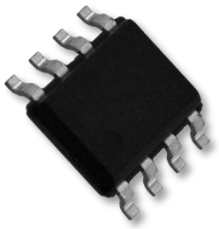


CEM6659

60V/-60V ▲ 56mΩ/100mΩ ▲ N&P Si MOSFET

SILICON Si MOSFET ▲ SMD type
N- and P-channel enhancement mode
UL94V-0 rated flame retardant epoxy
SO8 package ▲ MSL 3
Super high dense cell density for extremely low $R_{DS(ON)}$
High power and current handling capability

MAXIMUM RATINGS

Parameter (T_A = 25°C, unless otherwise noted)		N-Channel	P-Channel
Drain-Source Voltage	V_{DS}	60V	-60V
Gate-Source Voltage	V_{GS}	±20V	±20V
Continuous Drain Current at T_A = 25°C	I_D	4.1A	-3.1A
Pulsed Drain Current Note 1	I_{DM}	15A	-12A
Maximum Power Dissipation	P_D	2W	
Operating and Storage Temperature Range	T_J, T_{STG}	-55°C to +150°C	

THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Ambient Note 2	R_{TH_JA}	62.5°C/W

APPLICATIONS

Audio Amplifier	DC Fan	DC/DC Converter	Industrial Control	Load Switches

PIN DESCRIPTION

Circuit Diagram	Outline ▪ Top View	Pin No.	Description
D_1 (7,8), G_1 (2), S_1 (1), D_2 (5,6), G_2 (4), S_2 (3)	8 7 6 5 / 1 2 3 4	1	Source MOSFET 1
		2	Gate MOSFET 1
		3	Source MOSFET 2
		4	Gate MOSFET 2
		5	Drain MOSFET 2
		6	Drain MOSFET 2
		7	Drain MOSFET 1
		8	Drain MOSFET 1

N-CHANNEL ELECTRICAL CHARACTERISTICS ▲ T_A = 25°C, unless otherwise noted

Item	Condition	Symbol	Min.	Typ.	Max.	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250µA	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 = 250µA	$V_{GS(th)}$	1		3	V
Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 4.1A	$R_{DS(ON)}$		56	68	mΩ
Static Drain-Source On-Resistance	V_{GS} = 4.5V, I_D = 3.5A	$R_{DS(ON)}$		66	86	mΩ
Dynamic Characteristics Note 4						
Forward Transconductance	V_{DS} = 10V, I_D = 4.1A	g_{FS}		5		S
Input Capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1MHz	C_{ISS}		670		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}		45		pF
Switching Characteristics Note 4						
Turn-On Delay Time	V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, $R_{G(ext)}$ = 6Ω	$t_{D(ON)}$		11	25	ns
Turn-On Rise Time	V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, $R_{G(ext)}$ = 6Ω	t_R		3	10	ns
Turn-Off Delay Time	V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, $R_{G(ext)}$ = 6Ω	$t_{D(OFF)}$		30	60	ns
Turn-Off Fall Time	V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, $R_{G(ext)}$ = 6Ω	t_F		3	10	ns
Total Gate Charge	V_{DS} = 30V, V_{GS} = 10V, I_D = 4.1A	Q_G		13	17	nC
Gate Source Charge	V_{DS} = 30V, V_{GS} = 10V, I_D = 4.1A	Q_{GS}		1.7		nC
Gate Drain Charge	V_{DS} = 30V, V_{GS} = 10V, I_D = 4.1A	Q_{GD}		2.6		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Current Note 2		I_S			4.1	A
Drain-Source Diode Forward Voltage Note 3	V_{GS} = 0V, I_S = 2A	V_{SD}			1.2	V

Notes

1: Repetitive Rating: Pulse width limited by maximum junction temperature

2: Surface Mounted on FR4 Board, t ≤ 10 sec

3: Pulse Test: Pulse Width ≤ 300µs, Duty Cycle ≤ 2%.

4: Guaranteed by design, not subject to production testing.

P-CHANNEL ELECTRICAL CHARACTERISTICS ▲ T_A = 25°C, unless otherwise noted

Item	Condition	Symbol	Min.	Typ.	Max.	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250μA	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 = -250μA	$V_{GS(th)}$	-1		-3	V
Static Drain-Source On-Resistance	V_{GS} = -10V, I_D = -3.1A	$R_{DS(ON)}$		100	130	mΩ
Static Drain-Source On-Resistance	V_{GS} = -4.5V, I_D = -2.8A	$R_{DS(ON)}$		130	170	mΩ
Dynamic Characteristics Note 4						
Forward Transconductance	V_{DS} = -10V, I_D = -3.1A	g_{FS}		5		S
Input Capacitance	V_{DS} = -30V, V_{GS} = 0V, f = 1MHz	C_{ISS}		885		pF
Output Capacitance	V_{DS} = -30V, V_{GS} = 0V, f = 1MHz	C_{OSS}		85		pF
Reverse Transfer Capacitance	V_{DS} = -30V, V_{GS} = 0V, f = 1MHz	C_{RSS}		80		pF
Switching Characteristics Note 4						
Turn-On Delay Time	V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, $R_{G(ext)}$ = 6Ω	$t_{D(ON)}$		12	25	ns
Turn-On Rise Time	V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, $R_{G(ext)}$ = 6Ω	t_R		4	15	ns
Turn-Off Delay Time	V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, $R_{G(ext)}$ = 6Ω	$t_{D(OFF)}$		38	80	ns
Turn-Off Fall Time	V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, $R_{G(ext)}$ = 6Ω	t_F		12	25	ns
Total Gate Charge	V_{DS} = -30V, V_{GS} = -10V, I_D = -3.1A	Q_G		11	14	nC
Gate Source Charge	V_{DS} = -30V, V_{GS} = -10V, I_D = -3.1A	Q_{GS}		2.4		nC
Gate Drain Charge	V_{DS} = -30V, V_{GS} = -10V, I_D = -3.1A	Q_{GD}		1.6		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Current Note 2		I_S			-3.1	A
Drain-Source Diode Forward Voltage Note 3	V_{GS} = 0V, I_S = -1.3A	V_{SD}			-1.2	V

Notes

1: Repetitive Rating: Pulse width limited by maximum junction temperature

2: Surface Mounted on FR4 Board, t ≤ 10 sec

3: Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.

4: Guaranteed by design, not subject to production testing.

N-CHANNEL REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 ▪ Output Characteristics

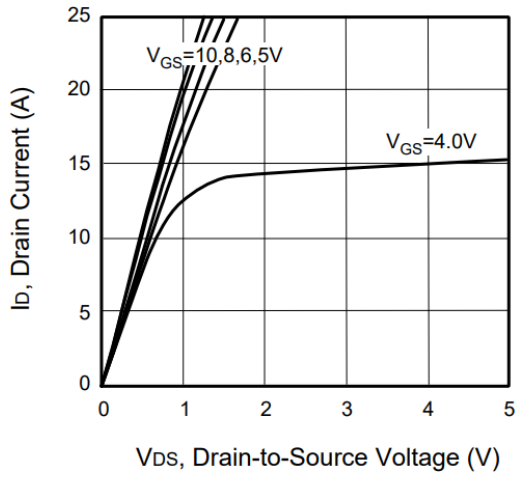


Fig. 2 ▪ Transfer Characteristics

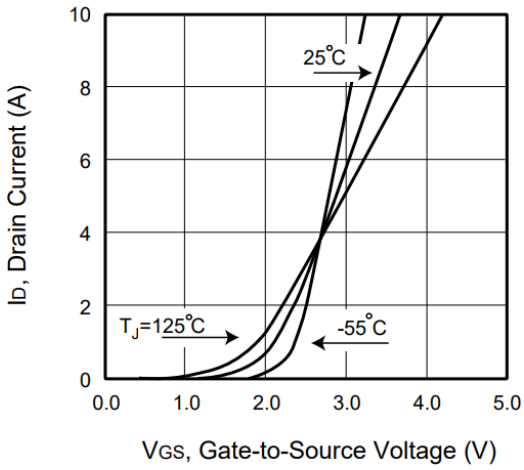


Fig. 3 ▪ Capacitance

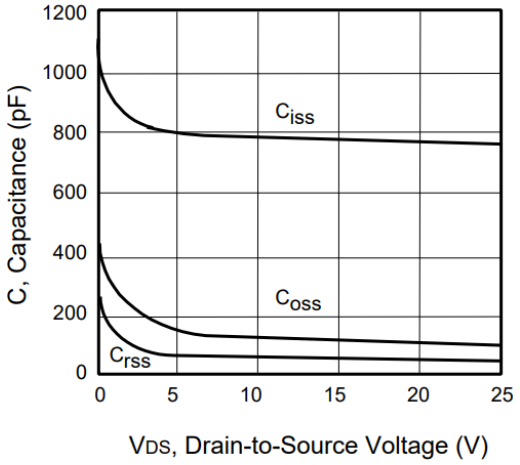


Fig. 4 ▪ On-Resistance Variation with Temperature

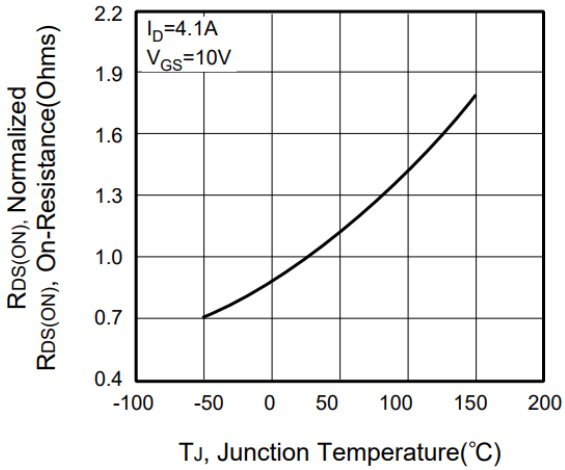


Fig. 5 ▪ Gate Threshold Variation with Temperature

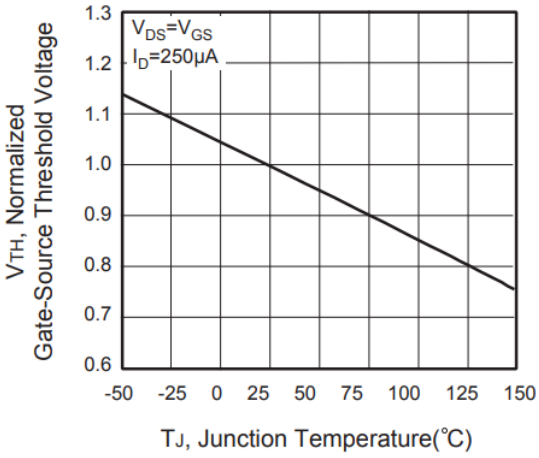
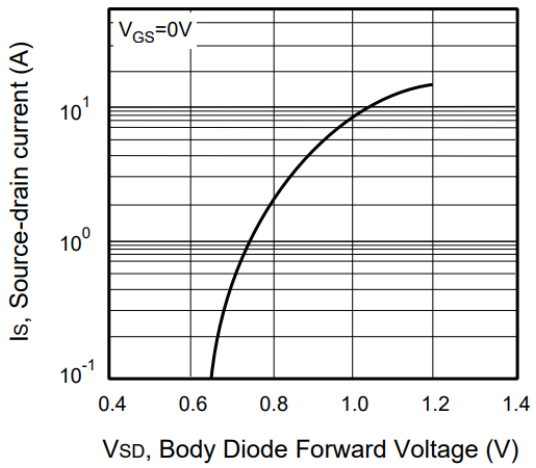


Fig. 6 ▪ Body Diode Forward Voltage Variation with Source Current



P-CHANNEL REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 ▪ Output Characteristics

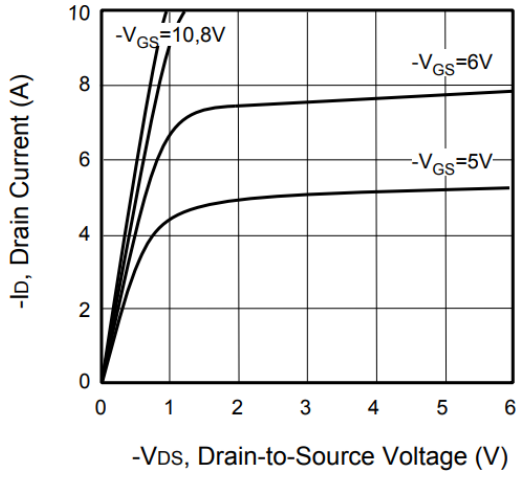


Fig. 8 ▪ Transfer Characteristics

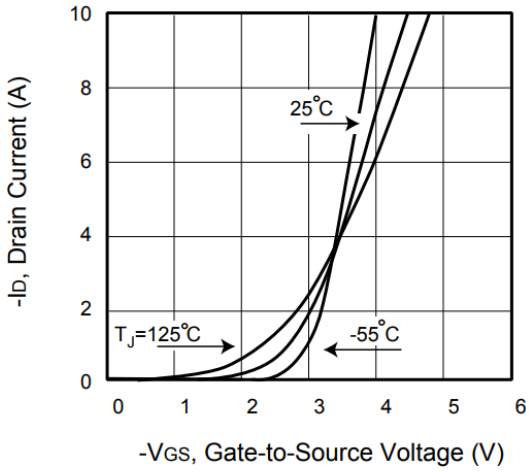


Fig. 9 ▪ Capacitance

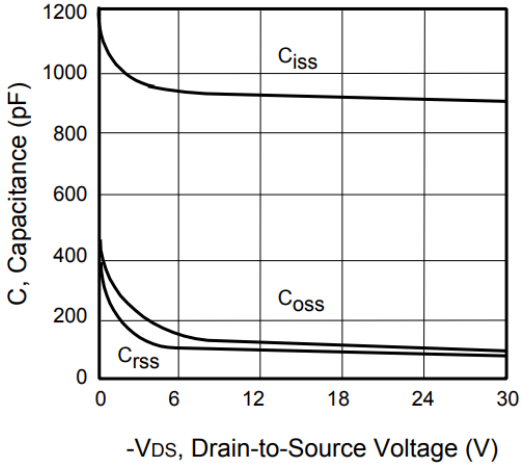


Fig. 10 ▪ On-Resistance Variation with Temperature

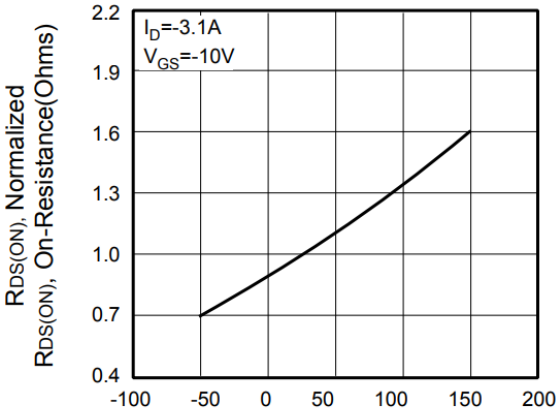


Fig. 11 ▪ Gate Threshold Variation with Temperature

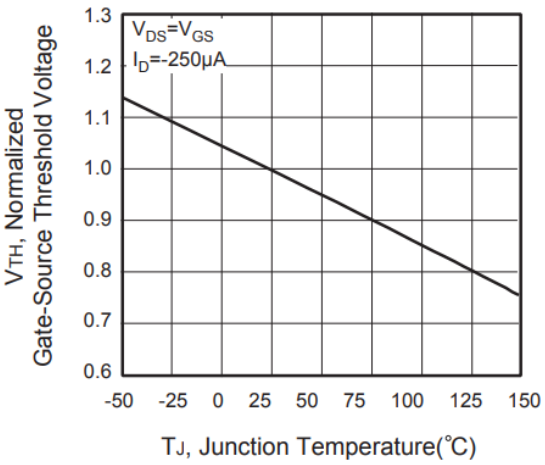
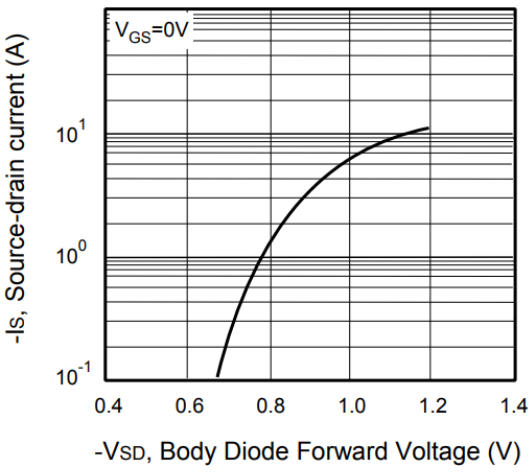


Fig. 12 ▪ Body Diode Forward Voltage Variation with Source Current



N-CHANNEL REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 13 ▪ Gate Charge

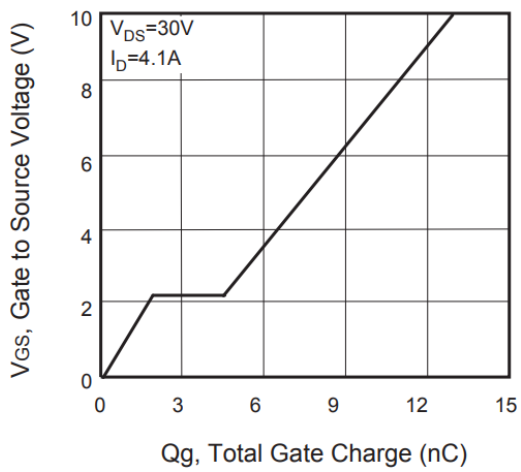
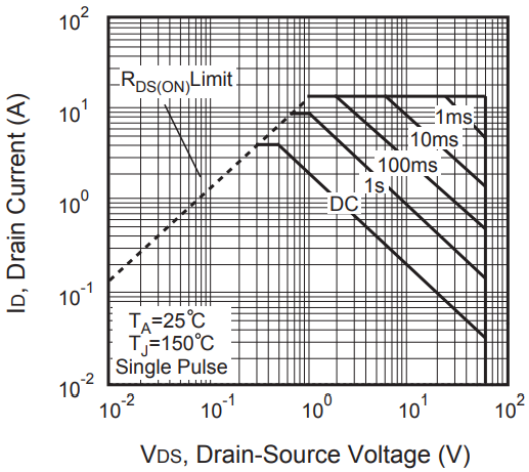


Fig. 14 ▪ Maximum Safe Operating Area



P-CHANNEL ▲ REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 15 ▪ Gate Charge

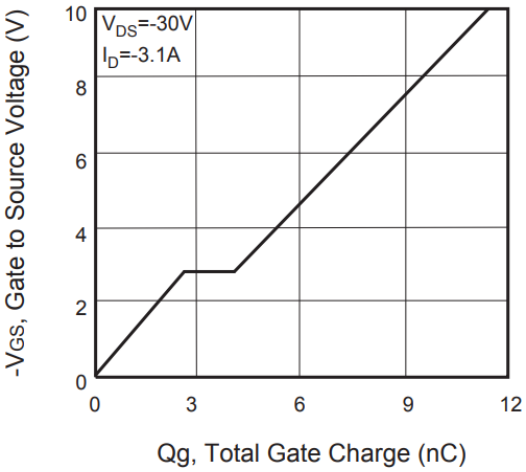
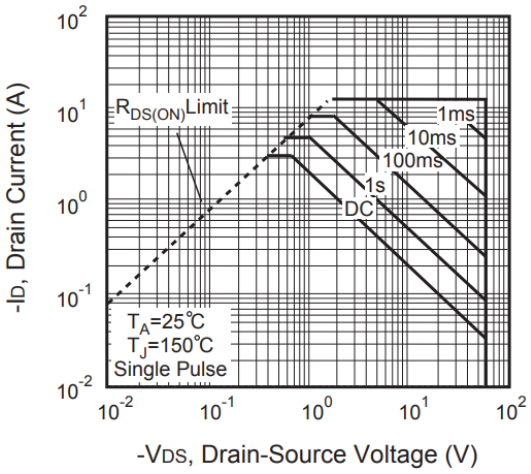


Fig. 16 ▪ Maximum Safe Operating Area



REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 17 ▪ Switching Test Circuit

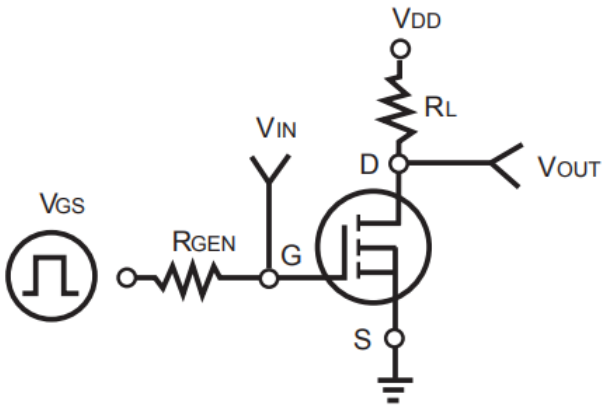


Fig. 18 ▪ Switching Waveforms

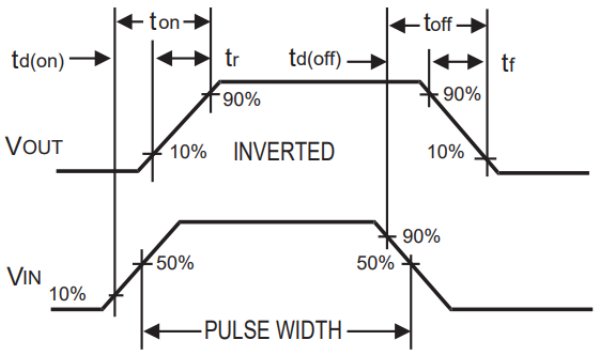
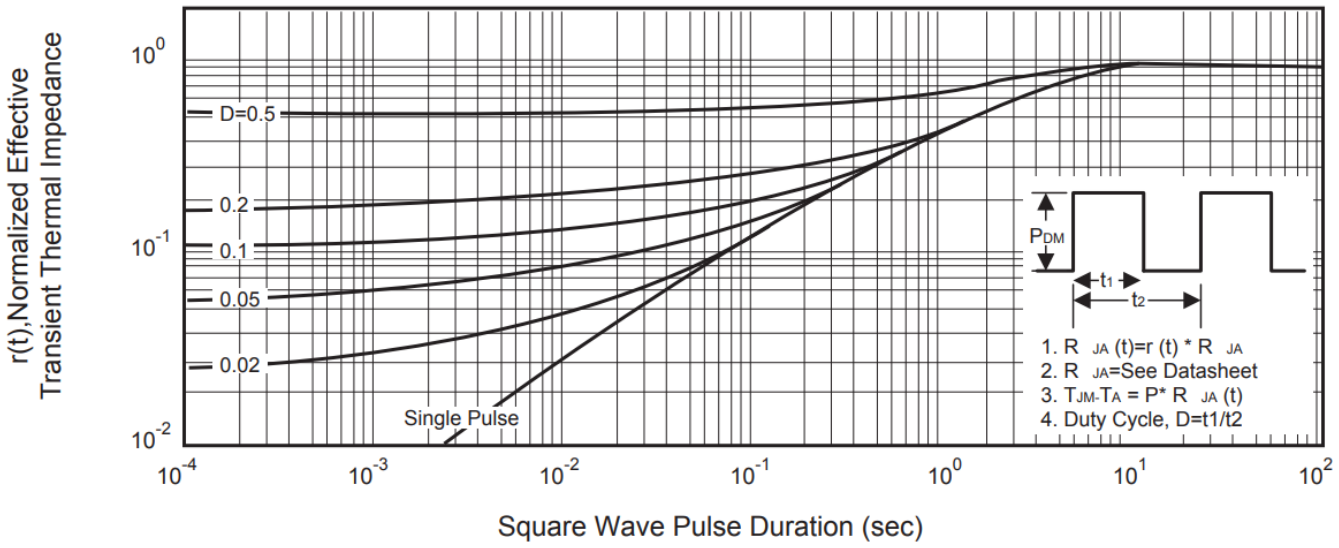
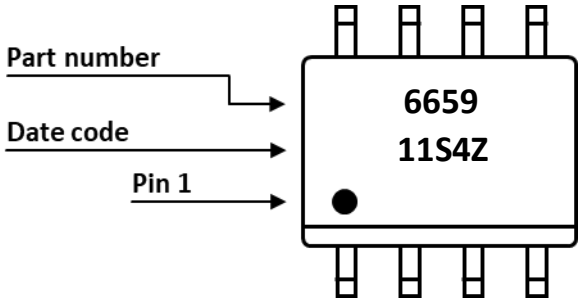


Fig. 19 ▪ Normalized Thermal Transient Impedance Curve

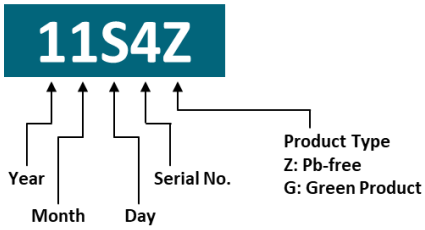


PART MARKING



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									

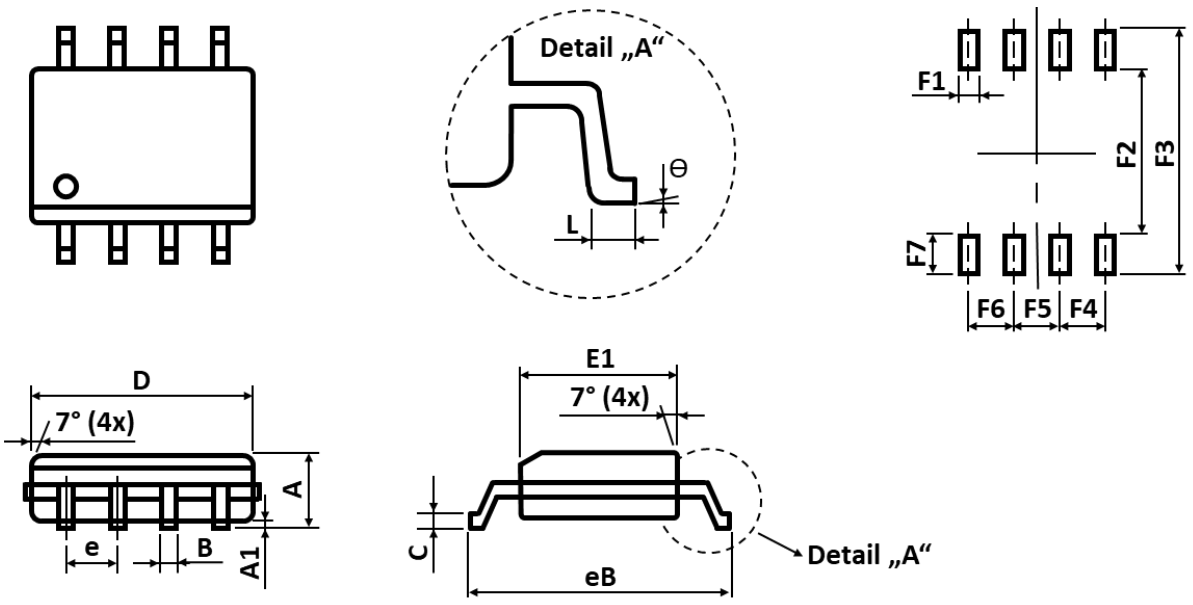
Coding list for „Month“

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 AND RECOMMENDED PAD LAYOUT



Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	1.350	-	1.750
A1	0.100	-	0.250
B	0.310	-	0.510
C	0.170	-	0.250
D	4.690	-	5.000

Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
E1	3.700		4.060
eB	5.800		6.200
e		1.270	
L	0.400		0.950
Θ	0°	-	8°

Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
F1	-	0.500	-
F2	-	4.250	-
F3	-	6.250	-
F4	-	1.270	-

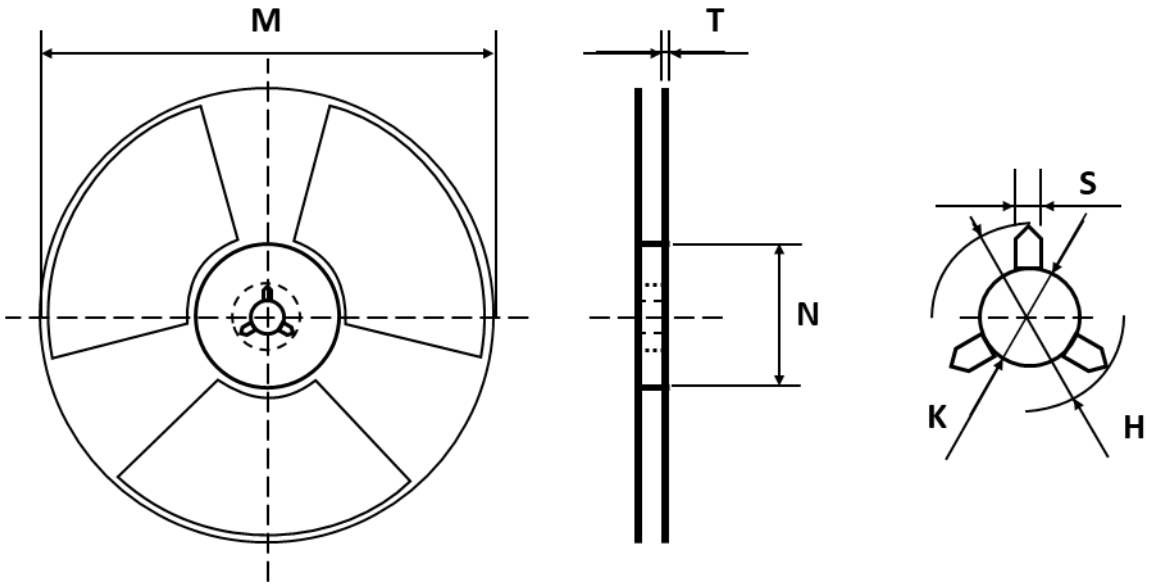
Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
F5	-	1.270	-
F6	-	1.270	-
F7	-	1.000	-

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

ORDERING INFORMATION

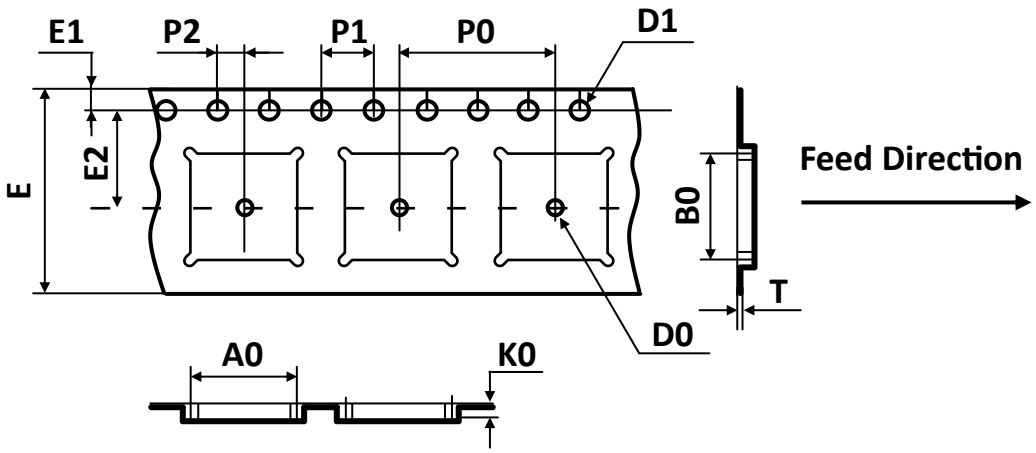
Part Number	Package	Packing	Reel Qty.	Inner Box Qty.	Outer Box Qty.
CEM6659	SO8	13” Reel	2,500pcs	5,000pcs	40,000pcs

REEL DIMENSIONS ▲ All dimensions in mm



Tape Size	Reel Size	M	N	T	H	K	S
12mm	Ø330	Ø330.00	Ø100.00	2.20	20.00	13.20	3.00
		±2.00	±0.50	±0.20	±1.00	±0.20	±1.00

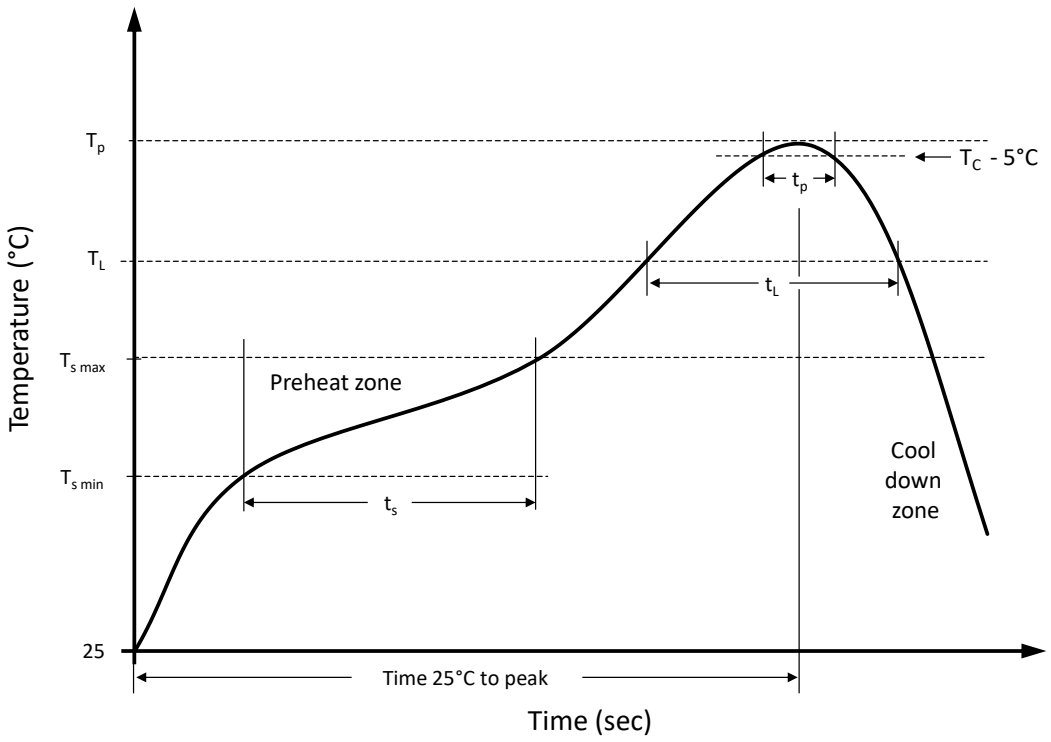
TAPE DIMENSIONS ▲ All dimensions in mm



Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
SO8	6.50	5.30	2.05	1.50	1.50	12.00	1.75	5.50	8.00	4.00	2.00	0.25
	±0.10	±0.10	±0.15	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10	±0.05	±0.02

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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