SEMiX® 3p

Trench IGBT Modules

SEMiX453GB12E4p

Features*

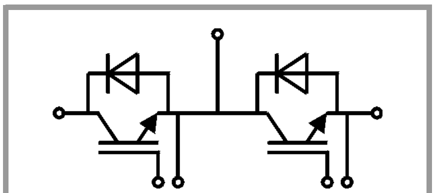
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Press-fit pins as auxiliary contacts
- UL recognized, file no. E63532

Typical Applications

- AC inverter drives
- UPS
- Renewable energy systems

Remarks

- Product reliability results are valid for T_j=150°C
- V_{isol} between temperature sensor and power section is only 2500V
- For storage and case temperature with TIM see document “TP(*) SEMiX 3p”



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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	678	A
		T_c = 80 °C	521	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	578	A
		T_c = 80 °C	433	A
I_{Fnom}			450	A
I_{FRM}	I_{FRM} = 3xI_{Fnom}		1350	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 25 °C		2430	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$			600	A
T_{stg}	module without TIM		-40 ... 125	°C
V_{isol}	AC sinus 50Hz, 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		1.80	2.05	V
		T_j = 150 °C		2.19	2.40	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		2.2	2.6	mΩ
		T_j = 150 °C		3.3	3.6	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 18 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		27.9		nF
C_{oes}		f = 1 MHz		1.74		nF
C_{res}		f = 1 MHz		1.53		nF
Q_G	V_{GE} = - 8 V...+ 15 V			2550		nC
R_{Gint}	T_j = 25 °C			1.7		Ω
$t_{d(on)}$	V_{CC} = 600 V I_C = 450 A V_{GE} = +15/-15 V $R_{G\ on}$ = 1.1 Ω $R_{G\ off}$ = 1.1 Ω di/dt_{on} = 7000 A/µs di/dt_{off} = 3300 A/µs dv/dt = 4800 V/µs L_s = 21 nH	T_j = 150 °C		160		ns
t_r		T_j = 150 °C		60		ns
E_{on}		T_j = 150 °C		32		mJ
$t_{d(off)}$		T_j = 150 °C		480		ns
t_f		T_j = 150 °C		115		ns
E_{off}		T_j = 150 °C		57		mJ
$R_{th(j-c)}$	per IGBT				0.066	K/W
$R_{th(c-s)}$	per IGBT (λ_{grease}=0.81 W/(m*K))			0.03		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material			0.021		K/W

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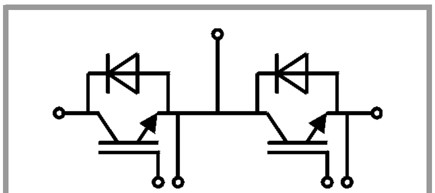
Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Inverse diode						
$V_F = V_{EC}$	I_F = 450 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.14	2.46	V
		T_j = 150 °C		2.07	2.38	V
V_{F0}	chiplevel	T_j = 25 °C		1.30	1.50	V
		T_j = 150 °C		0.90	1.10	V
r_F	chiplevel	T_j = 25 °C		1.87	2.1	mΩ
		T_j = 150 °C		2.6	2.8	mΩ
I_{RRM}	I_F = 450 A di/dt_{off} = 7000 A/µs V_{GE} = -15 V V_{CC} = 600 V	T_j = 150 °C		460		A
Q_{rr}		T_j = 150 °C		77		µC
E_{rr}		T_j = 150 °C		30		mJ
$R_{th(j-c)}$	per diode				0.1	K/W
$R_{th(c-s)}$	per diode (λ_{grease}=0.81 W/(m*K))			0.045		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.036		K/W
Module						
L_{CE}				20		nH
$R_{CC'+EE'}$	measured per switch	T_C = 25 °C		0.95		mΩ
		T_C = 125 °C		1.25		mΩ
$R_{th(c-s)1}$	calculated without thermal coupling			0.009		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module (λ_{grease}=0.81 W/(m*K))			0.014		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module, pre-applied phase change material			0.011		K/W
M_s	to heat sink (M5)		3		6	Nm
M_t		to terminals (M6)	3		6	Nm
						Nm
w					350	g
Temperature Sensor						
R_{100}	T_c=100°C (R_{25}=5 kΩ)			493 ± 5%		Ω
$B_{100/125}$	$R_{(T)}=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; T[K];			3550 ±2%		K



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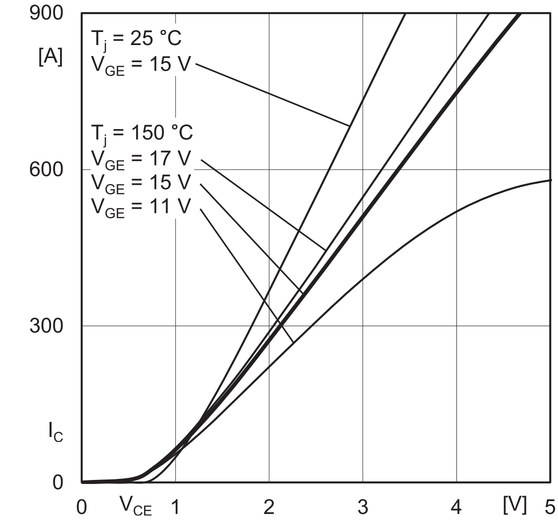


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

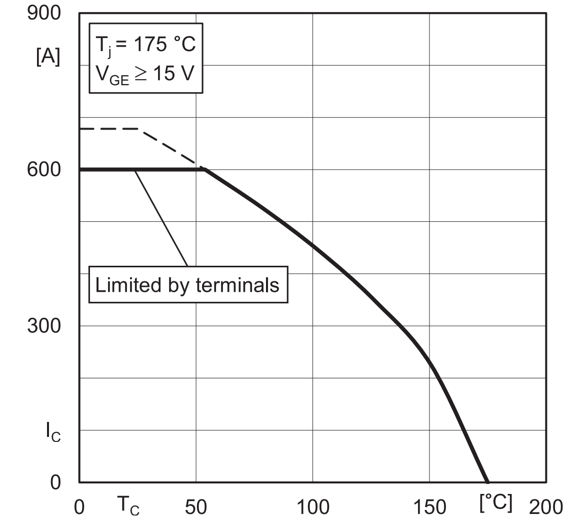


Fig. 2: Rated current vs. temperature $I_C = f (T_C)$

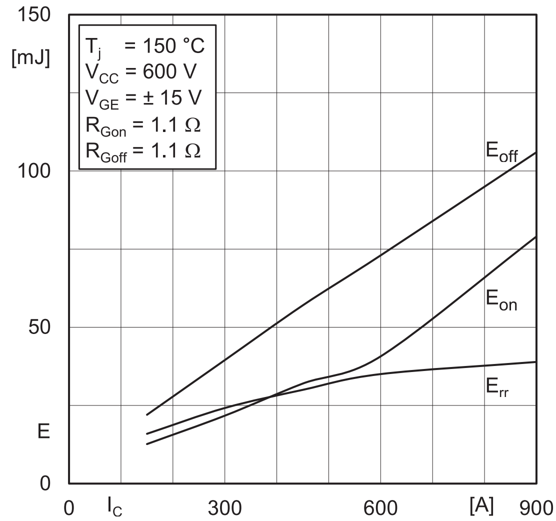


Fig. 3: Typ. turn-on /-off energy = f (I_C)

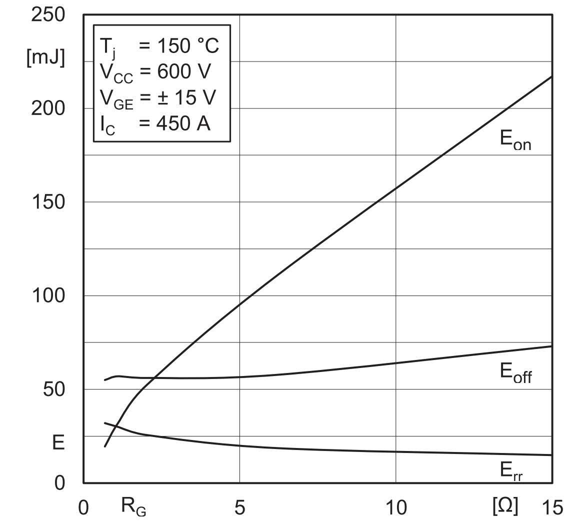


Fig. 4: Typ. turn-on /-off energy = f (R_G)

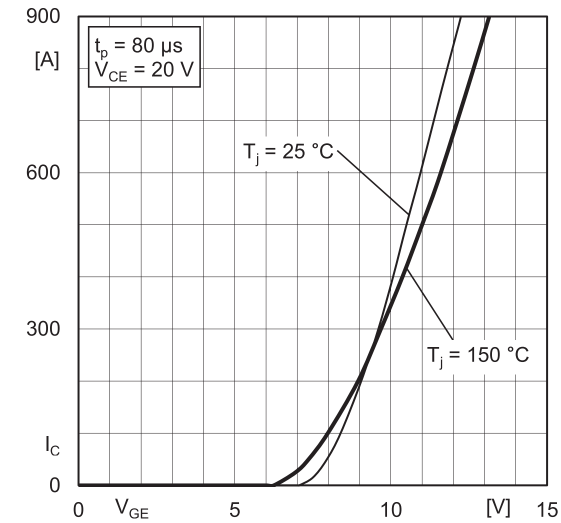


Fig. 5: Typ. transfer characteristic

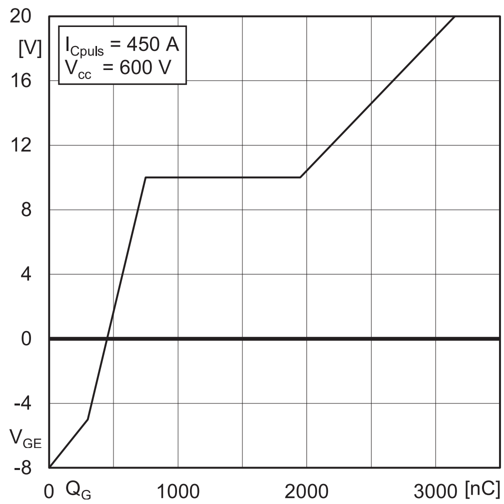


Fig. 6: Typ. gate charge characteristic

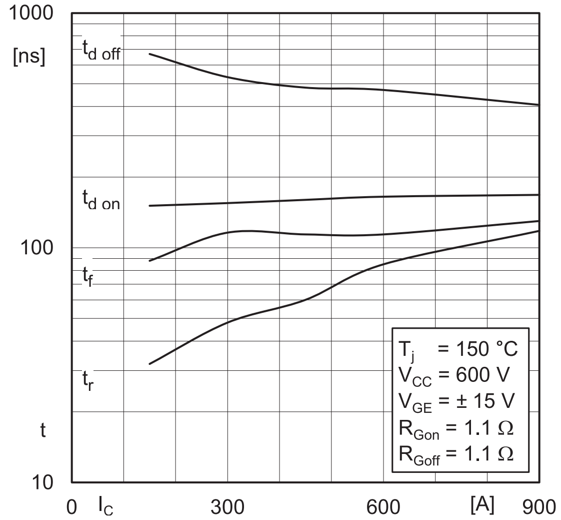


Fig. 7: Typ. switching times vs. I_C

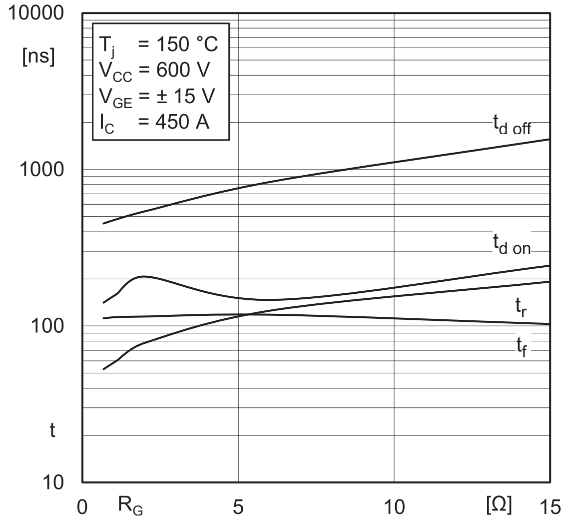


Fig. 8: Typ. switching times vs. gate resistor R_G

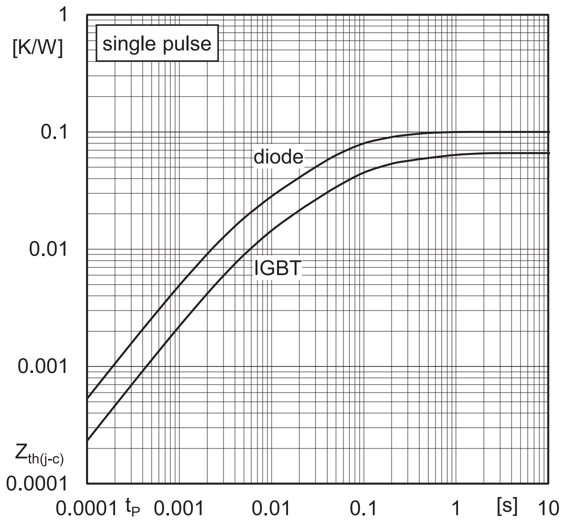


Fig. 9: Transient thermal impedance

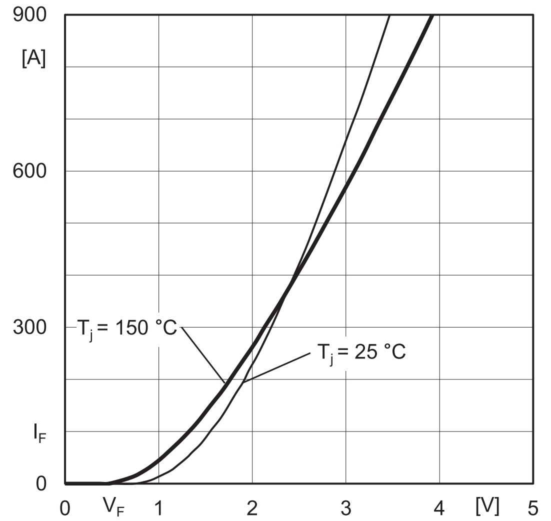


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+ EE'}$

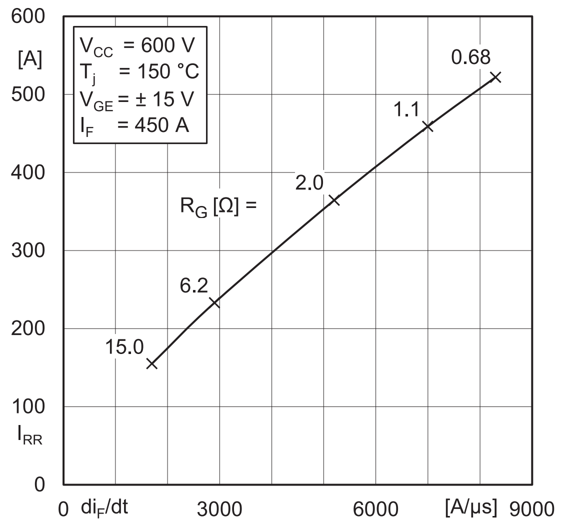


Fig. 11: Typ. CAL diode peak reverse recovery current

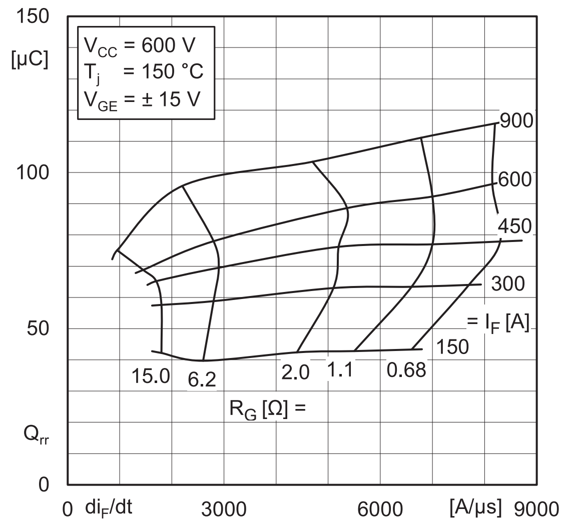
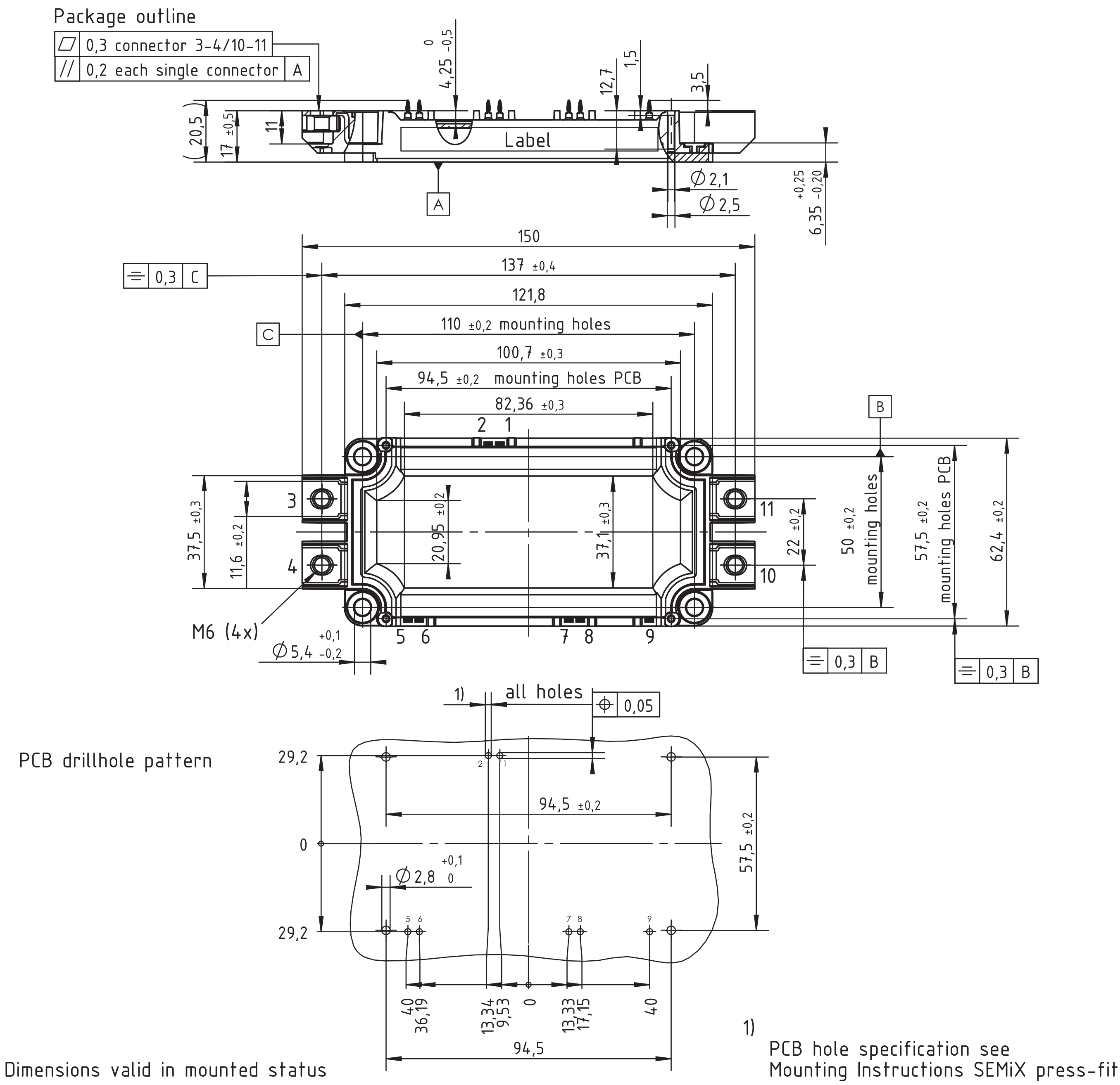


Fig. 12: Typ. CAL diode recovery charge



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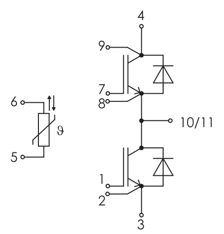

pinout

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

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