

## CEF9060N

55V ▲ 8.5mΩ ▲ 90A<sup>Note 4</sup> ▲ Si MOSFET

SILICON Si MOSFET ▲ THT type

N-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO220F-3L package ▲ Electrical insulated mounting tab

Super high dense cell density for extremely low  $R_{DS(ON)}$

High power and current handling capability

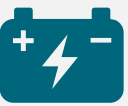




### MAXIMUM RATINGS

Parameter ( $T_C = 25^\circ\text{C}$ , unless otherwise noted)		Characteristics
Drain-Source Voltage	$V_{DS}$	55V
Gate-Source Voltage	$V_{GS}$	$\pm 20\text{V}$
Continuous Drain Current at $T_C = 25^\circ\text{C}$	$I_D$	90A <sup>Note 4</sup>
Pulsed Drain Current <sup>Note 1</sup>	$I_{DM}$ <sup>Note 5</sup>	360A <sup>Note 4</sup>
Maximum Power Dissipation at $T_C = 25^\circ\text{C}$	$P_D$	49W
Power Dissipation Derating above $25^\circ\text{C}$	$\Delta P_D$	0.33W/ $^\circ\text{C}$
Single Pulsed Avalanche Energy <sup>Note 6</sup>	$E_{AS}$	325mJ
Single Pulsed Avalanche Current <sup>Note 6</sup>	$I_{AS}$	50A
Operating and Storage Temperature Range	$T_J, T_{STG}$	$-55^\circ\text{C}$ to $+175^\circ\text{C}$

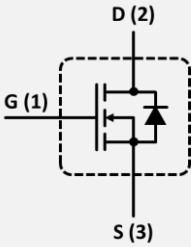
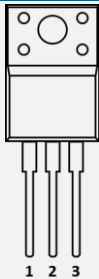
### THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Case	$R_{TH\_JC}$	$3^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{TH\_JA}$	$65^\circ\text{C/W}$

### APPLICATIONS

Battery Management Systems	DC/DC Converter	High Side Switches	Industrial Control	Low Side Switches
				

### PIN DESCRIPTION

Circuit Diagram	Outline - Front View	Pin No.	Description
		1 2 3	Gate Drain Source

## ELECTRICAL CHARACTERISTICS ▲ $T_C = 25^\circ\text{C}$ , unless otherwise noted

Item	Condition	Symbol	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	55			V
Zero Gate Voltage Drain Current	$V_{DS} = 55V, V_{GS} = 0V$	$I_{DSS}$			25	$\mu A$
Gate Body Leakage Current, Forward	$V_{GS} = 20V, V_{DS} = 0V$	$I_{GSSF}$			100	nA
Gate Body Leakage Current, Reverse	$V_{GS} = -20V, V_{DS} = 0V$	$I_{GSSR}$			-100	nA
<b>On Characteristics</b> <sup>Note 2</sup>						
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu A$	$V_{GS(th)}$	2		4	V
Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 62A$	$R_{DS(ON)}$		8.5	10.5	m $\Omega$
Forward Transconductance	$V_{DS} = 25V, I_D = 62A$	$g_{FS}$		30		S
<b>Dynamic Characteristics</b> <sup>Note 3</sup>						
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{ISS}$		3695		pF
Output Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{OSS}$		765		pF
Reverse Transfer Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{RSS}$		60		pF
<b>Switching Characteristics</b> <sup>Note 3</sup>						
Turn-On Delay Time	$V_{DD} = 28V, V_{GS} = 10V, I_D = 62A, R_{G(ext)} = 4.5\Omega$	$t_{D(ON)}$		24	48	ns
Turn-On Rise Time	$V_{DD} = 28V, V_{GS} = 10V, I_D = 62A, R_{G(ext)} = 4.5\Omega$	$t_R$		11.9	23.8	ns
Turn-Off Delay Time	$V_{DD} = 28V, V_{GS} = 10V, I_D = 62A, R_{G(ext)} = 4.5\Omega$	$t_{D(OFF)}$		60	120	ns
Turn-Off Fall Time	$V_{DD} = 28V, V_{GS} = 10V, I_D = 62A, R_{G(ext)} = 4.5\Omega$	$t_F$		19	38	ns
Total Gate Charge	$V_{DS} = 44V, V_{GS} = 10V, I_D = 62A$	$Q_G$		68.1	90.5	nC
Gate Source Charge	$V_{DS} = 44V, V_{GS} = 10V, I_D = 62A$	$Q_{GS}$		12.6		nC
Gate Drain Charge	$V_{DS} = 44V, V_{GS} = 10V, I_D = 62A$	$Q_{GD}$		22.7		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
Drain-Source Diode Forward Current		$I_S$			62	A
Drain-Source Diode Forward Voltage <sup>Note 2</sup>	$V_{GS} = 0V, I_S = 62A$	$V_{SD}$			1.3	V

### Notes

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature.
- 2: Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
- 3: Guaranteed by design, not subject to production testing.
- 4:  $L = 260\mu H$ ,  $I_{AS} = 50A$ ,  $V_{DD} = 24V$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ C$ .
- 5: Limited only by maximum temperature allowed.
- 6: Pulse width limited by safe operating area.

## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

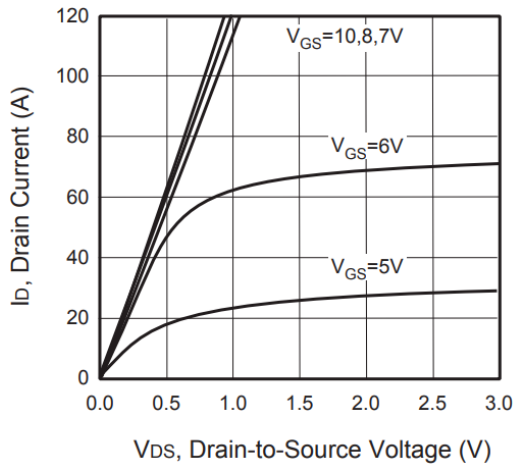


Fig. 2 • Transfer Characteristics

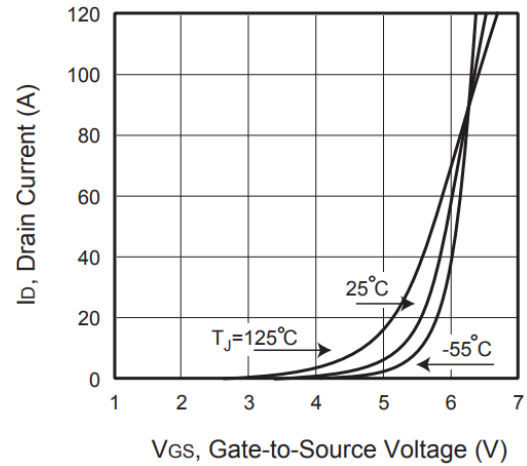


Fig. 3 • Capacitance

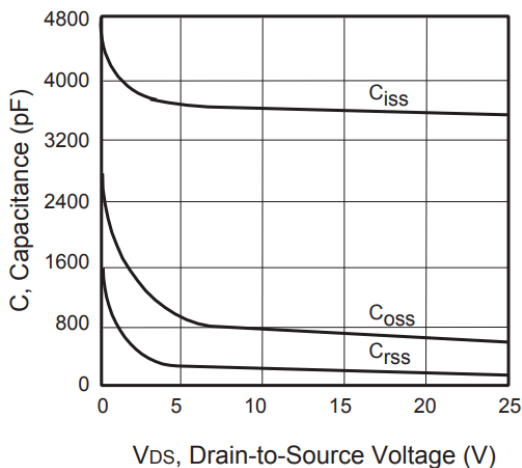


Fig. 4 • On-Resistance Variation with Temperature

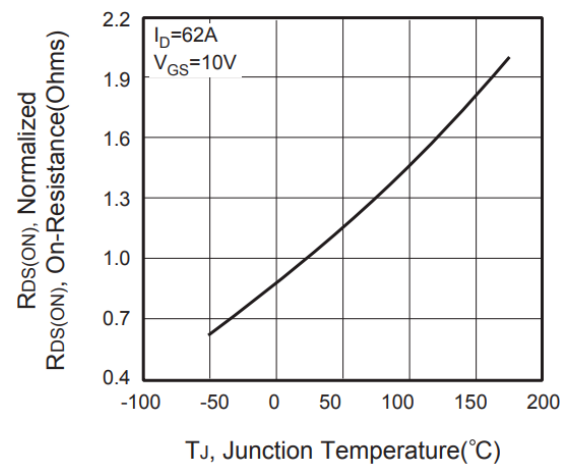


Fig. 5 • Gate Threshold Variation with Temperature

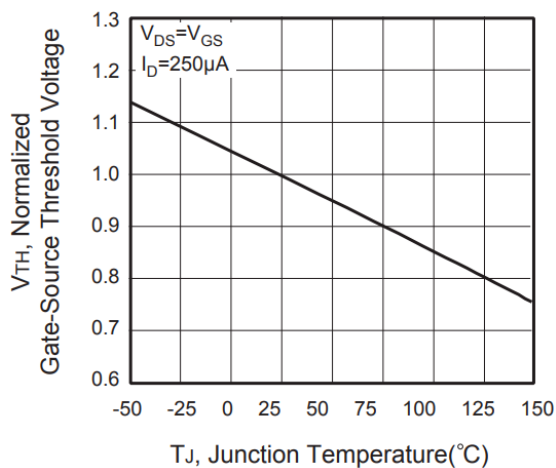
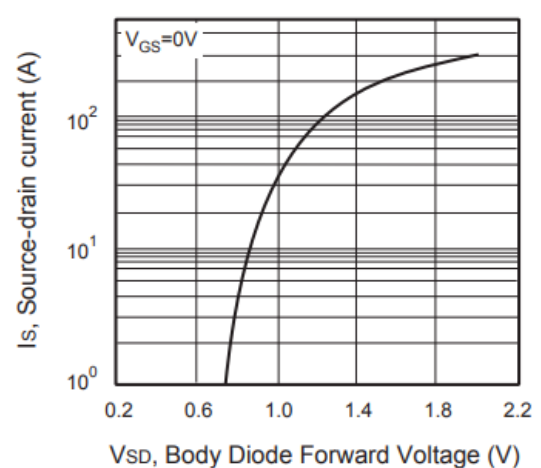


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

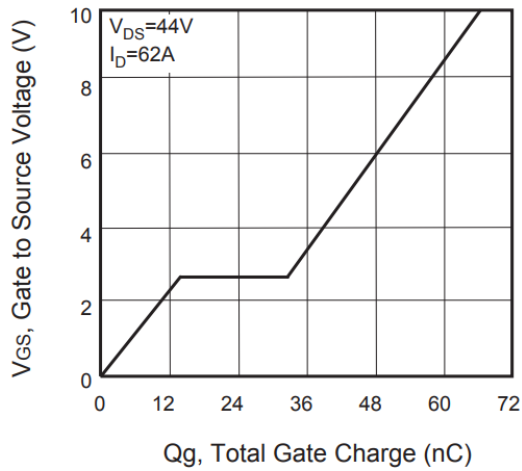


Fig. 8 • Maximum Safe Operating Area

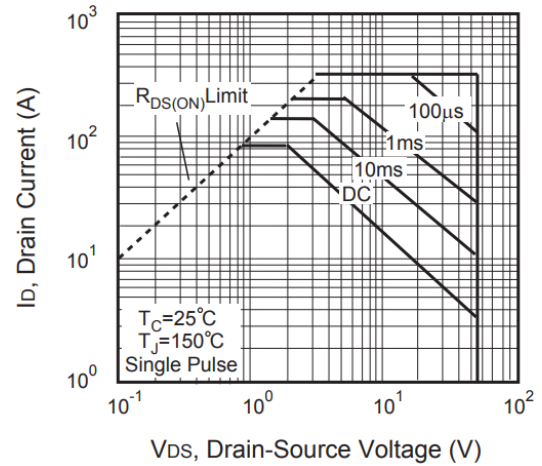


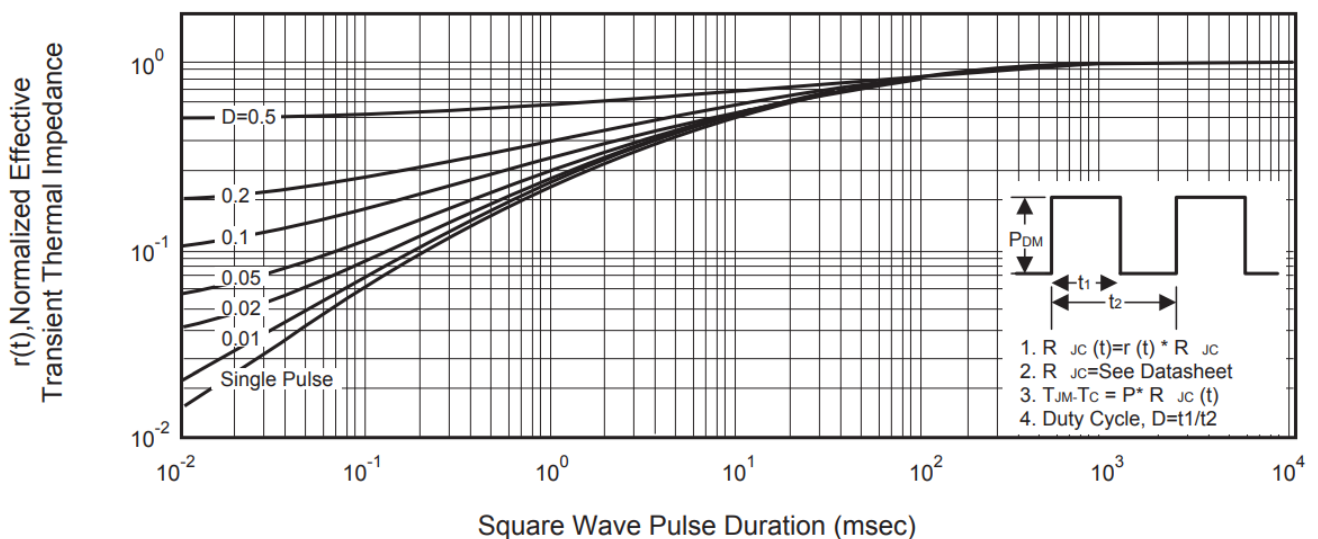
Fig. 9 • Switching Test Circuit



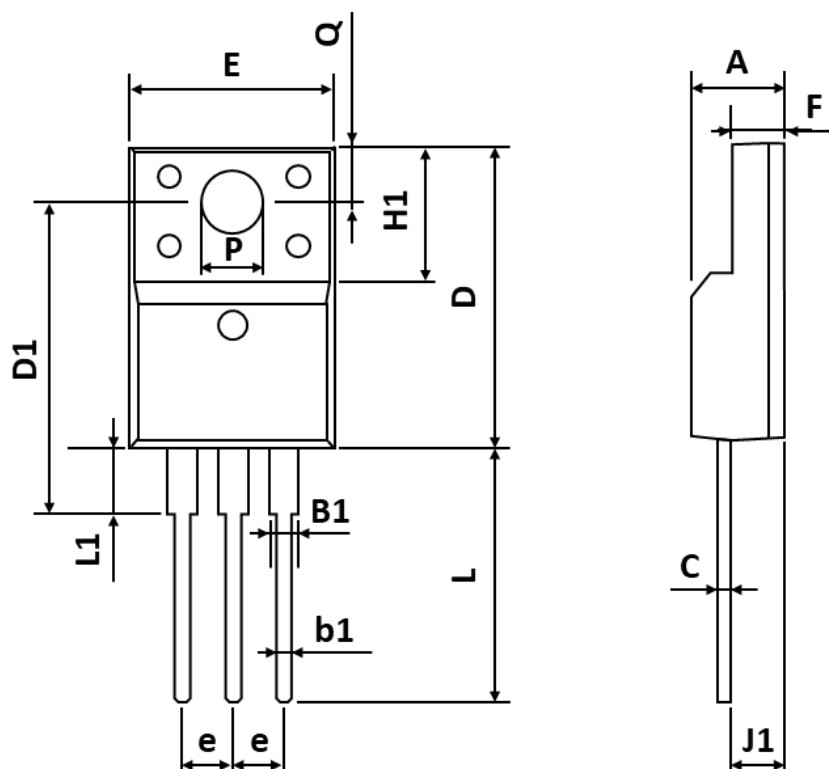
Fig. 10 • Switching Waveforms



Fig. 11 • Normalized Thermal Transient Impedance Curve



## PACKAGE OUTLINE

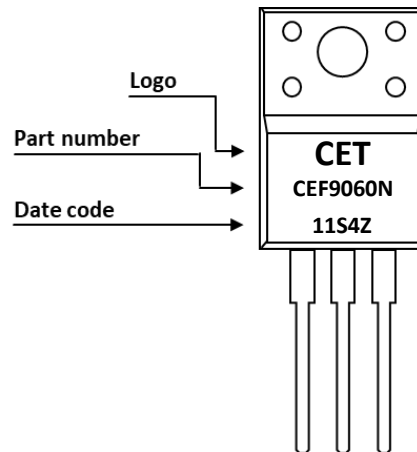


Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	4.500	-	5.000
B1	1.000	-	1.500
b1	0.700	-	0.950
C	0.420	-	0.700
D	15.670	-	16.070
D1	14.800	-	16.000
E	9.960	-	10.360
e	2.340	-	2.740
F	2.340	-	2.740
H1	6.480	-	6.900
J1	2.550	-	2.950
L	12.080	-	13.480
L1	2.230	-	3.650
Q	3.100	-	3.500
P	2.980	-	3.380

## ORDERING INFORMATION

Part Number	Package	Packing	Tube Qty.	Inner Box Qty.	Outer Box Qty.
CEF9060N	TO-220F-3L	Tube	50pcs	1,000pcs	4,000pcs

## PART MARKING



## DATE CODE

Example: 11S4Z



Coding list for „Day“

1	2	3	4	5	6	7	8	9	A
01	02	03	04	05	06	07	08	09	10
B	C	D	E	F	G	H	I	J	K
11	12	13	14	15	16	17	18	19	20
L	M	N	O	P	Q	R	S	T	U
21	22	23	24	25	26	27	28	29	30
V									
31									

Coding list for „Month“

1	2	3	4	5	6
Jan	Feb	Mar	Apr	May	Jun
7	8	9	A	B	C
Jul	Aug	Sep	Oct	Nov	Dec

Coding list for „Year“

0	1	2	3	4
2020	2021	2022	2023	2024
5	6	7	8	9
2025	2026	2027	2028	2029

## RECOMMENDED WAVE SOLDERING PROFILE ▲ THT PACKAGE



### Classification wave soldering profile ▲ Refer to EN 61760-1: 2006

Profile Features		Value ▲ Sn-Pb Assembly	Value ▲ Pb-free Assembly
Preheat temperature min.	$T_{s \min}$	100 °C	100 °C
Preheat temperature typical	$T_{s \text{ typ}}$	120 °C	120 °C
Preheat temperature max.	$T_{s \max}$	130 °C	130 °C
Preheat time $t_s$ from $T_{s \min}$ to $T_{s \max}$	$t_s$	70 seconds	70 seconds
Peak temperature	$T_p$	235 °C to 260 °C	245 °C to 260 °C
Time of actual peak temperature	$t_p$	Max. 10 seconds Max. 5 second each wave	Max. 10 seconds Max. 5 second each wave
Ramp-down rate min.		~ 2 °C/second	~ 2 °C/second
Ramp-down rate typical		~ 3.5 °C/second	~ 3.5 °C/second
Ramp-down rate max.		~ 5 °C/second	~ 5 °C/second
Time 25°C to 25°C		4 minutes	4 minutes

## REVISION TABLE

Revision	Date	Status	Notes
001	30/09/2022	Initial release	Initial publication

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