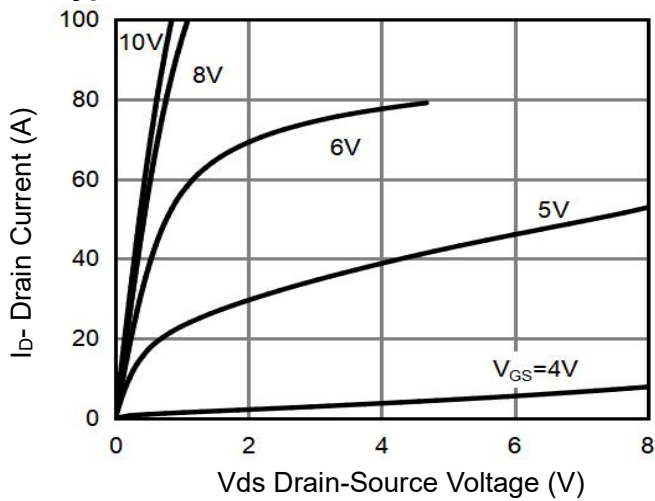
## Electrical Characteristics (T<sub>c</sub>=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	40	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
On Characteristics						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	2.0	3.0	4.0	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =20A	-	9.3	10.1	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =20A	-	30	-	S
Dynamic Characteristics						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, F=1.0MHz	-	700	950	pF
Output Capacitance	C <sub>oss</sub>		-	375	525	pF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	28	56	pF
Switching Characteristics (Note 2)						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =20V, I <sub>D</sub> =20A V <sub>GS</sub> =10V, R <sub>G</sub> =1.6Ω	-	6	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	2.8	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	23	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	3	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =20V, I <sub>D</sub> =20A, V <sub>GS</sub> =10V	-	14.6	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	4.7	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	4.1	-	nC
Drain-Source Diode Characteristics						
Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =20A	-	-	1.2	V
Diode Forward Current	I <sub>S</sub>		-	-	43	A
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub>	-	11	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100A/μs	-	19	-	nC

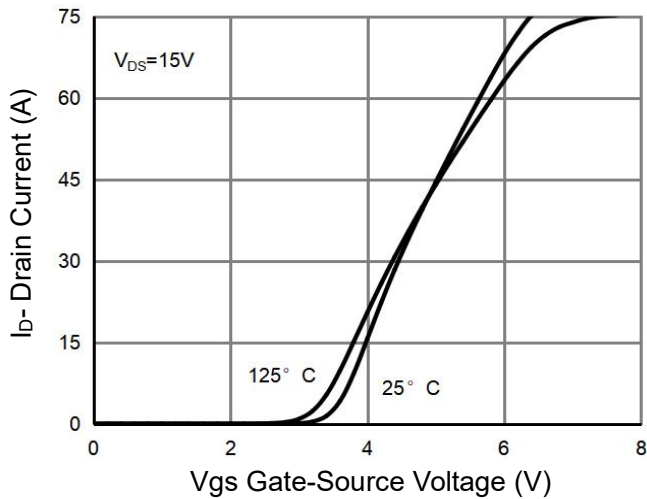
### Notes:

1. EAS condition : T<sub>J</sub>=25°C, V<sub>DD</sub>=20V, V<sub>G</sub>=10V, L=0.5mH, R<sub>G</sub>=25Ω
2. Guaranteed by design, not subject to production
3. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of T<sub>J</sub>(MAX)=175°C. The SOA curve provides a single pulse rating.
4. The value of R<sub>θJA</sub> is measured with the device mounted on 1in2 FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub> =25° C. The value in any given application depends on the user's specific board design, and the maximum temperature of 175° C may be used if the PCB allows it.

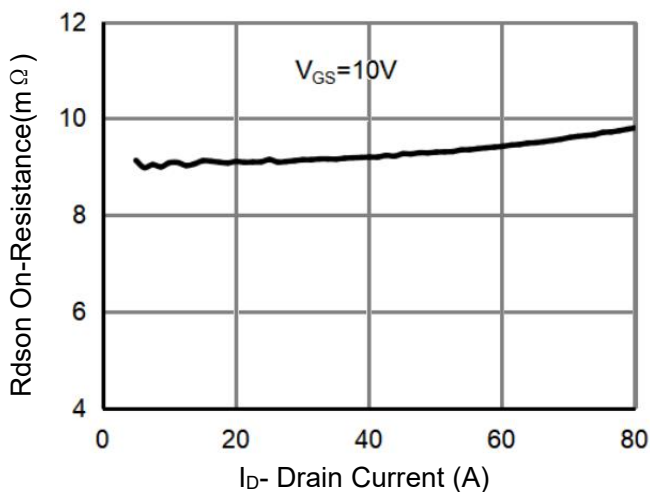
## Typical Electrical and Thermal Characteristics



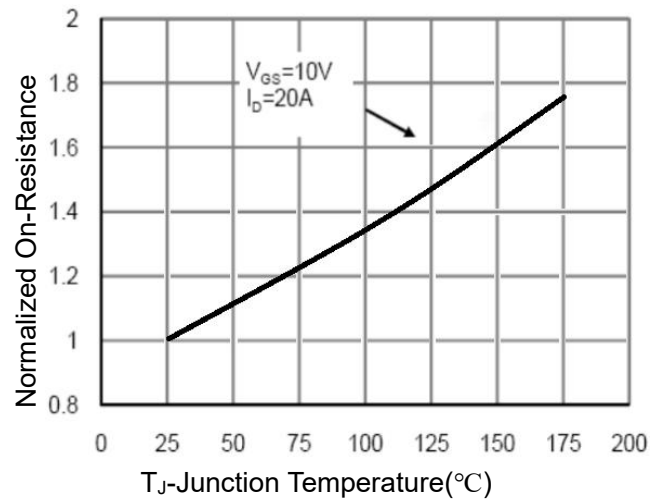
**Figure 1 Output Characteristics**



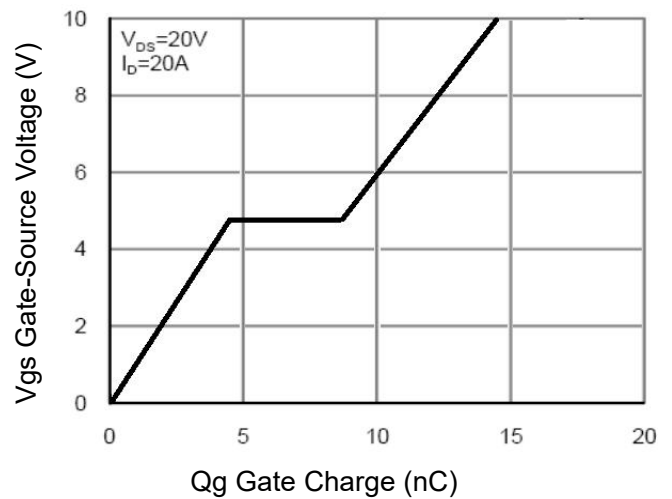
**Figure 2 Transfer Characteristics**



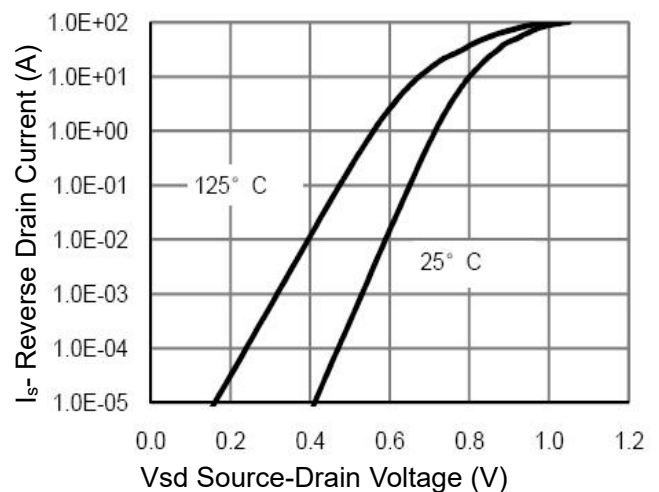
**Figure 3  $R_{DS(on)}$ - Drain Current**



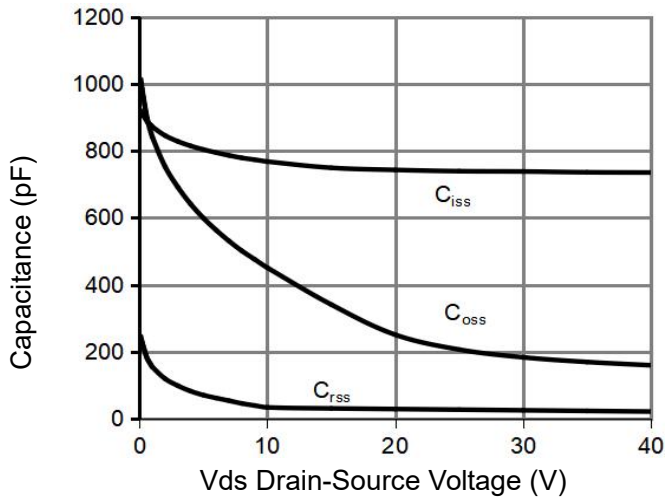
**Figure 4  $R_{DS(on)}$ -Junction Temperature**



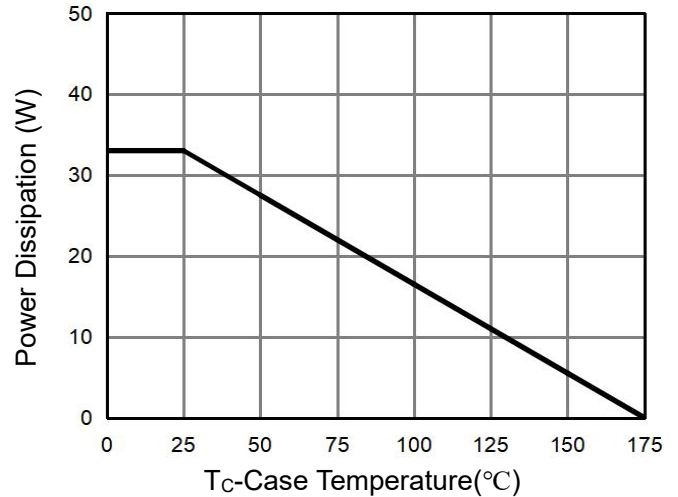
**Figure 5 Gate Charge**



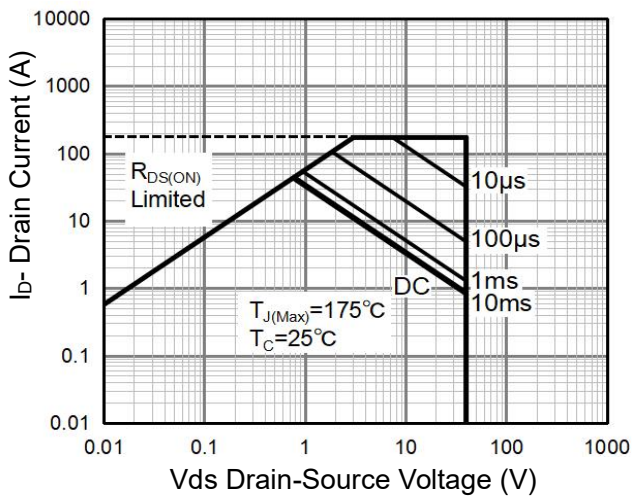
**Figure 6 Source- Drain Diode Forward**



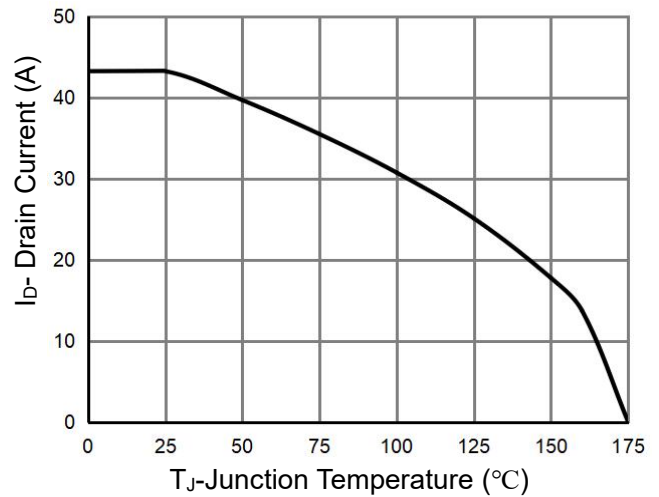
**Figure 7 Capacitance vs Vds**



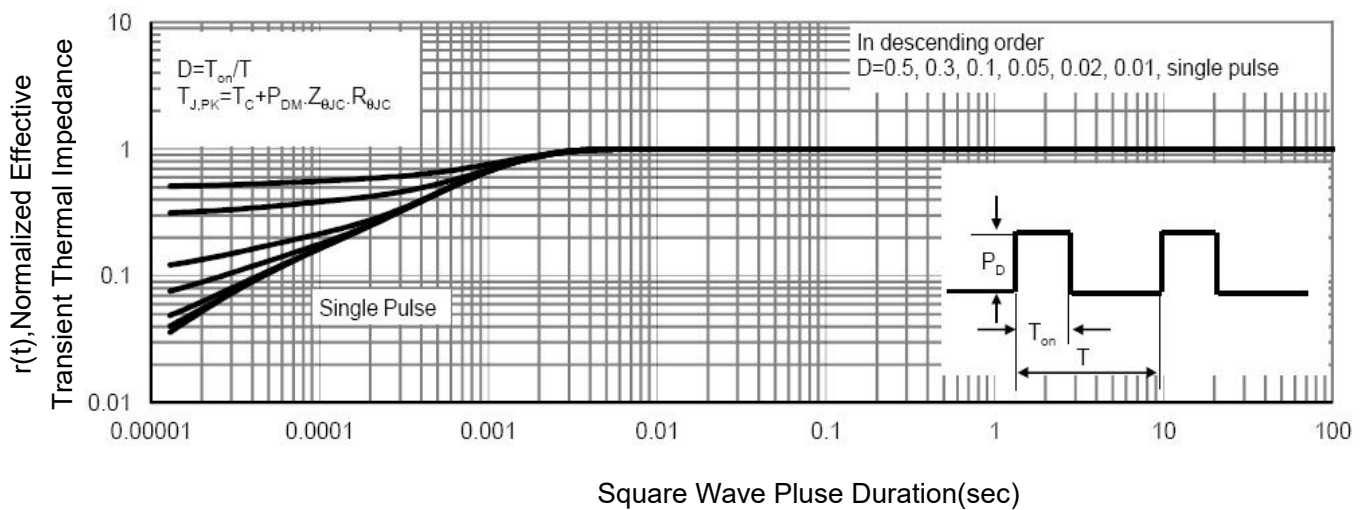
**Figure 9 Power De-rating**



**Figure 8 Safe Operation Area**(Note3)

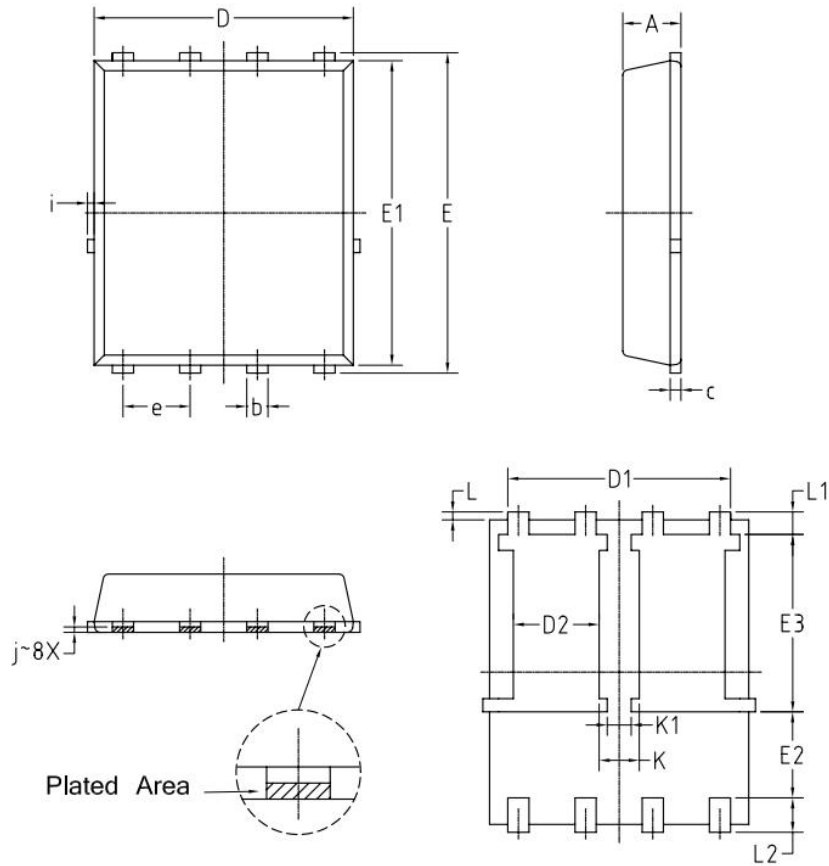


**Figure 10 Current De-rating**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## PDFN5X6-8L Package Information



SYMBOL	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	1.00	1.20	0.039	0.047
b	0.30	0.50	0.012	0.020
c	0.203 BSC		0.008 BSC	
D	4.80	5.00	0.189	0.197
D1	4.06	4.36	0.160	0.172
D2	1.47	1.77	0.058	0.070
E	5.90	6.20	0.232	0.244
E1	5.65	5.85	0.222	0.230
E2	1.45	—	0.057	—
E3	3.20	3.50	0.126	0.138
e	1.27 BSC		0.05 BSC	
L	0.05	0.25	0.002	0.010
L1	0.325	0.525	0.013	0.021
L2	0.500	0.800	0.020	0.031
i	—	0.20	—	0.008
K	0.61	0.91	0.024	0.036
K1	0.31	0.60	0.012	0.024
j	0.1015 BSC		0.004BSC	

## Revision History

Revision	Date	Subjects
V1.0	2023.06.15	Product data sheet
V2.0	2023.06.26	Figure 7 Capacitance vs Vds
V3.0	2023.07.19	R <sub>θJA</sub>
V4.0	2024.01.17	C <sub>iss</sub> C <sub>Oss</sub> C <sub>rss</sub> Max Value

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