

Fuji High-speed IGBT module (H-series)

Oct. 2009

ver. 2.00

**Fuji Electric Systems Co., Ltd.
Module Development Dept.
Energy & Environment Gr.**

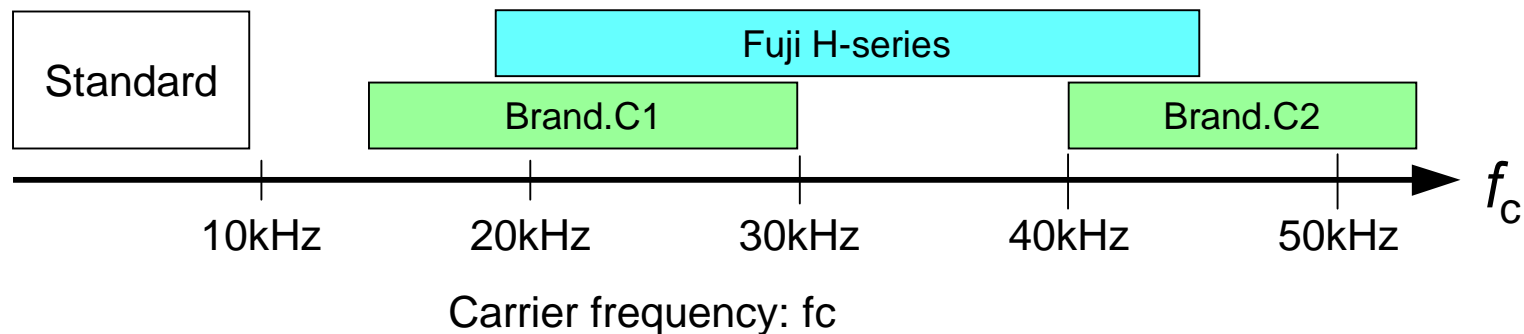
- High performance for high carrier frequency application

Optimized design for $f_c = 20 \sim 50\text{kHz}$

Lower switching loss, lower surge voltage

Low thermal impedance package

New Si_3N_4 -DCB substrate , RoHS package



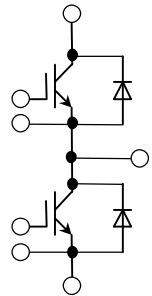
- 2in1 module and Chopper module lineup

2in1 module: 1200V / 100A ~ 200A

Chopper module: 1200V / 200A ~ 400A with NTC

2in1 module – 1/2 half-bridge *only for soft turn-on

High-speed IGBT + Standard, small FWD



2MBI100HB-120-50 (1200V/100A M233)

2MBI150HH-120-50 (1200V/150A M249)

2MBI200HH-120-50 (1200V/200A M249)

RoHS, SiN-DCB

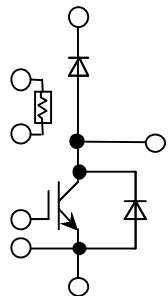


45mm

M233

Chopper module – PFC

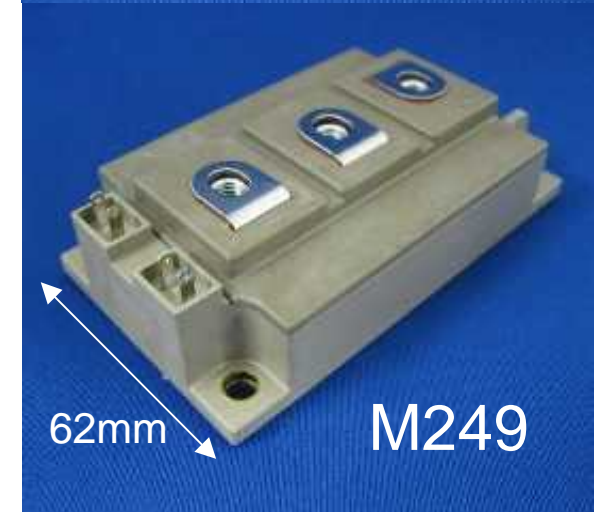
High-speed IGBT + High speed diode + NTC



1MBI200HH-120L-50 (1200V/200A M249)

1MBI300HH-120L-50 (1200V/300A M249)

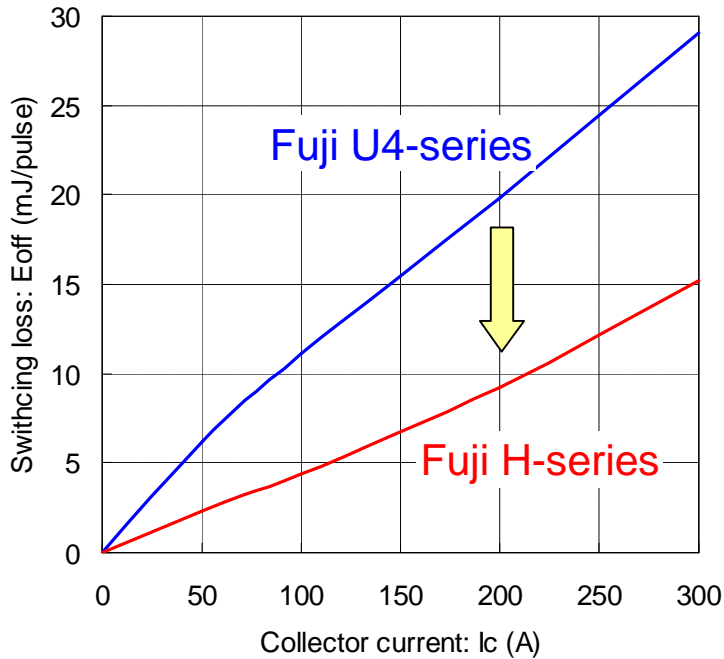
1MBI400HH-120L-50 (1200V/400A M249)



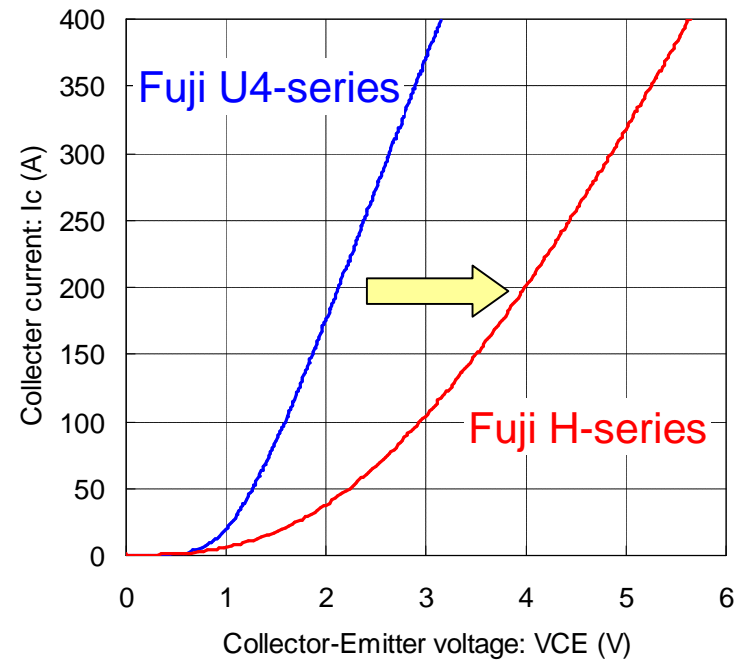
62mm

M249

Switching loss
(200A module)



Output characteristic
(200A module)

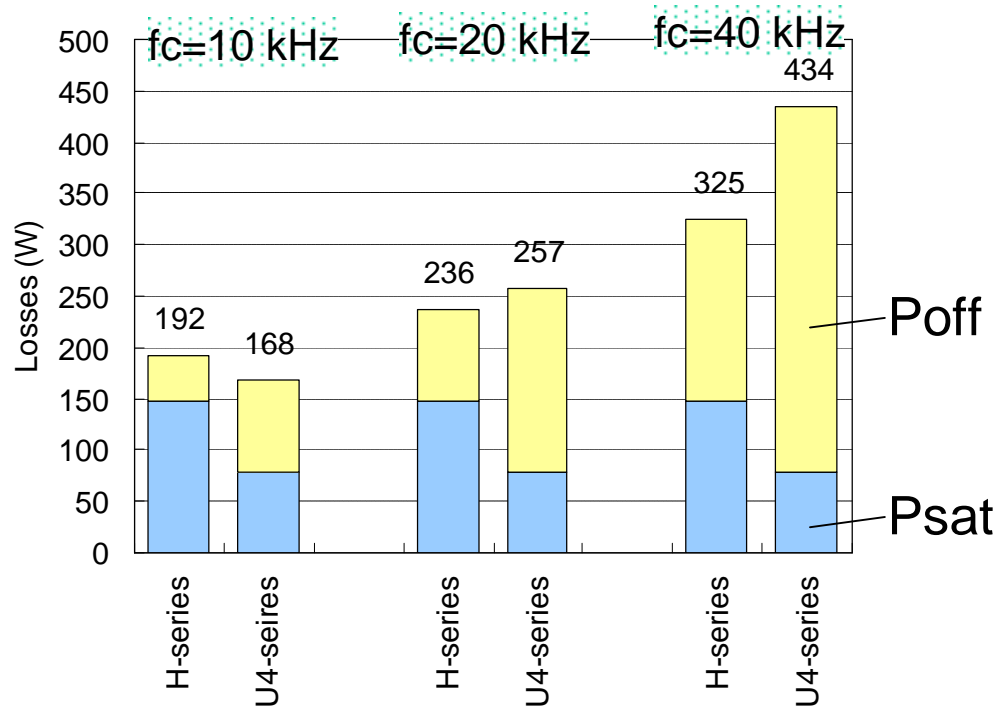


Lower switching loss, higher V_{on}
--> Suitable for higher carrier frequency application

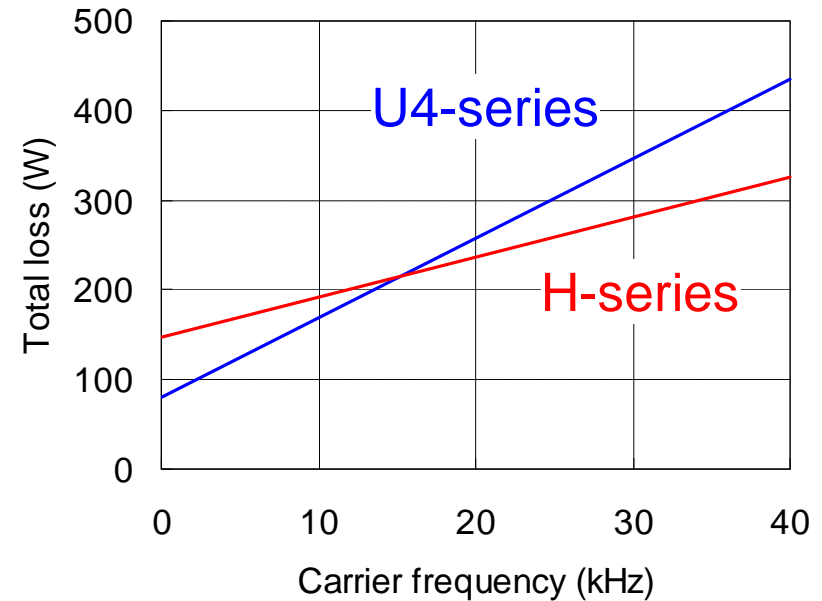
Condition: $V_{cc} = 600\text{ V}$, $I_c = 100\text{ A}$, duty = 0.5 , 200A module

Soft swithcing circuit: $P_{on}, P_{rr} = 0$, $P_f = 0$

Dissipation loss



fc vs. dissipation loss

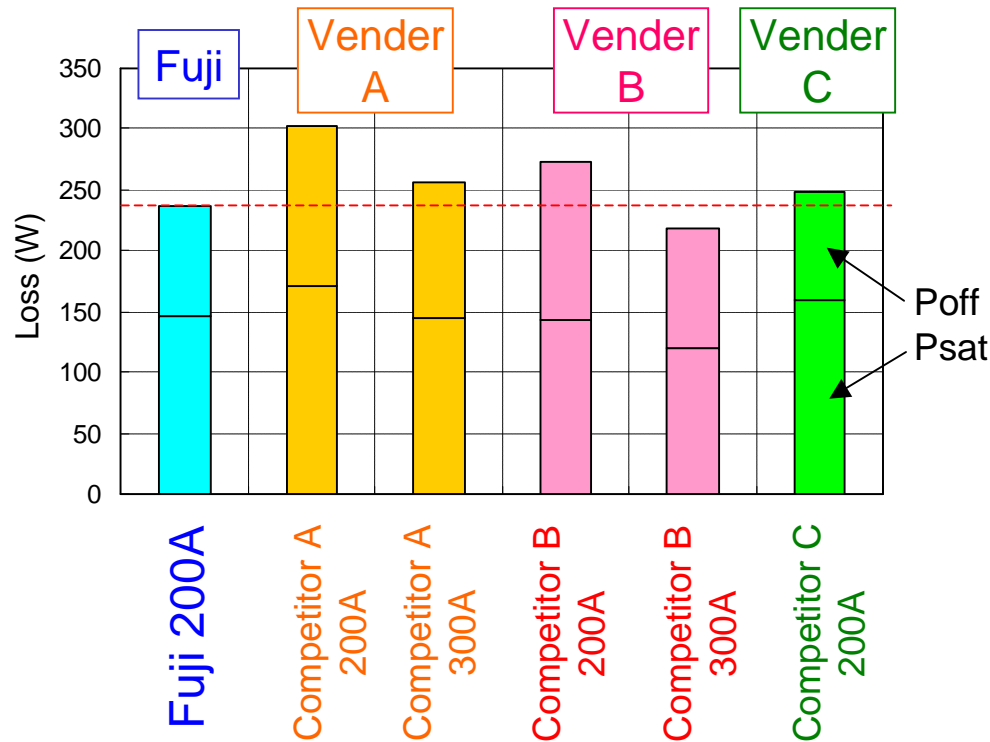


Optimized design for 20 ~ 50kHz

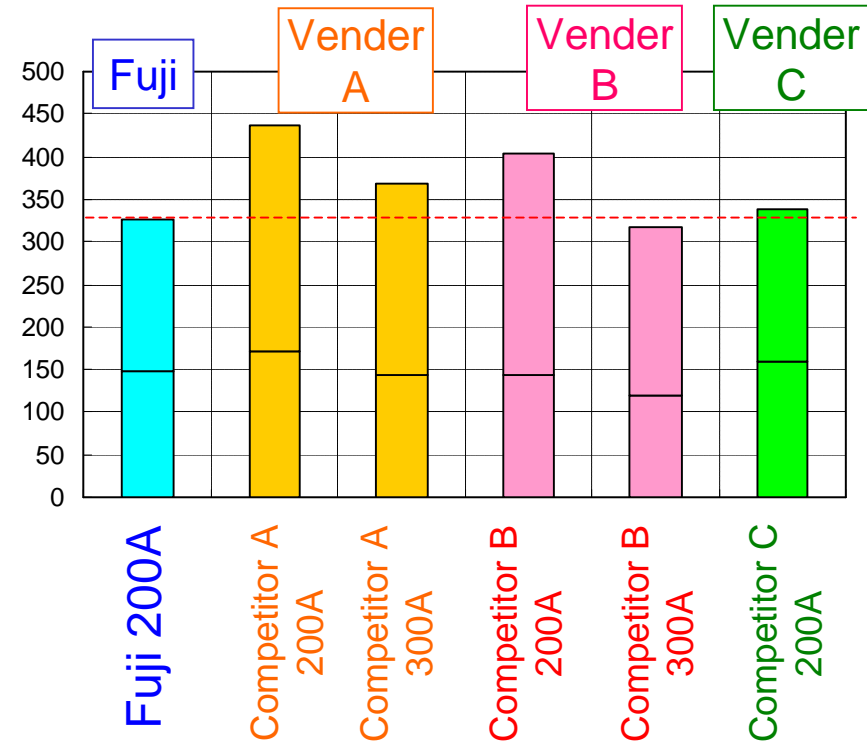
Soft turn-on, hard turn-off circuit

($P_{on}=0$, $P_f=0$, $P_{rr}=0$)

$I_o=100A$, $V_{dc}=600V$, $f_c=20kHz$



$I_o=100A$, $V_{dc}=600V$, $f_c=40kHz$

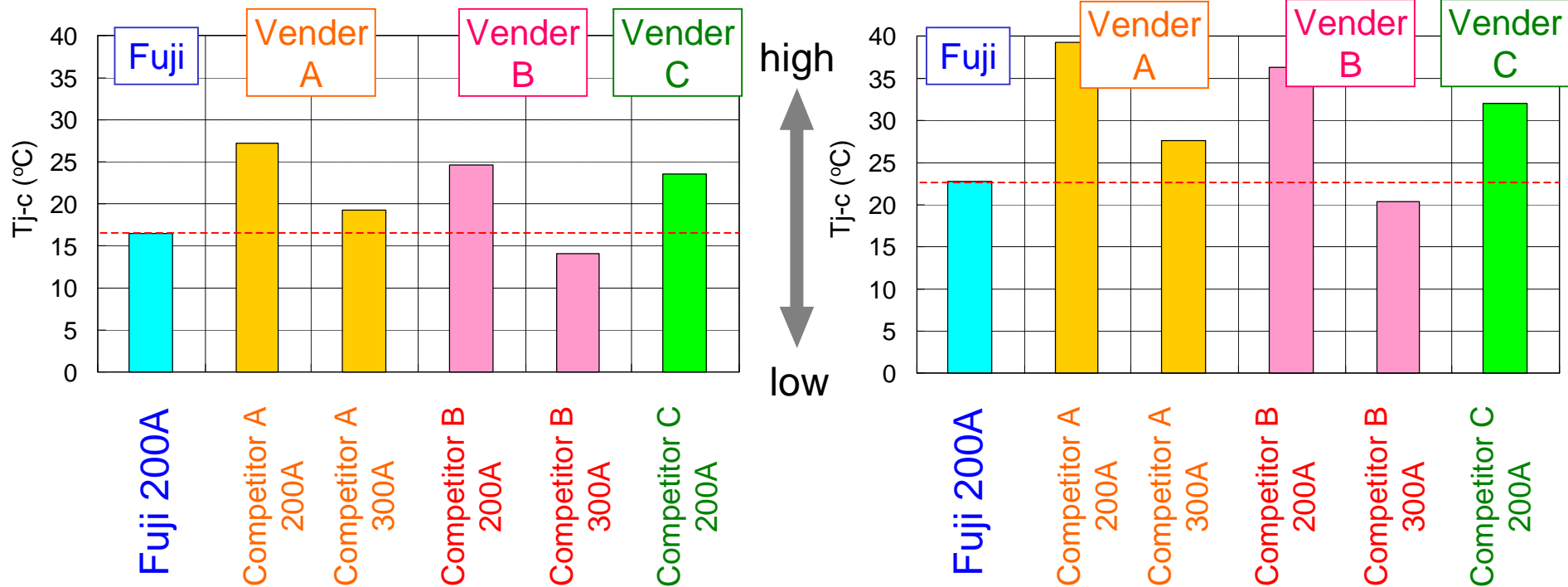


Fuji H-series is lowest dissipation loss

Soft turn-on, hard turn-off circuit ($P_{on}=0, P_f=0, P_{rr}=0$)

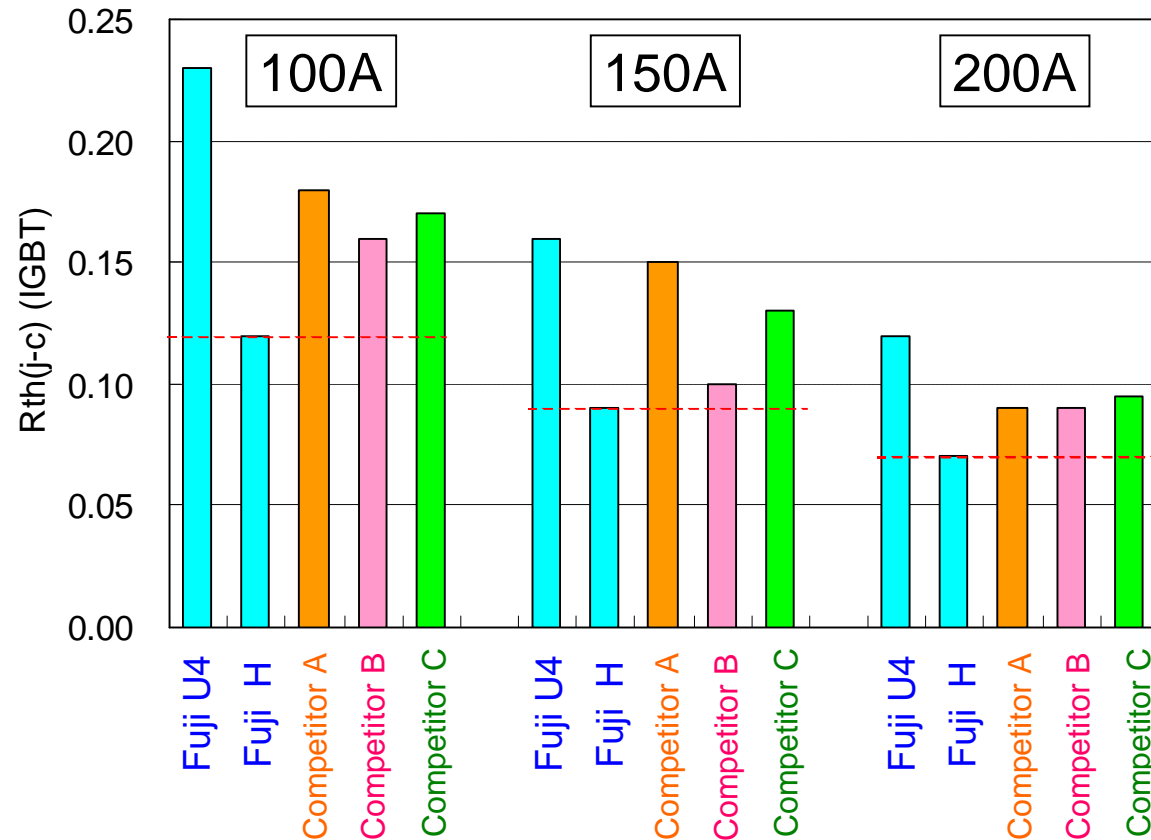
$I_o=100A, V_{dc}=600V, f_c=20kHz$

$I_o=100A, V_{dc}=600V, f_c=40kHz$



Fuji H-series is lowest ΔT_{j-c}

Comparison of Rth(j-c) (2in1)



Rth(j-c) of Fuji H-series is smaller than U4-series
 Rth(j-c) of Fuji H-series is smaller than competitor modules

		Al ₂ O ₃	Si ₃ N ₄	AlN
Thermal conductivity	[W/mK]	22	90	170
Required thickness	[mm]	0.38	0.32	0.635
Rthj-c for (100mm ² silicon)*1	[K/W]	0.23	0.14	0.13

*1) active area, not 10mm x 10mm

Simple calc data
2D model w. 45 deg. heat spreading



Al₂O₃

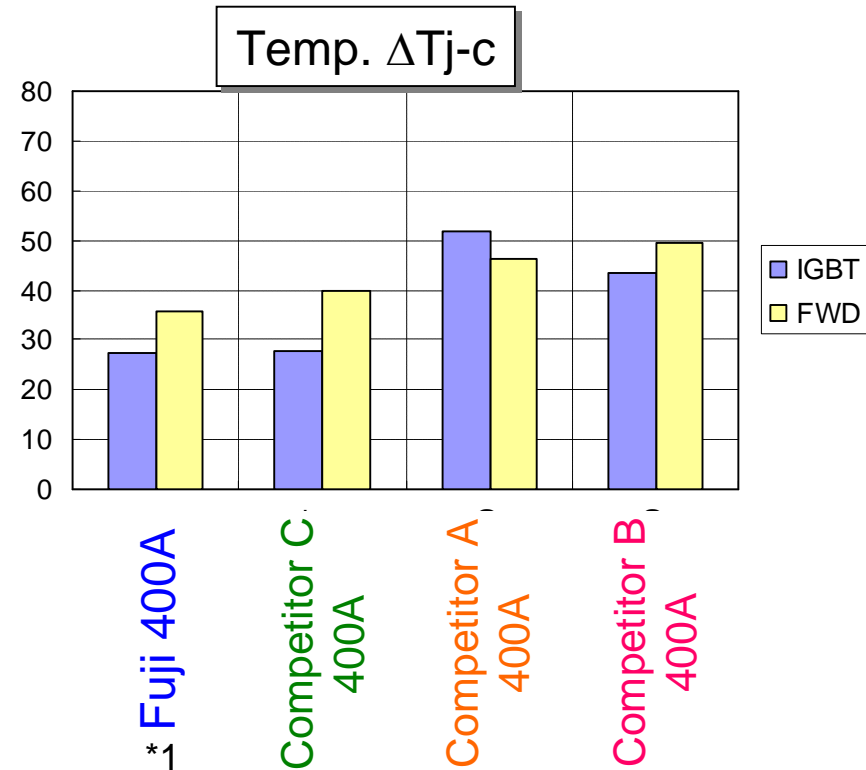
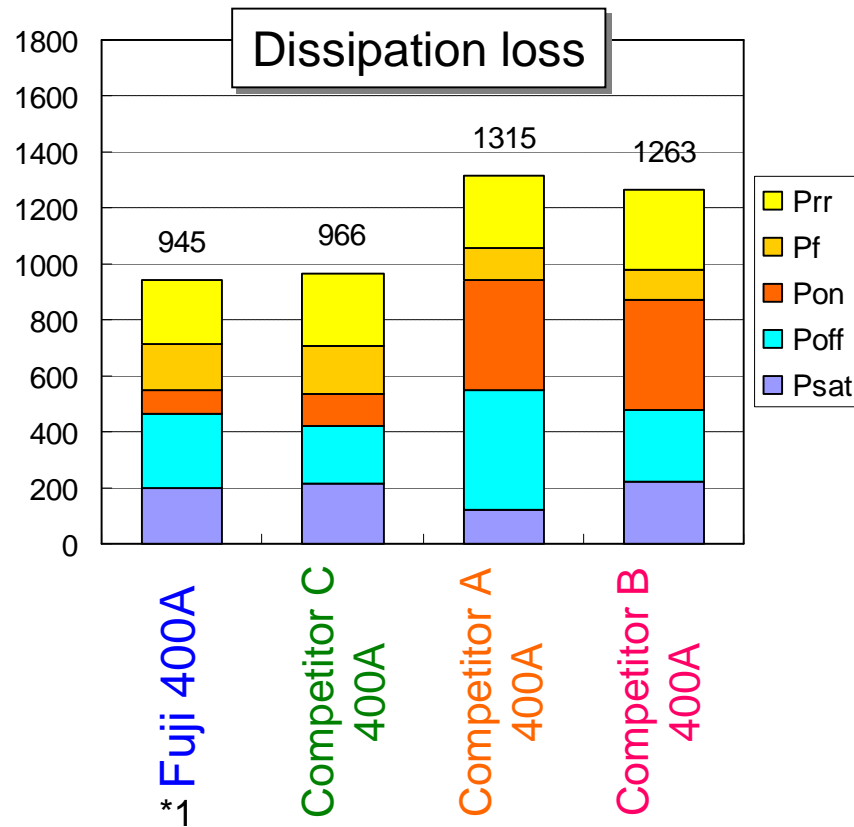


Si₃N₄
(Fuji)



AlN
(Competitor C)

Calc.condition: $I_o=150A$, $V_{dc}=600V$, $f_c=24kHz$, spec value.

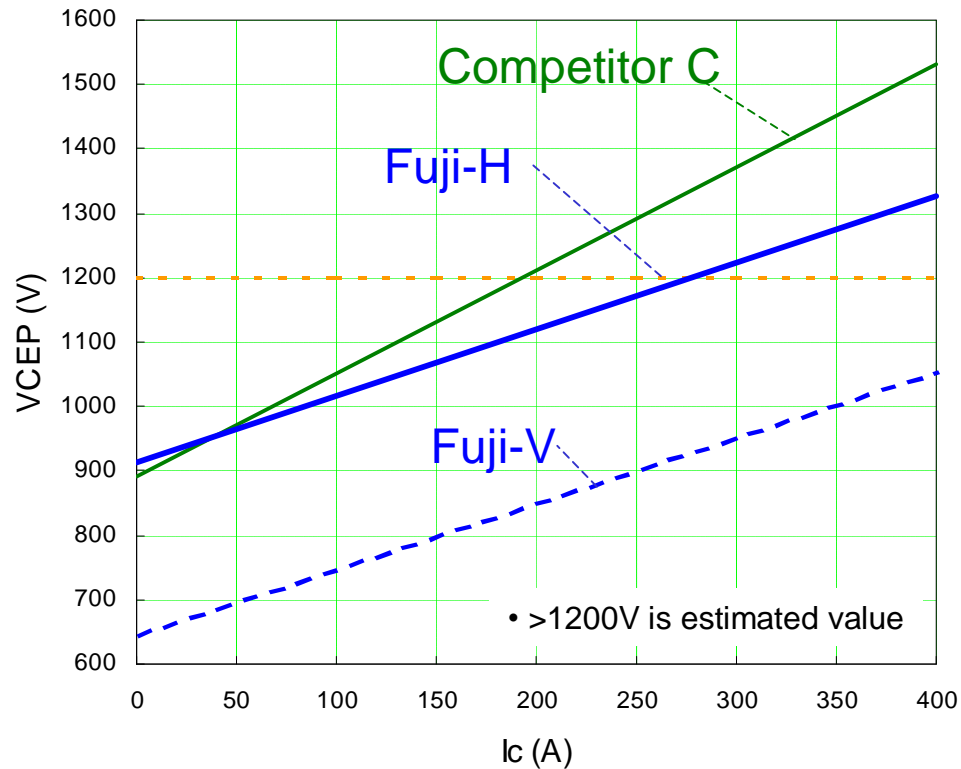


*1 Target value. not spec value.

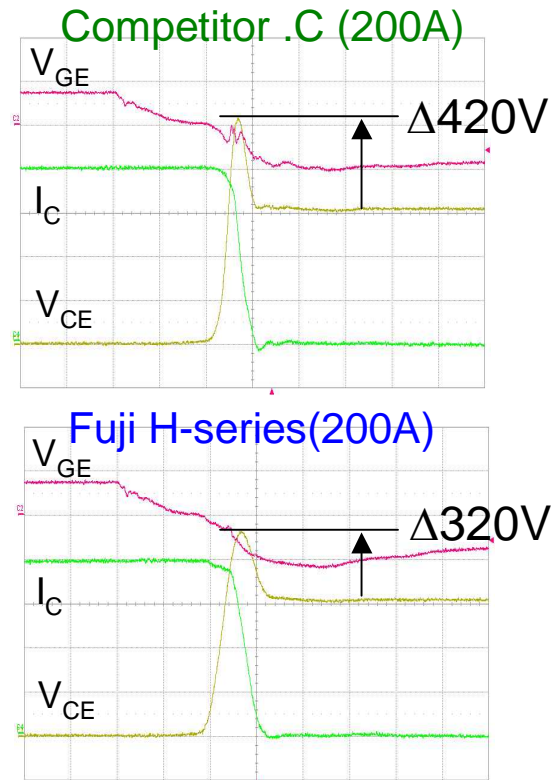
Fuji H-series chopper is lowest loss and lowest ΔT_{j-c}

Lower surge voltage than competitor module
(Surge voltage is higher than standard module)

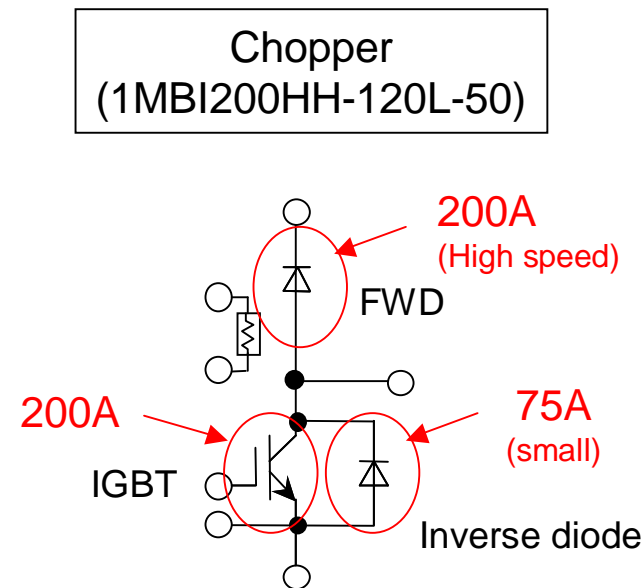
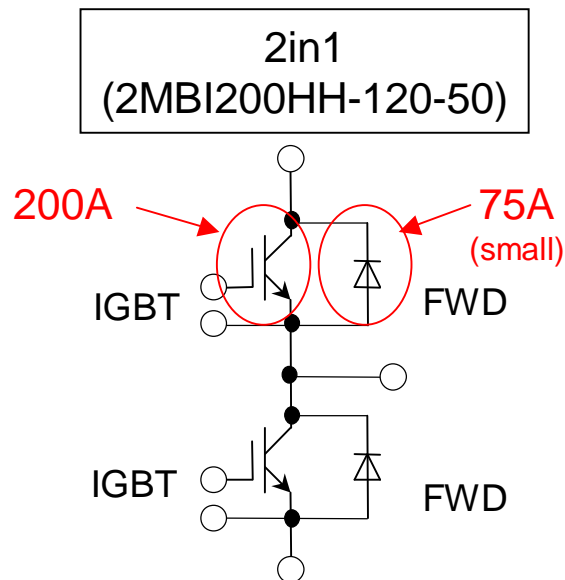
$T_j=125^\circ\text{C}$, $V_{GE}=\pm 15\text{V}$, $V_{DC}=800\text{V}$
 $R_G=1.6\text{ohm}$, $L_s=60\text{nH}$, with snubber



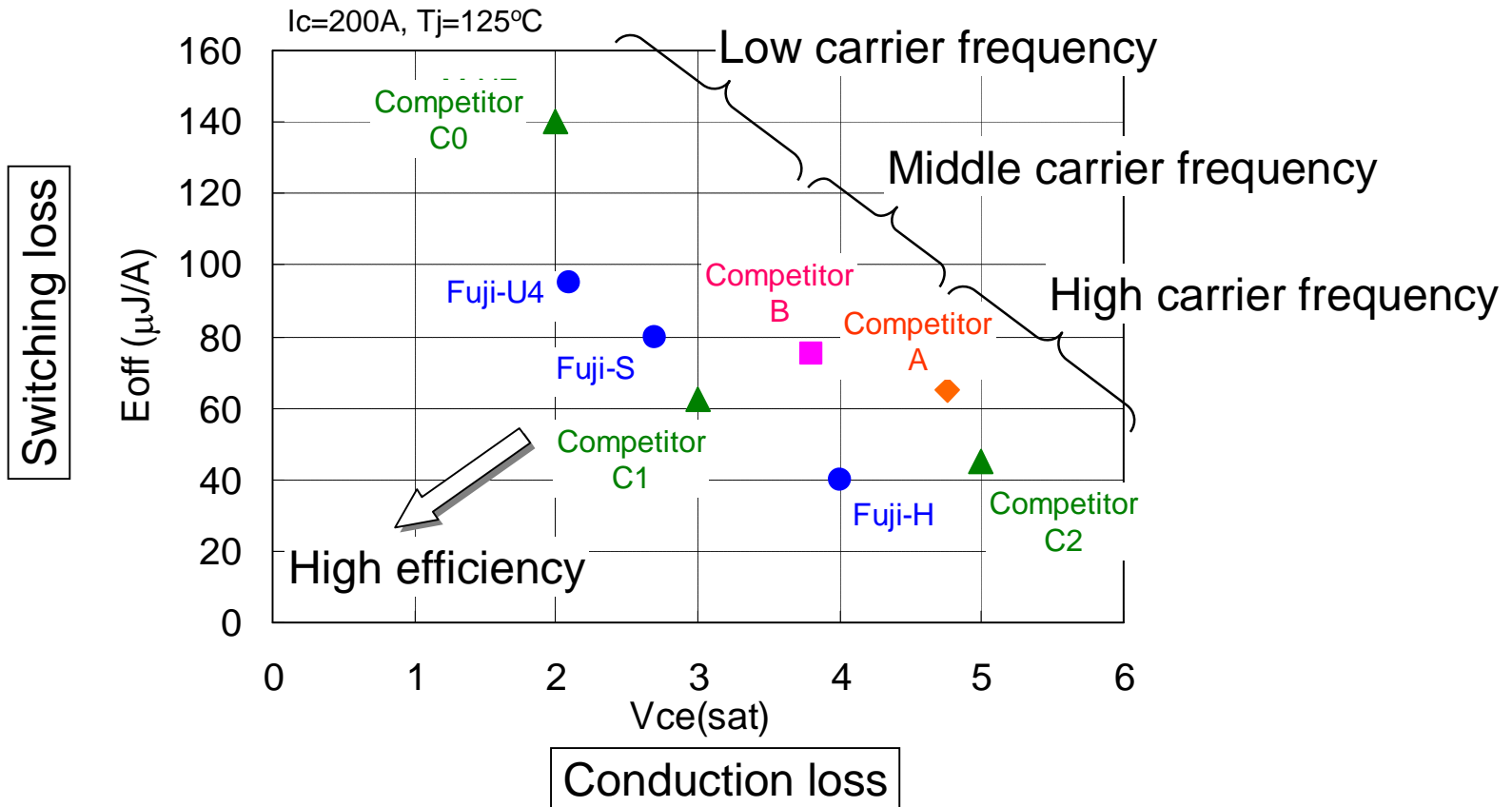
$T_j=125^\circ\text{C}$, $V_{GE}=\pm 15\text{V}$, $V_{DC}=600\text{V}$
 $R_G=1.6\text{ohm}$, $L_s=60\text{nH}$, with snubber



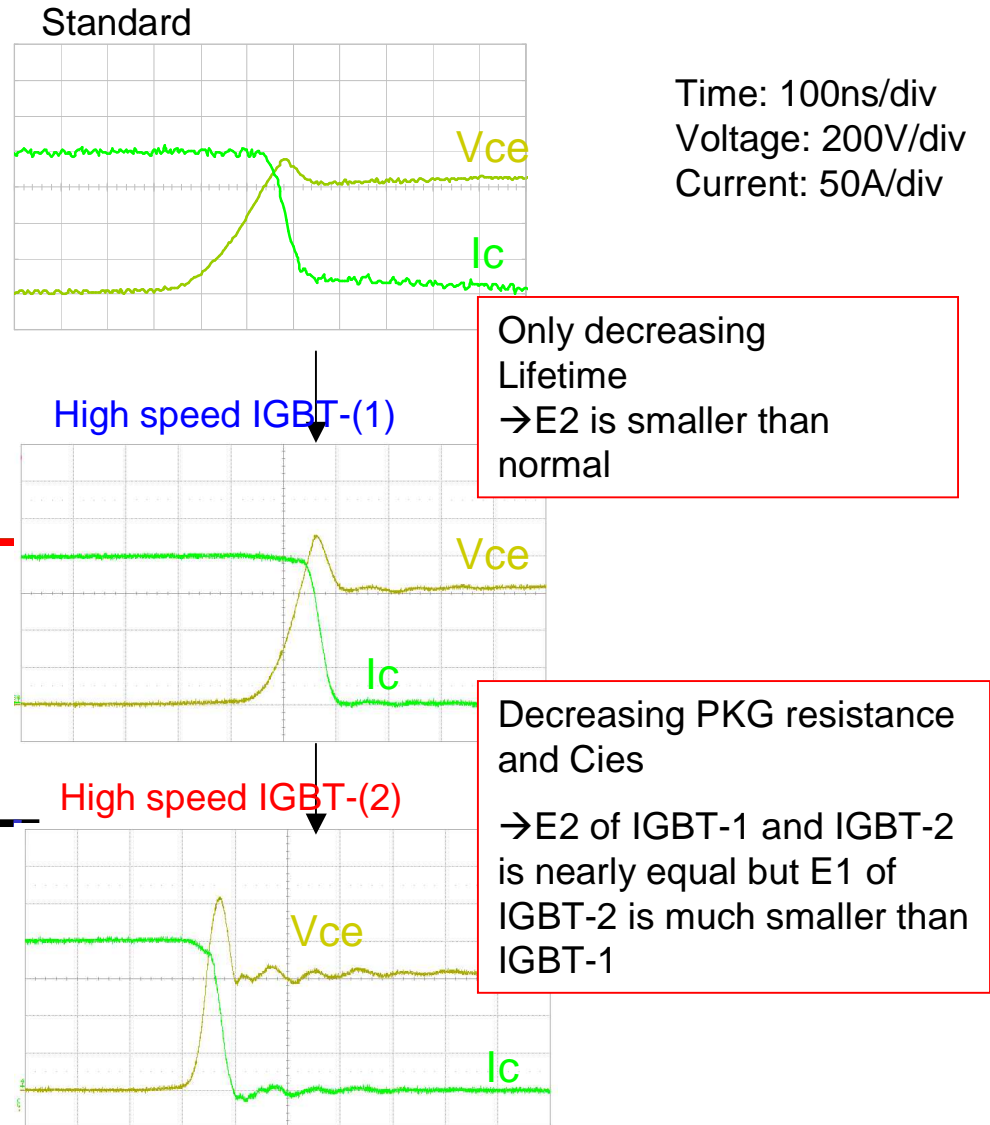
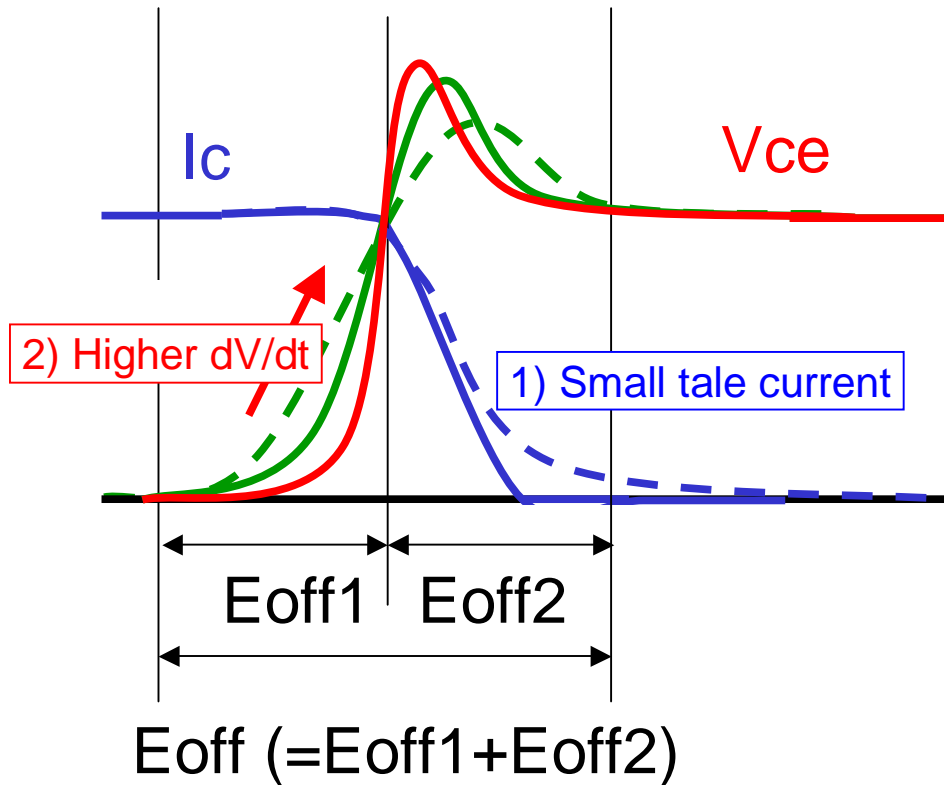
- Current rating of FWD chip in 2in1 module is **1/3** of IGBT chip.
- Current rating of inverse diode in chopper module is **1/3** of IGBT chip.



Application-optimized design

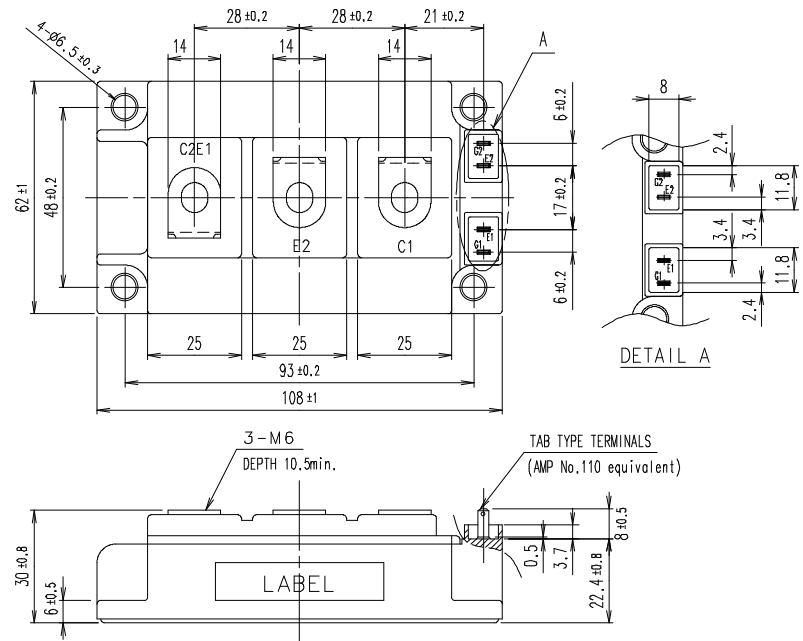
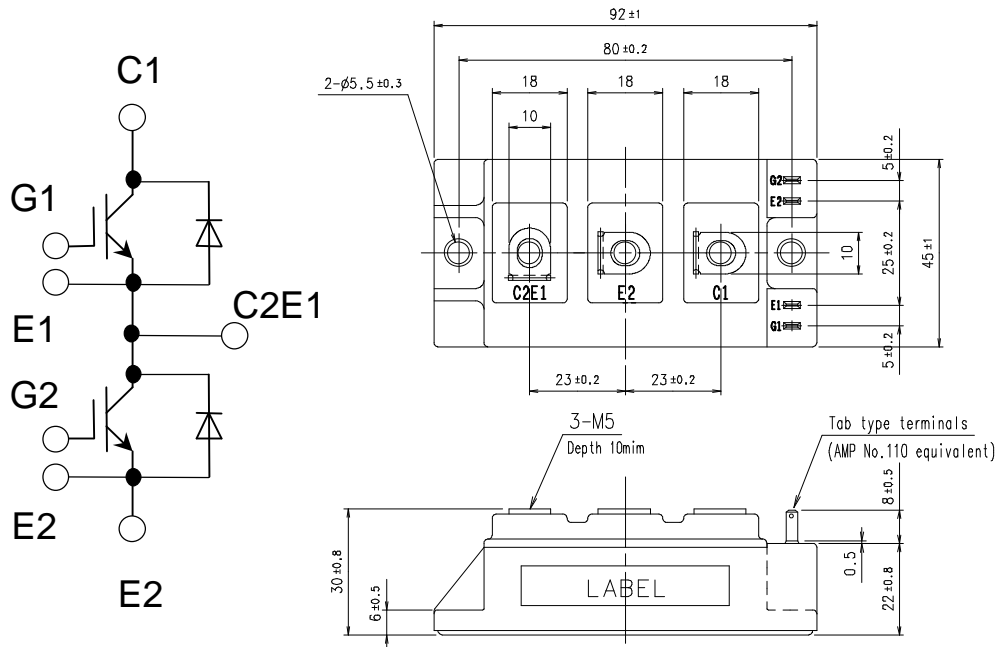


- - - Standard IGBT
- High speed IGBT-(1)
- High speed IGBT-(2)



2in1
1200V / 100A

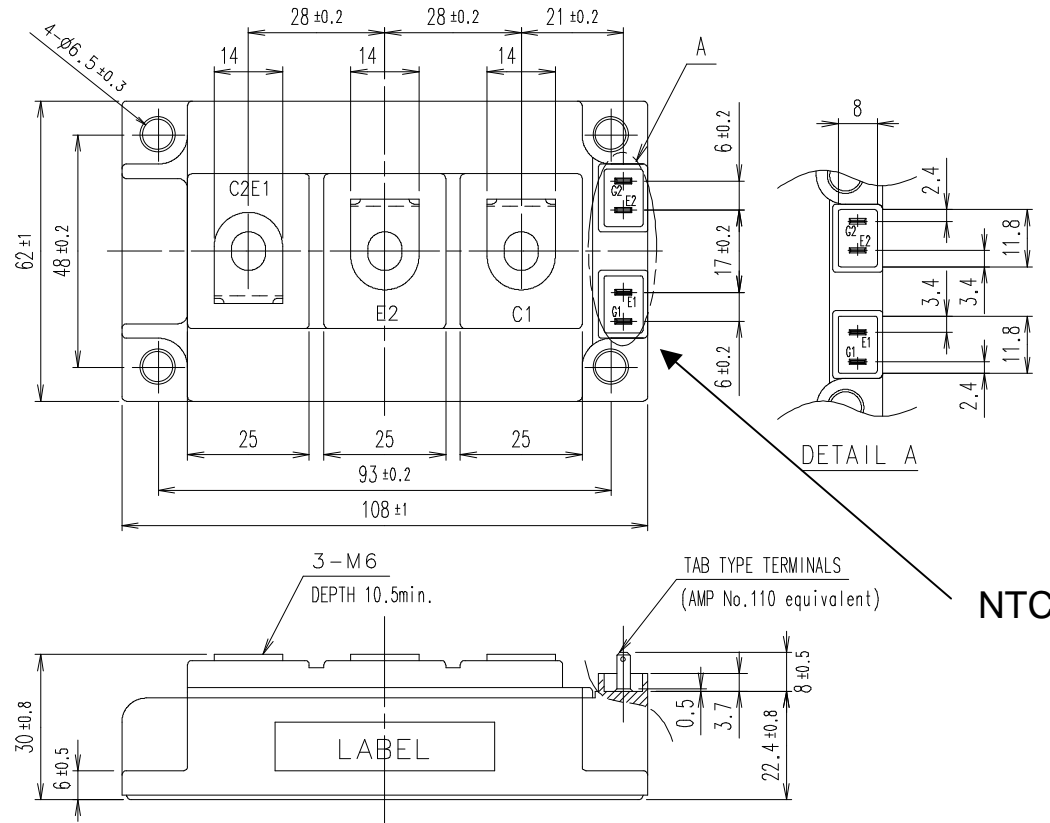
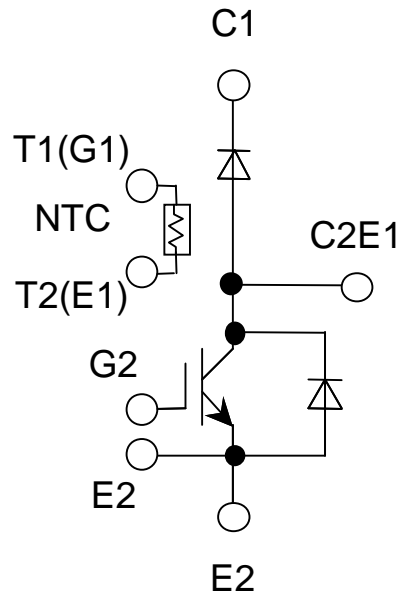
2in1
1200V / 150A, 200A



*RoHS pacakge

Package Outline (Chopper)

Chopper
1200V / 200A, 300A, 4500A



*RoHS package

High speed IGBT for higher carrier frequency application

Improved and optimized Von-Eoff trade-off

- S-series chip base (planar / NPT)
- Reduced lifetime, shorter cell pitch
- Lower surge voltage

High speed diode

Optimized V_F -Err trade-off

Low thermal impedance package

New DCB substrate: Si_3N_4

- Lower ΔT_{j-c} than competitor modules

Best choice for high carrier frequency application
($f_c = 20 \sim 50\text{kHz}$)

Sample : all type available in 3months after receiving order
MP : Dec. / 2009 ~