

## NCE Automotive N-Channel Super Trench Power MOSFET

### Description

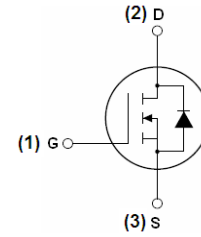
The NCEAP0178AK uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of  $R_{DS(ON)}$  and  $Q_g$ . This device is ideal for high-frequency switching and synchronous rectification.

### General Features

- $V_{DS} = 100V, I_D = 78A$   
 $R_{DS(ON)} = 7.2m\Omega(\text{typical}) @ V_{GS} = 10V$   
 $R_{DS(ON)} = 9.5m\Omega(\text{typical}) @ V_{GS} = 4.5V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested
- 100%  $\Delta V_d$ s tested
- **AEC-Q101 qualified**

### Application

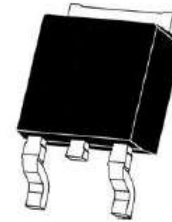
- Automotive application
- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification



Schematic diagram



Marking and pin assignment



TO-252-2L top view

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
AP0178AK	NCEAP0178AK	TO-252-2L	-	-	-

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

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	100	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	78	A
Drain Current-Continuous( $T_c = 100^\circ\text{C}$ )	$I_D(100^\circ\text{C})$	60	A
Pulsed Drain Current	$I_{DM}$	312	A
Maximum Power Dissipation	$P_D$	125	W
Derating factor		0.83	W/ $^\circ\text{C}$
Single pulse avalanche energy <sup>(Note 1)</sup>	$E_{AS}$	320	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175	$^\circ\text{C}$

### Thermal Characteristic

Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.2	$^\circ\text{C}/\text{W}$
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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	100	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =100V, 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	1.2	1.7	2.2	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =20A	-	7.2	8.5	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A	-	9.5	12	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =10V, I <sub>D</sub> =20A	40	-	-	S
<b>Dynamic Characteristics</b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =0V, F=1.0MHz	-	4200	5480	pF
Output Capacitance	C <sub>oss</sub>		-	354	425	pF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	23	30	pF
<b>Switching Characteristics</b> (Note 2)						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =50V, I <sub>D</sub> =20A V <sub>GS</sub> =10V, R <sub>G</sub> =4.7Ω	-	15	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	10	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	41	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	6	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =50V, I <sub>D</sub> =20A, V <sub>GS</sub> =10V	-	65	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	15.3	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	9	-	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>		-	-	78	A
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub>	-	101	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100A/μs	-	193	-	nC

### Notes:

1. EAS condition : T<sub>J</sub>=25°C, V<sub>DD</sub>=50V, V<sub>G</sub>=10V, L=0.5mH, R<sub>G</sub>=25Ω
2. Defined by design. Not Subject to production test
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

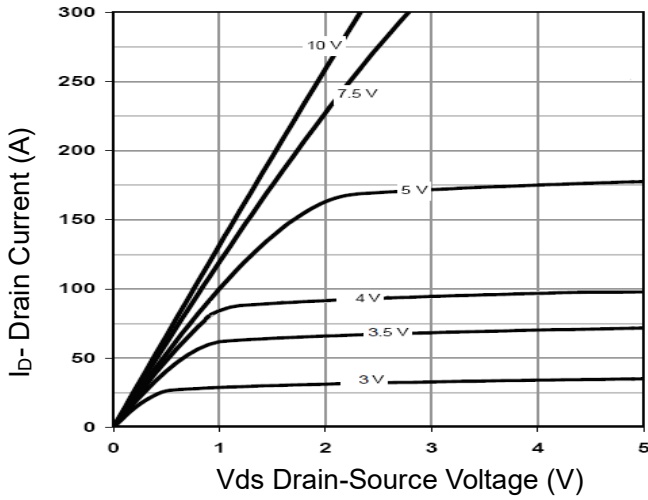


Figure 1 Output Characteristics

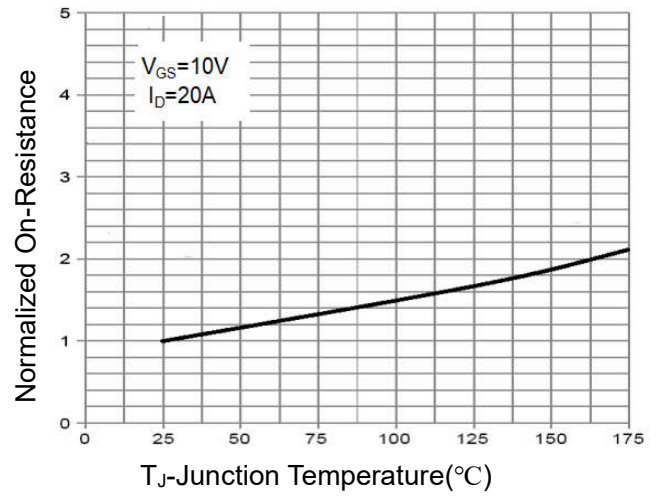


Figure 4 Rdson-Junction Temperature

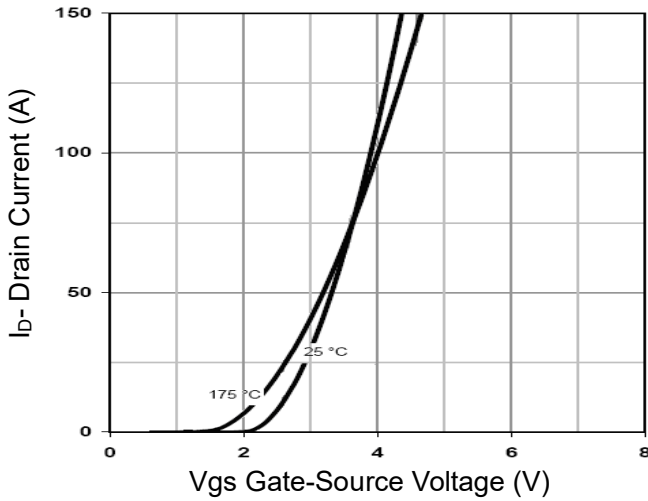


Figure 2 Transfer Characteristics

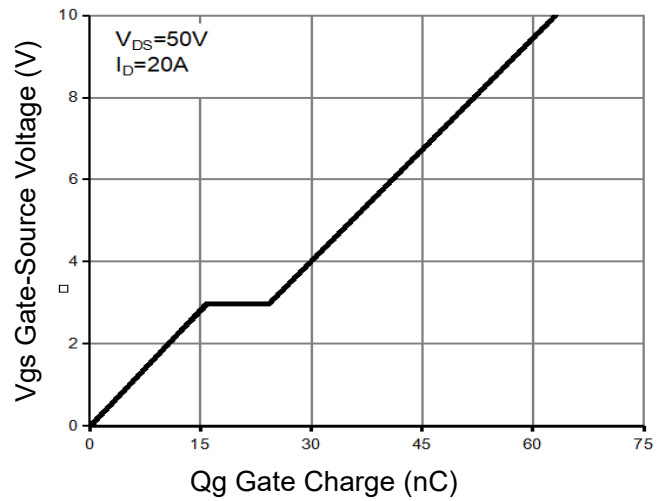


Figure 5 Gate Charge

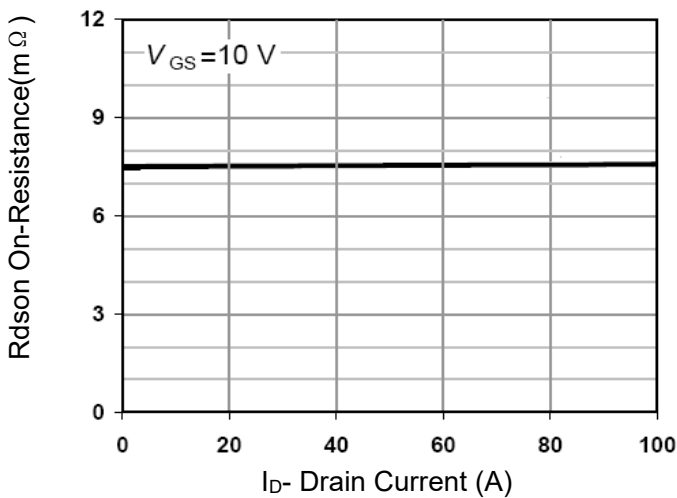


Figure 3 Rdson- Drain Current

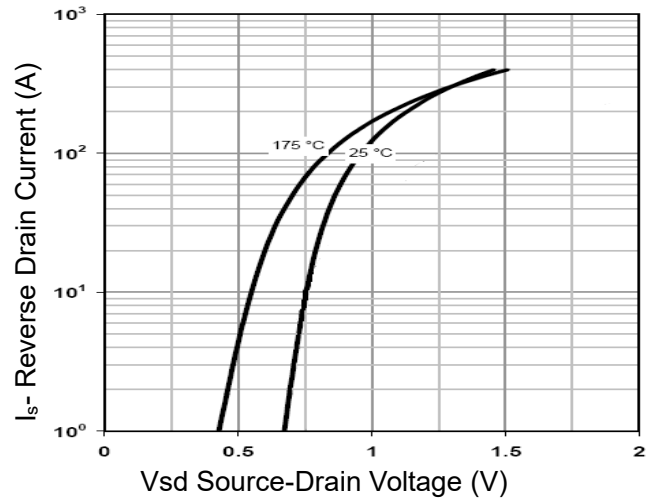


Figure 6 Source- Drain Diode Forward

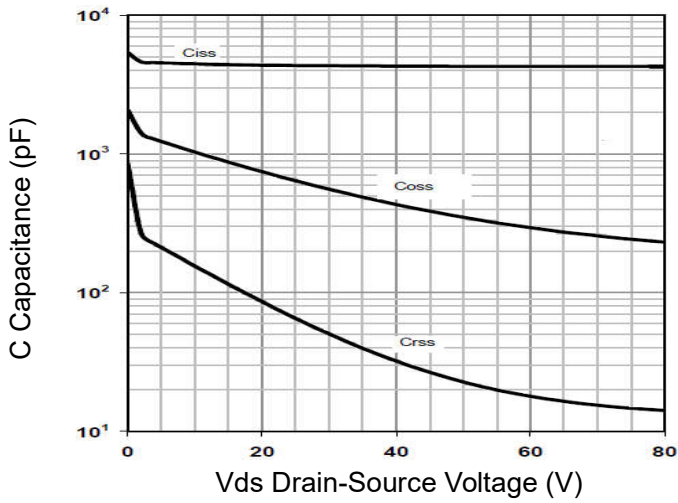


Figure 7 Capacitance vs Vds

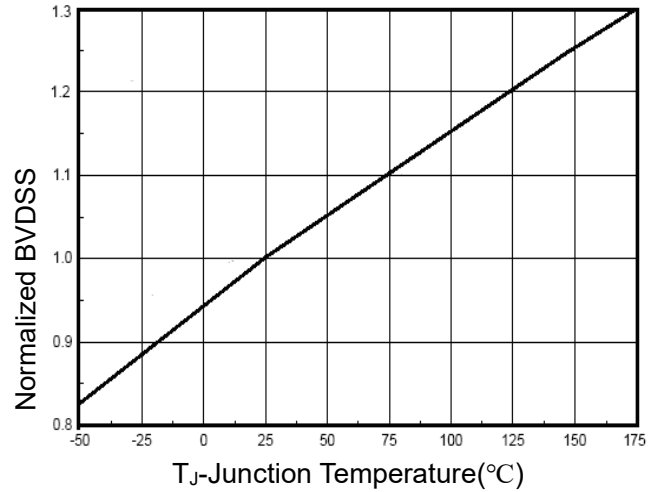


Figure 9  $BV_{DSS}$  vs Junction Temperature

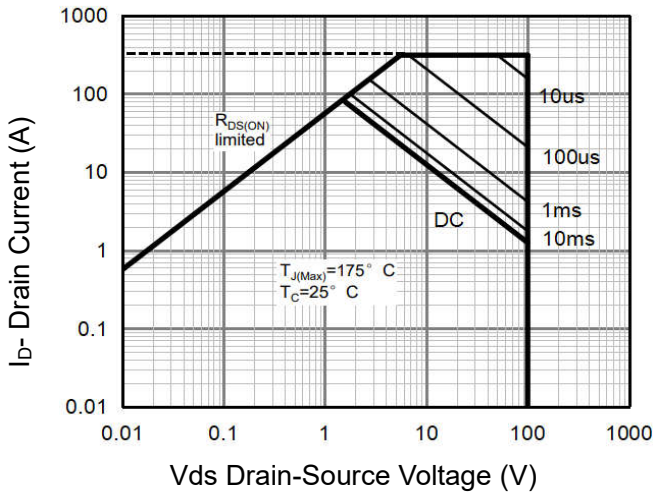


Figure 8 Safe Operation Area (Note3)

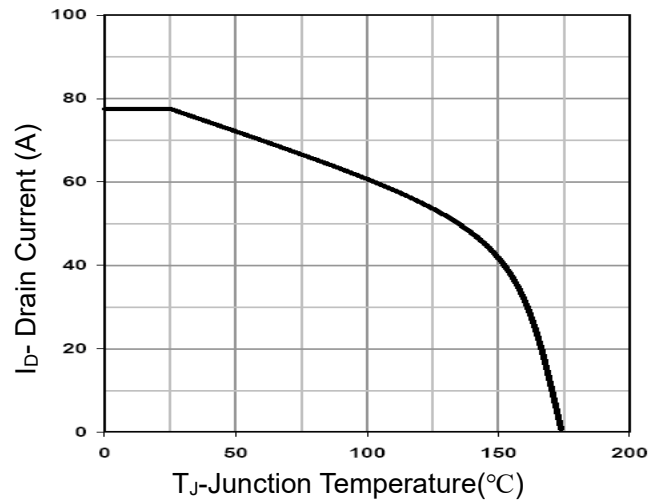


Figure 10 Current De-rating

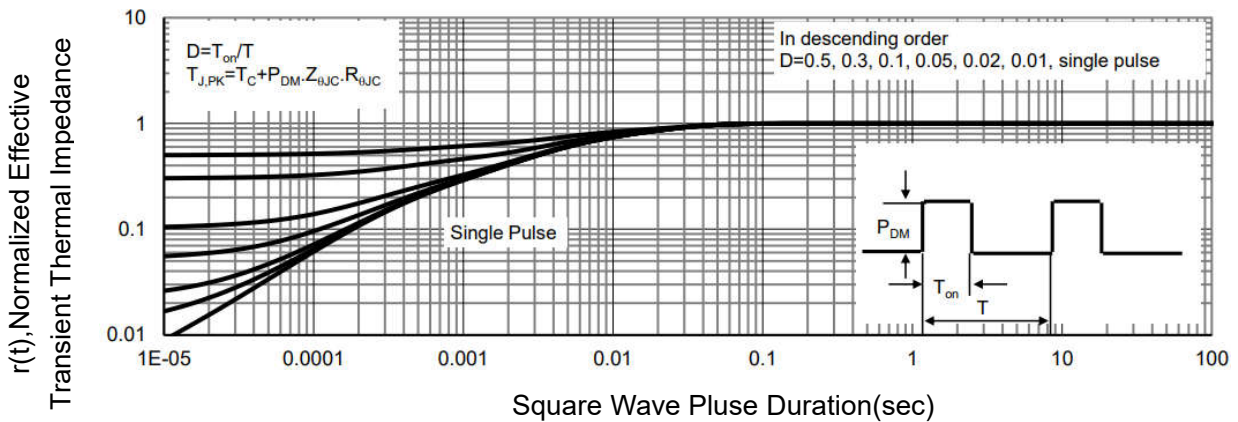
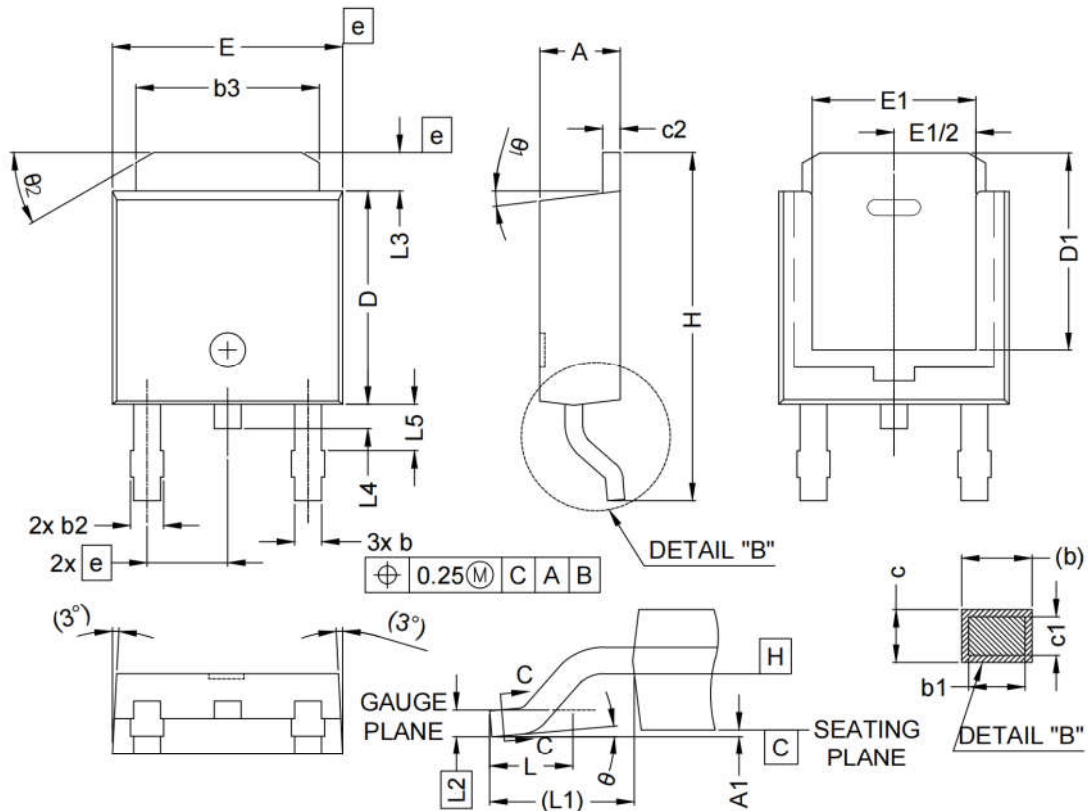


Figure 11 Normalized Maximum Transient Thermal Impedance

## TO-252-2L Package Information



SYMBOL	MIN.	MAX.	SYMBOL	MIN.	MAX.	SYMBOL	MIN.	MAX.
A	2.18	2.39	E	6.35	6.73	$\theta 1$	0°	15°
A1	-	0.13	E1	4.32	-	$\theta 2$	25°	35°
b	0.65	0.89	e	2.29 BSC				
b1	0.64	0.79	H	9.94	10.34			
b2	0.76	1.13	L	1.50	1.78			
b3	4.95	5.46	L1	2.74 REF				
c	0.46	0.61	L2	0.51 BSC				
c1	0.41	0.56	L3	0.89	1.27			
c2	0.46	0.60	L4	-	1.02			
D	5.97	6.22	L5	1.14	1.49			
D1	5.21	-	$\theta$	0°	10°			

NOTE ; 1.0 DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.  
 2.0 ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.  
 3.0 HEAT SINK SIDE FLASH IS MAX. 0.8mm.  
 4.0 RADIUS ON TERMINAL IS OPTIONAL.

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