Advanced Energy®

ARTESYN
iVS SERIES
Up to 4920 Watts Configurable
Power System

*i*VS™

PRODUCT DESCRIPTION

Advanced Energy's Artesyn iVS series power supply is a configurable power supply with market-leading density and efficiency. It features a very wide input voltage range and employs active power factor correction to minimize input harmonic current distortion and to ensure compliance with the international EN61000-3-2 standard. The power supplies also feature active AC inrush control to automatically limit inrush current at turn-on to 40 A maximum.

The iVS series power supply can deliver up to 4920 Watts maximum from the iVS8 and iVS8H case. When fed with a 180 to 264 Vac input, the iVS Series can achieve a very high – 85% typical efficiency at full case load.

SPECIAL FEATURES

- Full Medical EN60601 approval (Expect iVS8H)
- Intelligent I^{2}C control
- Voltage adjustment on all outputs (manual or I^{2}C)
- Configurable input and output OK signals and indicators
- Configurable inhibit/enable
- Configurable output UP/DOWN Sequencing
- High power density (12 W/in^3)
- Intelligent fan (speed control/fault status)
- Up controlled PFC input with active inrush protection
- I^{2}C monitor of voltage, current and temperature
- Programmable voltage, current limit, inhibit/enable through I^{2}C

- Optional extended hold-up module (SEMI F47 compliance)
- Increased power density to 150%
- Optional conformal coating
- Industrial temp range (-40°C to 70°C)
- Uses standard iVS modules
- Field upgradeable firmware
- RoHS compliant

SAFETY

- UL60950/UL2601
- CSA22.2 No. 234 Level 5
- EN62368-1/EN60601-1
- CE Mark to LVD
- CB Certificate and report
- UKCA Mark

AT A GLANCE

Total Power

Up to 4920 Watts

Input Voltage

85 to 264 Vac

380, 440 Vac

120 to 300 Vdc

1-phase

3-phase

# of Outputs

Up to 24

PMBus® Power Management. Defined.

RoHS

MODEL NUMBERS

Ordering Information

iVSX	-	3L0-1Q1-4LL0-ILL0	-	00	-	A	-	###
①		②		③		④		⑤

|		
①	Case Size	Case Size (inch) where X = **1-phase Input:** 1 = 5" x 5" x 11"; 1500 W - 3210 W, 9 Slots (127 x 127 x 279.4mm) 3 = 5" x 8" x 11"; 1800 W - 4500 W, 14 Slots (127 x 203.2 x 279.4mm) **3-phase Input:** 6 = 5" x 5" x 11"; 3210 W, 9 Slots (127 x 127 x 279.4mm) 8, 8H = 5" x 8" x 11"; 4920 W, 14 Slots (127 x 203.2 x 279.4mm)
②	3L0-1Q1-4LL0-ILL0 └──────Option Code └──────Voltage Code └──────Module Code	**Module Codes:** (None) = 36 W triple O/P (1 Slot) 1 = 210 W single O/P (1 Slot) 2 = 360 W single O/P (2 Slot) 3 = 750 W single O/P (3 Slot) 5 = 1500 W single O/P (4 Slot) 4 = 144 W dual O/P (1 Slot) HUP = Extra 30mS hold-up (1 slot) **Voltage Codes:** See Output Module Voltage/Current table on page 4 **Option Codes:** 0 = Standard 1 = Module enable 2 = Constant current 3 = 1 & 2 combined 4 = Set for use in standard (non-intelligent case) 5 = Shutdown mode for 1500 W 6 = 1 & 5 combined 7 - 9 = future
③	Case Option Codes	**First digit:** 0 - 9, A - Z parallel code (See Parallel Codes table on page 5-6) **Second digit:** 0 - 9, B - F code
④	Software Code	Software code used for configuration change. "A" is standard
⑤	Hardware Code	Factory assembled for hardware of firmware mods

Ordering Note:

1. USB to I²C module order code 73-769-001.

Advanced Energy

MODEL NUMBERS

Case Size

Case	Maximum Output Power		Dimensions Inch (mm)	Connections
1-phase Input				
iVS1 - 9 Slots	90 - 264 Vac 1500 W	170 - 264 Vac 3210 W	5" x 5" x 11" (127 x 127 x 279.4)	Terminal-Block
iVS3 - 14 Slots	90 - 264 Vac 1800 W	170 - 264 Vac 4500 W	5" x 8" x 11" (127 x 203.2 x 279.4)	Terminal-Block
3-phase Input				
iVS6 - 9 Slots	NA	170 - 264 Vac 3210 W	5" x 5" x 11" (127 x 127 x 279.4)	Terminal-Block
iVS8 - 14 Slots	NA	170 - 264 Vac 4920 W	5" x 8" x 11" (127 x 203.2 x 279.4)	Terminal-Block
iVS8H - 14 Slots	342 - 396 Vac 4200 W	396 - 480 Vac 4920 W	5" x 8" x 11" (127 x 203.2 x 279.4)	Terminal-Block

Case Input Type

Terminal Block (T)

iVS1, iVS3   iVS6

iVS8, iVS8H
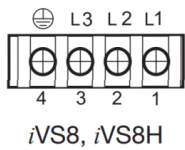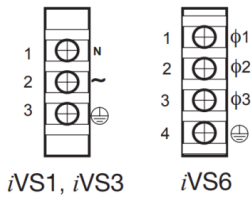
MODEL NUMBERS

Voltage Codes

Output Module Voltage/Current**											
Voltage	Voltage Code	Signal Output Module Code				Dual Output***		Triple Output			I²C Adjustment Ranges****
		1	2	3	5	4	4	-	-	-	
2.0	A	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	1.8 - 2.2
2.2	B	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	2.2 - 2.4
3.0	C	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	2.7 - 3.3
3.3	D	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	3.0 - 3.6
5.0	E	35 A	60 A	150 A	300 A	10 A	10 A	—	—	2 A	4.5 - 5.5
5.2	F	35 A	60 A	144 A	288 A	10 A	10 A	—	—	2 A	4.7 - 5.7
5.5	G	34 A	58 A	136 A	273 A	10 A	10 A	—	—	2 A	5.0 - 6.1
6.0	H	23 A	42 A	97.5 A	250 A	10 A*	10 A*	—	—	2 A	5.4 - 6.6
8.0	I	20 A	36 A	84.4 A	187.5 A	10 A	4 A	1 A	1 A	1 A	7.2 - 8.8
10.0	J	18 A	32 A	75 A	140 A	10 A	4 A	1 A	1 A	1 A	9.0 - 11.0
11.0	K	17 A	31 A	68 A	136.3 A	10 A	4 A	1 A	1 A	1 A	9.9 - 12.1
12.0	L	17 A	30 A	62.5 A	125 A	10 A	4 A	1 A	1 A	1 A	10.8 - 13.2
14.0	M	14 A	21 A	53.5 A	107 A	9 A	4 A	1 A	1 A	1 A	12.6 - 15.4
15.0	N	14 A	20 A	50 A	100 A	8 A	4 A	1 A	1 A	1 A	13.5 - 16.5
18.0	O	11 A	19 A	41.6 A	83.3 A	—	—	—	0.5 A	0.5 A	16.2 - 19.8
20.0	P	10.5 A	18 A	37.5 A	75 A	—	—	—	0.5 A	0.5 A	18.0 - 22.0
24.0	Q	8.5 A	15 A	30 A	62.5 A	4 A	2 A	—	0.5 A	0.5 A	21.6 - 26.4
28.0	R	6.7 A	11 A	26.8 A	53.5 A	3 A	2 A	—	0.5 A	0.5 A	25.2 - 30.8
30.0	S	6.5 A	11 A	25 A	50 A	—	—	—	—	—	27.0 - 33.0
33.0	T	6.2 A	10.9 A	22.7 A	35.8 A	—	—	—	—	—	29.7 - 36.3
36.0	U	5.8 A	10 A	20.8 A	35.8 A	—	—	—	—	—	32.4 - 39.6
42.0	V	4.2 A	7.5 A	16 A	35.7 A	—	—	—	—	—	37.8 - 46.2
48.0	W	4.0 A	7.5 A	15.6 A	31.2 A	—	—	—	—	—	43.2 - 52.8
54.0	X	3.7 A	6.0 A	13.9 A	27.7 A	—	—	—	—	—	48.6 - 59.4
60.0	Y	3.5 A	6.0 A	12.5 A	25 A	—	—	—	—	—	54.0 - 66.0
Contact Factory											
Special*	Z	35 A	60 A	150 A	300 A	—	10 A				2.3 - 2.6
Special*	Z	35 A	60 A	150 A	300 A	—	10 A				3.7 - 4.4
Special*	Z	20 A	36 A	80 A	140 A	—	8 A				6.7 - 7.1

Note:
*: Contact Factory for extended range down to 6 V.
**: Increments of current not shown can be achieved by paralleling modules (add currents of each module selected).
***: Total output power on dual model must not exceed 144 W.
****: For single output modules only. Green reference lines indicate physical module groupings.

MODEL NUMBERS

Parallel Codes (Case option code - first digit)

Parallel Code	Slot No.	iVS1, 6		iVS3, 8, 8H	
		Diagram	Possible Configurations	Diagram	Possible Configurations
1	1 & 2		210 210; 210 144; 144 144		210 210; 210 144; 144 144
2	2 & 3		360 360; 360 210; 360 144; + above		360 360; 360 210; 360 144; + above
3	3 & 4		750 360; 750 210; 750 144; 210 210; 210 144; 144 144		750 750; 750 360; 750 210; 750 144; 210 210; 210 144; 144 144
4	4 & 5		1500 210; 1500 144; 210 210; 210 144; 144 144; 360 210; 360 144		1500 1500; 1500 750; 1500 360; 1500 210; 1500 144; 210 210; 210 144; 144 144; 360 360; 360 210; 360 144
5	3, 4, & 5		750 210 210; 750 210 144; 750 144 144		750 210 210; 750 210 144; 750 144 144
6	iVS1,6: 4 & 6		1500 1500; 1500 750		
7	4, 5, & 6		1500 210 210; 1500 210 144; 1500 144 144		1500 210 210; 1500 210 144; 1500 144 144
8	iVS1, 6: 3 & 6 iVS3, 8: 4, 5, & 9		750 750		1500 1500 1500; 1500 1500 750; 1500 1500 360; 1500 1500 210; 1500 1500 144
9	iVS1,6: 1 & 6 iVS3, 8: 4, 5 & 9; 12 & 13		1500 1500; 1500 360; 1500 144		1500 1500 1500 360; 1500 1500 1500 210; 1500 1500 1500 144
A	VS1,6: 3 & 4; 8 & 9 iVS3, 8: 4 & 5; 11 & 12		750 210 & 750 210		1500 1500 & 750 750
C	iVS1,6: 3, 4 & 6 iVS3, 8: 6 & 7; 3, 4, 11 & 12		750, 360, 750		750 750 360 750 750
E	iVS1,6: 3, 4, 6; 8 & 9 iVS3, 8: 3, 4, 11, & 12		750, 360, 750, 210		750 750 750 750

MODEL NUMBERS

Parallel Codes Con`t (Case option code - first digit)

Parallel Code	Slot No.	iVS1, 6		iVS3, 8, 8H	
		Diagram	Possible Configurations	Diagram	Possible Configurations
F	iVS1,6: 7&8 iVS3, 8: 3 & 4; 11 & 12		360, 360		750 360 & 750 210; 750 750 & 750 750
G	iVS3, 8: 3,4 & 9				750 750 750
H	iVS3, 8: 11 & 12				750 750
J	iVS3, 8: 4 & 5; 9 & 10				1500 210 & 210 1500
K	iVS3, 8: 1 & 9; 5 & 12				1500 750 & 1500 750
L	iVS3, 8: 3 & 4; 7 & 8; 9 & 10				750 210 & 750 210 & 210 1500
M	iVS3, 8: 3, 4 & 9; 6 & 7				750 750 360 750
N	iVS3, 8: 4, 5 & 9; 12,13 & 14				1500, 1500, 1500, 210, 210
P	iVS3, 8: 1 & 9				1500, 750

MODEL NUMBERS

Air Flow Direction and Case option code

Second digit

0 = No options

1 = Reverse air

2 = Not used

3 = Global enable

4 = Fan idle with inhibit

5 = Opt 1 + Opt 3

6 = Opt 1 + Opt 4

7 = Opt 3 + Opt 4

8 = Opt 1 +3 +4

9 = RS485   73-544-001

B = USB   73-546-001

C = Opt 3 + Opt 9

D = CANBUS   73-544-004

E = Opt 3 + Opt D

F = RS485 - MODBUS 73-544-005

Reverse Airflow Direction

Normal Airflow Direction
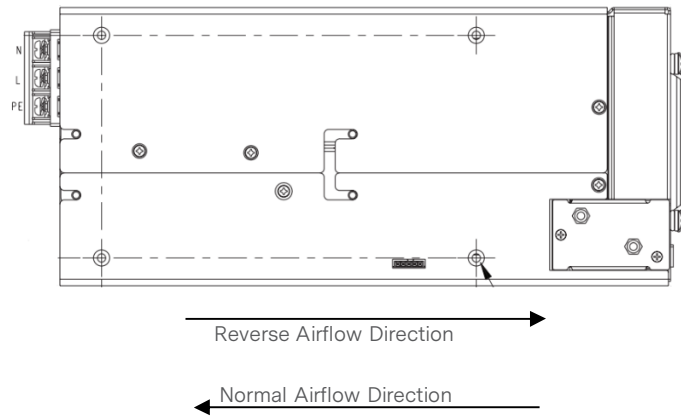
ELECTRICAL SPECIFICATIONS

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	**Models**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Input Voltage						
1-phase	iVS1 & iVS3	V_{IN}	90	-	264	Vac
3-phase	iVS6 & iVS8		170	-	264	Vac
3-phase	iVS8H		342	-	480	Vac
Maximum Output Power	iVS1	$P_{O,max}$	-	-	3210	W
	iVS3		-	-	4500	W
	iVS6		-	-	3210	W
	iVS8		-	-	4920	W
	iVS8H		-	-	4920	W
Isolation Voltage						
Input to outputs	iVS1, iVS3, iVS6, iVS8		-	-	4000	Vac
Input to safety ground			-	-	1500	Vac
Outputs to outputs			-	-	500	Vdc
Outputs to safety ground			-	-	500	Vdc
Isolation Voltage						
Input to outputs	iVS8H		-	-	4335	Vdc
Input to safety ground			-	-	4426	Vdc
Outputs to outputs			-	-	500	Vdc
Outputs to safety ground			-	-	500	Vdc
Ambient Operating Temperature						
Forward air	All models	T_A	-40	-	70[1]	°C
Reverse air	All models	T_A	-40	-	40	°C
Storage Temperature	All models	T_{STG}	-40	-	85	°C
Humidity (non-condensing)						
Operating	All models		10	-	95	%
Non-operating	All models		10	-	95	%
Altitude						
Operating	All models		-	-	10000	feet
Non-operating	All models		-	-	10000	feet

Note 1 - Derate each output 2.5% per degree from 50 °C to 70 °C. Cold start soak -20 °C, allow 10 minutes warm-up before all outputs are within specification. Reverse air to 40 °C maximum due to fan derating.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications						
Parameter	**Condition**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Operating Input Voltage, AC	iVS1, iVS3 iVS6, iVS8 iVS8H	$V_{IN,AC}$	90 170 342	115/230 - 380	264 264 480	Vac Vac Vac
Operating Input Voltage, DC[1]	iVS1, iVS3	$V_{IN,DC}$	120	-	300	Vdc
Maximum Input AC current	iVS1 iVS3 iVS6 iVS8 iVS8H	$I_{IN,AC}$	- - - - -	- - - - -	20 30 12 16 10	A A A A A
Input AC Frequency	All	$f_{IN,AC}$	47	50/60	63	Hz
Harmonic Line Currents	All	THD	Per EN61000-3-2			
Power Factor	$V_{IN,AC}$ = 115Vac $f_{IN,AC}$ = 47/63Hz I_O = $I_{O,max}$		-	0.99	-	
Inrush Current	$V_{IN,AC}$ = 264Vac		-	-	40	A_{PK}
Leakage Current to Earth Ground	iVS1, iVS3, iVS6, iVS8 $V_{IN,AC}$ = 240Vac $f_{IN,AC}$ = 47-63Hz		-	-	500	µA
	iVS8H $V_{IN,AC}$ = 480Vac $f_{IN,AC}$ = 60Hz		-	-	500	mA
PFC Switching Frequency	All	$f_{SW,PFC}$	400	-	600	KHz
Operating Efficiency @ 25 °C	I_O = $I_{O,max}$ $V_{IN,AC}$ = 180Vac to 264Vac	η	-	85	-	%
Global Inhibit/Enable			TTL, Logic "1" and Logic "0"			

Note 1 - Limited to 300 Vdc in medical applications.

ELECTRICAL SPECIFICATIONS

Single Output Module Specifications

Table 3. Single Output Module Specifications:						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	$\pm\%V_O$	-	1	-	%
Output Regulation	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	5	%
Output Voltage Adjustment Range[1]	All	$\pm\%V_O$	10	-	-	%
Margining	Single Output Module Only	$\pm\%V_O$	4	-	6	%
Output Ripple, pk-pk[2]	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	$\%V_O$	-	-	1	%
V_O Current Share Accuracy	50% to 100% $I_{O,max}$	$\%I_{O,max}$	-	-	5	%
V_O Minimum Current Share Loading		$\%I_{O,max}$	20	-	-	%
V_O Dynamic Response Peak Deviation[3] Settling Time	25% load change, slew rate = 1 A/ms	$\pm\%V_O$ t_s	- -	- -	2 300	% mSec
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.1	%

Note 1 - Full module adjustment range using I^{2}C, please refer to page 4.
Note 2 - 1% or 50 mV which is greater.
Note 3 - 2% or 100 mV which is greater, 5% for 1500W module.

ELECTRICAL SPECIFICATIONS

Dual Output Module Specifications

Table 4. Dual Output Module Specifications:						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	$\pm\%V_O$	-	1	-	%
Output Regulation[1]	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	0.4	%
Output Voltage Adjustment Range[2]	All	$\pm\%V_O$	10	-	-	%
Output Ripple, pk-pk[3]	Measure with a 0.1µF ceramic capacitor in parallel with a 10µF tantalum capacitor, 0 to 20MHz bandwidth	$\%V_O$	-	-	1	%
V_O Current Share Accuracy	50% to 100% $I_{O,max}$	$\%I_{O,max}$	-	-	5	%
V_O Dynamic Response Peak Deviation[4] Settling Time	30% load change, slew rate = 1 A/ms	$\pm\%V_O$ t_s	- -	- -	2 300	% mSec
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.1	%

Note 1 - 0.4% or 21 mV which is greater.
Note 2 - Full module adjustment range using I^{2}C, please refer to page 4.
Note 3 - 1% or 50 mV which is greater.
Note 4 - 2% or 100 mV which is greater.

ELECTRICAL SPECIFICATIONS

Triple Output Module Specifications

Table 5. Triple Output Module Specifications:						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Factory Set Point Accuracy	All	$\pm\%V_O$	-	1	-	%
Output Regulation	Inclusive of line, load, temperature change and warm-up drift	$\pm\%V_O$	-	-	4	%
Output Voltage Adjustment Range[1]	All	$\pm\%V_O$	10	-	-	%
Output Ripple, pk-pk[2]	Measure with a 0.1 µF ceramic capacitor in parallel with a 10 µF tantalum capacitor, 0 to 20 MHz bandwidth	$\%V_O$	-	-	1	%
V_O Dynamic Response Peak Deviation[3] Settling Time	30% load change, slew rate = 1 A/ms	$\pm\%V_O$ t_s	- -	- -	2 300	% mSec
V_O Long Term Stability Max change over 24 hours	After thermal equilibrium (30 mins)	$\pm\%V_O$	-	-	0.1	%

Note 1 - Full module adjustment range using I²C, please refer to page 4.
Note 2 - 1% or 50 mV which is greater.
Note 3 - 2% or 100 mV which is greater.

ELECTRICAL SPECIFICATIONS

System Timing Specifications

Table 6. System Timing Specifications					
Label	Parameter	Min	Typ	Max	Unit
T1	Delay from AC being applied to V_{SB} being within regulation.	-	-	1000	mSec
T2	Delay from AC being applied to all output voltages being within regulation.	-	-	2000	mSec
T3	Rise up time from main output from 10% to 90% of normal output voltage.	-	-	50	mSec
T4	Delay from output voltages within regulation limits to Global DC OK asserted high.	10	-	1000	mSec
T5	Delay from loss of AC input to main output drop to 90% normal output voltage (Hold up time).	15	-	-	mSec
T6	Delay from Global DCOK being asserted low to main output drop to 90% normal output voltage.	-	-	150	mSec
T7	Duration of Global DCOK being asserted low in the state during an off/on cycle using AC.	21	-	-	mSec
T8	Delay from Global Inhibit asserted High to Global DCOK asserted low.	20	-	-	mSec

ELECTRICAL SPECIFICATIONS

System Timing Diagram
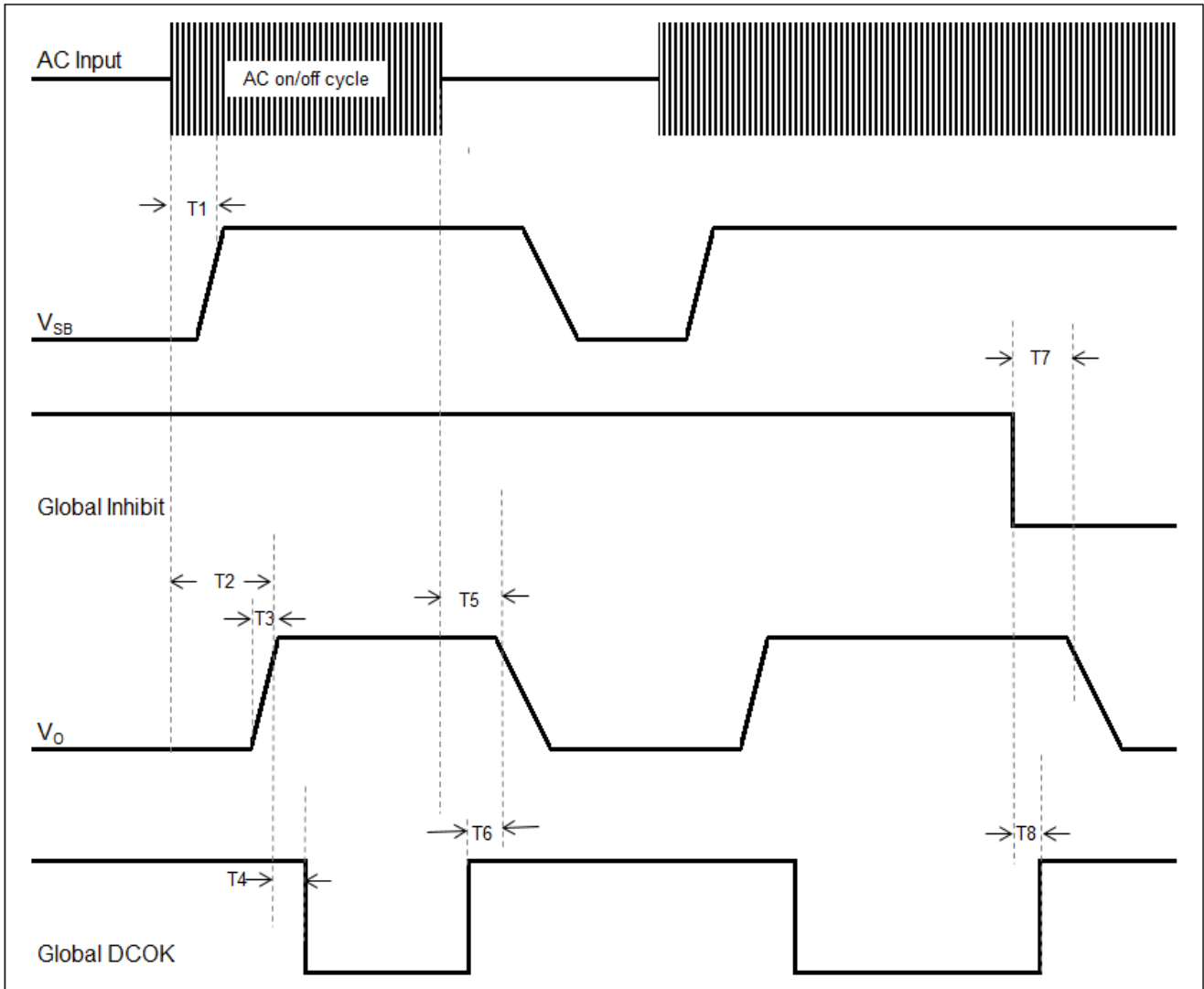
ELECTRICAL SPECIFICATIONS

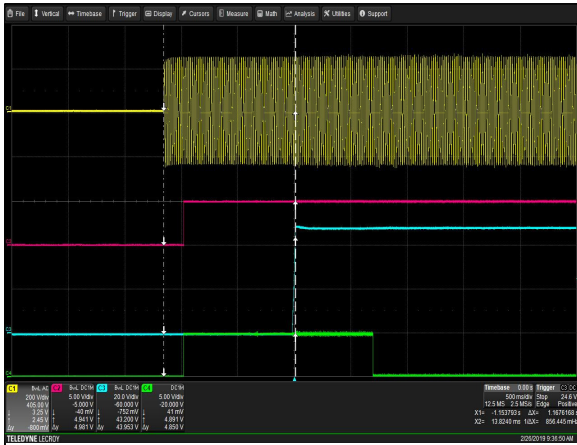## iVS1 Case Performance Curves
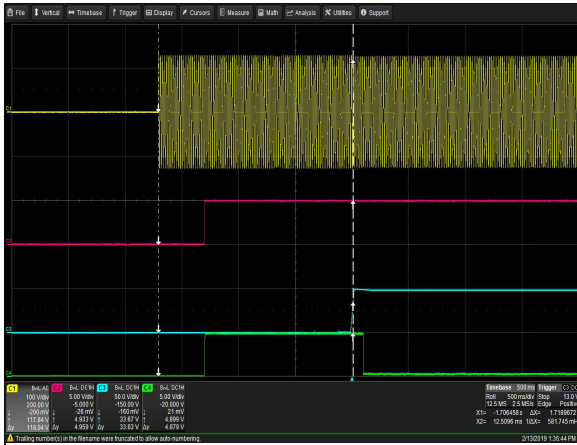
Figure 1: iVS1-3W0-3W0-1W0-70-A Turn-on delay via AC mains
Vin = 90Vac   Load: I_O = 31.25A I_{SB} = 1A
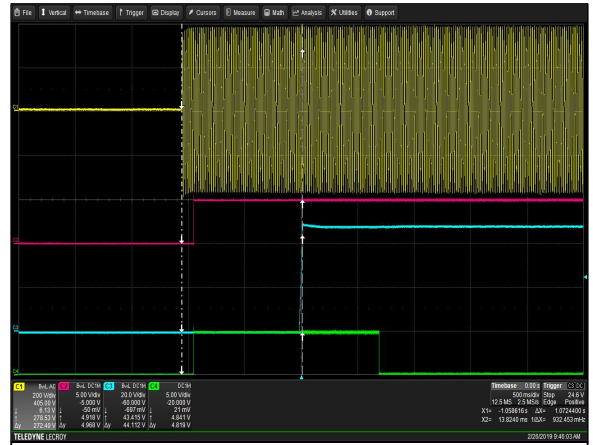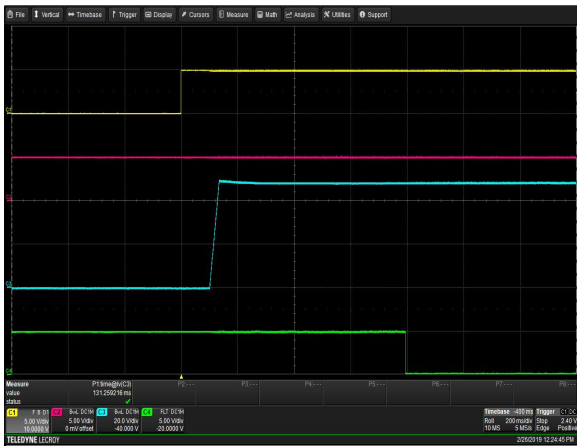Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK
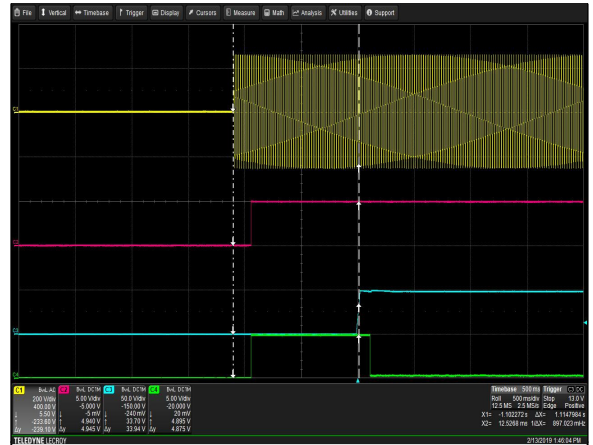
Figure 2: iVS1-3W0-3W0-1W0-70-A Turn-on delay via AC mains
Vin = 180Vac   Load: I_O = 66.88A I_{SB} = 1A
Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

Figure 3: iVS1-3W0-3W0-1W0-70-A Turn-on Delay via Global Inhibit
Vin = 90Vac   Load: I_O = 31.25A I_{SB} = 1A
Ch 1: Global Inhibit   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

Figure 4: iVS1-3W0-3W0-1W0-70-A Turn-on Delay via Global Inhibit
Vin = 180Vac   Load: I_O = 66.88A I_{SB} = 1A
Ch 1: Global Inhibit   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK
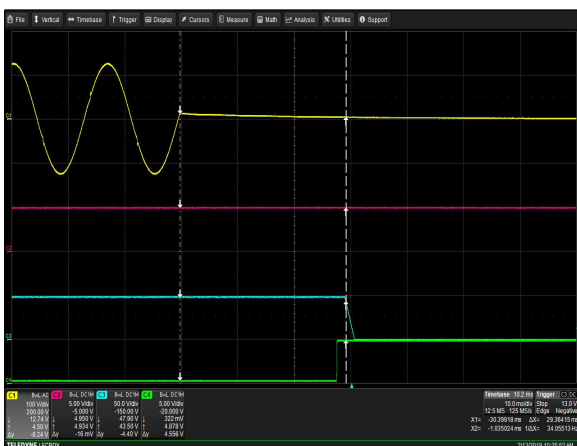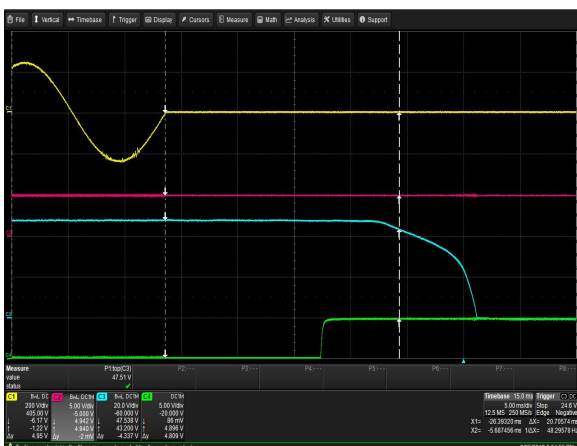

Figure 5: iVS1-3W0-3W0-1W0-70-A Hold-up Time
Vin = 90Vac   Load: I_O = 31.25A I_{SB} = 1A
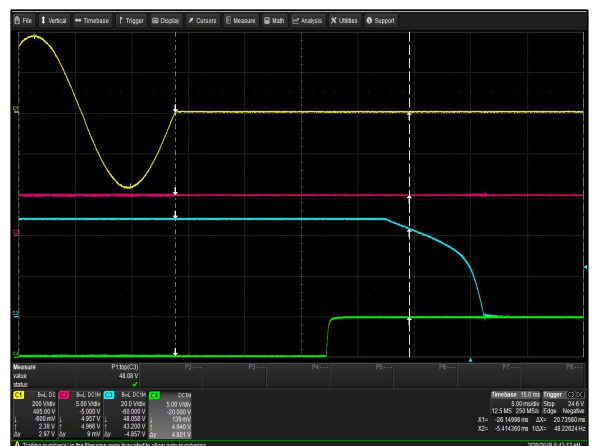Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK
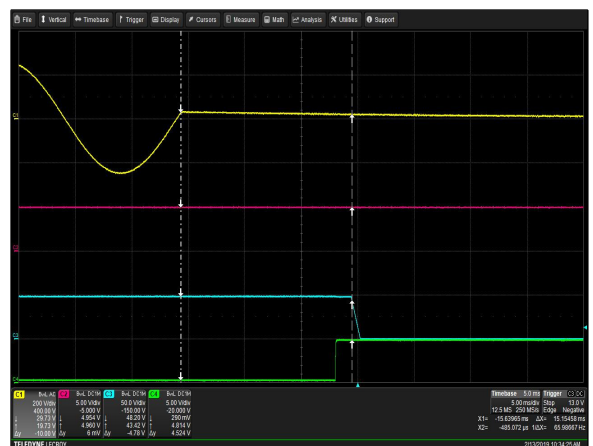
Figure 6: iVS1-3W0-3W0-1W0-70-A Hold-up Time
Vin = 180Vac   Load: I_O = 66.88A I_{SB} = 1A
Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

ELECTRICAL SPECIFICATIONS

iVS1 Case Performance Curves
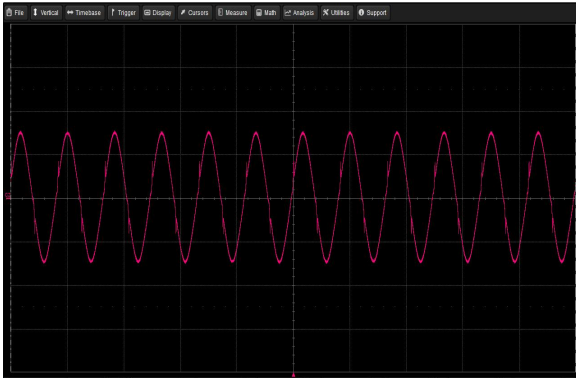
Figure 7: iVS1-3W0-3W0-1W0-70-A Input Current Waveform
Vin = 90Vac   Load: I_O = 31.25A
Ch 2: I_{IN}
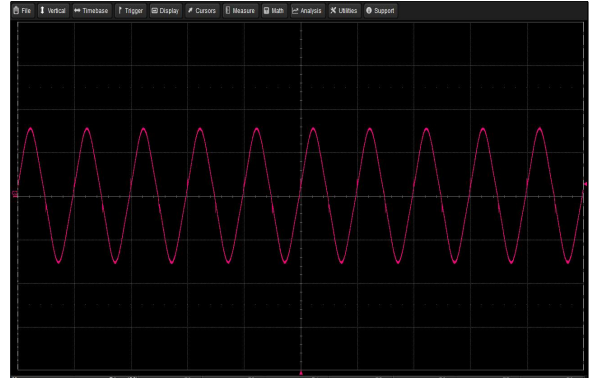
Figure 8: iVS1-3W0-3W0-1W0-70-A Input Current Waveform
Vin = 180Vac   Load: I_O = 66.8A I_{SB} = 1A
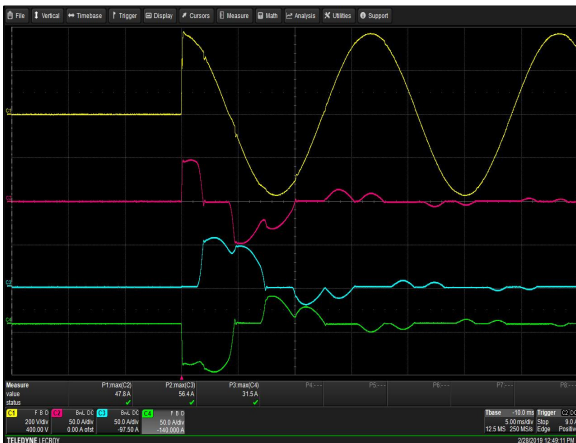Ch 2: I_{IN}
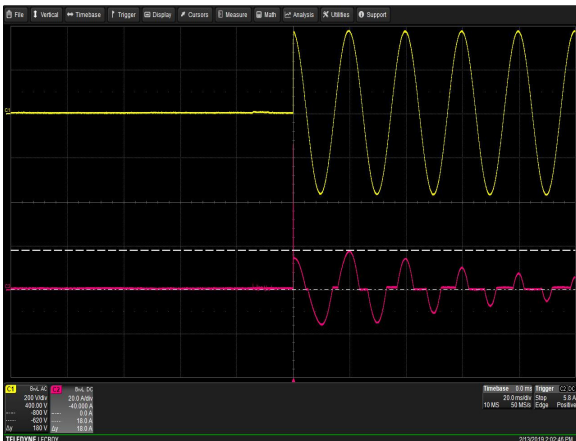
Figure 9: iVS1-3W0-3W0-1W0-70-A Start up Inrush Current
Vin = 264Vac   Load: I_O = 0A I_{SB} = 0A   Turn On Phase = 90°
Ch 1: V_{IN} Ch 2: I_{IN}
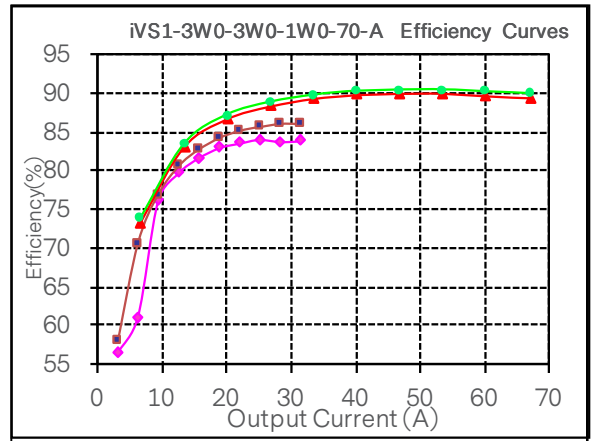
Figure 10: iVS1-3W0-3W0-1W0-70-A Efficiency Curves @ 25 degC
----- 90 Vac   ----- 115 Vac   ----- 230 Vac   ----- 264 Vac
Loading: I_O = 10% increment to 66.88 A, I_{SB} = 0 A

Advanced Energy

ELECTRICAL SPECIFICATIONS

iVS6 Case Performance Curves

Figure 11:   iVS6-3W0-3W0-1W0-70-A Turn-on delay via AC mains

Vin = 170Vac   Load: I_O = 66.5A I_{SB} = 1A

Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

Figure 12:   iVS6-3W0-3W0-1W0-70-A Turn-on delay via AC mains

Vin = 264Vac   Load: I_O = 66.5A I_{SB} = 1A

Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

Figure 13:   iVS6-3W0-3W0-1W0-70-A Turn-on Delay via Global Inhibit

Vin = 170Vac   Load: I_O = 66.5A I_{SB} = 1A

Ch 1: Global Inhibit   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

Figure 14:   iVS6-3W0-3W0-1W0-70-A Turn-on Delay via Global Inhibit

Vin = 264Vac   Load: I_O = 66.5A I_{SB} = 1A

Ch 1: Global Inhibit   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

Figure 15:   iVS6-3W0-3W0-1W0-70-A Hold-up Time

Vin = 170Vac   Load: I_O = 66.5A I_{SB} = 1A

Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

Figure 16:   iVS6-3W0-3W0-1W0-70-A Hold-up Time

Vin = 264Vac   Load: I_O = 66.5A I_{SB} = 1A

Ch 1: AC Mains   Ch 2: V_{SB} Ch 3: V_O Ch 4: Global DCOK

ELECTRICAL SPECIFICATIONS

iVS6 Case Performance Curves

Figure 17:   iVS6-3W0-3W0-1W0-70-A Input Current Waveform

Vin = 170Vac   Load: I_O = 66.5A

Ch 1: I_{IN}L1   Ch 2: I_{IN}L2   Ch 3: I_{IN}L3
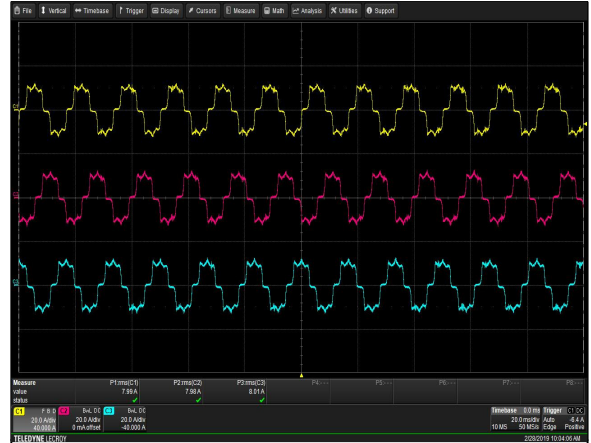
Figure 18:   iVS6-3W0-3W0-1W0-70-A Input Current Waveform

Vin = 180Vac   Load: I_O = 66.5A

Ch 1: I_{IN}L1   Ch 2: I_{IN}L2   Ch 3: I_{IN}L3

Figure 19:   iVS6-3W0-3W0-1W0-70-A Start up Inrush Current

Vin = 264Vac   Load: I_O = 0A I_{SB} = 0A   Turn On Phase = 90°

Ch 1: V_{IN} Ch 2: I_{IN}L1   Ch 3: I_{IN}L2   Ch 4: I_{IN}L3
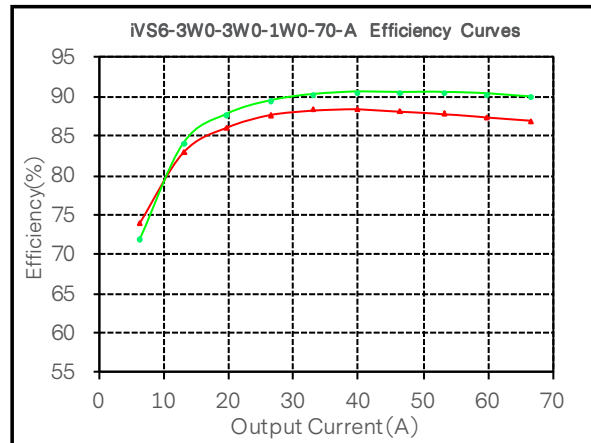
Figure 20: iVS6-3W0-3W0-1W0-70-A Efficiency Curves @ 25 degC
          ----- 170 Vac   ----- 264 Vac

Loading: I_O = 10% increment to 66.5 A, I_{SB} = 0 A

ELECTRICAL SPECIFICATIONS

Protection Function Specifications

Input Fuse

The iVS1 is equipped with an internal non user serviceable 30A 250Vac fast acting fuses for fault protection in both the L and N input.

The iVS3 is equipped with an internal non user serviceable 40A 300Vac fast acting fuses for fault protection in both the L and N input.

The iVS6 is equipped with an internal non user serviceable 16A 250Vac fast acting fuses for fault protection in both the L1, L2 and L3 lines input.

The iVS8 is equipped with an internal non user serviceable 25A 250Vac fast acting fuses for fault protection in both the L1, L2 and L3 lines input.

The iVS8H is equipped with an internal non user serviceable 10A 500Vac fast acting fuses for fault protection in both the L1, L2 and L3 lines input.

Over Voltage Protection (OVP)

The power supply latches off during output overvoltage with the AC line recycled to reset the latch.

Parameter	Output Voltage	Min	Nom	Max	Unit
Single Output Module OVP	2 - 5.5 V 6 - 60 V	122 110	- -	134 120	$\%V_O$
Dual Output Module OVP	2 - 6 V 8 - 28 V	122 110	- -	134 120	$\%V_O$
Triple Output Module OVP	All	110	-	120	$\%V_{O,max}$

Over Current Protection (OCP)

The iVS series power supply includes internal current limit circuitry to prevent damage in the event of overload or short circuit. Recovery is automatic when the overload is removed. The customer could set the OCP mode to foldback (default setting) or constant current or shut down (1500 W module only).

Parameter	Min	Nom	Max	Unit
Single Output Module OCP	105	-	120	$\%I_O$
Dual Output Module OCP Main output of dual output module Aux output of dual output module	 105 105	 - -	 120 140	 $\%I_O$ $\%I_O$
Triple Output Module OCP	105	-	130	$\%I_O$

ELECTRICAL SPECIFICATIONS

Short Circuit Protection (SCP)

The iVS series power supply will withstand a continuous short circuit with no permanent damage, applied to its main output during start-up or while running. A short is defined as impedance less than 0.1 ohm. Recovery is automatic upon removal of short.

Over Temperature Protection (OTP)

All outputs disabled when internal temp exceeds safe operating range. OTP trigger could be configured through iVS GUI and the OTP range could be set from 20 $^\circ$C to 125 $^\circ$C. An ACOK 5ms early warning signal is provided before the sync pulses go off. Recovery will be automatic.

MECHANICAL SPECIFICATIONS

iVS Case Mechanical Outlines (unit: mm)

iVS1 (1500/3210 Watts Max)

Case Size: iVS1: 5" x 5" x 11" (127 mm x 127 mm x 279.4 mm)

Weight: 6.2 lbs (2.81 Kg)
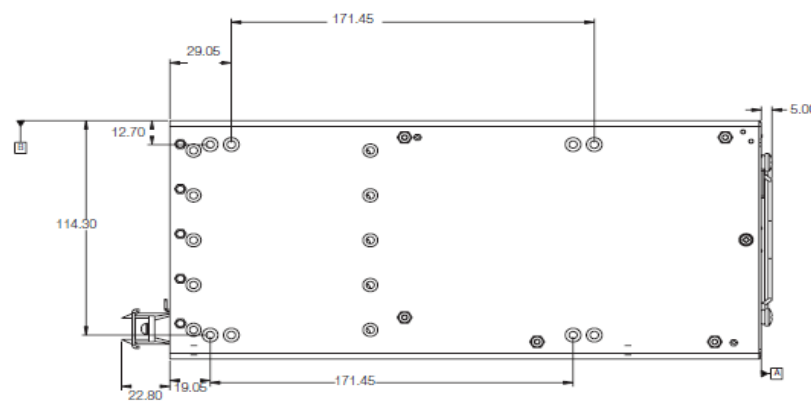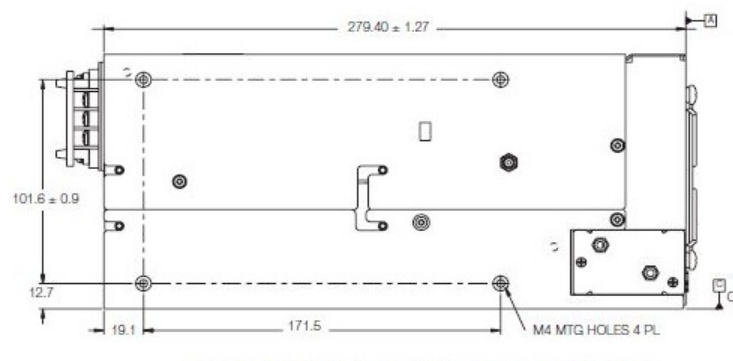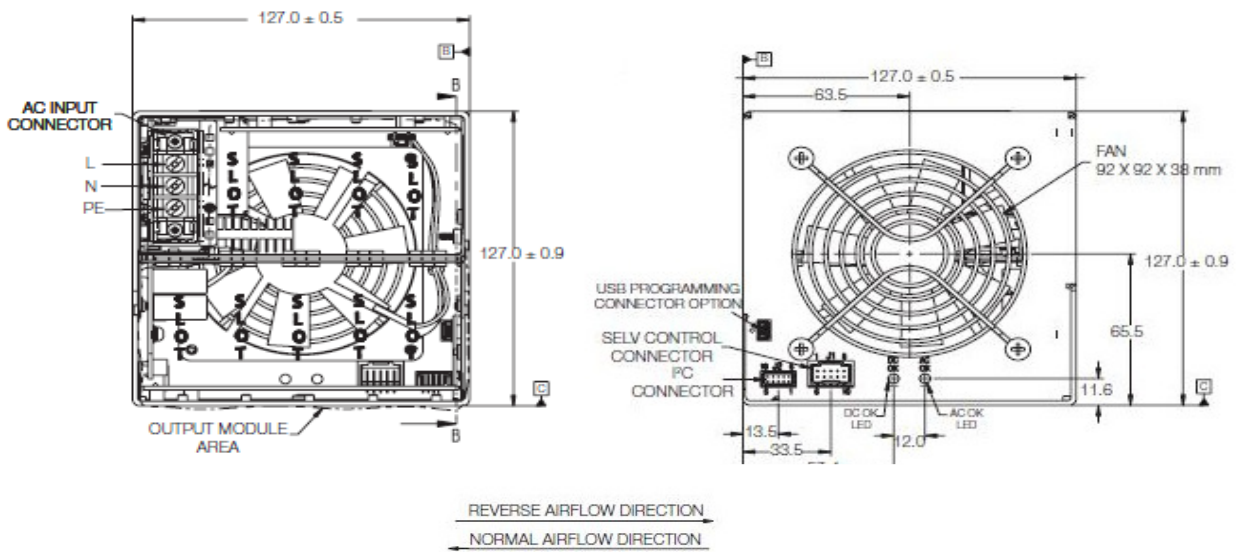
MECHANICAL SPECIFICATIONS

iVS Case Mechanical Outlines (unit: mm)

iVS3 (1800/4500 Watts Max)

Case Size: iVS3: 5" x 8" x 11" (127 mm x 203.2 mm x 279.4 mm)

Weight: 9.0 lbs (4.09 Kg)

REVERSE AIRFLOW DIRECTION

NORMAL AIRFLOW DIRECTION
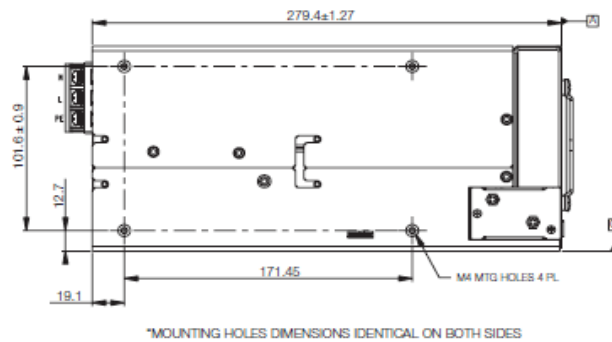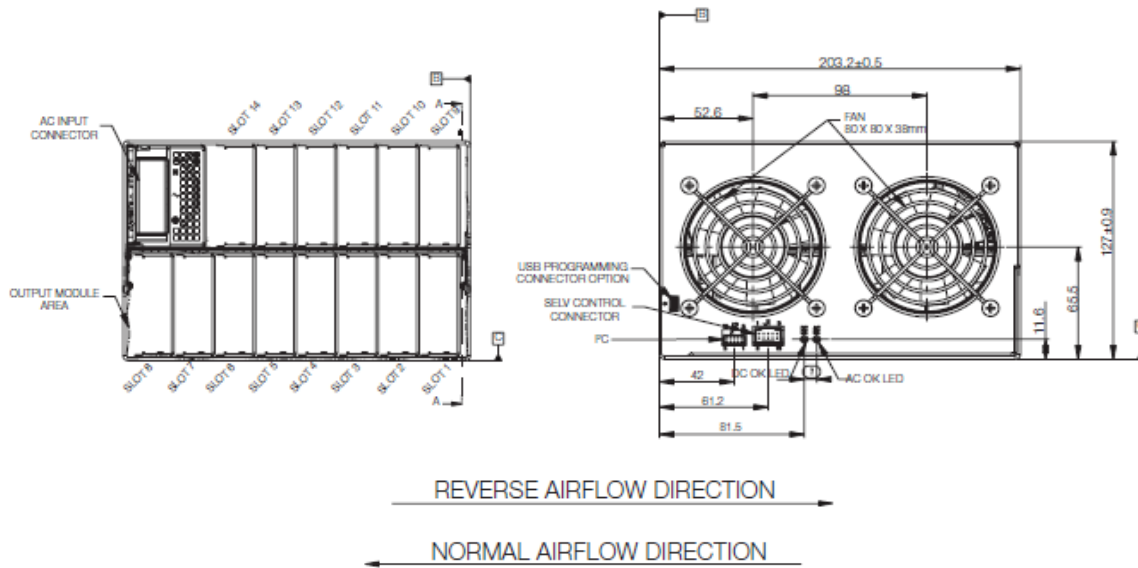
*MOUNTING HOLES DIMENSIONS IDENTICAL ON BOTH SIDES
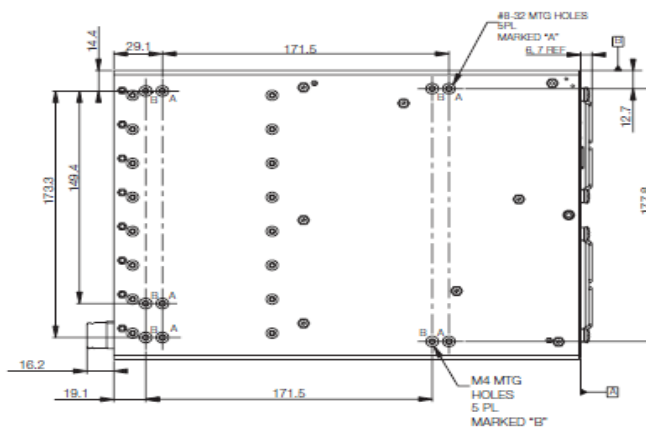
MECHANICAL SPECIFICATIONS

iVS Case Mechanical Outlines (unit: mm)

iVS6 (3210 Watts Max)

Case Size: iVS6: 5" x 5" x 11" (127 mm x 127 mm x 279.4 mm)

Weight: 6.0 lbs (2.72 Kg)
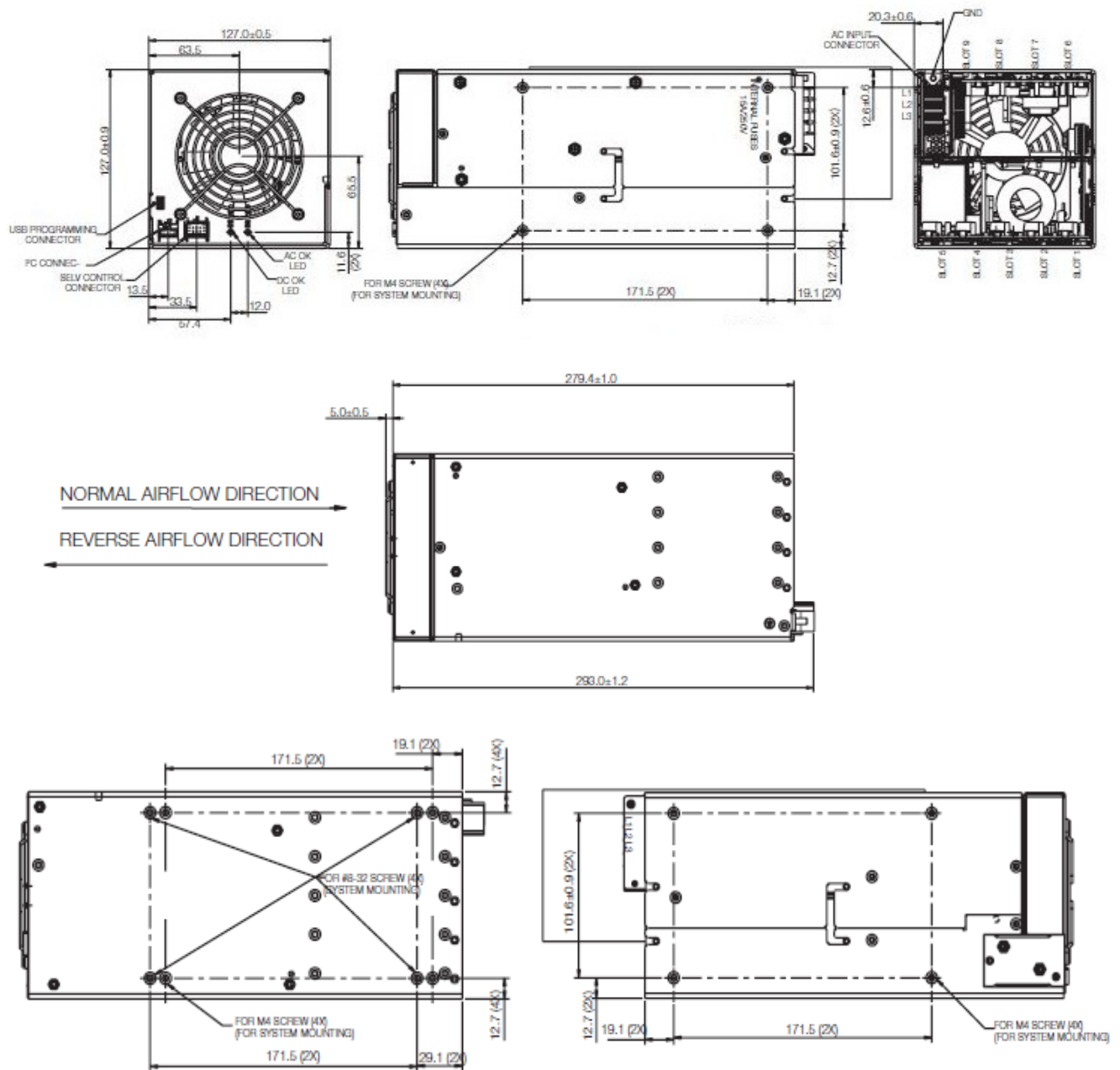
MECHANICAL SPECIFICATIONS

iVS Case Mechanical Outlines (unit: mm)

iVS8 (4920 Watts Max)

iVS8H (4920 Watts Max)

Case Size: iVS8: 5" x 8" x 11" (127 mm x 203.2 mm x 279.4 mm)

Weight: 9.0 lbs (4.09 Kg)

NORMAL AIRFLOW DIRECTION

REVERSE AIRFLOW DIRECTION
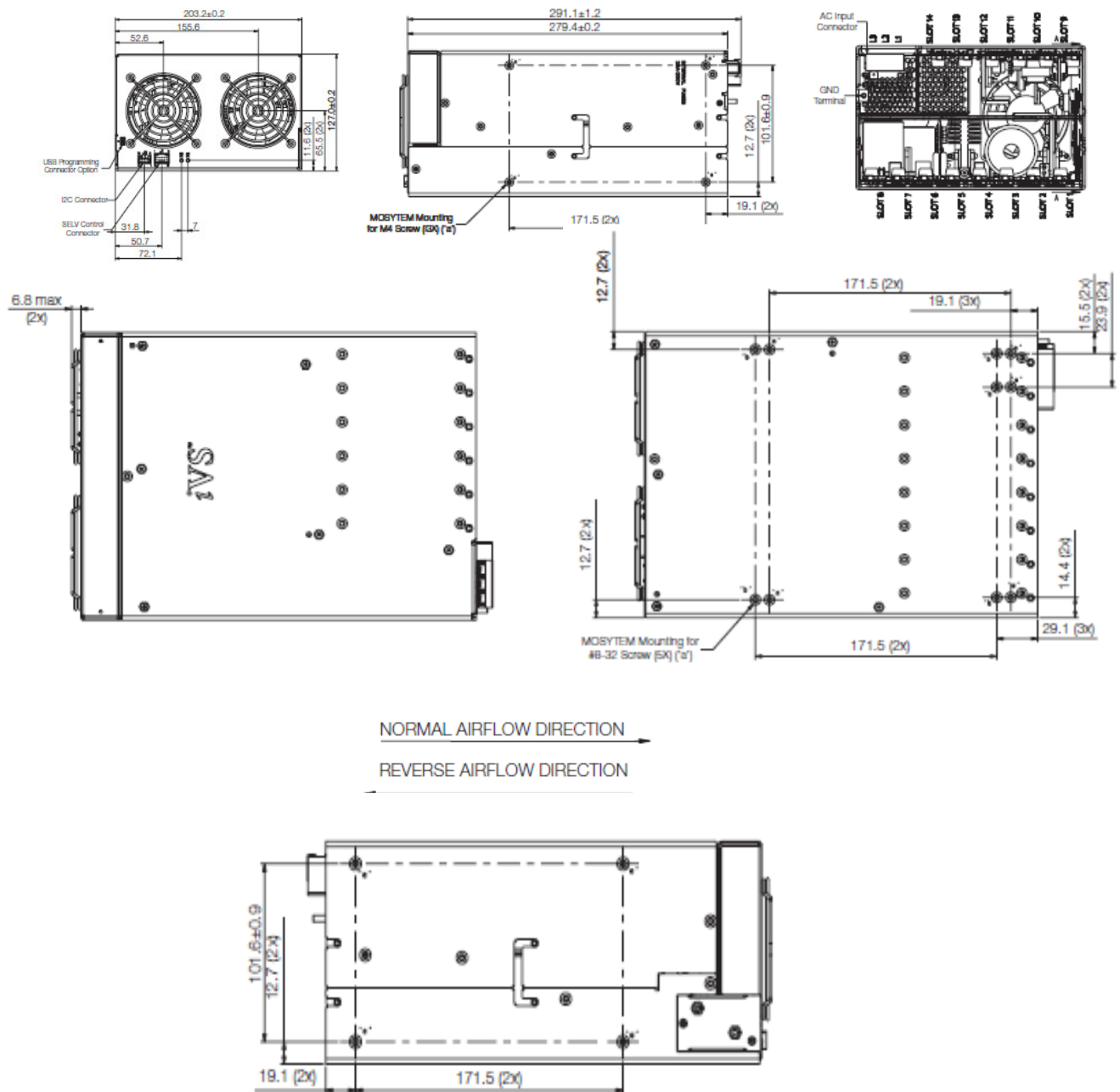
MECHANICAL SPECIFICATIONS

Single Output Module Mechanical Outlines (unit: mm)

210 Watts

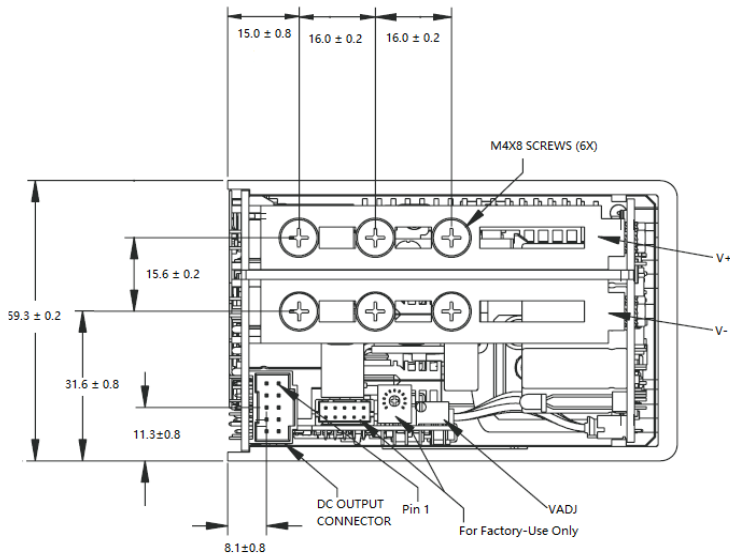Weight: 0.6 lb (0.27 Kg)
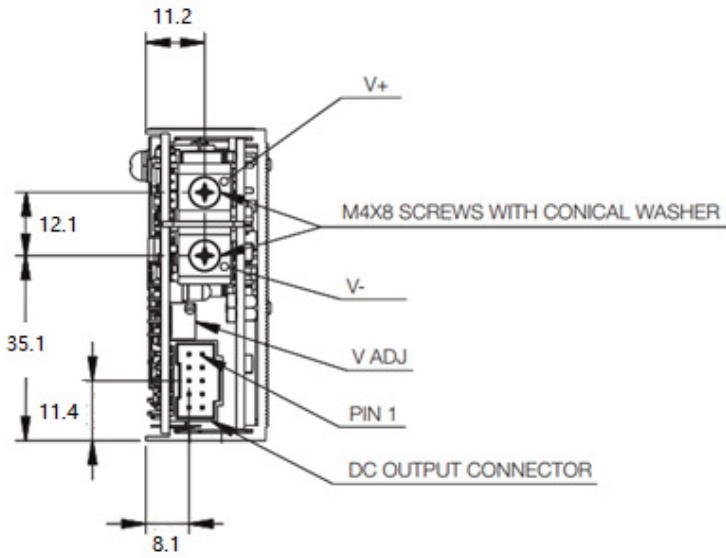
360 Watts

Weight: 1 lb (0.45 Kg)
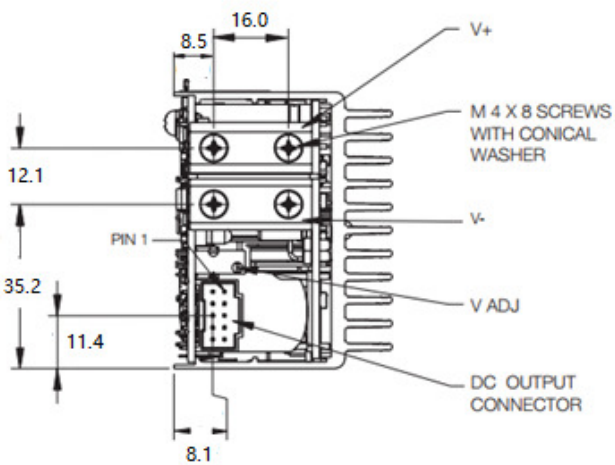
MECHANICAL SPECIFICATIONS

Single Output Module Mechanical Outlines (unit: mm)

750 Watts

Weight: 1.6 lb (0.73 Kg)
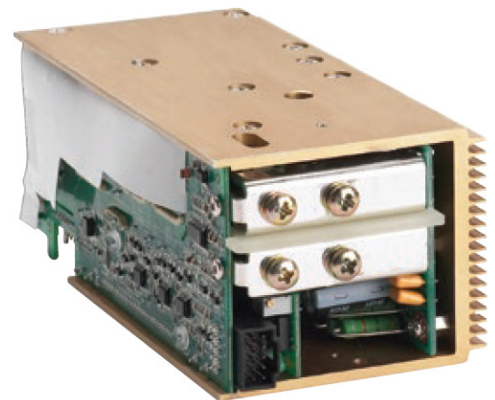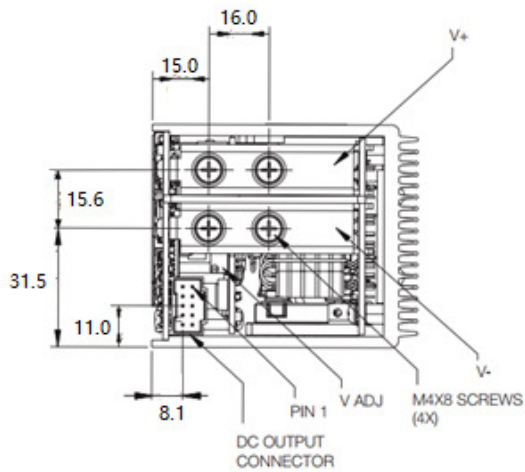
1500 Watts (2~8V)

Weight: 2 lb (0.91 Kg)
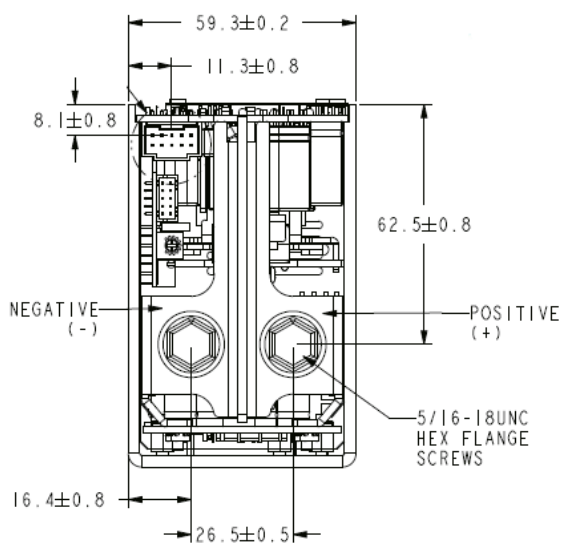
MECHANICAL SPECIFICATIONS

Single Output Module Mechanical Outlines (unit: mm)
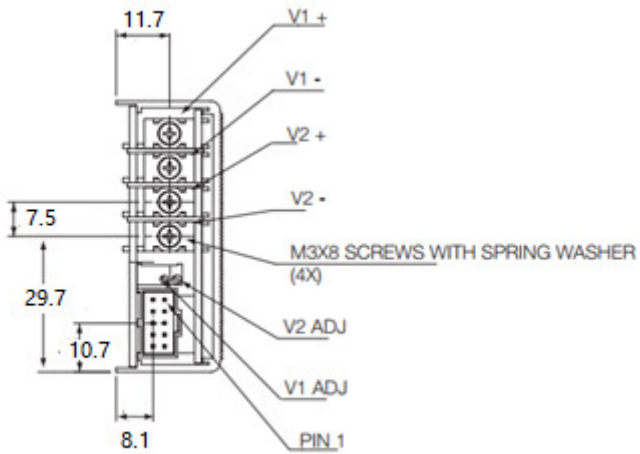
1500 Watts (10~60V)

Weight: 2 lb (0.91 Kg)

MECHANICAL SPECIFICATIONS

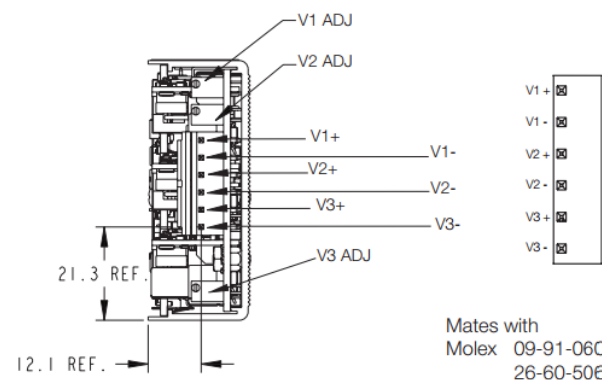## Dual Output Module Mechanical Outlines (unit: mm)

144 Watts

Weight: 0.6 lb (0.27 Kg)

Triple Output Module Mechanical Outlines (unit: mm)
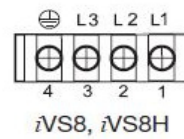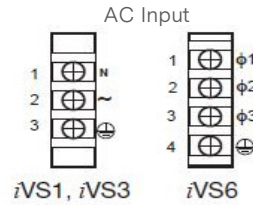
36 Watts

Weight: 0.42 lb (0.19 Kg)

# MECHANICAL SPECIFICATIONS

Connector Definitions - Case

AC Input Connector

	Single Phase	3 Phase
Pin 1 –	AC Neutral	Line 1
Pin 2 –	AC Line (hot)	Line 2
Pin 3 –	Chassis (earth) ground	Line 3
Pin 4 –	Not used	Chassis (earth) ground

AC Input

iVS1, iVS3   iVS6

L3 L2 L1
4 3 2 1

iVS8, iVS8H

PFC Input Connector - J1

Pin 1   – Input AC OK - "emitter"

Pin 2   – Input AC OK - "collector"

Pin 3   – Global DC OK - "emitter"

Pin 4   – Global DC OK - "collector"

Pin 5   – Spare

Pin 6   – Global inhibit/optional enable logic "1"

Pin 7   – Global inhibit/optional enable logic "0"

Pin 8   – Global inhibit/optional enable return

Pin 9   – +5VSB housekeeping

Pin 10 – +5VSB housekeeping return

Connector J1

1 ●●●●● 5
6 ●●●●● 10
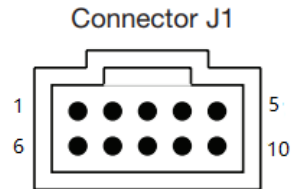
I^{2}C Bus Output Connector - J2

Pin 1   – No connection

Pin 2   – No connection

Pin 3   – No connection

Pin 4   – Serial clock signal (SCL)

Pin 5   – Serial data signal (SDA)

Pin 6   – Address bit 0 (A0)

Pin 7   – Address bit 1 (A1)

Pin 8   – Address bit 2 (A2)

Pin 9   – Secondary return (GND)

Pin 10 – 5 Vcc external bus (5 Vcc. Bus)

Connector J2

10   6
5   1

MECHANICAL SPECIFICATIONS

Connector Definitions - Single Output Module

J1 Control Connector

Pin 1   – + Remote Sense

Pin 2   – Remote Margin / V.Program

Pin 3   – Margin High

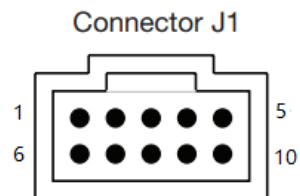Pin 4   – - Remote Sense / Margin Low

Pin 5   – Spare

Pin 6   – Module, Isolated Inhibit

Pin 7   – Module Inhibit Return

Pin 8   – Current Share (SWP)

Pin 9   – Spare

Pin 10 – Spare

Connector J1

1					5
6					10

Connector Definitions - Dual Output Module

J1 Control Connector

Pin 1   – + Remote Sense

Pin 2   – Spare

Pin 3   – Spare

Pin 4   – - Remote Sense

Pin 5   – Spare
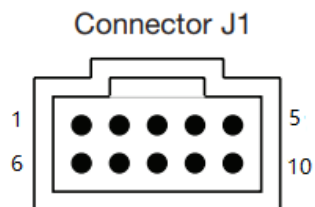
Pin 6   – Module, Isolated Inhibit

Pin 7   – Module Inhibit Return

Pin 8   – Current Share (Main output of Dual output)

Pin 9   – + Remote Sense V2

Pin 10 – - Remote Sense V2

Note: All iVS modules have a green DCOK LED. (except for 36W module)

Connector J1

1					5
6					10

MECHANICAL SPECIFICATIONS

Power / Signal Mating Connectors and Pin Types

Table 9. Mating Connectors for iVS (or equivalent)		
Reference		**Mating Connector or Equivalent**
AC Input Connector	Terminal Block	Molex 19324-0003 Ring lug
DC Output Connector	Single Output Module (210 W/360 W/750 W and 10.0 V~60.0 V/1500 W modules)	Molex 19141-0058 Spade lug
	Single Output Module (2.0 V~8.0 V /1500 W module)	Molex 19044-0168 Ring lug
	Dual Output Module	Molex 19324-0002 Ring lug
	Triple Output Module	Molex 09-91-0600 Housing Molex 26-60-5060 Pin
Case PFC Input Connector - J1		Molex 90142-0010 Housing Molex 90119-2110 Pin Artesyn Connector Kit Part No: 70-841-004
Case I^{2}C Bus Output Connector- J2		Landwin 2050S1000 Housing Landwin 2053T011V Pin or JST PHDR-10VS Housing JST SPHD-002T-P0.5 (28-24) JST SPHD-001T-P0.5 (26-22) Artesyn Connector Kit Part No: 70-841-023
Module Control Connector - J1		Molex 90142-0010 Housing Molex 90119-2110 Pin Artesyn Connector Kit Part No: 70-841-004

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

iVS series power supply is designed to meet the following EMC immunity specifications.

Table 7. Environmental Specifications	
Document	**Description**
FCC Part 15 Subpart J Class B/ EN55022, Level B (iVS1, iVS3, iVS6, iVS8) EN55022, Level A (iVS8H)	Conducted and Radiated EMI Limits
EN61000-3-2	Harmonics
EN61000-3-3	Voltage Fluctuations
EN 61000-4-2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Electrostatic discharge immunity test. +/-8KV air, +/-6KV contact discharge, performance Criteria B
EN 61000-4-4	Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity Test. 2KV for AC power port, 1.0KV for DC ports, I/O and signal ports performance Criteria B
EN 61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques – 2KV common mode and 1KV differential mode for AC ports and 0.5kV differential mode for DC power, I/O and signal ports, performance criteria B.
EN 61000-4-11	Electromagnetic Compatibility (EMC) - Testing and measurement techniques : Voltage Dips and Interruptions: 30% reduction for 500mS- Criteria B>95% reduction for 10mS, Criteria A, >95% reduction for 5000mS, Criteria C
EN55024	Information Technology Equipment-Immunity Characteristics, Limits and Method of Measurements

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The iVS series 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.

| Table 8. Safety Certifications for iVS Series Power Supply System		
Standard	**File #**	**Description**
UL 60950 2nd Edition	E186249-A155-UL-X3	US ITE Requirements
CSA 22.2 No. 60950-1-07 2nd Edition	2400643	Canadian ITE Requirements
IEC60950-1 2nd Edition CB Certificate	DK-44012-UL	International ITE Requirements
EN62368-1		International ITE Requirements
EN60601-1	211-400876-000	European Medical Requirements
IEC60601-1	SG-MD-00499	International Medical Requirements
ANSI/AAMI ES60601-1 (2005 + C1:09 + A2:10 + A1:12), CAN/CSA-C22.2 No. 60601-1 (2014)	E182560-V4-S6	US Medical Requirement
CE (LVD+RoHS), EN60950-1	16336	European Requirements
UKCA Mark		UK Requirements

ENVIRONMENTAL SPECIFICATIONS

EMI Emissions

The iVS series has been designed to comply with the Class B limits of EMI requirements of EN55022 (FCC Part 15) and CISPR 22 (EN55022) for emissions and relevant sections of EN61000 for immunity.

Conducted Emissions

The applicable standard for conducted emissions is EN55022 (FCC Part 15). Conducted noise can appear as both differential mode and common mode noise currents. Differential mode noise is measured between the two input lines, with the major components occurring at the supply fundamental switching frequency and its harmonics. Common mode noise, a contributor to both radiated emissions and input conducted emissions, is measured between the input lines and system ground and can be broadband in nature.
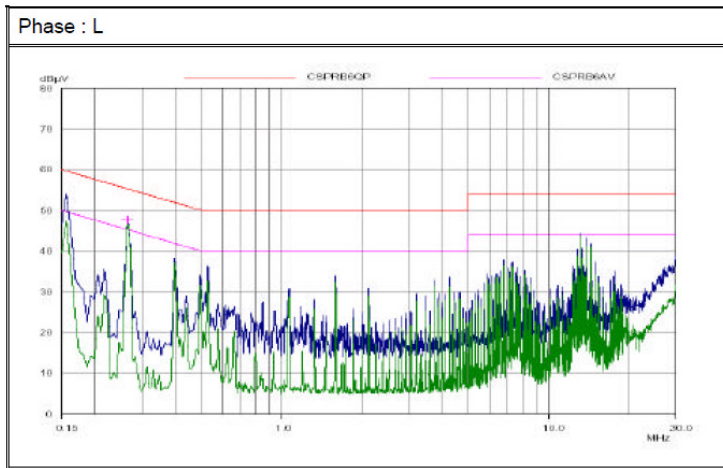
The iVS series power supply has internal EMI filters to ensure the convertors' conducted EMI levels comply with EN55022 (FCC Part 15) Class B limits. The EMI measurements are performed with resistive loads at maximum rated loading.

Sample of EN55022 Conducted EMI Measurement at 120Vac input and 1100W R-load.

Note: Pink Line refers to Artesyn Quasi Peak margin, which is 3dB below the CISPR international limit. Red Line refers to the Artesyn Average margin, which is 3dB below the CISPR international limit.

Conducted EMI emissions specifications of the iVS series:

Parameter	Model	Symbol	Min	Typ	Max	Unit
FCC Part 15, class B	All	Margin	3	-	-	dB
CISPR 32 (EN55022), class B	All	Margin	3	-	-	dB

Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. The shielding effect provided by the system enclosure may bring the EMI level from Class A to Class B. It is thus recommended that radiated EMI be evaluated in a system environment. The applicable standard is EN55022 Class B (FCC Part 15). Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55022 can be difficult, because the standard calls for 1m leads to be attached to the input and outputs and aligned such as to maximize the disturbance. In such a set-up, it is possible to form a perfect dipole antenna that very few ac-dc convertors could pass. However, the standard also states that 'an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature

The iVS series power supply will start-up at -20 ^{O}C and could operate from -40 ^{O}C to 50 ^{O}C with full load after 30 min warm up period. It could provide derated output power from 50 ^{O}C up to 70 ^{O}C ambient temperature, derate each output 2.5% per degree from 50 ^{O}C to 70 ^{O}C.

Forced Air Cooling

The iVS series power supply includes internal cooling fans as part of the power supply assembly to provide forced air-cooling to maintain and control temperature of devices and ambient temperature in the power supply to appropriate levels.

The fan noise is less than 65 dBA with 80% load @ 30 ^{O}C at nominal input voltage with Smart Fan algorithm to be optimized based on module and rack thermal sensors.

When modules are inhibited via software control, the fan is reduced to idle and acoustic noise is less than 46 dBA. When modules are off via front panel switch, fans are at idle for 1 min, and off for 9 min.

ENVIRONMENTAL SPECIFICATIONS

Storage and Shipping Temperature

The iVS series power supply can be stored or shipped at temperatures between -40 ^{O}C to +85 ^{O}C and relative humidity from 10% to 95% non-condensing.

Altitude

The iVS series power supply will operate within specifications at altitudes up to 10,000 feet above sea level. Linear to 50% output from 10,000 feet to 30,000 feet. The power supply will not be damaged when stored at altitudes of up to 30,000 feet above sea level.

Humidity

The iVS series power supply will operate within specifications when subjected to a relative humidity from 10% to 95% non-condensing. The iVS series power supply can be stored in a relative humidity from 10% to 95% non-condensing.

Vibration

The iVS series power supply will pass the following vibration specifications:

Non-Operating Random Vibration

Acceleration	6.07		gRMS
Frequency Range	10 - 2000		Hz
Duration	30		Mins
Direction	3 mutually perpendicular axis		
PSD Profile	FREQ (Hz)	SLOPE (db/oct)	PSD (g²/Hz)
	10	/	0.005
	20	/	0.01
	80	/	0.04
	350	/	0.04
	2000	/	0.007

Operating Random Vibration

Acceleration	4.22		gRMS
Frequency Range	10 - 500		Hz
Duration	30		Mins
Direction	3 mutually perpendicular axis		
PSD Profile	FREQ (Hz)	SLOPE (db/oct)	PSD (g²/Hz)
	10	/	0.002
	350	/	0.04
	500	/	0.0198

ENVIRONMENTAL SPECIFICATIONS

Shock

The iVS series power supply will pass the following vibration specifications:

Non-Operating Half-Sine Shock

Acceleration	30	G
Duration	26	mSec
Pulse	Trapezoidal	
Number of Shock	1 shocks in each of 6 faces	

Operating Half-Sine Shock

Acceleration	40	G
Duration	6	mSec
Pulse	Half-Sine	
Number of Shock	1 shocks in each of 6 faces	

POWER AND CONTROL SIGNAL DESCRIPTIONS

AC Input Connector

This connector supplies the AC Mains to the iVS series power supply.

	Single Phase	3-phase
Pin 1 –	AC Neutral	Line 1
Pin 2 –	AC Line (hot)	Line 2
Pin 3 –	Chassis (earth) ground	Line 3
Pin 4 –	Not used	Chassis (earth) ground
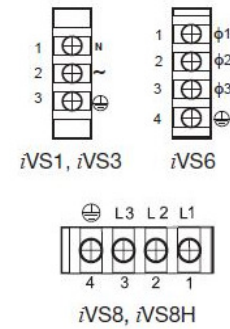
iVS Case - PFC Input Connector (J1)
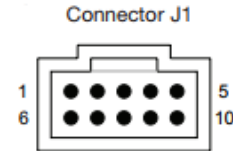
Input AC OK - "collector" / Input AC OK - "emitter"- (pins 1,2)

Input ACOK - "Collector" and Input ACOK - "Emitter" are output of an uncommitted bipolar junction transistor, there is an internal 470 ohm resistor in series with the collector of the transistor for current limiting. AC is OK when the transistor is On. AC is not OK when the transistor is Off. A green LED is provided in the iVS Case as visual indicator of the status of ACOK signal.

Sink Current: 50 mA max, 5 ms minimum warning time.

Recommended circuit configuration for AC_OK Signal:
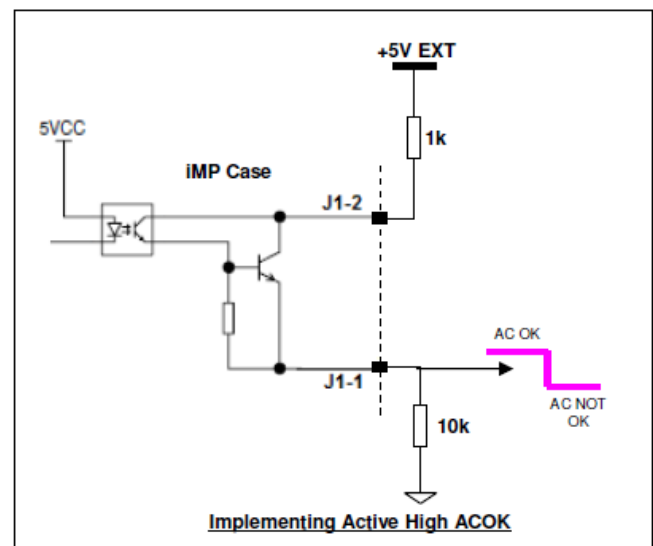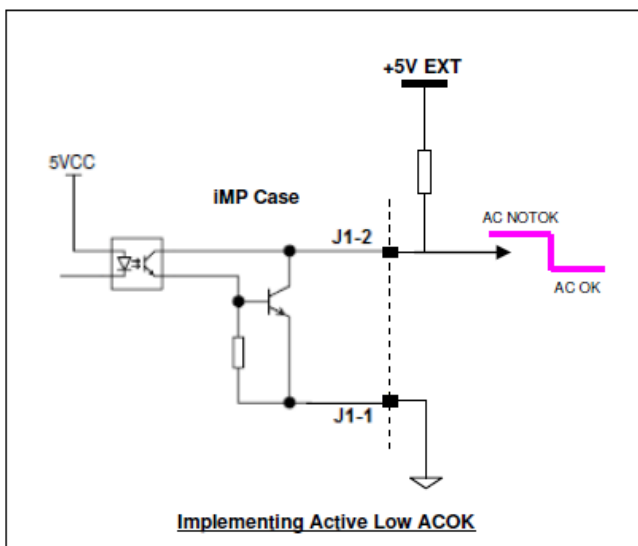
POWER AND CONTROL SIGNAL DESCRIPTIONS

Global DC OK - "collector" /Global DC OK - "emitter" - (pins 3,4)

DCOK - "Emitter" (pin 8) and DCOK - "Collector" (pin9) signal functions as DC OK signal. These signals are connected to an uncommitted transistor. When all modules outputs are OK, the transistor is On. When any output of modules is not OK, the transistor is Off. This isolated DC OK signal logic low level is < 1.1 V and logic high level > 4.7 V.

Max Sink current is 50 mA. Recommended supply voltage is 5 V.

Recommended circuit configuration for DC_OK Signal:
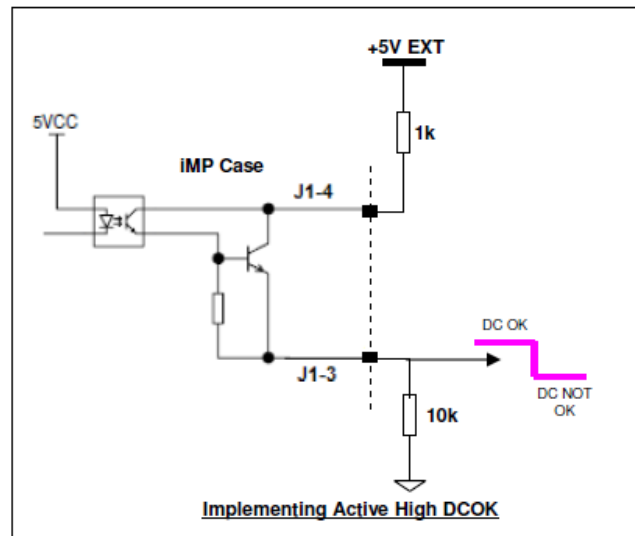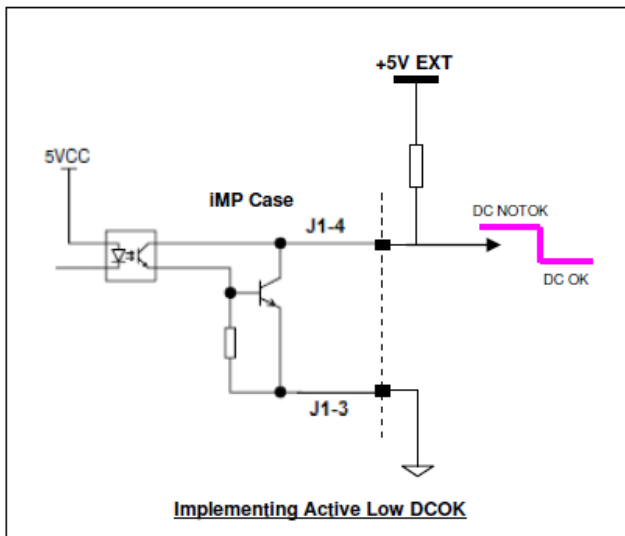
External Sync - (pin 5)

An input pin use used to synchronize connected DC-DC output modules for better EMI response, apply an external clock frequency of 500 kHz +/-20% (5 V amplitude) to synchronize connected DC-DC output modules. Since the switching frequency of the module will follow the sync signal frequency, this can be use to adjust the switching frequency of the modules within allowable range. Note the effective switching frequency in the module is half of the External Sync input frequency.

POWER AND CONTROL SIGNAL DESCRIPTIONS

Global inhibit/optional enable logic "0" (DEFAULT) - (pin 6)
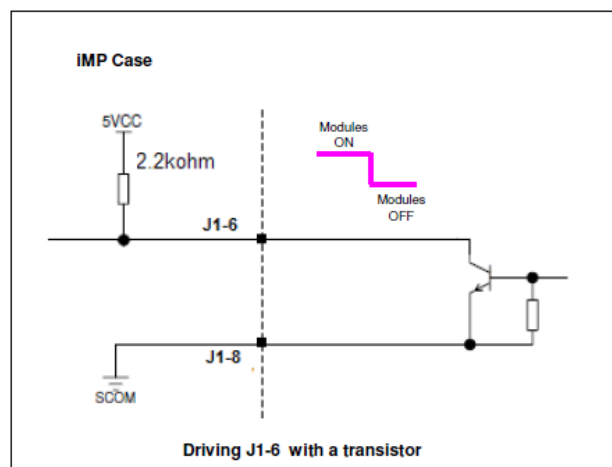
This signal is a TTL input to a microcontroller inside the iVS case, an internal 2.2 Kohm resistor is connected between this pin and internal 5 V supply to make the signal initially HIGH.

Enable Logic "0" (DEFAULT setting), active High is the default Logic when Global Enable Option is NOT selected.

ON except the modules set to Module Option code 1 'Module Enable mode'.

When pin is left open or pull HIGH (2 V - 5 V), the modules are ON and can be disable/enable by PMBus operation command. The Modules set to Module Option Code 1 'Module Enable mode' will remain OFF until enable by its Module Inhibit Pin.

When the pin is pull LOW (< 0.8 V) the modules will turn OFF, the PMBus OPERATION COMMAND alone cannot enable the modules.

Driving J1-6 with a transistor

The logic of the signal is reverse when Case Option Code 3 - 'Global Enable option' is selected'.

When the pin is left open or pull HIGH (2 V - 5 V), all the Modules are OFF, the PMBus OPERATION COMMAND alone cannot enable the modules.

When pin is pull LOW (< 0.8 V), the Modules are ON and can be disable/enable by PMBus OPERATION COMMAND. The Modules set to Module Option Code 1 'Module Enable mode' will remain OFF enable by its Module Inhibit pin.

Driving J1-6 with a transistor with Global Enable Option
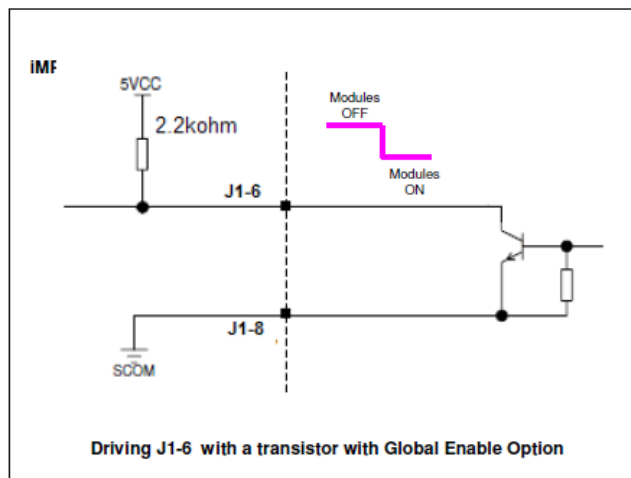
# POWER AND CONTROL SIGNAL DESCRIPTIONS

Global inhibit/optional enable logic "1" (DEFAULT) - (pin 7)

This pin is a TTL input to a microcontroller inside the iVS case, an internal 2.2 Kohm resistor is connected between this pin and ground to make the signal initially LOW.

Logic "1" (Default), active LOW is the default Logic when 'Global Enable Option' is NOT selected. Upon application of correct AC input all the modules are ON except the modules set to Module Option code 1 'Module Enable mode'.

When pin is left open or pull LOW (< 0.8 V), the modules are ON and can be disable/enable by PMBus operation command. The Modules set to Module Option Code 1 'Module Enable mode' will remain OFF until enable by its Module Inhibit pin.

When pin is pull HIGH (> 2 V- 5 V), the installed modules will turn OFF, the PMBus OPERATION Command alone cannot enable the modules. The 5V standby output can be used as external supply to drive pin 7.
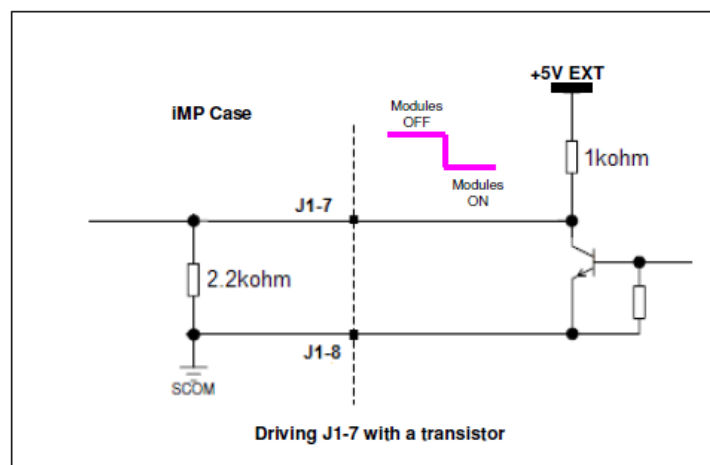

Driving J1-7 with a transistor

The logic of the signal is reverse when Case Option Code3 - 'Global Enable option' is selected.

When pin is left open or pull LOW (< 0.8 V) all the Modules are OFF, the PMBus OPERATION Command alone cannot enable the modules.

When pin is pull HIGH (> 2 V - 5 V), the Modules will turn ON and can be disable/enable by PMBus OPERATION COMMAND. The modules set to Module Option Code 1 'Module Enable mode' will remain OFF until enable by its Module Inhibit pin. The 5 V standby output can be used to drive this pin.

Note: pin 6 and pin 7 are independent signals, both signals must assume the correct logic levels to turn ON the modules.

Driving J1-7 with a transistor with Global Inhibit Option
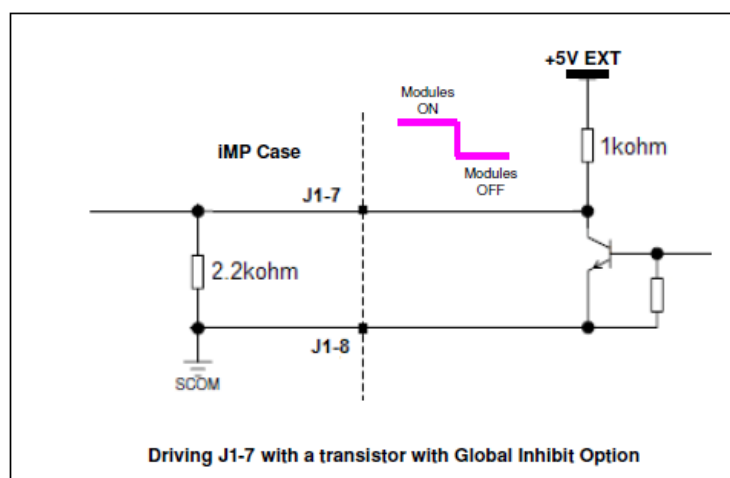
POWER AND CONTROL SIGNAL DESCRIPTIONS

Global inhibit/optional enable return - (pin 8)

Ground reference for Global Enable/Optional Enable. This pin is electrically connected to pin 10 - +5 VSB housekeeping return.

+5VSB housekeeping - (pin 9)

+5VSB housekeeping is the standby output of the power supply rated 5 V / 1 A. This output is available every time the input AC voltage to the power supply is within 85Vac - 264Vac. This output is not affected by Global Inhibit function.

+5VSB housekeeping return - (pin 10)

The ground reference of +5VSB housekeeping, this ground is not connected to the chassis of the power supply.

Mating connector to J1

Housing: 90142-0010 (Molex)

Pin: 90119-2110 (Molex)

Connector kit part number: 70-841-004

POWER AND CONTROL SIGNAL DESCRIPTIONS

iVS Case I²C Bus Signal Connector - J2

No Connection - (pins 1, 2, 3)

Serial clock signal (SCL) and Serial data signal (SDA) - (pins 4,5)

These are pins for I²C communication and must be pulled-up in the system by 1K ohm resistor to 5V Housekeeping; a current source pull-up can also be used. If multiple units are used inside a system, the 5V Housekeeping of each unit must be connected in parallel in the system, otherwise, the SCL and SDA bus will be pulled low by the unit without AC power.

Address bit 0 (A0) , Address bit 1 (A1), Address bit 2 (A2) - (pins 6,7,8)

Multiple configured iVS power supplies can be used in a single system, the power supplies can have parallel outputs or providing multiple outputs. The iVS CASE has three address pins allowing the system to assign different addresses to multiple PSUs used within the system. The I²C devices inside the iVS CASE are EEPROM to store FRU data and microcontroller for PMBus. Pull the address pin to Secondary Return (COM) to set the address to "0" or High (or open) to set it the address to "1".

Secondary return (GND) - (pin 9)

Ground Reference for the signals of J2 connector. This pin is electrical connected to +5VSB housekeeping return of J1 connector.

5 Vcc external bus (5 VCC. BUS) - (pin 10)

This pin is an input to the iVS Case, applying 5V to this signal will provide external power to the I²C devices - EEPROM and Microcontroller. The pin can be used to enable the I2C communication using external power supply and allow reading of manufacturing from a non-working PSU without powering the supply. Do not supply voltage > 5.5 V to prevent damaging the I²C devices.

POWER AND CONTROL SIGNAL DESCRIPTIONS

iVS Single Output Module Control Connector – J1

+ Remote Sense , - Remote Sense - (pin 1, 4)

Remote sense of the output modules use to compensate up to 500 mV of cable drop.

Connect the - Remote Sense and + Remote Sense to output 'V-' and 'V+' respectively at the point of load to compensate up to 500 mV of voltage drop along the power cables, note that compensating too much voltage drop can cause overvoltage and latch the output. Leaving the remote sense floating will not cause the module to malfunction.
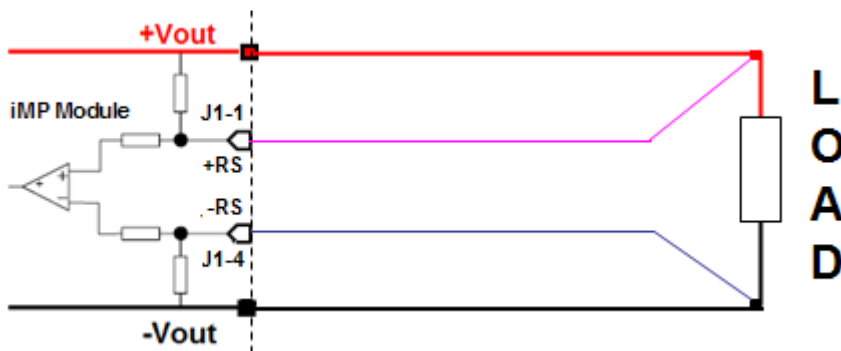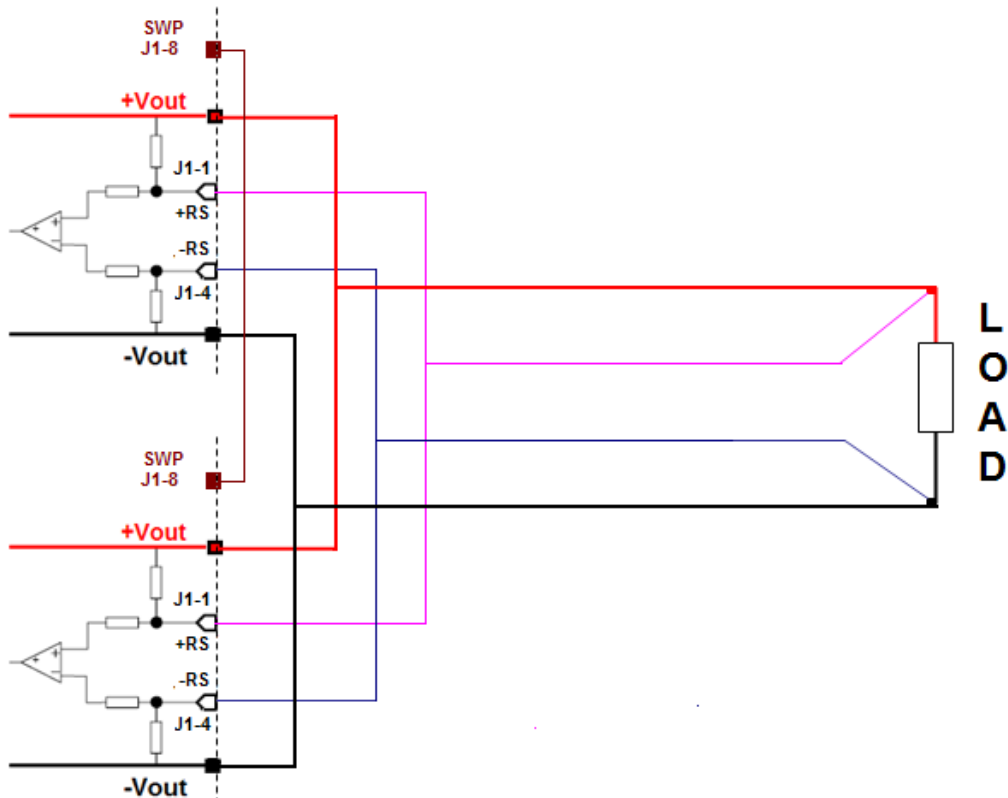
Figure 21. Typical implementation of remote sensing

Figure 22. Remote sensing with modules in parallel

POWER AND CONTROL SIGNAL DESCRIPTIONS

Remote Margin / V. Program, Margin High, Margin Low - (pin 2, 3, 4)

Used to remotely adjust the output voltage regulation by +/- 4% - 6%.

Connect Remote Margin (pin 2) to Margin High (pin 3) to increase output voltage by 4% - 6% of the rated output.

Connect Remote Margin (pin 2) to Margin Low (pin 4) to reduce the output voltage by 4% - 6%.
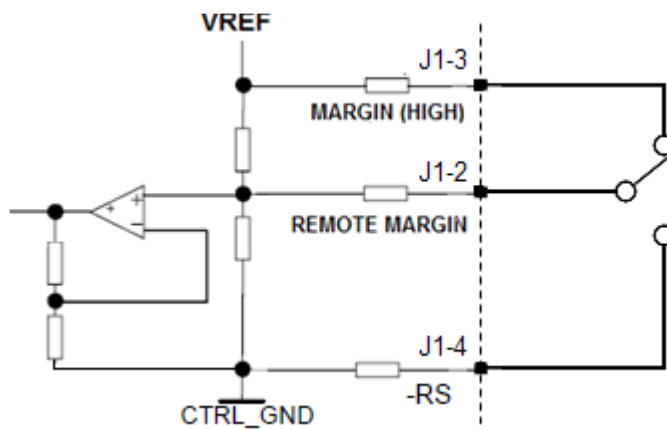

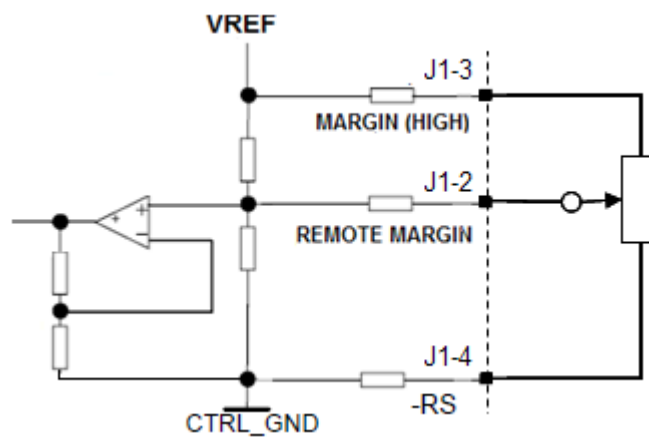Figure 23. Remote margining using Single Pole

Figure 24. Remote margining using a potentiometer

POWER AND CONTROL SIGNAL DESCRIPTIONS

Module, Isolated Inhibit, Module Inhibit Return - (pin 6, 7)

Module, Isolated Inhibit (pin 6) and Module Inhibit Return (pin 7) use to remotely enable/disable the module, apply 5V across the Module ISO Inhibit and Module Inhibit Return to disable the module.
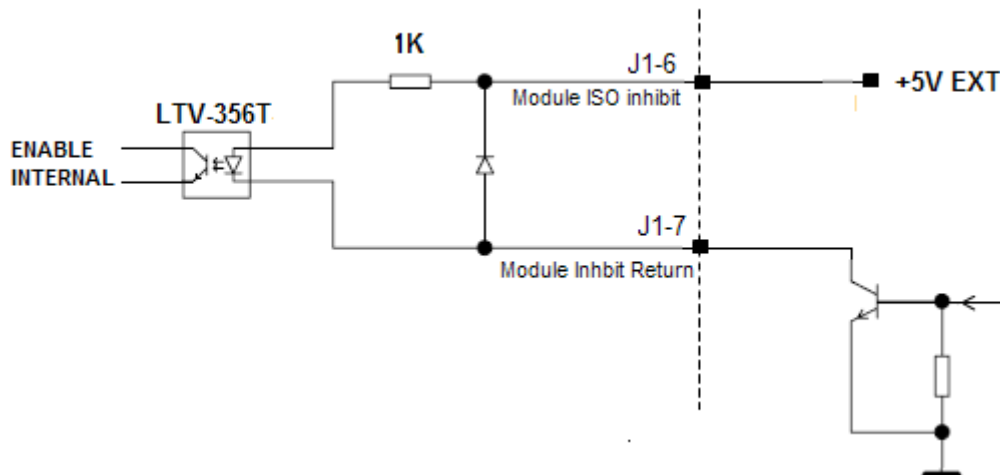

Figure 25. Driving with 5V external supply and bipolar transistor

Current Share (SWP) - (pin 8)

Current Share (pin 8) is an input/output signal of the module, when multiple modules are connected in parallel the Current Share Pins of each of the parallel modules must be connected together to achieve low error current sharing. Since, the output voltage of Current Share signal is proportional to the actual output current the pin can be used as output current monitor, the pin will have 6 V nominal output at full rated load. For illustration, refer to figure in "Remote Sensing with module in parallel".

POWER AND CONTROL SIGNAL DESCRIPTIONS

iVS Dual Output Module Control Connector - J1

+ Remote Sense , -Remote Sense - (pin 1, 4)

Remote Sense of the output modules use to compensate up to 500 mV of cable drop.

Pin 1 (+ Remote Sense) and Pin 4 (- Remote Sense) are the pair of main output V1 for the dual output module.

Pin 9 (+ Remote Sense V2) and Pin 10 (- Remote Sense V2) is the pair of remote sense for slave output V2 of the dual output module.

Module, Isolated Inhibit , Module Inhibit Return - (pin 6, 7)

Refer to page 49. The Module Inhibit enable/disable both outputs.

SCOM - (pin 6)

Ground Reference of the output module, this is connected to COM of output V2.

Current Share (SWP) - (pin 8)

Refer to page 49. The current share could work on main output of dual output module.

COMMUNICATION BUS DESCRIPTIONS

I²C Bus Signals Connector – J2

The iVS series power supply contains enhanced monitor and control functions implemented via the I²C bus. The iVS series I²C functionality (PMBus™ and FRU data) can be accessed via the output connector control signals. The communication bus is powered either by the internal 5V supply or from an external power source connected to the StandBy Output (ie: accessing an unpowered power supply as long as the StandBy Output of another power supply connected in parallel is on).

If units are connected in parallel or in redundant mode, the standby outputs must be connected together in the system. Otherwise, the I²C bus will not work properly when a unit is inserted into the system without the DC source connected.

Note: PMBus™ functionality can be accessed only when the PSU is powered-up.

Guaranteed communication I²C speed is 100KHz.

Serial clock signal (SCL) and Serial data signal (SDA) - (pins 4,5)

These pins for I²C communication are internally pulled up to internal 5 V supply with a 39 Kohm resistor; a current source pull-up can also be used. If multiple units are used inside a system, the 5 V housekeeping supply of each unit must be connected in parallel in the system, otherwise, the SCL and SDA bus will be pulled low by the unit without AC power.

Address bit 0 (A0) , Address bit 1 (A1), Address bit 2 (A2) - (pins 6,7,8)

Multiple configured iVS power supplies can be used in a single system, the power supplies can have parallel outputs or providing multiple outputs. The iVS case has three address pins allowing the system to assign different addresses to multiple PSUs used within the system. The I²C devices inside the iVS case are EEPROM to store FRU data and microcontroller for PMBus. The table on page 51 listed all the possible addresses of the two I²C devices inside the PSU. Pull the address pin to secondary return (COM) to set the address to "0" or High (or open) to set it the address to "1".

I²C Bus Communication Interval

The interval between two consecutive I²C communications to the power supply should be at least 50ms to ensure proper monitoring functionality.

I²C Bus Signal Integrity

The noise on the I²C bus (SDA, SCL lines) due to the power supply will be less than 400 mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100 MHz. Measurements should be make at the power supply output connector with 1 Kohm resistors pulled up to StandBy Output and 20 pF ceramic capacitors to StandBy Output return.

The noise on the address lines A0 and A1 will be less than 100 mV peak-to-peak. This noise measurement should be made at the power supply output connector.

COMMUNICATION BUS DESCRIPTIONS

I²C Bus Internal implementation, Pull-ups and Bus Capacitances
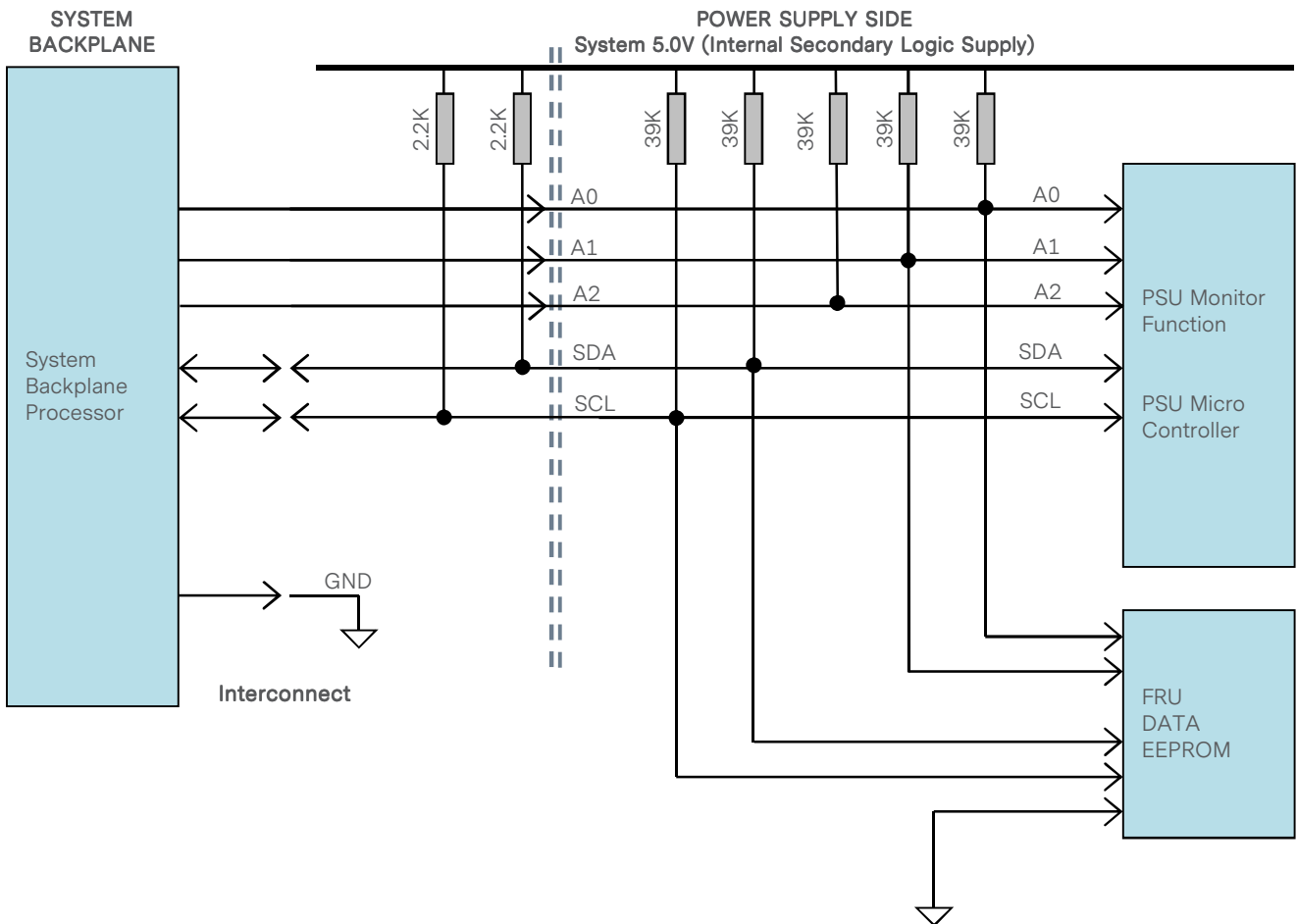
I²C Bus - Recommended external pull-ups

Electrical and interface specifications of I²C signals (referenced to standby output return pin, unless otherwise indicated):

Parameter	Condition	Symbol	Min	Type	Max	Unit
SDA, SCL Internal Pull-up Resistor		R_{int}	-	39	-	Kohm
SDA, SCL Internal Bus Capacitance		C_{int}	-	0	-	pF
Recommended External Pull-up Resistor		R_{ext}	-	2.2	-	Kohm

COMMUNICATION BUS DESCRIPTIONS
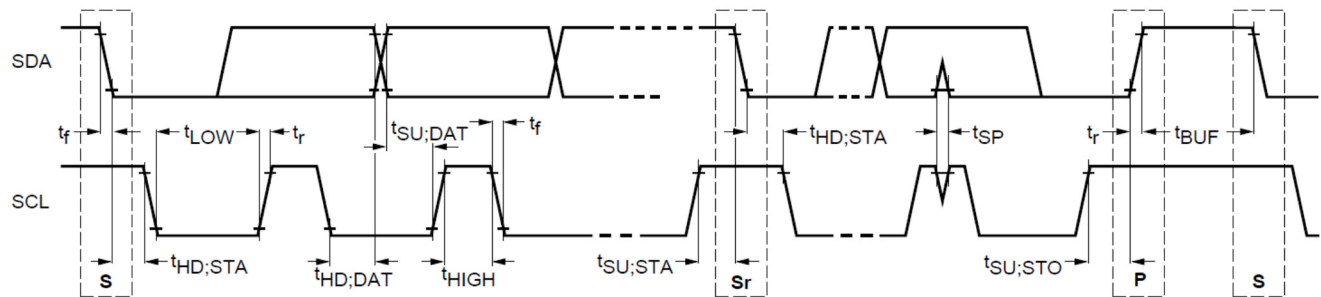
Logic Levels

iVS series power supply I²C communication bus will respond to logic levels as per below:

Logic High: 3.3V nominal (Spec is 2.1V to 5.5V)**
Logic Low: 500mV nominal (Spec is 800mV max)**

**Note: Artesyn 73-769-001 I²C adapter was used.

Timings

Parameter	Symbol	Standard-Mode Specs		Actual Measured		Unit
		Min	Max			
SCL clock frequency	f_{SCL}	0	100	99.5		KHz
Hold time (repeated) START condition	$t_{HD;STA}$	4.0	-	4.76		uS
LOW period of SCL clock	t_{LOW}	4.7	-	14.86		uS
HIGH period of SCL clock	t_{HIGH}	4.0	-	4.41		uS
Setup time for repeated START condition	$t_{SU;STA}$	4.7	-	4.90		uS
Data hold time	$t_{HD;DAT}$	0	3.45	0.52		uS
Data setup time	$t_{SU;DAT}$	250	-	4752		nS
Rise time	t_r	-	1000	SCL = 5.1	SDA = 702	nS
Fall time	t_f	-	300	SCL = 143	SDA = 282	nS
Setup time for STOP condition	$t_{SU;STO}$	4.0	-	5.96		uS
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	30.36		uS

Note: Artesyn 73-769-001 I²C adapter (USB-to-I2C) and iVS Software GUI software were used.

COMMUNICATION BUS DESCRIPTIONS

Device Addressing

Multiple configured iVS power supplies can be used in a single system, the power supplies can have parallel outputs or providing multiple outputs. The iVS CASE has three address pins allowing the system to assign different addresses to multiple PSUs used within the system. The I^{2}C devices inside the iVS-CASE are EEPROM to store FRU data and microcontroller for PMBus. The table below listed all the possible addresses of the two I^{2}C devices inside the PSU. Pull the address pin to Secondary return (COM) to set the address to "0" or High (or open) to set it the address to "1".

PSU Slot	Slot ID Bits			PMBus™ Address	EEPROM (FRU) Read Address
	A0	A1	A2		
1	0	0	0	0x30	0xA0
2	0	0	1	0x32	0xA2
3	0	1	0	0x34	0xA4
4	0	1	1	0x36	0xA6
5	1	0	0	0x38	0xA8
6	1	0	1	0x3A	0xAA
7	1	1	0	0x3C	0xAC
8	1	1	1	0x3E*	0xAE

* Default PMBus™ address when A0, A1, A2 are left open.

COMMUNICATION BUS DESCRIPTIONS

I²C Clock Synchronization

The iVS series power supply might apply clock stretching. An addressed slave power supply may hold the clock line (SCL) low after receiving (or sending) a byte, indicating that it is not yet ready to process more data. The system master that is communicating with the power supply will attempt to raise the clock to transfer the next bit, but must verify that the clock line was actually raised. If the power supply is clock stretching, the clock line will still be low (because the connections are open-drain).

The maximum clock low timeout for iVS series power supply is 37 ms.

The maximum transaction timeout condition for clock stretching for iVS series power supply is 100 ms.
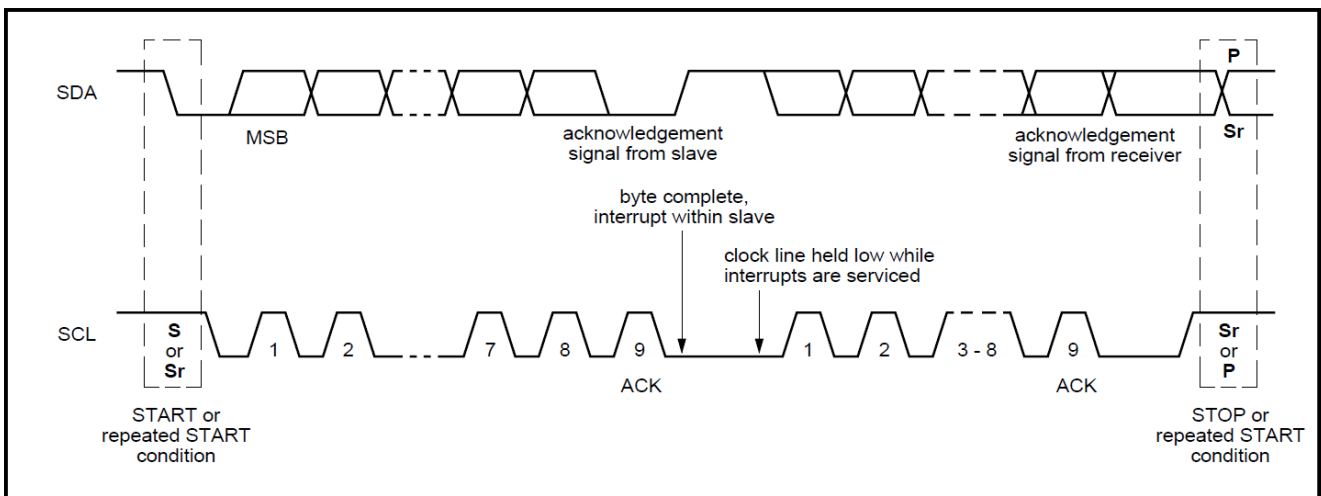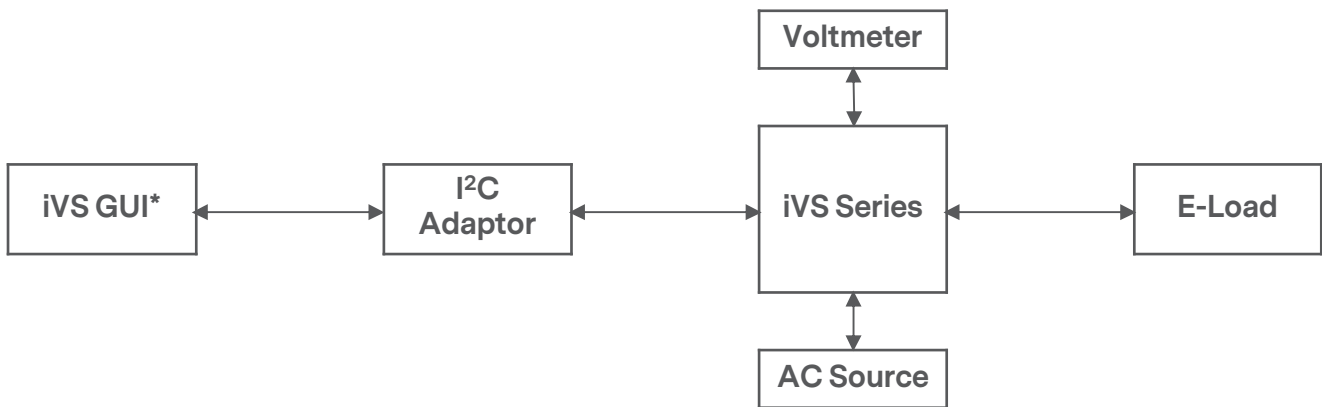
PMBUS™ SPECIFICATIONS

The iVS series is compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

iVS Series PMBus™ General Instructions

Equipment Setup

The following is typical I²C communication setup:

PMBus™ Writing Instructions

When writing to any PMBus™ R/W registers, ALWAYS do the following:

Disable Write Protect (command 10h) by writing any of the following accordingly:

Levels: 00h – Enable writing to all writeable commands

20h – Disables write except 10h, 01h, 00h, 02h and 21h commands

40h – Disables write except 10h, 01h, and 00h commends

80h – Disable write except 0x00h

To save changes on the USER PMBus™ Table:

Use send byte command: 15h STORE_USER_ALL

Wait for 5 seconds, turn-off the PSU, wait for another 5 seconds before turning it on.

Note:

* Please refer to "iVS I²C protocol Technical Reference Note" for iVS GUI function.

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 iVS series power supply. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 10uF tantalum capacitor will be used. Oscilloscope can be set to 20MHz bandwidth for this measurement.
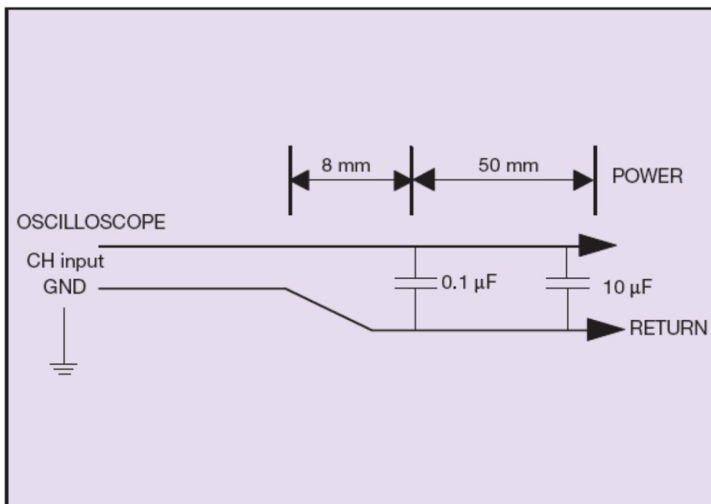
RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	05.20.2019	First Issue	E. Bai
1.1	08.06.2019	Correct Description of T5 and T7 on page 13	E. Bai
1.2	08.14.2019	Correct I2C pull-up resistor, add mating connecter, etc.	E. Bai
1.3	03.02.2020	Update Input Voltage of iVS8	E. Bai
1.4	06.18.2020	Update output regulation spec	E. Bai
1.5	07.20.2020	Update the input frequency	E. Bai
1.6	12.23.2020	Update the altitude, leakage current and EMI level of iVS8H Update the isolation spec, input current and ripple notes.	E. Bai
1.7	01.30.2022	Update input voltage typo for iVS6	K. Wang
1.8	04.08.2022	Update input connector on page 31	E. Bai
1.9	11.10.2022	Update on page 50, Universal GUI to iVS Software GUI	E. Bai

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 | TRUST

For international contact information, visit advancedenergy.com.

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

iVS - Rev.11.10.22_#1.9