

CEF13N65S

650V ▲ 270mΩ ▲ 13.8A^{Note 4} ▲ 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}	650V
Gate-Source Voltage	V_{GS}	$\pm 30\text{V}$
Continuous Drain Current at $T_C = 25^\circ\text{C}$	I_D	13.8A ^{Note 4}
Continuous Drain Current at $T_C = 100^\circ\text{C}$	I_D	6.2A ^{Note 4}
Pulsed Drain Current ^{Note 1}	I_{DM} ^{Note 5}	55.2A ^{Note 4}
Maximum Power Dissipation at $T_C = 25^\circ\text{C}$	P_D	60W
Power Dissipation Derating above 25°C	ΔP_D	0.48W/ $^\circ\text{C}$
Single Pulsed Avalanche Energy ^{Note 6}	E_{AS}	306mJ
Single Pulsed Avalanche Current ^{Note 6}	I_{AS}	3.5A
Operating and Storage Temperature Range	T_J, T_{STG}	-55°C to $+150^\circ\text{C}$

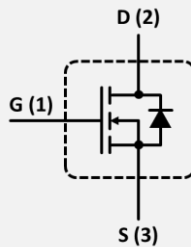
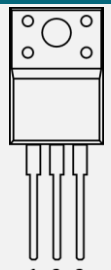
THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Case	R_{TH_JC}	2.1 $^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	R_{TH_JA}	65 $^\circ\text{C}/\text{W}$

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
Off Characteristics						
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	μA
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
On Characteristics ^{Note 2}						
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu A$	$V_{GS(th)}$	2.5		4.5	V
Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 6A$	$R_{DS(ON)}$		270	320	m Ω
Dynamic Characteristics ^{Note 3}						
Input Capacitance	$V_{DS} = 150V, V_{GS} = 0V, f = 1MHz$	C_{ISS}		910		pF
Output Capacitance	$V_{DS} = 150V, V_{GS} = 0V, f = 1MHz$	C_{OSS}		60		pF
Reverse Transfer Capacitance	$V_{DS} = 150V, V_{GS} = 0V, f = 1MHz$	C_{RSS}		15		pF
Switching Characteristics ^{Note 3}						
Turn-On Delay Time	$V_{DD} = 400V, V_{GS} = 10V, I_D = 6A, R_{G(ext)} = 10\Omega$	$t_{D(ON)}$		30		ns
Turn-On Rise Time	$V_{DD} = 400V, V_{GS} = 10V, I_D = 6A, R_{G(ext)} = 10\Omega$	t_R		13		ns
Turn-Off Delay Time	$V_{DD} = 400V, V_{GS} = 10V, I_D = 6A, R_{G(ext)} = 10\Omega$	$t_{D(OFF)}$		65		ns
Turn-Off Fall Time	$V_{DD} = 400V, V_{GS} = 10V, I_D = 6A, R_{G(ext)} = 10\Omega$	t_F		11		ns
Total Gate Charge	$V_{DS} = 400V, V_{GS} = 10V, I_D = 1A$	Q_G		25		nC
Gate Source Charge	$V_{DS} = 400V, V_{GS} = 10V, I_D = 1A$	Q_{GS}		4		nC
Gate Drain Charge	$V_{DS} = 400V, V_{GS} = 10V, I_D = 1A$	Q_{GD}		10		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Current		I_S			8.6	A
Drain-Source Diode Forward Voltage	$V_{GS} = 0V, I_S = 8.6A$	V_{SD}			1.2	V
Reverse Recovery Time	$I_D = 6A, di/dt = 100A/\mu s$	t_{RR}		240		ns
Reverse Recovery Charge	$I_D = 6A, di/dt = 100A/\mu s$	Q_{RR}		2.35		μC
Peak Reverse Recovery Current	$I_D = 6A, di/dt = 100A/\mu s$	I_{RR}		16.8		A

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: $L = 50mH, I_{AS} = 3.5A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^\circ C$

REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

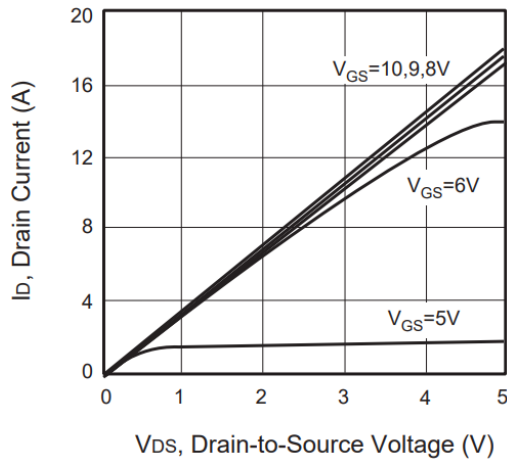


Fig. 2 • Transfer Characteristics

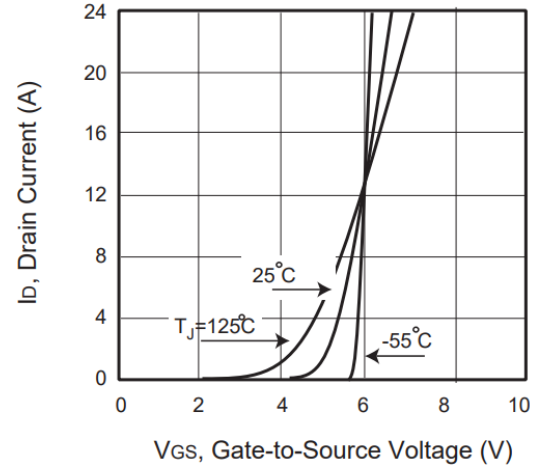


Fig. 3 • Capacitance

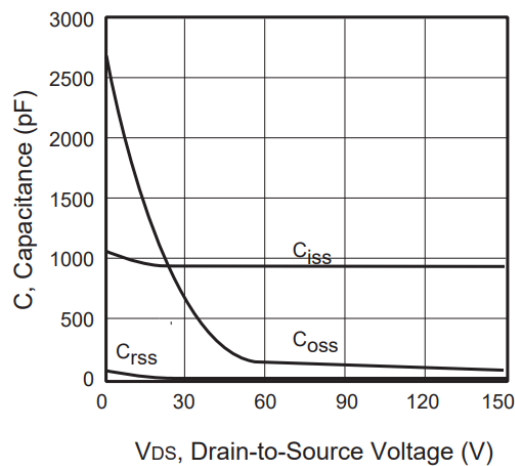


Fig. 4 • On-Resistance Variation with Temperature

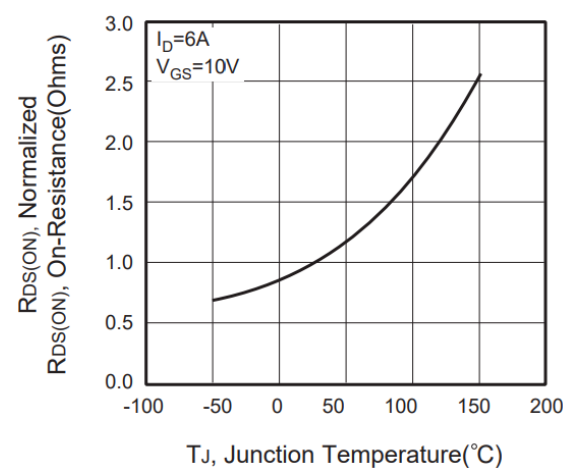


Fig. 5 • Gate Threshold Variation with Temperature

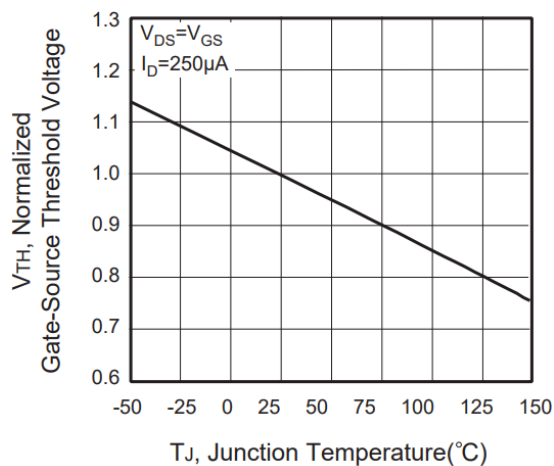
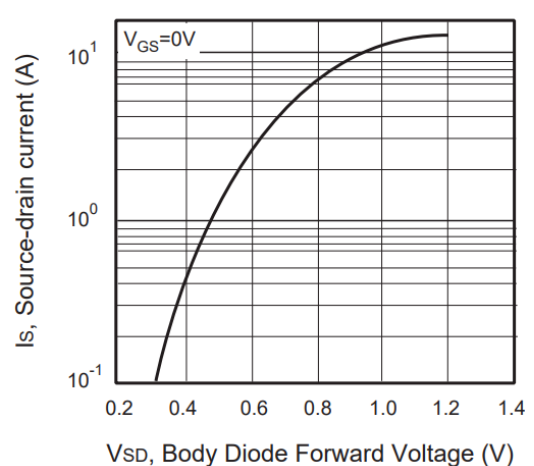


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

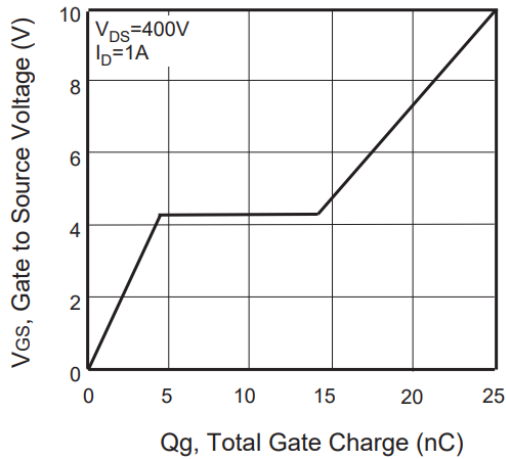


Fig. 8 • Maximum Safe Operating Area

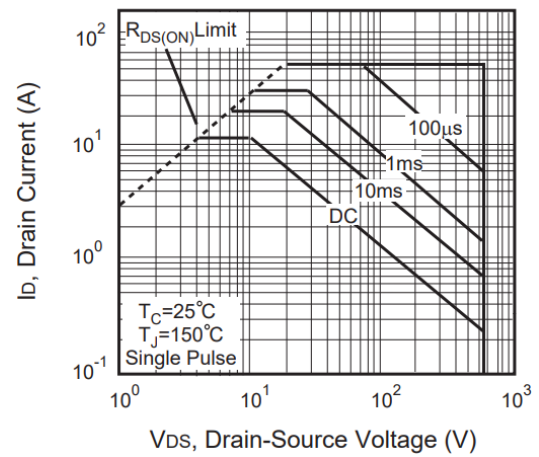


Fig. 9 • Breakdown Voltage Variation vs. Temperature

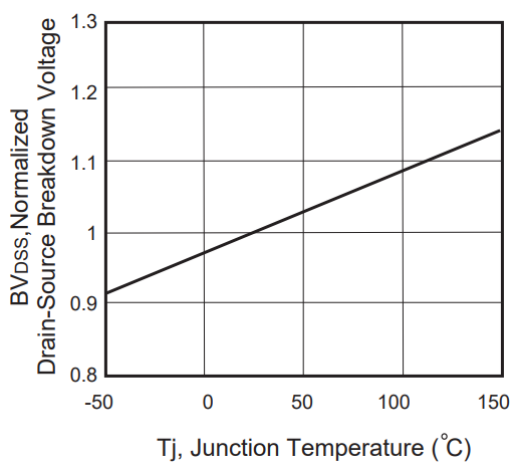


Fig. 10 • Switching Test Circuit

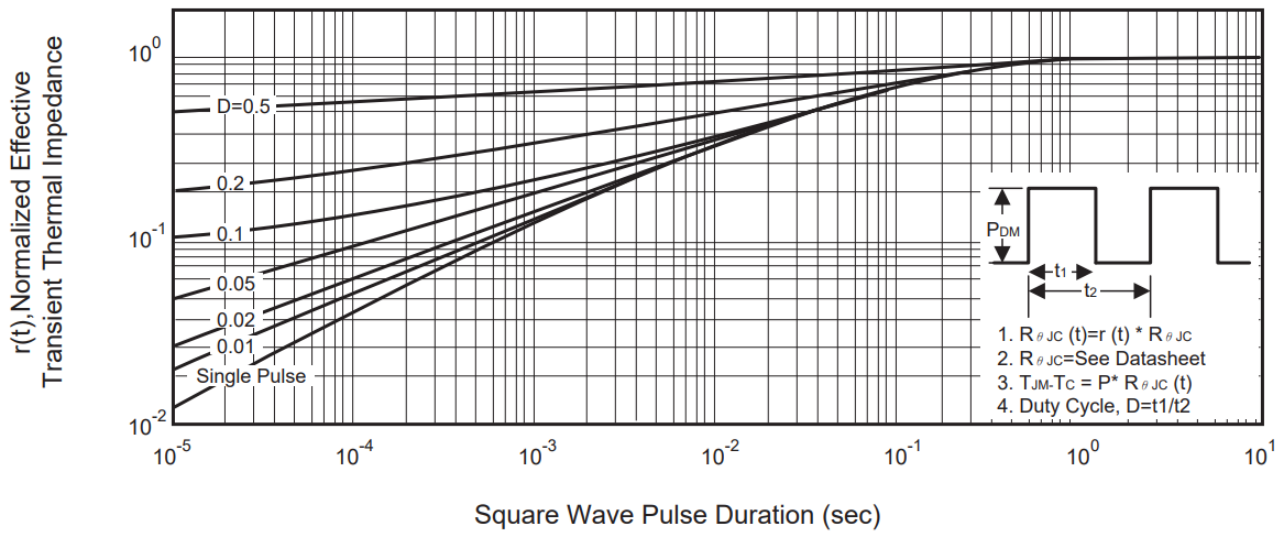


Fig. 11 • Switching Waveforms

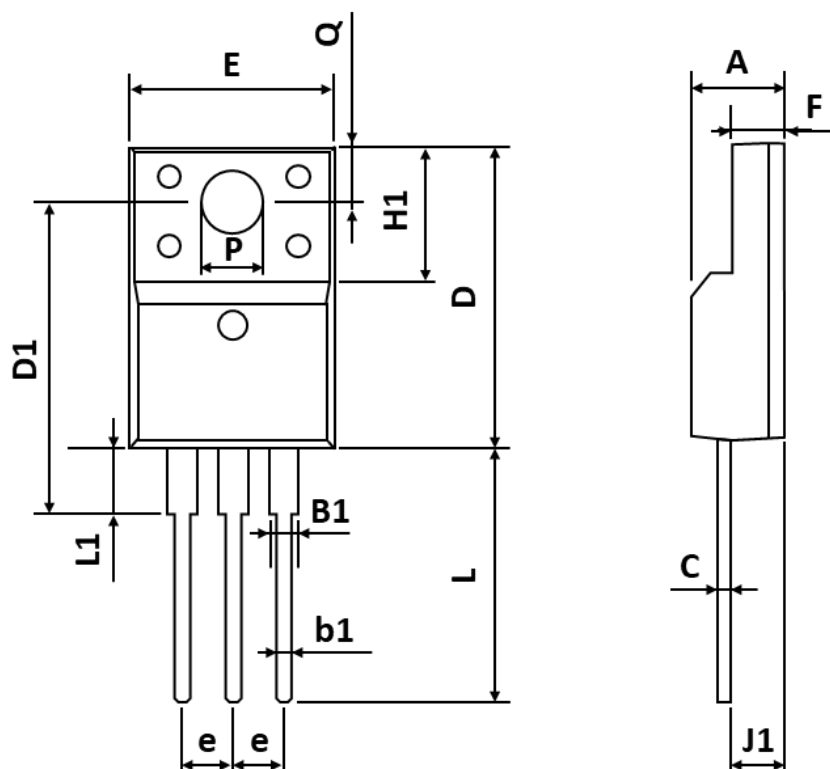


REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 12 • Normalized Thermal Transient Impedance Curve



PACKAGE OUTLINE

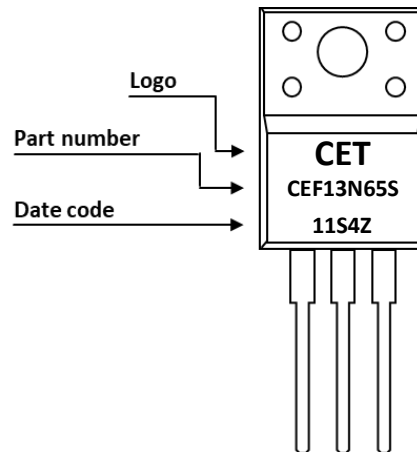


Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	4.500	-	5.000
B1	1.000	-	1.500
b1	0.700	-	0.950
C	0.420	-	0.700
D	15.670	-	16.070
D1	14.800	-	16.000
E	9.960	-	10.360
e	2.340	-	2.740
F	2.340	-	2.740
H1	6.480	-	6.900
J1	2.550	-	2.950
L	12.080	-	13.480
L1	2.230	-	3.650
Q	3.100	-	3.500
P	2.980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

ORDERING INFORMATION

Part Number	Package	Packing	Tube Qty.	Inner Box Qty.	Outer Box Qty.
CEF13N65S	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	$T_{s\ typ}$	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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