



# CEP12N65

650V ▲ 610mΩ ▲ 12A ▲ Si MOSFET

SILICON Si MOSFET ▲ THT type

N-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO220-3L package

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

**High power and current handling capability**



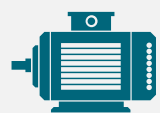




## MAXIMUM RATINGS

Parameter ( $T_C = 25^\circ\text{C}$ , unless otherwise noted)		Characteristics
Drain-Source Voltage	$V_{DS}$	650V
Gate-Source Voltage	$V_{GS}$	$\pm 30\text{V}$
Continuous Drain Current at $T_C = 25^\circ\text{C}$	$I_D$	12A
Pulsed Drain Current <sup>Note 1</sup>	$I_{DM}$ <sup>Note 5</sup>	48A
Maximum Power Dissipation at $T_C = 25^\circ\text{C}$	$P_D$	250W
Power Dissipation Derating above $25^\circ\text{C}$	$\Delta P_D$	$1.67\text{W}/^\circ\text{C}$
Single Pulsed Avalanche Energy <sup>Note 6</sup>	$E_{AS}$	607mJ
Single Pulsed Avalanche Current <sup>Note 6</sup>	$I_{AS}$	4.5A
Operating and Storage Temperature Range	$T_J, T_{STG}$	$-55^\circ\text{C}$ to $+175^\circ\text{C}$

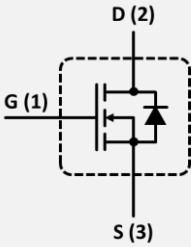
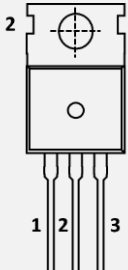
## THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Case	$R_{TH\_JC}$	$0.6^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{TH\_JA}$	$62.5^\circ\text{C}/\text{W}$

## APPLICATIONS

EV Charging	Industrial Inverters	Motors & Drives	Power Factor Correction	Renewable Energy	SMPS	UPS
						

## 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	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	650			V
Zero Gate Voltage Drain Current	$V_{DS} = 650V, V_{GS} = 0V$	$I_{DSS}$			1	$\mu A$
Gate Body Leakage Current, Forward	$V_{GS} = 30V, V_{DS} = 0V$	$I_{GSSF}$			100	nA
Gate Body Leakage Current, Reverse	$V_{GS} = -30V, V_{DS} = 0V$	$I_{GSSR}$			-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	$V_{GS} = 10V, I_D = 5.5A$	$R_{DS(ON)}$		610	730	m $\Omega$
<b>Dynamic Characteristics</b> <sup>Note 3</sup>						
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{ISS}$		1745		pF
Output Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{OSS}$		205		pF
Reverse Transfer Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{RSS}$		20		pF
<b>Switching Characteristics</b> <sup>Note 3</sup>						
Turn-On Delay Time	$V_{DD} = 300V, V_{GS} = 10V, I_D = 12A, R_{G(ext)} = 25\Omega$	$t_{D(ON)}$		31		ns
Turn-On Rise Time	$V_{DD} = 300V, V_{GS} = 10V, I_D = 12A, R_{G(ext)} = 25\Omega$	$t_R$		129		ns
Turn-Off Delay Time	$V_{DD} = 300V, V_{GS} = 10V, I_D = 12A, R_{G(ext)} = 25\Omega$	$t_{D(OFF)}$		106		ns
Turn-Off Fall Time	$V_{DD} = 300V, V_{GS} = 10V, I_D = 12A, R_{G(ext)} = 25\Omega$	$t_F$		63		ns
Total Gate Charge	$V_{DS} = 400V, V_{GS} = 10V, I_D = 12A$	$Q_G$		45		nC
Gate Source Charge	$V_{DS} = 400V, V_{GS} = 10V, I_D = 12A$	$Q_{GS}$		8		nC
Gate Drain Charge	$V_{DS} = 400V, V_{GS} = 10V, I_D = 12A$	$Q_{GD}$		21		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
Drain-Source Diode Forward Current		$I_S$			12	A
Drain-Source Diode Forward Voltage <sup>Note 2</sup>	$V_{GS} = 0V, I_S = 12A$	$V_{SD}$			1.4	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: Limited only by maximum temperature allowed.
- 5: Pulse width limited by safe operating area.
- 6:  $L = 60mH, I_{AS} = 4.5A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

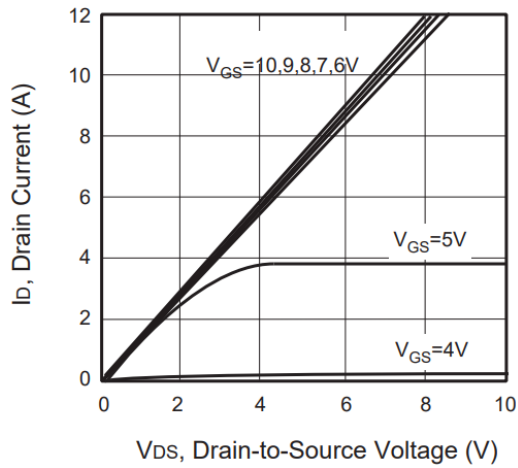


Fig. 2 • Transfer Characteristics

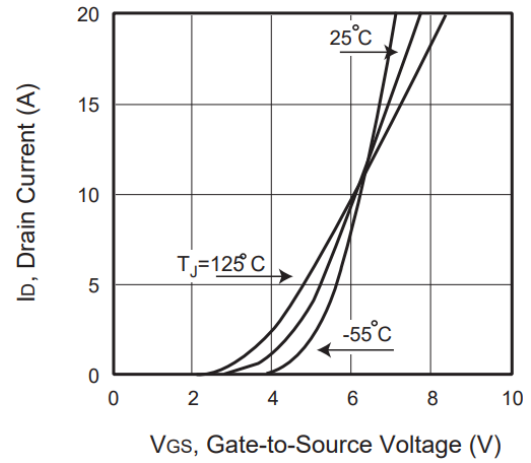


Fig. 3 • Capacitance

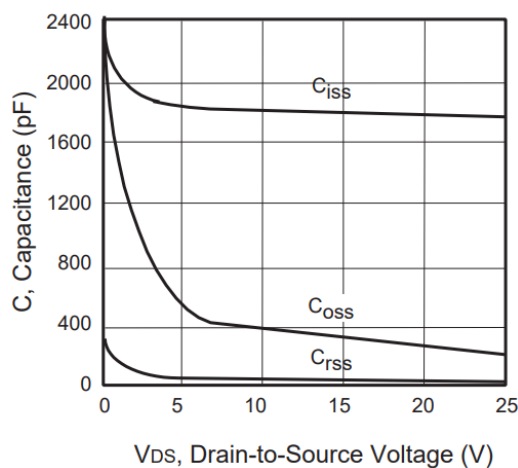


Fig. 4 • On-Resistance Variation with Temperature

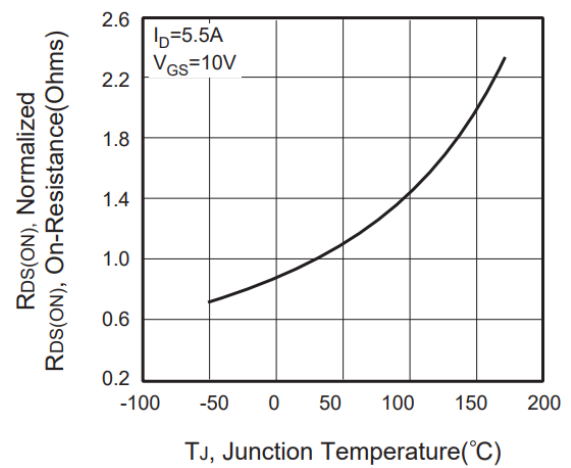


Fig. 5 • Gate Threshold Variation with Temperature

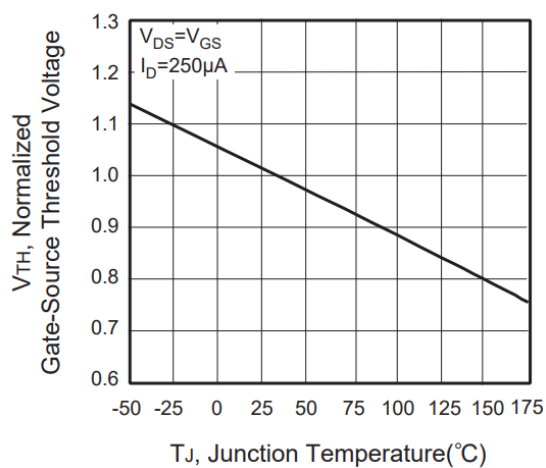
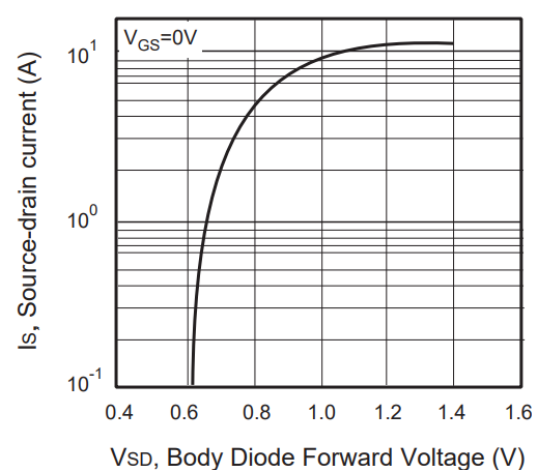


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

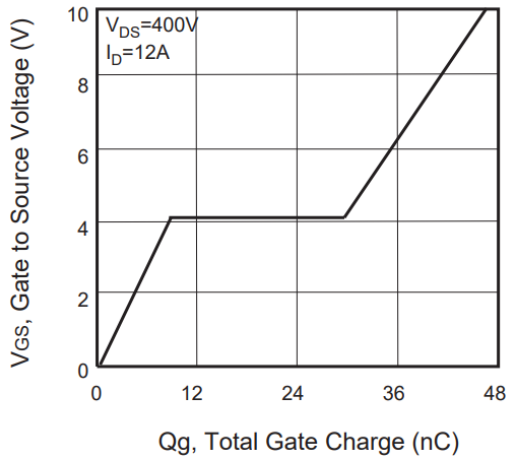


Fig. 8 • Maximum Safe Operating Area

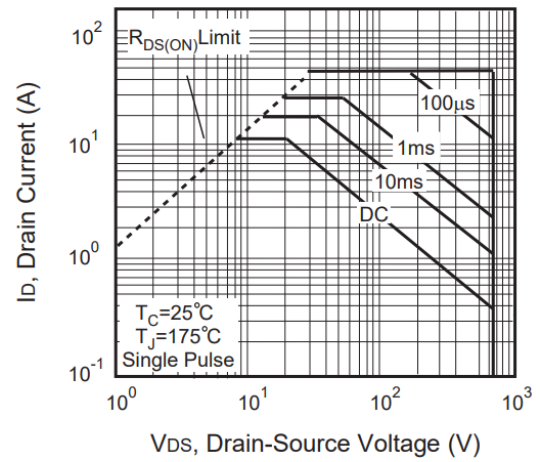


Fig. 9 • Switching Test Circuit



Fig. 10 • Switching Waveforms

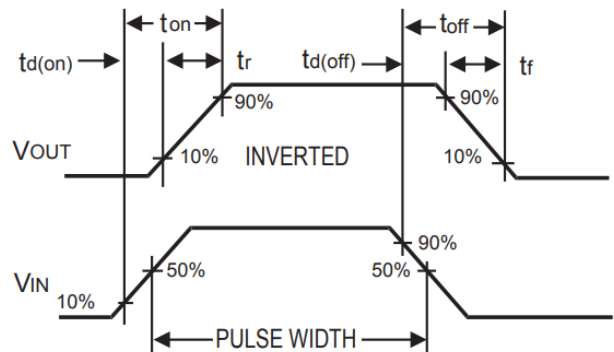
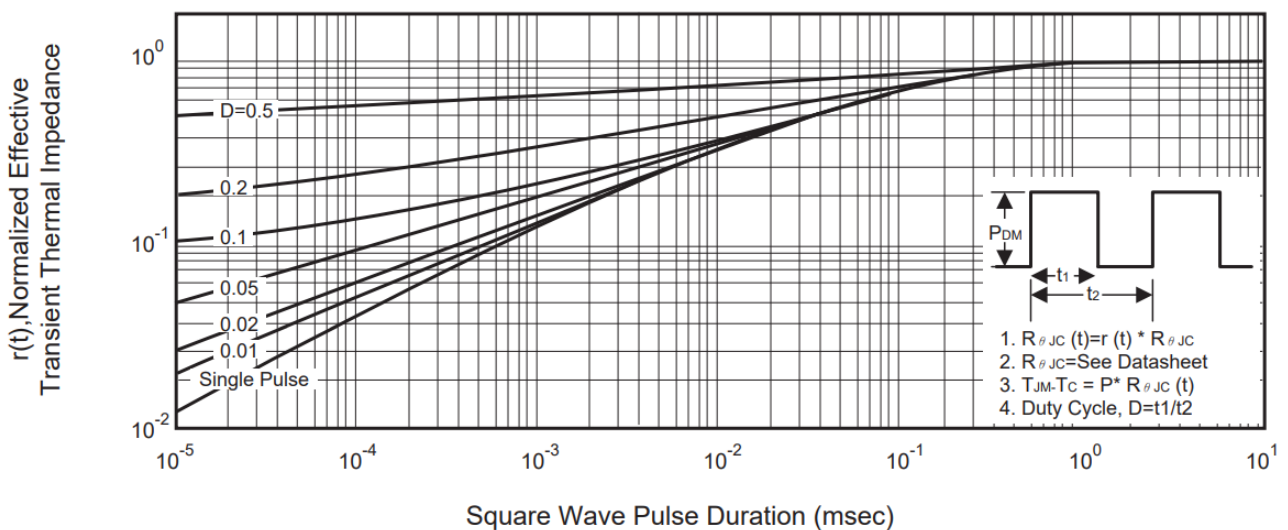


Fig. 11 • Normalized Thermal Transient Impedance Curve



## PACKAGE OUTLINE

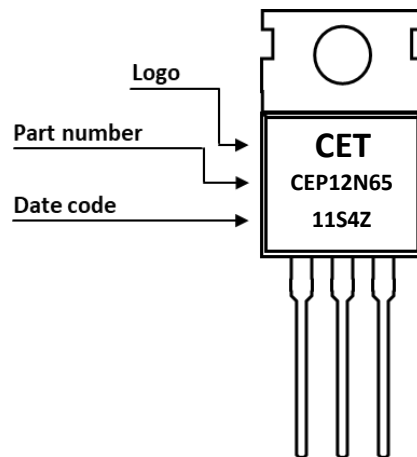


Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	4.43	4.53	4.63
A1	2.30	2.40	2.50
A2	7.70	7.90	8.10
B	9.80	10.00	10.20
C	1.25	1.30	1.40
C1	0.45	0.50	0.60
D	3.45	3.60	3.70
E	2.45	2.54	2.60
F	0.70	0.80	0.95
F1	1.15	1.33	1.50
L	26.80	28.80	30.80
L1	9.20	9.30	9.40
L2	12.80	13.10	13.40
L3	2.70	2.80	2.90
L4	3.50	3.70	3.80
L5	2.60	2.90	3.20
L6	15.40	15.80	16.20
L7	6.20	6.50	6.80
H	12.95	13.25	13.55

## ORDERING INFORMATION

Part Number	Package	Packing	Tube Qty.	Inner Box Qty.	Outer Box Qty.
CEP12N65	TO-220-3L	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	$T_{s\ typ}$	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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