VFD-350C-230

350W AC Input Variable Frequency Drive Module with PFC Function

User's Manual

Video

IEC61800-5-1 BS EN/EN61800-5-1 TPTC004

ECO Industrial Automate Household

Features

- 90~264Vac input, built-in PFC boost to 380VDC
- Power stage, 3-phase switches with sensors in one unit for external control (control board VFD-CB sold sperately)
- High peak current up to 200% and 5 seconds
- Fanless design for silent operation and long lifetime
- Protections: Short circuit / OCP
- Internal sensors feed out for control:
  Current sensor - motor torque control
  DC bus voltage sensor - OVP/UVP
  Temperature sensor - OTP
- -30~+60℃ wide operating temperature
- Suitable for 3-phase motor drive (e.g. BLDC, Induction motor, SynRM)
- 3 years warranty

Applications

- HVAC
- Fan
- Water/Air pump
- Power tools
- Conveyor
- Automatic door
- Fitness equipment

GTIN CODE

MW Search: https://www.meanwell.com/serviceGTIN.aspx

Description

The VFD-350C-230 is an universal variable frequency drive power module providing integrated power stage, gate drivers and basic VFD sensors such as three phase output current and temperature sensors. This product can be implemented for a three phase motor drive solution by coordinating with an external motor drive controller in logic level and analog I/O. The power stage input is single phase full range from 90VAC to 264VAC with PFC function. The 3-phase motor output is up to 240V with 200% peak current capability. The VFD-350C-230 is suitable for three-phase motor drive, such as BLDC, Induction motor, and SynRM applications.

Model Encoding

VFD - 350 C - 230

- 230 — Nominal output voltage
- C — Metal case type
- 350 — Wattage

MEAN WELL

350W AC Input Variable Frequency Drive Module with PFC Function **VFD-350C-230**

SPECIFICATION

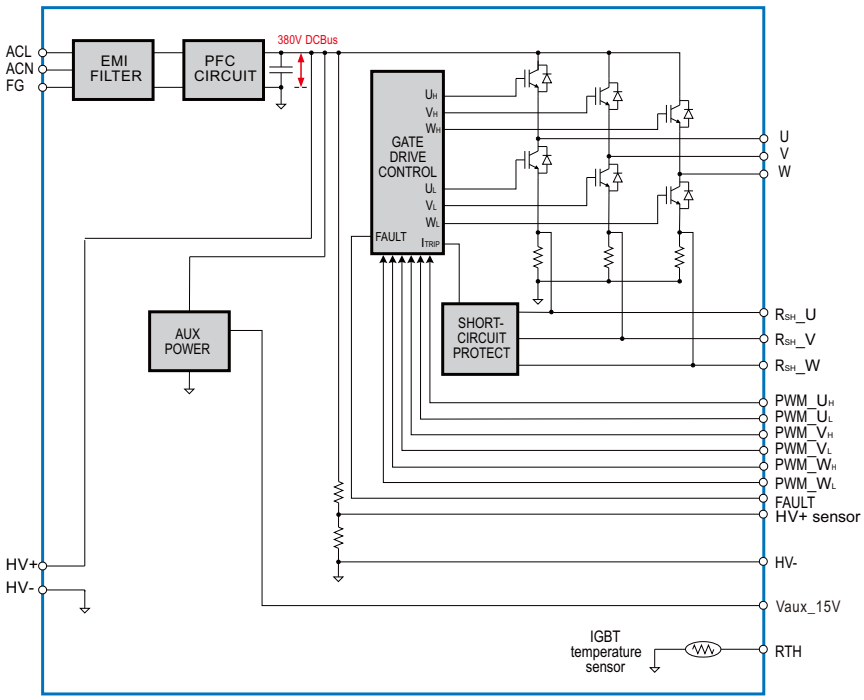
MODEL NO.			VFD-350C-230
PWM OUTPUT (Note 1,2,3,4)	VOLTAGE RANGE(UVW)		380Vmax, line-to-line voltage 0~268V adjustable with modulated PWM , suitable for 3PH 200-240V class motor
	CURRENT	Rated	1.4A
		Peak	2.8A for 5 seconds
	RATED POWER		350W
	EFFICIENCY		93%
	DC BUS VOLTAGE		380±5VDC
	PWM FREQUENCY		2.5 KHz ~ 15 KHz
INPUT	RATED INPUT VOLTAGE		90 ~ 264VAC
	INPUT FREQUENCY RANGE (Hz)		47 ~ 63Hz
	POWER FACTOR (Typ.)		PF>0.99/115VAC, PF>0.93/230VAC at full load
	RATED INPUT CURRENT		3.5A /115VAC 2A/230VAC
	INRUSH CURRENT		Cold start 70A /230VAC
	LEAKAGE CURRENT		<2mA/240VAC
CONTROL / FUNCTION (Note 5)	3-PHASE PWM CONTROL		PWM control signal to gate driver for IGBTs. (CN93, PIN8~13) 3.3V TTL/CMOS input: High(>2.7V): IGBT ON ; Low(<0.4V): IGBT OFF
	3-PHASE CURRENT SENSOR		Built-in 100mΩ low-side shunt resistors on UVW phase (CN93, PIN4~6)
	DC BUS VOLTAGE SENSOR		DC BUS voltage sensor output (CN93, PIN1) 2.5V@DC BUS 380V
	THERMAL SENSOR		Built-in 10KΩ NTC for sensing IGBTs operating temperature. (TSM2A103F34D1R (Thinking Electronic), PIN3 of CN93)
	FAULT SIGNAL		Inverter fault signal(Short circuit/OCP, CN93, PIN7). 3.3V TTL/CMOS output: Normal: High(>3V); Abnormal: Low(<0.5V)
	AUXILIARY POWER		Non-isolated 15V output power for external control board (CN93,PIN 14 to PIN2) 15V@0.1A ; Tolerance +/- 0.5V, Ripple 1Vp-p max
PROTECTION	SHORT CIRCUIT		Protection type : Shut down o/p voltage, re-power on to recover
ENVIRONMENT	WORKING TEMP.		-30 ~ +60℃ (Refer to "Dreating Curve")
	WORKING HUMIDITY		20 ~ 90% RH non-condensing
	STORAGE TEMP., HUMIDITY		-40 ~ +85℃, 10 ~ 95% RH non-condensing
	VIBRATION		10 ~ 500Hz, 2G 10min./1cycle, period for 60min. each along X, Y, Z axes
SAFETY & EMC	SAFETY STANDARDS		CB IEC61800-5-1,TUV/BS EN/EN61800-5-1,EAC TP TC004 approved
	WITHSTAND VOLTAGE		I/P-FG:2KVAC
	ISOLATION RESISTANCE		I/P-FG:100M Ohms/500VDC/25℃/ 70%RH
	EMC EMISSION	Parameter	Standard / Test Level / Note
		Conducted	BS EN/EN IEC61800-3 / Class A, C2
		Radiated	BS EN/EN IEC61800-3 / Class A, C2
		Harmonic Current	BS EN/EN IEC61000-3-2 / Class A
		Voltage Flicker	BS EN/EN61000-3-3 / -----
	EMC IMMUNITY	BS EN/EN IEC61800-3, second environment	
		Parameter	Standard / Test Level /Note
		ESD	BS EN/EN61000-4-2 / Level 3, 8KV air ; Level 2, 4KV contact
		Radiated	BS EN/EN IEC61000-4-3 / Level 3
		EFT/Burest	BS EN/EN61000-4-4 / Level 3
		Surge	BS EN/EN61000-4-5 / Level 3, 2KV/Line-Earth ; Level 3, 1KV/Line-Line
		Conducted	BS EN/EN61000-4-6 / Level 3
		Magnetic Field	BS EN/EN61000-4-8 / Level 4
		Voltage Dips and Interruptions	BS EN/EN IEC61000-4-11 / >95% dip 0.5 periods, 30% dip 25 periods, >95% interruptions 250 periods
		Voltage deviation	IEC 61000-2-4 Class 2 / ±10% Un
		Total Harmonic distortion (THD) Individual Harmonic orders	IEC 61000-2-4 Class 3 IEC 61000-4-13 Class 3 / THD 12 %
		Frequency variations	IEC 61000-2-4 / ±4%
		Frequency rate of change	IEC 61000-2-4 / 2%/s
OTHERS	MTBF		2078.9K hrs min.Telcordia SR-332 (Bellcore) ; 191.5K hrs min.MIL-HDBK-217F (25℃)
	DIMENSION (L*W*H)		146*62*31mm
	PACKING		0.38Kg;32pcs/13.18kg/0.87CUFT

NOTE

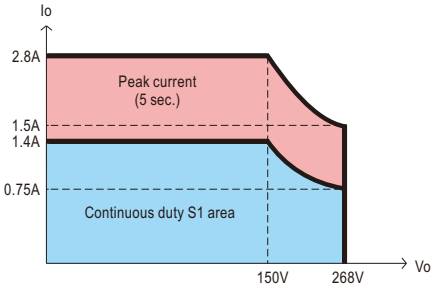
1. 3-phase 220V motor is recommended.Please consider the rated current when used for 100-120V class motor.
2. Refer to peak current capability in "V/I Curve".
3. Efficiency is tested with inductive load at rated current and full power.
4. All parameters NOT specially mentioned are measured at 230VAC input, rated load and 25℃ of ambient temperature.
5. Please refer to "Functional Manual" for more details.

※ Product Liability Disclaimer：For detailed information, please refer to https://www.meanwell.com/serviceDisclaimer.aspx

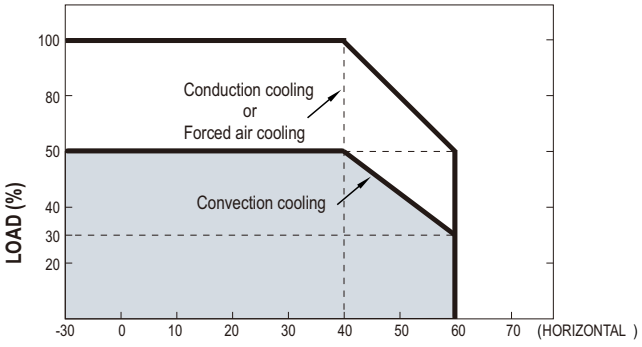
Block Diagram



V/I CURVE

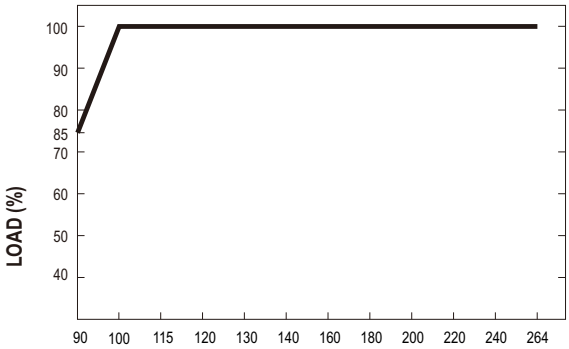


Derating Curve



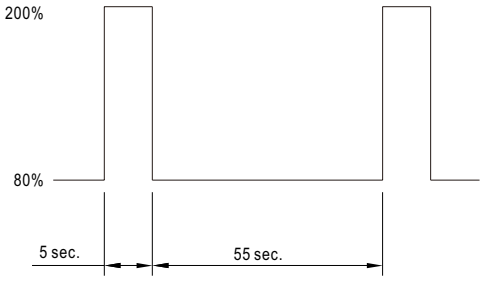
AMBIENT TEMPERATURE

Output Derating VS Input Voltage

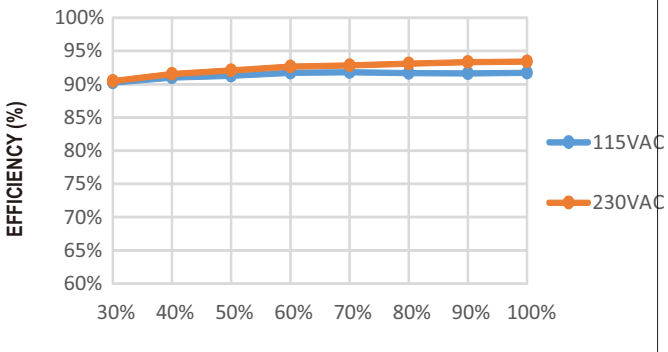


INPUT VOLTAGE (VAC) 60Hz

Peak Current



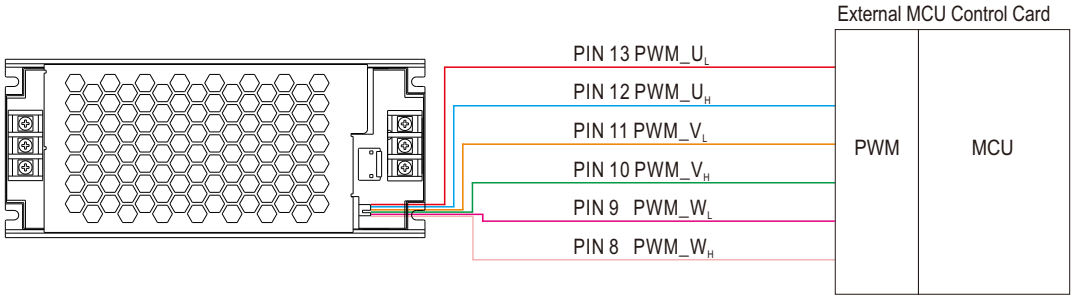
Efficiency vs Load



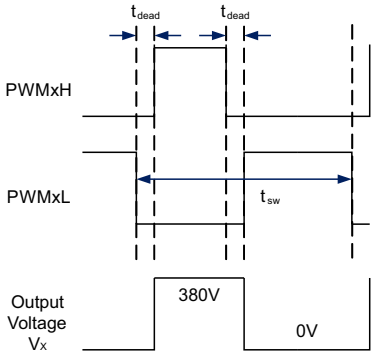
■ Function Manual

1. 3-phase PWM Control (CN93, PIN8~13)

VFD-350C-230 provides six-switch circuit by using 3 half-bridge IGBTs. IGBTs of each phase is controlled by PWM_U_H/U_L, PWM_V_H/V_L and PWM_W_H/W_L (PIN 8~13). The input requirement for PWM is compatible with both TTL and CMOS 3.3V signals. Please refer to the diagram below.



WARNING: It is necessary to keep minimum dead-time between the upper and lower switch of each phase.



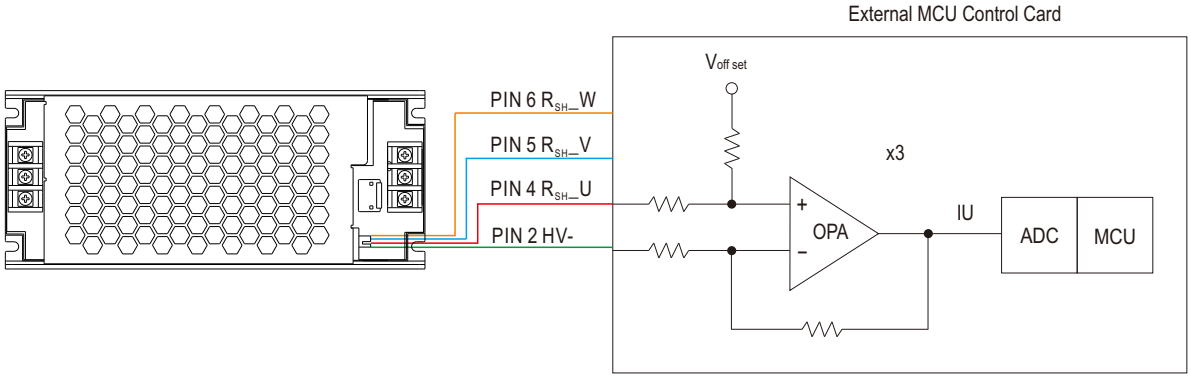
t_{dead} (Min.)	300ns

t_{dead} : Switching dead-time x = U, V, W

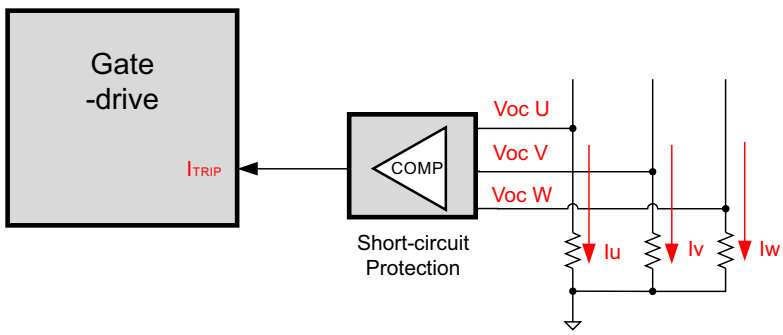
t_{sw} : Switching period

2. 3-phase Current Detection & Overcurrent Protection (CN93, PIN4~6)

Low-side shunt resistors 100mΩ are installed on each phase of VFD-350C-230 for current measurement and short-circuit detection. It's suggested to shorten the length of external detection circuit and detect the signal with a OPAs. Please refer to diagram below.

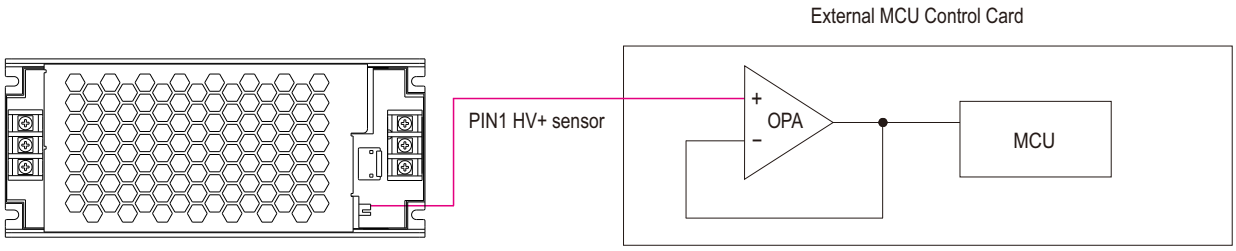


If output current exceeds 200% of rated value, the internal protection circuit will be triggered and shut down the gate driver for protection.



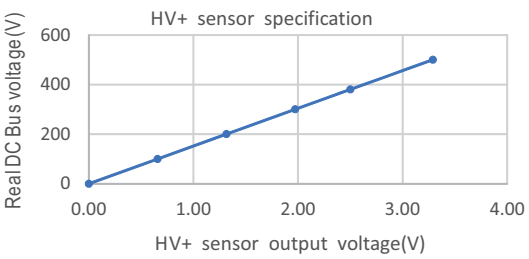
3. DC BUS Voltage Detection (CN93, PIN1)

VFD-350C-230 is build-in with DC bus voltage sensor(HV+ sensor, PIN 1). The sensor provides a 2.5V output when DC bus voltage is at 380V. It's suggested to detect the signal by OPAs. When the voltage of the DC bus exceed 420V, the PWM input signal must shut down for protection.



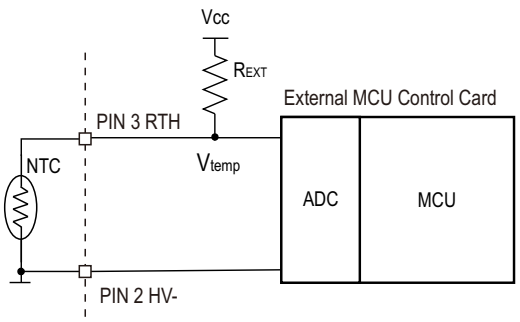
Equation for DC bus voltage calculation:

$$V_{DC\,BUS} = \frac{380 \times HV+sensor}{2.5}$$

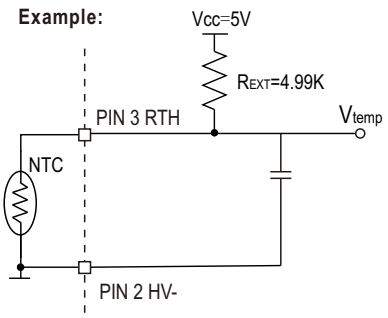


4. IGBT Temperature Detection (CN93, PIN3)

VFD-350C-230 is built-in a NTC resistor for detecting IGBTs temperature. Users can detect IGBTs temperature for protection. (NTC type: TSM2A103F34D1R, Thinking Electronic) The recommended detection circuit is below. It's suggested to shutdown the PWMs input, if the temperture is above 100℃.



Example:

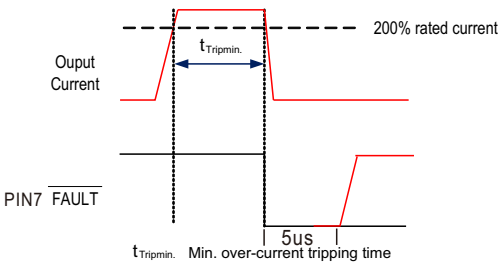


$$V_{temp}=V_{cc} \times \frac{R_{NTC}}{R_{EXT}+R_{NTC}}$$

T_{NTC}	R_{NTC}	V_{temp}
45°C	4.88KΩ	2.47V
100°C	0.96KΩ	0.83V

5. Fault signal

If the VFD-350C-230 encounters an overcurrent condition and remains in that state for the minimum overcurrent time, the FAULT signal will be activated (active low) to notify the external controller or circuit.

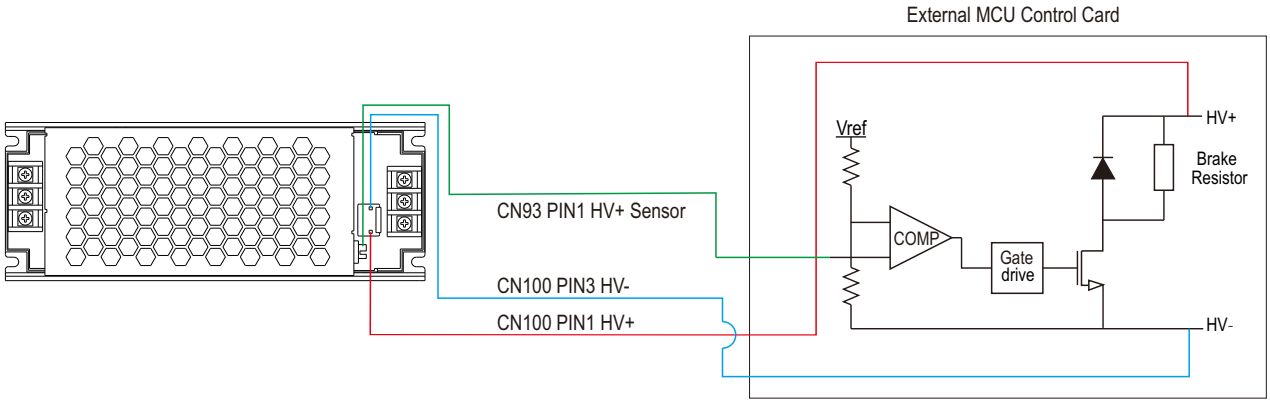


$t_{Tripmin.}$	1us

6. Brake Recommandations(CN100,PIN1,3)

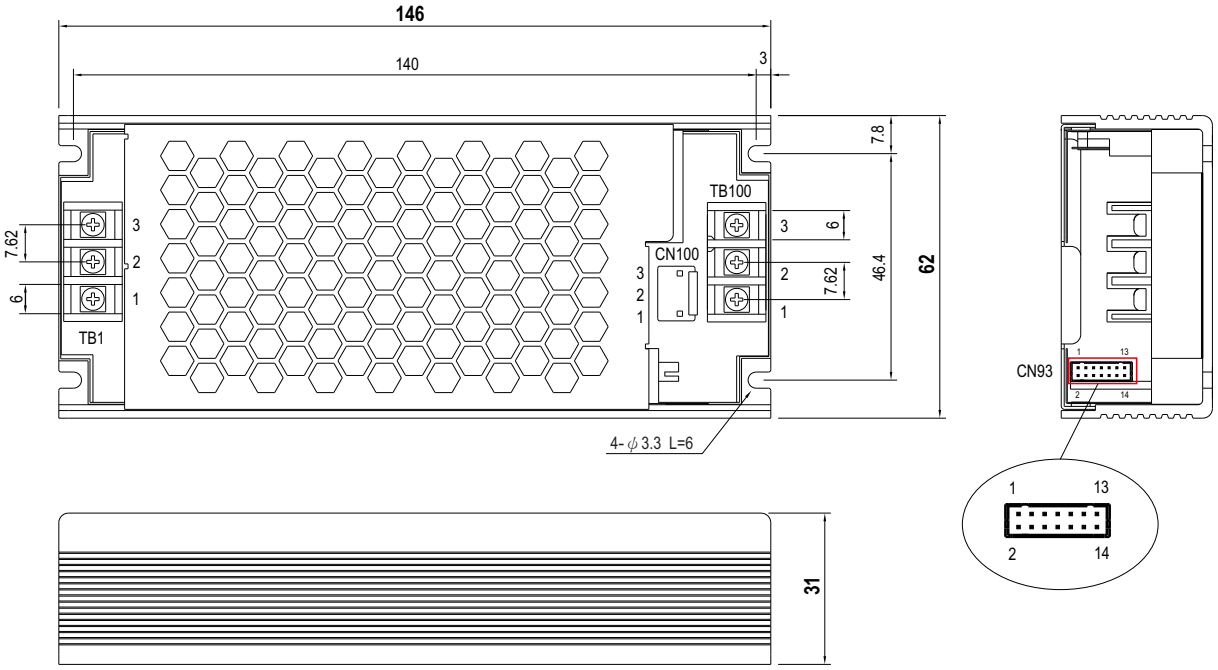
VFD-350C-230 reserved CN100 PIN1,3 that connect to HV+,HV- for brake circuit design .

The maximum voltage on DC Bus(HV+) shall not be higher than 420V.



■ Mechanical Specification

(Unit: mm , tolerance ± 1mm)



AC Input Terminal Pin NO. Assignment (TB1)

Pin No.	Assignment
1	AC/L
2	AC/N
3	⏚

Output Terminal Pin NO. Assignment (TB100)

Pin No.	Assignment
1	U
2	V
3	W

380V DC Bus Connector(CN100): JST B3P-VH or equivalent

Pin No.	Assignment
1	HV+
2	No Pin
3	HV-

Mating housing: JST VHR or equivalent
Terminal: JST SVH-21T-P1.1 or equivalent
※ CN100 is used for installing regenerative brake device, avoiding VFD-350C-230 damage.

Control Pin NO. Assignment (CN93) : HRS DF11-14DP-2DS or equivalent

Pin No.	Assignment	Pin No.	Assignment
1	HV+ sensor	8	PWM_W_H
2	HV-	9	PWM_W_L
3	RTH	10	PWM_V_H
4	R_{SH}_U	11	PWM_V_L
5	R_{SH}_V	12	PWM_U_H
6	R_{SH}_W	13	PWM_U_L
7	FAULT	14	V_{aux_15V}

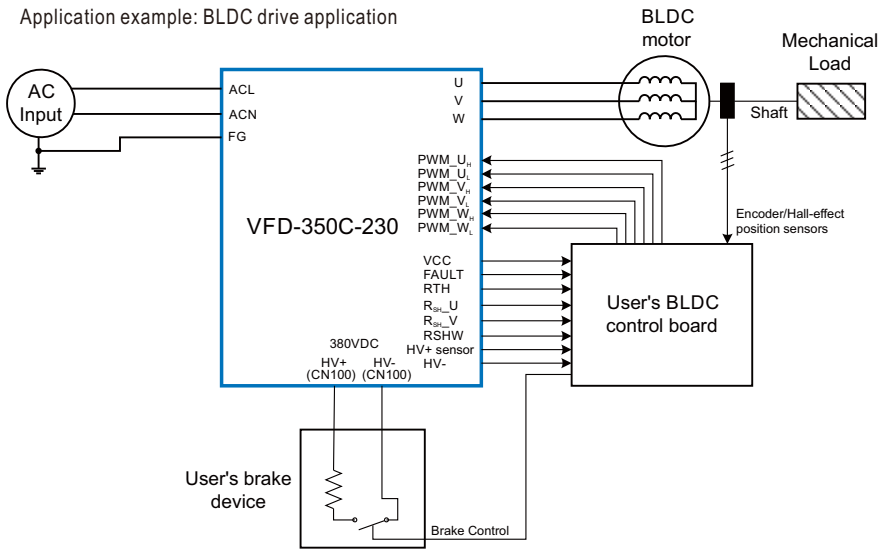
Mating housing: HRS DF11-14DS or equivalent
Terminal HRS DF11-**SC or equivalent

※Control Pin No. Assignment(CN93) :

Pin No.	Function	Description
1	HV+ sensor	DC BUS voltage sensor output, reference to pin 2(HV-)
2	HV-	DC BUS voltage sensor output ground
3	RTH	Temperature sensor
4	R_{SH}_U	U phase current sensor output
5	R_{SH}_V	V phase current sensor output
6	R_{SH}_W	W phase current sensor output
7	FAULT	Over current detection. Normal > 3V, Abnormal < 0.5V
8	PWM_W_H	W phase high side logic input, on > 2.7V ; off < 0.4V
9	PWM_W_L	W phase low side logic input, on > 2.7V ; off < 0.4V
10	PWM_V_H	V phase high side logic input, on > 2.7V ; off < 0.4V
11	PWM_V_L	V phase low side logic input, on > 2.7V ; off < 0.4V
12	PWM_U_H	U phase high side logic input, on > 2.7V ; off < 0.4V
13	PWM_U_L	U phase low side logic input, on > 2.7V ; off < 0.4V
14	Vaux_15V	Auxiliary voltage output 15V reference to pin2 (HV-). The maximum load current is 0.1A

■ Application

Application example: BLDC drive application



1.The figure shows a BLDC drive system set up with VFD-350C-230.

2.Developers can control the PWM signal of 6-switch by using SPWM or SVPWM, etc. for 3-phase voltage modulation, and build the control method base on the current shunt sensors on 3-phase low-side switch(R_{SH}_U/V/W) and the DC BUS voltage sensor(HV+ sensor) which provided by VFD-350C-230.

3.Developers can select the appropriate BLDC position sensors such as encoder or Hall-effect sensors to fit their applications.

4.It's suggested to install the brake circuit/device at the HV+/HV- pin(DC BUS,CN100) to avoid the DC BUS OVP when BLDC is decelerating.

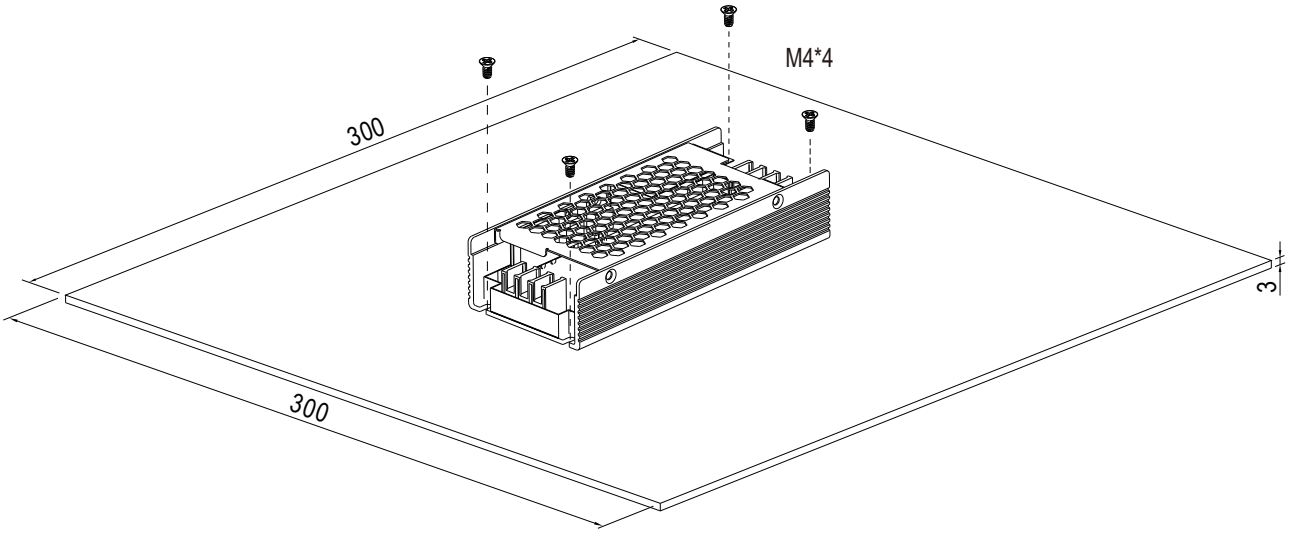
5.It's suggested to shut down the PWM input or connect to brake resistor device for safety when DC Bus voltage is higher than 420V.

6.If VFD-350C-230 was applied with non-appropriate control, such as accelerating too quickly or bad current control, it might trig the VFD-350C-230's fault-state to shut down the output voltage(low-level on FAULT pin).

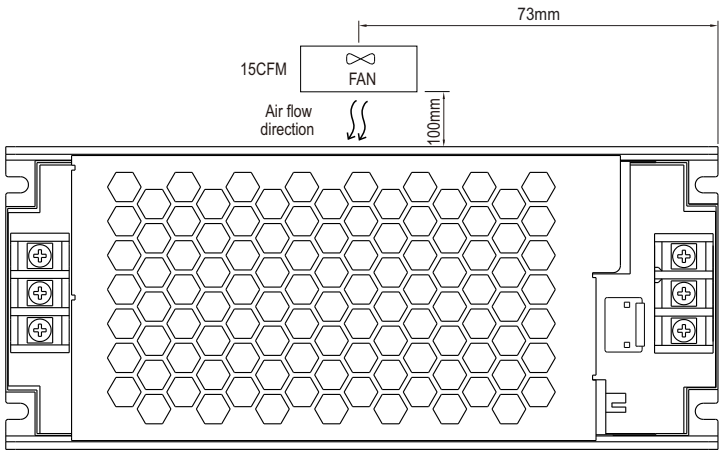
■ Installation

1.Operate with additional aluminum plate

In order to meet the"Derating Curve"and the "Static Characteristics" ,VFD series must be installed onto an aluminum plate(or the cabinet of the same size) on the bottom.The size of the suggested aluminum plate is shown as below. And for optimizing thermal performance, the aluminum plate must have an even and smooth surface (or coated with thermal grease), and VFD series must be firmly mounted at the center of the aluminum plate.



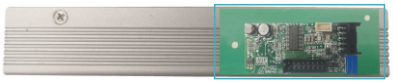
2.With 15CFM forced air



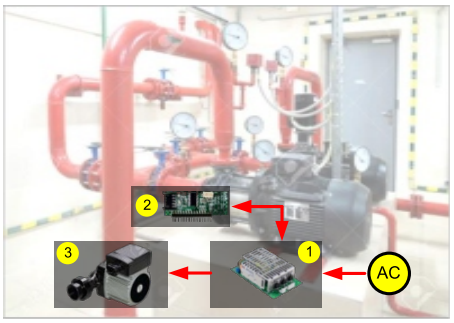
■ Accessory List

If you have any control requirement of specific application, please consult MEAN WELL for more details.

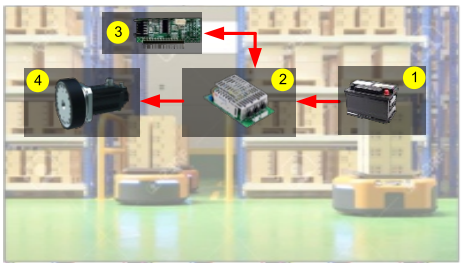
Motor control board (Motor control board and VFD drive module should be ordered separately):

MW's order No.	Control Board	Assembly Suggestion	Quantity
VFD-CB			1

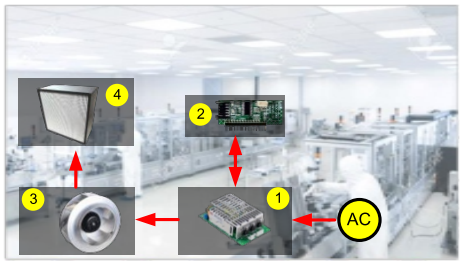
■ Typical Application



1. Variable Frequency Module (VFD series)
2. Control board of Variable Frequency Drive (Designed by User or Soluton Provided by MEAN WELL)
3. 3-phase Pump Motor



1. Battery
2. Variable Frequency Module (VFD series)
3. Control board of Variable Frequency Drive (Designed by User or Soluton Provided by MEAN WELL)
4. 3-phase Wheel Motor for AGV Application



1. Variable Frequency Module (VFD series)
2. Control board of Variable Frequency Drive (Designed by User or Soluton Provided by MEAN WELL)
3. 3-phase Fan Motor
4. HEPA for Filtering Air

■ DEMO KIT

Please contact MEAN WELL for more detail.

VFD Demo Kit Main Function and Features.

1. Built-in VFD-350P-230 and 230V motor.
2. Motor start /stop/ forward/ reverse/speed control.
3. Motor start /stop/forward /reverse indicator right.
4. Motor speed (RDM)display.
5. Control board replaceable.
6. Support external motor connection.

■ Installation Manual

Please refer to : http://www.meanwell.com/manual.html