

## NCE Automotive N-Channel Super Trench Power MOSFET

### Description

The NCEAP40T20AD 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.

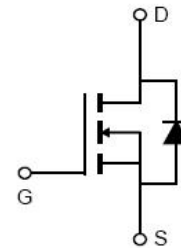
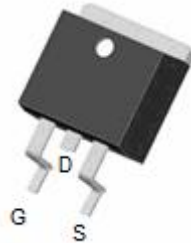
### Application

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

### General Features

- $V_{DS} = 40V, I_D = 295A$  (Silicon Limited)  
 $R_{DS(ON)} = 1.3m\Omega$ , typical@  $V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- Pb-free lead plating
- 175°C operating temperature
- 100% UIS tested
- 100%  $\Delta V_{ds}$  tested
- **AEC-Q101 qualified**

TO-263



Schematic Diagram

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
AP40T20AD	NCEAP40T20AD	TO-263-2L	-	-	-

### 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 (Silicon Limited) <sup>(Note 1)</sup>	$I_D$	295	A
	$I_D(100^\circ C)$	212	A
Drain Current-Continuous (Package Limited)	$I_D$	240	A
Pulsed Drain Current	$I_{DM}$	960	A
Maximum Power Dissipation	$P_D$	270	W
Derating factor		1.8	W/ $^\circ C$
Single pulse avalanche energy <sup>(Note 2)</sup>	$E_{AS}$	1692	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175	$^\circ C$

### Thermal Characteristic

Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.56	$^\circ C/W$
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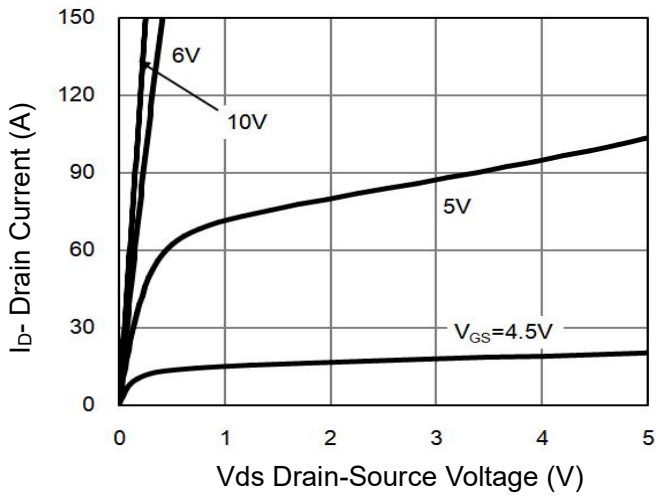
## Electrical Characteristics (T<sub>c</sub>=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
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
<b>On Characteristics</b>						
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	-	1.3	1.6	mΩ
Gate resistance	R <sub>G</sub>	F=1.0MHz	-	5	-	Ω
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =20A	-	90	-	S
<b>Dynamic Characteristics</b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, F=1.0MHz	-	5834.6	-	pF
Output Capacitance	C <sub>oss</sub>		-	2320.5	-	pF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	70	-	pF
<b>Switching Characteristics</b> (Note 1)						
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	-	14.5	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	8	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	58	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	10	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =20V, I <sub>D</sub> =20A, V <sub>GS</sub> =10V	-	91	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	29.4	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	19	-	nC
<b>Drain-Source Diode Characteristics</b>						
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>		-	-	295	A
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub>	-	38	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100A/μs (Note3)	-	125	-	nC

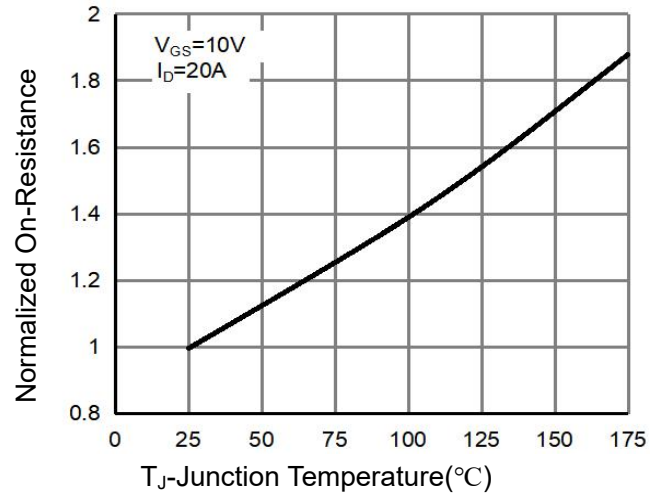
### Notes:

1. Defined by design. Not Subject to production test
2. 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
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(MAX)</sub>=175°C. The SOA curve provides a single pulse rating.

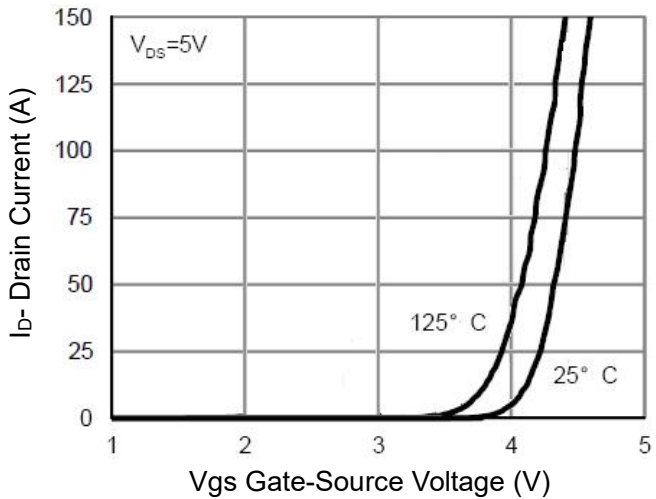
## Typical Electrical and Thermal Characteristics



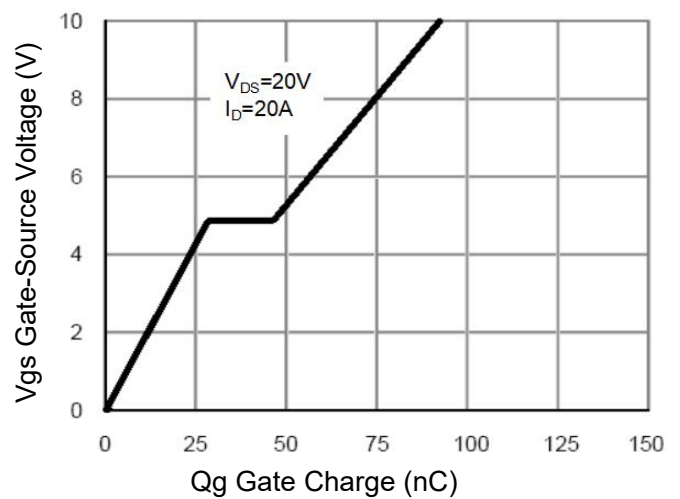
**Figure 1 Output Characteristics**



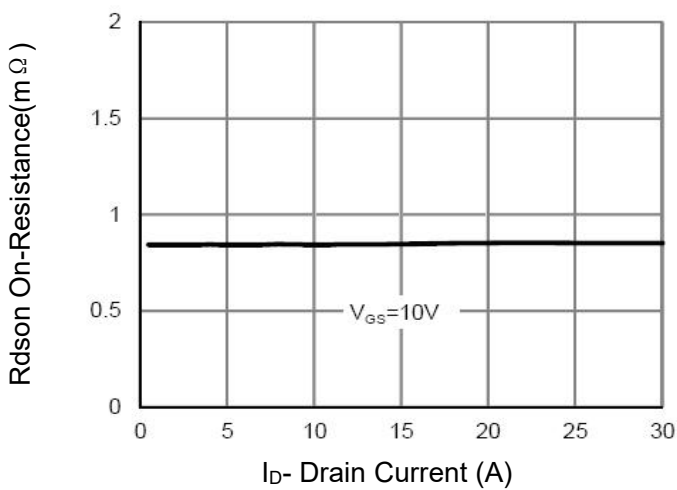
**Figure 4 Rdson-Junction Temperature**



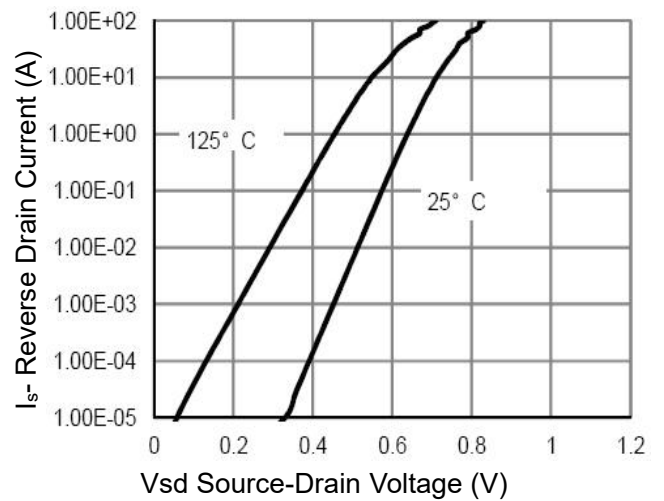
**Figure 2 Transfer Characteristics**



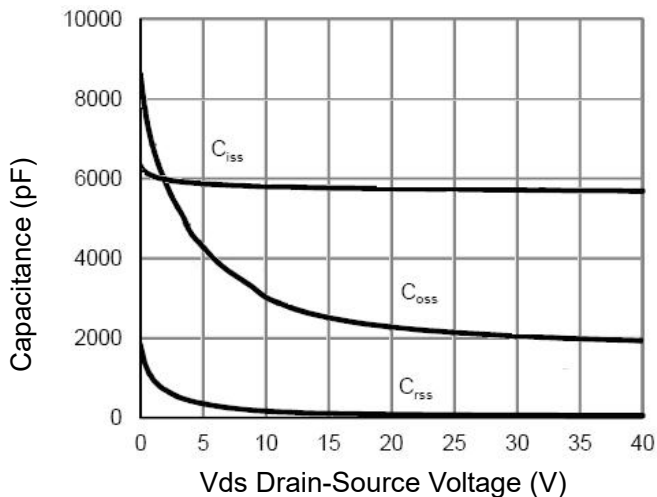
**Figure 5 Gate Charge**



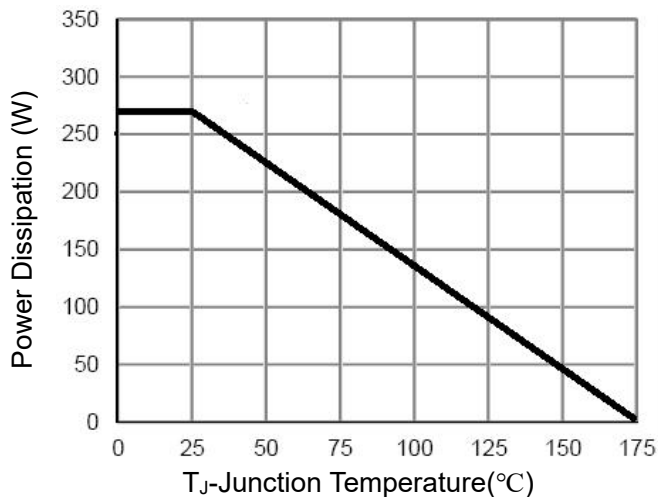
**Figure 3 Rdson- Drain Current**



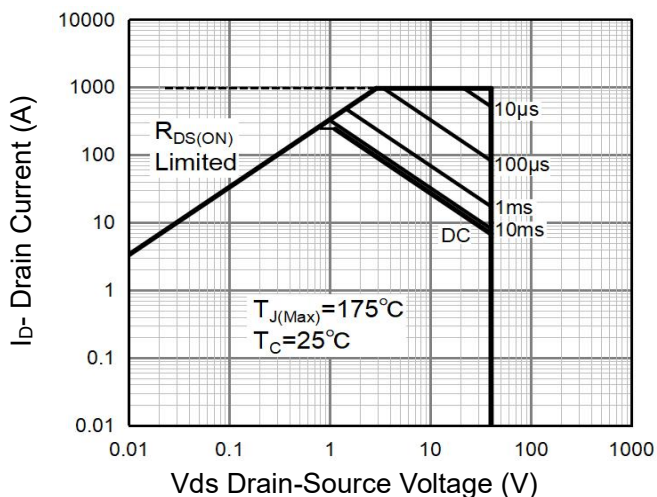
**Figure 6 Source- Drain Diode Forward**



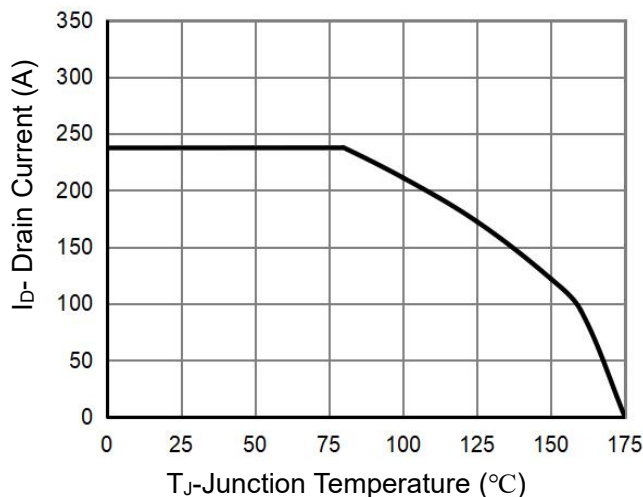
**Figure 7 Capacitance vs Vds**



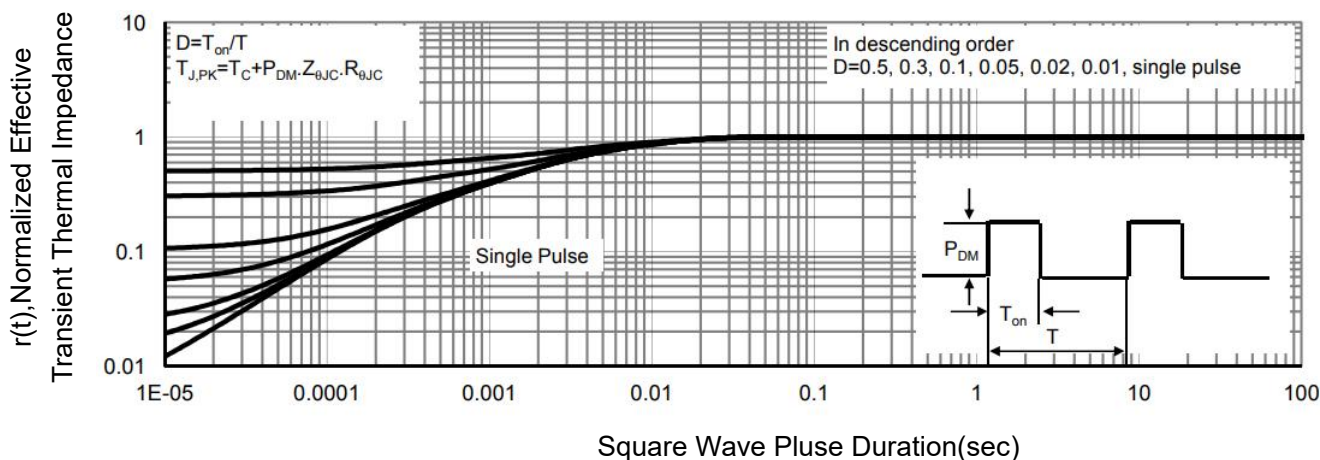
**Figure 9 Power De-rating**



**Figure 8 Safe Operation Area** (Note 3)

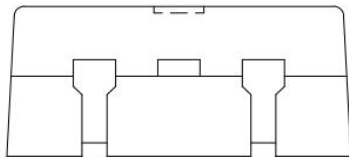
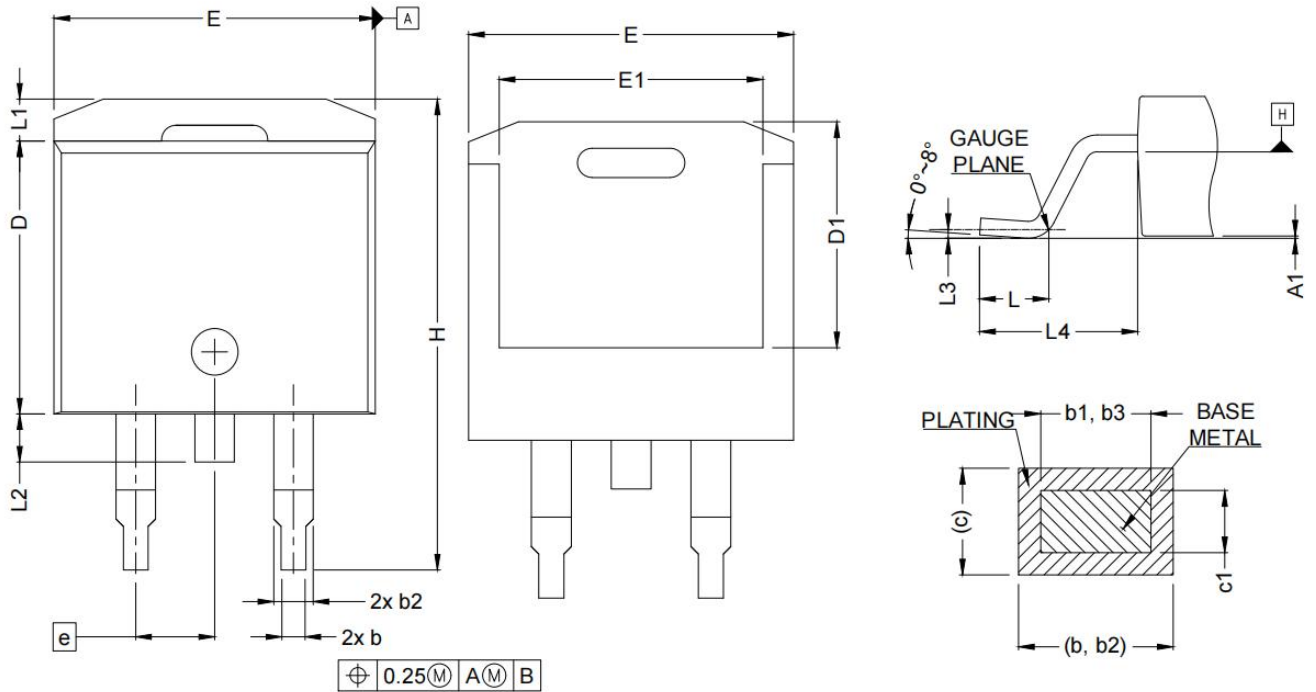


**Figure 10 Current De-rating**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## TO-263-2L Package Information



**OPTION 1**

2 LEADs

SYMBOL	MIN.	MAX.	SYMBOL	MIN.	MAX.
A	4.36	4.56	E	10.15	10.55
A1	0	0.25	E1	8.10	8.70
b	0.70	0.90	e	2.54 BSC	
b1	0.51	0.89	H	15.00	15.60
b2	1.17	1.37	L	1.90	2.50
b3	1.17	1.37	L1	-	1.65
c	0.38	0.69	L2	-	1.78
c1	0.38	0.53	L3	0.25 TYP	
c2	1.19	1.34	L4	4.78	5.28
D	8.60	9.00	J1	2.56	2.96
D1	6.90	7.50			

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