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Apr.	M.Fukunaga '023-2/15			M.Fukunaga '02-6/13

PM52AUBZ060-1

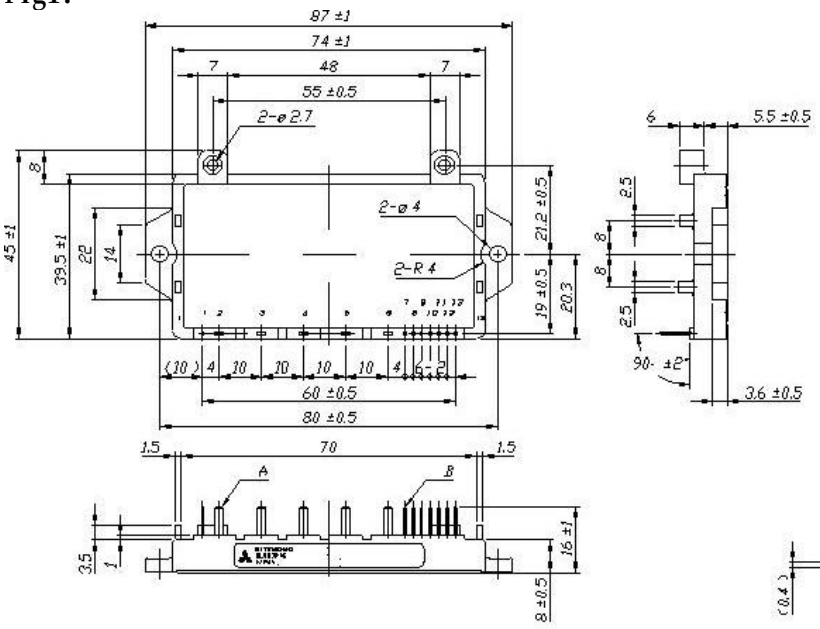
・Applications

AC100V/20A, 200V/20A input Power Factor Corrector, PAM controller for Air Conditioner and General purpose Condenser Input Type Invertor use.

・Outline and Rating

- A/F IPM Input Current Rating Ii: 100% load: 20A(rms)
  125% load: 25A(rms), 1min.
- Variable DC Output Voltage Controll Function
- With control function of output voltage repression under light load
- With Function of Soft Start
- Protection Functions
  - ・Output Voltage repression under light load ------ OV1
  - ・Output Over Voltage protection ---------- OV2 (OV2 >OV1)
  - ・Under Voltage lockout protection ----------UV
  - ・Over Temperature protevtion ----------OT
  - ・Short circuit current protection ----------SC

Fig1.



1. Vo
2. P2
3. L
4. N2
5. P1
6. N1
7. GND
8. V_{sig}
9. TEST
10. Fo
11. ON/OFF
12. V_{ctrl}
13. VD

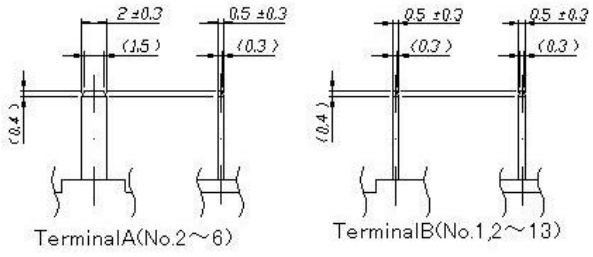
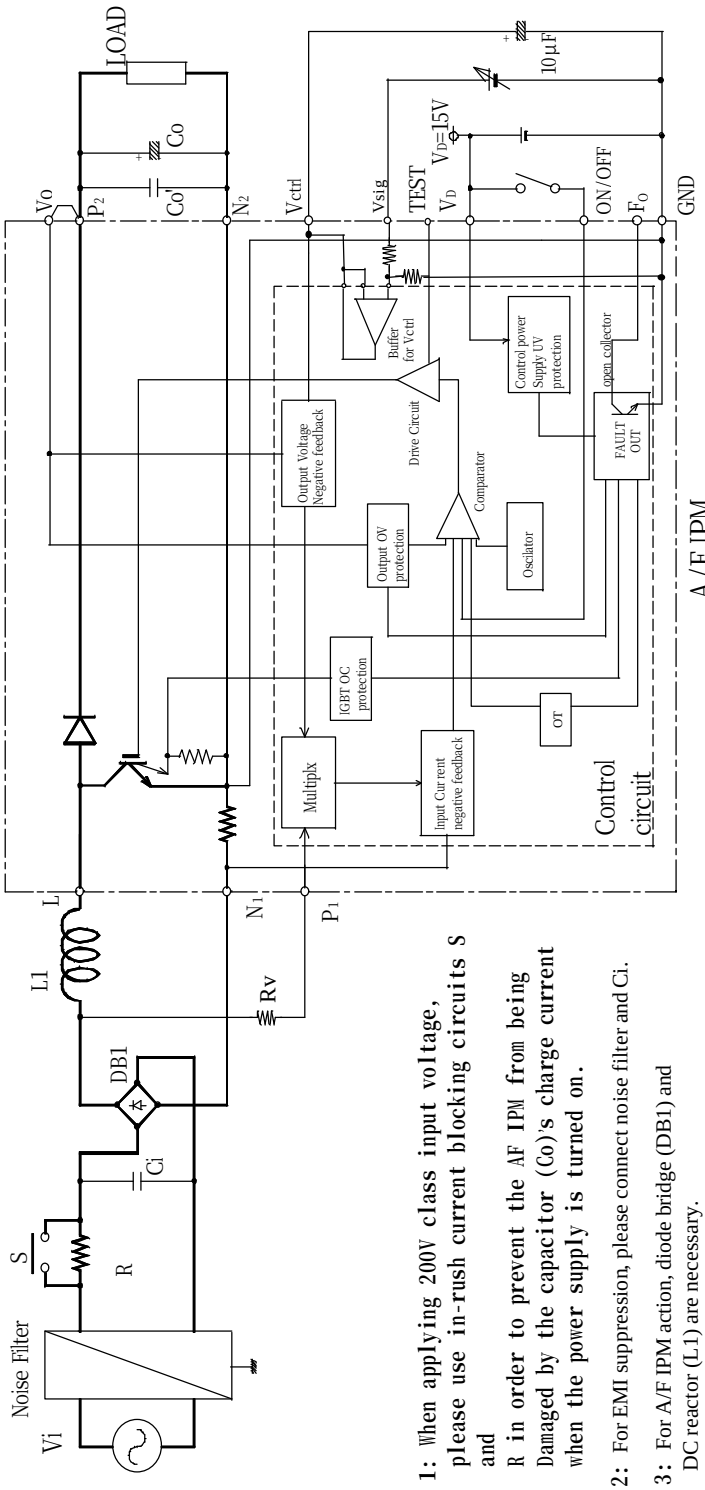


Fig2: Block Diagram of AFIPM



Note 1: When applying 200V class input voltage, please use in-rush current blocking circuits S and R in order to prevent the AF IPM from being Damaged by the capacitor (Co)'s charge current when the power supply is turned on.

Note 2: For EMI suppression, please connect noise filter and Ci.

Note 3: For A/F IPM action, diode bridge (DB1) and DC reactor (L1) are necessary.

Note 4: Due to high-speed switching, a surge voltage can be easily generated between P2 and N2. Because rectangular wave current that is switched by A/F IPM flows between P2-Co-N2, the area between P2-Co-N2 should be kept as small as possible (with short wiring.) Please use a high frequency electrolytic capacitor for the Co and connect it to a capacitor (Co') that is capable of handling high frequency such

Note 5: Please make sure to short-circuit between Vo and P2 terminals because the Vo terminal is output DC voltage
negative feedback. When the Vo terminal is opened, A/F IPM can be damaged.

Note 6: Recommended circuit constant:
L=1mH, Ci=3.3μF, Co'=3.3μF, Co=1000μF

Note 7: Selection of Rv:
7-1) When applying 100V input voltage, please use Rv=0Ω.
7-2) When applying 200V class input voltage, please use 270kΩ.

Maximum Ratings (Tj = 25°C, unless otherwise noted)

Main Circuit Part

Item	Symbol	Condition	Ratings	Unit
Supply Voltage	V_i	Applied Between : L-N1,P1-N1	264	V_{rms}
Supply Voltage (surge)	$V_{i(surge)}$	Applied Between : L-N1,P1-N1 , Surge value , Non-operating	500	V
Output Voltage (surge)	$V_{O(surge)}$	Applied Between : P2-N2 , Surge value, Non-operating	500	V
Collector-Emitter Voltage	V_{CES}	—	600	V
Repetitive Peak Reverse Voltage	V_{RRM}	—	600	V
Input Current (100% Load)	I_i	$T_C \leqq +90°C$, V_i=100～200V,V_O=300V	20	A_{rms}
Input Current (125% Load)	$I_{i(OVER\ LOAD)}$	$T_C \leqq +90°C$, V_i=100～200V,V_O=300V 1min Non-reptitive	25	A_{rms}
I^2t for Fu sing	I^2t	Value for 1msec of Surge Current	120	A^2s
Load	-	V_i=100V	2.0	kW
Load	-	V_i=200V	4.0	kW
Junction Temperature	Tj	(Note-1)	-20～+125	°C

Control Part

Item	Symbol	Condition	Rating	Unit
Supply Voltage	V_D	Applied Between : V_D-GND	20	V
Control Voltage	V_{sig}	Applied Between : V_{sig}-GND	0～V_D	V
ON/OFF Signal Voltage	$V_{ON/OFF}$	Applied Between : ON/OFF-GND	0～V_D	V

Total System

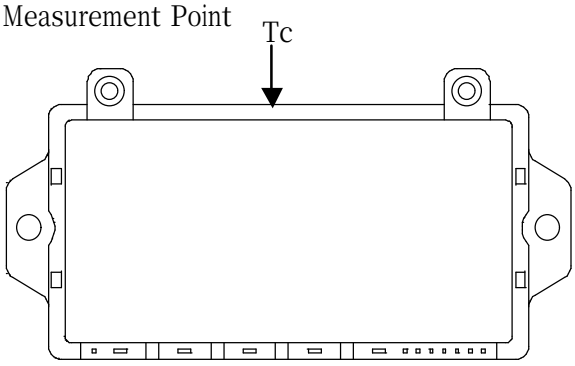
Item	Symbol	Condition	Rating	Unit
Output Voltage	V_O	(Note-2)	420	V
Module Case Operating Temperature	T_C	(Note-3)	-20～+100	°C
Storage Temperature	Tstg		-40～+125	
Isolation Voltage	V_{iso}	60Hz, Sinusoidal Charged part to Base, AC 1 min.	2500	Vrms

(Note-1) The item defines the maximum junction temperature for the power elements (IGBT/Diode) of the A/F IPM to ensure safe operation. However, these power elements can endure junction temperature as high as 150°C if it is a short time. A/F IPM can use virtual junction temperature to 150°C if less than accumulation time 100hr.

(Note-2) Peak value of output voltage Vo (it has instantaneous value) is less than rated value (420V), including in the case that output voltage is overshooting.

(Note-3) Tc measurement point: 3mm deep at the center of the side of the base plate.

Fig.3: Case Temperature (Tc) Measurement Point



Electrical Characteristics (Tj=25°C,V_D=15V,L1=1mH,Co=1mF unless otherwise noted)

Main Circuit Part

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Switching Time	$t_{c(on)}$	V_{CE}=300V, I_{CE}=30A	—	0.07	—	μs
	$t_{c(off)}$	Tj=125°C	—	0.25	—	
	t_{rr}	V_{CE}=300V, I_F=30A,Tj=125°C	—	0.07	—	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_{CE}=50A	—	1.8	2.4	V
FWDi Forward Voltage	V_F	I_F=50A	—	2.0	3.0	V
Collector-Emitter Cutoff Current	I_{CES}	V_{CE}=600V	—	—	1.0	mA
Repetitive Peak Reverse Current	I_{RRM}	V_{RRM}= 600V	—	—	1.0	mA
Reverse Recovery Current	I_{rr}	V_{CE}=300V,I_{CE}=30A	—	45	—	A

Control Part

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_D	Applied between : V_D-GND	13.5	15	16.5	V
Circuit Current (Active)	I_D		—	25	30	mA
Circuit Current(Non-active)	I_D		—	13	—	mA
Input On Threshold Voltage	$V_{th(ON)}$		—	2.8	3.3	V
Input Off Threshold Voltage	$V_{th(OFF)}$		1.9	2.4	—	V
Switching Frequency	f_{SW}		18	20	22	kHz
Supply Circuit Under Voltage Protection	UV	Trip Level (Note-4)	11.5	12.0	12.5	V
	UV_r	Reset Level (Note-4)	12.0	12.5	13.0	V
V_{ctrl} Current	I_{ctrl}	V_O = 300V, V_D =15V, V_{ctrl} = 1.04V	—	-0.31	—	mA
Output Voltage Protection	OV1	Trip Level (Note-5)	V_O+10	V_O+20	V_O+30	V
	$OV1_r$	Reset Level (Note-5)	OV1-9	OV1-7	OV1-5	V
Over Voltage Protection	OV2	Trip Level (Note-6)	420	435	450	V
Short Circuit Current Trip Level	SC	Trip Level (Note-7)	—	150	—	A
Oner Temperature Protection	OT	Trip Level (Note-8)	100	110	120	°C
	OTr	Reset Level (Note-8)	—	90	—	°C
Fault Output Current	I_{FOH}	V_D=15V, V_{FO}= 15V (Non-Operating)	—	—	20	μA
Fault Output Voltage	V_{FOL}	V_D=15V ,I_{FOL}≦10mA (Operating)	—	—	0.8	V
Fault Output Pulse Width	t_{FO}	V_D=15V (Operating)	1.0	1.8	—	ms

(Note-4) Fault output is given when the internal UV protection (Auto-reset)
(Note-5) Fault output is not given when the internal OV1 protection (Auto-reset)
(Note-6) Fault output is given when the internal OV2 protection (Reset when ON/OFF(Terminal-11) is Low)
(Note-7) Fault output is given when the internal SC protection (Reset when ON/OFF(Terminal-11) is Low)
(Note-8) Fault output is given when the internal OT protection (Auto-reset)

Total System

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Output Voltage Adjust(1)	V_O	Vi=100V, LR=400Ω,Vsig=1.38V	351	360	369	V
Output Voltage Adjust(2)	V_O	Vi=100V, LR=400Ω,Vsig=2.08V	291	300	309	V
Output Voltage Adjust(3)	V_O	Vi=100V, LR=400Ω,Vsig=3.26V	191	200	209	V
Output Voltage Stability(1-1) (vs Input Voltage)	—	V_O=300V, LR=400Ω $\frac{Vo(Vi=90V)-Vo(Vi=100V)}{Vo(Vi=100V)}\times 100(\%)$	-1	—	+1	%
Output Voltage Stability(1-2) (vs Input Voltage)	—	V_O=300V, LR=400Ω $\frac{Vo(Vi=110V)-Vo(Vi=100V)}{Vo(Vi=100V)}\times 100(\%)$	-1	—	+1	%
Output Voltage Stability(2) (vs Load)	—	V_i=100V,V_O=300V $\frac{Vo(Load=400\Omega)-Vo(Load=48\Omega)}{Vo(Load=48\Omega)}\times 100(\%)$	0	—	+6	%
Output Voltage Stability(3-1) (vs Ambient Temp.)	—	V_i=100V,V_O=300V,LR=400Ω $\frac{Vo(Ta=-20℃)-Vo(Ta=+25℃)}{Vo(Ta=+25℃)}\times 100(\%)$	-3	—	0	%
Output Voltage Stability(3-2) (vs Ambient Temp.)	—	V_i=100V,V_O=300V,LR=400Ω $\frac{Vo(Ta=+100℃)-Vo(Ta=+25℃)}{Vo(Ta=+25℃)}\times 100(\%)$	0	—	+3	%
Rise Time	—	V_i=100V,V_O=300V,LR=48Ω	—	—	100	ms
Over Shoot Voltage	—	V_i=100V,V_O=300V,LR=400Ω,L1=1mH	—	—	30	V
Power Factor	cosΦ	V_i=100V,V_O=300V,LR=48Ω	0.99	0.995	1.0	—

Thermal Resistance

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Junction to case Thermal Resistance	$R_{th(j-c)Q}$	IGBT	—	—	0.94	°C／W
	$R_{th(j-c)Di}$	FWDi	—	—	1.2	
Contact Thermal Resistance	$R_{th(c-f)}$	Case to fin, (per 1 module) Thermal grease applied	—	—	0.09	

Mechanical Ratings and characteristics

Item	—	Condition	Min.	Typ.	Max.	Unit
Mounting torque	—	Mounting part screw : M 3.5	0.78	0.98	1.18	N・m
Weight	—	—	—	50	—	g

Recommended Conditions For Use

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_i	Applied Between : P1-N1 ,	90	—	264	V_{rms}
Supply Voltage	V_D	Applied between : V_D-GND	13.5	15	16.5	V
Input Current	I_i		—	—	20	A_{rms}
Output Voltage	V_O		170	300	400	V
Load	—	V_i=100V,V_O=300V	100	—	2000	W
Reactor	L		—	1	—	mH
Input Capacitor	Ci		—	3.3	—	μH
Output Capacitor	Co		1000	—	—	μH
Outrut Capacitor	Co '		—	3.3	—	μH

Fig4: Circuit of Terminal V_{sig}

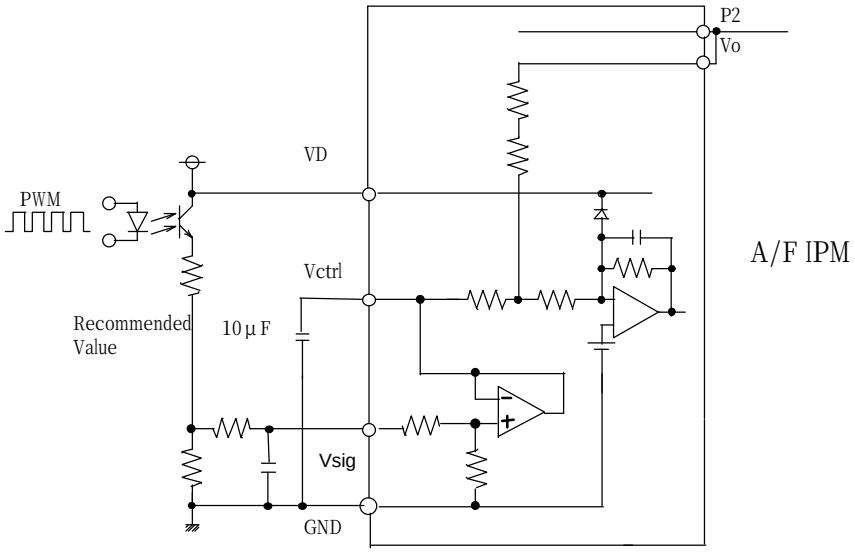
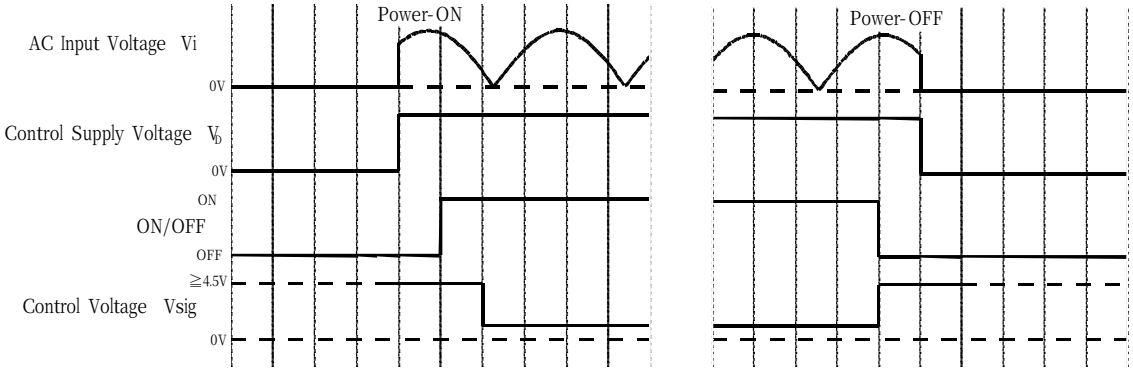


Fig.5-1: AC Input Voltage and Control Singal Timing Chart



Please apply the POWER-ON/OFF signals as descrbed in the above timing chart.
And please apply to adjust the PAM control signal (Vsin) after turning on the ON/OFF switch.

Fig.5-2: AC Input Voltage and Control Singal Timing Chart (After Vsig set up, ON/OFF signal OFF → ON)

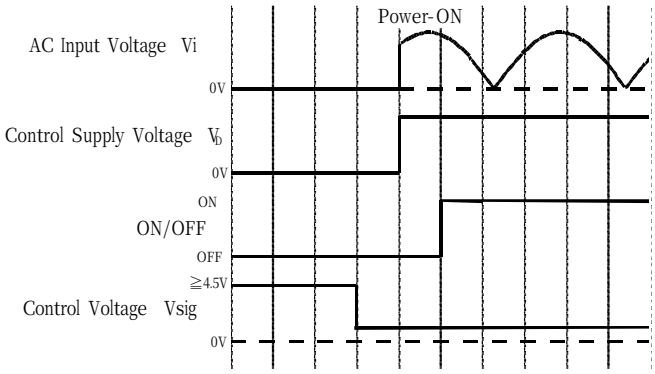
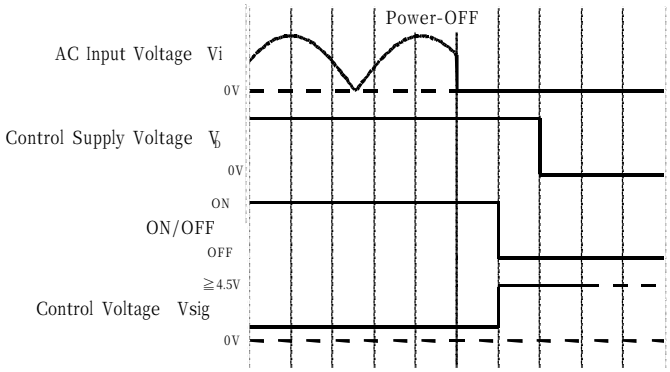


Fig.5-3: AC Input Voltage and Control Singal Timing Chart (After Vi cut-off, ON/OFF signal ON → OFF)



In condition to use A/F IPM by external circuit connection of Fig.2, A/F IPM is not damaged in the sequence of Fig.5-3 as well.

A/F IPM is not damaged in the sequence of Fig.5-2 and Fig.5-3, but give it when unavoidable. Please normally supply/ cut-off the input power supply and input signals by the sequence of fig.5-1.

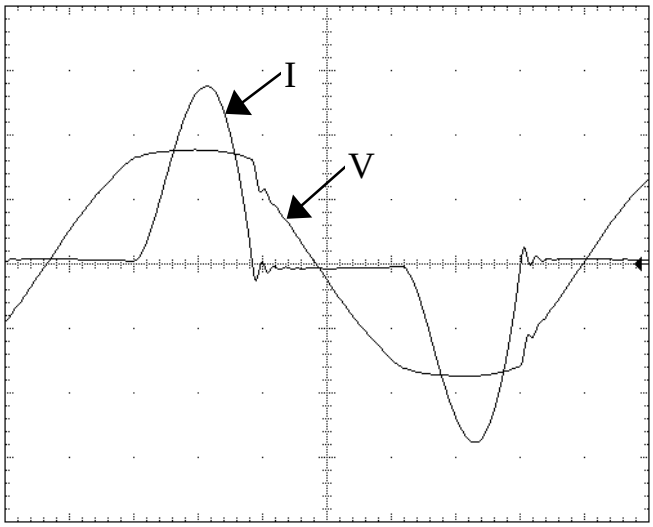


Fig6: AC Input Waveforms without A/F IPM

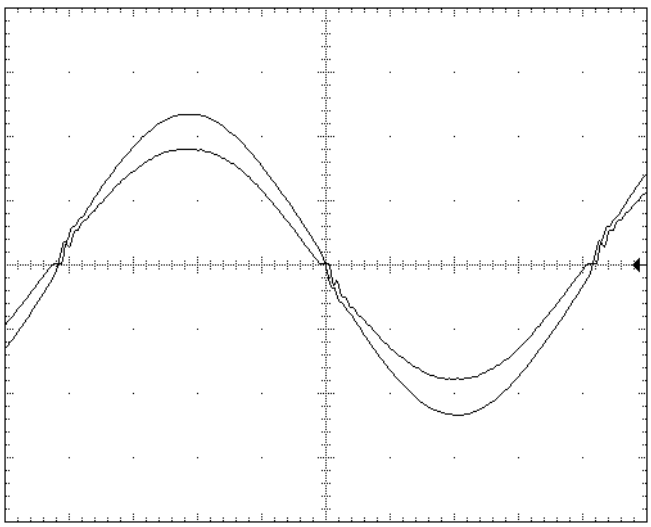


Fig7: AC Input Waveform with A/F IPM