SEMITRANS® 3

IGBT4 Modules

SKM450GM12E4D1

Features*

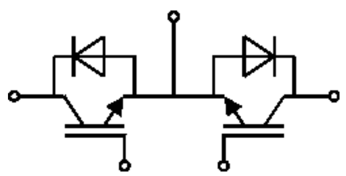
- IGBT4 = 4th generation medium fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 12kHz
- UL recognized, file no. E63532
- SKM…**D1**: increased diode performance

Typical Applications

- Matrix Inverter
- Bidirectional switch

Remarks

- Case temperature limited to T_c = 125°C max.
- Recommended T_{op} = -40 ... +150°C
- Product reliability results valid for T_j = 150°C



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Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT				
V_{CES}	T_j = 25 °C		1200	V
I_C	T_j = 175 °C	T_c = 25 °C	699	A
		T_c = 80 °C	538	A
I_{Cnom}			450	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		1350	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V V_{GE} ≤ 15 V V_{CES} ≤ 1200 V	T_j = 150 °C	10	µs
T_j			-40 ... 175	°C
Inverse diode				
V_{RRM}	T_j = 25 °C		1200	V
I_F	T_j = 175 °C	T_c = 25 °C	623	A
		T_c = 80 °C	466	A
I_{Fnom}			500	A
I_{FRM}	I_{FRM} = 2xI_{Fnom}		1000	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 25 °C		2736	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$			500	A
T_{stg}	module without TIM		-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min		4000	V

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
$V_{CE(sat)}$	I_C = 450 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.84	2.07	V
		T_j = 150 °C		2.23	2.42	V
V_{CE0}	chiplevel	T_j = 25 °C		0.80	0.90	V
		T_j = 150 °C		0.70	0.80	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		2.3	2.6	mΩ
		T_j = 150 °C		3.4	3.6	mΩ
$V_{GE(th)}$	V_{GE}=V_{CE}, I_C = 16.4 mA		5	5.8	6.5	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C				5	mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		27.2		nF
C_{oes}		f = 1 MHz		1.76		nF
C_{res}		f = 1 MHz		1.50		nF
Q_G	V_{GE} = - 8 V...+ 15 V			2500		nC
R_{Gint}	T_j = 25 °C			1.9		Ω
$t_{d(on)}$	V_{CC} = 600 V I_C = 450 A V_{GE} = +15/-15 V $R_{G\,on}$ = 1 Ω $R_{G\,off}$ = 1 Ω di/dt_{on} = 8100 A/µs di/dt_{off} = 3400 A/µs	T_j = 150 °C		253		ns
t_r		T_j = 150 °C		59		ns
E_{on}		T_j = 150 °C		28		mJ
$t_{d(off)}$		T_j = 150 °C		505		ns
t_f		T_j = 150 °C		112		ns
E_{off}		T_j = 150 °C		58		mJ
$R_{th(j-c)}$	per IGBT				0.062	K/W
$R_{th(c-s)}$	per IGBT (λ_{grease}=0.81 W/(m*K))			0.028		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material			0.017		K/W

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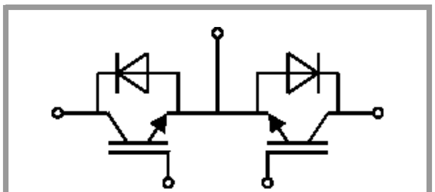

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Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
$V_F = V_{EC}$	I_F = 450 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.04	2.35	V
		T_j = 150 °C		1.94	2.23	V
V_{F0}	chiplevel	T_j = 25 °C		1.30	1.50	V
		T_j = 150 °C		0.90	1.10	V
r_F	chiplevel	T_j = 25 °C		1.64	1.88	mΩ
		T_j = 150 °C		2.3	2.5	mΩ
I_{RRM}	I_F = 450 A di/dt_{off} = 8000 A/µs V_{GE} = -15 V V_{CC} = 600 V	T_j = 150 °C		504		A
Q_{rr}		T_j = 150 °C		75		µC
E_{rr}		T_j = 150 °C		31		mJ
$R_{th(j-c)}$	per diode				0.095	K/W
$R_{th(c-s)}$	per diode (λ_{grease}=0.81 W/(m*K))			0.037		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.03		K/W
Module						
L_{CE}				15		nH
$R_{CC'+EE'}$	measured per switch	T_C = 25 °C		0.55		mΩ
		T_C = 125 °C		0.85		mΩ
$R_{th(c-s)1}$	calculated without thermal coupling			0.008		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module (λ_{grease}=0.81 W/(m*K))			0.013		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module, pre-applied phase change material			0.009		K/W
M_s	to heat sink M6		3		5	Nm
M_t		to terminals M6	2.5		5	Nm
						Nm
w					325	g

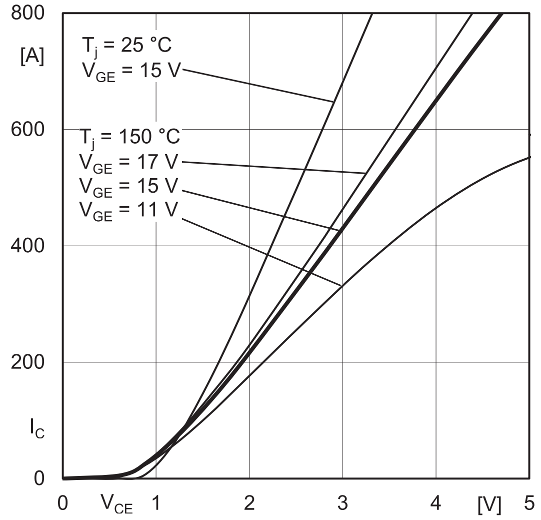


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

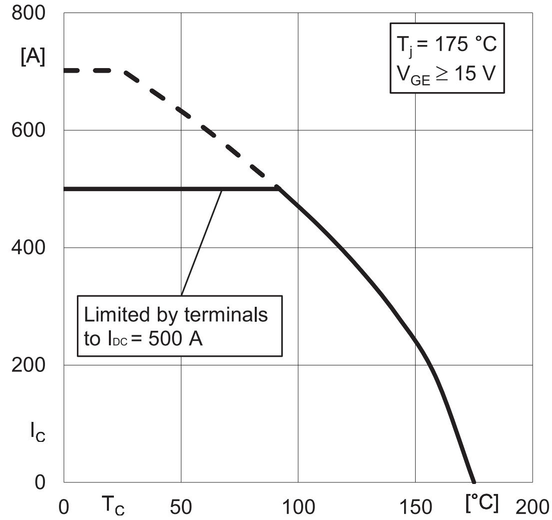


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

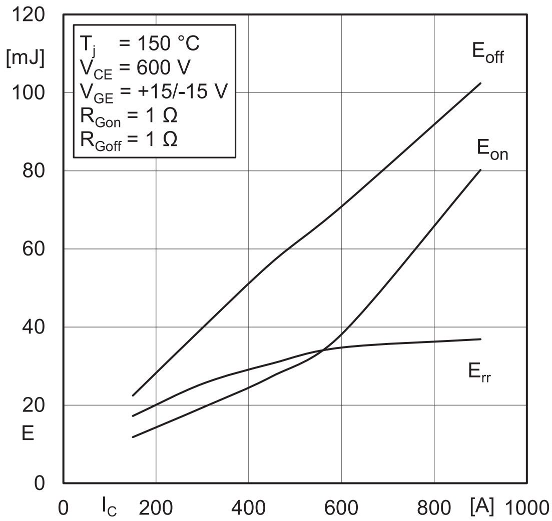


Fig. 3: Typ. turn-on /-off energy = f (I_C)

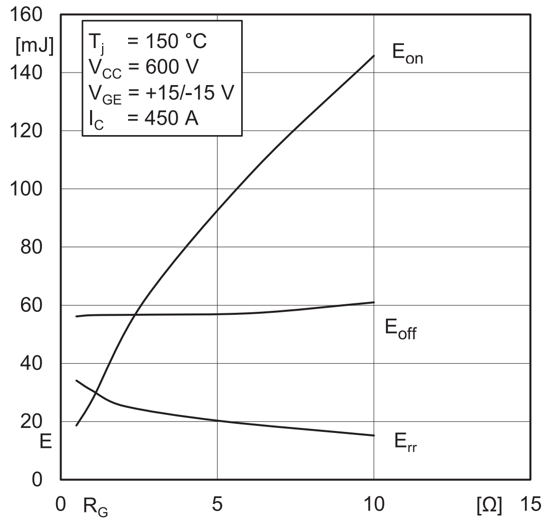


Fig. 4: Typ. turn-on /-off energy = f (R_G)

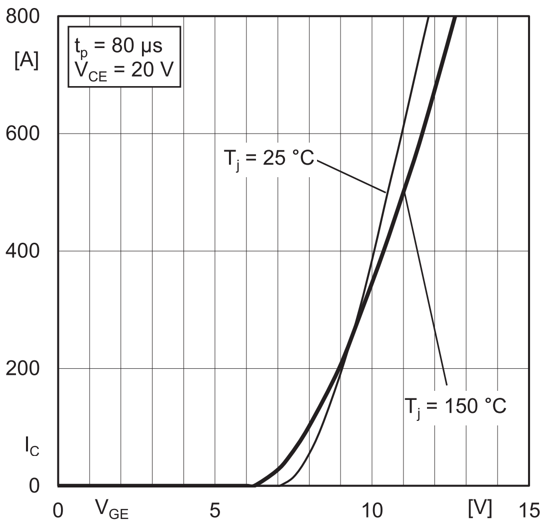


Fig. 5: Typ. transfer characteristic

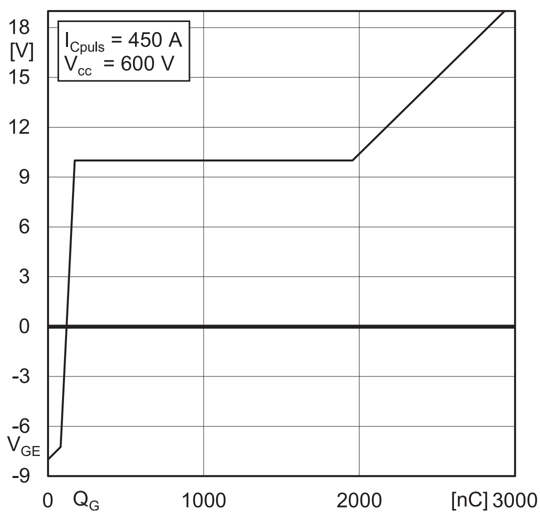


Fig. 6: Typ. gate charge characteristic

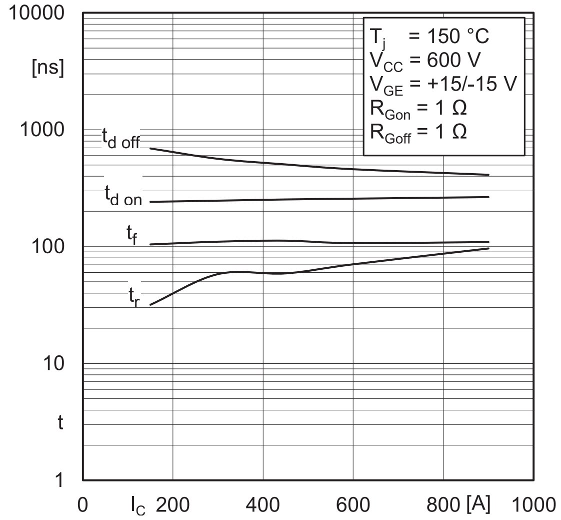


Fig. 7: Typ. switching times vs. I_C

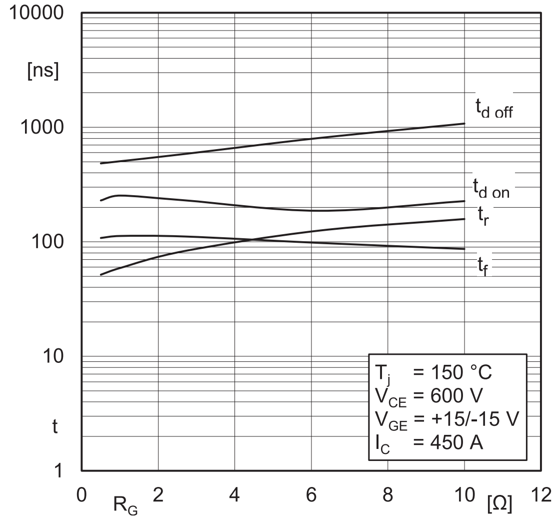


Fig. 8: Typ. switching times vs. gate resistor R_G

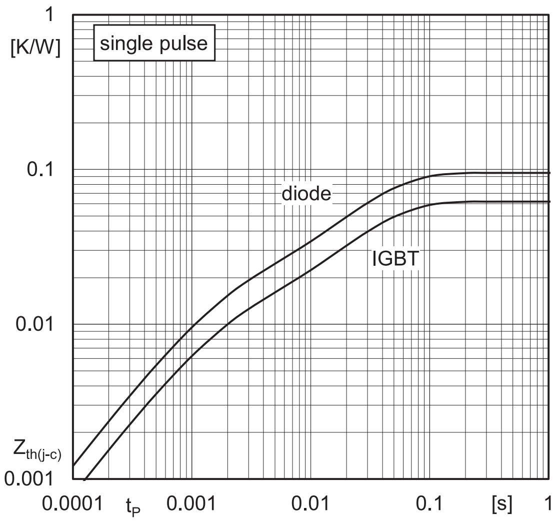


Fig. 9: Transient thermal impedance

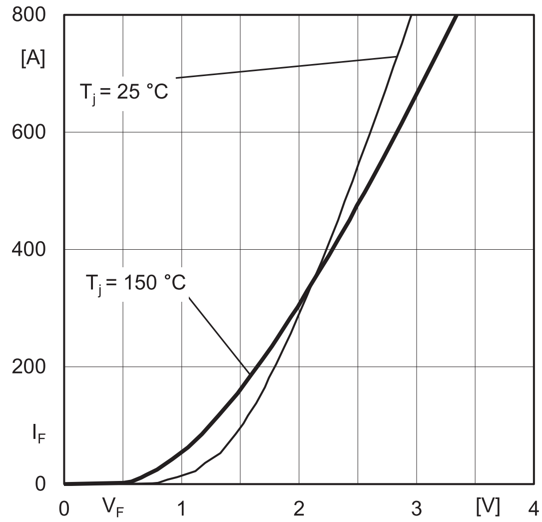


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

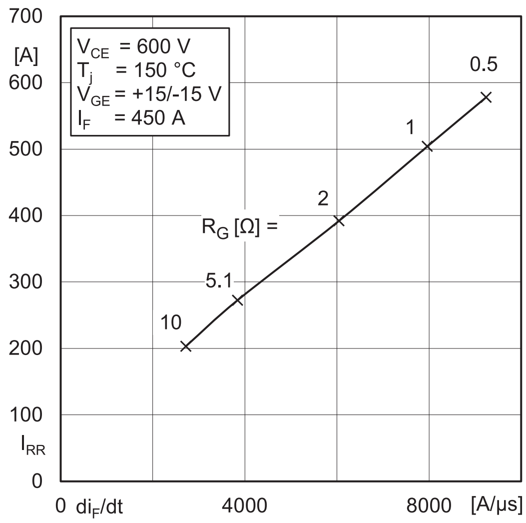


Fig. 11: Typ. CAL diode peak reverse recovery current

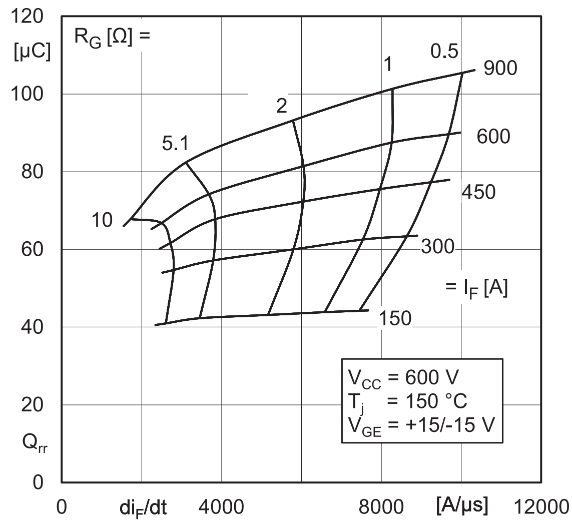
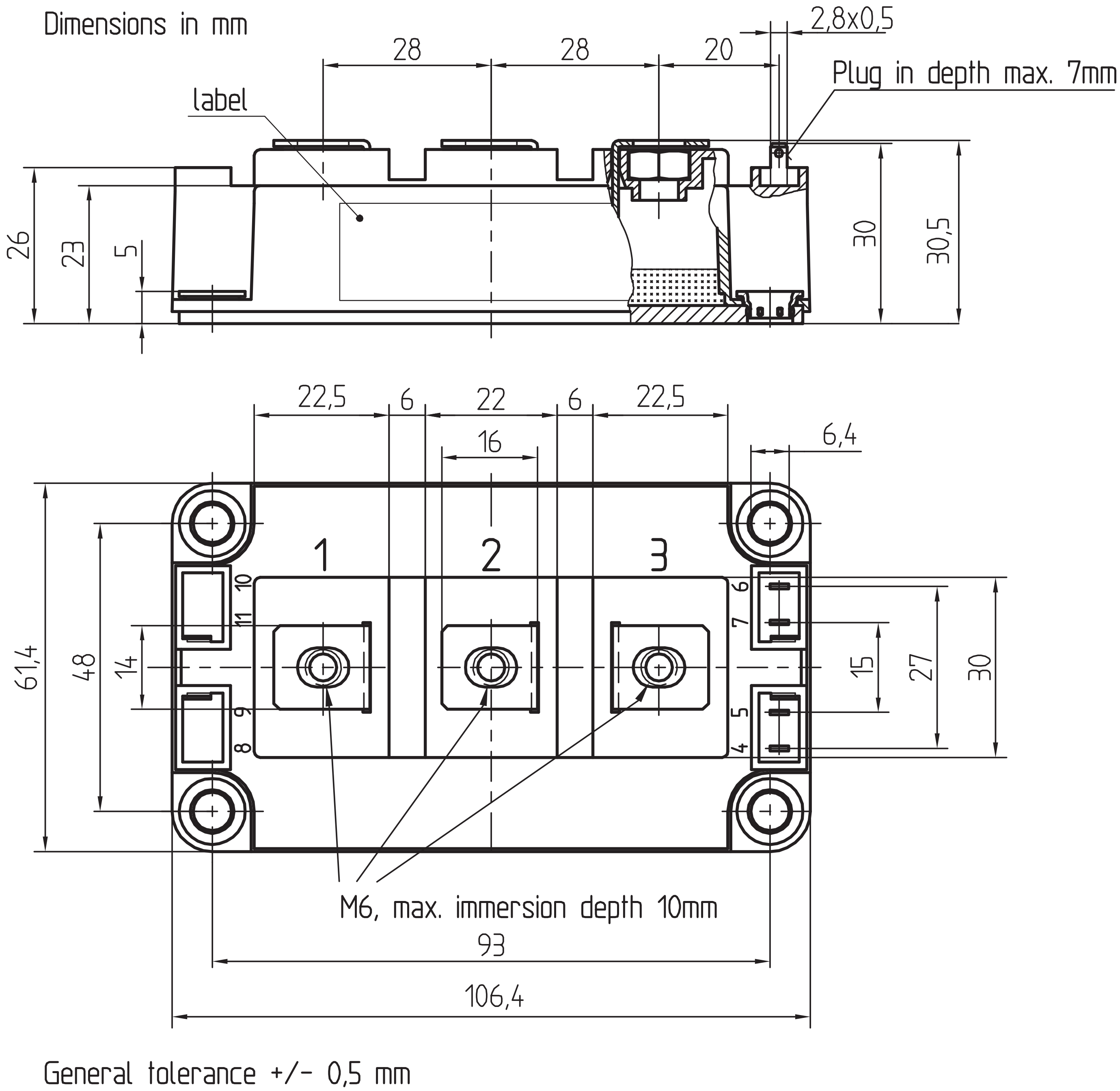


Fig. 12: Typ. CAL diode peak reverse recovery charge



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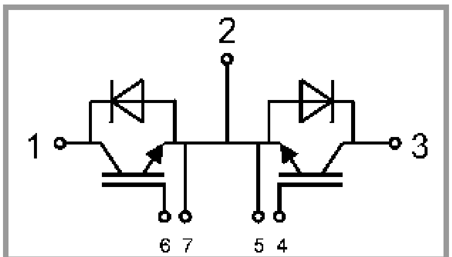

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This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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