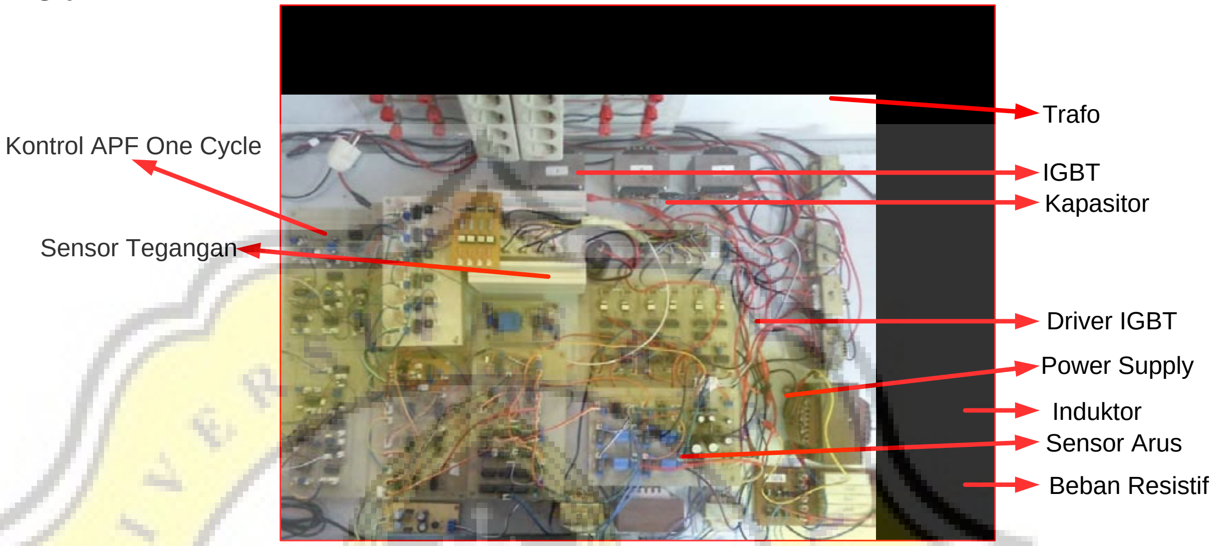
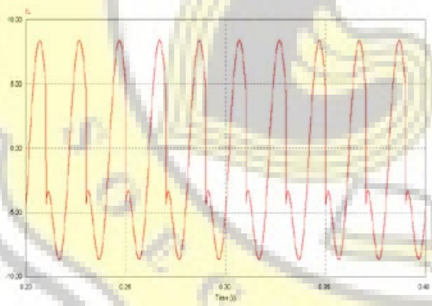
Lampiran

Berikut adalah lampiran dari tugas akhir tapis daya aktif shunt berbasis one cycle control, berupa gambar alat, gambar bentuk gelombang hasil simulasi dan pengujian di laboratorium, serta datasheet IGBT.

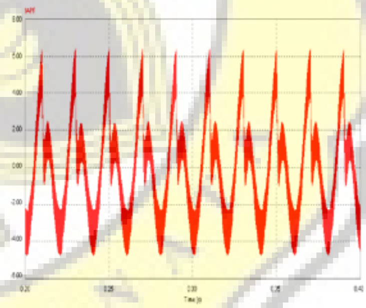


Gambar Alat Tapis Daya Aktif Shunt berbasis One – Cycle Control

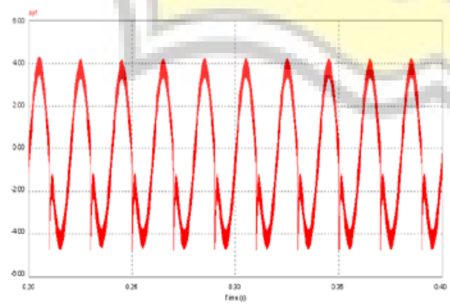
Berikut adalah gambar hasil simulasi PSIM:



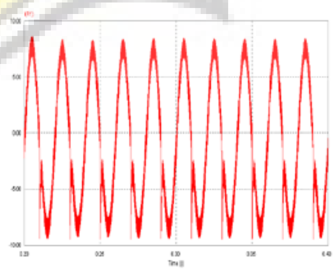
Arus Beban



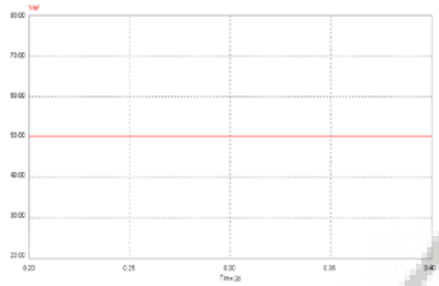
Arus Kompensasi



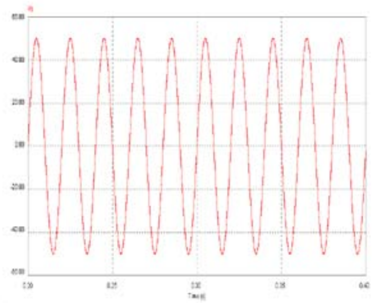
Arus APF



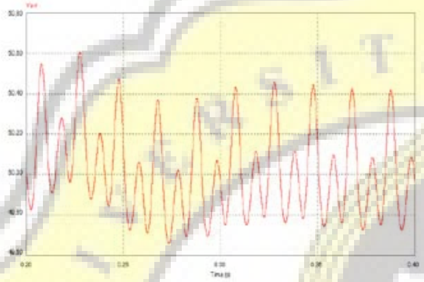
Arus Sumber



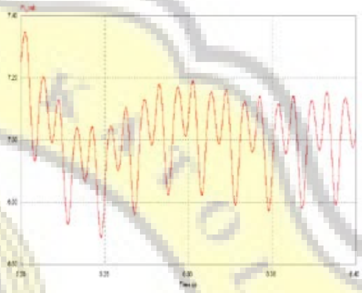
Tegangan Referensi



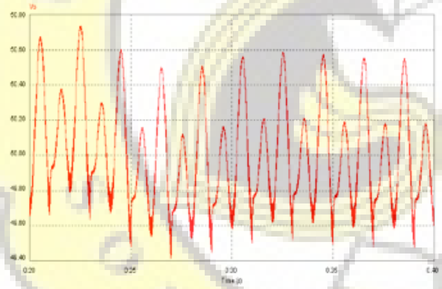
Tegangan Sumber



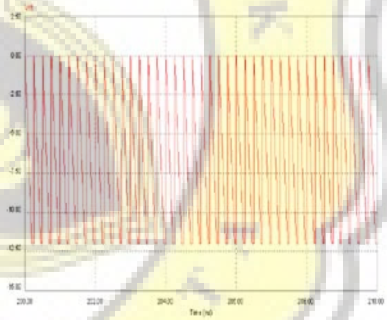
Tegangan Aktual



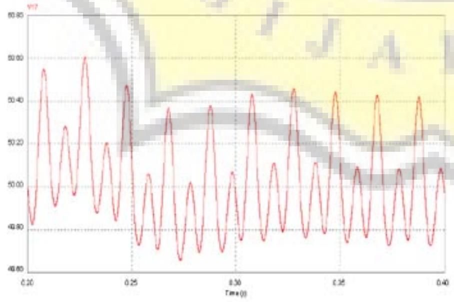
Keluaran Sensor Tegangan



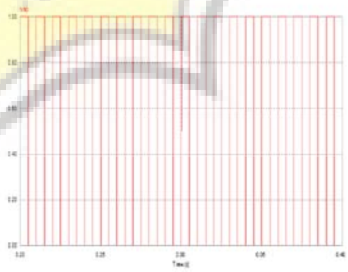
Keluaran PI



Keluaran Integrator

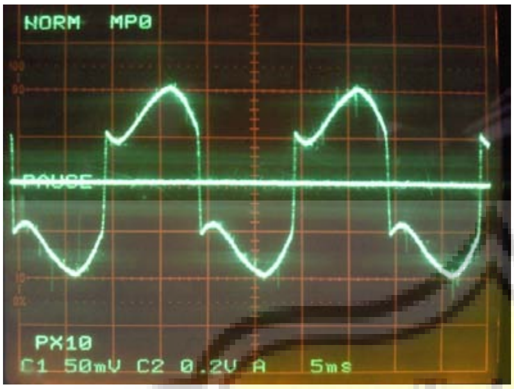


Keluaran LPF

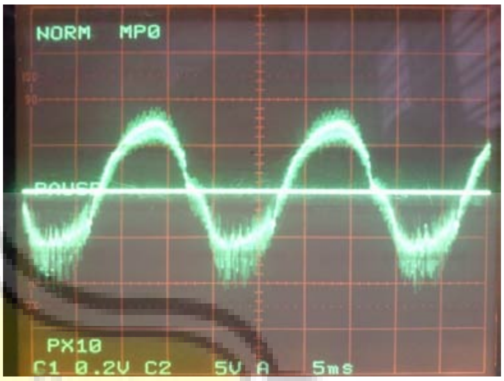


Keluaran dari Penyearah

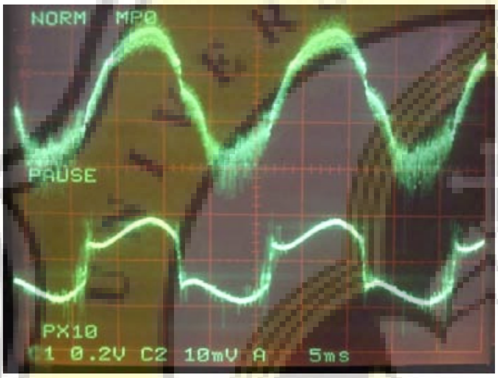
Berikut adalah gambar hasil pengujian di lab:



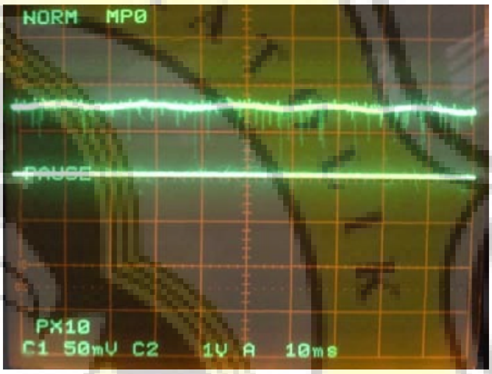
Arus Beban



Arus Sumber

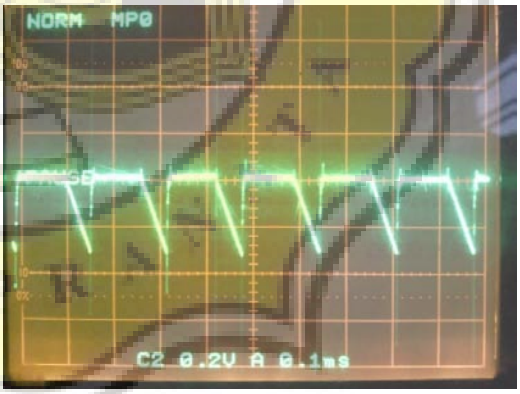


Arus Beban dan Arus

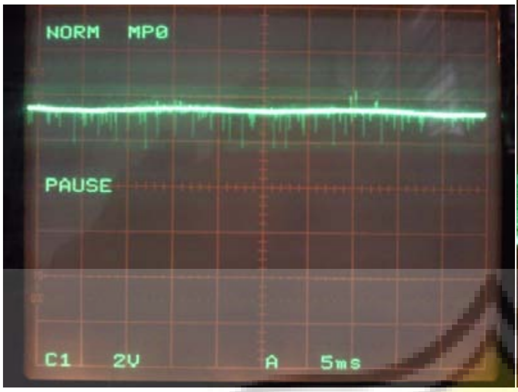


Sumber Output PI

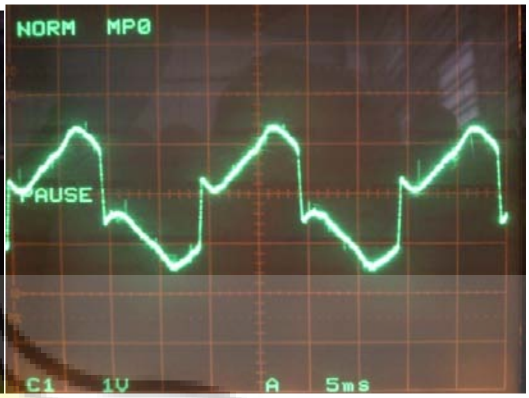
Output Clock 555



Output Integrator



Output LPF



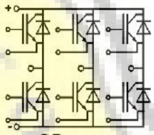
Output Sensor Arus sebelum diinjek Arus kompensasi

SEMIKRON

SEMITRANS® M
IGBT Modules

SKM 22 GD 123 D
SKM 22 GD 123 D L*)

Sixpack



GD

Absolute Maximum Ratings Symbol	Conditions 1)	Values	Units
V_{CES}		1200	V
V_{CGR}	R_{GE} = 20 kΩ	1200	V
I_C	T_{case} = 25/80 °C	25 / 15	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	50 / 30	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	145	W
T_j, (T_{stg})		– 40 . . .+150 (125)	°C
V_{isol}	AC, 1 min.	2 500	V
humidity	DIN 40 040	Class F	
climate	DIN IEC 68 T.1	55/150/56	
Inverse Diode			
I_F = – I_C	T_{case} = 25/80 °C	25 / 15	A
I_{FM} = – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	50 / 30	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	200	A
I^2t	t_p = 10 ms; T_j = 150 °C	200	A^2s

Characteristics Symbol	Conditions 1)	min.	typ.	max.	Units
$V_{(BR)GES}$	V_{GE} = 0, I_C = 0,5 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	0,3	0,5	mA
	V_{CE} = V_{CES}, T_j = 125 °C	–	1,8	–	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	150	nA
V_{CEsat}	I_C = 15 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 22 A	–	3(3,7)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 15 A	–	12	–	S
C_{CHC}	per IGBT	–	–	300	pF
C_{ies}	V_{GE} = 0	–	1000	–	pF
C_{oes}	V_{CE} = 25 V	–	150	–	pF
C_{res}	f = 1 MHz	–	70	–	pF
L_{CE}		–	–	60	nH
$t_{d(on)}$	V_{CC} = 600 V	–	40	–	ns
t_r	V_{GE} = + 15 V / - 15 V 3)	–	35	–	ns
$t_{d(off)}$	I_C = 15 A, ind. load	–	350	–	ns
t_f	R_{Gon} = R_{Goff} = 52 Ω	–	70	–	ns
E_{on} 5)	T_j = 125 °C	–	2	–	mWs
E_{off} 5)		–	1,4	–	mWs
Inverse Diode 8)					
V_F = V_{EC}	I_F = 15 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 25 A	–	2,3(2,1)	–	V
V_{TO}	T_j = 125 °C	–	1,1	1,2	V
r_T	T_j = 125 °C	–	45	70	mΩ
I_{RR}	I_F = 15 A; T_j = 25 (125) °C 2)	–	12(16)	–	A
Q_{rr}	I_F = 15 A; T_j = 25 (125) °C 2)	–	1(2,7)	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,86	°C/W
R_{thjc}	per diode 8)	–	–	1,5	°C/W
R_{thch}	per module	–	–	0,05	°C/W

Features

- MOS input (voltage controlled)
- N channel, homogeneous Si
- Low inductance case
- Very low tail current with low temperature dependence
- High short circuit capability, self limiting to 6 * I_{cnom}
- Latch-up free
- Fast & soft inverse CAL diodes 8)
- Isolated copper baseplate using DCB Direct Copper Bonding Technology
- Large clearance (9 mm) and creepage distances (13 mm).

Typical Applications

- Switched mode power supplies
- Three phase inverters for AC motor speed control
- General power switching applications
- Pulse frequencies also above 15 kHz

1) T_{case} = 25 °C, unless otherwise specified
2) I_F = – I_C, V_R = 600 V, – di_F/dt = 400 A/µs, V_{GE} = 0 V
3) Use: V_{GEoff} = -5 ... -15 V
5) See fig. 2 + 3; R_{Goff} = 52 Ω
8) CAL = Controlled Axial Lifetime Technology.

***) Main terminals = 2 mm dia.**

Cases and mech. data → B6 - 10 Sixpack

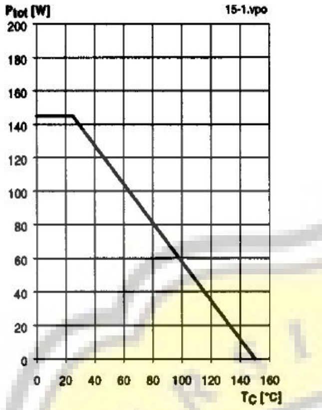
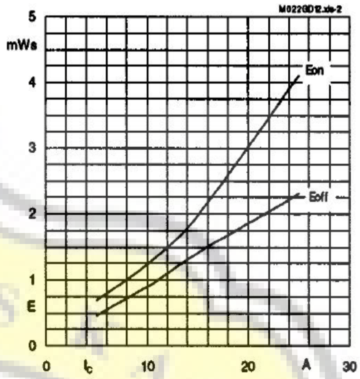
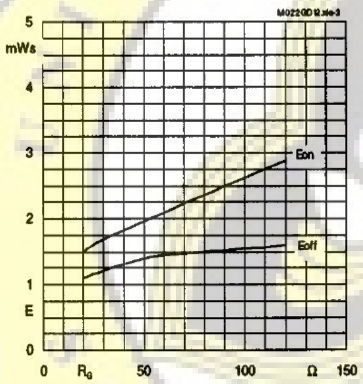


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



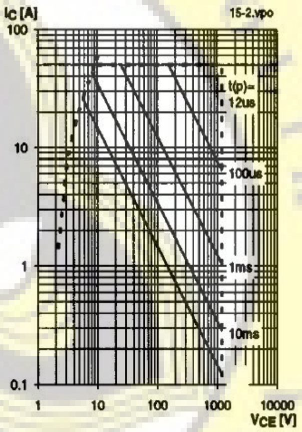
$T_j = 125$ °C
$V_{CE} = 600$ V
$V_{GE} = \pm 15$ V
$R_G = 52\ \Omega$

Fig. 2 Turn-on /-off energy = f (I_C)



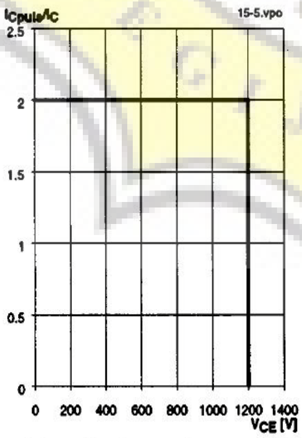
$T_j = 125$ °C
$V_{CE} = 600$ V
$V_{GE} = \pm 15$ V
$I_C = 15$ A

Fig. 3 Turn-on /-off energy = f (R_G)



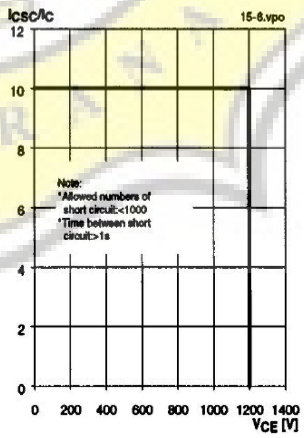
1 pulse
$T_C = 25$ °C
$T_j \leq 150$ °C

Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$



$T_j \leq 150$ °C
$V_{GE} = \pm 15$ V
$R_{g(off)} = 52\ \Omega$
$I_C = 15$ A

Fig. 5 Turn-off safe operating area (RBSOA)



$T_j \leq 150$ °C
$V_{GE} = \pm 15$ V
$t_{sc} \leq 10$ ms
$L < 25$ nH
$I_{CN} = 15$ A

Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

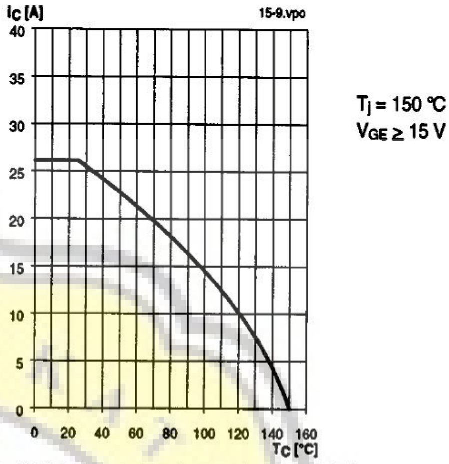


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

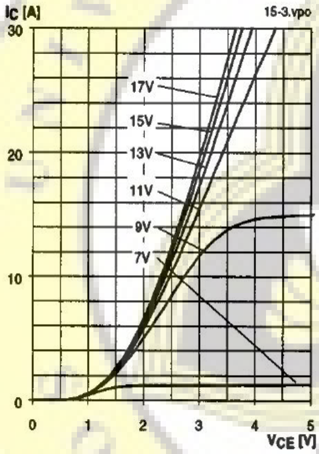


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

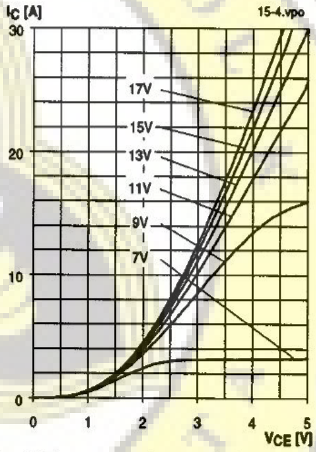


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

$P_{cond(t)} = V_{CEsat(t)} \cdot I_{C(t)}$

$V_{CEsat(t)} = V_{CE(TO)(Tj)} + r_{CE(Tj)} \cdot I_{C(t)}$

$V_{CE(TO)(Tj)} \leq 1{,}5 + 0{,}002\ (T_j - 25)$ [V]

$r_{CE(Tj)} = 0{,}067 + 0{,}00026\ (T_j - 25)$ [Ω]

valid for $V_{GE} = +15\,^{+2}_{-1}$ [V]; $I_C > 0{,}3\ I_{Cnom}$

Fig. 11 Typ. saturation characteristic (IGBT)
Calculation elements and equations

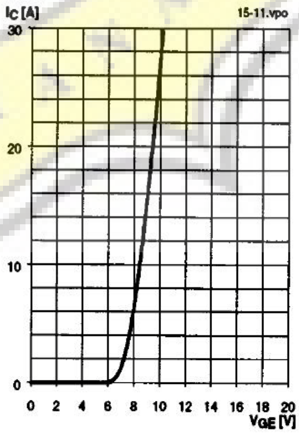


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V

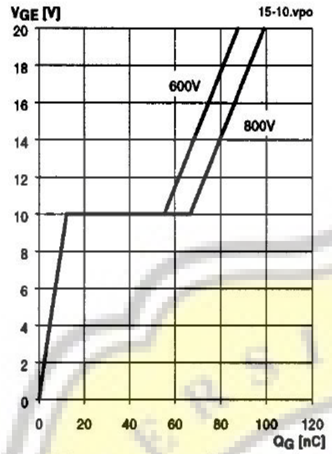


Fig. 13 Typ. gate charge characteristic

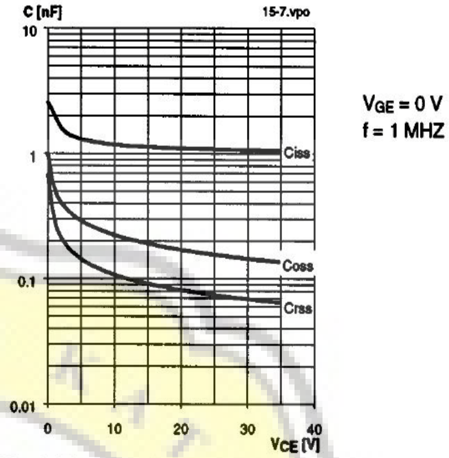


Fig. 14 Typ. capacitances vs. V_{CE}

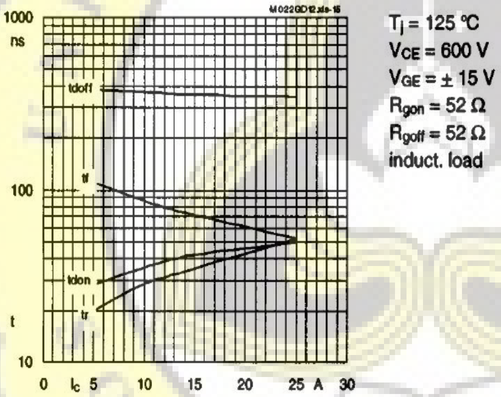


Fig. 15 Typ. switching times vs. I_C

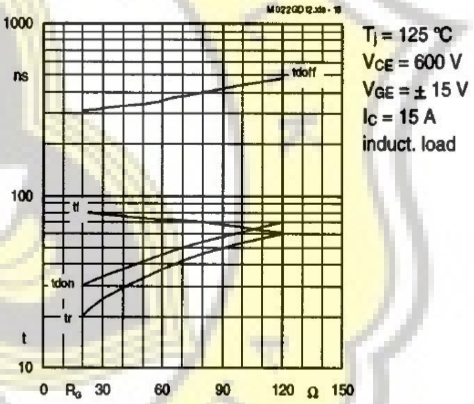


Fig. 16 Typ. switching times vs. gate resistor R_G

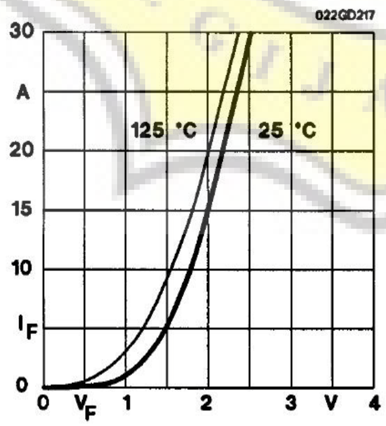


Fig. 17 Typ. CAL diode forward characteristic

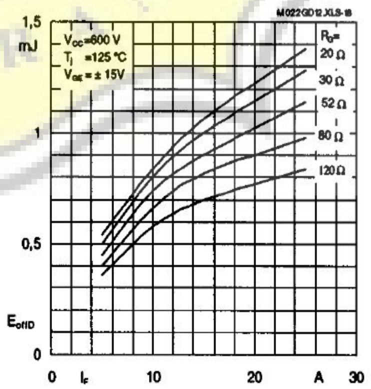


Fig. 18 Diode turn-off energy dissipation per pulse

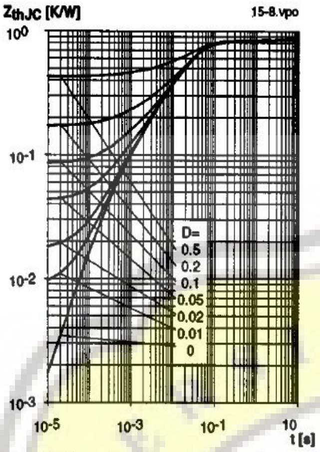


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

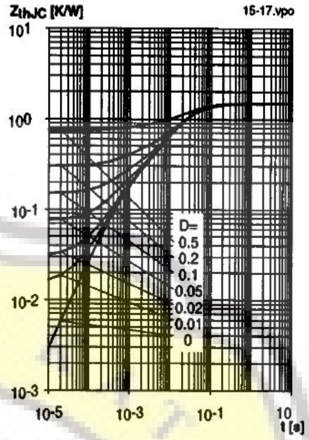


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

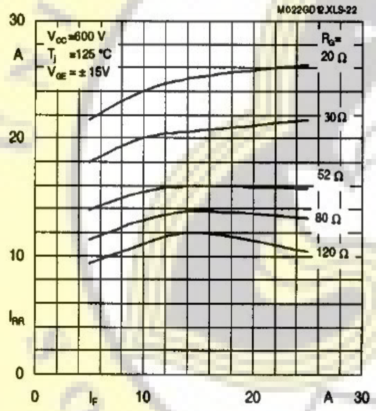


Fig. 22 CAL diode peak reverse recovery current $I_R = f(I_F; R_G)$

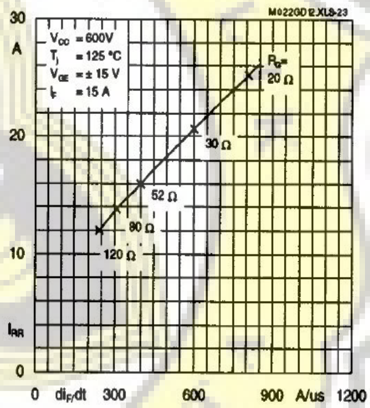


Fig. 23 CAL diode peak reverse recovery current $I_{RR} = (di/dt)$

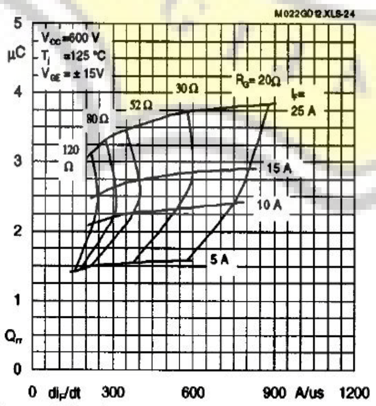
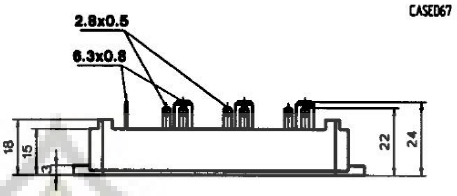
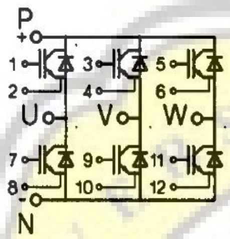


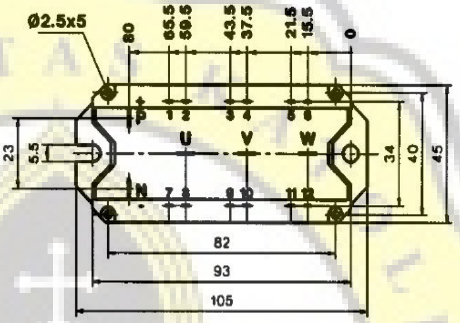
Fig. 24 CAL diode recovered charge $Q_{rr} = f(di/dt)$

SKM 22 GD 123 D

SEMITRANS Sixpack
Case D 67
UL Recognized
File no. E 63 532
SKM 22 GD 123 D

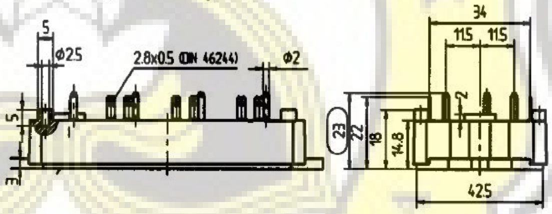


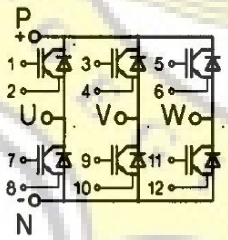


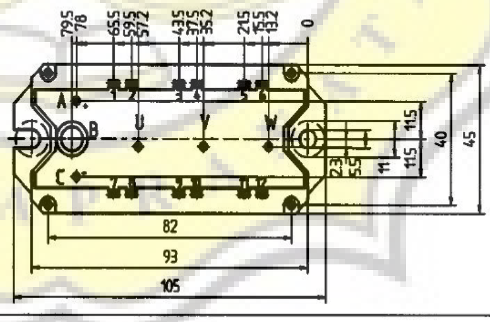


SEMITRANS Sixpack
Case D 68
UL Recognized
Special version on request
SKM 22 GD 123 DL
SKM 40 GD 123 DL
SKM 75 GD 123 DL

Remark: The pin height of 23,2 mm will be changed into 24,5 ± 0,2 mm during 1996







Dimensions in mm

Case outlines and circuit diagrams

Mechanical Data						
Symbol	**Conditions**		**Values**			**Units**
			min.	**typ.**	**max.**	
M_1	to heatsink, SI Units	(M5)	4	–	5	Nm
	to heatsink, US Units		35	–	44	lb.in.
a			–	–	5x9,81	m/s^2
w			–	–	190	g

This is an electrostatic discharge sensitive device (ESD). Please observe the international standard IEC 747-1, Chapter IX.

Two devices are supplied in one SEMIBOX A.
Larger packing units (10 and 20 pieces) are used if suitable.
SEMIBOX → page C - 1.