

CEU6659

60V/-60V ▲ 62mΩ/105mΩ ▲ N&P Si MOSFET

SILICON Si MOSFET ▲ SMD type

N- and P-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO252-4L package ▲ MSL 3

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)		N-Channel	P-Channel
Drain-Source Voltage	V_{DS}	60V	-60V
Gate-Source Voltage	V_{GS}	$\pm 20\text{V}$	$\pm 20\text{V}$
Continuous Drain Current ^{Note 4}	I_D	9A	-6A
Pulsed Drain Current ^{Note 1}	I_{DM}	32A	-24A
Maximum Power Dissipation	P_D	10.4W	
Power Dissipation Derating above 25°C	ΔP_D	0.08W/ $^\circ\text{C}$	
Operating and Storage Temperature Range	T_J, T_{STG}	-55°C to $+150^\circ\text{C}$	

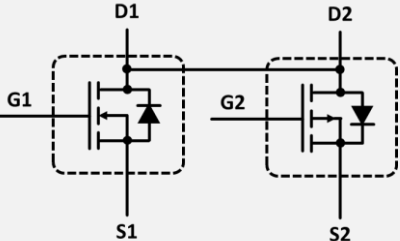
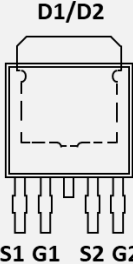
THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Case	R_{TH_JC}	12°C/W
Thermal Resistance, Junction-to-Ambient	R_{TH_JA}	50°C/W

APPLICATIONS

Battery Protection	Bi-Directional Switches	Industrial Control	Load Switches	24V Systems
				

PIN DESCRIPTION

Circuit Diagram	Outline - Top View	Pin No.	Description
		S1 G1 S2 G2 D1 D2	Source N-Channel Gate N-Channel Source P-Channel Gate P-Channel Drain N-Channel Drain P-Channel

N-CHANNEL ELECTRICAL CHARACTERISTICS ▲ $T_A = 25^\circ\text{C}$, 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						
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu A$	$V_{GS(th)}$	1		3	V
Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 5A$	$R_{DS(ON)}$		62	72	m Ω
Static Drain-Source On-Resistance	$V_{GS} = 4.5V, I_D = 3A$	$R_{DS(ON)}$		79	100	m Ω
Dynamic Characteristics ^{Note 4}						
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	C_{ISS}		390		pF
Output Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	C_{OSS}		115		pF
Reverse Transfer Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	C_{RSS}		30		pF
Switching Characteristics ^{Note 4}						
Turn-On Delay Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, R_{G(ext)} = 3.3\Omega$	$t_{D(ON)}$		8		ns
Turn-On Rise Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, R_{G(ext)} = 3.3\Omega$	t_R		3		ns
Turn-Off Delay Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, R_{G(ext)} = 3.3\Omega$	$t_{D(OFF)}$		27		ns
Turn-Off Fall Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, R_{G(ext)} = 3.3\Omega$	t_F		3		ns
Total Gate Charge	$V_{DS} = 48V, V_{GS} = 4.5V, I_D = 5A$	Q_G		7		nC
Gate Source Charge	$V_{DS} = 48V, V_{GS} = 4.5V, I_D = 5A$	Q_{GS}		1		nC
Gate Drain Charge	$V_{DS} = 48V, V_{GS} = 4.5V, I_D = 5A$	Q_{GD}		4		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Current ^{Note 2}		I_S			8.6	A
Drain-Source Diode Forward Voltage ^{Note 3}	$V_{GS} = 0V, I_S = 5A$	V_{SD}			1.2	V

Notes

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2: Surface Mounted on FR4 Board, $t \leq 10$ sec
- 3: Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
- 4: Calculated continuous current based on the maximum allowable junction temperature.

P-CHANNEL ELECTRICAL CHARACTERISTICS ▲ $T_A = 25^\circ\text{C}$, 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						
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = -250\mu A$	$V_{GS(th)}$	-1		-3	V
Static Drain-Source On-Resistance	$V_{GS} = -10V, I_D = -3A$	$R_{DS(ON)}$		105	125	m Ω
Static Drain-Source On-Resistance	$V_{GS} = -4.5V, I_D = -2A$	$R_{DS(ON)}$		135	175	m Ω
Dynamic Characteristics ^{Note 4}						
Input Capacitance	$V_{DS} = -25V, V_{GS} = 0V, f = 1MHz$	C_{ISS}		605		pF
Output Capacitance	$V_{DS} = -25V, V_{GS} = 0V, f = 1MHz$	C_{OSS}		155		pF
Reverse Transfer Capacitance	$V_{DS} = -25V, V_{GS} = 0V, f = 1MHz$	C_{RSS}		45		pF
Switching Characteristics ^{Note 4}						
Turn-On Delay Time	$V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, R_{G(ext)} = 3.3\Omega$	$t_{D(ON)}$		10		ns
Turn-On Rise Time	$V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, R_{G(ext)} = 3.3\Omega$	t_R		4		ns
Turn-Off Delay Time	$V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, R_{G(ext)} = 3.3\Omega$	$t_{D(OFF)}$		40		ns
Turn-Off Fall Time	$V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, R_{G(ext)} = 3.3\Omega$	t_F		7		ns
Total Gate Charge	$V_{DS} = -48V, V_{GS} = -4.5V, I_D = -3A$	Q_G		10		nC
Gate Source Charge	$V_{DS} = -48V, V_{GS} = -4.5V, I_D = -3A$	Q_{GS}		2		nC
Gate Drain Charge	$V_{DS} = -48V, V_{GS} = -4.5V, I_D = -3A$	Q_{GD}		5		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Current ^{Note 2}		I_S			-6	A
Drain-Source Diode Forward Voltage ^{Note 3}	$V_{GS} = 0V, I_S = -1A$	V_{SD}			-1.2	V

Notes

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2: Surface Mounted on FR4 Board, $t \leq 10$ sec
- 3: Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
- 4: Calculated continuous current based on the maximum allowable junction temperature.

N-CHANNEL ▲ REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

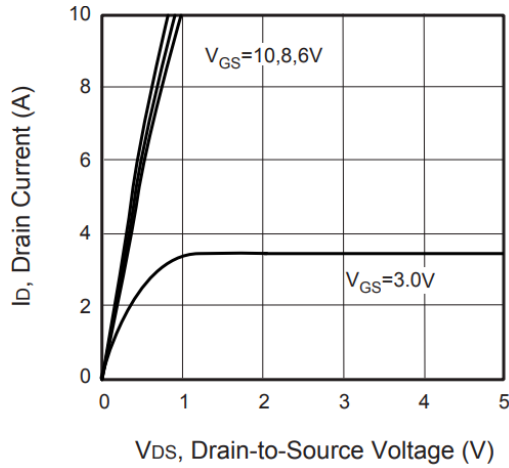


Fig. 2 • Transfer Characteristics

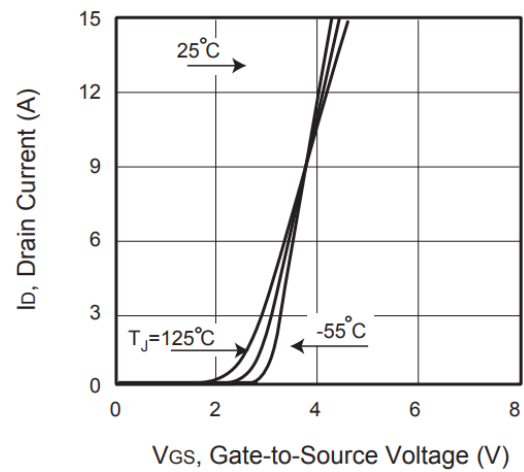


Fig. 3 • Capacitance

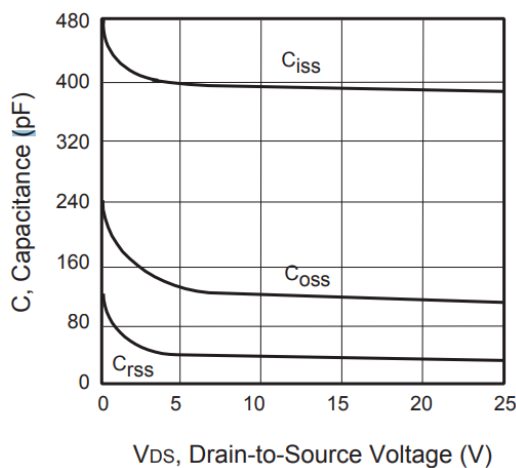


Fig. 4 • On-Resistance Variation with Temperature

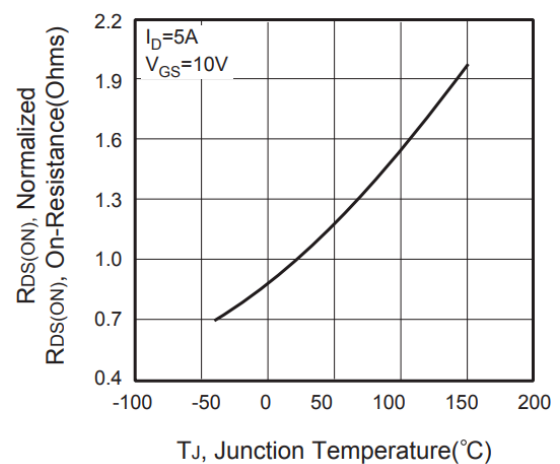


Fig. 5 • Gate Threshold Variation with Temperature

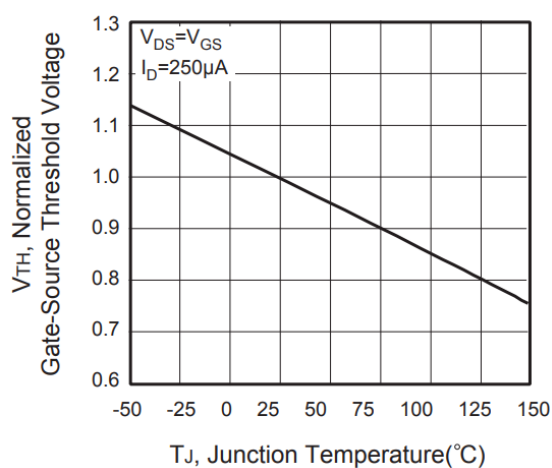
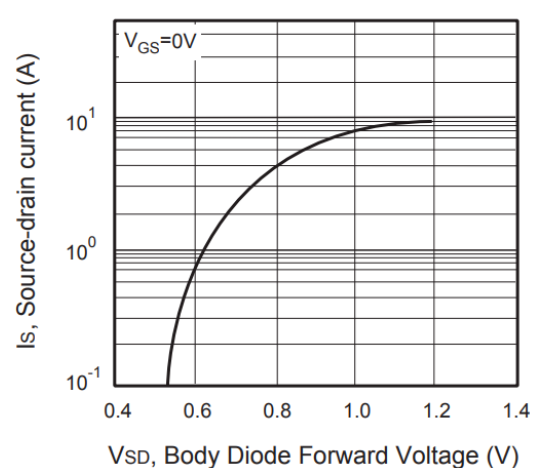


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



P-CHANNEL ▲ REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Output Characteristics

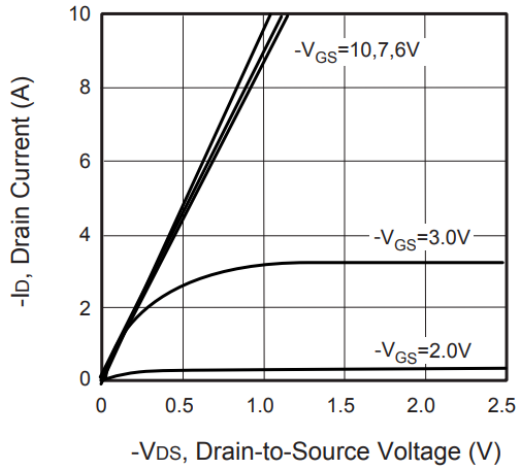


Fig. 8 • Transfer Characteristics

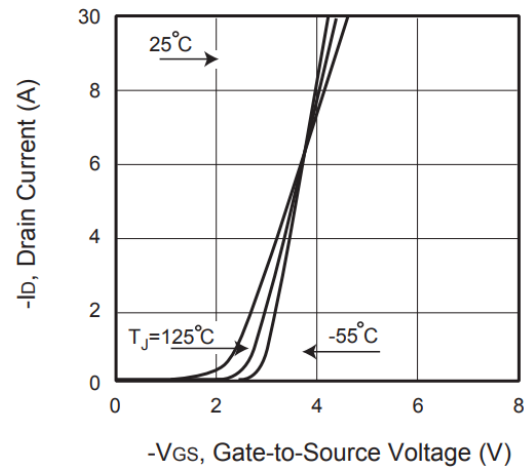


Fig. 9 • Capacitance

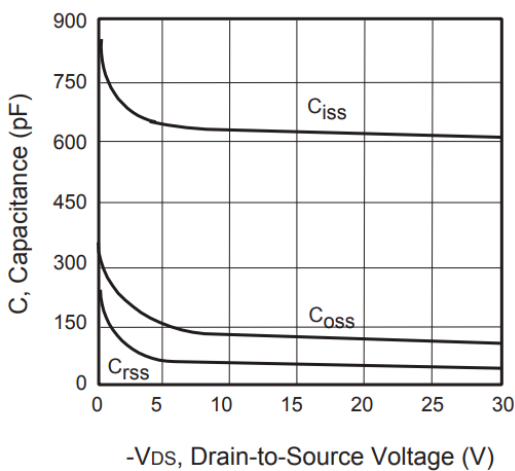


Fig. 10 • On-Resistance Variation with Temperature

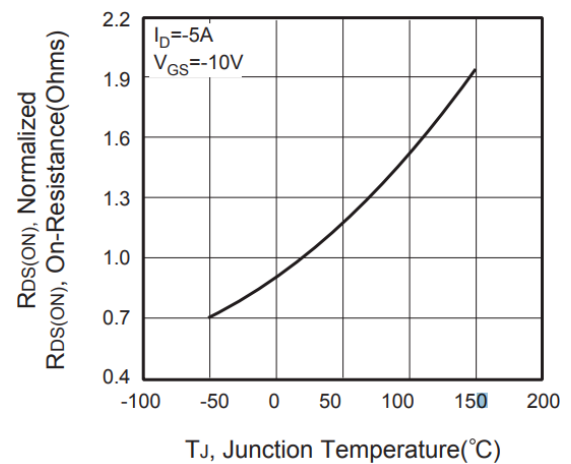


Fig. 11 • Gate Threshold Variation with Temperature

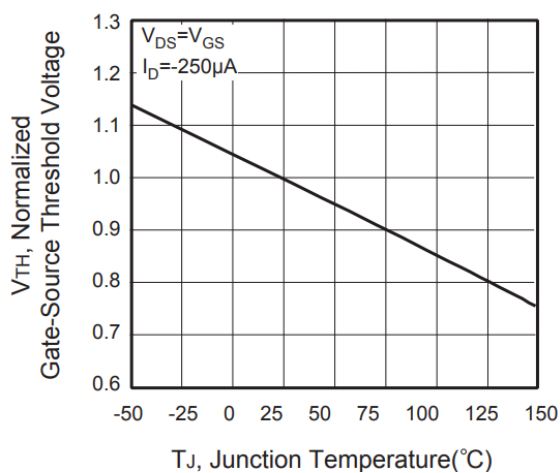
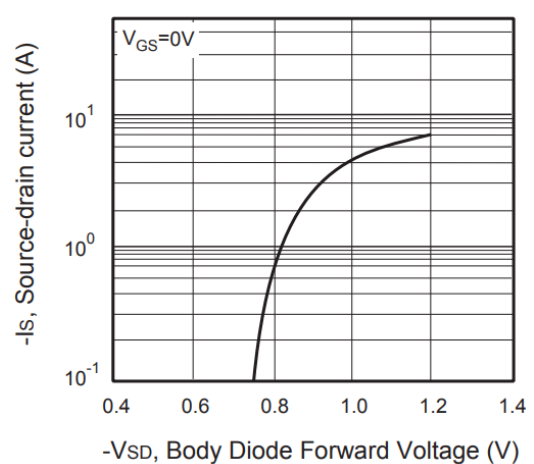


Fig. 12 • Body Diode Forward Voltage Variation with Source Current



N-CHANNEL ▲ REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 13 • Gate Charge

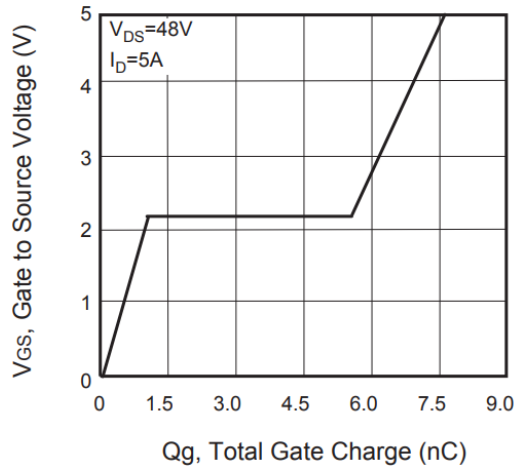
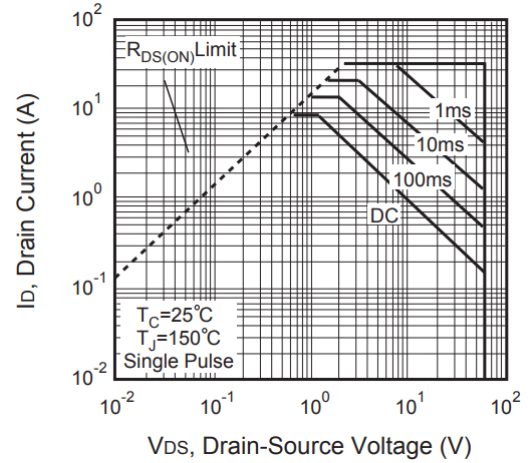


Fig. 14 • Maximum Safe Operating Area



P-CHANNEL ▲ REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 15 • Gate Charge

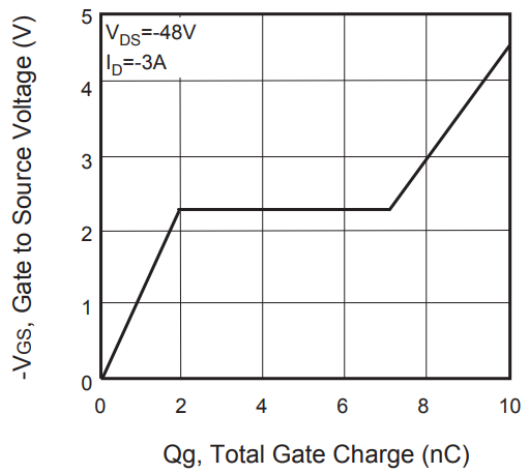
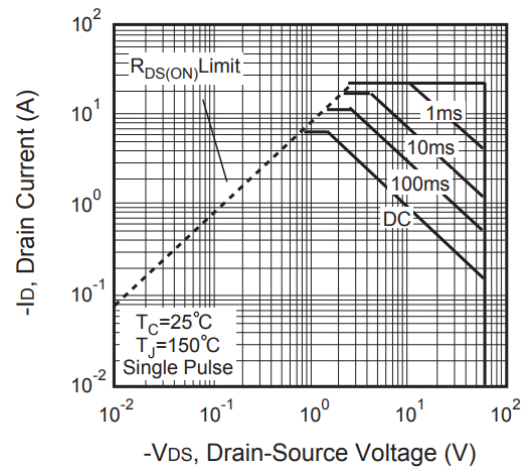


Fig. 16 • Maximum Safe Operating Area



REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 17 • Switching Test Circuit

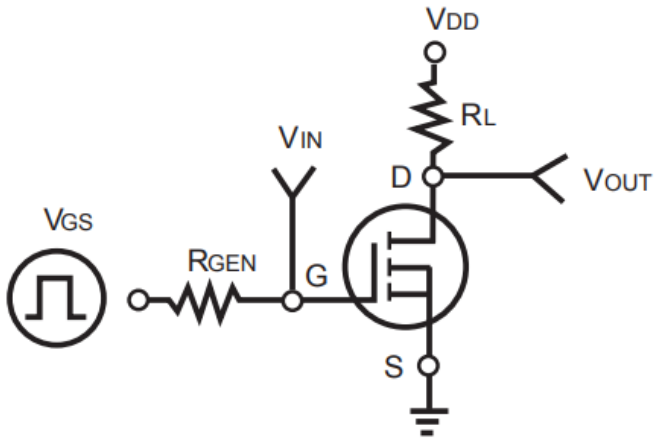


Fig. 18 • Switching Waveforms

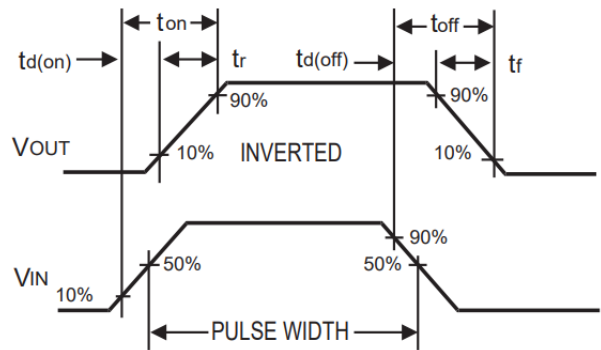
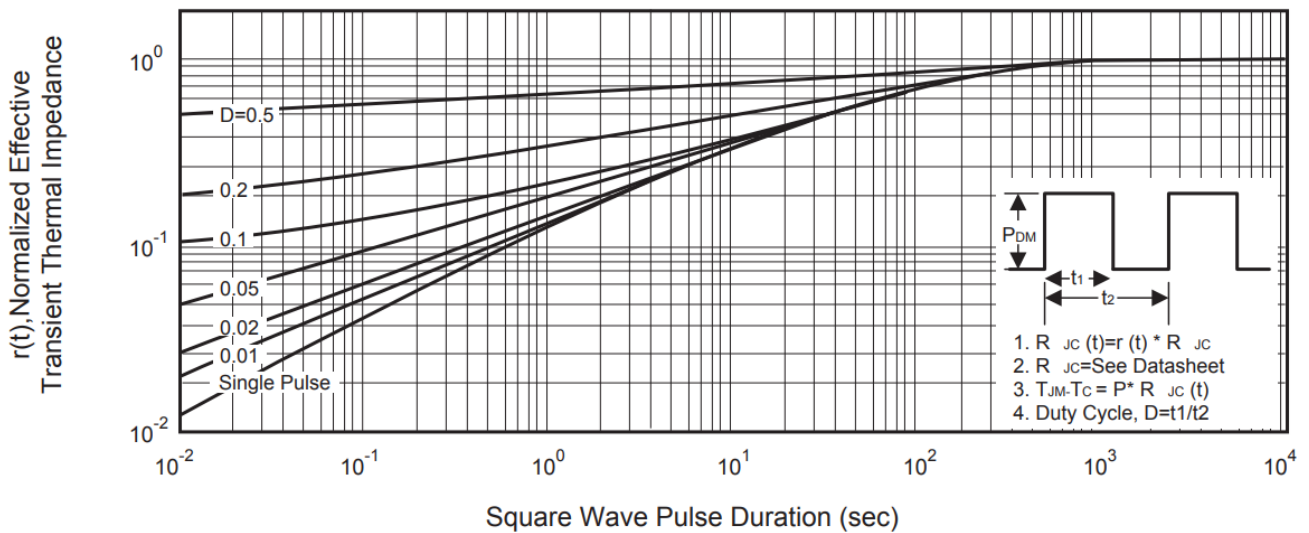
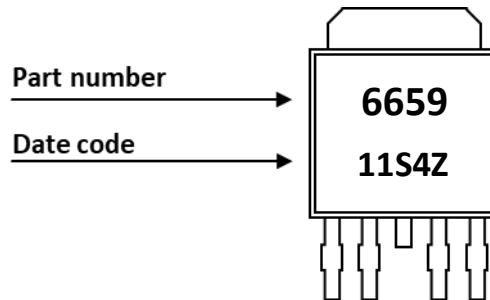


Fig. 19 • Normalized Thermal Transient Impedance Curve

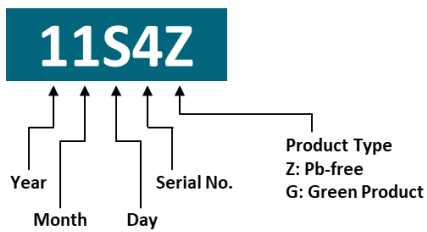


PART MARKING



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									

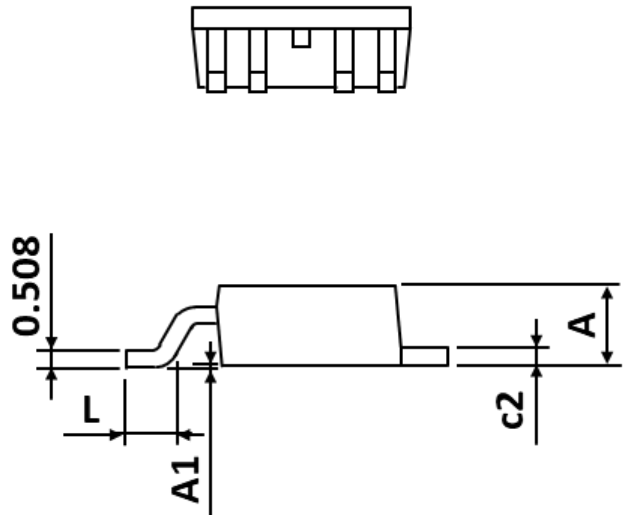
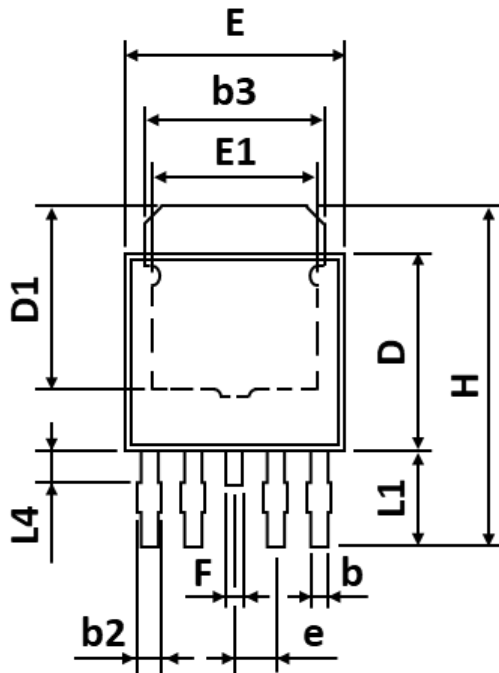
Coding list for „Month“

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

PACKAGE OUTLINE



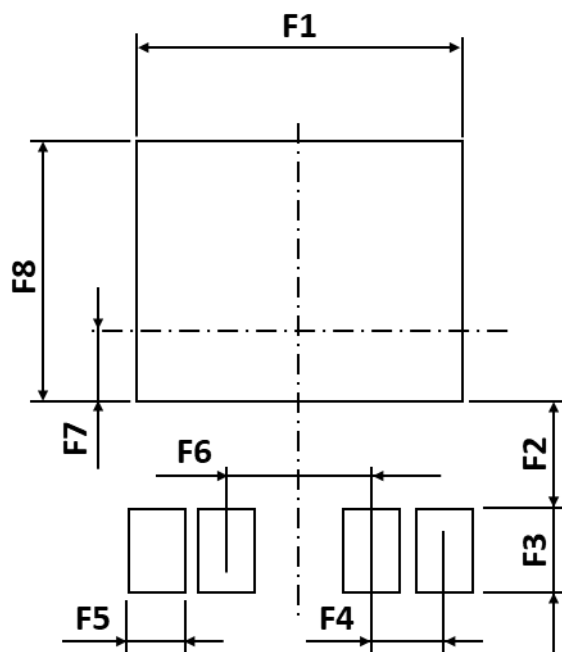
Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	2.200	2.300	2.400
A1	0.000	0.080	0.150
b	0.450	0.530	0.600
b2	0.500	0.650	0.800
b3	5.200	5.350	5.500
c2	0.450	0.500	0.550
D	5.400	5.600	5.800
D1	4.570	-	-

Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
E	6.400	6.600	6.800
E1	3.810	-	-
e	1.27 REF		
F	0.400	0.500	0.600
H	9.400	9.800	10.200
L	1.400	1.590	1.700
L1	2.400	2.700	3.000
L4	0.800	1.000	1.200

ORDERING INFORMATION

Part Number	Package	Packing	Reel Qty.	Inner Box Qty.	Outer Box Qty.
CEU6659	TO252-4L (DPAK-4L)	Reel	2,500pcs	5,000pcs	40,000pcs

RECOMMENDED PAD LAYOUT



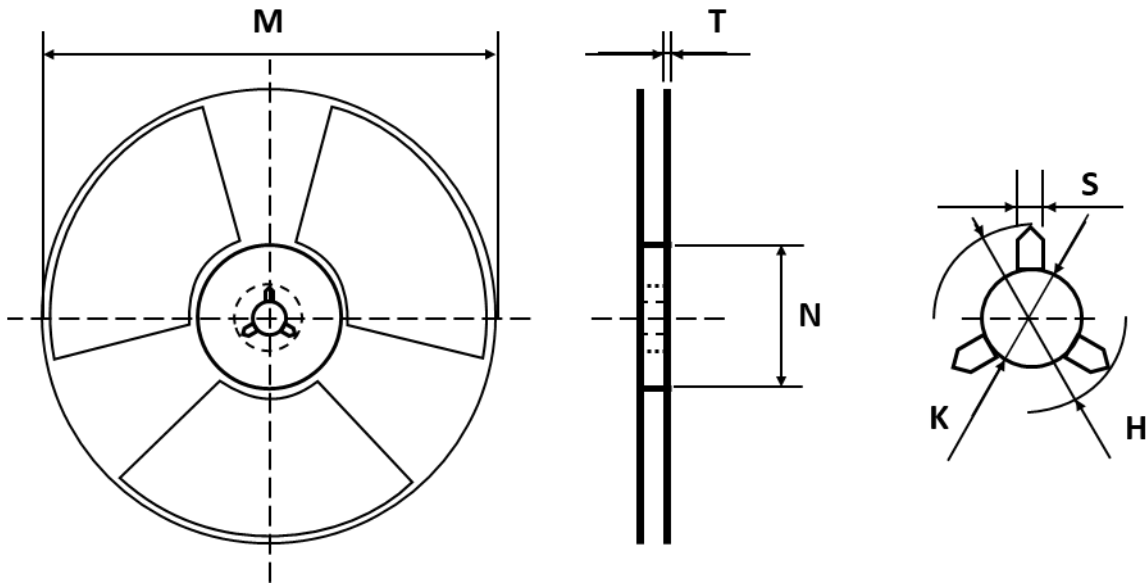
Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
F1	-	5.730	-
F2	-	2.660	-
F3	-	2.000	-
F4	-	1.270	-

Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
F5	-	1.000	-
F6	-	2.540	-
F7	-	1.640	-
F8	-	6.170	-

Notes:

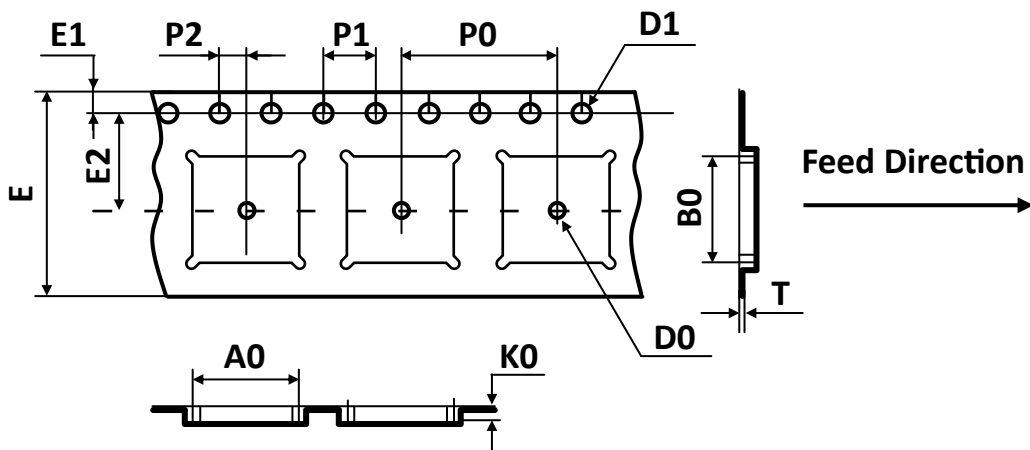
1. The suggested land pattern dimensions have been provided for reference only.
2. For further information, please reference document IPC-7351A.

REEL DIMENSIONS ▲ All dimensions in mm



Tape Size	Reel Size	M	N	T	H	K	S
16mm	Ø330	Ø330.00	Ø100.00	2.10	22.00	13.00	2.00
		±2.00	±0.50	±0.20	±0.50	+0.50 -0.20	+0.50 -0.20

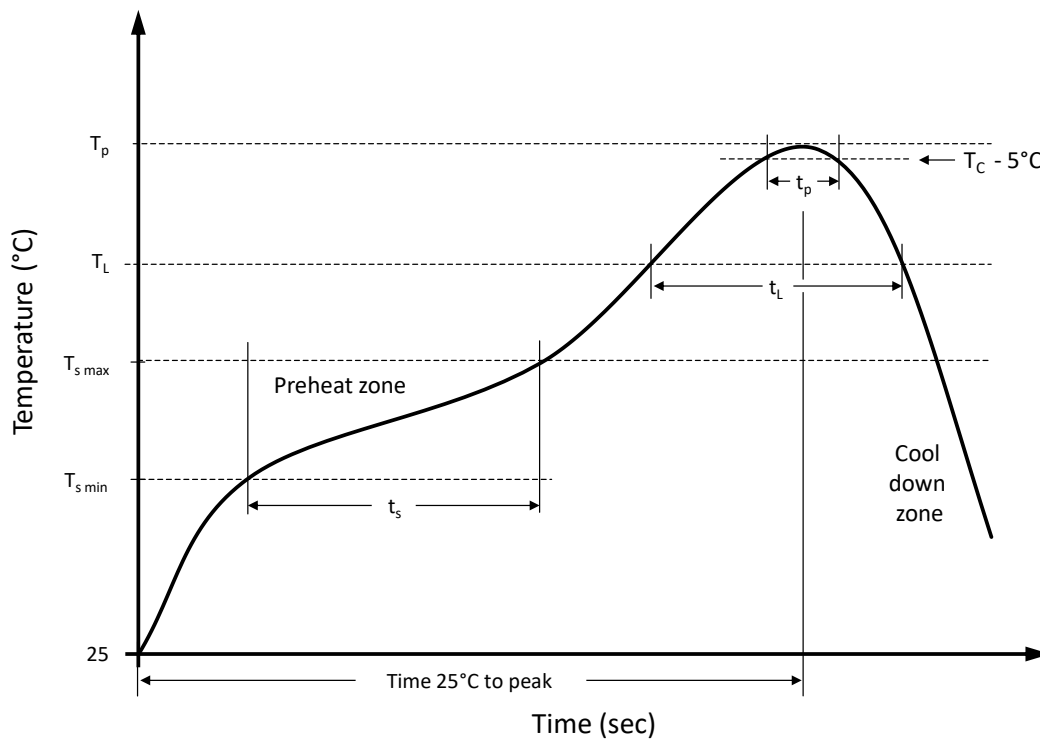
TAPE DIMENSIONS ▲ All dimensions in mm



Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
TO252-4L (DPAK-4L)	6.90	10.50	2.70	1.50	1.50	16.00	1.75	7.50	8.00	4.00	2.00	0.30
	±0.10	±0.10	±0.10	MIN	±0.10	+0.30 -0.20	±0.10	±0.10	±0.10	±0.10	±0.10	±0.05

Note: All dimensions meet EIA-481-D requirements.

RECOMMENDED REFLOW SOLDERING PROFILE



Recommended reflow soldering conditions ▲ Refer to JEDEC J-STD-020E

Profile Features		Sn-Pb Eutetic Assembly	Pb-Free Assembly
Preheat temperature min.	$T_{s \min}$	100 °C	150 °C
Preheat temperature max.	$T_{s \max}$	150 °C	200 °C
Preheat time t_s from $T_{s \min}$ to $T_{s \max}$	t_s	120 seconds	120 seconds
Ramp-up rate (T_L to T_p)		max. 3 °C/second	max. 3 °C/second
Liquidous temperature	T_L	183 °C	217 °C
Time t_L maintained above T_L	t_L	150 seconds max.	150 seconds max.
Peak package body temperature	T_p	235°C	260°C
Timeframe of within 5°C below and up to max actual peak body temperature	t_p	20 seconds max.	30 seconds max.
Ramp-down rate (T_L to T_p)		max. 6 °C/second	max. 6 °C/second
Time 25°C to peak temperature		max. 6 minutes	max. 8 minutes

REVISION TABLE

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

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All MGT products with the technical specifications described are suitable for use in certain applications. Operating, production, storage and environmental conditions can have a massive influence on the parameters mentioned in the data sheets, which cause the performance to vary over time.

It is subject to the user's duty of care to design and validate his products in such a way that appropriate measures are taken, such as protective circuits or redundant systems to ensure the safety standards required in the application.

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