Fairchild IGBT Module Solution

2004. 1

PD Discrete Business
Fairchild Semiconductor

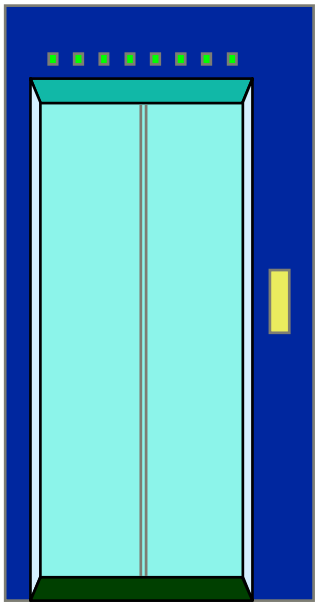
Contents

IGBT application

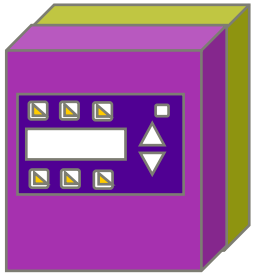
IGBT

Module & Discrete

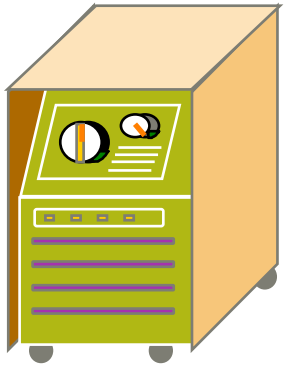
- ***Elevator***



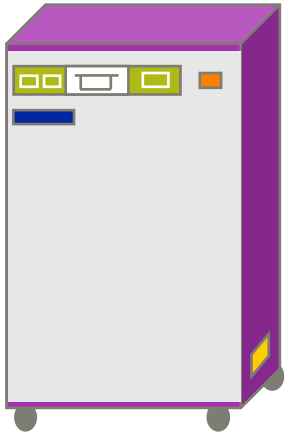
- ***F.A.***
  - ***Inverter, AC servo, Robotics***



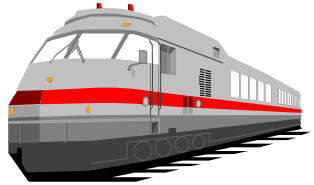
- ***Welding machine***



- ***Power Supply***
  - ***UPS, SMPS***

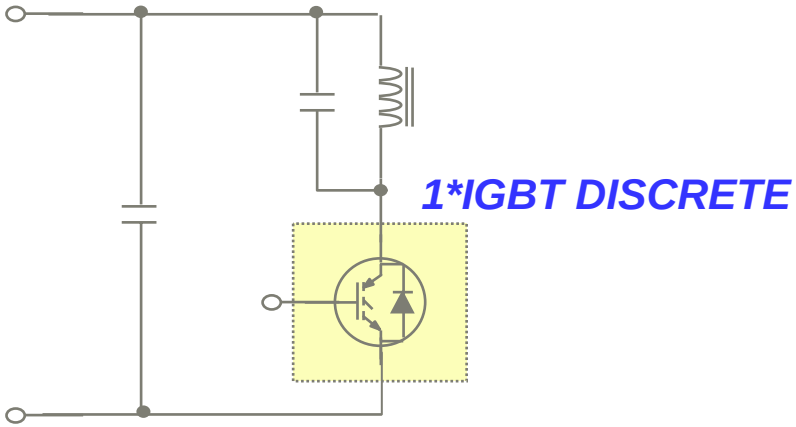


- ***Transportation***
  - ***-Ignition control, Battery charger***

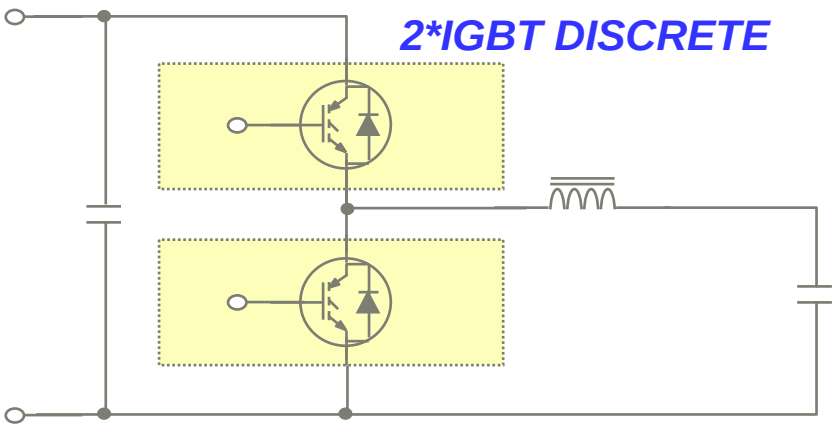


Examples of Application Circuit (I)

- ☞ home appliance (IH-JAR, IH-Cooker, MWO..)
- ☞ Package Type : TO-220, TO-3P, TO-264
- ☞ Current rating : 30 ~ 80A



SINGLE ENDED TYPE
(V_{CE} : 900 ~ 1700V)

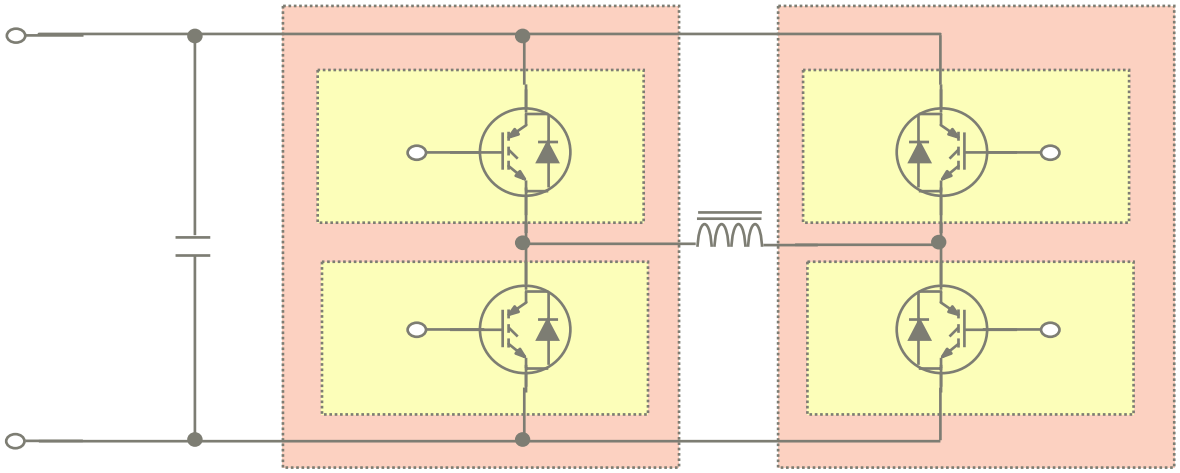


HALF BRIDGE TYPE
(V_{CE} : 600V)

Examples of Application Circuit (II)

- ☞ **Industrial Equipment (Welding, UPS, IH Heater)**
- ☞ **Package Type : 2-PAK,1-PAK Module**
- ☞ **Current Rating : 600V : 50 ~ 600A, #1200V : 50A ~ 200A**

4*1-PAK IGBT MODULE
2*2-PAK IGBT MODULE

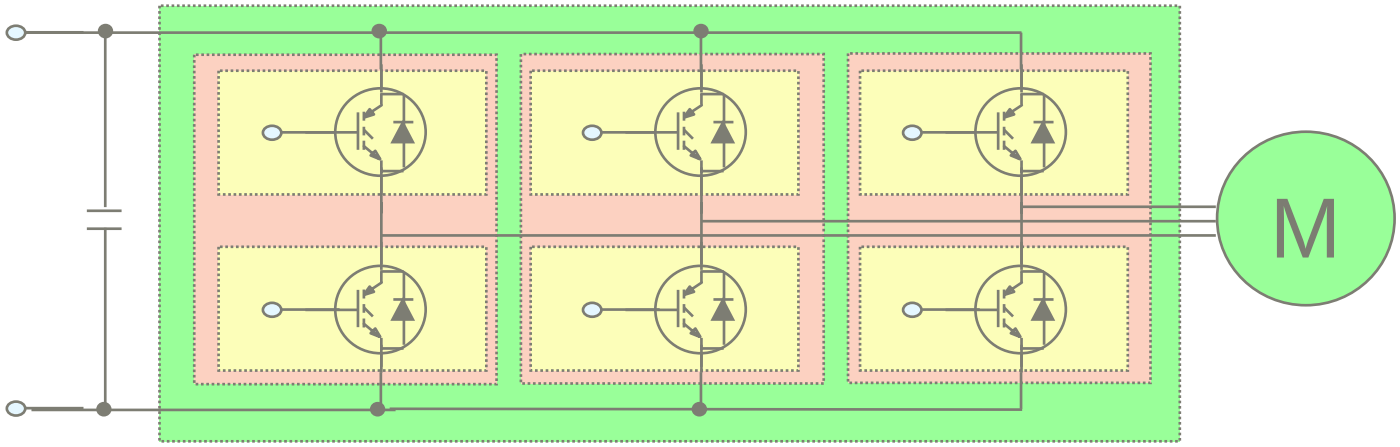


FULL BRIDGE TYPE

Examples of Application Circuit (III)

- ☞ 3Phase Motor Drive.(Inverter,Frequency Converter)
- ☞ Package Type : 6-Pak,2-Pak,1-Pak Module
- ☞ Current Rating : 600V : 50 ~ 600A, 1200V : 50A ~ 200A

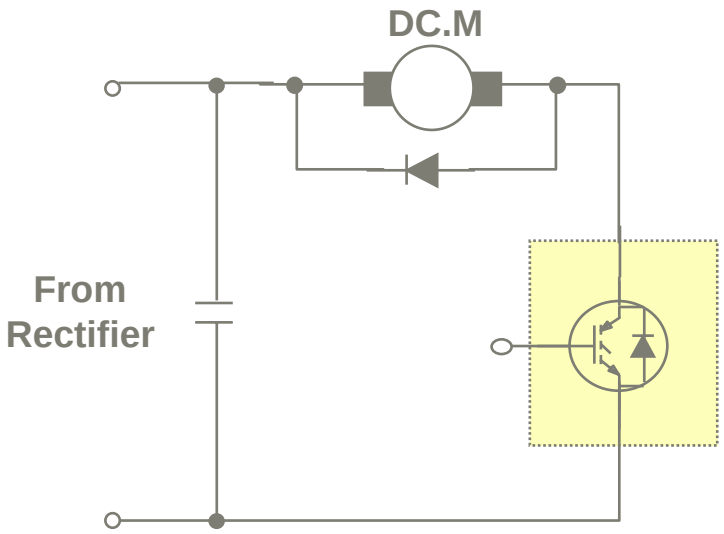
*6*Discrete CO-PAK*
*1*6-PAK IGBT MODULE*
*2*2-PAK IGBT MODULE*
*6*1-PAK IGBT MODULE*



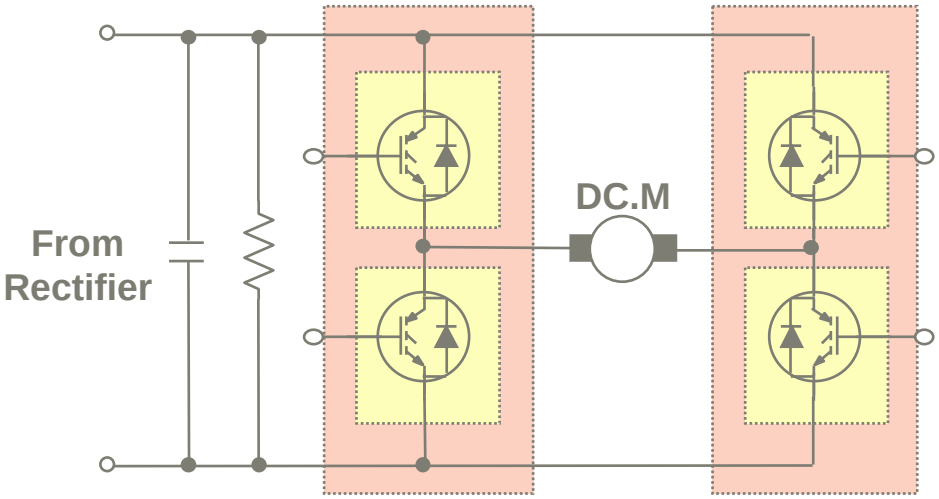
3PHASE BRIDGE TYPE

Examples of Application Circuit (Ⅳ)

DC Chopper

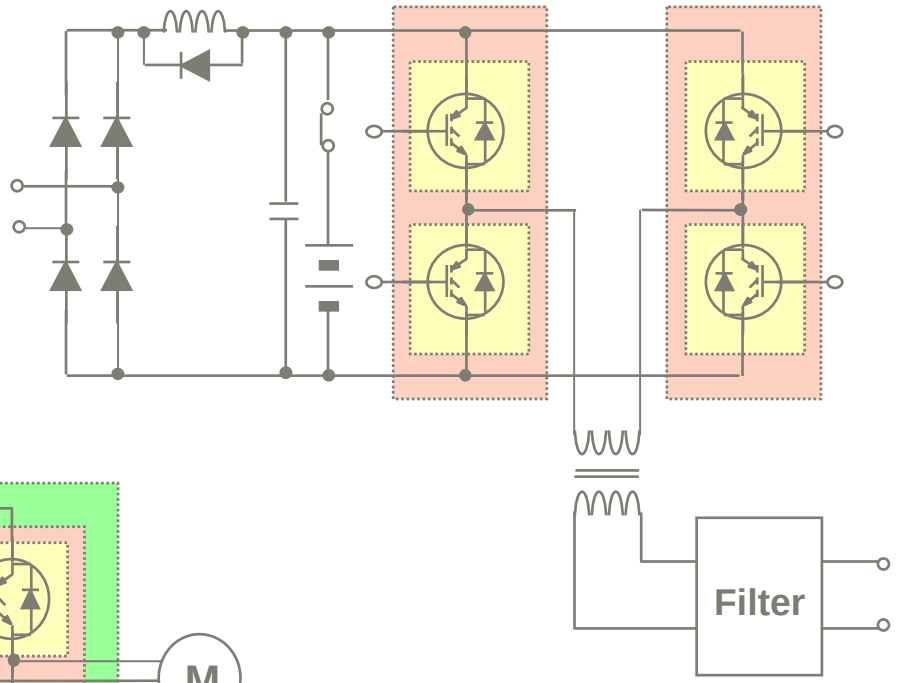


DC Servo (NC, ROBOT)

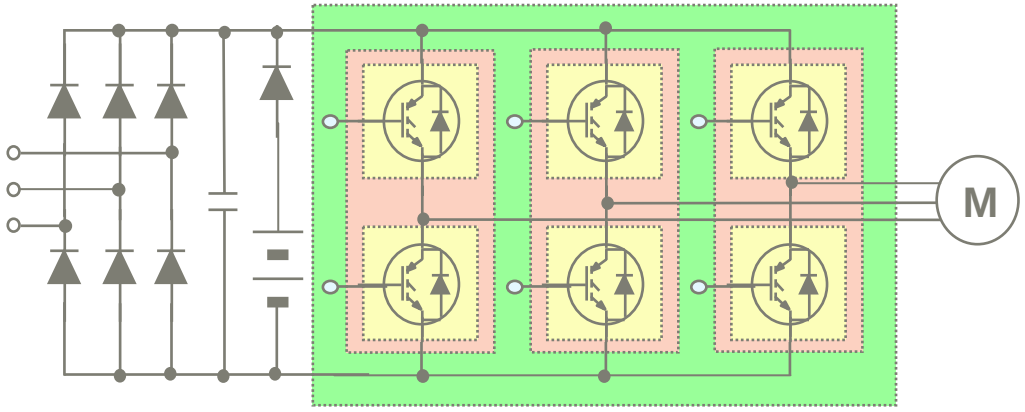


Examples of Application Circuit (Ⅴ)

Low Output CVCF Inverter

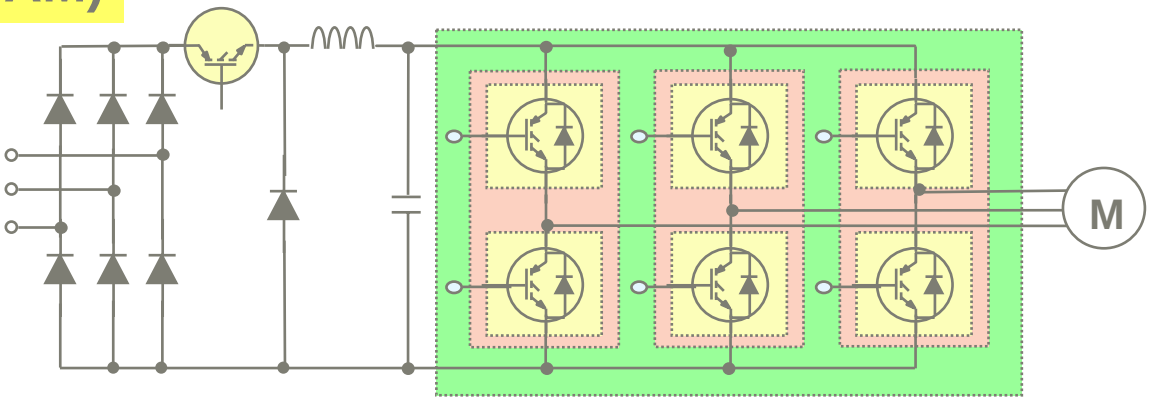


CVCF Inverter (UPS)

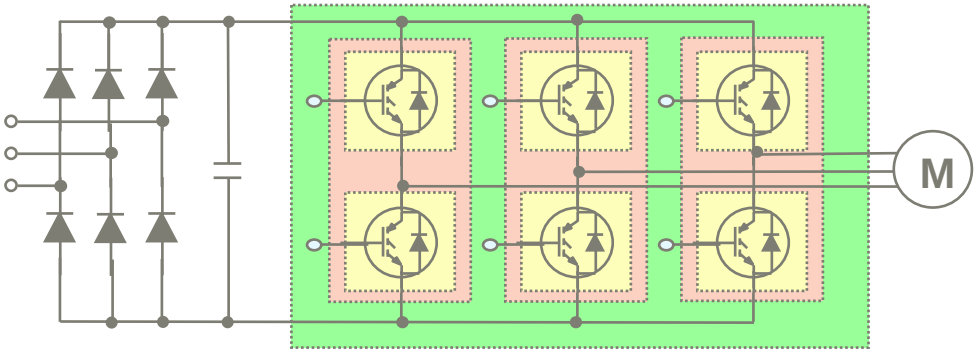


Examples of Application Circuit (VI)

VVVF Inverter (PAM)

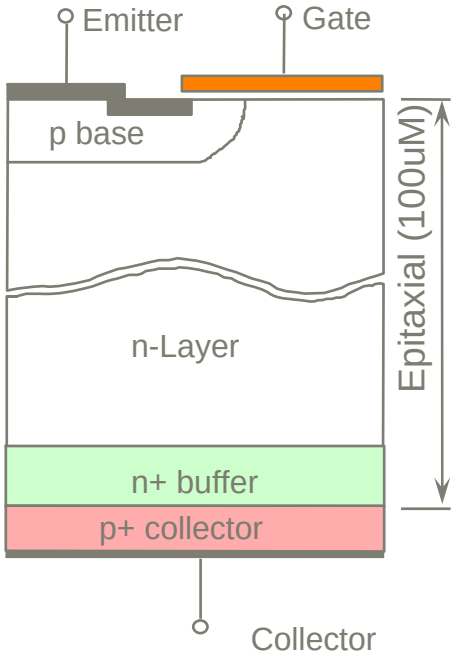


VVVF Inverter (PWM)



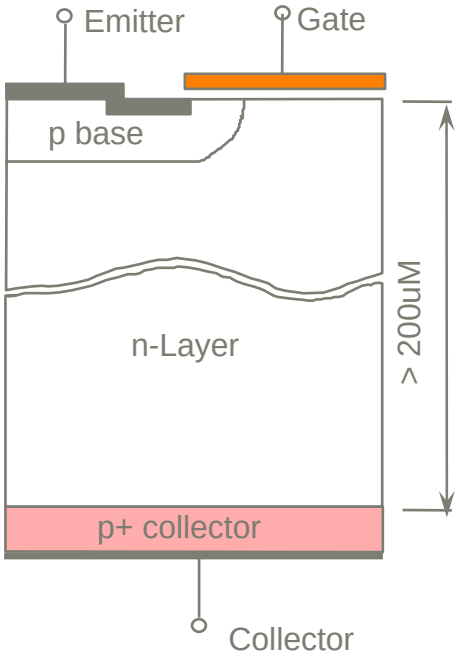
PT – NPT Comparison

PT
(Punch Through)



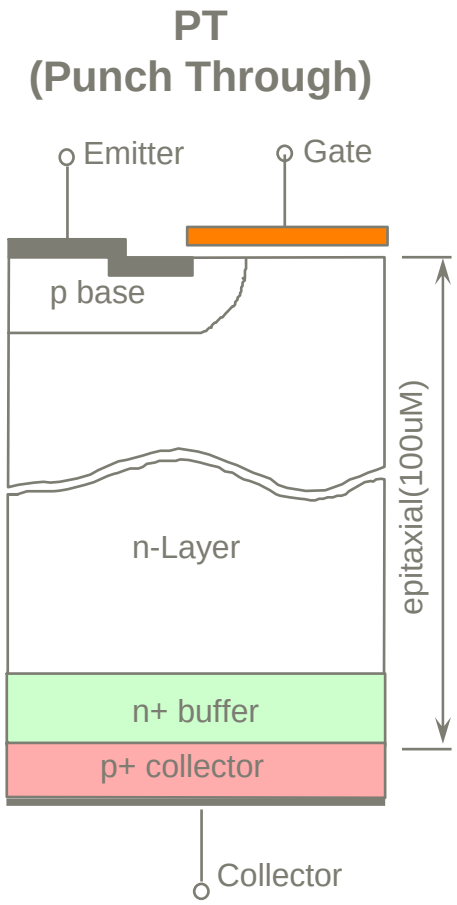
.Good Productivity
.Cost High
.Bad to Parallel Connect
.Good SOA

NPT
(Non Punch Through)



.Good Productivity
.Cost Low
.Easy to Parallel Connect
.Excellent SOA
.Long Tail Current

PT (Punch through) IGBTs



- Material :

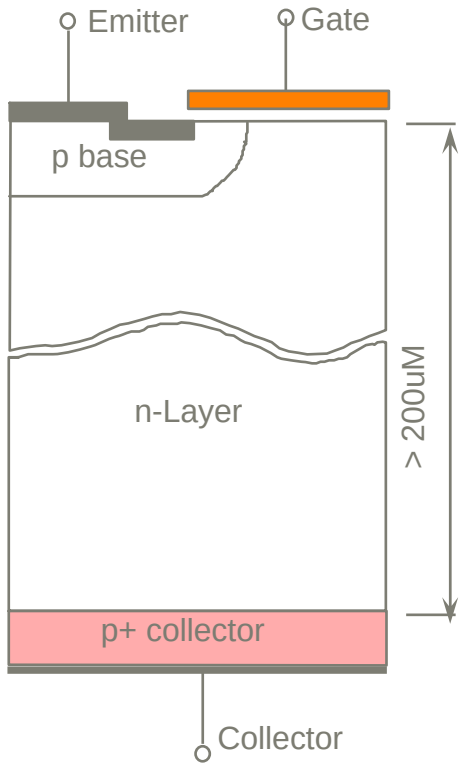
  N- EPI / N+ EPI / P+ wafer

- N+ Buffer layer between N- and P+ collector
- Asymmetric Blocking Characteristic

  ⇒ Forward Blocking, But No Reverse Blocking
- Lifetime Control by Heavy Dose EBI
- Low Vce(sat) , Fast Switching
- Large Leakage Current
- Negative Temperature Coefficient Characteristics
- Effective in Voltage range < 600 V

NPT (Non Punch through) IGBTs

NPT
(Non Punch Through)



- Material :

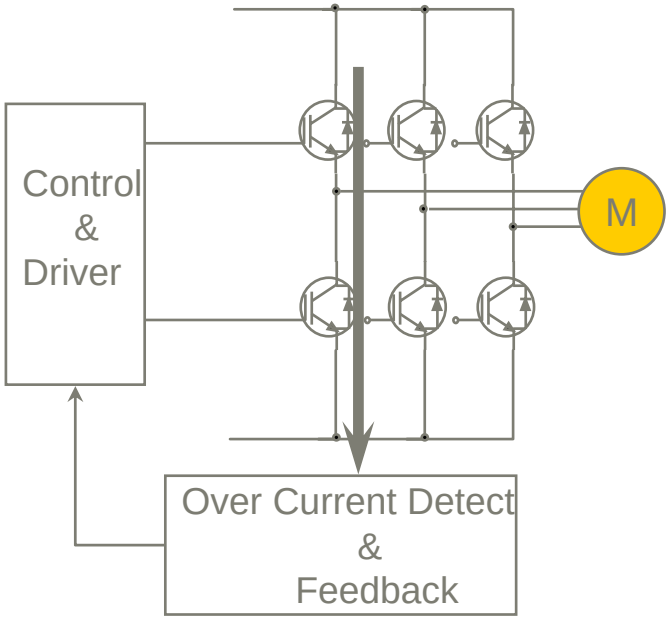
  N- Wafer / P+ Diffusion

- No N+ Buffer layer between N- and P+ collector
- Symmetric Blocking Characteristic

  $\Rightarrow$ Forward and Reverse Voltage Blocking
- No Lifetime Control or He^{4+} Ion Irradiation
- Long Tail Current
- Small Leakage Current
- Positive Temperature Coefficient Characteristics
- Large SOA
- Effective in Voltage range > 1200V

Short Circuit Withstand Time(Tsc)

- IGBTs are need to be protected from over current caused by Motor destruction or fault by noise.
  Normally protection circuit has delay time(3~7uS),so IGBTs have to withstand certain time under Short circuit condition
  - Motor drive product (RUF-Series) is guaranteed at least 10uS for Tsc.

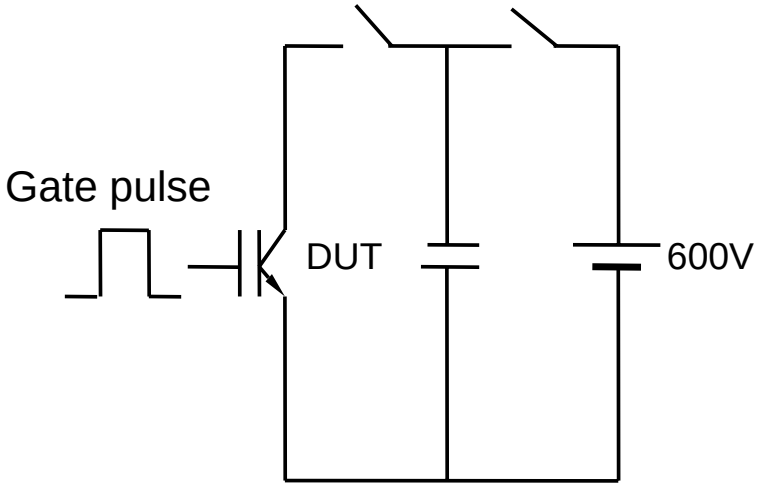


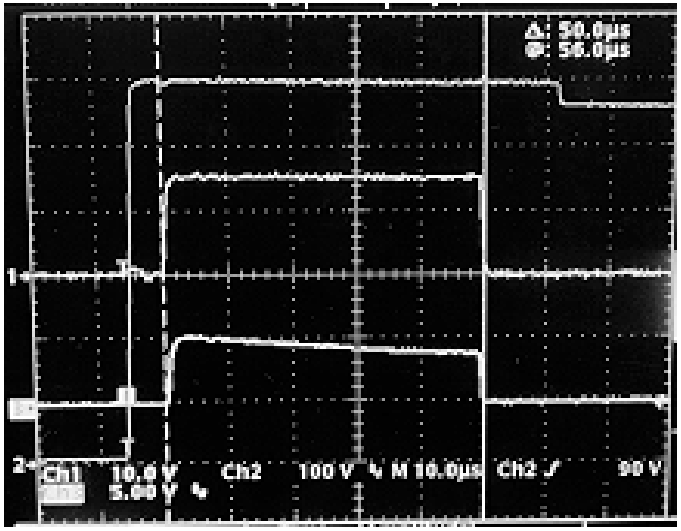
Delay time 3~7uS

SC --> Detecting abnormal condition (Over Vce(sat),DC line current) --> Feedback --> Gate Turn-off (Soft Turn-off)

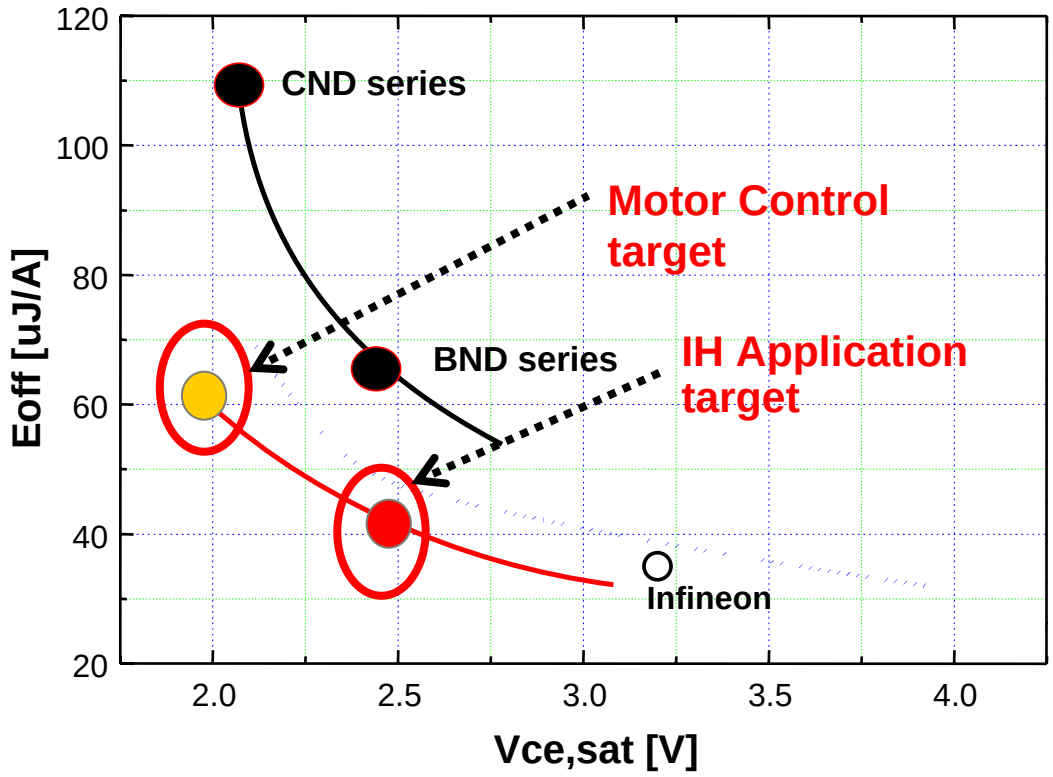
Short Circuit Withstand Time(Tsc)

- Motor Control requires Tsc longer than 10 usec
  - Large Voltage(DC Link Voltage) and Large Current (5 to 10 times larger than rated Ic) Condition
  - Longer Tsc requires Larger Vth

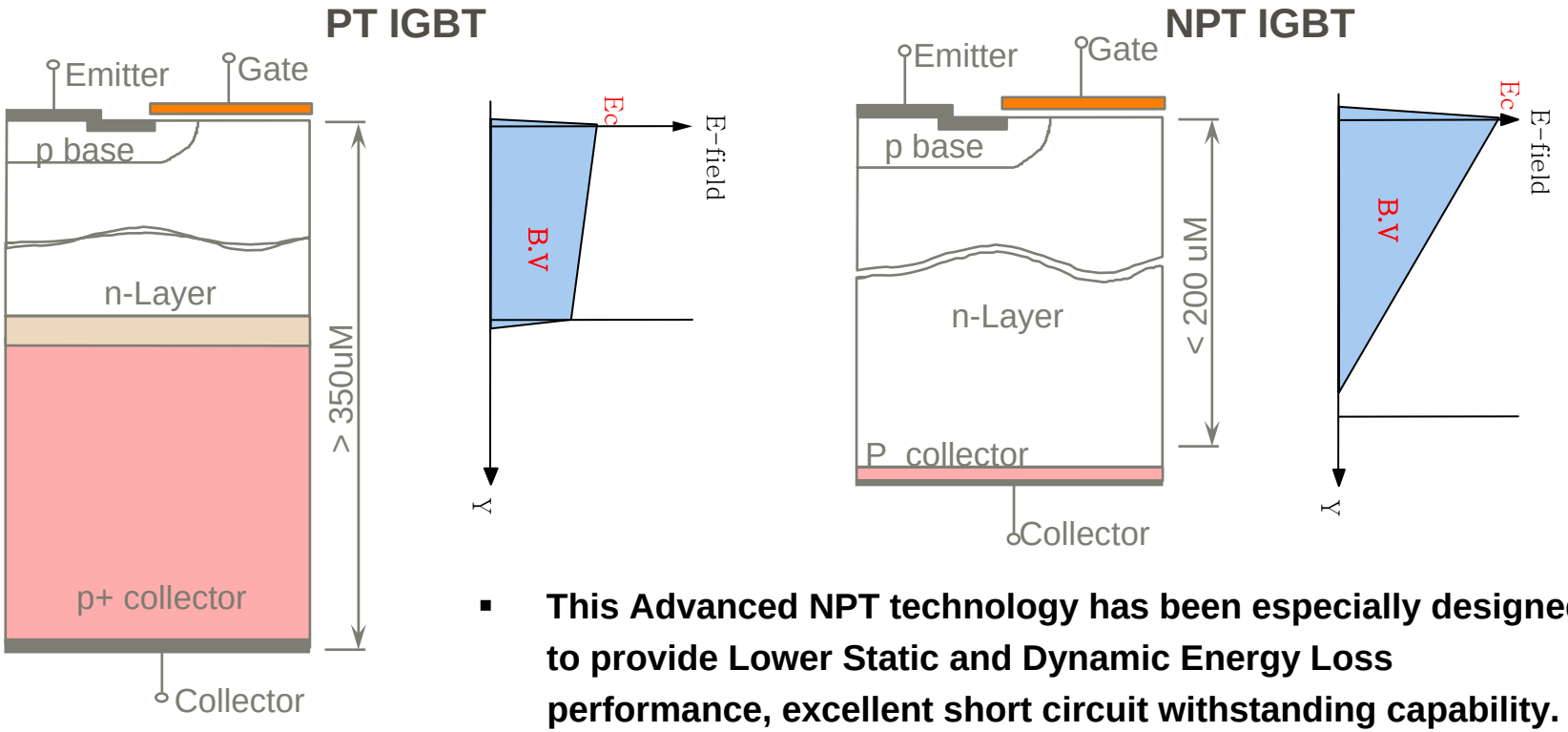




NPT IGBT target for 1200V Module



What is Merit of NPT ?



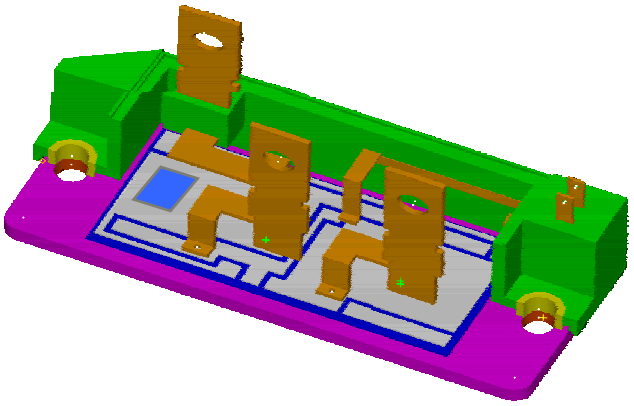
- **This Advanced NPT technology has been especially designed to provide Lower Static and Dynamic Energy Loss performance, excellent short circuit withstanding capability.**
- **These devices are designed according to their application such as IH and Inverter application.**
- **This Advanced NPT technology development targets for provide a leadership position in this market area with its performance and cost competency.**

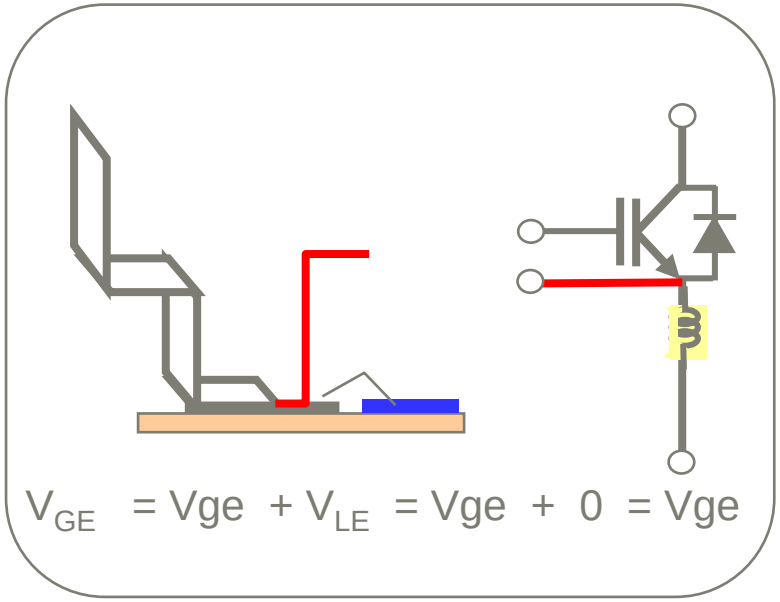
1. IGBT 2-PAK Module (7PM)

2-PAK Module - G series

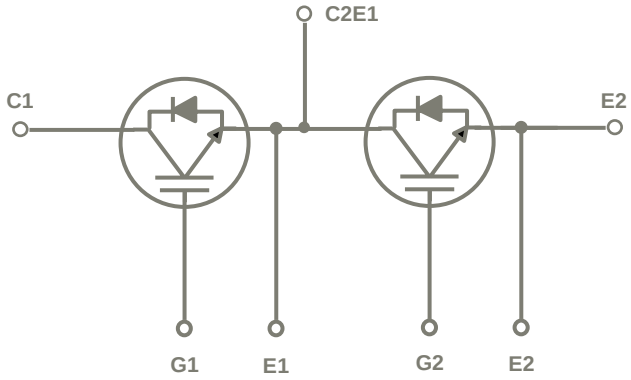
- G series
  - ☞ Reduced Package Internal Stray Inductance
  - ☞ Optimized Switching Characteristics (Low Switching Noise)
  - ☞ 3 Types of Package by Current Ratings
  - ☞ UL Approval : E209204

New package (G Series)





2-PAK Module - G Series



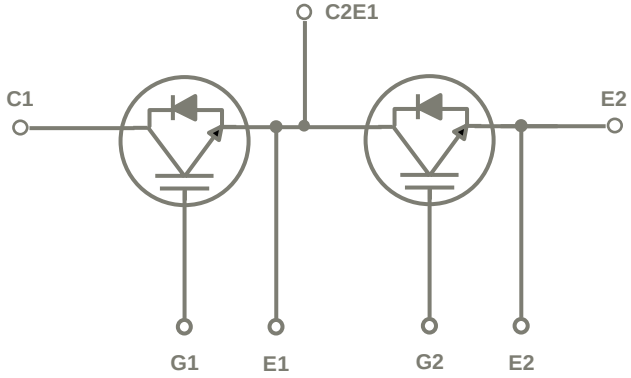
Internal Circuit Diagram

7PM-GA
600V 50/75/100/150A
1200V 50/75A

❑ LINE UP

DEVICE	BVces [V]	Ic [A]	Vce(sat) [V] typ.	Tf [uS] typ.	Status
FMG2G50US60	600	50	2.2	0.12	Now
FMG2G75US60	600	75	2.2	0.12	Now
FMG2G100US60	600	100	2.2	0.12	Now
FMG2G150US60E	600	150	2.2	0.12	Now
FMG2G50US120	1200	50	2.3	0.15	1Q, 2004
FMG2G75US120	1200	75	2.3	0.15	1Q, 2004

New 2-PAK Module - G Series



Internal Circuit Diagram

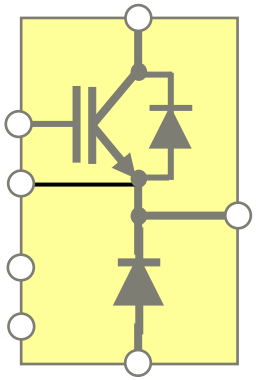
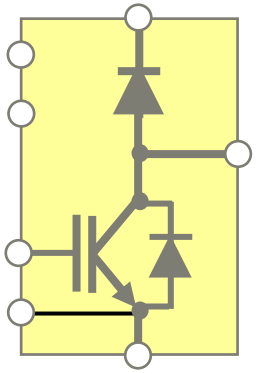
7PM-HA
600V 150/200/300A
1200V 100/150A

7PM- IA
600V 300/400A
1200V 200A

❑ LINE UP

DEVICE	BVces [V]	Ic [A]	Vce(sat) [V] typ.	Tf [uS] typ.	Status
FMG2G150US60	600	150	2.2	0.12	Now
FMG2G200US60	600	200	2.2	0.12	Now
FMG2G300US60E	600	300	2.2	0.12	Now
FMG2G300US60	600	300	2.2	0.12	Now
FMG2G400US60	600	400	2.2	0.18	Now
FMG2G100US120	1200	100	2.3	0.15	1Q, 2004
FMG2G150US120	1200	150	2.3	0.15	1Q, 2004
FMG2G200US120	1200	200	2.3	0.18	1Q, 2004

Line-Up of Chopper Module in 7PM-GA Package

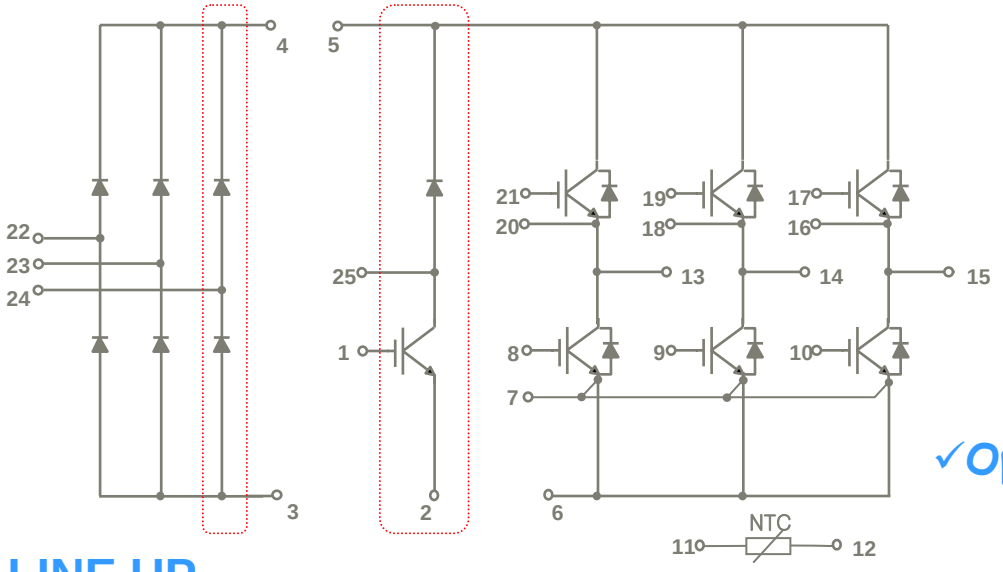
Chopper Module	Ordering Code	Status	Remark
High Side type 	FMG1G50US60H FMG1G75US60H FMG1G100US60H FMG1G150US60HE FMG1G150US60H FMG1G200US60H FMG1G300US60HE FMG1G300US60H FMG1G400US60HE	Now	
Low Side type 	FMG1G50US60L FMG1G75US60L FMG1G100US60L FMG1G150US60LE FMG1G150US60L FMG1G200US60L FMG1G300US60LE FMG1G300US60L FMG1G400US60LE	Now	

2. IGBT Power Integrated Module

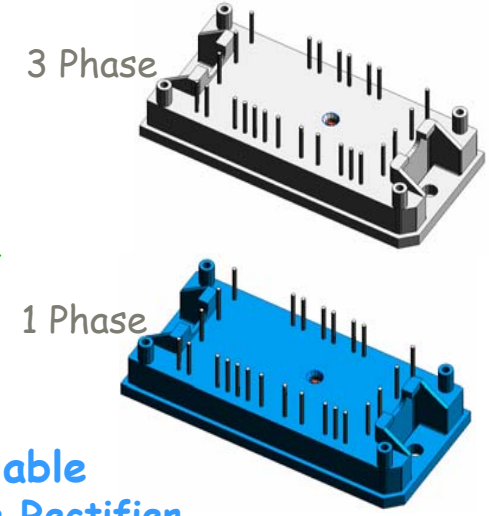
(25PM / 24PM)

Power Integrated Module - 25PM

❑ 3 Phase Rectifier + Brake + 3 Phase Inverter + NTC



25PM-AA



✓Options Available

- 1 Phase Rectifier
- Without Brake

❑ LINE UP

DEVICE	BVces [V]	Ic [A]	Vce(sat) [V] typ.	Tf [uS] typ.	Status
FMS7G10US60	600	10	2.2	0.12	Now
FMS7G15US60	600	15	2.2	0.12	Now
FMS7G20US60	600	20	2.2	0.12	Now
FMS7G5US120	1200	5	2.3	0.15	2Q, 2004
FMS7G10US120	1200	10	2.3	0.15	2Q, 2004
FMS7G15US120	1200	15	2.3	0.15	2Q, 2004

Line-Up Plan

of New Power Integrated Module - 25PM 600V

Voltage Ratings	Current Ratings	Input	Brake	Ordering Code
600V	10A	1 Phase	X	FMS6G10US60S
			O	FMS7G10US60S
		3 Phase	X	FMS6G10US60
			O	FMS7G10US60
	15A	1 Phase	X	FMS6G15US60S
			O	FMS7G15US60S
		3 Phase	X	FMS6G15US60
			O	FMS7G15US60
	20A	1 Phase	X	FMS6G20US60S
			O	FMS7G20US60S
		3 Phase	X	FMS6G20US60
			O	FMS7G20US60

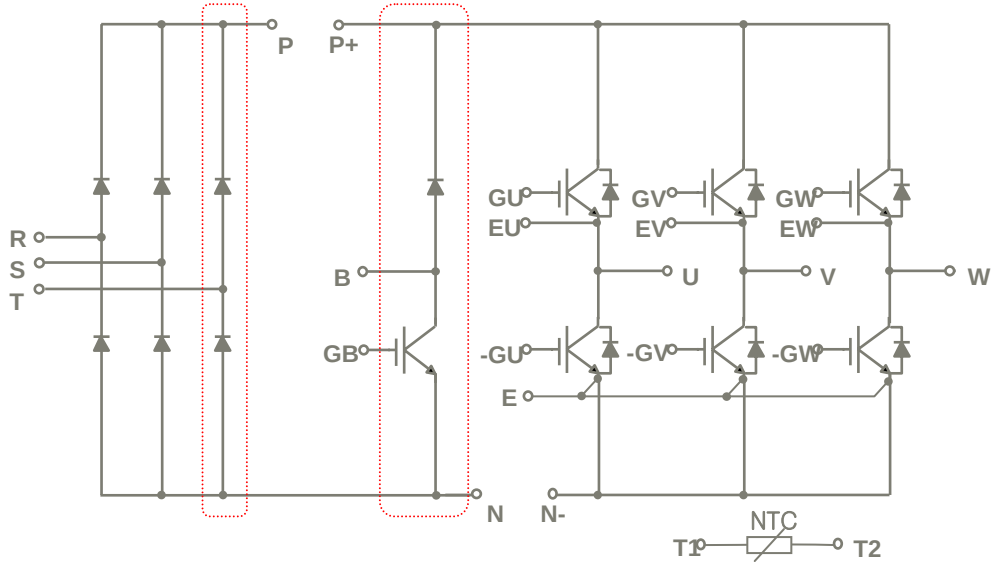
Line-Up Plan

of New Power Integrated Module - 25PM 1200V

Voltage Ratings	Current Ratings	Input	Brake	Ordering Code
1200V	5A	3 Phase	X	FMS6G5US120
			O	FMS7G5US120
	10A	3 Phase	X	FMS6G10US120
			O	FMS7G10US120
	15A	3 Phase	X	FMS6G15US120
			O	FMS7G15US120

New Power Integrated Module - 24PM (type 1)

❑ 3 Phase Rectifier + Brake + 3 Phase Inverter + NTC



24PM-AA

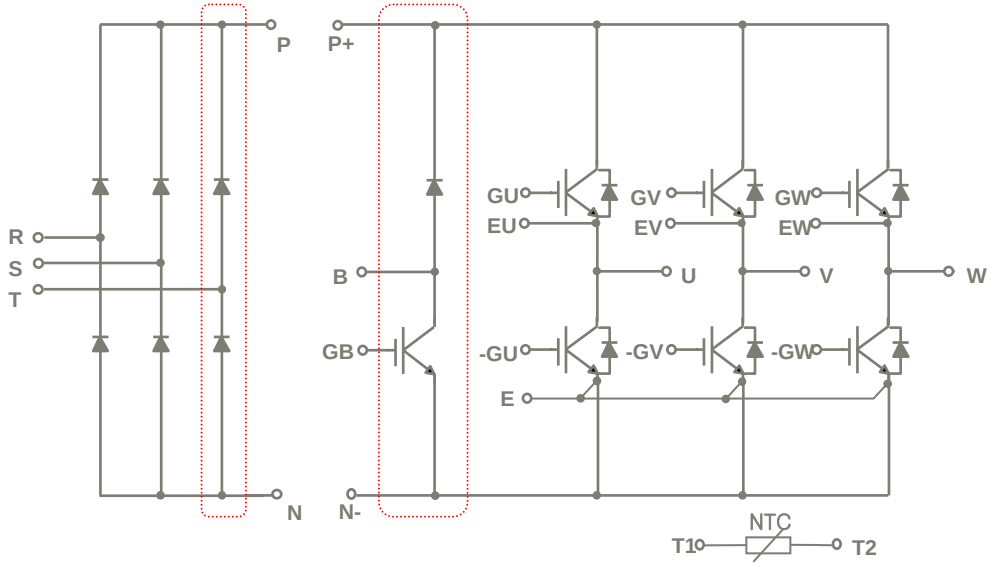
✓Options Available
- ➢ 1 Phase Rectifier
- ➢ Without Brake

❑ LINE UP

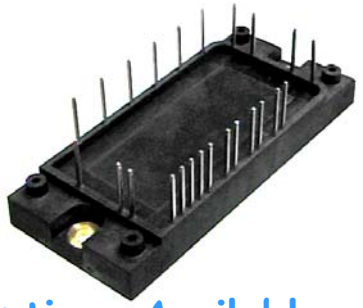
DEVICE	BVces [V]	Ic [A]	Vce(sat) [V] typ.	Tf [uS] typ.	Status
FMM7G20US60I	600	20	2.2	0.12	Now
FMM7G30US60I	600	30	2.2	0.12	Now
FMM7G50US60I	600	50	2.2	0.12	Now
FMM7G20US120I	1200	20	2.3	0.15	?
FMM7G25US120I	1200	25	2.3	0.15	?

New Power Integrated Module - 24PM (type 2)

❑ 3 Phase Rectifier + Brake + 3 Phase Inverter + NTC



24PM-AA



✓Options Available

- ➢ 1 Phase Rectifier
- ➢ Without Brake

❑ LINE UP

DEVICE	BVces [V]	Ic [A]	Vce(sat) [V] typ.	Tf [uS] typ.	Status
FMM7G20US60N	600	20	2.2	0.12	Now
FMM7G30US60N	600	30	2.2	0.12	Now
FMM7G50US60N	600	50	2.2	0.12	Now
FMM7G20US120N	1200	20	2.3	0.15	?
FMM7G25US120N	1200	25	2.3	0.15	?

Line UP Plan

of New Power Integrated Module - 24PM

Voltage Ratings	Current Ratings	Recti. Phases	Brake	Ordering Code
600V	20A	1 Phase	X	FMM6G20US60S
			O	FMM7G20US60SN/SI
		3 Phase	X	FMM6G20US60
			O	FMM7G20US60N/I
	30A	1 Phase	X	FMM6G30US60S
			O	FMM7G30US60SN/SI
		3 Phase	X	FMM6G30US60
			O	FMM7G30US60N/I
	50A	3 Phase	X	FMM6G50US60
			O	FMM7G50US60N/I
1200V	20A	3 Phase	X	FMM6G20US120
			O	FMM7G20US120N/I
	25A	3 Phase	X	FMM6G25US120
			O	FMM7G25US120N/I

Standard Module Cross Reference

Rating	Package	FSC	Mitsubishi	Fuji	Toshiba	Eupec	Tyco	IXYS
600V	25PM	FMS7G10US60	CM15TF-12H				P83A	MUBW10-06
		FMS7G15US60	CM20TF-12H				P84A	MUBW15-06
		FMS7G20US60					P85A	MUBW20-06
		FMS7G30US60					P86A	
	24PM	FMM7G20US60		7MBR20SA-060		BSM20GP60		
		FMM7G30US60	CM30TF-12H	7MBR30SA-060		BSM30GP60		
		FMM7G50US60		7MBR50SA-060		BSM50GP60		
	2-PAK	FMG2G50US60	CM50DY-12H	2MBI50N-060	MG50J2YS50	BSM50GB60DLC		
		FMG2G75US60	CM75DY-12H	2MBI75N-060	MG75J2YS50	BSM75GB60DLC		
		FMG2G100US60	CM100DY-12H	2MBI100N-060	MG100J2YS50	BSM100GB60DLC		
		FMG2G150US60	CM150DY-12H	2MBI150N-060	MG150J2YS50	BSM150GB60DLC		
		FMG2G150US60E	CM150DY-12H	2MBI150NC-060	MG150J2YS50	BSM150GB60DLC		
		FMG2G200US60	CM200DY-12H	2MBI200N-060	MG200J2YS50	BSM200GB60DLC		
		FMG2G300US60E	CM300DY-12H	2MBI300NB-060	MG300J2YS50	BSM300GB60DLC		
		FMG2G300US60	CM300DY-12H	2MBI300N-060	MG300J2YS50	BSM300GB60DLC		
		FMG2G400US60	CM400DY-12H	2MBI400N-060				
1200V	25PM	FMS7G5US120					P88A	
		FMS7G10US120					P89A	MUBW10-12
		FMS7G15US120					P80A	MUBW15-12
	24PM	FMM7G20US120						
		FMM7G25US120		7MBR25SA-120		BSM25GP120		
	2-PAK	FMG2G50US120	CM50DY-24H	2MBI50N-120	MG50Q2YS50	BSM50GB120DLC		
		FMG2G75US120	CM75DY-24H	2MBI75N-120	MG75Q2YS50	BSM75GB120DLC		
		FMG2G100US120	CM100DY-24H	2MBI100NC-120	MG100Q2YS50	BSM100GB120DLC		
		FMG2G150US120	CM150DY-24H	2MBI150NC-120	MG150Q2YS50	BSM150GB120DLC		
		FMG2G200US120	CM200DY-24H	2MBI200N-120	MG200Q2YS50	BSM200GB120DLC		

Ordering Information of IGBT Module