

## NCE N-Channel Super Junction Power MOSFET (With Fast Body Diode)

### General Description

The series of devices use advanced super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

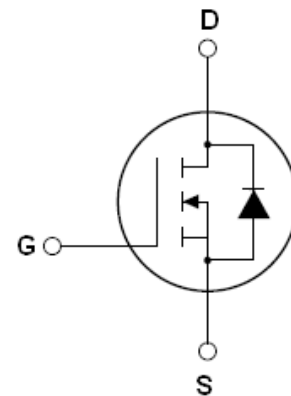
### Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- Intrinsic fast-recovery body diode
- Extreme low reverse recovery charge
- 100% Avalanche Tested
- ROHS compliant

### Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)
- Strongly recommended for bridge topologies

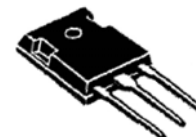
$V_{DS}@T_{jmax}$	560	V
$R_{DS(ON)}$	210	mΩ
$I_D$	20	A



Schematic diagram

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE20NF50T	TO-247	NCE20NF50T



TO-247

Table 1. Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ )

Parameter	Symbol	NCE20NF50T	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	500	V
Gate-Source Voltage ( $V_{DS}=0V$ )	$V_{GS}$	$\pm 30$	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	20	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	12.5	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	60	A
Drain Source voltage slope, $V_{DS} = 400\text{ V}$ , $I_D = 20\text{ A}$ , $T_j = 125^\circ\text{C}$	dv/dt	50	V/ns
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	208	W
Derate above $25^\circ\text{C}$		1.67	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	$E_{AS}$	690	mJ
Avalanche current (Note 1)	$I_{AR}$	20	A
Repetitive Avalanche energy, $t_{AR}$ limited by $T_{jmax}$ (Note 1)	$E_{AR}$	1	mJ

Parameter	Symbol	NCE20NF50T	Unit
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+150	°C

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

Parameter	Symbol	NCE20NF50T	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	0.6	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	°C /W

**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

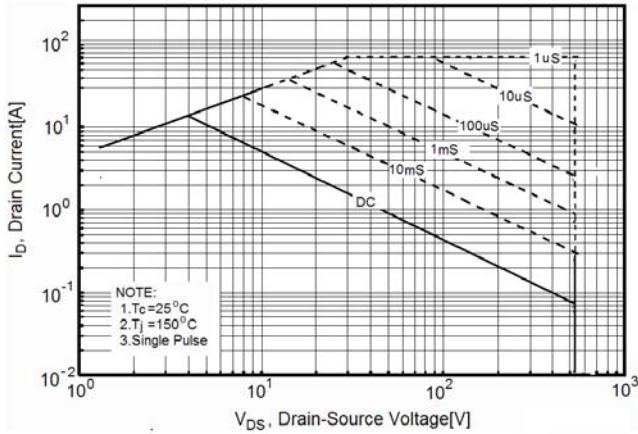
Parameter	Symbol	Condition	Min	Typ	Max	Unit	
<b>On/off states</b>							
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	500			V	
Zero Gate Voltage Drain Current( $T_C=25^\circ C$ )	$I_{DSS}$	$V_{DS}=500V, V_{GS}=0V$			1	$\mu A$	
Zero Gate Voltage Drain Current( $T_C=125^\circ C$ )	$I_{DSS}$	$V_{DS}=500V, V_{GS}=0V$			100	$\mu A$	
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30V, V_{DS}=0V$			$\pm 100$	nA	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3		5	V	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=10A$		180	210	m $\Omega$	
<b>Dynamic Characteristics</b>							
Forward Transconductance	$g_{FS}$	$V_{DS} = 20V, I_D = 10A$		17.5		S	
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		2400		pF	
Output Capacitance	$C_{oss}$			180		pF	
Reverse Transfer Capacitance	$C_{rss}$			5.7		pF	
Total Gate Charge	$Q_g$	$V_{DS}=400V, I_D=20A,$ $V_{GS}=10V$		59		nC	
Gate-Source Charge	$Q_{gs}$			10		nC	
Gate-Drain Charge	$Q_{gd}$			26		nC	
Intrinsic gate resistance	$R_G$	$f = 1 MHz$ open drain		0.9		$\Omega$	
<b>Switching times</b>							
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=20A,$ $R_G=3.6\Omega, V_{GS}=10V$		10		nS	
Turn-on Rise Time	$t_r$			5		nS	
Turn-Off Delay Time	$t_{d(off)}$			50	100	nS	
Turn-Off Fall Time	$t_f$			5	12	nS	
<b>Source- Drain Diode Characteristics</b>							
Source-drain current(Body Diode)	$I_{SD}$	$T_C=25^\circ C$			20	A	
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				60	A	
Forward on voltage	$V_{SD}$	$T_J=25^\circ C, I_{SD}=20A, V_{GS}=0V$		0.9	1.3	V	
Reverse Recovery Time	$t_{rr}$	$T_J=25^\circ C, I_F=20A, di/dt=100A/\mu s$		190		nS	
Reverse Recovery Charge	$Q_{rr}$				1.5		$\mu C$
Peak reverse recovery current	$I_{rrm}$				13		A

Notes 1. Repetitive Rating: Pulse width limited by maximum junction temperature

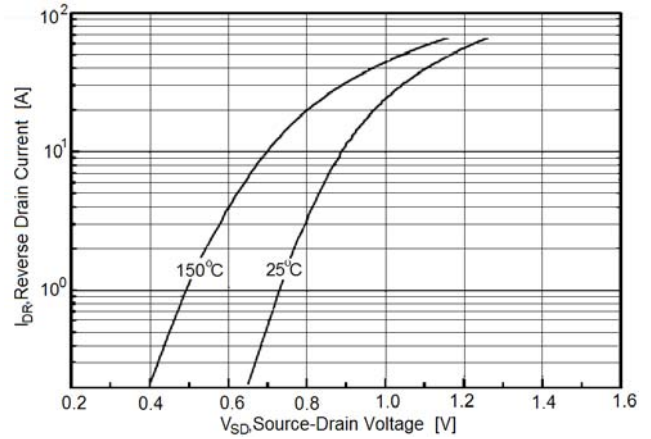
2.  $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

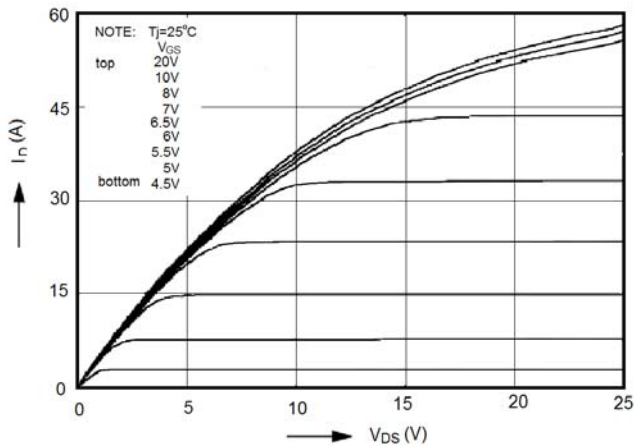
**Figure1. Safe operating area for NCE20NF50T**



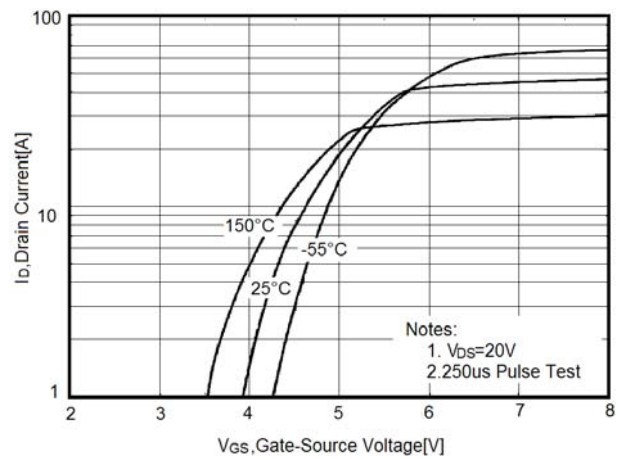
**Figure2. Source-Drain Diode Forward Voltage**



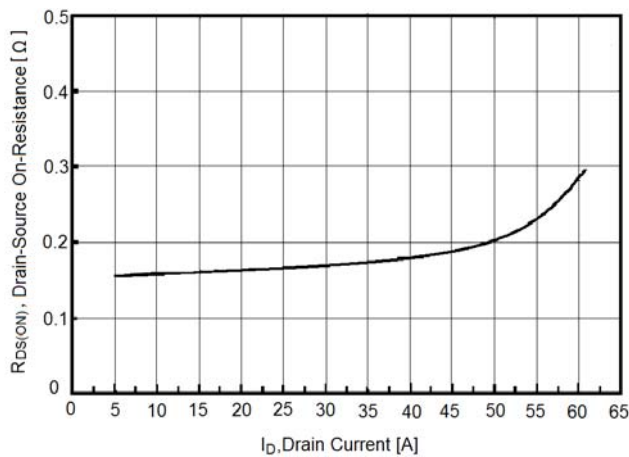
**Figure3. Output characteristics**



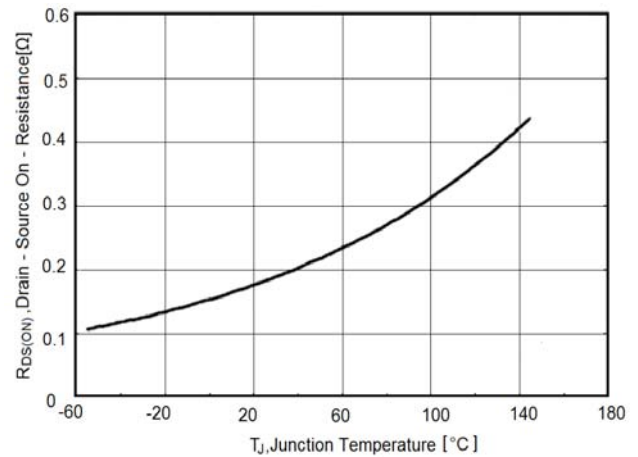
**Figure4. Transfer characteristics**



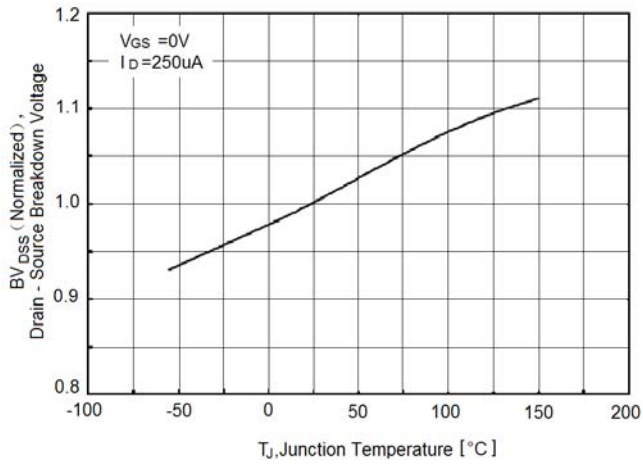
**Figure5. Static drain-source on resistance**



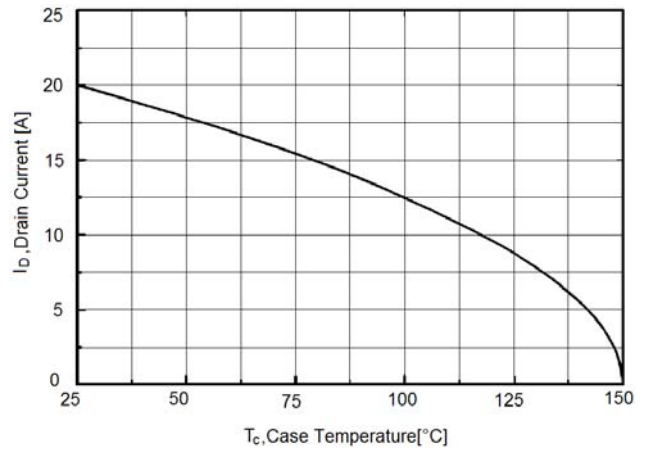
**Figure6. RDS(ON) vs Junction Temperature**



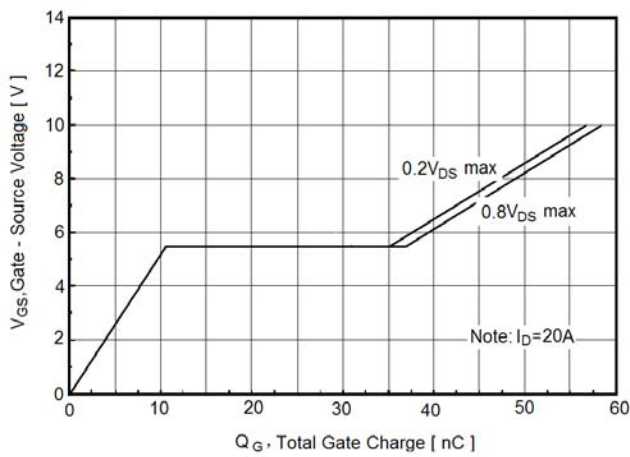
**Figure7.  $BV_{DSS}$  vs Junction Temperature**



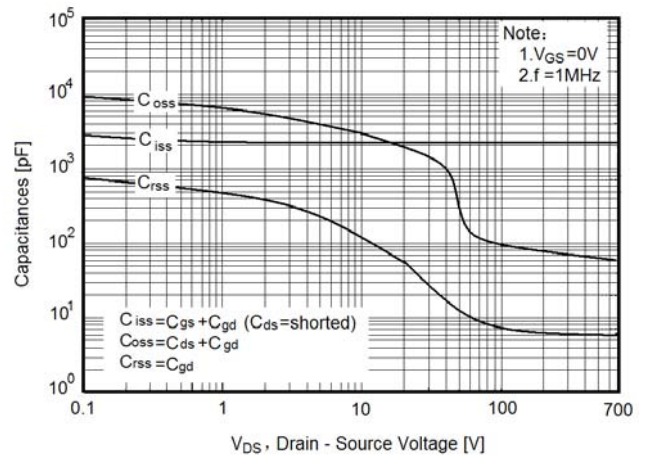
**Figure8. Maximum  $I_D$  vs Junction Temperature**



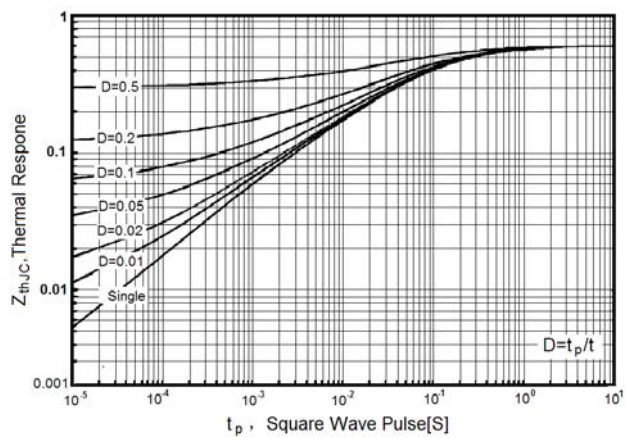
**Figure 9. Gate charge waveforms**



**Figure10. Capacitance**

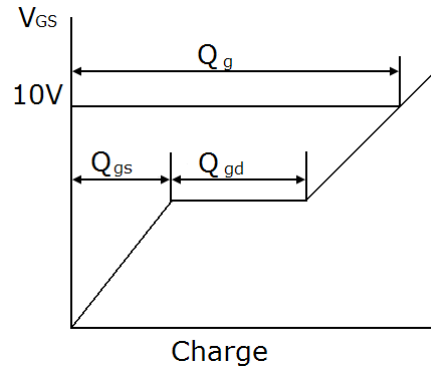
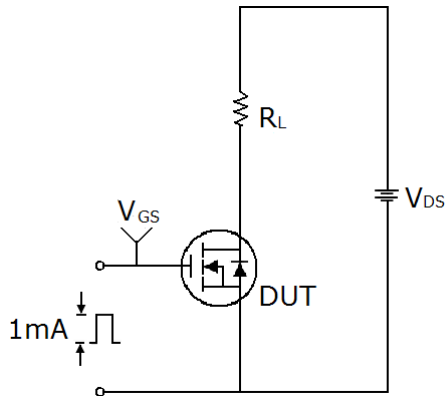


**Figure11. Transient Thermal Impedance**

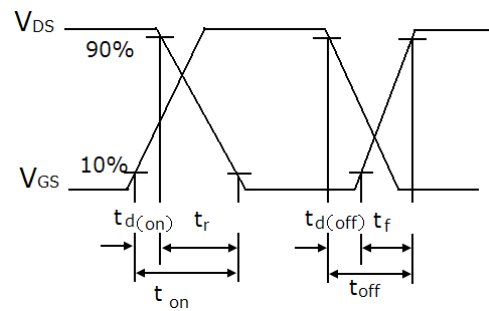
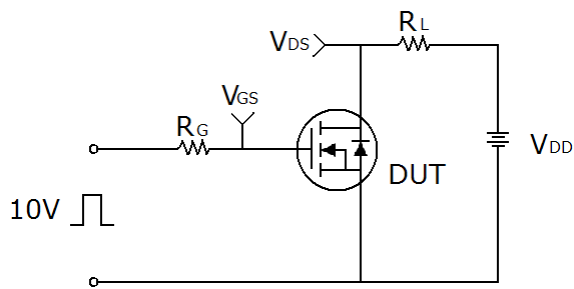


## Test circuit

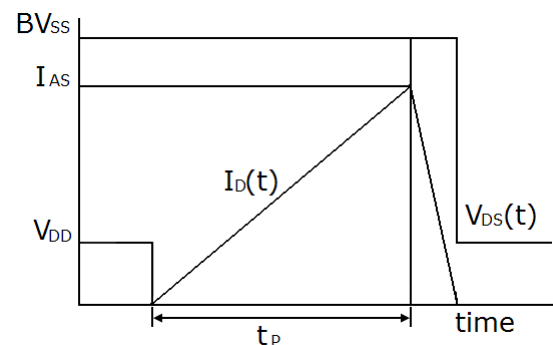
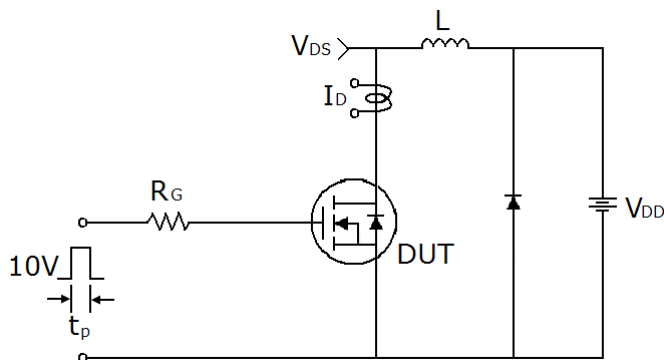
### 1) Gate charge test circuit & Waveform



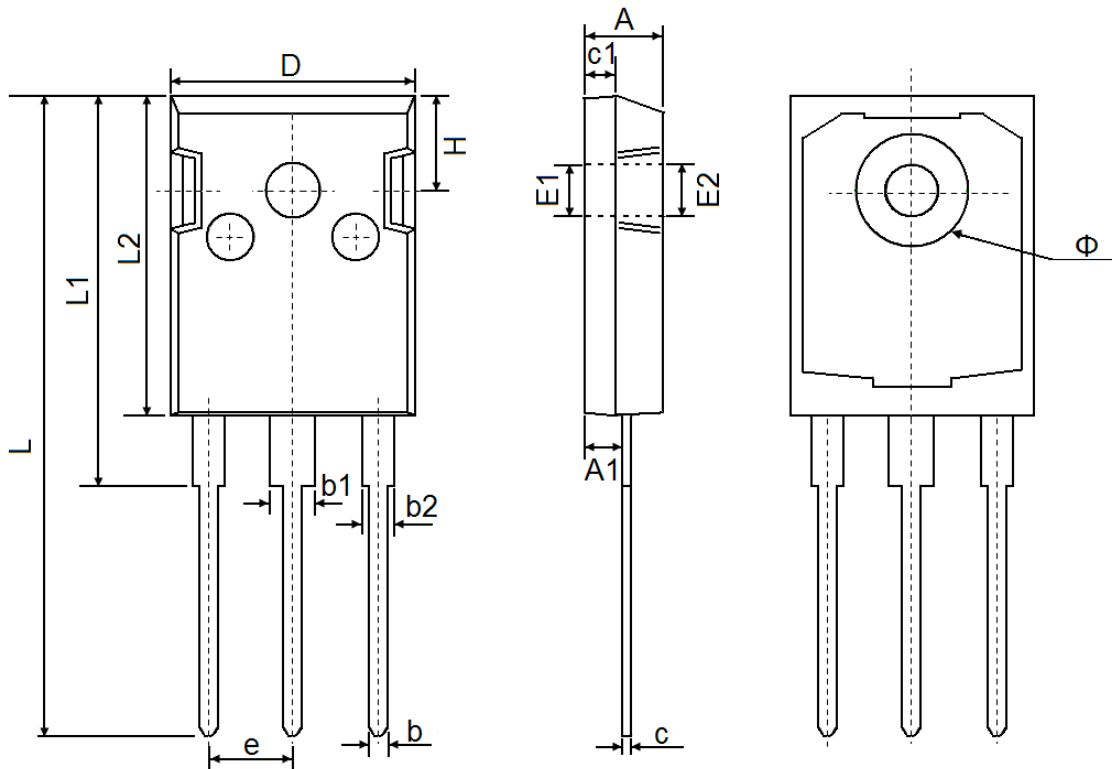
### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms



## TO-247 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.850	5.150	0.191	0.200
A1	2.200	2.600	0.087	0.102
b	1.000	1.400	0.039	0.055
b1	2.800	3.200	0.110	0.126
b2	1.800	2.200	0.071	0.087
c	0.500	0.700	0.020	0.028
c1	1.900	2.100	0.075	0.083
D	15.450	15.750	0.608	0.620
E1	3.500 REF		0.138 REF	
E2	3.600 REF		0.142 REF	
L	40.900	41.300	1.610	1.626
L1	24.800	25.100	0.976	0.988
L2	20.300	20.600	0.799	0.811
Φ	7.100	7.300	0.280	0.287
e	5.450 TYP		0.215 TYP	
H	5.980 REF		0.235 REF	

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