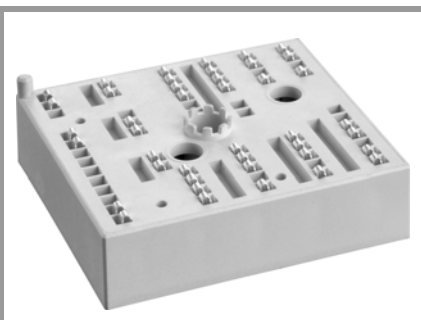


SKiIP 29TMLI12F4V1



MiniSKiIP® 2

3-Level TNPC IGBT-Module

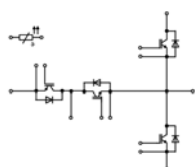
SKiIP 29TMLI12F4V1

Features*

- Fast Trench 4 IGBTs
- Trench IGBTs
- Robust and soft diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532

Remarks*

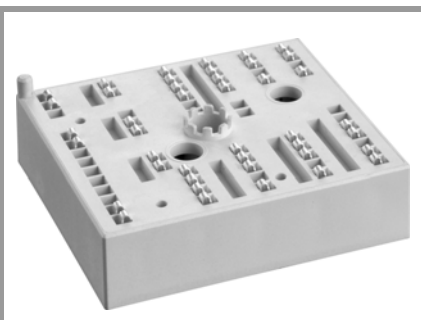
- Case temperature limited to $T_C=125^\circ\text{C}$ max.; $T_C = T_S$ (for baseplateless modules)
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{jop} = -40 \dots +150^\circ\text{C}$)
- IGBT 1: outer IGBTs T1&T4
- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
- Diode 2: inner diodes D2&D3



TMLI

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT1				
V_{CES}	$T_j = 25^\circ\text{C}$		1200	V
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	144	A
		$T_j = 175^\circ\text{C}$	115	A
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	172	A
		$T_j = 175^\circ\text{C}$	138	A
I_{Cnom}			150	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$		450	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800 \text{ V}, V_{GE} \leq 15 \text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 1200 \text{ V}$		6	μs
T_j			-40 ... 175	$^\circ\text{C}$
IGBT2				
V_{CES}	$T_j = 25^\circ\text{C}$		650	V
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	131	A
		$T_j = 175^\circ\text{C}$	104	A
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	150	A
		$T_j = 175^\circ\text{C}$	120	A
I_{Cnom}			150	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$		450	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 360 \text{ V}, V_{GE} \leq 15 \text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 650 \text{ V}$		6	μs
T_j			-40 ... 175	$^\circ\text{C}$
Diode1				
V_{RRM}	$T_j = 25^\circ\text{C}$		1200	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	148	A
		$T_j = 175^\circ\text{C}$	117	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	170	A
		$T_j = 175^\circ\text{C}$	136	A
I_{Fnom}			150	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$		450	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$		774	A
T_j			-40 ... 175	$^\circ\text{C}$
Diode2				
V_{RRM}	$T_j = 25^\circ\text{C}$		650	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	129	A
		$T_j = 175^\circ\text{C}$	99	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	155	A
		$T_j = 175^\circ\text{C}$	121	A
I_{Fnom}			150	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$		300	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$		1200	A
T_j			-40 ... 175	$^\circ\text{C}$
Module				
$I_t(\text{RMS})$			100	A
T_{stg}			-40 ... 125	$^\circ\text{C}$
V_{isol}	AC sinus 50 Hz, $t = 1 \text{ min}$		2500	V

SKiIP 29TMLI12F4V1



MiniSKiIP® 2

3-Level TNPC IGBT-Module

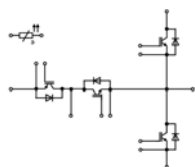
SKiIP 29TMLI12F4V1

Features*

- Fast Trench 4 IGBTs
- Trench IGBTs
- Robust and soft diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532

Remarks*

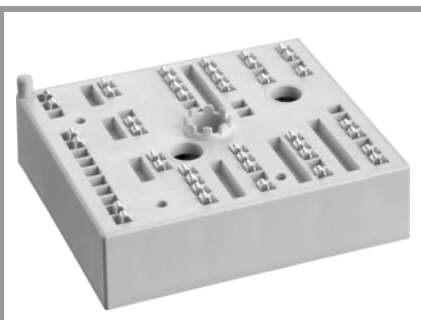
- Case temperature limited to $T_C = 125^\circ\text{C}$ max.; $T_C = T_S$ (for baseplateless modules)
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{jop} = -40 \dots +150^\circ\text{C}$)
- IGBT 1: outer IGBTs T1&T4
- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
- Diode 2: inner diodes D2&D3



TMLI

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	$I_C = 150\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		2.05	2.42	V
		$T_j = 150^\circ\text{C}$		2.59	2.96	V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$		1.10	1.28	V
		$T_j = 150^\circ\text{C}$		0.95	1.13	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		6.3	7.6	m Ω
		$T_j = 150^\circ\text{C}$		11	12	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 5.2\text{ mA}$		5.2	5.8	6.4	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$				0.3	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		8.80		nF
C_{oes}		$f = 1\text{ MHz}$		0.58		nF
C_{res}		$f = 1\text{ MHz}$		0.47		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$			850		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			5.0		Ω
$t_{d(on)}$	$V_{CE} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		155		ns
t_r	$I_C = 150\text{ A}$	$T_j = 150^\circ\text{C}$		54		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		5.2		mJ
$t_{d(off)}$	$R_{G on} = 1.6\ \Omega$	$T_j = 150^\circ\text{C}$		323		ns
t_f	$R_{G off} = 1.6\ \Omega$	$T_j = 150^\circ\text{C}$		66		ns
E_{off}	$di/dt_{on} = 2550\text{ A}/\mu\text{s}$ $di/dt_{off} = 1850\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		6.1		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$			0.35		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$			0.26		K/W
IGBT2						
$V_{CE(sat)}$	$I_C = 150\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		1.45	1.77	V
		$T_j = 150^\circ\text{C}$		1.70	2.10	V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$		0.90	1.00	V
		$T_j = 150^\circ\text{C}$		0.82	0.90	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		3.7	5.1	m Ω
		$T_j = 150^\circ\text{C}$		5.9	8.0	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 2.4\text{ mA}$		5.1	5.8	6.4	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}, T_j = 25^\circ\text{C}$				0.3	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		9.24		nF
C_{oes}		$f = 1\text{ MHz}$		0.60		nF
C_{res}		$f = 1\text{ MHz}$		0.27		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$			1360		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			2.0		Ω
$t_{d(on)}$	$V_{CE} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		118		ns
t_r	$I_C = 150\text{ A}$	$T_j = 150^\circ\text{C}$		40		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		1.6		mJ
$t_{d(off)}$	$R_{G on} = 1.6\ \Omega$	$T_j = 150^\circ\text{C}$		276		ns
t_f	$R_{G off} = 1.6\ \Omega$	$T_j = 150^\circ\text{C}$		79		ns
E_{off}	$di/dt_{on} = 3900\text{ A}/\mu\text{s}$ $di/dt_{off} = 1650\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		6.1		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$			0.57		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$			0.46		K/W

SKiIP 29TMLI12F4V1



MiniSKiIP® 2

3-Level TNPC IGBT-Module

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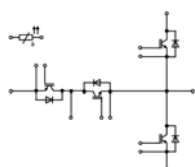
Features*

- Fast Trench 4 IGBTs
- Trench IGBTs
- Robust and soft diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532

Remarks*

- Case temperature limited to $T_C=125^\circ\text{C}$ max.; $T_C = T_S$ (for baseplateless modules)
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{jop} = -40 \dots +150^\circ\text{C}$)
- IGBT 1: outer IGBTs T1&T4
- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
- Diode 2: inner diodes D2&D3

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
$V_F = V_{EC}$	$I_F = 150\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		2.17	2.49	V
		$T_j = 150^\circ\text{C}$		2.11	2.42	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$		1.30	1.50	V
		$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$		5.8	6.6	m Ω
		$T_j = 150^\circ\text{C}$		8.1	8.8	m Ω
I_{RRM}	$I_F = 150\text{ A}$	$T_j = 150^\circ\text{C}$		191.3		A
Q_{rr}	$di/dt_{off} = 3760\text{ A}/\mu\text{s}$ $V_R = 300\text{ V}$	$T_j = 150^\circ\text{C}$		26		μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		6.5		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			0.45		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			0.36		K/W
Diode2						
$V_F = V_{EC}$	$I_F = 150\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		1.40	1.76	V
		$T_j = 150^\circ\text{C}$		1.39	1.77	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$		1.04	1.24	V
		$T_j = 150^\circ\text{C}$		0.85	0.99	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$		2.4	3.5	m Ω
		$T_j = 150^\circ\text{C}$		3.6	5.2	m Ω
I_{RRM}	$I_F = 150\text{ A}$	$T_j = 150^\circ\text{C}$		131.4		A
Q_{rr}	$di/dt_{off} = 2640\text{ A}/\mu\text{s}$ $V_R = 300\text{ V}$	$T_j = 150^\circ\text{C}$		13.5		μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		2.4		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			0.73		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			0.56		K/W
Module						
L_{sCE1}				-		nH
L_{CE}				-		nH
$R_{CC'+EE'}$			$T_s = 25^\circ\text{C}$	-		m Ω
			$T_s = 125^\circ\text{C}$	-		m Ω
M_s	to heat sink		2		2.5	Nm
M_t				-		Nm
						Nm
w				55		g
Temperature Sensor						
R_{100}	$T_r=100^\circ\text{C}$ ($R_{25}=1000\Omega$)			1670 \pm 3%		Ω
$R(T)$	$R(T)=1000\Omega[1+A(T-25^\circ\text{C})+B(T-25^\circ\text{C})^2]$ $A = 7.635 \cdot 10^{-3}\text{ }^\circ\text{C}^{-1}$, $B = 1.731 \cdot 10^{-5}\text{ }^\circ\text{C}^{-2}$					



TMLI

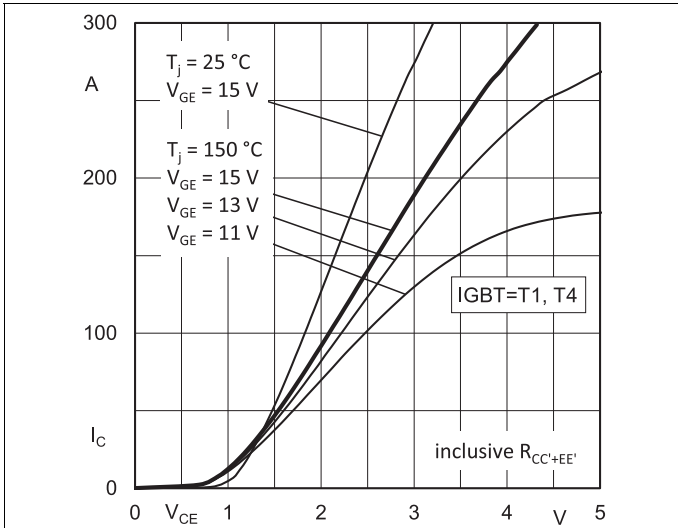


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

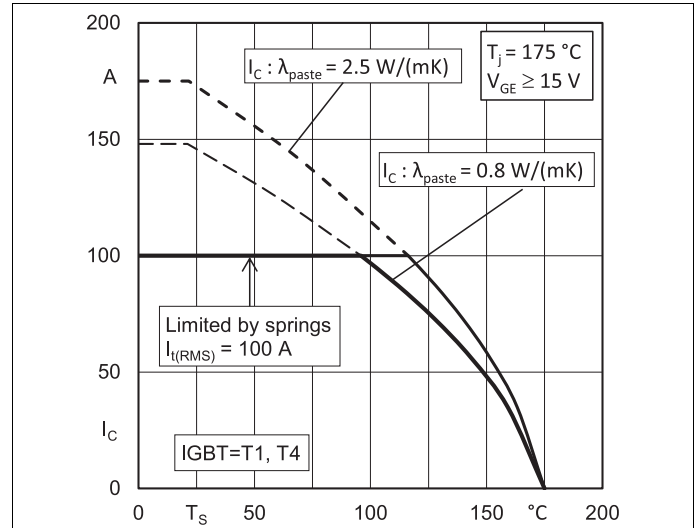


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_s)$

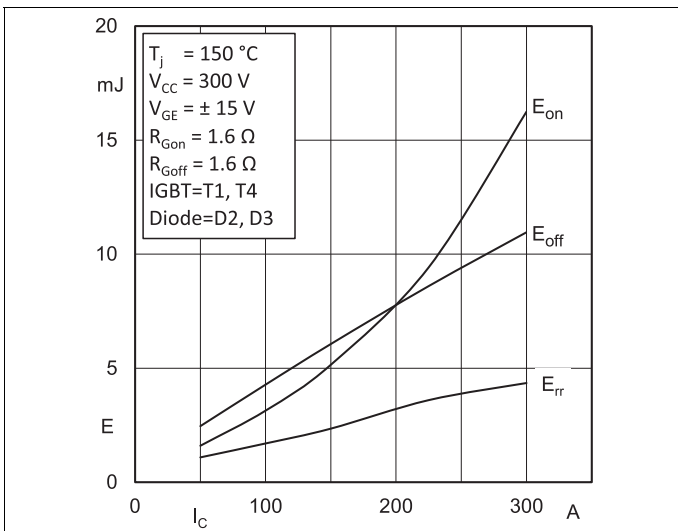


Fig. 3: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(I_c)$

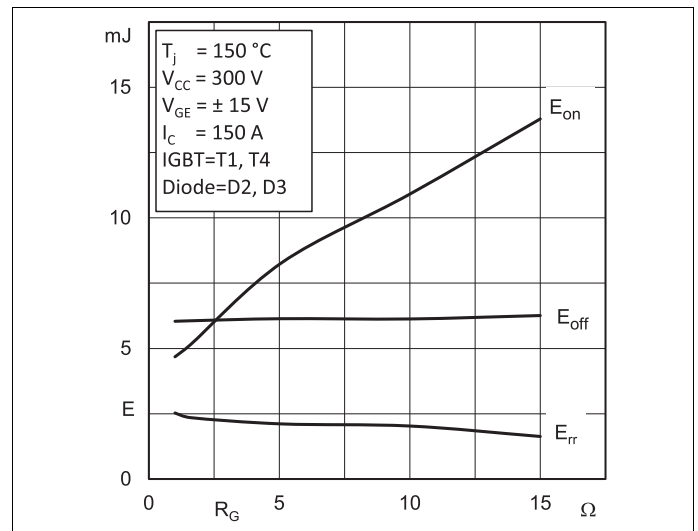


Fig. 4: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(R_G)$

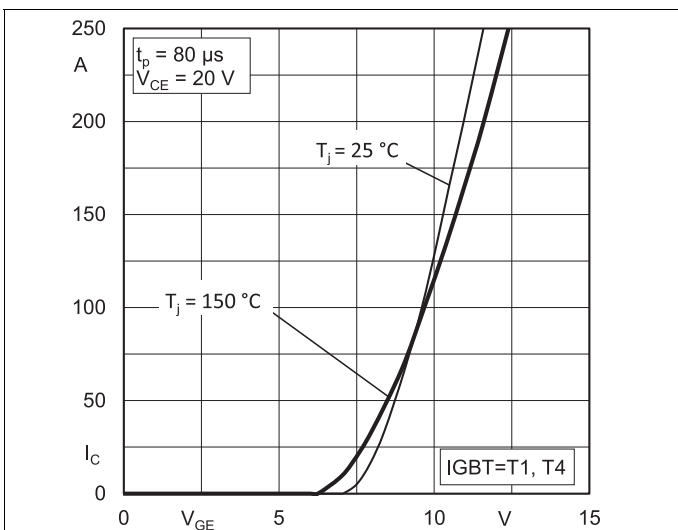


Fig. 5: Typ. IGBT1 transfer characteristic

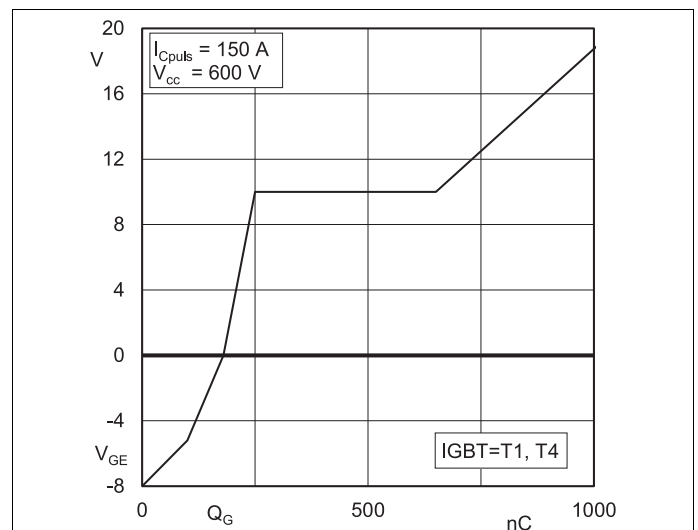
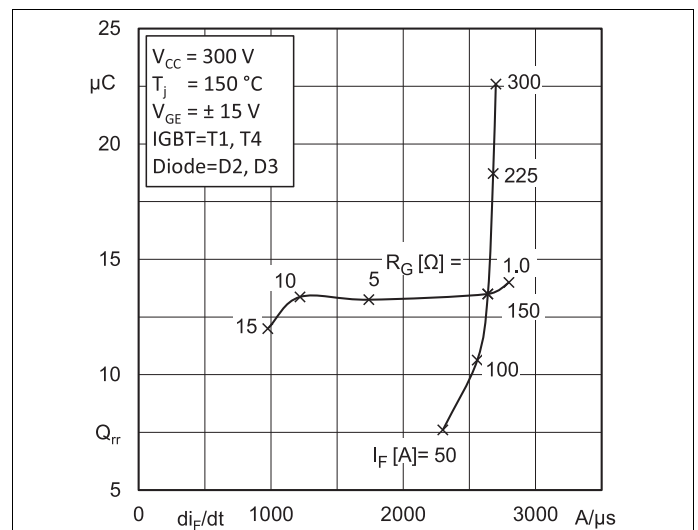
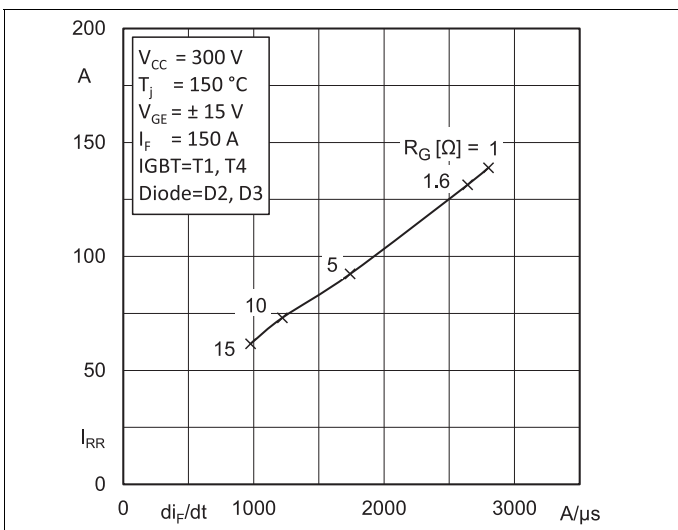
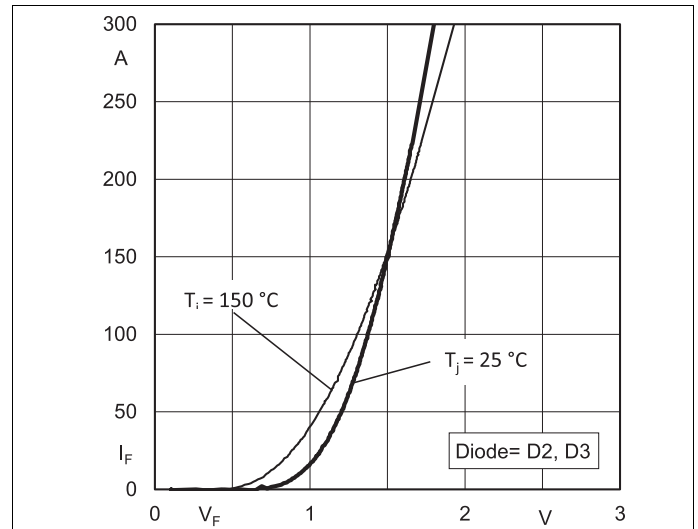
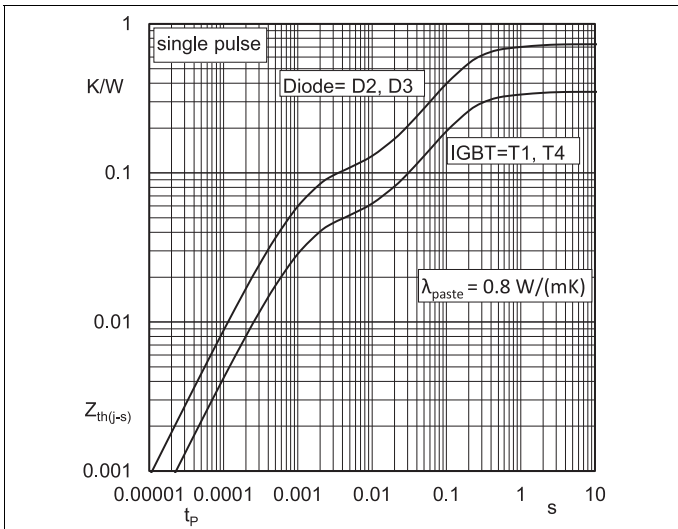
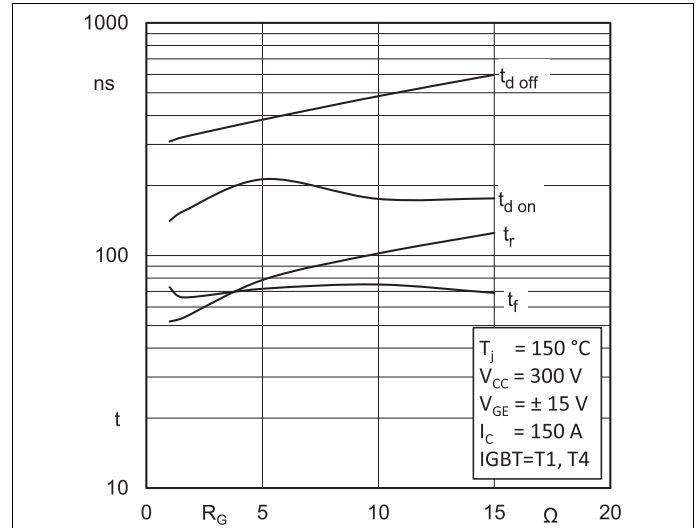
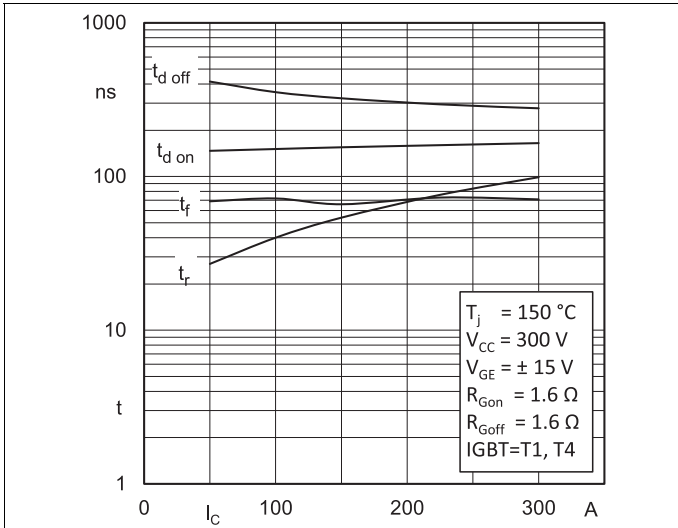
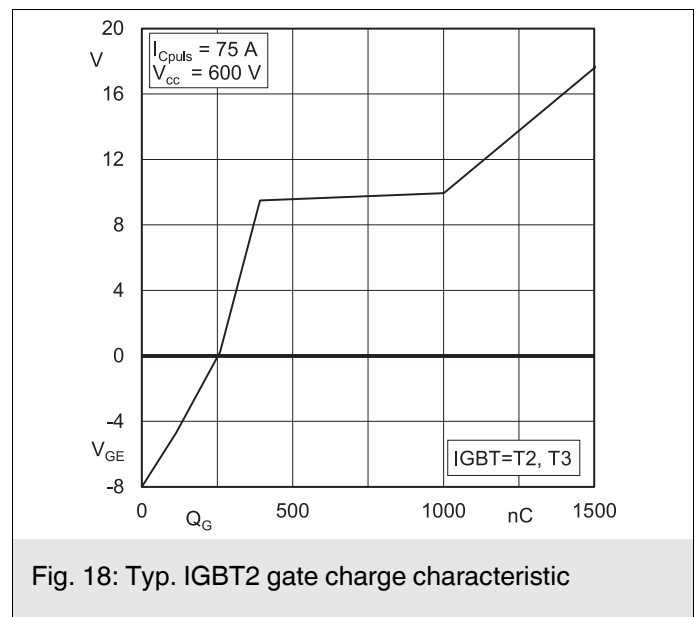
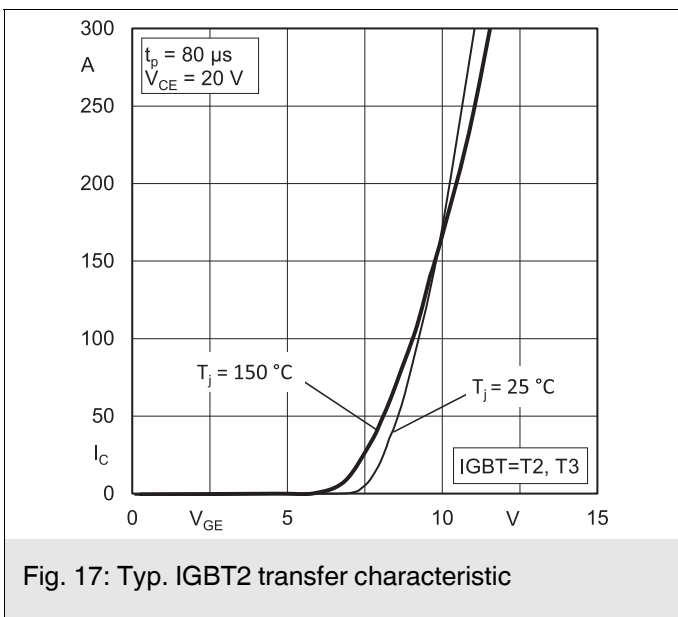
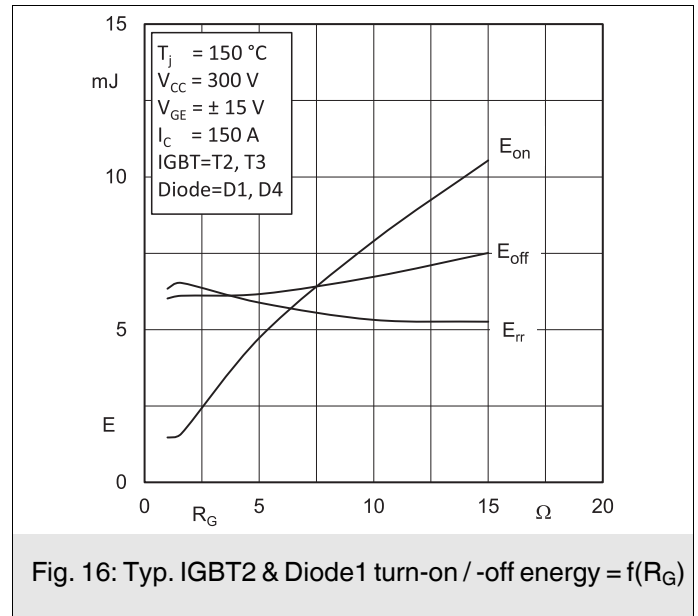
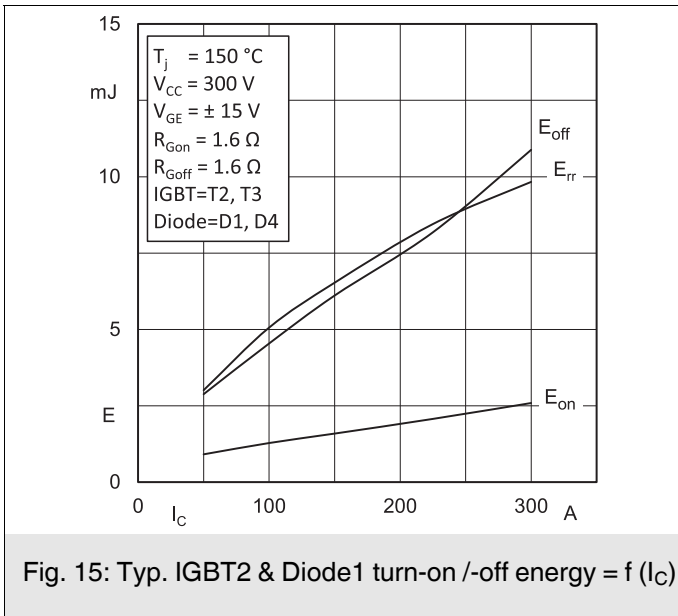
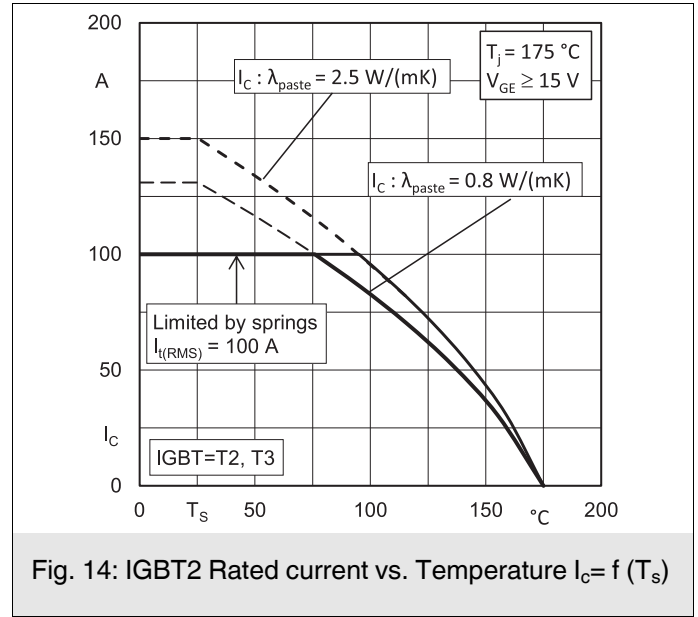
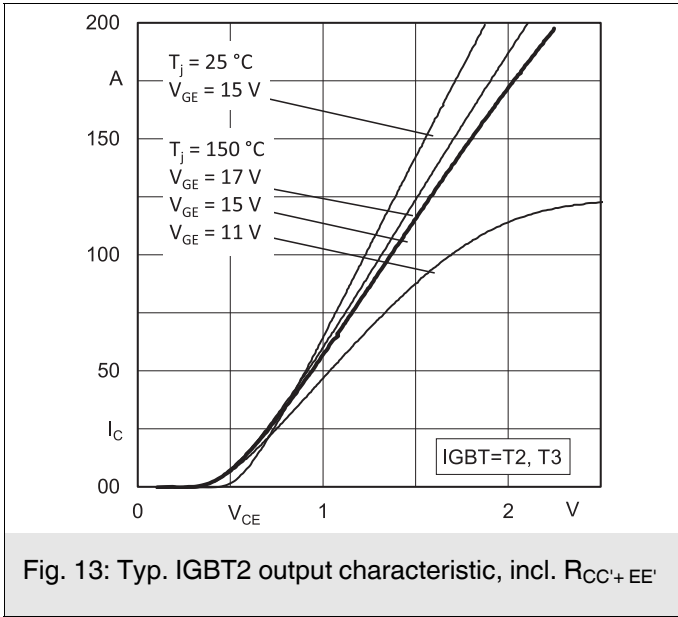


Fig. 6: Typ. IGBT1 gate charge characteristic





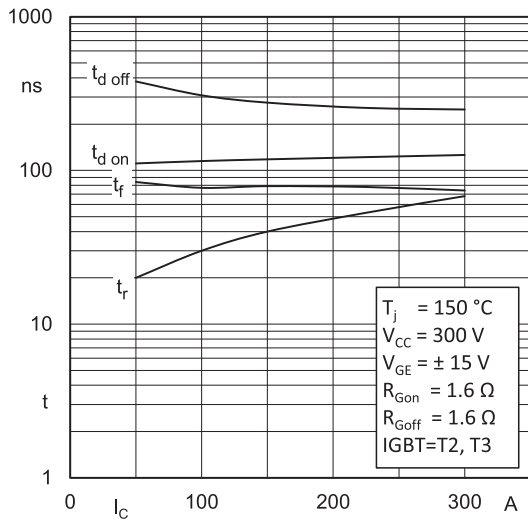


Fig. 19: Typ. IGBT2 switching times vs. I_C

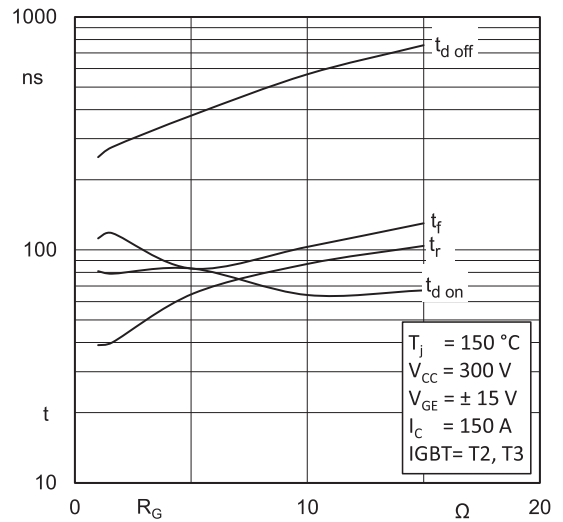


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

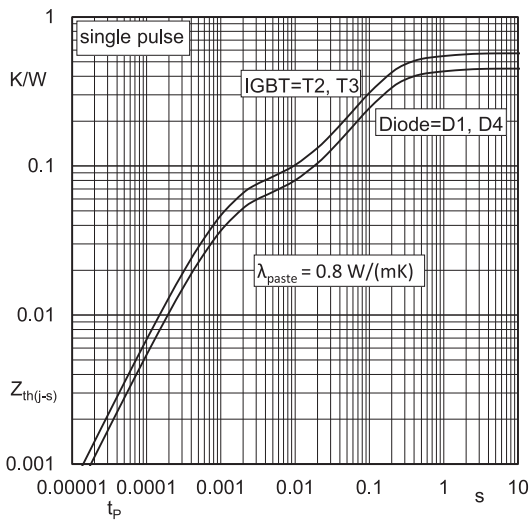


Fig. 21: Transient thermal impedance of IGBT2 & Diode1

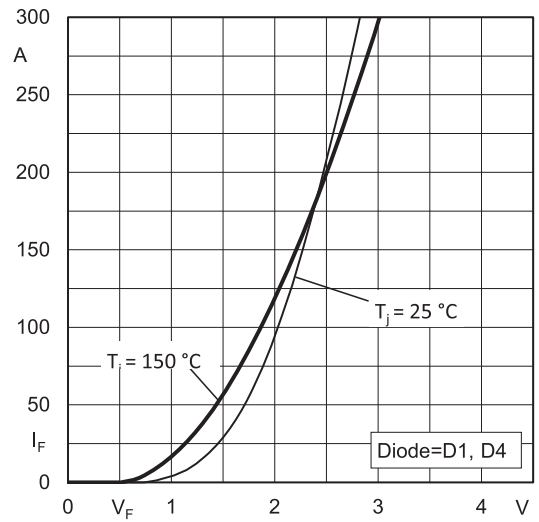


Fig. 22: Typ. Diode1 forward characteristic, incl. $R_{CC+EE'}$

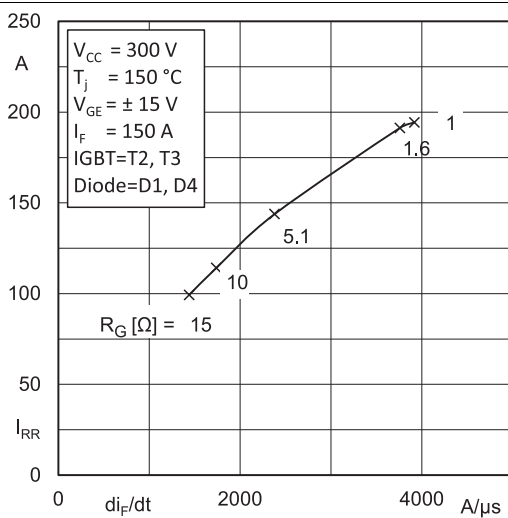


Fig. 23: Typ. Diode1 peak reverse recovery current

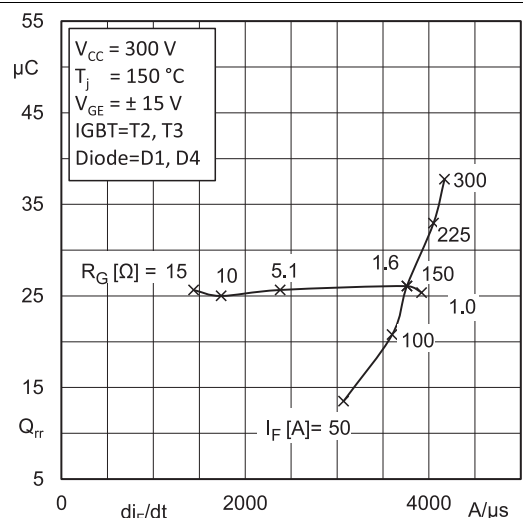
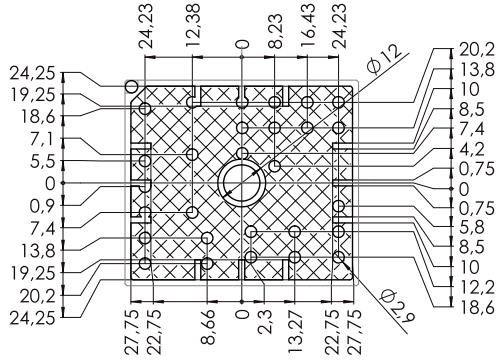


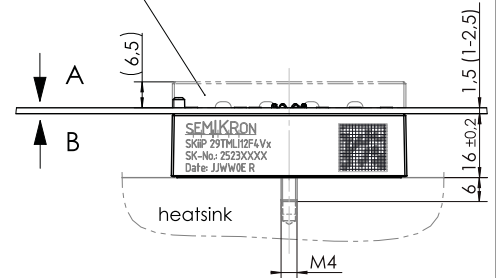
Fig. 24: Typ. Diode1 recovery charge

A

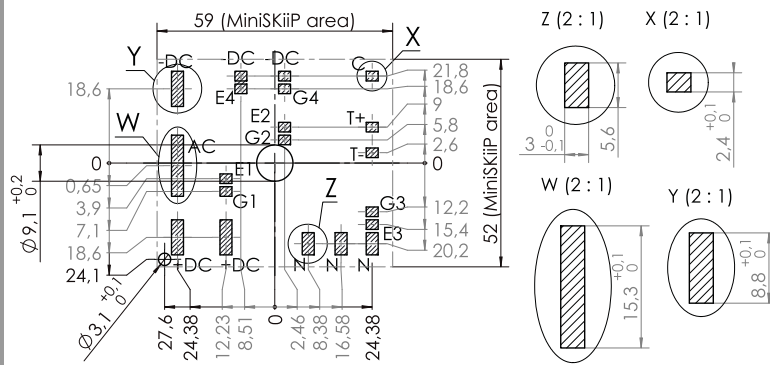
Mounting area for SMD, height max. 3,5
only valid for standard pressure part



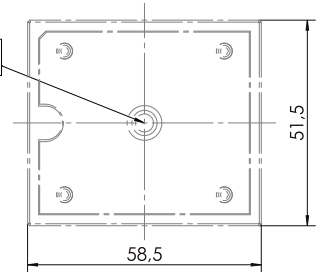
standard pressure part
not part of MiniSKiIP, must
be ordered separately



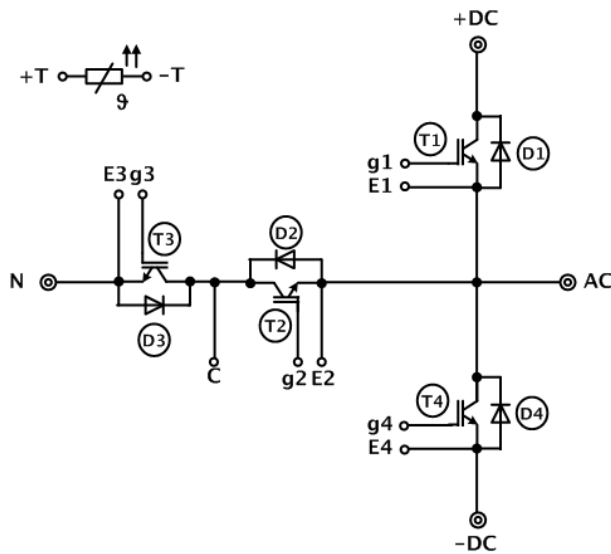
B



For mounting please follow
the assembly instruction



pinout, dimensions



- ⊙ power connector
- control connector

pinout

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

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