TECHNICAL REFERENCE NOTE

ARTESYN
AIF 300V Vin SERIES
600 Watts Full Brick DC-DC Converter



PRODUCT DESCRIPTION

Advanced Energy's Artesyn AIF 300V Vin series is an isolated, single output DC to DC converter module, providing up to 600 W output with a maximum baseplate operating temperature of 100°C with no de-rating. The AIF 300V Vin series features full safety isolated low voltage secondary side control and Artesyn Linear Programming (ALP™) or through I²C bus for convenient adjustment of the module's parameters.

AT A GLANCE

Total Power

600 Watts

Input Voltage

250 to 420 Vdc

# of Outputs

Single

RoHS

SPECIAL FEATURES

- 600W continuous power at 100°C baseplate temperature
- 108 W/in³ (6.6 W/cm³)
- High efficiency: 5 V@90%, 12 V@87%
- Low output ripple and noise
- Positive and negative enable function
- Excellent transient response
- OVP, OCP, V_{adj} control with ALP™ analog mode linear control, or through I²C bus for digital mode control
- Parallelable with accurate current sharing
- Switching frequency 400 KHz

SAFETY

- UL/cUL 60950
- EN 62368-1
- TUV EN60950
- UKCA Mark
- CE Mark

TYPICAL APPLICATIONS

- Industrial

©2024 Advanced Energy Industries, Inc.

MODEL NUMBERS

Model Number	Output Voltage	Minimum Load	Maximum Load	Maximum Power
AIF120Y300-L/N-L/-NTL	1.8 Vdc	0 A	120 A	216 W
AIF120F300-L/N-L/-NTL	3.3 Vdc	0 A	120 A	396 W
AIF80A300-L/N-L/-NTL	5.0 Vdc	0 A	80 A	400 W
AIF50B300-L/N-L/-NTL	12 Vdc	0 A	50 A	600 W
AIF40C300-L/N-L/-NTL	15 Vdc	0 A	40 A	600 W
AIF25H300-L/N-L/-NTL	24 Vdc	0 A	25 A	600 W

AIF	XX	X	300	N or No suffix	-	NT	L
①	②	③	④	⑤		⑥	⑦

①	Model series	Full brick size unit
②	Output current	120: 120 A rated output current 80: 80 A rated output current 50: 50 A rated output current 40: 40 A rated output current 25: 25 A rated output current
③	Output voltage	Y: 1.8 Vdc F: 3.3 Vdc A: 5.0 Vdc B: 12 Vdc C: 15 Vdc H: 24 Vdc
④	Input voltage	300 Vdc
⑤	Enable	N: Negative logic enable No suffix: Positive logic enable
⑥	Mounting hole	NT: Non-thread mounting hole
⑦	RoHS status	L: RoHS 6 compliance

©2024 Advanced Energy Industries, Inc.

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Stress in excess of those listed in the “Absolute Maximum Ratings” may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply’s reliability.

Table 1. Absolute Maximum Ratings

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage DC Continuous operation DC Transient (100ms)	 All models All models	 $V_{IN,DC}$ $V_{IN,trans}$	 250 -	 300 -	 420 450	Vdc
Maximum Output Power	All models	$P_{O,max}$	-	-	600	W
Isolation Voltage Input to output	 All models		 2700	 -	 -	Vdc
Operating Baseplate Temperature	All models	T_B	-20	-	+100	^{O}C
Startup Baseplate Temperature	All models	T_B	-40	-	+100	^{O}C
Storage Temperature	All models	T_{STG}	-55	-	+125	^{O}C
Operating Humidity (non-condensing)	All models		15	-	95	%
MTBF	All models		0.3	-	-	10^6 Hrs

Note: STANDARD TEST CONDITION on a single module unless otherwise indicated, specifications apply over all operating input voltage and temperature conditions.

T_A	$25^{O}C$
V_{IN}	300 V±2%
Enable	Connect to -SENSE (for models with suffix "N")
Enable	Open (for models without suffix "N")
CLK IN	Open
CLK OUT	Open
C SHARE	Open
Iout	75% I_O max ± 2%
+Sense	Connect to $+V_O$
-Sense	Connect to $-V_O$
V ADJ	Open
C MON	Open
TEMP MON	Open
C LIM ADJ	Open
OVP ADJ	Open
PG/ID	Open
I/P Cap requirement	68 uF/450 V min.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Continuous Operating Input Voltage		All	$V_{IN,DC}$	250	300	420	Vdc
Input Under Voltage Turn-on Turn-off		I_O = 10% $I_{O,max}$	 $V_{IN,DC}$ $V_{IN,DC}$	 205 175	 - -	 245 215	Vdc
Input Reflected-Ripple Current[1]	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	Bandwidth = 5 Hz to 20 MHz;12 µH source impedance; T_A = 25 °C.	I_{IN}	- - - - - -	20 20 20 30 30 30	- - - - - -	mA_{PK-PK}
Input Current[2]	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	V_{IN} = $V_{IN,min}$, I_O = $I_{O,max}$ V_O = $V_{O,nom}$	$I_{IN,max}$	- - - - - -	- - - - - -	1.14 2.0 1.9 2.8 2.8 2.8	A
Input Current	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	V_{IN} = 0 - $V_{IN,max}$, I_O = $I_{O,max}$ V_O = $V_{IN,nom}$	$I_{IN,max}$	- - - - - -	- - - - - -	1.3 2.3 2.3 3.4 3.4 3.4	A
Efficiency	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	V_{IN} = $V_{IN,nom}$, I_O = $I_{O,max}$ T_A = 25°C	η	80 87 88 86 90 90	- 89 90 87 - -	- - - - - -	%
Break Regulation		All	-	-	215	245	Vdc
Inrush Transient[3]		All	I^2t	-	-	2.8	A^2S
CLK IN Frequency Voltage Level		 All Internal AC coupled		 720 3.3	 800 -	 880 5.5	 KHz V_{PK-PK}
Enable Positive Logic Low Logic - Module Off High Logic - Module On		Without suffix "N"	 V_{EN} V_{EN}	 0 2	 - -	 0.7 10	Vdc
Enable Negative Logic Low Logic - Module On High Logic - Module Off		With suffix "N"	 V_{EN} V_{EN}	 0 2	 - -	 0.7 10	Vdc
Enable Low Sourced Current		V_{Enable} = 0.7 V		-	-	150	uA
Enable Turn-On Delay		All		-	-	30	mS

Note 1 - External input capacitance required. See Figure 44 for the Input Reflected-Ripple Current Test Setup.
Note 2 - An input line fuse is recommended for use (e.g. Littelfuse type, 10 A 250 V FB).
Note 3 - See Figure 45 for the Inrush Current Test Setup. Input capacitor with 68 uF/450 Vmin must always be added.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications, con't

Parameter		Condition	Symbol	Min	Typ	Max	Unit
No load Input Power	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	All	$P_{IN,max}$	- - - - - -	- - - - - -	25 25 25 5 5 5	W
Turn-On Time		$I_O = I_{O,max}$ V_O within 1%; No external output capacitance	$T_{ON,max}$	-	-	350	mS
Input Capacitance		All	C_{IN}	-	0.6	0.8	uF

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Output Voltage Setpoint	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	$V_{IN,min}$ to $V_{IN,max}$; $I_O = I_{O,max}$; $T_A = 25^oC$	$V_{O,set}$	1.782 3.267 4.950 11.88 14.85 23.76	- - - - - -	1.818 3.333 5.050 12.12 15.15 24.24	Vdc
Output Current	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	All	I_O	- - - - - -	- - - - - -	120 120 80 50 40 25	A
Line and Load Regulation	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	All	$V_{O,load}$	- - - - - -	- - - - - -	10 10 0.2 0.2 0.2 0.2	mV mV % % % %
Output Voltage Adjust[1]	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	V_{adj} = 0 V	V_O	48 48 78 78 78 78	50 50 80 80 80 80	52 52 82 82 82 82	%
Output Voltage Adjust	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	V_{adj} = 2 V	V_O	108 108 108 118 118 118	110 110 120 120 120 120	112 112 122 122 122 122	%
Output Ripple and Noise	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	5 Hz to 20 MHz Bandwidth	V_O	- - - - - -	- - - - - -	100 100 100 240 300 480	mV_{PK-PK}
External Load Capacitance	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	All	C_O	- - - - - -	- - - - - -	20000 33000 10000 10000 3300 10000	uF

Note 1 - The combination of remote sense and trim do not exceed a total of 0.5V.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications Con't

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Switching Frequency		All	f_{SW}	360	400	440	KHz
Output Power	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	All	$P_{O,max}$	0 0 0 0 0 0	- - - - - -	216 396 400 600 600 600	W
Current Share Accuracy		Cshare connected together, $I_O \geq 80\% I_{O,max}$	I_O	-	± 3	± 10	%
Number of Parallel Unit[1]		All		-	-	10	pcs
Over Current Protection (Constant Current)		V_O = 97% V_O	I_O	105	110	115	$\%I_{O,max}$
Short Circuit Current (Hiccup Mode)		All		-	-	150	$\%I_{O,max}$
Over Voltage Protection Level (Latch Mode)		All	V_O	110	115	120	%
Over Voltage Protection Adjust		All	V_O	110	-	150	%
Over Temperature Protection Shut down[2] Auto-recovery[3]		All	T_A T_B	105 85	- -	120 100	^{O}C
Internal Temperature Monitor Temperature Coefficient Source Impedance		All		9.8 -	10.0 1	10.2 -	mV/^{O}C Kohm
Temperature Coefficient		T_C = -40 ^{O}C to 100 ^{O}C		-	-	0.02	$\%V_O/^{O}C$
V_O Dynamic Response	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	25% to 75% load change @ 1A/uS recovery to 1%V_O V_{IN} = $V_{IN,nom}$ T_A = 25°C	V_O	- - - - - -	- - - - - -	150 165 250 600 750 1200	mV
Vo Dynamic Response Settling Time		25% to 75% load change @ 1A/uS V_{IN} = $V_{IN,nom}$ T_A = 25°C	T_S	-	-	250	uS

Note 1 - See Figure 43 for modules in parallel connection.
Note 2 - Trip Point – shut down and auto-recovery.
Note 3 - Auto-recovery temperature (Baseplate Temperature).

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications Con't

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Output Current Monitor I_{mon} at $I_{O,max;}$ Monitored I_O Range I_{mon} Compliance Voltage		All		0.9 20 -	1.0 - -	1.1 100 5.0	mA $\%I_{O,max}$ Vdc
Turn-on Output Voltage Overshoot		$I_O = I_{O,max;}$ $T_A = 25^oC;$ no external O/P capacitor		-	3	5	$\%V_O$
CLK OUT Frequency Voltage Level No. of Fan Out Unit		All Internal AC coupled All		720 3.3 -	800 - -	880 5.5 2	KHz V_{PK-PK} pcs
Turn-Off Negative Voltage		Resistive loading, wire length of 10 cm		-	-	-0.7	Vdc
Power Good Monitor PG/ID Low		Power Fault, $I_{sink} \leq 10$ mA		-	-	0.2	Vdc
Power Good Monitor	AIF120Y300 AIF120F300 AIF80A300 AIF50B300 AIF40C300 AIF25H300	PG/ID Internal Pull-up Resistance to Vo	R	1.76 3.23 4.99 11.7 14.7 23.5	1.8 3.3 5.1 12 15 24	1.84 3.37 5.21 12.3 15.3 24.5	Kohm

ELECTRICAL SPECIFICATIONS

AIF120Y300N-L Performance Curves

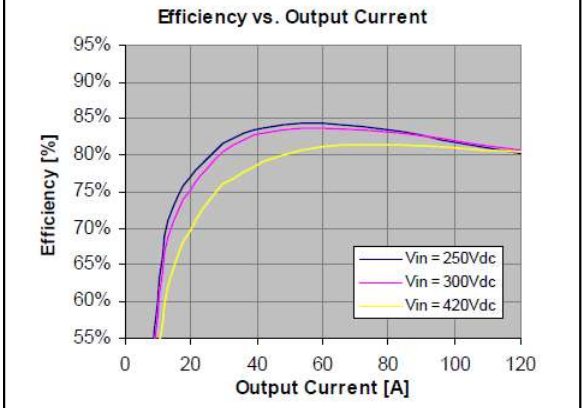


Figure 1: Efficiency Curves vs Load Current (T_B) = 45°C.

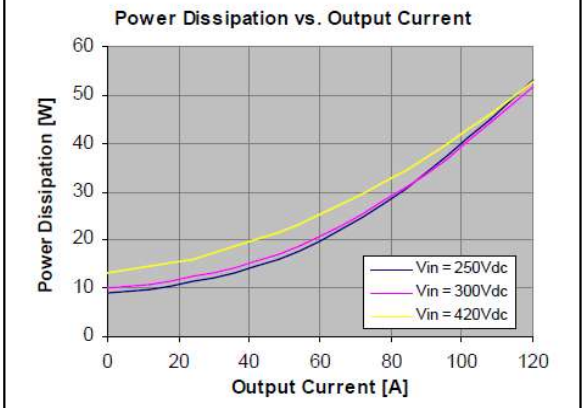


Figure 2: Power Dissipation vs. Load Current (T_B) = 45°C.

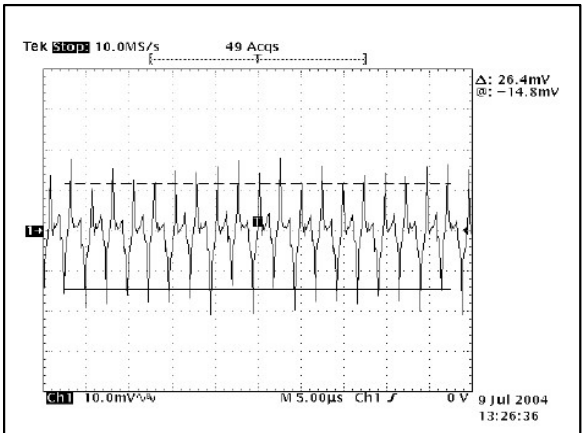


Figure 3 Output Ripple Waveform, V_{IN} = 300Vdc, I_O = 120A, (T_B) = 45°C.
CH1: V_O

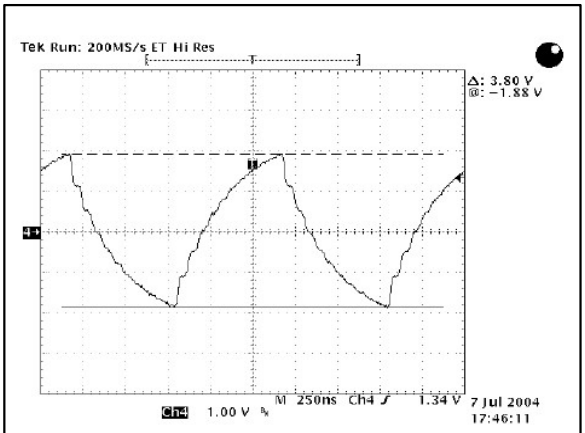


Figure 4: Clock Out Waveform, V_{IN} = 300Vdc, (T_B) = 45°C.
CH4: CLK OUT

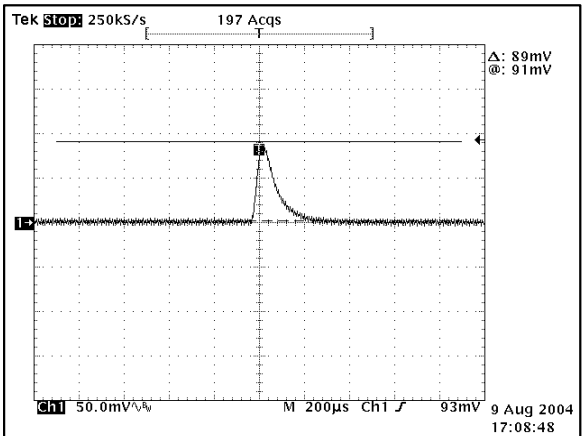


Figure 5: Transient Response - V_O Deviation (Hi-Lo) (T_B) = 45°C.
CH1: V_O

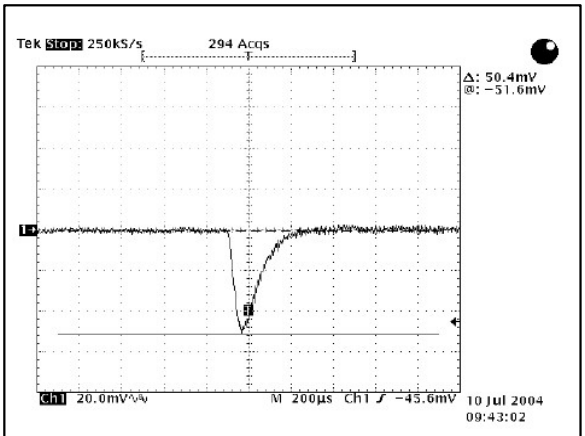


Figure 6: Transient Response - V_O Deviation (Lo-Hi) (T_B) = 45°C.
CH1: V_O

ELECTRICAL SPECIFICATIONS

AIF120Y300N-L Performance Curves

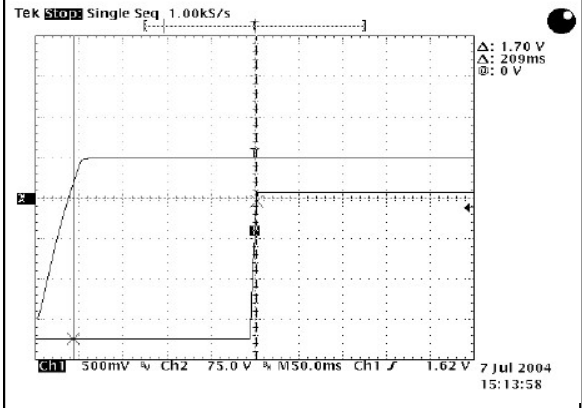


Figure 7: Turn-on Time (Input to Output) (T_B) = 45°C.
CH1: V_O CH2: V_{IN}

ELECTRICAL SPECIFICATIONS

AIF80A300N-L Performance Curves

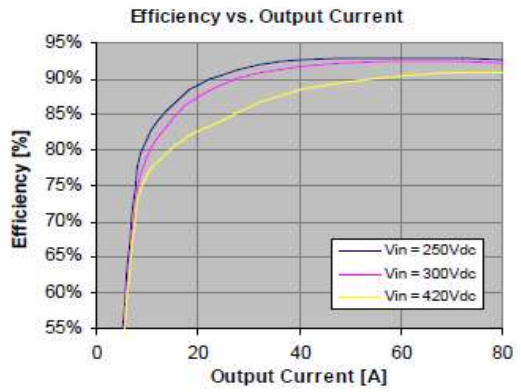


Figure 8: Efficiency Curves vs Load Current (T_A) = 25°C.

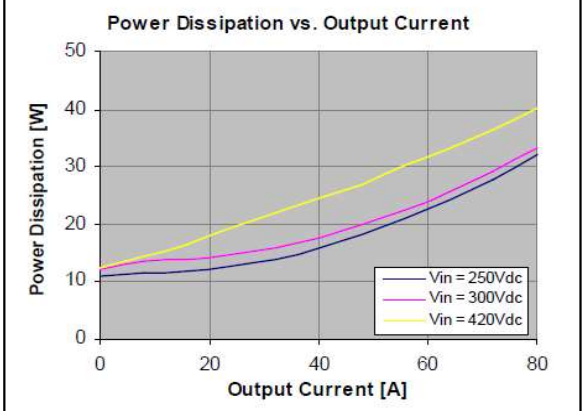


Figure 9: Power Dissipation vs. Load Current (T_A) = 25°C.

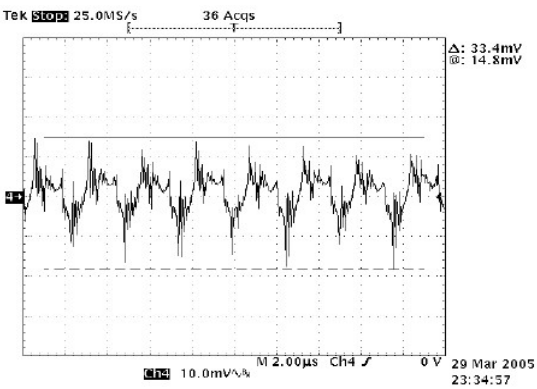


Figure 10: Output Ripple Waveform, V_{IN} = 300Vdc, I_O = 80A, (T_A) = 25°C
CH4: V_O

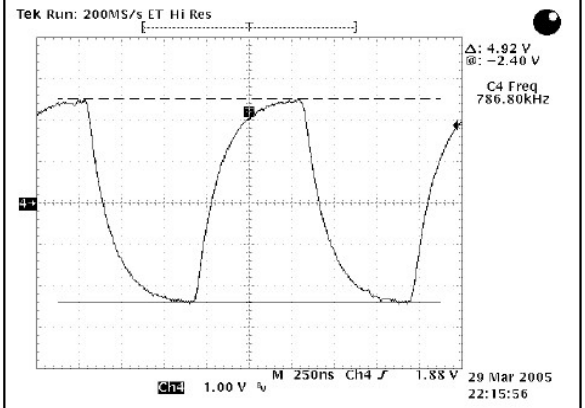


Figure 11: Clock Out Waveform, V_{IN} = 300V, (T_A) = 25°C
CH4: CLK OUT

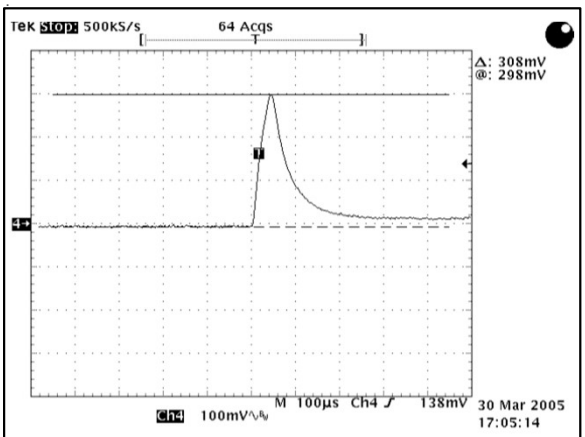


Figure 12: Transient Response - V_O Deviation (Hi-Lo) (T_A) = 25°C
CH4: V_O

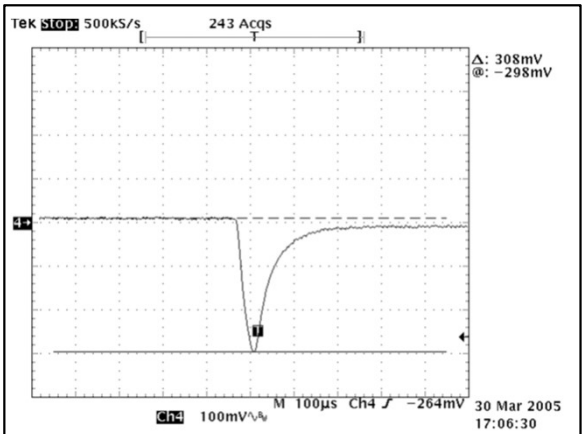


Figure 13: Transient Response - V_O Deviation (Lo-Hi) (T_A) = 25°C
CH4: V_O

ELECTRICAL SPECIFICATIONS

AIF80A300N-L Performance Curves

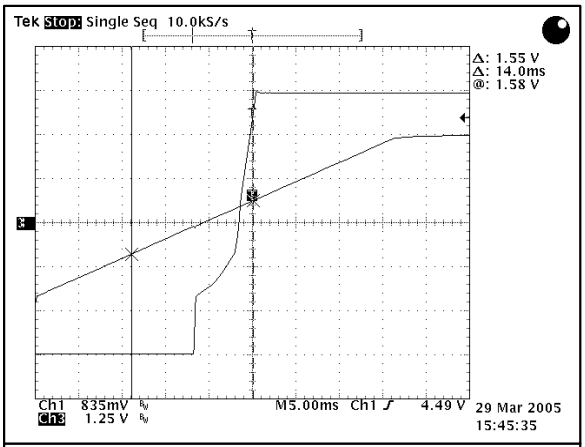


Figure 14: Turn-on Time (Enable to Output), V_{IN} = 300Vdc, I_O = 80A, (T_A) = 25°C.
CH1: V_O CH3: V_{Enable}

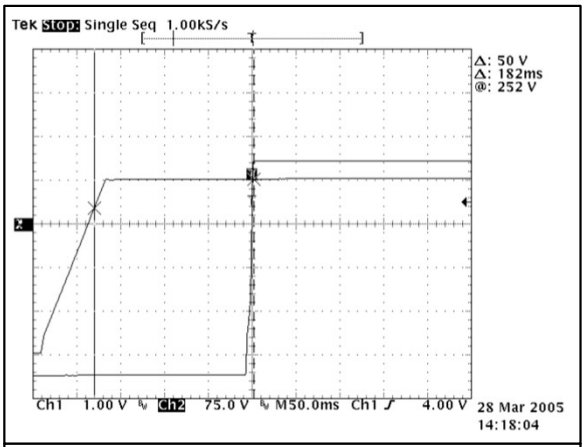


Figure 15: Turn-on Time (Input to Output), V_{IN} = 300Vdc, I_O = 80A, (T_A) = 25°C.
CH1: V_O CH2: V_{IN}

ELECTRICAL SPECIFICATIONS

AIF50B300N-L Performance Curves

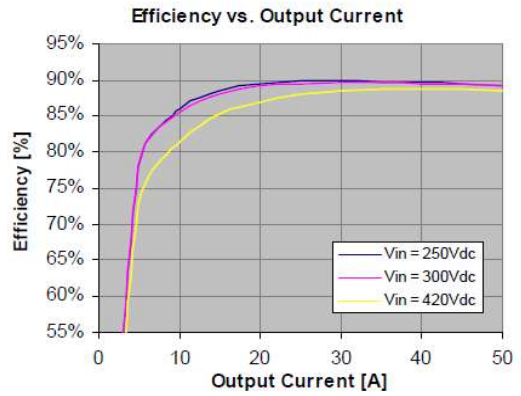


Figure 16: Efficiency Curves vs Load Current (T_B) = 45°C.

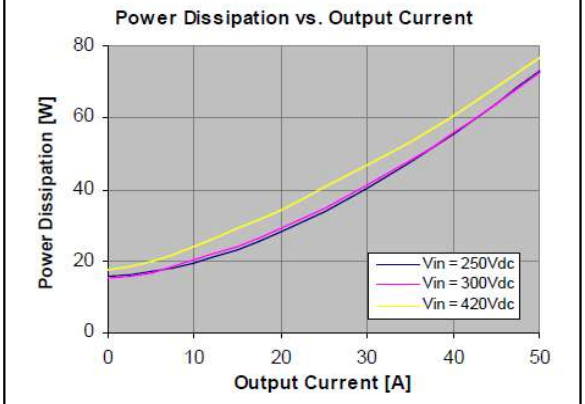


Figure 17: Power Dissipation vs Load Current (T_B) = 45°C.

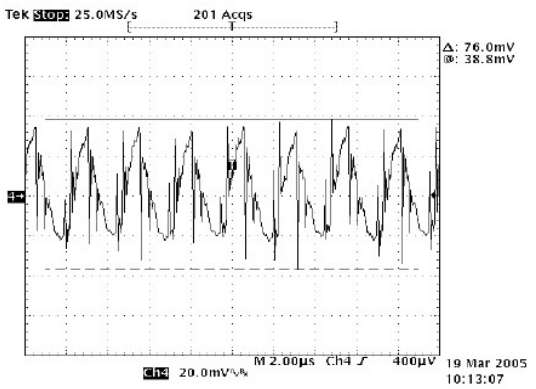


Figure 18: Output Ripple Waveform, V_{IN} = 300Vdc, I_O = 50A, (T_A) = 25°C.
CH4: V_O

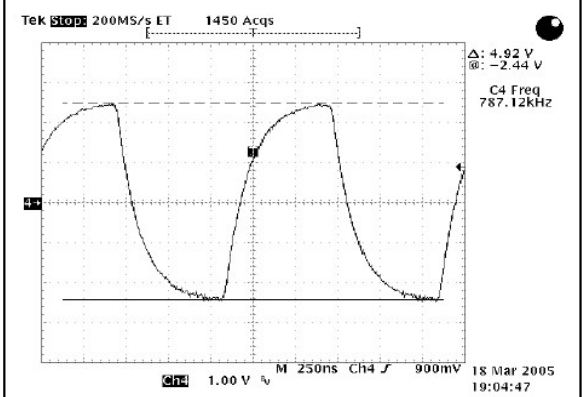


Figure 19: Clock Out Waveform, V_{IN} = 300Vdc, (T_A) = 25°C.
CH4: CLK OUT

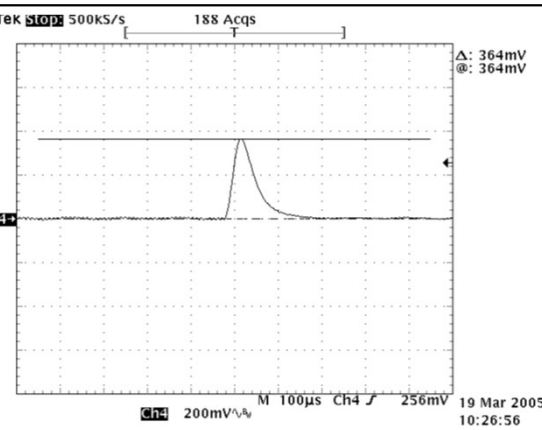


Figure 20: Transient Response - V_O Deviation (Hi-Lo) (T_A) = 25°C.
CH4: V_O

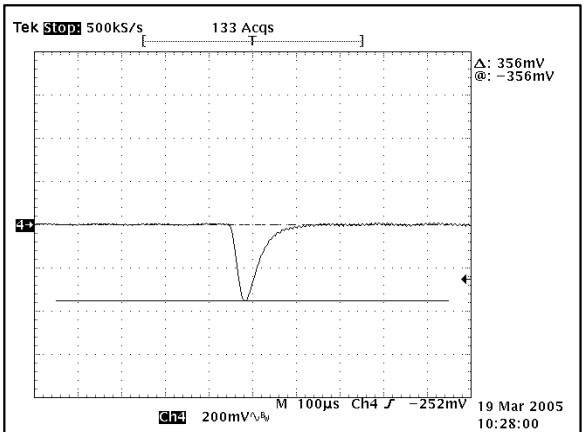


Figure 21: Transient Response - V_O Deviation (Lo-Hi) (T_A) = 25°C.
CH4: V_O

ELECTRICAL SPECIFICATIONS

AIF50B300N-L Performance Curves

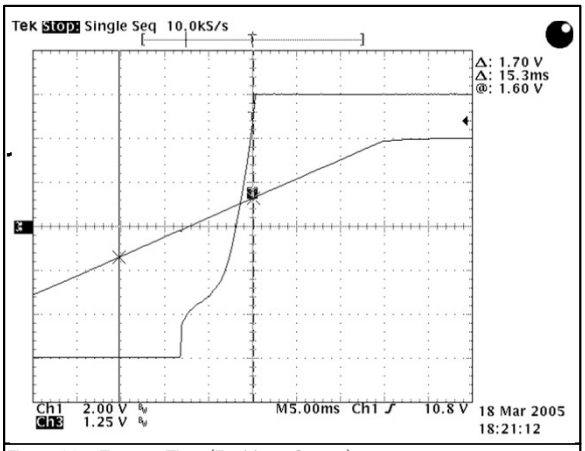


Figure 22: Turn-on Time (Enable to Output)
V_{IN} = 300Vdc, I_O = 50A, (T_A) = 25°C
CH1: V_O CH3: V_{Enable}

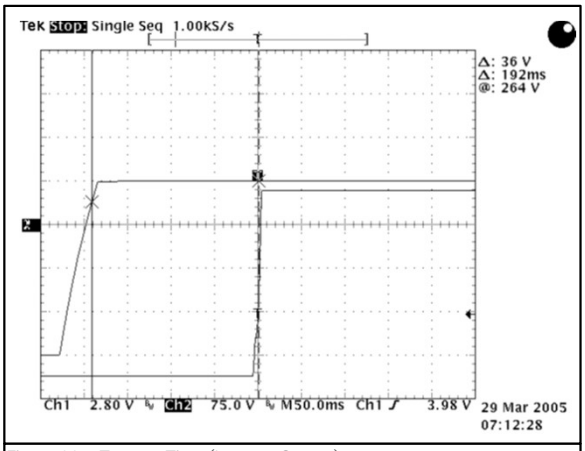


Figure 23: Turn-on Time (Input to Output)
V_{IN} = 300Vdc, I_O = 50A, (T_A) = 25°C
CH1: V_O CH2: V_{IN}

ELECTRICAL SPECIFICATIONS

AIF40C300N-L Performance Curves

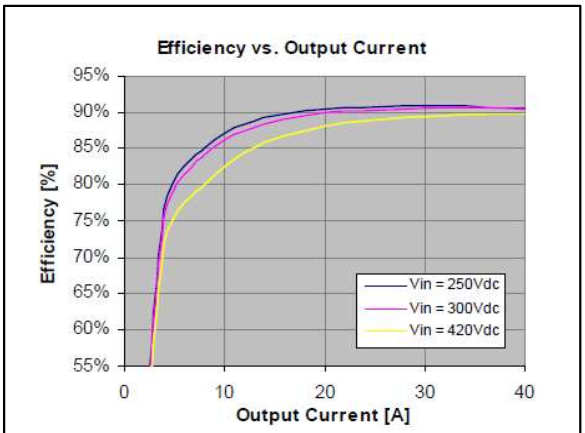


Figure 24: Efficiency Curves vs Load Current (T_B) = 25°C.

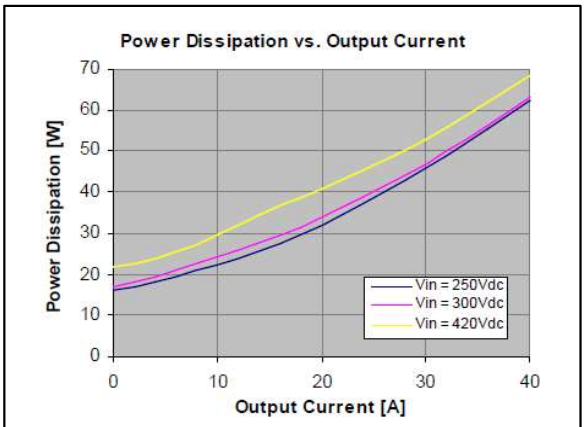


Figure 25: Power Dissipation Curves vs Load Current (T_B) = 25°C.

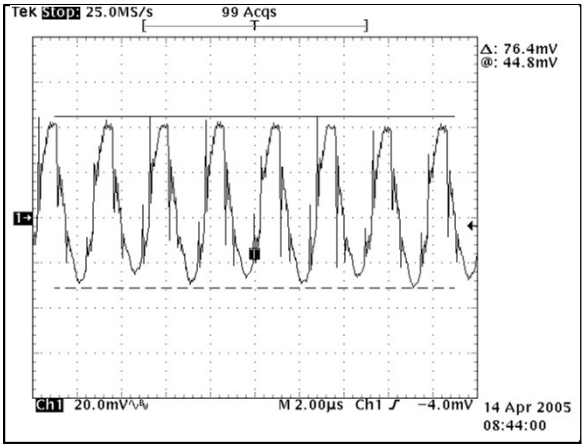


Figure 26: Output Ripple Waveform, V_{IN} = 300Vdc, I_O = 40A, (T_A) = 25°C.
CH1: V_O

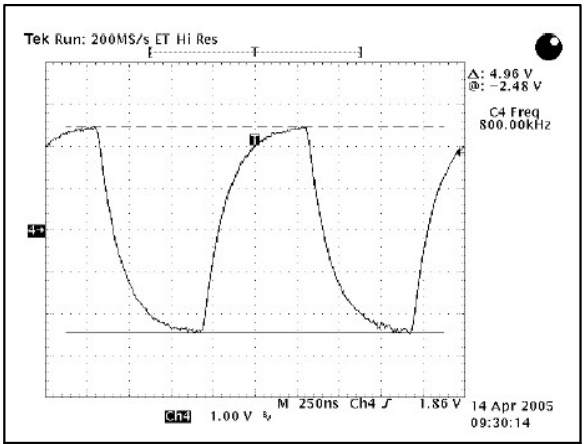


Figure 27: Clock Out Waveform, V_{IN} = 300Vdc, (T_A) = 25°C.
CH4: CLK OUT

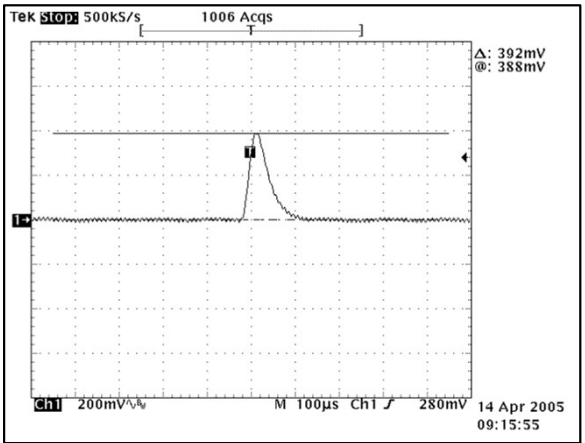


Figure 28: Transient Response - V_O Deviation (Hi-Lo) (T_A) = 25°C.
CH1: V_O

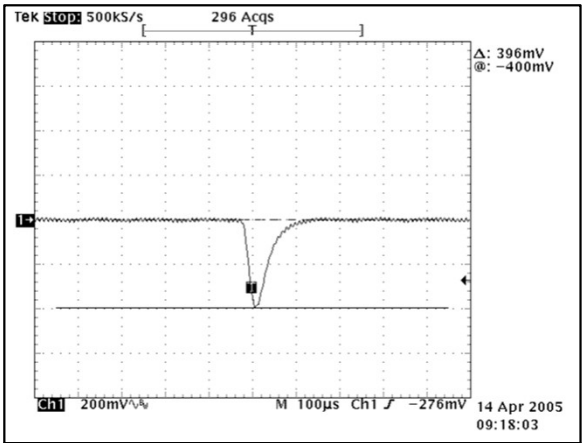


Figure 29: Transient Response - V_O Deviation (Lo-Hi) (T_A) = 25°C.
CH1: V_O

ELECTRICAL SPECIFICATIONS

AIF40C300N-L Performance Curves

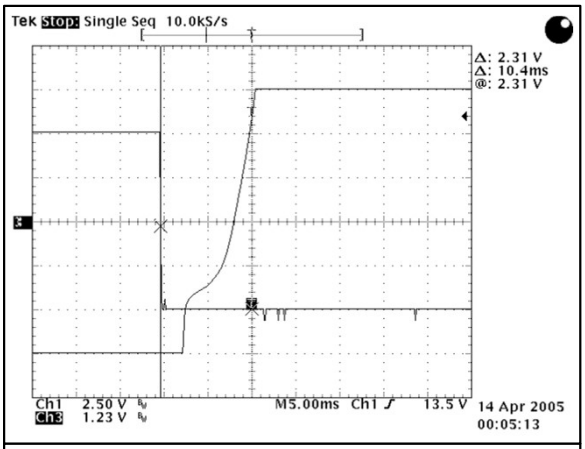


Figure 30: Turn-on Time (Enable to Output)
V_{IN} = 300Vdc, I_O = 40A, (T_A) = 25°C.
CH1: V_O CH3: V_{Enable}

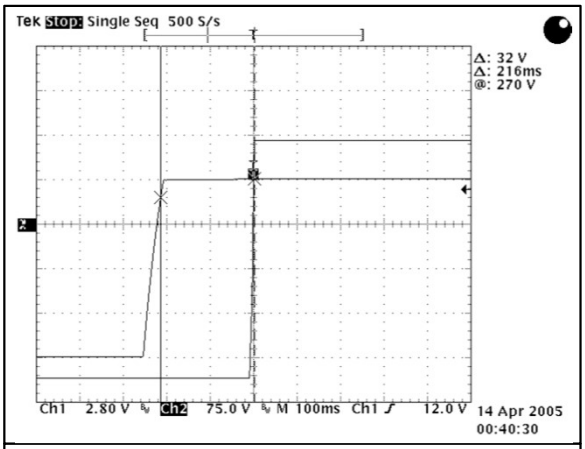


Figure 31: Turn-on Time (Input to Output)
V_{IN} = 300Vdc, I_O = 40A, (T_A) = 25°C.
CH1: V_O CH2: V_{IN}

ELECTRICAL SPECIFICATIONS

AIF25H300N-L Performance Curves

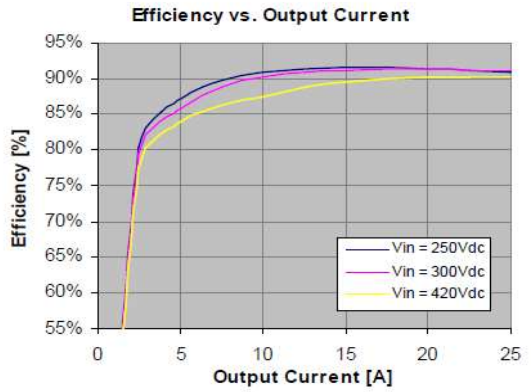


Figure 32: Efficiency Curves vs Load Current (T_B) = 45°C.

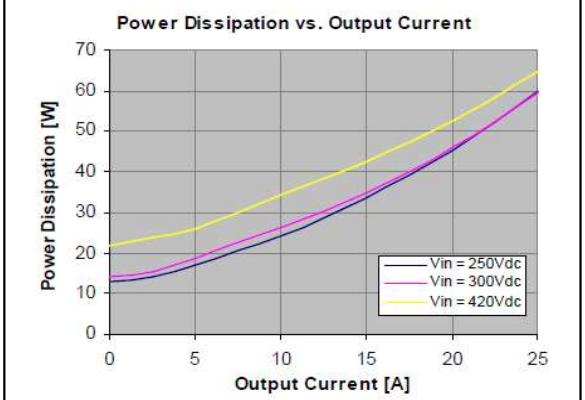


Figure 33: Power Dissipation vs Load Current (T_B) = 45°C.

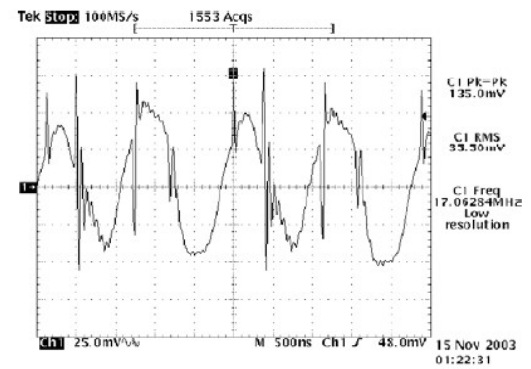


Figure 34: Output Ripple Waveform, V_{IN} = 300Vdc, I_O = 25A, (T_B) = 45°C.
CH1: V_O

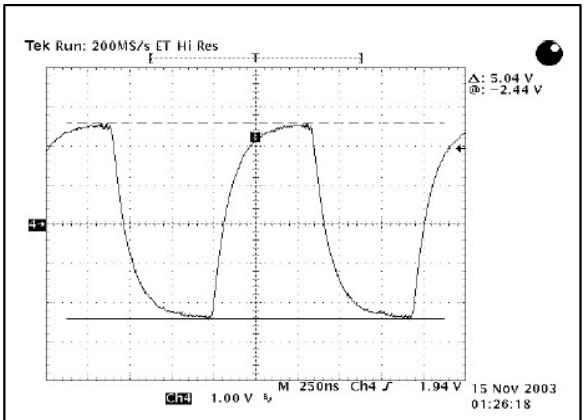


Figure 35: Clock Out Waveform (T_B) = 45°C.
CH4: CLK OUT

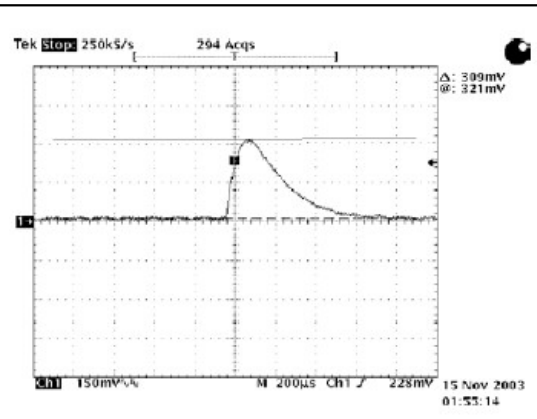


Figure 36: Transient Response - V_O Deviation (Hi-Lo) (T_B) = 45°C.
CH1: V_O

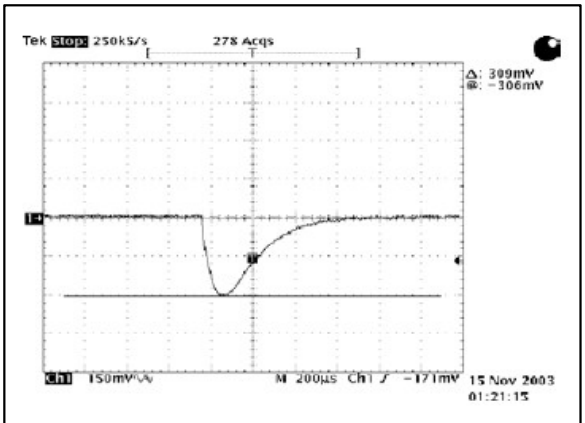


Figure 37: Transient Response - V_O Deviation (Lo-Hi) (T_B) = 45°C.
CH1: V_O

ELECTRICAL SPECIFICATIONS

AIF25H300N-L Performance Curves

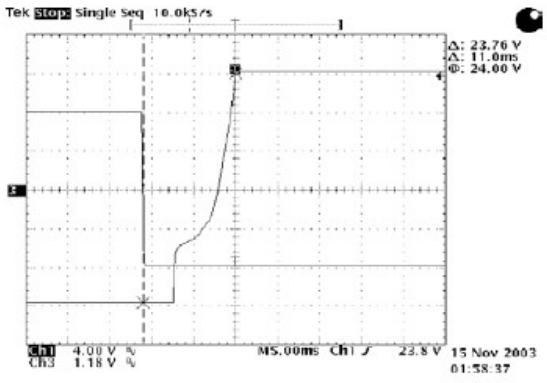


Figure 38: Turn-on Time (Enable to Output)
V_{IN} = 300Vdc, I_O = 25A, (T_B) = 45°C.
CH1: V_O CH3: V_{Enable}

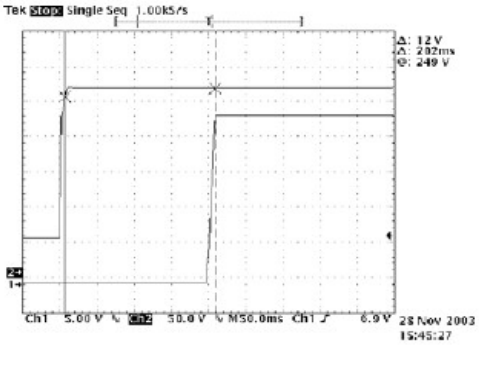
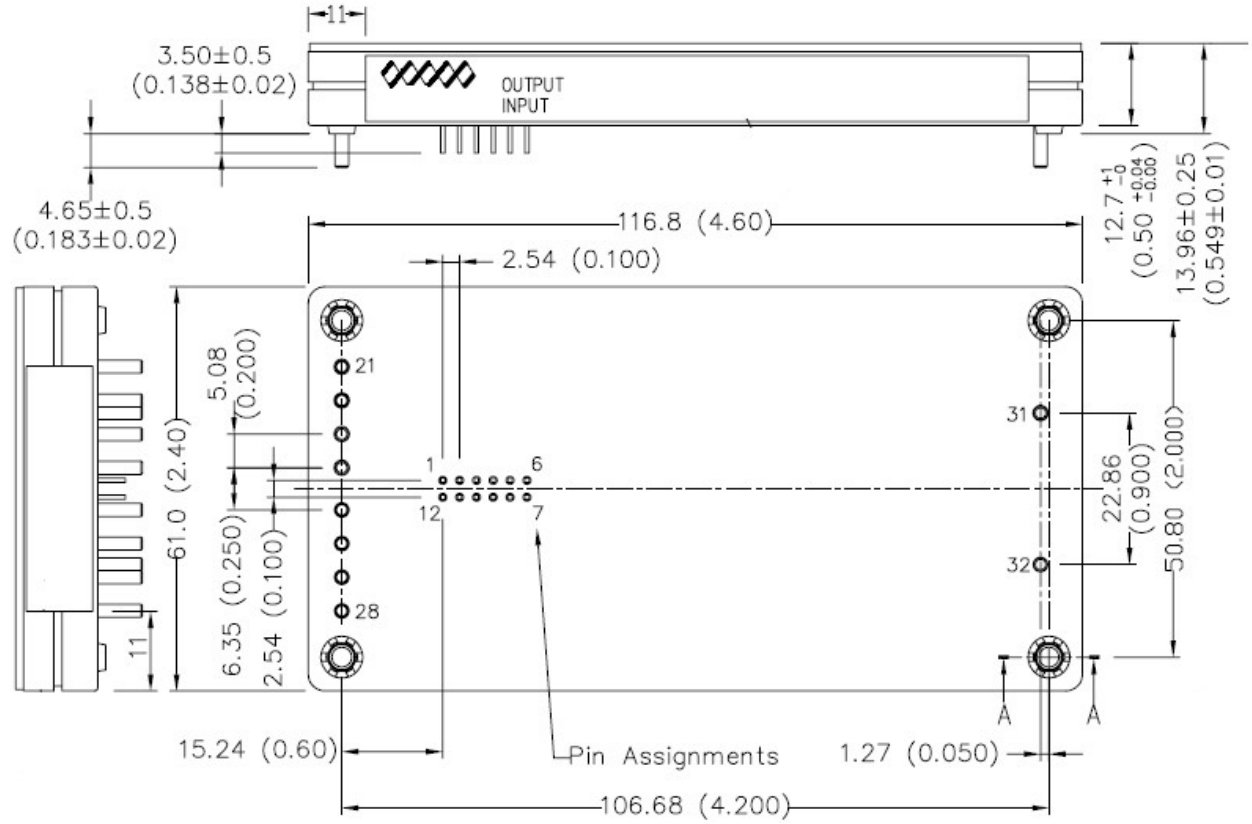
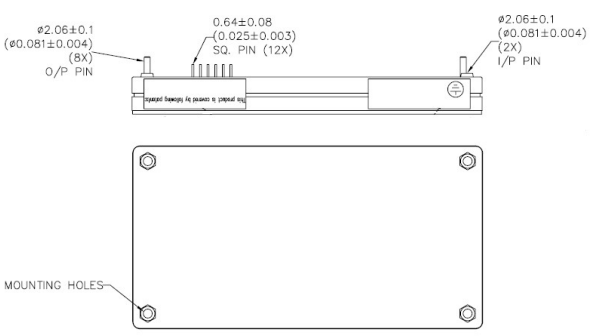


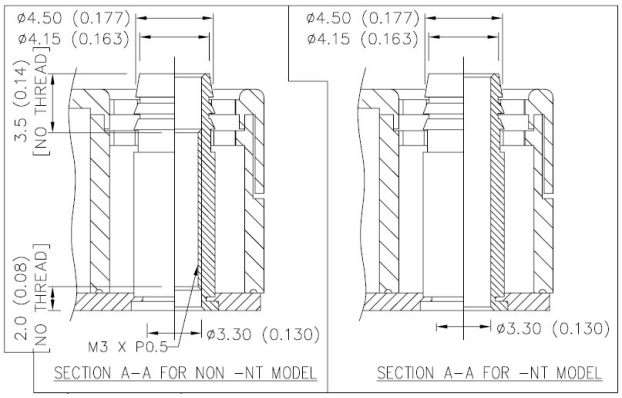
Figure 39: Turn-on Time (Input to Output)
V_{IN} = 250V, (T_B) = 45°C.
CH1: V_O CH2: V_{IN}

MECHANICAL SPECIFICATIONS

Mechanical Outlines (unit: mm)







Parameter	Device	Symbol	Min	Typ	Max	Unit
Dimension	All	L	-	4.6 [116.8]	-	in [mm]
		W	-	2.4 [61.0]	-	in [mm]
		H	-	0.5 [12.7]	-	in [mm]

MECHANICAL SPECIFICATIONS

Connector Definitions

Pin Assignments		
Input (AC)	Output (DC)	Control Pin
31. L1 Positive	21. Positive	1. +SENSE
32. L2 Negative	22. Positive	2. TEMP MON
	23. Positive	3. C MON
	24. Positive	4. C SHARE
	25. Negative	5. CLK OUT
	26. Negative	6. CLK IN
	27. Negative	7. PG/ID
	28. Negative	8. CL A /I²C CLK
		9. OVP A /DCS
		10. V A / I²C DATA
		11. ENABLE
		12. -SENSE

MECHANICAL SPECIFICATIONS

Weight

The AIF 300V Vin series weight is 0.55 lbs/250 g typically.

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The AIF 300V Vin power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

Safety Certifications for AIF 300V Vin power supply system:

Table 4. Safety Certifications for AIF 300Vin Series Module

Standard	Agency	Description
EN 60950-1/A12:2011	CE (LVD+RoHS)	European Requirements
UL/cUL 60950, 3rd Edition	UL+CUL	US and Canada Requirements
EN 62368-1	TUV-SUD	European Requirements
UKCA Mark		UK Requirements
CE Mark		European Requirements

ENVIRONMENTAL SPECIFICATIONS

Recommend external EMI Filter Schematic

CLASS CISPR22 A - This is a system test and not a component level test. See below for the recommend EMI Filter Schematic.

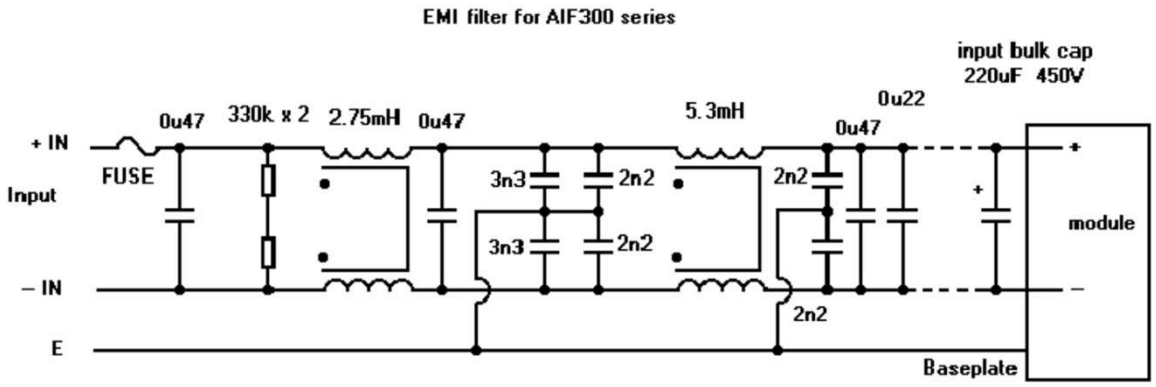


Figure 40: EMI Filter Schematic

Conducted Emissions

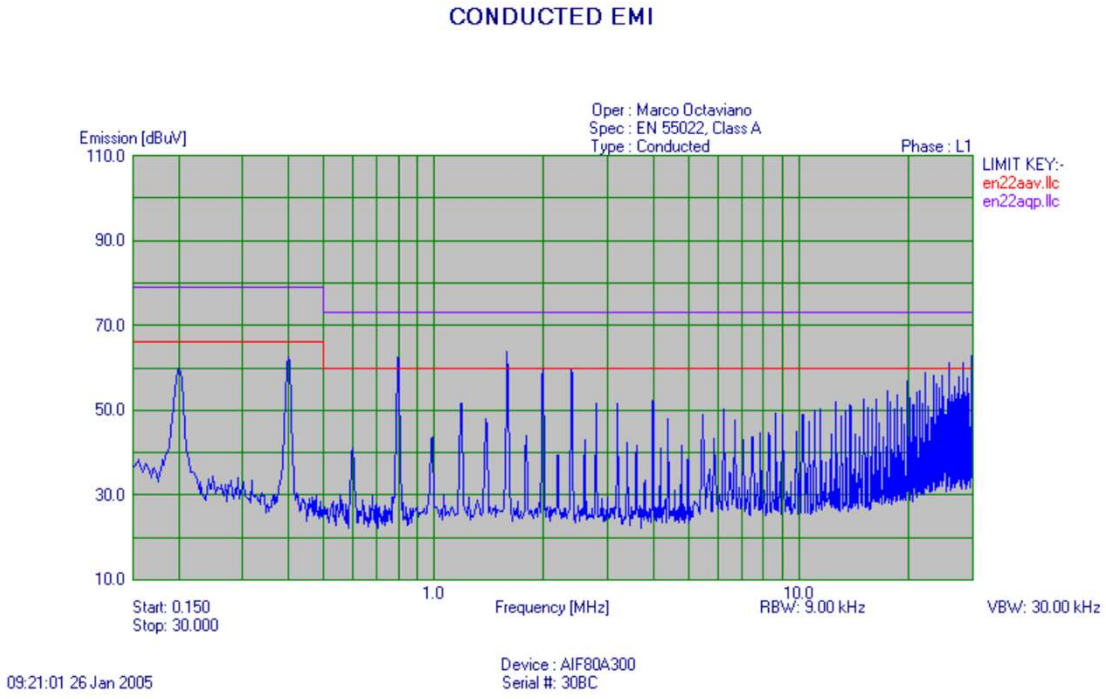


Figure 41: Conduct EMI Scan (without filter)

ENVIRONMENTAL SPECIFICATIONS

Vibration

Endurance Random Vibration (Non-operating)

The AIF 300V Vin power supply will pass the following random vibration test at the following non-operating condition:

Frequency Range	10 – 200 Hz; 200 – 2000 Hz
PSD	0.01 g^2 / Hz; 0.003 g^2 / Hz
Acceleration	2.5 g RMS (typical level)
Duration	20 mins per axis

Endurance Random Vibration (Operating)

The AIF 300V Vin power supply will pass the following random vibration test with the unit at operating mode at nominal lines and full load condition, with POK monitored.

Frequency Range	10 – 500 Hz
PSD	0.002 g^2 / Hz flat
Acceleration	1 g RMS
Duration	20 mins per axis

Shock

Shock (Non-operating)

The AIF 300V Vin power supply will pass the following shock specifications at non-operating test condition.

Acceleration	30 g
Duration	6 ms minimum
Pulse	Half-Sine
Direction	All 6 faces, 3 times in each positive and negative directions

Shock (Operating)

The AIF 300V Vin power supply will pass the following shock specifications at operating test condition.

Acceleration	4 g
Duration	22 ms minimum
Pulse	Half-Sine
Direction	All 6 faces, 3 times in each positive and negative directions

ENVIRONMENTAL SPECIFICATIONS

Isolation Specifications

Parameter	Min	Typ	Max	Unit
Isolation Capacitance	-	300	-	pF
Isolation Resistance	10	-	-	Mohm

Insulation Specifications

Parameter	Min	Typ	Max	Unit
Input to Output @ 500 Vdc	10	-	-	Mohm
Input to Baseplate @ 500 Vdc	10	-	-	Mohm
Output to Baseplate @ 500 Vdc	10	-	-	Mohm

ESD

The AIF 300V Vin power supply is designed to meet the following Electrostatic Discharge (ESD) test specifications:

Contact discharge	6 KV
Air discharge	8 KV

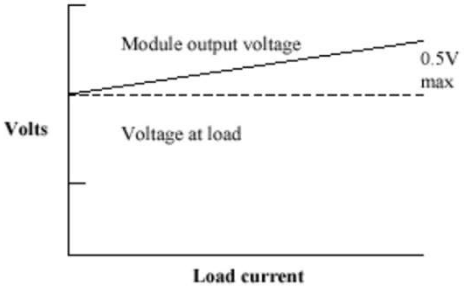
POWER AND CONTROL SIGNAL DESCRIPTIONS

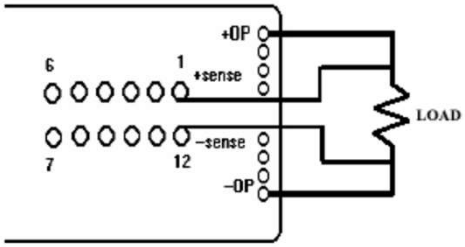
Control Signals

Remote Sense (+SENSE, -SENSE) - (pin 1, pin 12)

Connect the +SENSE and –SENSE pins of the module directly to the load to allow the module to compensate for the voltage drop across the conductors carrying the load current. If remote sensing is not required (for example if the load is close to the module) the sense pins should be connected directly to the module's output pins to ensure accurate regulation.

Note: If the sense leads fail open circuit, the module will revert to local sense at the output pins. Incorrect connection of sense leads may damage the module. remote sense compensation at nominal V_O only.





POWER AND CONTROL SIGNAL DESCRIPTIONS

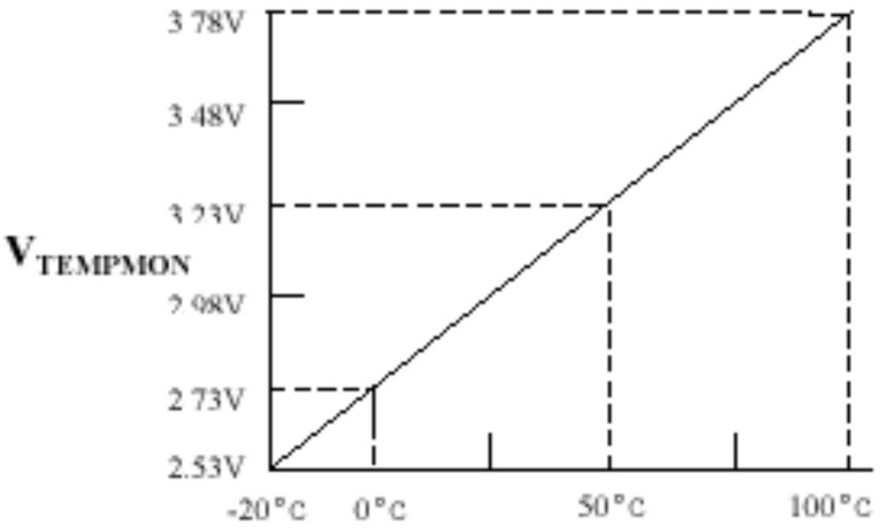
Temperature Monitoring (TEMP MON) - (pin 2)

The TEMP MON pin provides an indication of the module's internal temperature. The voltage at the TEMP MON pin is proportional to the temperature of the module baseplate at 10 mV per ^{O}C, where:

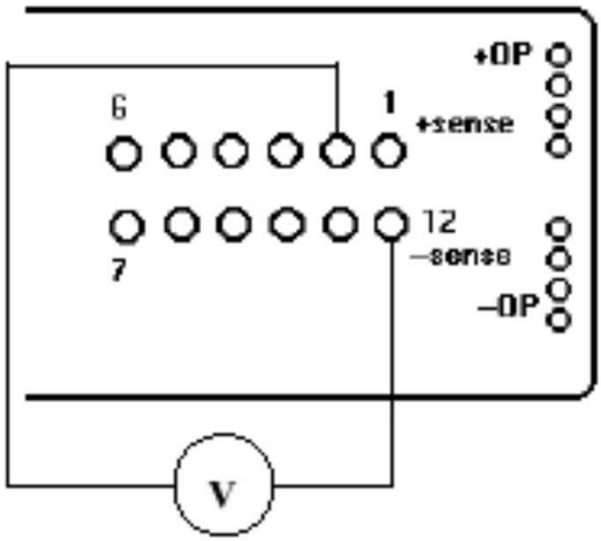
Module temperature (^{O}C) = ($V_{temp,mon}$ X 100) – 273

The temperature monitor signal can be used by thermal management systems (e.g. to control a variable speed fan). It can also be used for over temperature warning.

If the module's baseplate temperature exceeds 110°C, the module will be latched. Module will operate back normally once the temperature drop below 100°C.



Module internal temperature

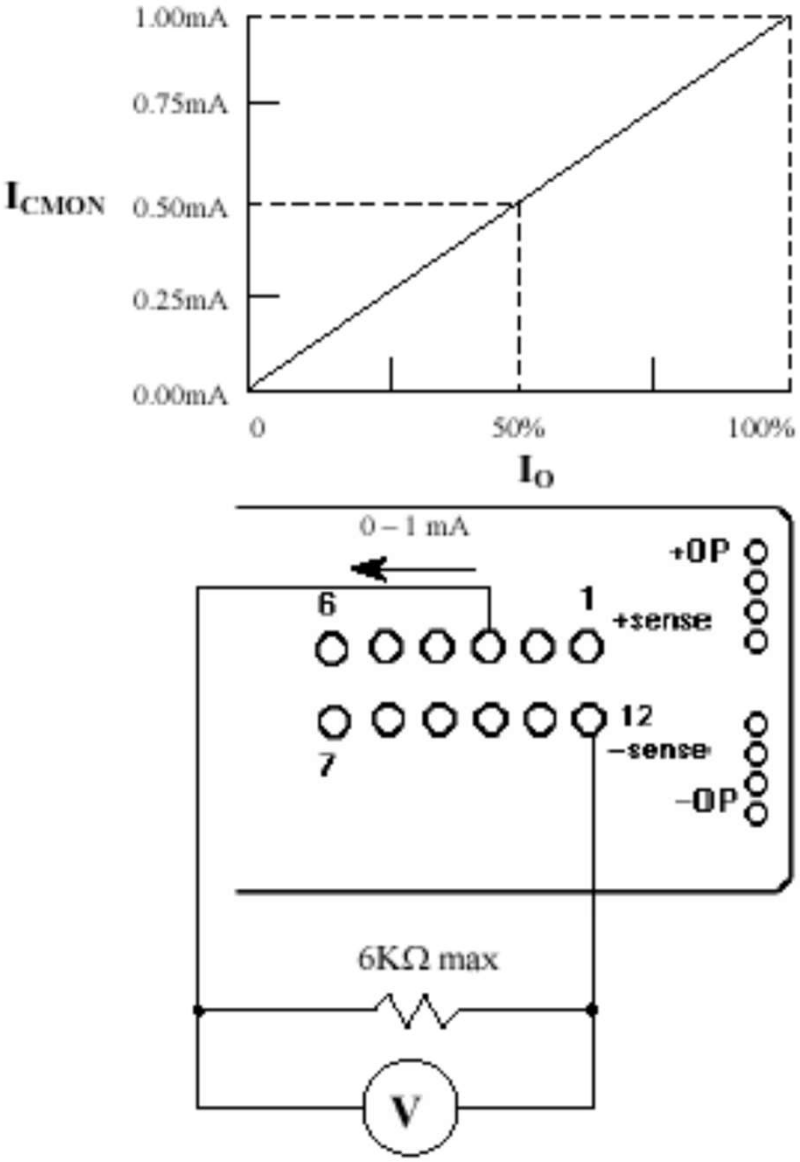


POWER AND CONTROL SIGNAL DESCRIPTIONS

Current Monitoring (C MON) - (pin 3)

The C MON pin provides an indication of the amount of current supplied by the module. The output of the C MON pin is a current source proportional to the output current of the module, where 0.2 mA to 1 mA is 20% to 100% $I_{O,rated}$.

The C MON output can be paralleled with C MON outputs from other modules to indicate the total current supplied in a paralleled system.



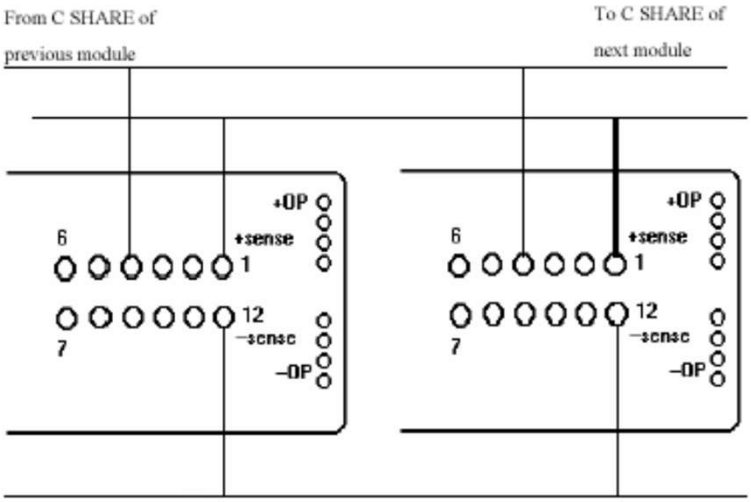
POWER AND CONTROL SIGNAL DESCRIPTIONS

Current Share (C SHARE) - (pin 4)

To ensure that all modules in a parallel system accurately share current, the C SHARE pins on each module should be connected together.

The voltage on the C SHARE pins represents the average load current per module. Each module compares this average with its own current and adjusts its output voltage to correct the error. In this way the module maintains accurate current sharing.

Note: The +SENSE and -SENSE pins of each module must also be connected together to ensure accurate current sharing.

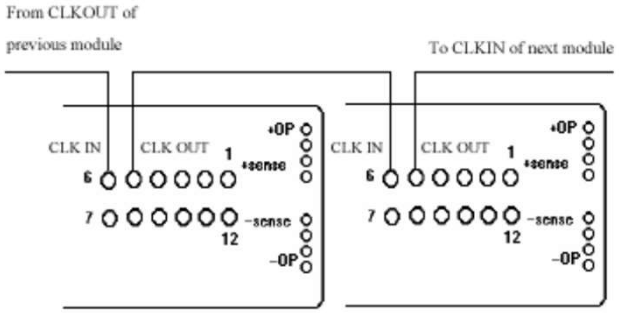


Clock Signals (CLK IN, CLK OUT) - (pin 5, pin 6)

The module's internal clock is accurate and stable over its full operating range and synchronization is not normally required, but it can reduce noise in paralleled systems.

Clock signals can be wired in series (the CLK OUT pin of one module to the CLK IN pin of the next etc) in which case all the modules will be synchronized with the first module in the chain. Alternatively, an external clock signal of 5 Vpk-pk at 800 KHz ±10% can be connected to the CLK IN pins of all the modules.

If the clock input to any module fails, the module will automatically switch back to its internal clock and will continue to operate normally. The CLK IN and CLK OUT signals are AC coupled, so any module can clock another module regardless of polarity.

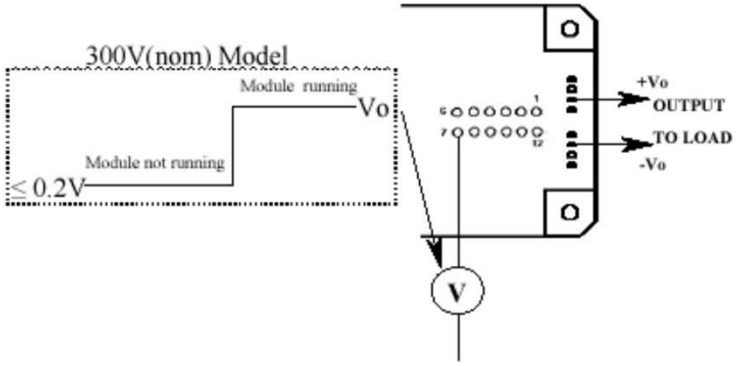


POWER AND CONTROL SIGNAL DESCRIPTIONS

Power Good / Identification (PG/ID) - (pin 7)

This pin provides an indication that the module's converters are working, and can also be used to identify the factory set output voltage of the module. The PG/ID pin goes high to the level of the output voltage (V_O) to indicate that the module is operating and delivering power. The output goes low if the converters stop operating due to a fault such as an overtemperature or overvoltage condition. The PG/ID pin will also go low if the module is disabled via the ENABLE pin or under light load condition.

The resistance between the PG/ID pin and the +ve output of the module can be used to identify the module with no power applied according to the table:



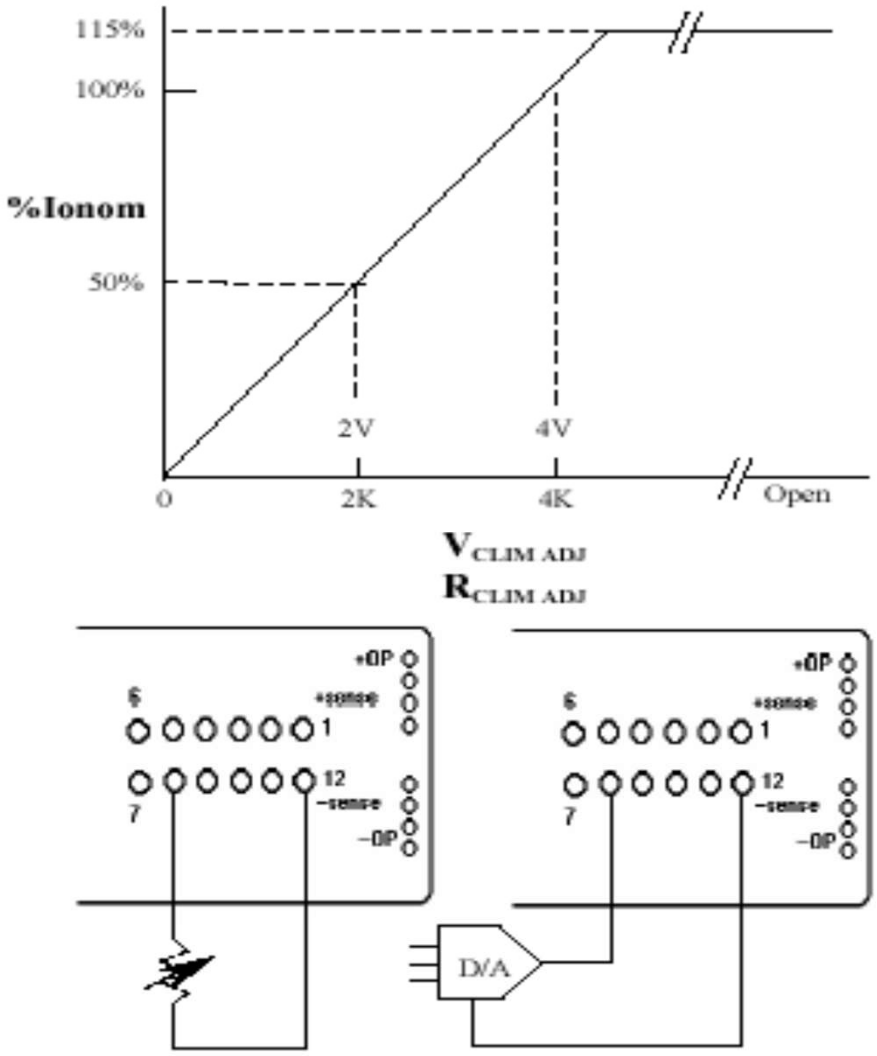
Model Number	Resistance (kΩ)
AIF120Y300-L/N-L/-NTL	1.8
AIF120F300-L/N-L/-NTL	3.3
AIF80A300-L/N-L/-NTL	5.1
AIF50B300-L/N-L/-NTL	12
AIF40C300-L/N-L/-NTL	15
AIF25H300-L/N-L/-NTL	24

POWER AND CONTROL SIGNAL DESCRIPTIONS

Over Current Protection and Current Limit Adjustment (C LIM ADJ) - (pin 8)

A constant current limiting circuit protects the module under overload or short circuit conditions. Module will operate back normally once the overload/fault is removed.

With the C LIM ADJ pin left unconnected, the current limit is factory set to 115% of the module's rated output. Current limit may be adjusted across the range from 20% to 100% using an external voltage source (0.8 to 4 V, capable of sinking 1 mA) or a resistor (800 ohm to 4 Kohm) connected between C LIM ADJ and -SENSE.



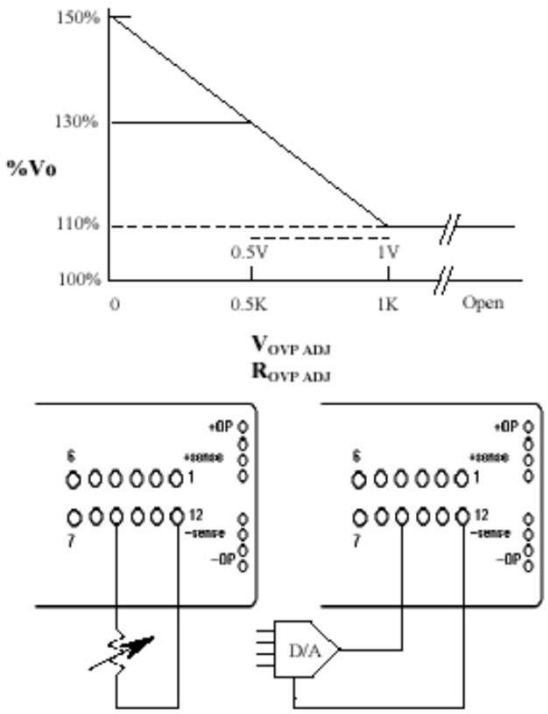
POWER AND CONTROL SIGNAL DESCRIPTIONS

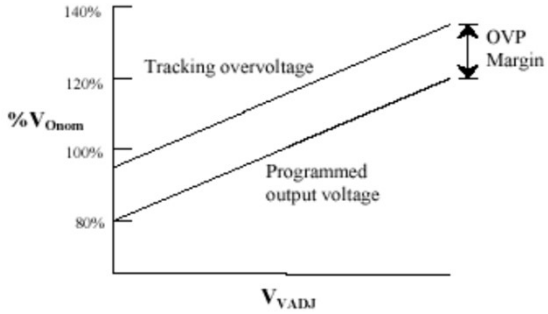
Overvoltage Protection (OVP) and Overvoltage Protection Adjustment (OVP ADJ) - (pin 9)

An independent overvoltage circuit monitors the module's output pins and will shut the module down in the event of an internal or external fault which causes the output voltage to rise above the preset limit. The module is reset by removing and re-applying the input power or toggle the ENABLE OFF/ON.

The overvoltage set point may be adjusted between 10% and 50% above the output voltage (V_O), and automatically tracks adjustments made to the output voltage using $V_{adj.}$

OVP ADJ should be used to increase the OVP margin when the voltage drop between power output pins and remote sense is more than 0.2 V.

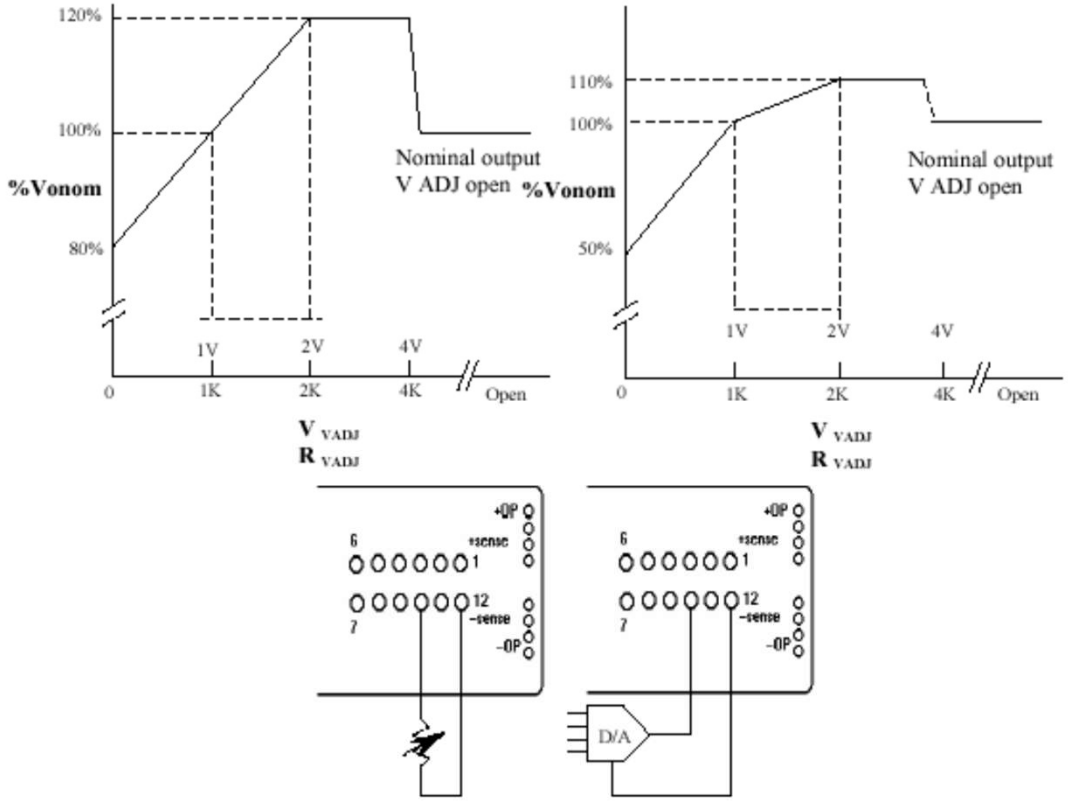




POWER AND CONTROL SIGNAL DESCRIPTIONS

Output Voltage Adjustment (V ADJ) - (pin 10)

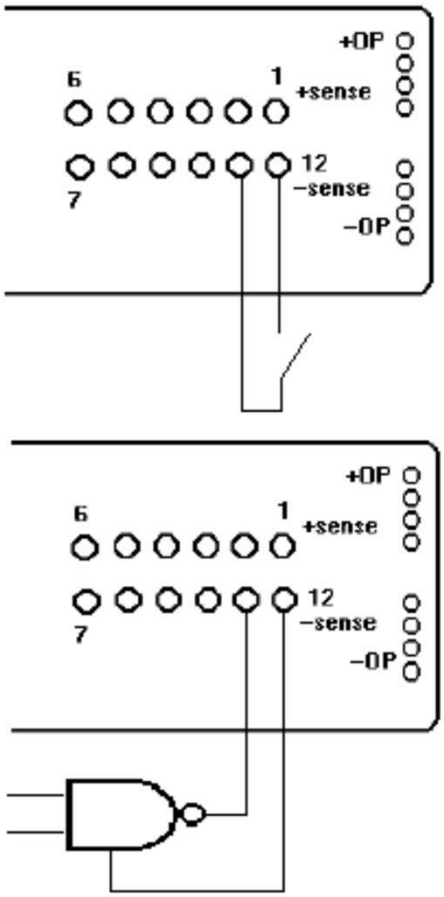
The output voltage of the module may be accurately adjusted by up -50%, +20% of the nominal factory set output. Adjustment is carried out using either an external voltage source (0 to 2 V, capable of sinking 1 mA) or resistor (0 to 2 K) connected between V_{adj} and -SENSE.



POWER AND CONTROL SIGNAL DESCRIPTIONS

Enable Control (ENABLE) - (pin 11)

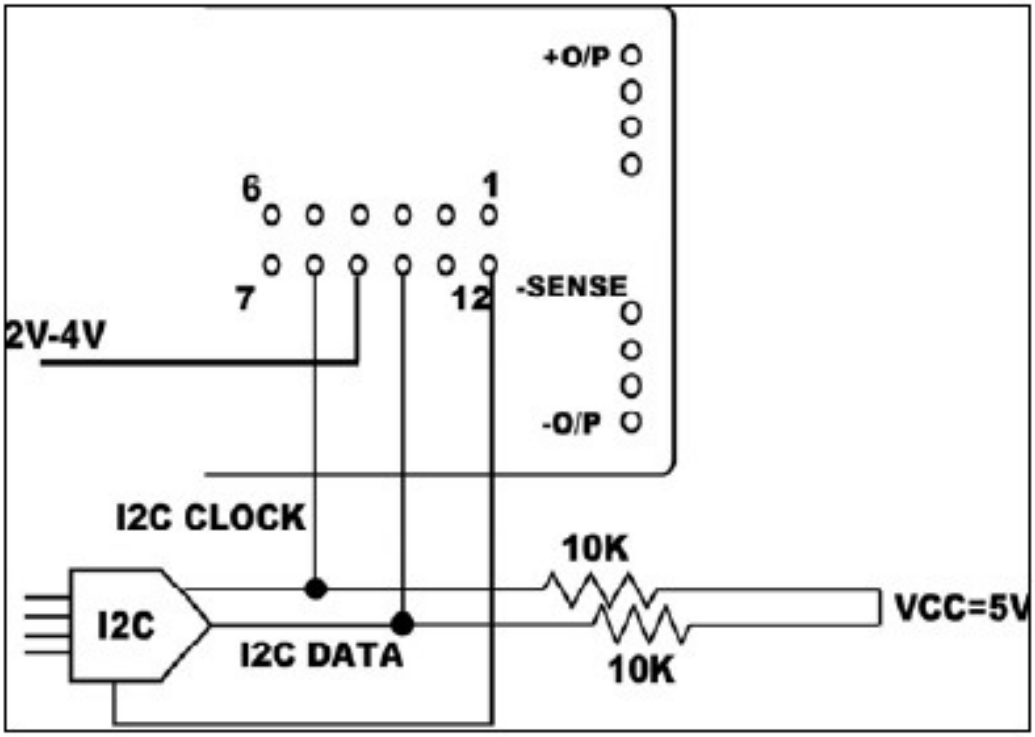
The Enable pin is a TTL compatible input used to turn the output of the module on or off. For models without suffix “N”, the output is enabled when the ENABLE pin open or driven to a logic high >2 V, and disabled when the ENABLE pin is connected to -SENSE or driven to a logic low of < 0.7 V. For models with suffix “N”, the output is enabled when the ENABLE pin is connected to -SENSE or driven to a logic low of < 0.7 V, and disabled when the ENABLE pin is open or driven to a logic high > 2 V.



POWER AND CONTROL SIGNAL DESCRIPTIONS

I²C Digital Control (DCS, I2C CLK, I2C DATA) - (Pin 9 & Pin 8 & Pin 10)

The module shall be capable to be controlled by I²C interface, which is SMBus compatible, via I²C CLK and I²C DATA pins. These two pins share the same pin location of CLIM ADJ and V ADJ pins respectively. Digital control is selected when Digital Control Select (DCS) pin voltage is between from 2 V to 4 V. When digital control is selected, analog adjust pin function is disabled. DCS signal shall only be applied when the module is powered off or disabled. An external 10k pull-up resistor is necessary for each I²C CLK, and I²C DATA pin, for 100 KHz I²C bus frequency.



I²C COMMUNICATION PROTOCOL

Command Word

Command word is sent by master system to inform slave device that what kind of operation the master like to do. It is a 16-bit data. Bit 0 to bit 9 indicate the data need to transfer (e.g. the value of OV_ADJ). As there are two different lengths of data, one is 8-bit and the other is 10-bit. So, if 10-bit data is transmitting/receiving, whole 10 bits (DATA9 - DATA0) will be used. In 8 bits case, only the least significant 8 bits (DATA7 - DATA0) will be used. The two bits (DATA9 and DATA8) will be cleared. The 5 bits (REG4 - REG0) indicate which command needs to. When the master requests data from the slave, the DATA9 - DATA0 bits should be cleared. And during setting the four information items (Model Name, Serial No., Firmware Version, Model Revision), DATA9 - DATA8 should be cleared and is followed by the actual data.

The format of the 16-bits command word is as follow:

Bit 15							Bit 8
DSR	REG4	REG3	REG2	REG1	REG0	DATA9	DATA8
Bit 7							**Bit 0**
DATA7	DATA6	DATA5	DATA4	DATA3	DATA2	DATA1	DATA0

The DSR (Data Set Read) bit controls read/write of data. If the master send a 0 (write operation) for this bit, the slave device will get the command register and data. And then set the value of the corresponding command register. If the master sends a 1 (read operation) for this bit, the slave device will get the current value of the corresponding command register and send it to the master.

The table below shows the register mapping:

Command Register	Coding (REG4 – REG0)
MODEL_NO (read/write*)	00000
SERIAL_NO (read/write*)	00001
FIRMWARE_VER (read/write*)	00010
MODEL_REV (read/write*)	00011
SLAVE_ADDRESS (read/write)	00100
OVP_ADJ (read/write)	00101
V_ADJ (read/write)	00110
CLIM ADJ (read/write)	00111
TMON (read only)	01000
VOUT (read only)	01001
CMON (read only)	01010
RESET (write only)	01111
LOCK (write only*)	10000
UNLOCK (write only*)	10001
REC_ALP (write only) Set Reset	 10010 10011
REC_ALP State (read only)	10100

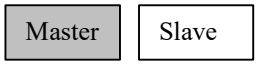
*Remark: write functions only used to production.

COMMUNICATION BUS DESCRIPTIONS

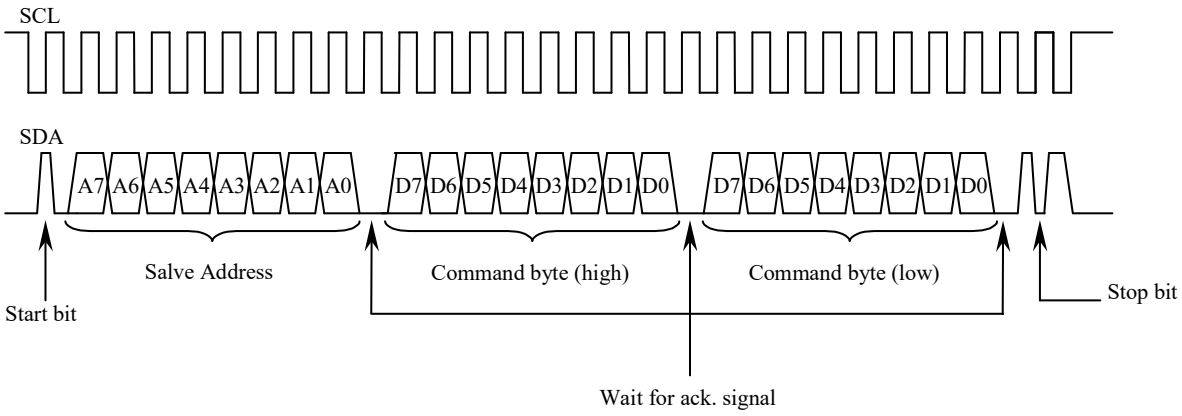
Data Transfer Structure on I²C Bus

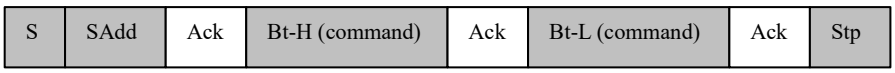
Terms	Description	No. of bits
Stt	Start bit	1
Sadd	Slave address	8
Ack	Acknowledge	1
Bt-H	Higher byte	8
Bt-L	Lower byte	8
StD(1st, 2nd,...nth)	String of bytes(1st byte, 2nd byte,.....nth byte)	8
Stp	Stop Bit	1

In the block diagram below, gray boxes indicate master-send signal; white boxes indicate slave-send signal.



Set Data to Slave

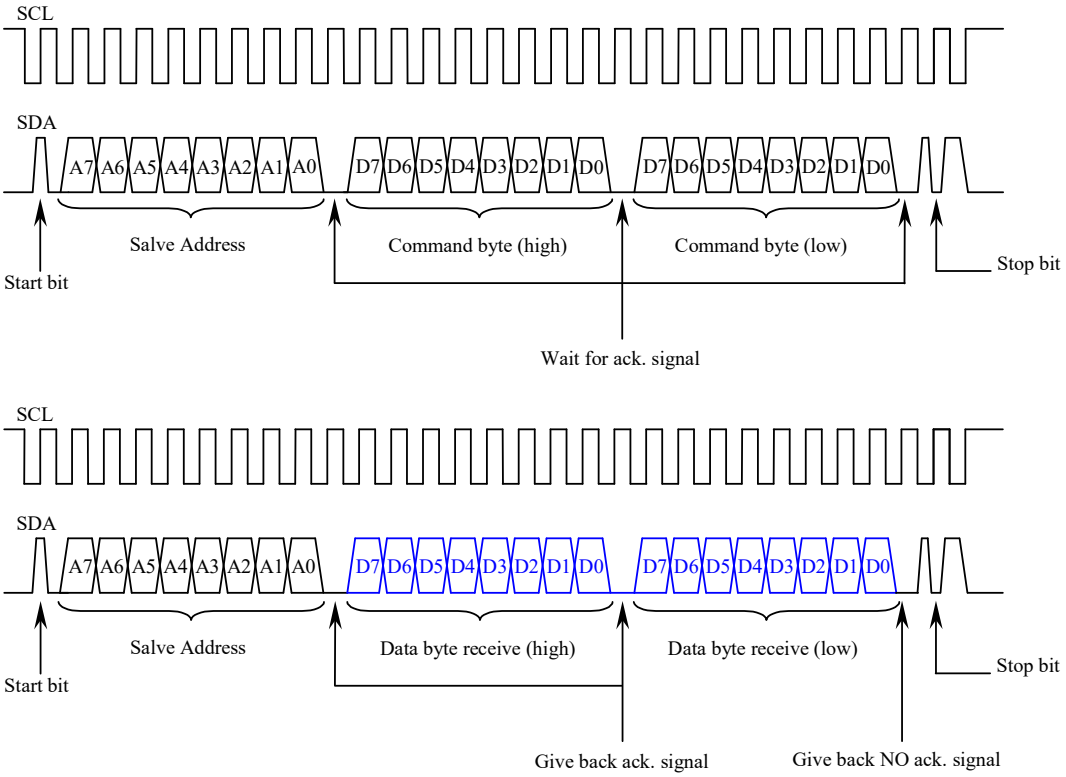




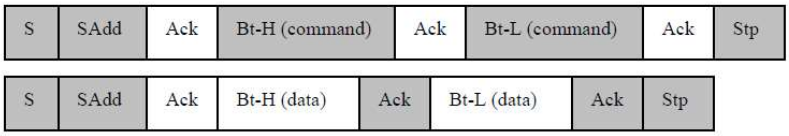
Procedures:
1. The master device gives a Start condition via SDA.
2. Master sends the 8-bit slave address in which bit 0 of it should be 0 (0 indicate a write condition to slave) via SDA.
3. The addressed slave device give out acknowledge via SDA.
4. The master sends the high byte of command code via SDA.
5. The slave give out acknowledge via SDA.
6. The master sends the low byte of command code via SDA.
7. Slave gives out acknowledge after receiving the last byte.
8. Master gives a STOP condition via SDA to stop the transaction.

COMMUNICATION BUS DESCRIPTIONS

Read Data from Slave (2-Byte Data)



SCL and SDA signal of read mode (2 bytes of data read)



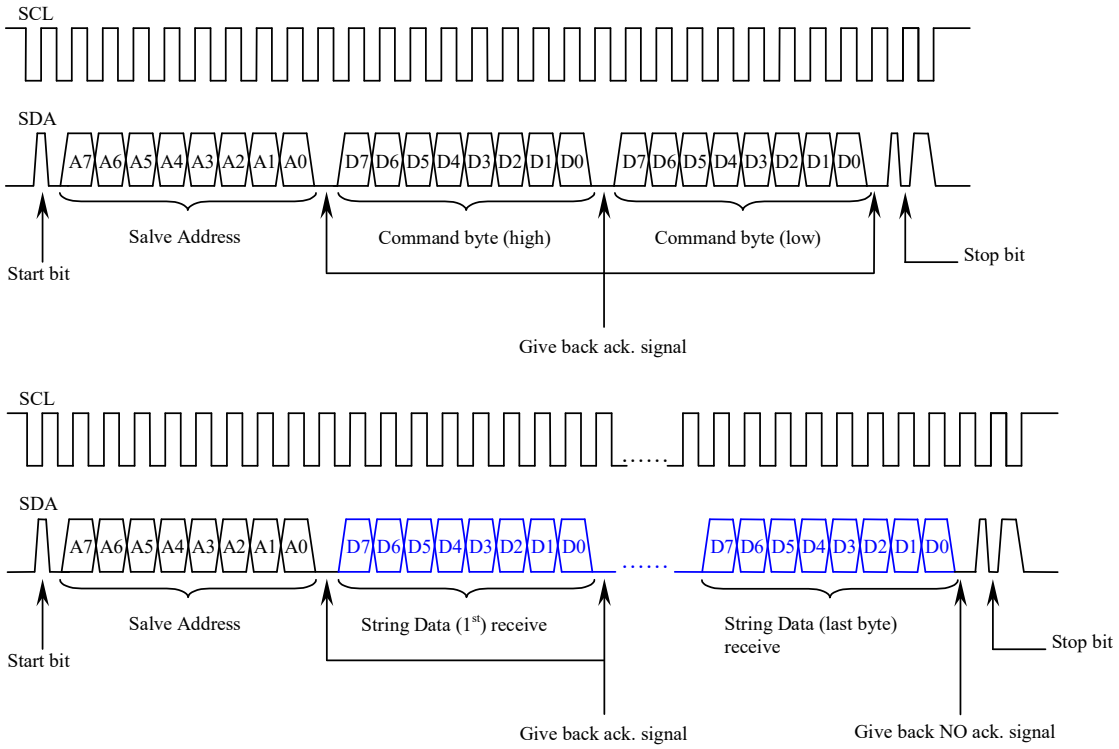
Block diagram of read mode (2 bytes of data read)

Procedures:

1. The master device gives out a start condition on SDA.
2. Master sends the 8 bits slave address which bit 0 of it should be 0 (0 indicates write mode for slave) via SDA.
3. The addressed slave device gives back acknowledge via SDA.
4. Master sends out the high byte of the 2-bytes command word.
5. Slave device gives back acknowledge again.
6. Master sends out the low byte of the 2-bytes command word.
7. Slave device gives back acknowledge again.
8. Master sends out a stop condition to prepare for the next transaction.
9. Master gives out a start condition again for the next transaction.
10. Master sends the 8 bits slave address which bit 0 of it should be 1(1 indicates read mode for slave) via SDA.
11. Slave give back an acknowledge signal.
12. Slave then sends out the high byte of desired data.
13. Master gives back acknowledge to slave.
14. Slave sends the low byte of the desired data.
15. Master gives back acknowledge and sends out a stop condition to close the transaction.

COMMUNICATION BUS DESCRIPTIONS

Read Data from Slave (String of Data)



SCL and SDA signal of read mode (String of data)



Block diagram of read mode (String of data).

Procedures:

1. The master device gives out a start condition on SDA.
2. Master sends the 8 bits slave address which bit 0 of it should be 0 (0 indicates write mode for slave) via SDA.
3. The addressed slave device gives back acknowledge via SDA.
4. Master sends out the high byte of the 2-bytes command word.
5. Slave device gives back acknowledge again.
6. Master sends out the low byte of the 2-bytes command word.
7. Slave device gives back acknowledge again.
8. Master sends out a stop condition to prepare for the next transaction.
9. Master gives out a start condition again for the next transaction.
10. Master sends the 8 bits slave address which bit 0 of it should be 1(1 indicates read mode for slave) via SDA.
11. Slave give back an acknowledge signal.
12. Slave then sends out the first byte of desired data.
13. Master gives back acknowledge to slave.
14. Repeat 12 and 13 until the end of bytes.
15. Master gives back acknowledge and sends out a stop condition to close the transaction.

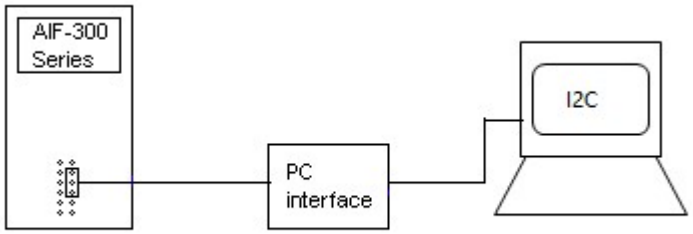
DIGITAL CONTROL DEMO USER GUIDE

This Demo program is developed to test and evaluate I²C control features of AIF 300V Vin DC/DC modules.

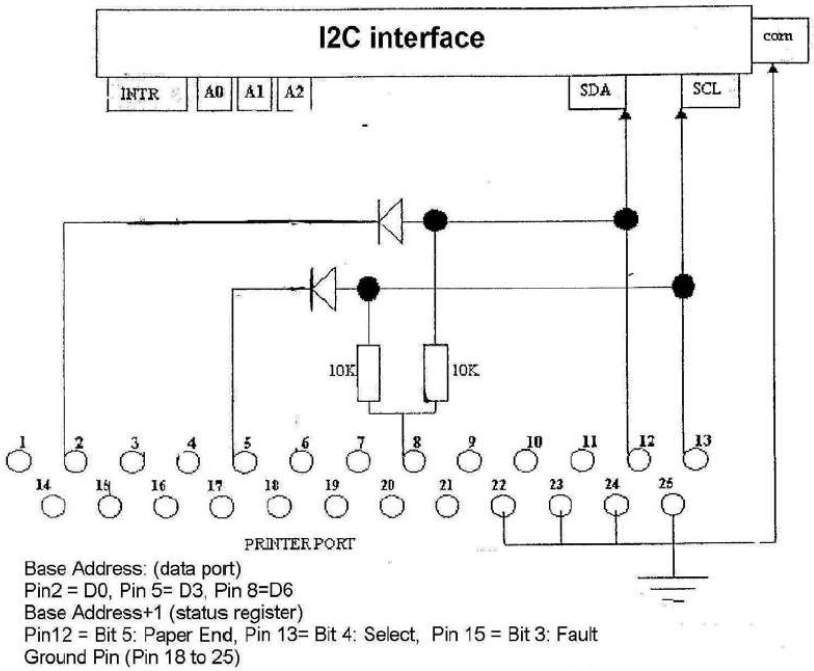
Equipment required:
1. One or more modules of AIF 300V Vin series.
2. PC - Module interface hardware.
3. PC

Hardware Setup

The picture shown below is the setup of the hardware.



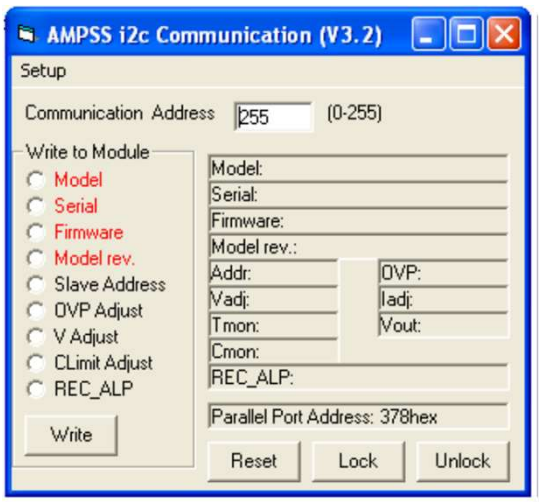
PC-I²C Interface Circuit Diagram



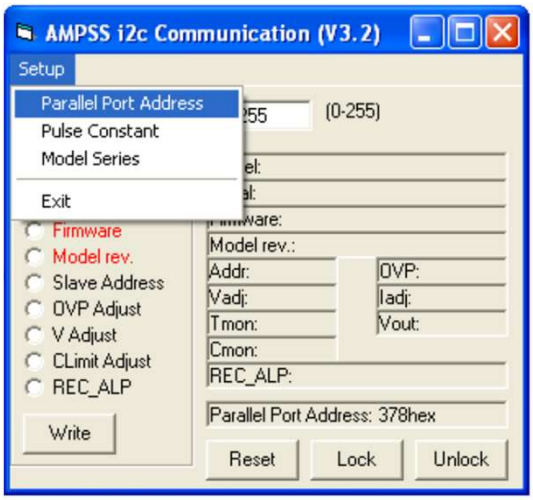
DIGITAL CONTROL DEMO USER GUIDE

Software Setup

Click on the program “Ampss68.exe”. Then following dialog box shows:



Click on “Setup”, to setting “Parallel Port Address” value, “Pulse Constant” value, and “Model series” to select model.

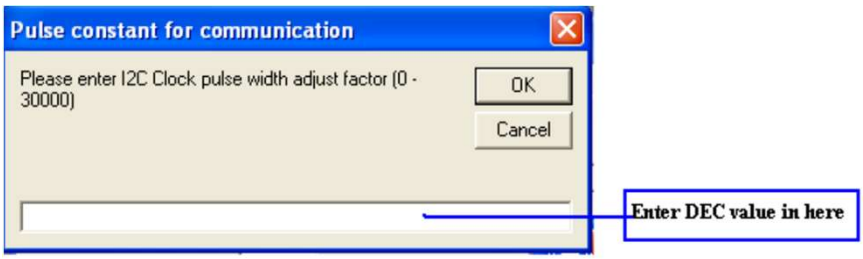


Then a new dialog box shows and enter the right value into it and click “OK”:

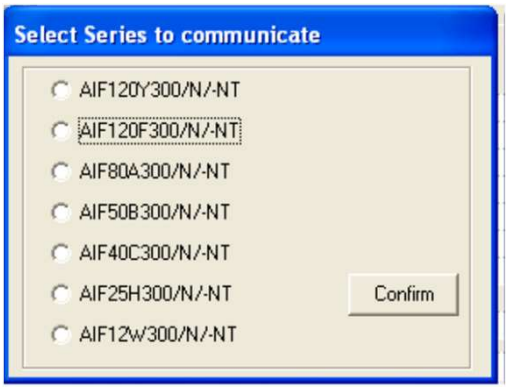


DIGITAL CONTROL DEMO USER GUIDE

Click “Pulse Constant” , set the desired pulse constant value into the dialog box below and click “OK”:

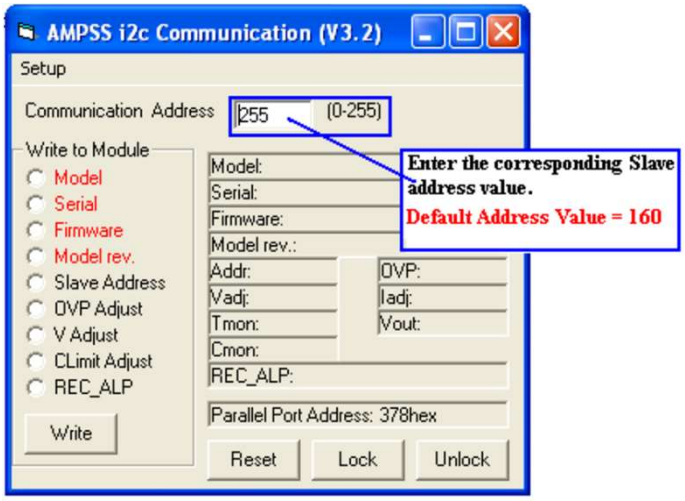


Click “Model Series” , select the model on the dialog box below and click “Confirm”:



Select Module

Enter the slave address of the module that you want to control:

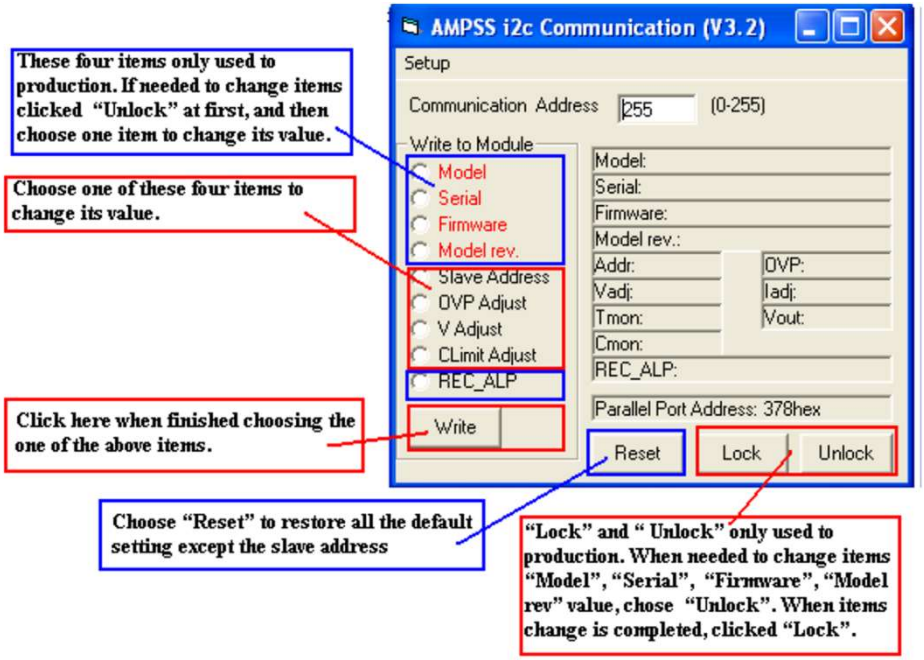


Note: “0” and “1” are the globe address of MMIIC. So, it can only perform “write” function when the UUT address is set to 0 or 1.

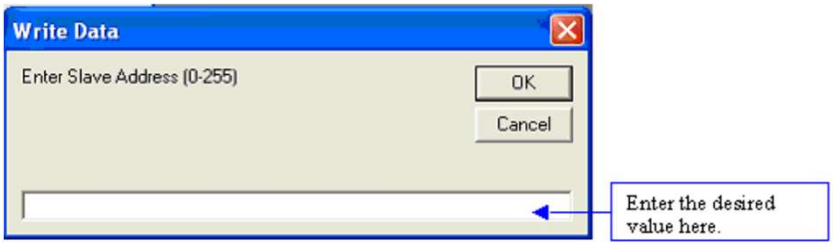
DIGITAL CONTROL DEMO USER GUIDE

Write Value

Click on the circle beside the desired item that needs to be changed its value.



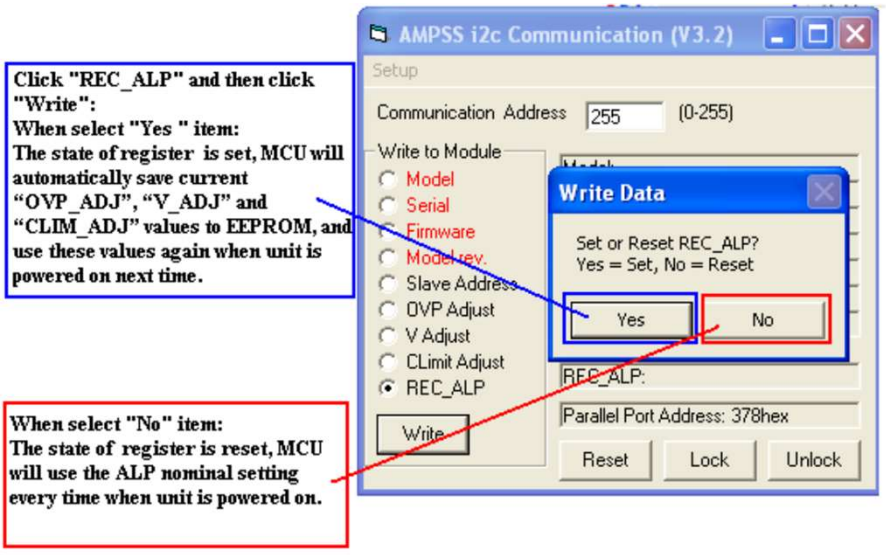
After choosing the desired item, click on "Write" below the items. Then a new dialog box shows (except "Reset" option). Fill the box with the new value and click "OK". Or click "Cancel " to cancel this operation.



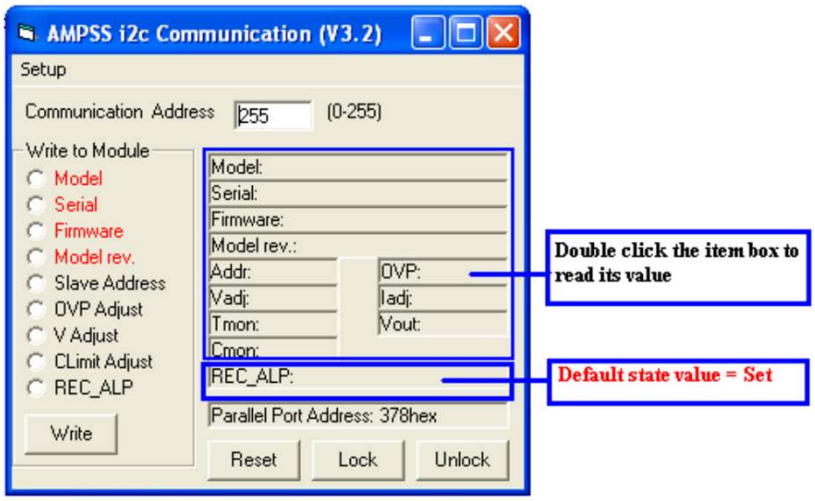
Click the item "REC_ALP", and then click "Write " to set the register "REC_ALP" state as shows:

DIGITAL CONTROL DEMO USER GUIDE

Click the item “REC_ALP”, and then click “Write “ to set the register “REC_ALP” state as shows:

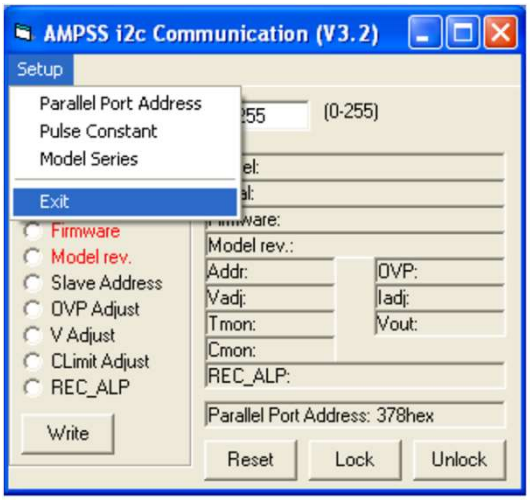


Double click on the item box to read the corresponding value:



DIGITAL CONTROL DEMO USER GUIDE

Exit Program: click on “Setup” and choose “Exit” to exit the program.



APPLICATION NOTE

Typical Application

Below is the typical application of the AIF 300V Vin series power supply.

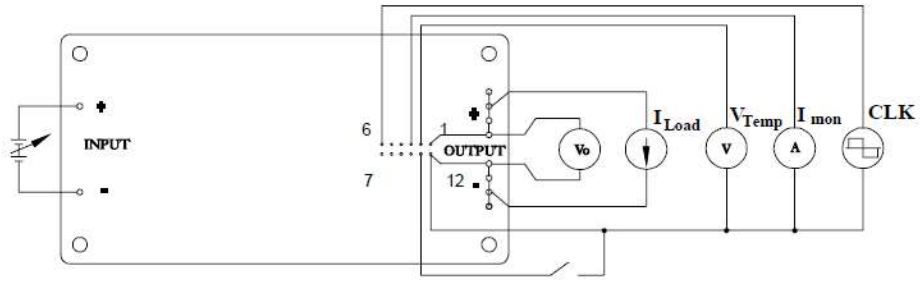


Figure 42. Single Module Operation

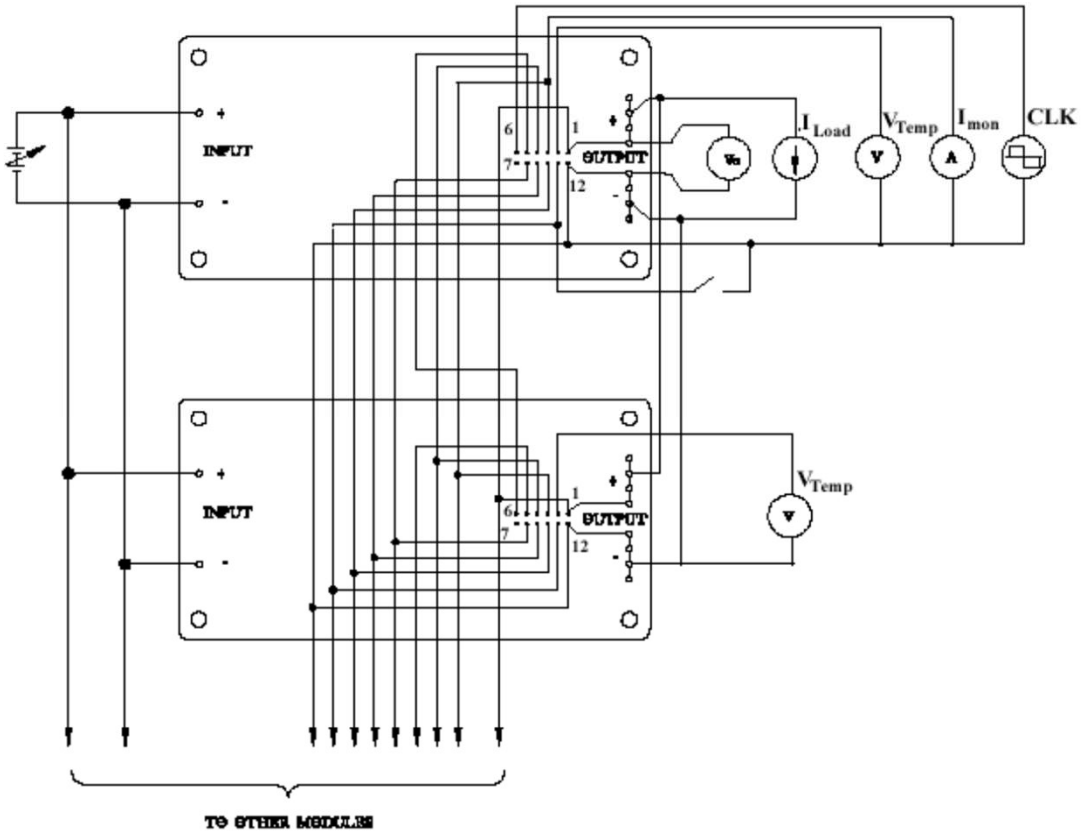


Figure 43. Modules Connection for Parallel Operation (View from baseplate).

APPLICATION NOTE

Input Reflected-Ripple Current Test Configuration

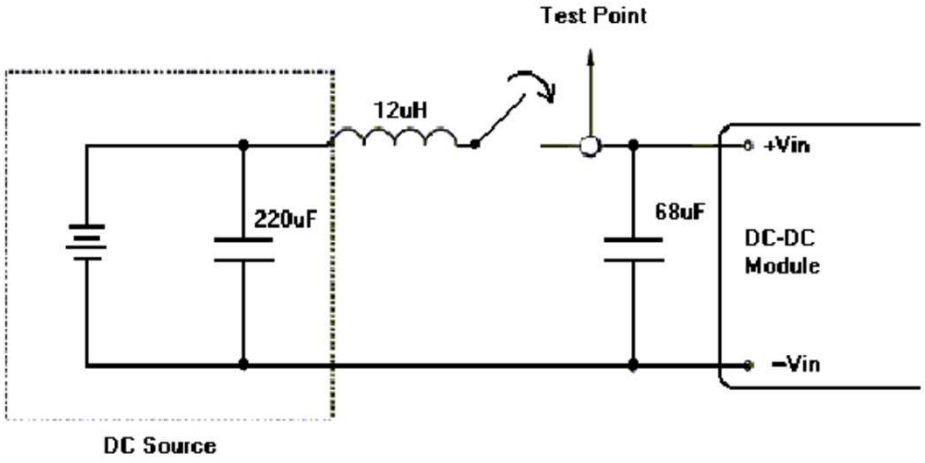


Figure 44. Measure input reflected-ripple current with a simulated source inductance of 12 µH.

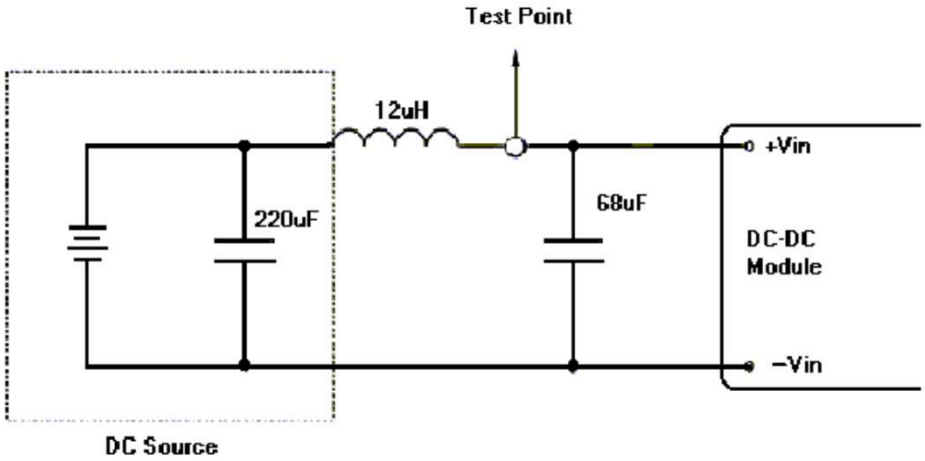


Figure 45. Measure input inrush current with a simulated source inductance of 12 µH and input bulk capacitor of 68 µF.

APPLICATION NOTE

Recommended OPTO Isolation Circuit

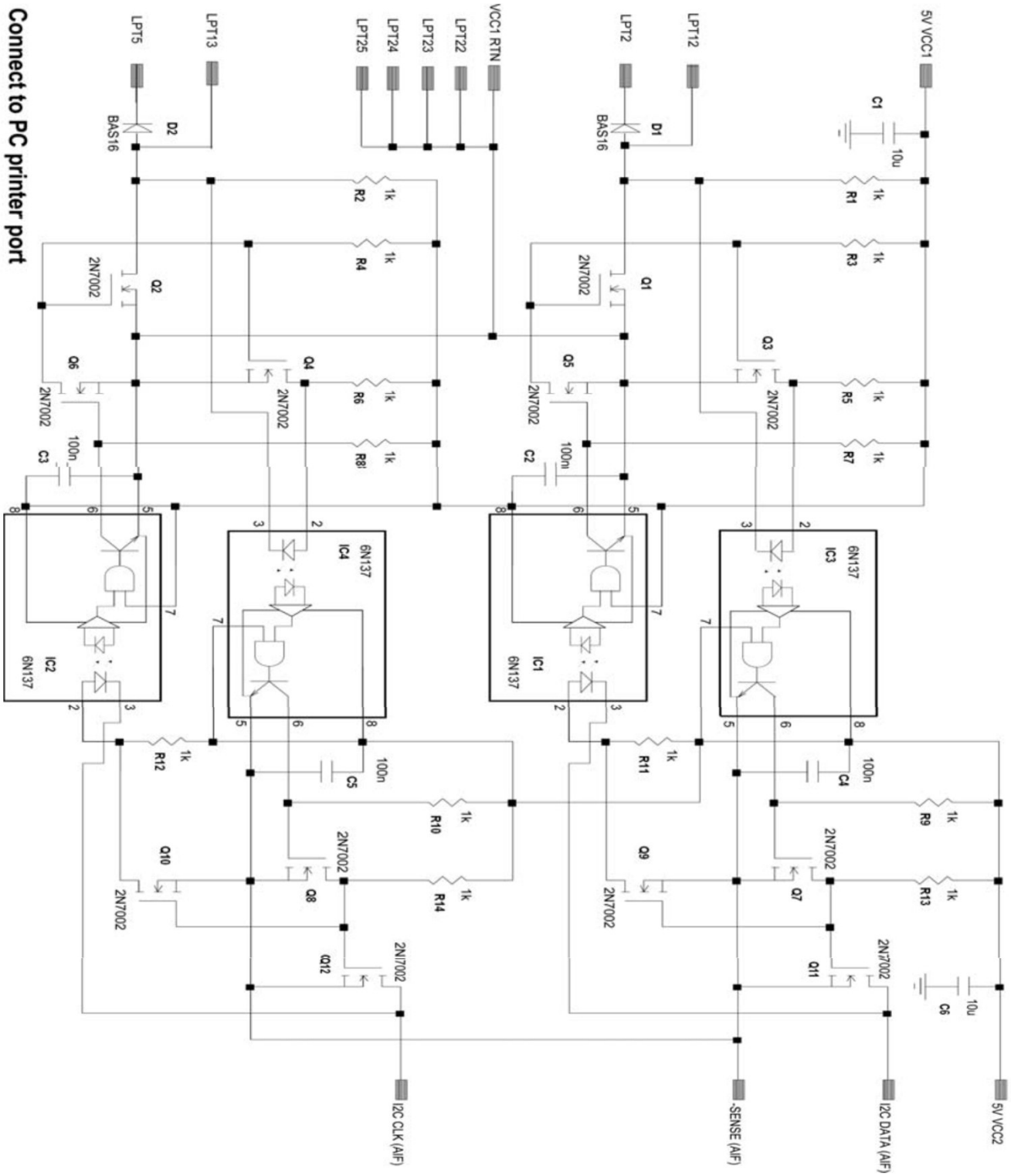


Figure 46. Recommended OPTO Isolation Circuit

APPLICATION NOTE

Parallel Operation with OPTO Isolation Circuit

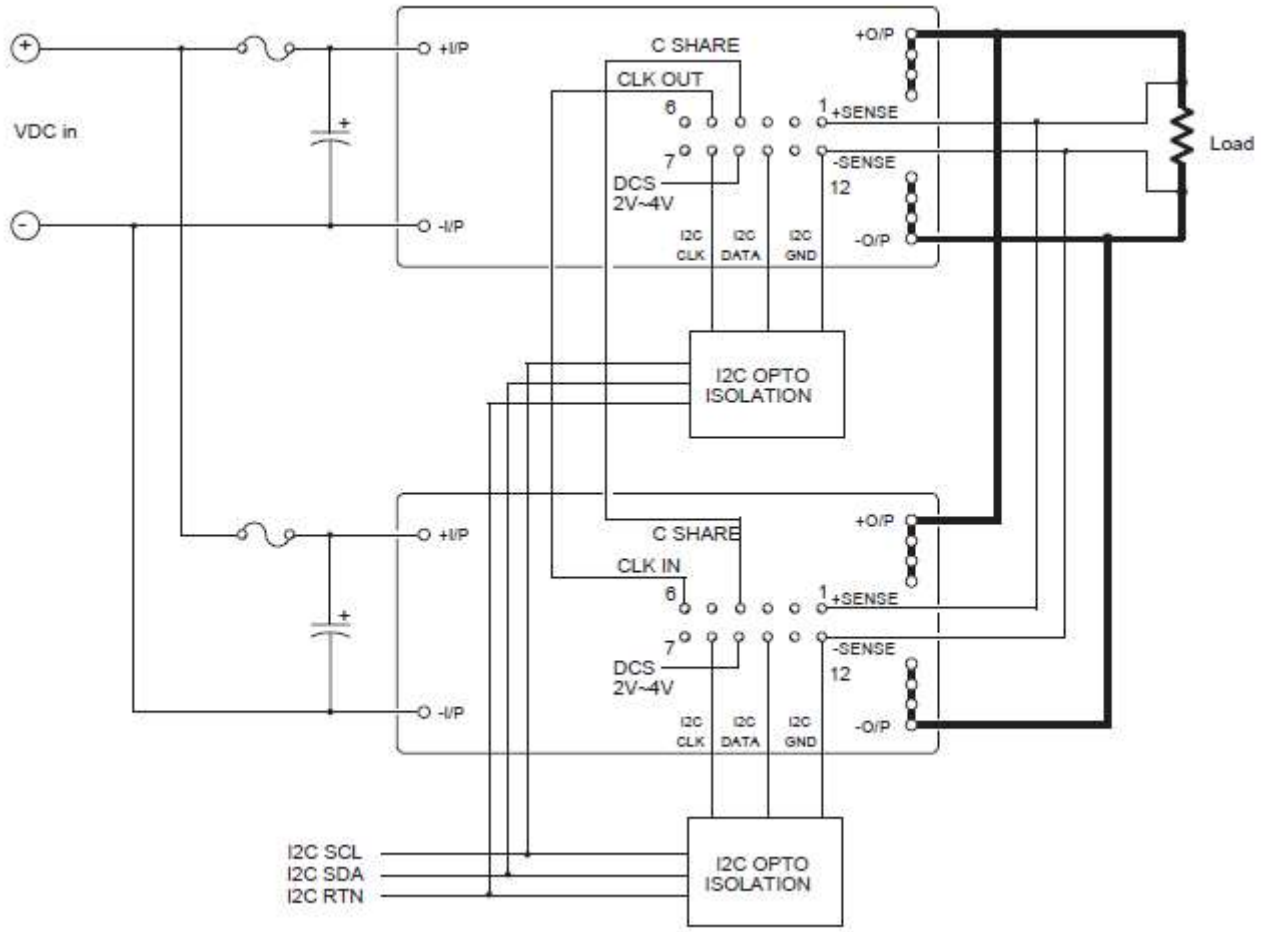


Figure 47. Parallel Operation with OPTO Isolation Circuit.

APPLICATION NOTE

Digital Control

The module shall be capable to be controlled by I²C interface, which is SMBus compatible, via I²C CLK and I²C DATA pins. These two pins share the same pin location of CLIM ADJ and V_ADJ pins respectively. Digital control is selected when Digital Control Select (DCS) pin voltage is between 2 V - 4 V.

There are 8 command registers for read operation, 4 command registers for read/write operation and 2 command register for write operation.

Command Register	Description
MODEL_NO (read only)	Read model name of the module
SERIAL_NO (read only)	Read serial number on bar code label
FIRMWARE_VER (read only)	Read firmware version
MODEL_REV (read only)	Read model revision
SLAVE_ADDRESS (read/write)	Read or set slave address of the module
OVP_ADJ (read/write)	Read or set overvoltage protection threshold of the module
V_ADJ (read/write)	Read or set output voltage of the module
CLIM ADJ (read/write)	Read or set current limit protection threshold of the module
TMON (read only)	Read baseplate temperature of the module
VOUT (read only)	Read output voltage of the module
CMON (read only)	Read output current of the module
RESET (write only)	Reset all control parameters to factory setting
REC_ALP (write only)	When register is set, MCU will automatically save current “OVP_ADJ”, “V_ADJ” and “CLIM_ADJ” values to EEPROM, and use these values again when unit is powered on next time. When register is reset, the MCU will use the ALP nominal setting every time when unit is powered on. Default is "Set."
REC_ALP_STATE (Read only)	Read register REC_ALP state is “Set “ or “Reset”

Digital Data Conversion

Each control and monitoring data is in 10-bit format. The data conversion formulae are as follows.

OVP_ADJ

The range of the OVP_ADJ can be adjusted from 115% to 145% of $V_{O,nom}$. The received/transmitted data is calculated by the equation below.

Receive Data (from module to PC):

Input Data: MCU OVP ADJ (integer)

Output Data: OVPADJ% (round to 1decimal place)

$$\text{OVPadj\%} = 145\% - \frac{\text{MCU OVPadj}}{205} \times 30\%$$

APPLICATION NOTE

Transmit Data (from PC to module):
Input Data: OVPADJ (round to 1 decimal place)
Output Data: MCU OVPADJ (integer)

$$\text{MCU OVPadj} = \frac{145\% - \text{OVPadj}\%}{30\%} \times 205$$

V_ADJ

V_ADJ range between 80% to 120% module: (5Vo and above model)

The range of the V_ADJ can be adjusted from 80% to 120% of $V_{O,nom}$. The received / transmitted data is calculated by the equation below.

Receive Data (from module to PC):
Input Data: MCU V_ADJ (integer)
Output Data: V_ADJ% (round to 1decimal place)

$$\text{Vadj}\% = 80\% + \frac{\text{MCU Vadj}}{410} \times 40\%$$

Transmit Data (from PC to module):
Input Data: V_ADJ (round to 1 decimal place)
Output Data: MCU V_ADJ (integer)

$$\text{MCU Vadj} = \frac{\text{Vadj}\% - 80\%}{40\%} \times 410$$

V_ADJ range between 50% to 115% module: (Below 5Vo model)

The range of the V_ADJ can be adjusted from 50% to 110% of V_O (nom). The received/transmitted data is calculated by the equation below.

V_ADJ between 50% to 100%:

Receive Data (from module to PC):
Input Data: MCU V_ADJ (integer)
Output Data: V_ADJ% (round to 1decimal place)

$$\text{Vadj}\% = 50\% + \frac{\text{MCU Vadj}}{205} \times 50\%$$

Transmit Data (from PC to module):
Input Data: V_ADJ (round to 1 decimal place)
Output Data: MCU V_ADJ (integer)

$$\text{MCU Vadj} = \frac{\text{Vadj}\% - 50\%}{50\%} \times 205$$

V_ADJ between 100% to 115%:

Receive Data (from module to PC):
Input Data: MCU V_ADJ (integer)
Output Data: V_ADJ% (round to 1decimal place)

$$\text{Vadj}\% = 100\% + \frac{\text{MCU Vadj} - 205}{205} \times 10\%$$

APPLICATION NOTE

Transmit Data (from PC to module):

Input Data: V_ADJ (round to 1 decimal place)
Output Data: MCU V_ADJ (integer)

$$\text{MCU Vadj} = \frac{\text{Vadj\% - 90\%}}{10\%} \times 205$$

CLIM ADJ

The range of the CLIM ADJ can be adjusted from 0% to 102.5% or 110% of rated I_O. The received/transmitted data is calculated by the equation below.

Receive Data (from module to PC):

Input Data: MCU CLIM ADJ (integer)
Output Data: CLIM ADJ% (round to 1decimal place)

Case 1: MCU CLIM ADJ ≠ 841

$$\text{CLIMadj\%} = \frac{\text{MCU CLIMadj}}{840} \times 102.5\%$$

Case 2: MCU CLIM ADJ >= 841

$$\text{CLIMadj\%} = 110\%$$

Transmit Data (from PC to module):

Input Data: CLIM ADJ (round to 1 decimal place)
Output Data: MCU CLIM ADJ (integer)

Case1: CLIM ADJ% ≠ 110%

$$\text{MCU CLIMadj} = \frac{\text{CLIMadj\%}}{102.5\%} \times 840$$

Case2: CLIM ADJ% >= 110%

$$\text{MCU CLIMadj} = 841$$

TMON

Baseplate temperature monitoring is a read only data. It is ranged from -40 ^{O}C to 120 ^{O}C. The temperature of module can be calculated by the equation below:

Receive Data (from module to PC):

Input Data: MCU Tmon (integer)
Output Data: Baseplate Temperature in ^{O}C (round to 1 decimal place)

$$\text{Baseplate Temperature in °C} = \frac{\text{MCU Tmon}}{1024} \times 500 - 273$$

APPLICATION NOTE

VOUT

Output Voltage is a read only data. The output voltage can be calculated by the equation below:
Receive Data (from module to PC):

Input Data: MCU V_O (integer)
Output Data: Output Voltage in $\%V_{O,nom}$ (round to 1 decimal place)

$$\text{Output Voltage in \%Vonom} = \frac{\text{MCU Vout}}{Vo_REF} \times 100\%$$

Module Name	V_O_REF
AIF120Y300-L / N-L / -NTL	369
AIF120F300-L / N-L / -NTL	676
AIF80A300-L / N-L / -NTL	813
AIF50B300-L / N-L / -NTL	820
AIF40C300-L / N-L / -NTL	830
AIF25H300-L / N-L / -NTL	820

CMON

Current monitoring is a read only data. It is ranged from 0% to 100% of rated I_O. The output current of module can be calculated by the equation below:

Receive Data (from module to PC):

Input Data: MCU CMON (round to 1 decimal place)

Output Data: Output Current Monitor in % $I_{O,max}$ (integer)

$$\text{Output Current Monitor in \%Iomax} = \frac{\text{MCU Cmon}}{614} \times 100\%$$

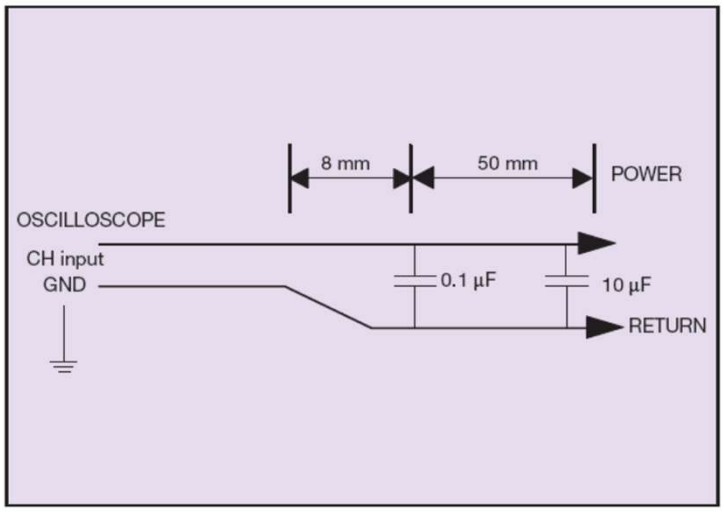
DEFAULT FACTORY SETTING

Control data	Factory Setting
Slave Address	0010100000 (A0h = 160) (8 bit addressing)
OVP ADJ	0011001101 (00CDh = 205) (125% of V_O)
V ADJ	0011001101 (00CDh = 205) (100% of V_O (nom))
CLIM ADJ	1111111111 (0349h = 841) (110% of rated I_O)

APPLICATION NOTES

Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the AIF 300V Vin series module. When measuring output ripple and noise, a scope jack in parallel with a 0.1 uF ceramic chip capacitor, and a 10 uF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20 MHz bandwidth for this measurement.



RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	2022.04.25	Update to AE template	V. Guo
1.1	2024.08.28	Update the pin definition with real module	K. Wang

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

PRECISION | POWER | PERFORMANCE

For international contact information,
visit advancedenergy.com.

powersales@aei.com (Sales Support)
productsupport.ep@aei.com (Technical Support)
+1 888 412 7832

Specifications are subject to change without notice. Not responsible for errors or omissions. ©2020 Advanced Energy Industries, Inc. All rights reserved. Advanced Energy®, and AE® are U.S. trademarks of Advanced Energy Industries, Inc.

AIF 300V Vin - Rev.08.28.24_#1.1