



CED6196

60V ▲ 20mΩ ▲ 28.8A ▲ Si MOSFET

SILICON Si MOSFET ▲ THT type

N-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO251 (E-PAK) 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}	60V
Gate-Source Voltage	V_{GS}	$\pm 20\text{V}$
Continuous Drain Current at $T_C = 25^\circ\text{C}$	I_D	28.8A
Continuous Drain Current at $T_C = 100^\circ\text{C}$	I_D	18A
Pulsed Drain Current ^{Note 1}	I_{DM}	115A
Maximum Power Dissipation at $T_C = 25^\circ\text{C}$	P_D	35.7W
Power Dissipation Derating above 25°C	ΔP_D	$0.28\text{W}/^\circ\text{C}$
Single Pulsed Avalanche Energy ^{Note 5}	E_{AS}	50mJ
Single Pulsed Avalanche Current ^{Note 5}	I_{AS}	10A
Operating and Storage Temperature Range	T_J, T_{STG}	-55°C to $+150^\circ\text{C}$

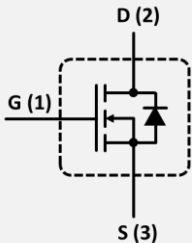
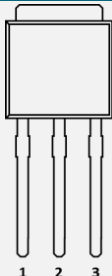
THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Case	R_{TH_JC}	$3.5^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient ^{Note 2}	R_{TH_JA}	$50^\circ\text{C}/\text{W}$

APPLICATIONS

Battery Management Systems	DC/DC Converter	DC Fan	Industrial Control	Power 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
Off Characteristics						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	BV_{DSS}	60			V
Zero Gate Voltage Drain Current	$V_{DS} = 60V, V_{GS} = 0V$	I_{DSS}			1	μA
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
On Characteristics ^{Note 3}						
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu A$	$V_{GS(th)}$	1		3	V
Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 19A$	$R_{DS(ON)}$		20	24	m Ω
Static Drain-Source On-Resistance	$V_{GS} = 4.5V, I_D = 10A$	$R_{DS(ON)}$		23	30	m Ω
Dynamic Characteristics ^{Note 4}						
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	C_{ISS}		1465		pF
Output Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	C_{OSS}		80		pF
Reverse Transfer Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	C_{RSS}		70		pF
Switching Characteristics ^{Note 4}						
Turn-On Delay Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 20A, R_{G(ext)} = 4.7\Omega$	$t_{D(ON)}$		15		ns
Turn-On Rise Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 20A, R_{G(ext)} = 4.7\Omega$	t_R		4		ns
Turn-Off Delay Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 20A, R_{G(ext)} = 4.7\Omega$	$t_{D(OFF)}$		37		ns
Turn-Off Fall Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 20A, R_{G(ext)} = 4.7\Omega$	t_F		5		ns
Total Gate Charge	$V_{DS} = 48V, V_{GS} = 4.5V, I_D = 20A$	Q_G		13.5		nC
Gate Source Charge	$V_{DS} = 48V, V_{GS} = 4.5V, I_D = 20A$	Q_{GS}		3.6		nC
Gate Drain Charge	$V_{DS} = 48V, V_{GS} = 4.5V, I_D = 20A$	Q_{GD}		8.6		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Current		I_S			28.8	A
Drain-Source Diode Forward Voltage ^{Note 3}	$V_{GS} = 0V, I_S = 28A$	V_{SD}			1.2	V

Notes

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature.
- 2: Device mounted on FR4 board, $t \leq 10$ sec.
- 3: Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
- 4: Guaranteed by design, not subject to production testing.
- 5: $L = 1mH, I_{AS} = 10A, V_{DD} = 25V, R_G = 25\Omega$, Starting $T_J = 25^\circ C$

REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

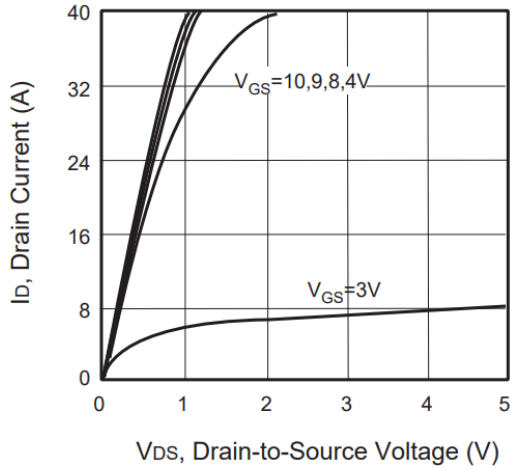


Fig. 2 • Transfer Characteristics

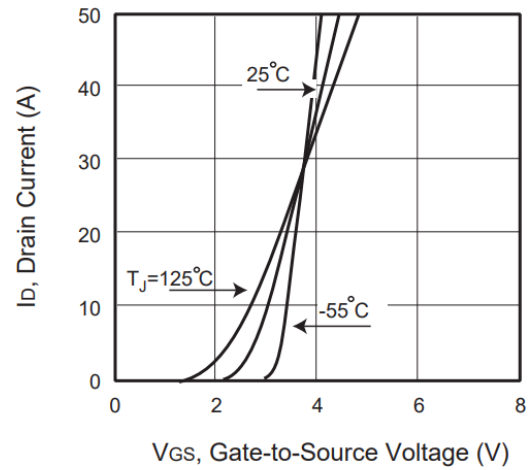


Fig. 3 • Capacitance

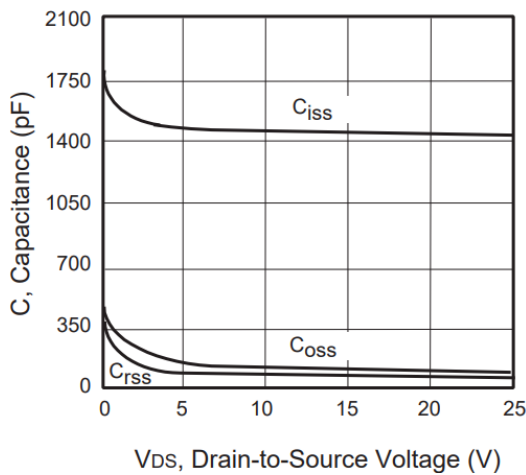


Fig. 4 • On-Resistance Variation with Temperature

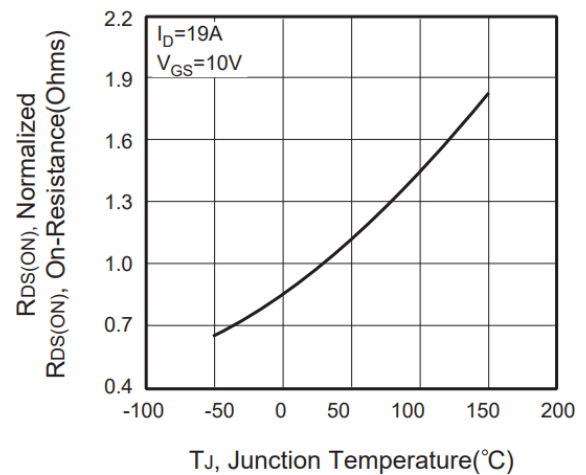


Fig. 5 • Gate Threshold Variation with Temperature

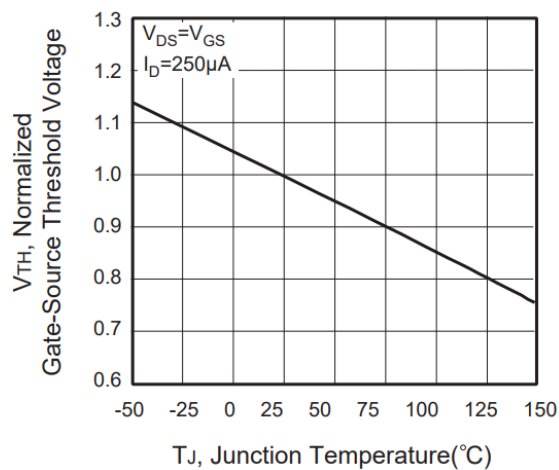
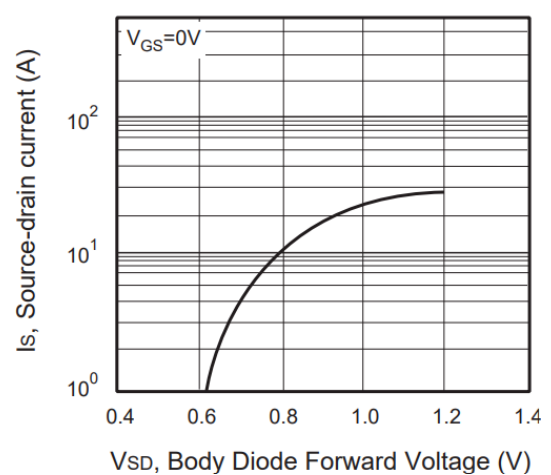


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

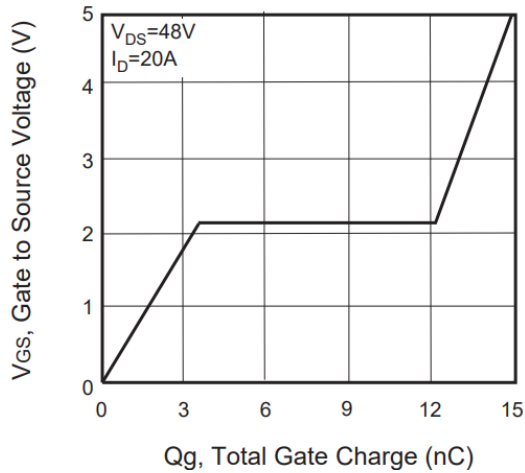


Fig. 8 • Maximum Safe Operating Area

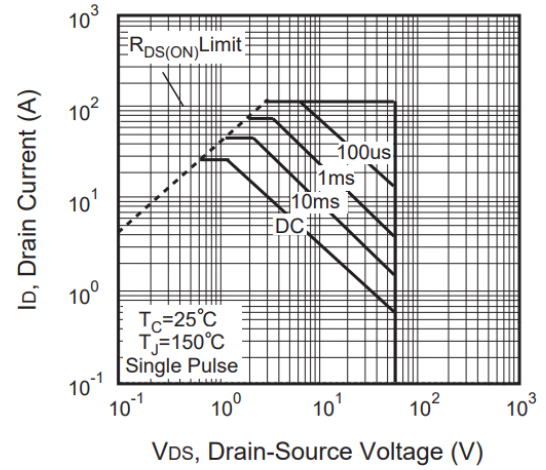


Fig. 9 • Breakdown Voltage Variation vs. Temperature

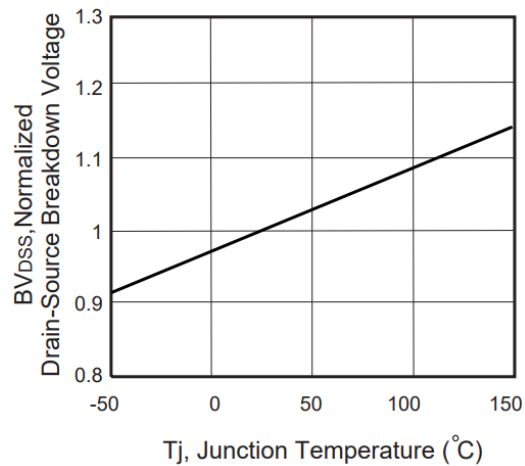
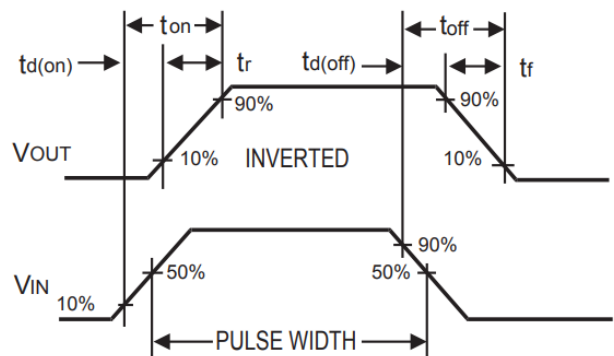


Fig. 10 • Switching Test Circuit

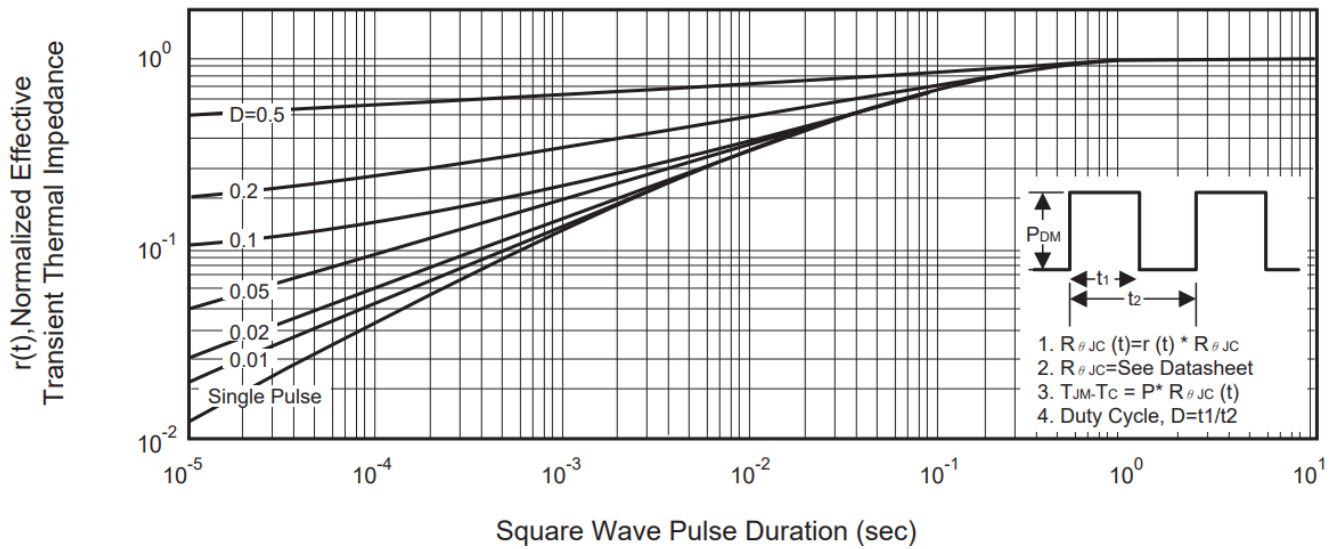


Fig. 11 • Switching Waveforms

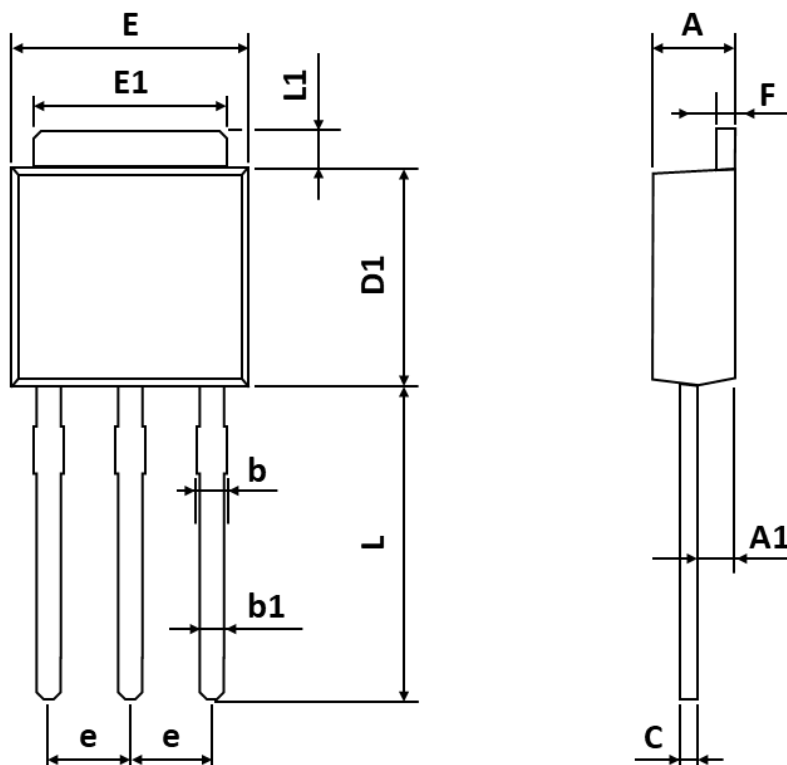


REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 12 • Normalized Thermal Transient Impedance Curve



PACKAGE OUTLINE

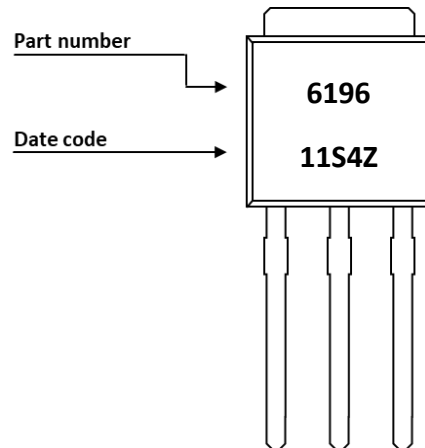


Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	2.180	-	2.400
A1	0.860	-	1.500
b	0.700	-	0.960
b1	0.700	-	0.860
C	0.400	-	0.610
D1	5.400	-	6.630
E	6.050	-	7.010
E1	4.950	-	5.460
e	1.980	-	2.590
F	0.400	-	0.890
L	8.500	-	9.650
L1	0.500	-	1.800

ORDERING INFORMATION

Part Number	Package	Packing	Tube Qty.	Inner Box Qty.	Outer Box Qty.
CED6196	TO251 (E-PAK)	Tube	80pcs	4,000pcs	16,000pcs

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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