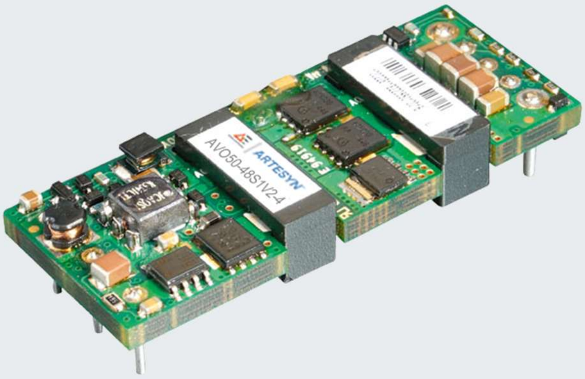
ARTESYN AVO50 SERIES

50 Watts 1/8 Brick Converter



PRODUCT DESCRIPTION

Advanced Energy's Artesyn AVO50 series is a single output DC/DC converter with standard eighth-brick form factor and pin configuration. It delivers up to 25A output current output. Above 91% efficiency and excellent thermal performance makes it an ideal choice to supply power in datacom and telecommunication applications. It can operate over an ambient temperature range of -40^{O}C to +85^{O}C.

AT A GLANCE

Total Power

50 Watts

Input Voltage

36 to 75 Vdc

# of Outputs

Single

RoHS

SPECIAL FEATURES

- Delivers up to 25A output current
- Industry standard eighth brick foot print 57.9mm x 22.9mm x 8.9mm (2.28" x 0.9" x 0.35")
- Basic isolation
- Ultra high efficiency: 91% at 5V full load (Vin = 48Vdc)
- Improved thermal performance: full load at 55°C at 1m/s (200LFM) for 5Vo
- High power density
- Low output noise
- 2:1 wide input voltage of 36 to 75Vdc
- CNT function
- Remote sense
- Trim function: +10%/-20%
- Input under-voltage lockout
- Output over-current protection
- Output over-voltage protection
- Over-temperature protection
- RoHS 3.0

SAFETY

- IEC/EN/UL/CSA 60950
- EN 62368
- CE and UKCA Mark

TYPICAL APPLICATIONS

- Datacom
- Telecommunication

MODEL NUMBERS

Standard	Output Voltage	Pin length	Remote ON/OFF logic	RoHS Status
AVO50-48S1V2-4	1.2Vdc	4.8mm	Negative	RoHS 3.0
AVO50-48S1V2P-4	1.2Vdc	4.8mm	Positive	RoHS 3.0
AVO50-48S1V5-4	1.5Vdc	4.8mm	Negative	RoHS 3.0
AVO50-48S1V5P-4	1.5Vdc	4.8mm	Positive	RoHS 3.0
AVO50-48S1V8-4	1.8Vdc	4.8mm	Negative	RoHS 3.0
AVO50-48S1V8P-4	1.8Vdc	4.8mm	Positive	RoHS 3.0
AVO50-48S2V5-4	2.5Vdc	4.8mm	Negative	RoHS 3.0
AVO50-48S2V5P-4	2.5Vdc	4.8mm	Positive	RoHS 3.0
AVO50-48S3V3P-4	3.3Vdc	4.8mm	Positive	RoHS 3.0
AVO50-48S05-4	5Vdc	4.8mm	Negative	RoHS 3.0
AVO50-48S12-6L	12Vdc	3.8mm	Negative	RoHS 3.0
AVO50-48S12P-4	12Vdc	4.8mm	Positive	RoHS 3.0

Order Information

AVO50	-	48	S	05	P	B	-	6	L
①		②	③	④	⑤	⑥		⑦	⑧

①	Model series	AVO: high efficiency eighth brick series, 50: output power 50W
②	Input voltage	48: 36V ~ 75V input range, rated input voltage 48V
③	Output number	S: single output
④	Rated output voltage	1V2: 1.2V output; 1V5: 1.5V output; 1V8: 1.8V output 2V5: 2.5V output; 3V3: 3.3V output; 05: 5V output; 12: 12V output
⑤	CNT logic	Default: negative logic; P: positive logic
⑥	Baseplate	B: with baseplate; default: open frame
⑦	Pin length	Omit for 5.8mm±0.5mm 4: 4.8mm±0.5mm 6: 3.80mm±0.25mm 8: 2.80mm±0.25mm
⑧	RoHS status	L: RoHS 3.0

Options

None

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 Operating -Continuous Non-operating -100mS	 All All	$V_{IN,DC}$	 0 0	 - -	 75 100	 Vdc Vdc
Maximum Output Power	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	$P_{O,max}$	0	-	24.0 30.0 36.0 50.0 49.5 50.0 50.0	W
Ambient Operating Temperature	All	T_A	-40	-	+85	°C
Board Operating Temperature	All	T_c	-	-	+100	°C
Storage Temperature	All	T_{STG}	-55	-	+125	°C
Isolation Voltage[1] Input to outputs	All		-	-	2000	Vdc
Isolation Resistance	All		10	-	-	Mohm
Isolation Capacitance	All		-	1000	-	pF
Humidity (non-condensing) Operating	All		-	-	85	%

Note 1 - 1mA for 60s, slew rate of 2000V/10s.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications

Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC		All	$V_{IN,DC}$	36	48	75	Vdc
Turn-on Voltage Threshold		$I_O = I_{O,max}$	$V_{IN,ON}$	31	34	36	Vdc
Turn-off Voltage Threshold		$I_O = I_{O,max}$	$V_{IN,OFF}$	30	33	35	Vdc
Supply voltage rejection (1kHz)		All	-	50	60	-	dB
Maximum Input Current ($I_O = I_{O,max}$)		$V_{IN,DC}$ = 0 to $V_{IN,\ max}$	$I_{IN,max}$	-	-	2.5	A
Input Fuse		Fast blow type. An input line fuse must always be used.		-	5	-	A
Recommended External Input Capacitance		Low ESR capacitor recommended	C_{IN}	-	47	-	uF
Input Reflected Ripple Current		Through 12uH source impedance, 5Hz to 20MHz, Ta = 25 °C		-	-	20	mAp-p
Efficiency	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	T_A=25 °C V_{IN}= V_{IN},nom $I_O = I_{O,max}$	η	- - - - - - -	88 87 89 90 91 91 91	- - - - - - -	%
	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	T_A=25 °C V_{IN}= V_{IN},nom $I_O = 50\% I_{O,max}$	η	- - - - - - -	86 86 88 88 91 90 89	- - - - - - -	%

Note 1 - Ta = 25 °C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise indicated.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications							
Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Output Voltage setpoint	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	V_{IN} = $V_{IN,min}$ to $V_{IN,max}$ I_O=$I_{O,max}$ T_A=25 ^oC	$V_{O, set}$	1.18 1.48 1.77 2.46 3.25 4.95 11.85	1.2 1.5 1.8 2.5 3.3 5 12	1.22 1.52 1.83 2.54 3.35 5.05 12.15	Vdc
Output Voltage Line Regulation	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	$V_{IN,min}$ to $V_{IN,max}$		- - - - - - -	1 1 1 1 1 4 9	- - - - - - -	mV
Output Voltage Load Regulation	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	$I_{O,min}$ to $I_{O,max}$		- - - - - - -	1 1 1 1 1 5 5	- - - - - - -	mV
Output Voltage Temperature Regulation		T_C=-40 ~+100^oC	$\%V_O$	-	-	0.02	$\%/^oC$
Output Voltage Trim Range	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	All	V_O	80 80 80 80 80 80 90	- - - - - - -	110 110 110 110 110 110 110	$\%V_O$
Output Ripple, pk-pk	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	Measure with a 1uF@10V, X7R ceramic capacitor in parallel with a 470µF @10V LOW ESR Aluminum capacitor, 0 to 20MHz bandwidth	V_O	- - - - - - -	50 55 45 50 50 55 55	- - - - - - -	mV_{PK-PK}
Output Current	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	All	I_O	0 0 0 0 0 0 0	- - - - - - -	20 20 20 20 15 10 4.2	A

Note 1 - Ta = 25 ^oC, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications, con't							
Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Output DC current-limit inception[2]	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	All	I_O	22 22 22 22 16.5 11 4.6	- - - - - - -	28 28 28 28 21 14 7.0	A
V_O Load Capacitance[3]	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	All	C_O	220 220 220 220 220 220 220	470 470 470 470 470 470 470	10,000 10,000 10,000 10,000 10,000 5000 1000	uF
V_O Dynamic Response Peak Deviation	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	50%~75%~50% 25% load change slew rate = 0.1A/us	$\pm V_O$	- - - - - - -	60 60 40 50 95 100 150	- - - - - - -	mV
V_O Dynamic Response Settling Time	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	50%~75%~50% 25% load change slew rate = 0.1A/us	T_s	- - - - - - -	300 110 105 60 60 120 120	- - - - - - -	uSec
V_O Dynamic Response Peak Deviation	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	50%~75%~50% 25% load change slew rate = 1A/us	$\pm V_O$	- - - - - - -	130 130 110 150 130 130 180	- - - - - - -	mV
V_O Dynamic Response Settling Time	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	50%~75%~50% 25% load change slew rate = 1A/us	T_s	- - - - - - -	300 100 110 130 80 130 300	- - - - - - -	uSec

Note 2 - Hiccup: auto-restart when over-current condition is removed.
Note 3 - High frequency and low ESR is recommended.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications, con't							
Parameter		**Condition[1]**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Turn-on transient	Rise time	$I_O = I_{max}$	T_{rise}	-	-	20[4]	mS
	Output voltage overshoot	$I_O = I_{O,max}$	$\%V_O$	-	0	-	%
Enable pin voltage	Logic Low	All		-0.7	-	1.2	V
	Logic High			3.5	-	12	V
Enable pin current	Logic Low	leakage current, @10V		-	-	1.0	mA
	Logic High			-	-	-	µA
Output over-voltage protection[5]	AVO50-48S1V2 AVO50-48S1V5 AVO50-48S1V8 AVO50-48S2V5 AVO50-48S3V3 AVO50-48S05 AVO50-48S12	All	V_O	1.4 1.8 2.2 3.0 3.9 6.0 14.4	-	2.0 2.5 3.0 3.8 5.0 7.5 18	V
Switching frequency		All	f_{SW}	-	310	-	KHz
Output over-temperature protection[6]		All	T	110	120	135	^{O}C
Over-temperature hysteresis		All	T	5	-	-	^{O}C
+ Sense		All	%Vo	-	-	10	%
- Sense		All	%Vo	-	-	10	%
MTBF		Bellcore TR-NWT-000332 $I_O = I_{max}$ T_c=25 ^{O}C		-	2.5	-	10^6 h

Note 4 - 40mS for AVO50-48S12-6L.
Note 5 - Hiccup: auto-restart when over-voltage condition is removed.
Note 6 - Auto recovery.

ELECTRICAL SPECIFICATIONS

AVO50-48S1V2 Performance Curves

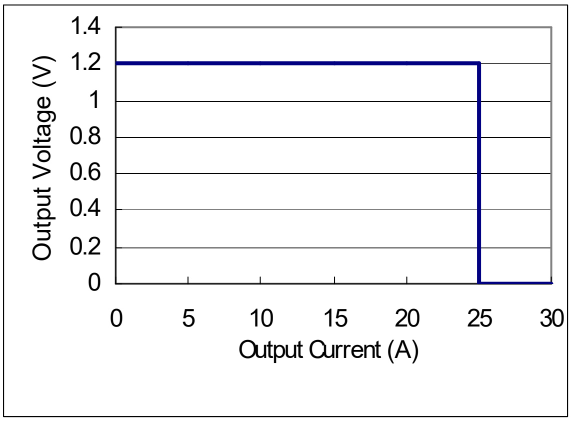


Figure 1: AVO50-48S1V2 Typical over-current

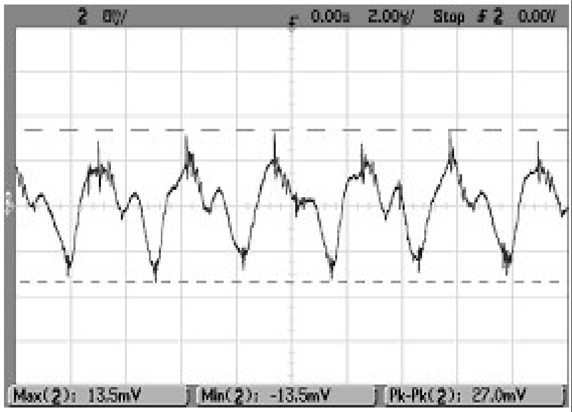


Figure 2: AVO50-48S1V2 Ripple and Noise Measurement

Ch 1: Vo

Figure 3: AVO50-48S1V2 typical start-up from power on

Ch 1: Vin Ch 2: Vo

Figure 4: AVO50-48S1V2 typical start-up from CNT on

Ch 1: CNT Ch 2: Vo

Figure 5: AVO50-48S1V2 Transient Response
50%~25% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

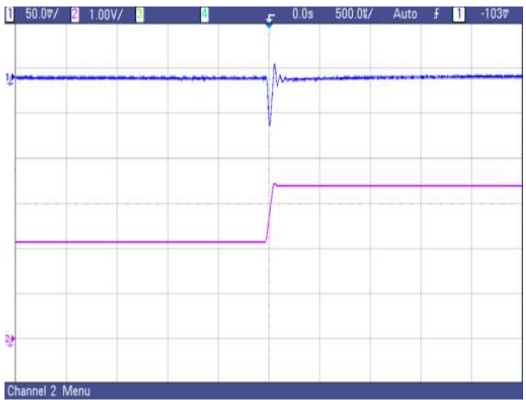


Figure 6: AVO50-48S1V2 Transient Response
50%~75% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

ELECTRICAL SPECIFICATIONS

AVO50-48S1V2 Performance Curves

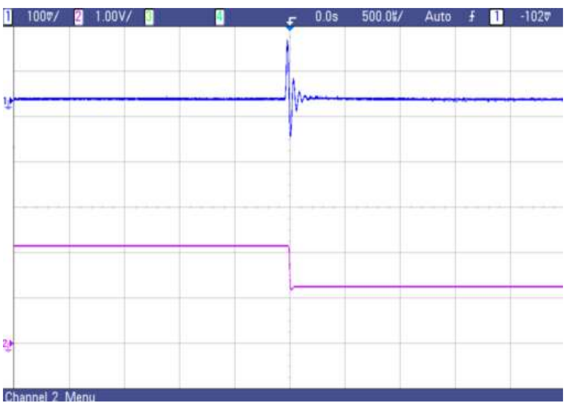


Figure 7: AVO50-48S1V2 Transient Response
50%~25%load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

Figure 8: AVO50-48S1V2 Transient Response
50%~75% load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

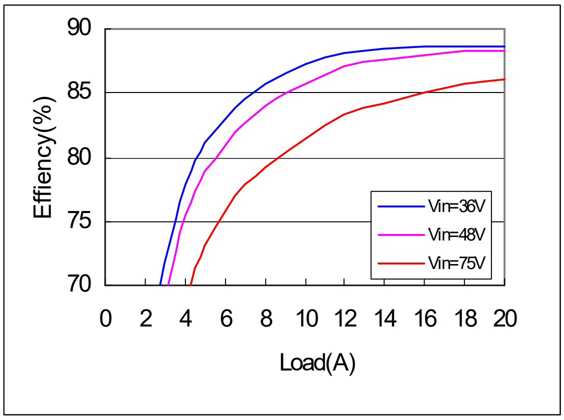


Figure 9: AVO50-48S1V2 Efficiency Curves @ 25 degC

Loading: Io = 10% increment to 20A

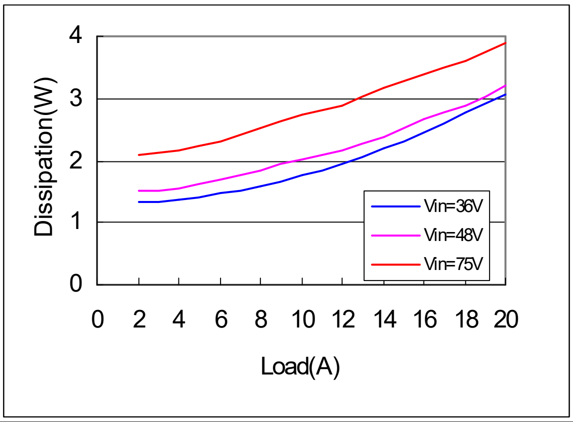


Figure 10: AVO50-48S1V2 Typical power dissipation curve

Loading: Io = 10% increment to 20A

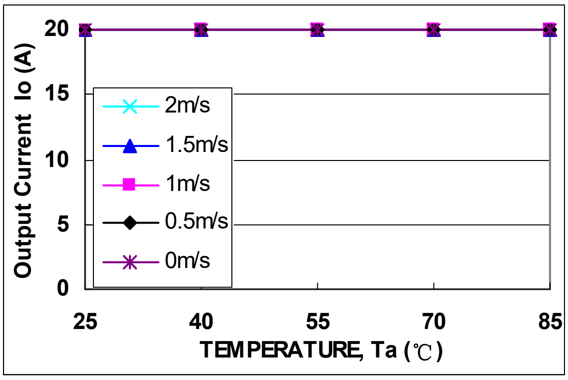


Figure 11: AVO50-48S1V2 output power derating

Airflow direction from -Vin to +Vin; Vin=48V

ELECTRICAL SPECIFICATIONS

AVO50-48S1V5 Performance Curves

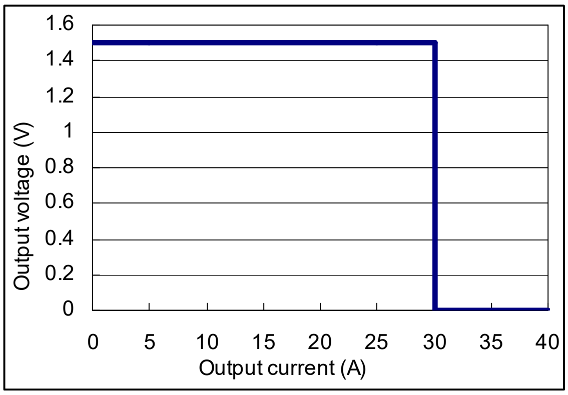


Figure 12: AVO50-48S1V5 Typical over-current

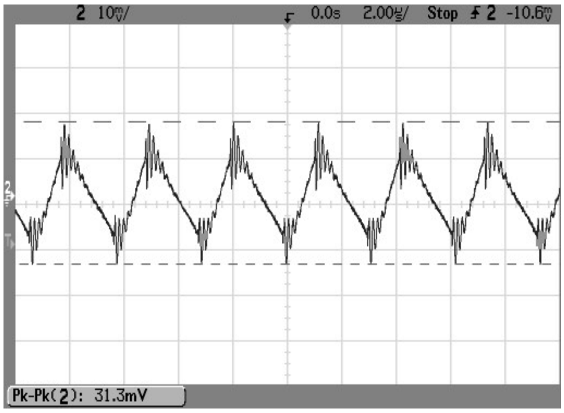


Figure 13: AVO50-48S1V5 Ripple and Noise Measurement

Ch 1: Vo

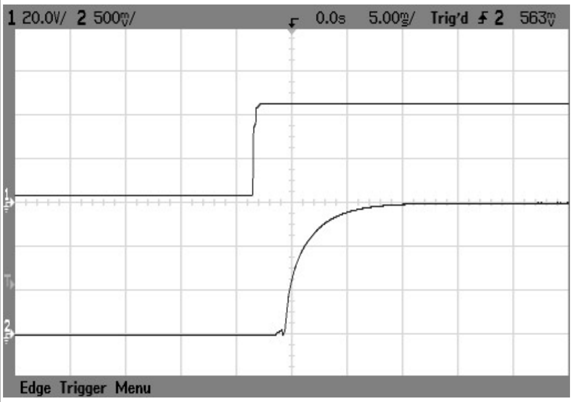


Figure 14: AVO50-48S1V5 typical start-up from power on

Ch 1: Vin Ch 2: Vo

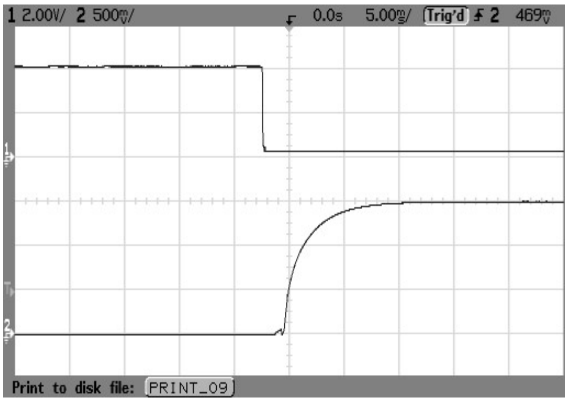


Figure 15: AVO50-48S1V5 typical start-up from CNT on

Ch 1: CNT Ch 2: Vo

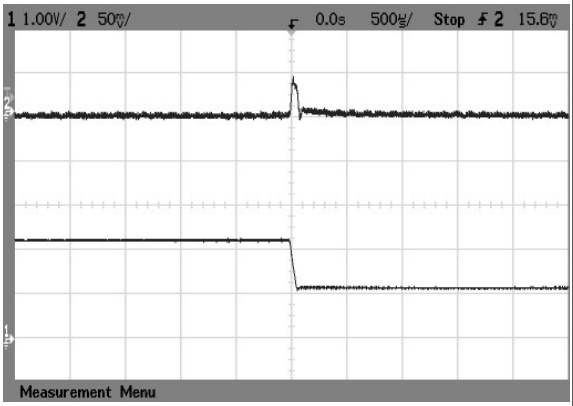


Figure 16: AVO50-48S1V5 Transient Response
50%~25% load change, 0.1A/uS slew rate, Vin=48V

Ch 1: Io Ch 2: Vo

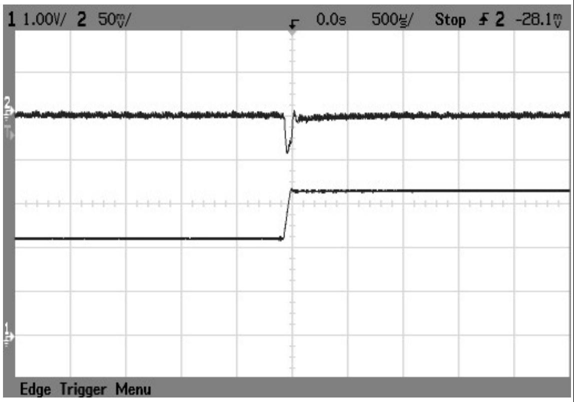


Figure 17: AVO50-48S1V5 Transient Response
50%~75% load change, 0.1A/uS slew rate, Vin=48V

Ch 1: Io Ch 2: Vo

ELECTRICAL SPECIFICATIONS

AVO50-48S1V5 Performance Curves

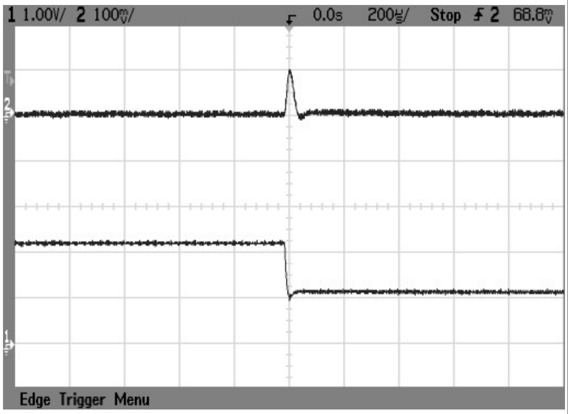


Figure 18: AVO50-48S1V5 Transient Response
50%~25%load change, 1A/uS slew rate, Vin=48V
Ch 1: Io Ch 2: Vo

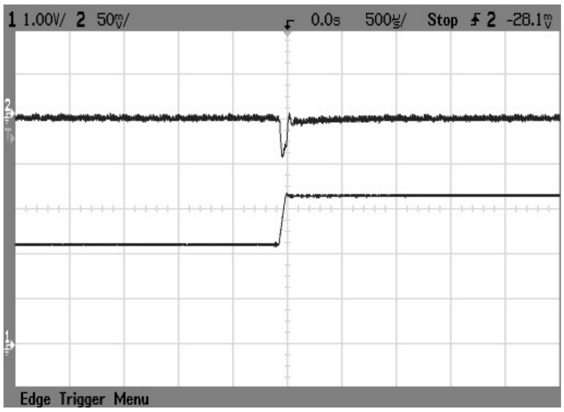


Figure 19: AVO50-48S1V5 Transient Response
50%~75% load change, 1A/uS slew rate, Vin=48V
Ch 1: Io Ch 2: Vo

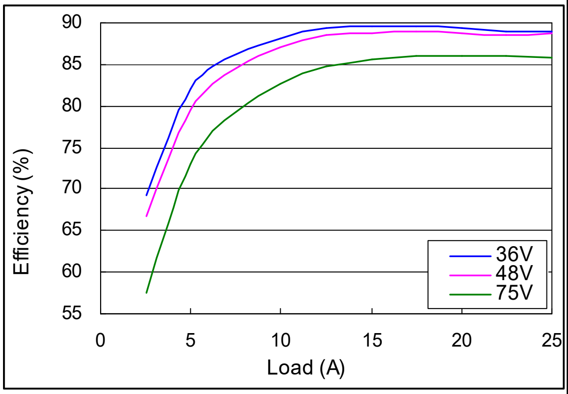


Figure 20: AVO50-48S1V5 Efficiency Curves @ 25 degC

Loading: Io = 10% increment to 25A

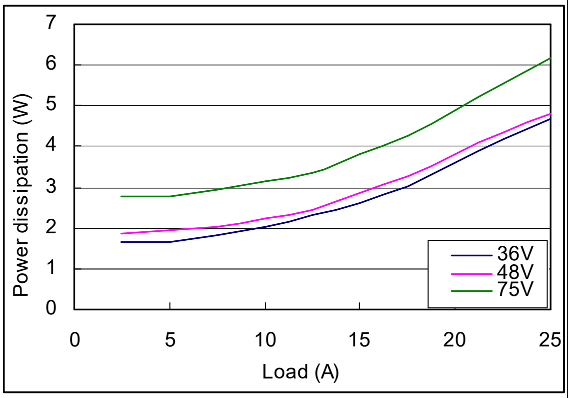


Figure 21: AVO50-48S1V5 Typical power dissipation curve

Loading: Io = 10% increment to 25A

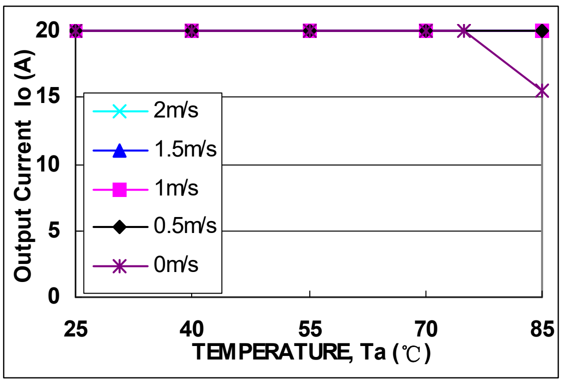


Figure 22: AVO50-48S1V5 output power derating

Airflow direction from -Vin to +Vin; Vin=48V

ELECTRICAL SPECIFICATIONS

AVO50-48S1V8 Performance Curves

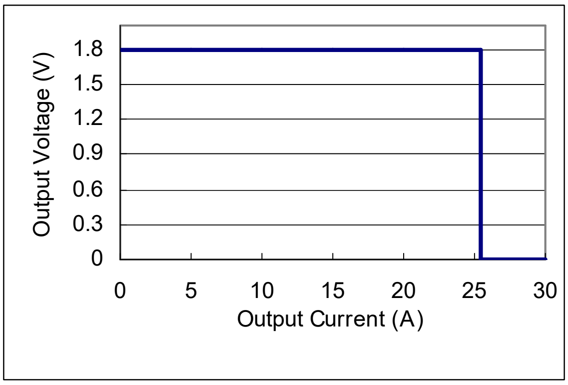


Figure 23: AVO50-48S1V8 Typical over-current

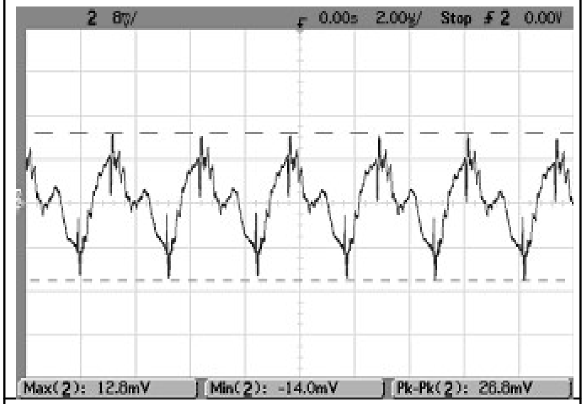


Figure 24: AVO50-48S1V8 Ripple and Noise Measurement

Ch 1: Vo

Figure 25: AVO50-48S1V8 typical start-up from power on

Ch 1: Vin Ch 2: Vo

Figure 26: AVO50-48S1V8 typical start-up from CNT on

Ch 1: CNT Ch 2: Vo

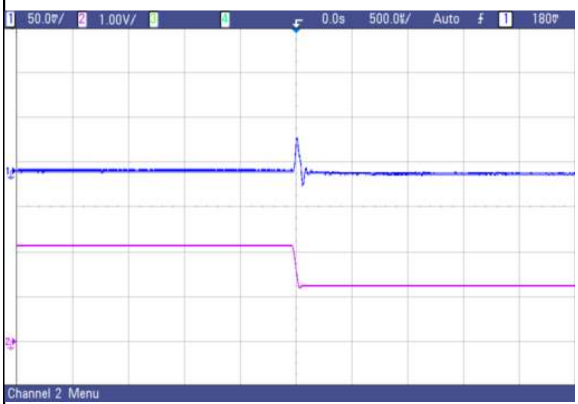


Figure 27: AVO50-48S1V8 Transient Response
50%~25% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

Figure 28: AVO50-48S1V8 Transient Response (500uS/div)
50%~75% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

ELECTRICAL SPECIFICATIONS

AVO50-48S1V8 Performance Curves

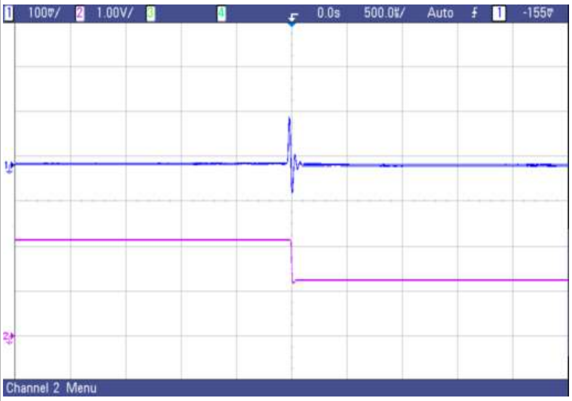


Figure 29: AVO50-48S1V8 Transient Response
50%~25%load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

Figure 30: AVO50-48S1V8 Transient Response
50%~75% load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

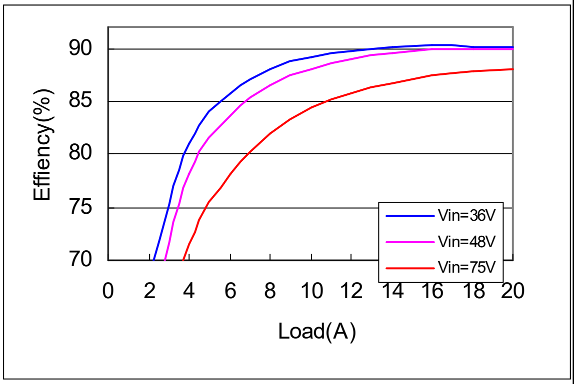


Figure 31: AVO50-48S1V8 Efficiency Curves @ 25 degC

Loading: Io = 10% increment to 20A

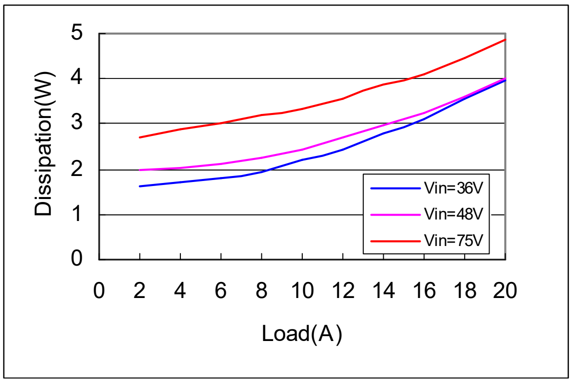


Figure 32: AVO50-48S1V8 Typical power dissipation curve

Loading: Io = 10% increment to 20A

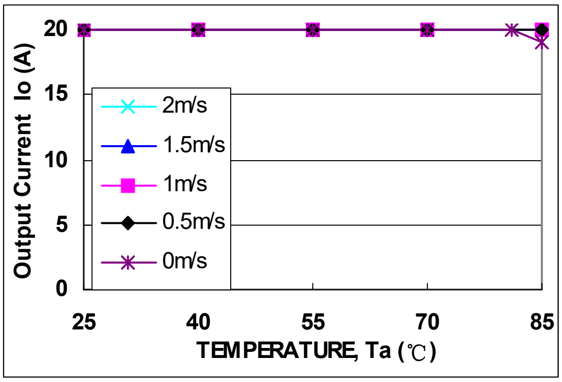


Figure 33: AVO50-48S1V8 output power derating

Airflow direction from -Vin to +Vin; Vin=48V

ELECTRICAL SPECIFICATIONS

AVO50-48S2V5 Performance Curves

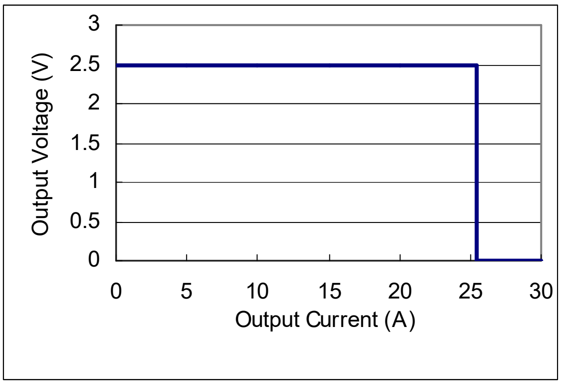


Figure 34: AVO50-48S2V5 Typical over-current

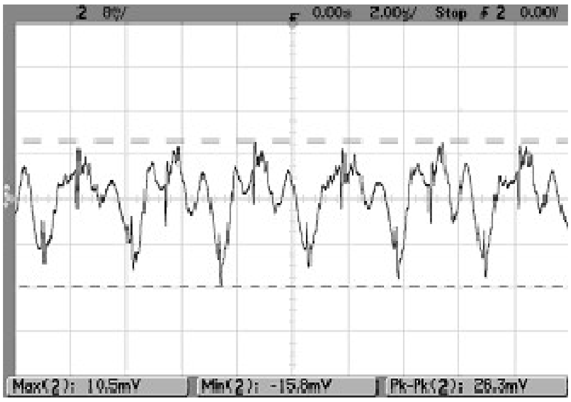


Figure 35: AVO50-48S2V5 Ripple and Noise Measurement

Ch 1: Vo

Figure 36: AVO50-48S2V5 typical start-up from power on

Ch 1: Vo Ch 2: Vin

Figure 37: AVO50-48S2V5 typical start-up from CNT on

Ch 1: Vo Ch 2: CNT

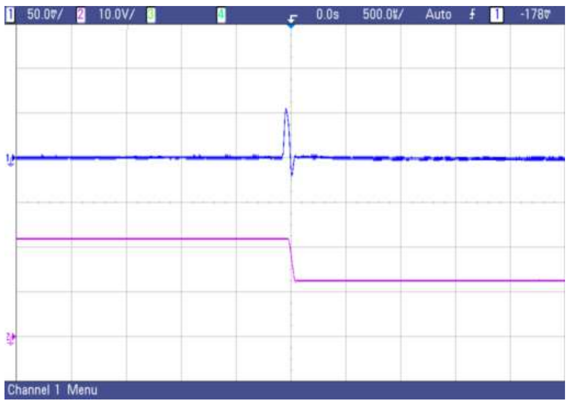


Figure 38: AVO50-48S2V5 Transient Response
50%~25% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

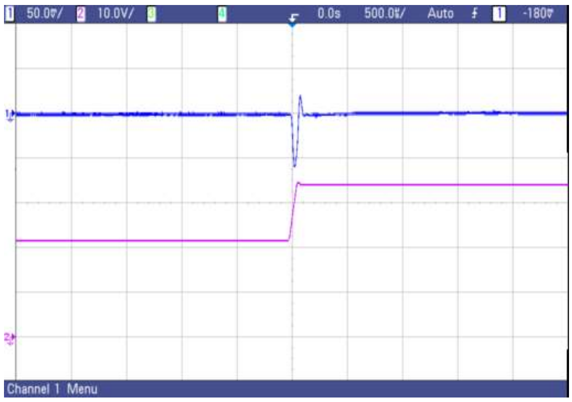


Figure 39: AVO50-48S2V5 Transient Response
50%~75% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

ELECTRICAL SPECIFICATIONS

AVO50-48S2V5 Performance Curves

Figure 40: AVO50-48S2V5 Transient Response
50%~25%load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

Figure 41: AVO50-48S2V5 Transient Response
50%~75% load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

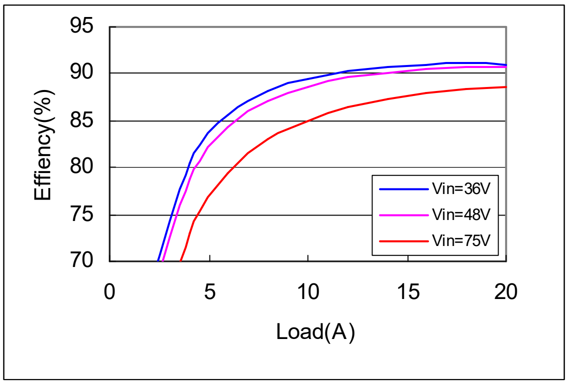


Figure 42: AVO50-48S2V5 Efficiency Curves @ 25 degC

Loading: Io = 10% increment to 20A

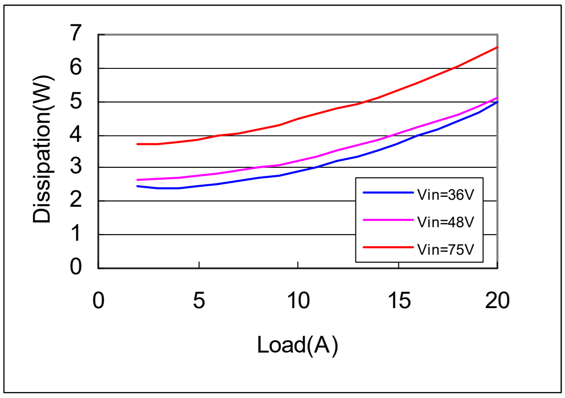


Figure 43: AVO50-48S2V5 Typical power dissipation curve

Loading: Io = 10% increment to 20A

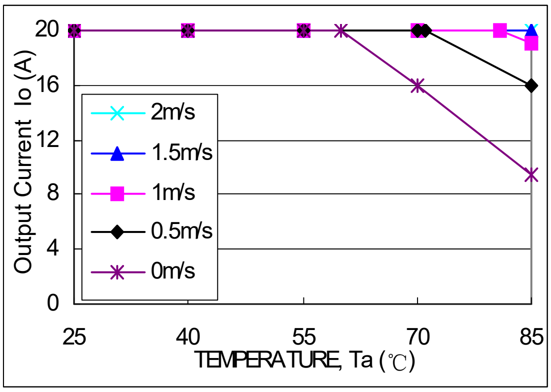


Figure 44: AVO50-48S2V5 output power derating

Airflow direction from –Vin to +Vin; Vin=48V

ELECTRICAL SPECIFICATIONS

AVO50-48S3V3 Performance Curves

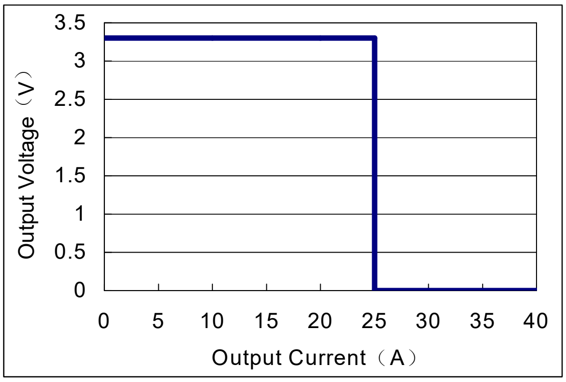


Figure 45: AVO50-48S3V3 Typical over-current

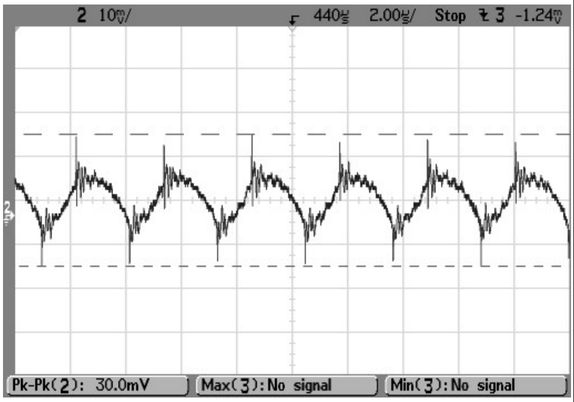


Figure 46: AVO50-48S3V3 Ripple and Noise Measurement

Ch 1: Vo

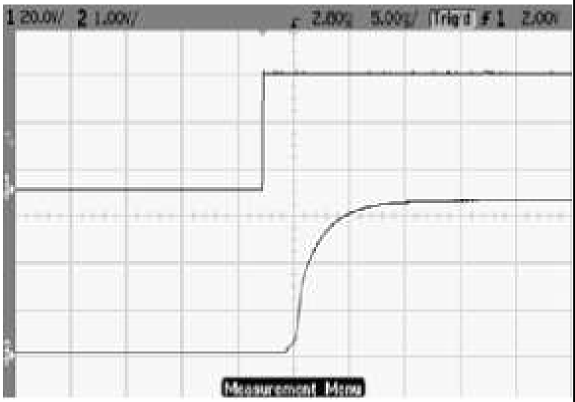


Figure 47: AVO50-48S3V3 typical start-up from power on

Ch 1: Vin Ch 2: Vo

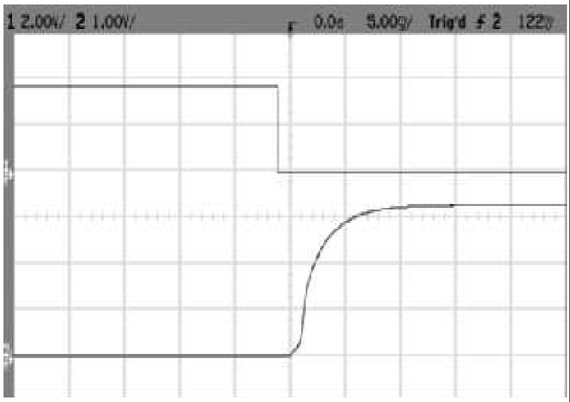


Figure 48: AVO50-48S3V3 typical start-up from CNT on

Ch 1: CNT Ch 2: Vo

Figure 49: AVO50-48S3V3 Transient Response
50%~25% load change, 0.1A/uS slew rate, Vin=48V

Ch 1: Vo Ch 2: Io

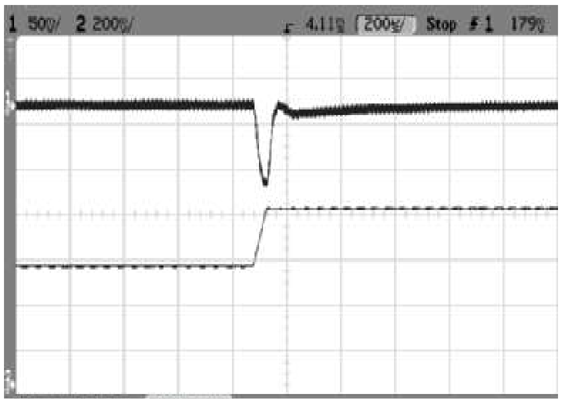


Figure 50: AVO50-48S3V3 Transient Response
50%~75% load change, 0.1A/uS slew rate, Vin=48V

Ch 1: Vo Ch 2: Io

ELECTRICAL SPECIFICATIONS

AVO50-48S3V3 Performance Curves

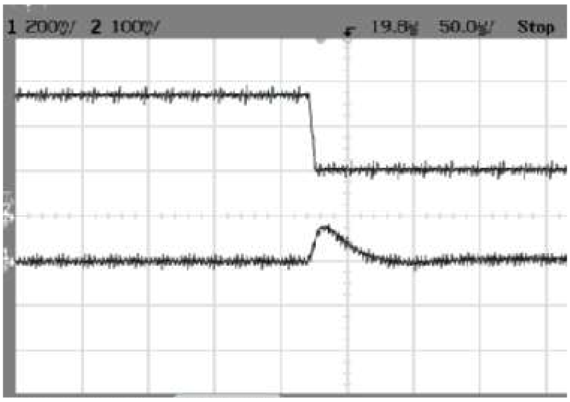


Figure 51: AVO50-48S3V3 Transient Response
50%~25%load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

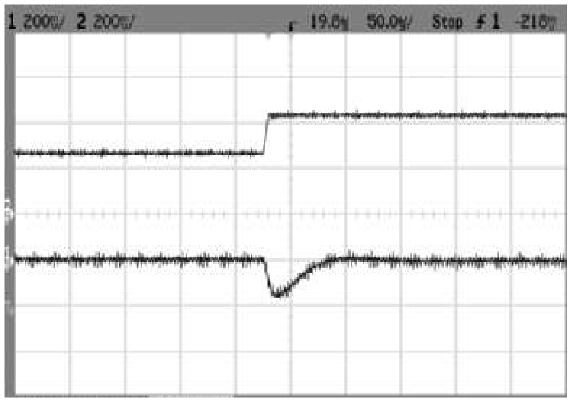


Figure 52: AVO50-48S3V3 Transient Response
50%~75% load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

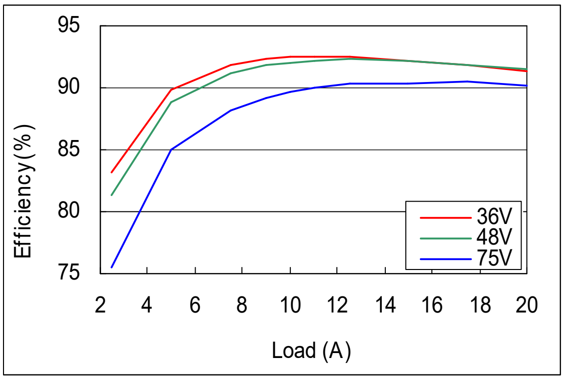


Figure 53: AVO50-48S3V3 Efficiency Curves @ 25 degC

Loading: Io = 10% increment to 20A

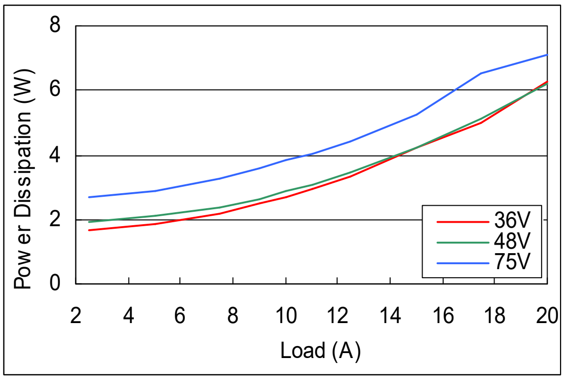


Figure 54: AVO50-48S3V3 Typical power dissipation curve

Loading: Io = 10% increment to 20A

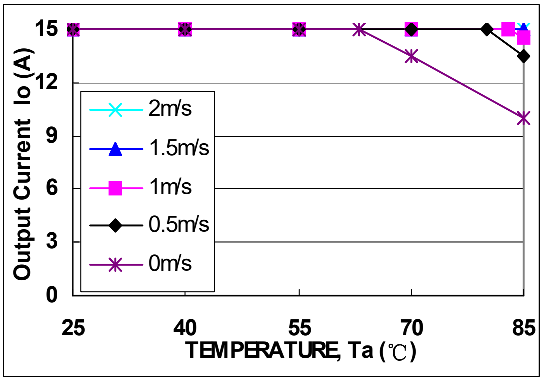


Figure 55: AVO50-48S3V3 output power derating

Airflow direction from -Vin to +Vin; Vin=48V

ELECTRICAL SPECIFICATIONS

AVO50-48S05 Performance Curves

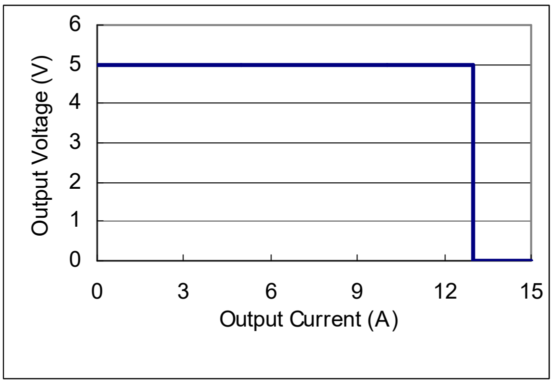


Figure 56: AVO50-48S05 Typical over-current

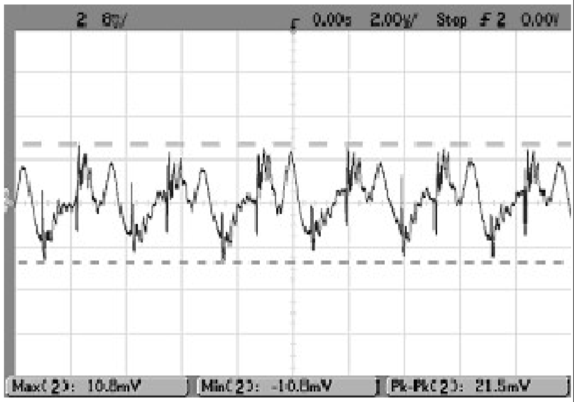


Figure 57: AVO50-48S05 Ripple and Noise Measurement

Ch 1: Vo

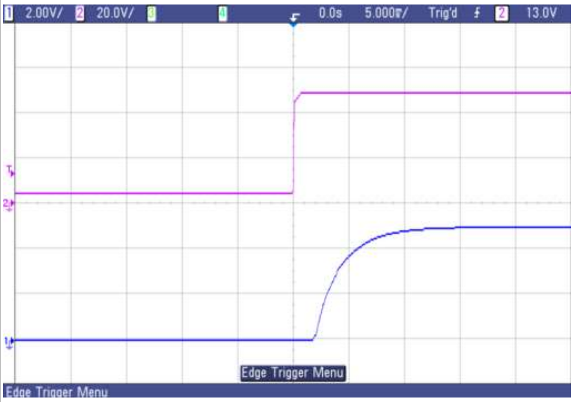


Figure 58: AVO50-48S05 typical start-up from power on

Ch 1: Vo Ch 2: Vin

Figure 59: AVO50-48S05 typical start-up from CNT on

Ch 1: Vo Ch 2: CNT

Figure 60: AVO50-48S05 Transient Response
50%~25% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

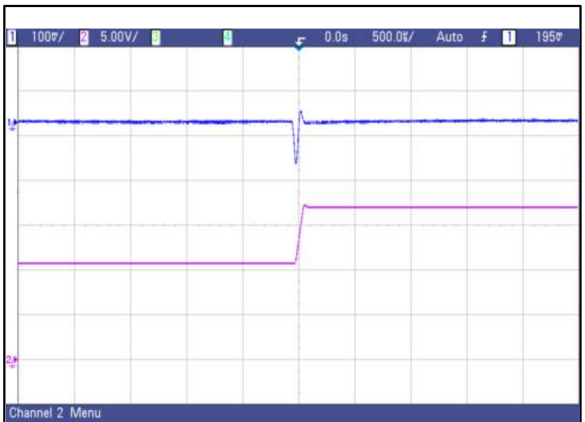


Figure 61: AVO50-48S05 Transient Response
50%~75% load change, 0.1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

ELECTRICAL SPECIFICATIONS

AVO50-48S05 Performance Curves

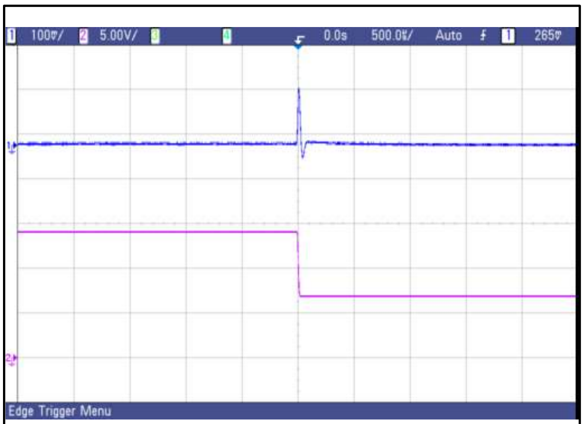


Figure 62: AVO50-48S05 Transient Response
50%~25%load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

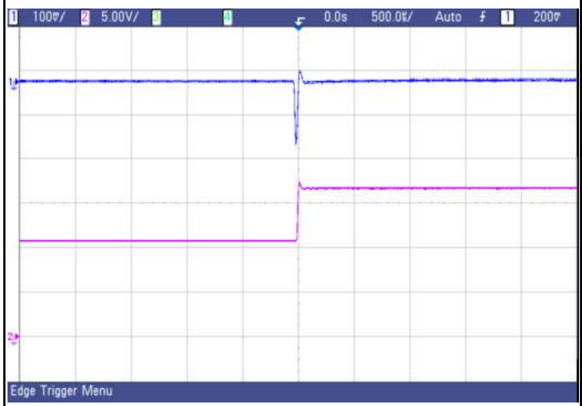


Figure 63: AVO50-48S05 Transient Response
50%~75% load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

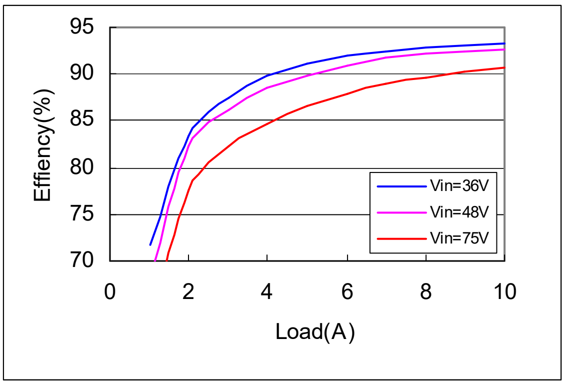


Figure 64: AVO50-48S05 Efficiency Curves @ 25 degC

Loading: Io = 10% increment to 10A

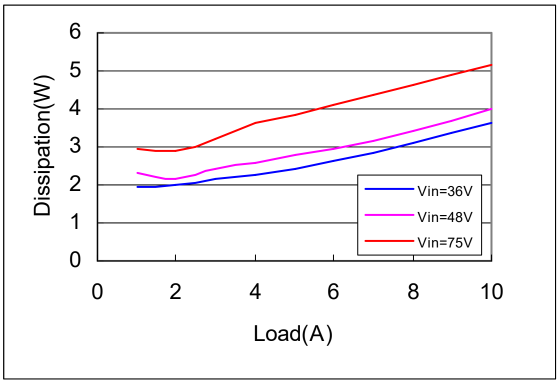


Figure 65: AVO50-48S05 Typical power dissipation curve

Loading: Io = 10% increment to 10A

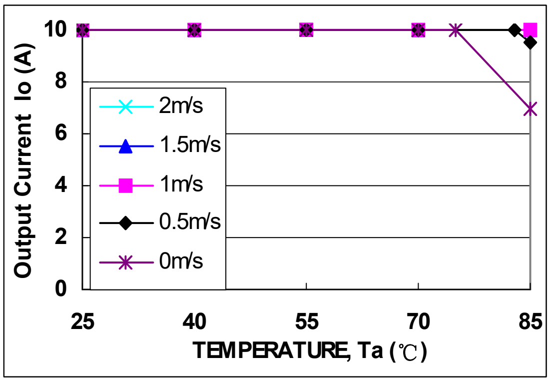


Figure 66: AVO50-48S05 output power derating

Airflow direction from -Vin to +Vin; Vin=48V

ELECTRICAL SPECIFICATIONS

AVO50-48S12 Performance Curves

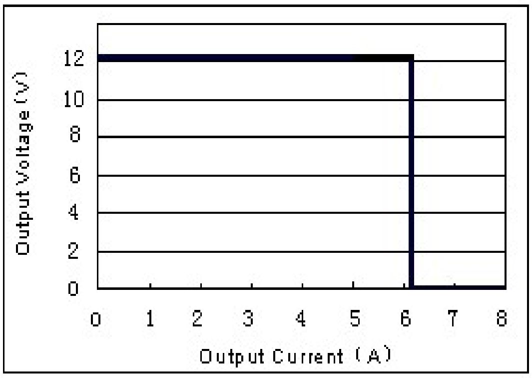


Figure 67: AVO50-48S12 Typical over-current

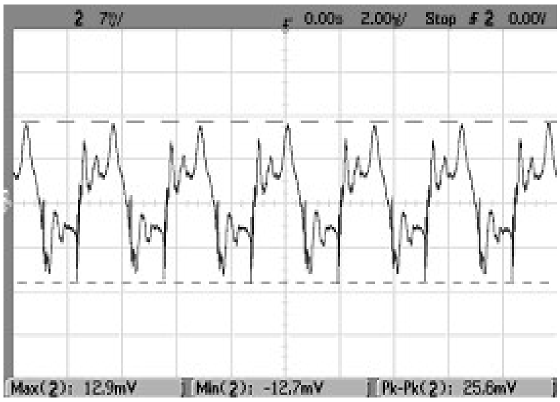


Figure 68: AVO50-48S12 Ripple and Noise Measurement

Ch 1: Vo

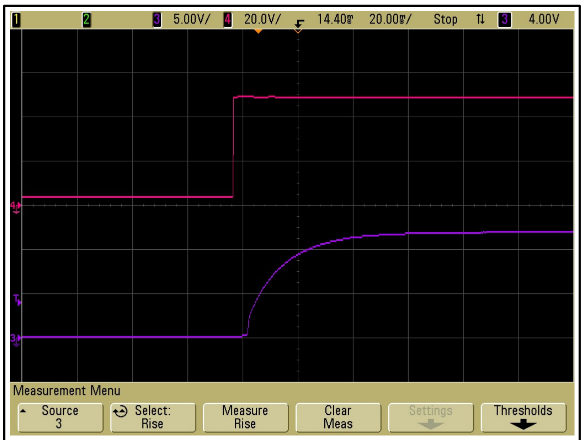


Figure 69: AVO50-48S12 typical start-up from power on

Ch 1: Vin Ch 2: Vo

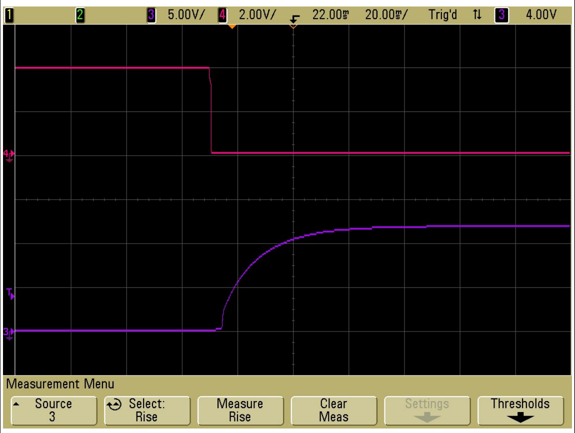


Figure 70: AVO50-48S12 typical start-up from CNT on

Ch 1: CNT Ch 2: Vo

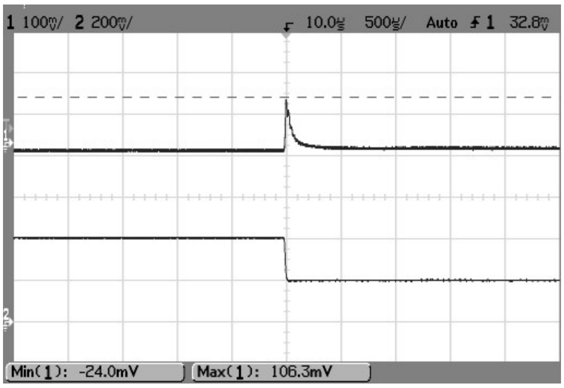


Figure 71: AVO50-48S12 Transient Response
50%~25% load change, 0.1A/uS slew rate, Vin=48V

Ch 1: Vo Ch 2: Io

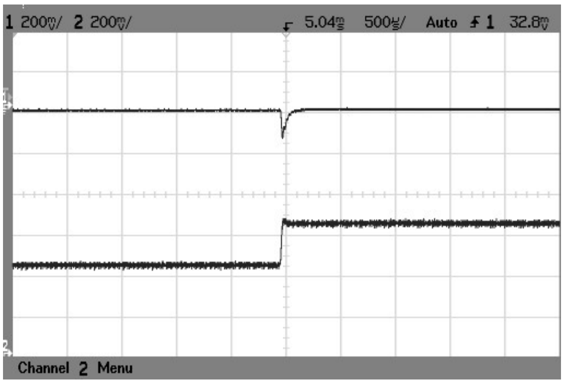


Figure 72: AVO50-48S12 Transient Response
50%~75% load change, 0.1A/uS slew rate, Vin=48V

Ch 1: Vo Ch 2: Io

ELECTRICAL SPECIFICATIONS

AVO50-48S1V2 Performance Curves

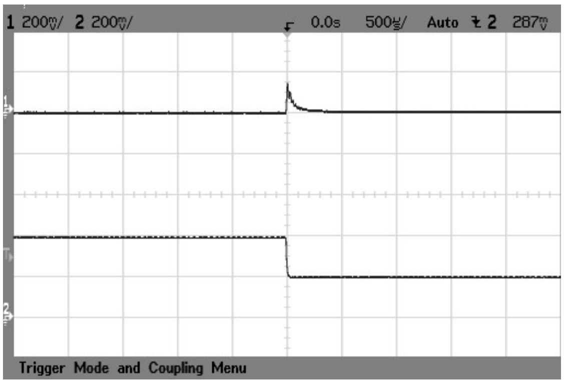


Figure 73: AVO50-48S12 Transient Response
50%~25%load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

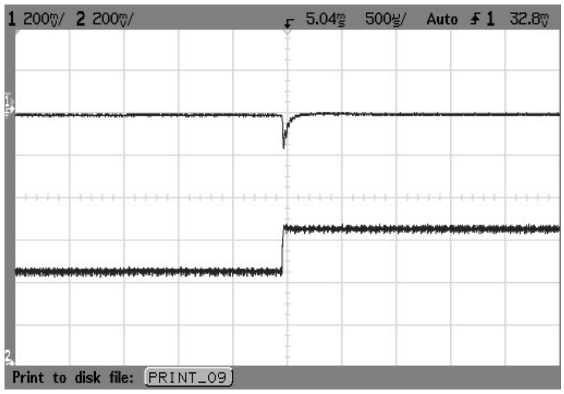


Figure 74: AVO50-48S12 Transient Response
50%~75% load change, 1A/uS slew rate, Vin=48V
Ch 1: Vo Ch 2: Io

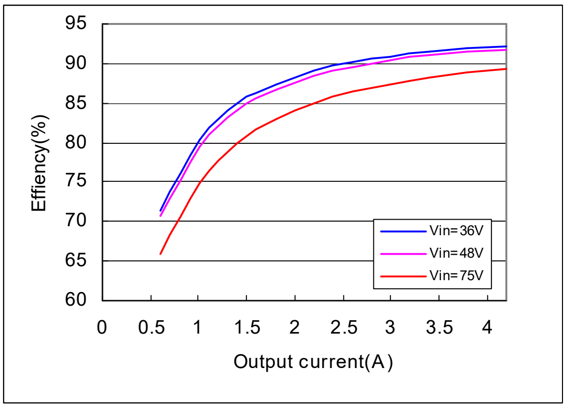


Figure 75: AVO50-48S12 Efficiency Curves @ 25 degC

Loading: Io = 10% increment to 4A

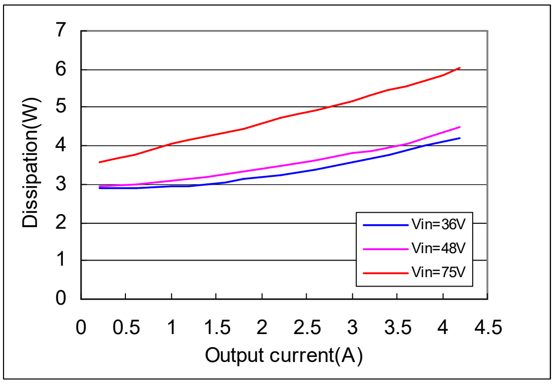


Figure 76: AVO50-48S12 Typical power dissipation curve

Loading: Io = 10% increment to 4A

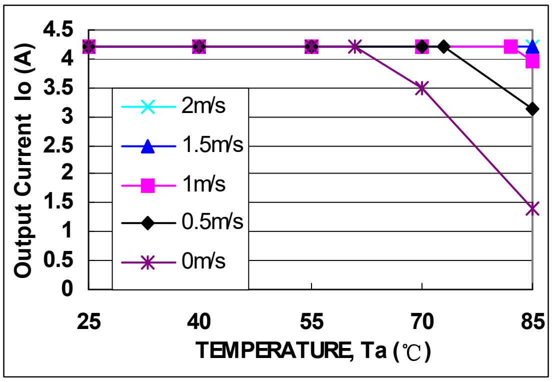


Figure 77: AVO50-48S12 output power derating

Airflow direction from -Vin to +Vin; Vin=48V

ELECTRICAL SPECIFICATIONS

Protection Function Specifications

Input Fusing

The converter has no internal fuse. An external fuse must always be employed! To meet international safety requirements, a 250V rated fuse should be used. If one of the input lines is connected to chassis ground, then the fuse must be placed in the other input line.

Standard safety agency regulations require input fusing. Recommended rating is 5A for the converter.

Note: The fuse is fast blow type.

Over Voltage Protection (OVP)

The output over-voltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, then the converter will work on intermittent mode. When the over-voltage condition is removed, the converter will automatically restart.

The protection mechanism is such that the converter can continue in this condition until the fault is cleared.

Over Current Protection (OCP)

The converter feature foldback current limiting as part of their Over-current Protection (OCP) circuits. When output current exceeds 110 to 140% of rated current, such as during a short circuit condition, the converter will work on intermittent mode, also can tolerate short circuit conditions indefinitely. When the over-current condition is removed, the converter will automatically restart.

Input Reverse Voltage Protection

Under installation and cabling conditions where reverse polarity across the input may occur, reverse polarity protection is recommended. Protection can easily be provided as shown in Figure 78. In both cases the diode used is rated for 10A/100V. Placing the diode across the inputs rather than in-line with the input offers an advantage in that the diode only conducts in a reverse polarity condition, which increases circuit efficiency and thermal performance.

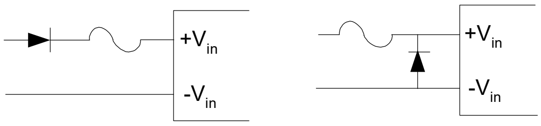


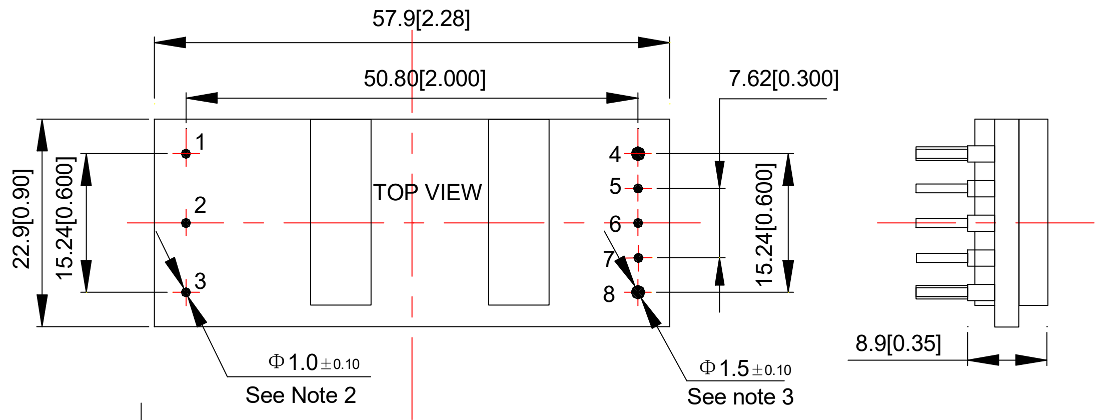
Figure 78 Reverse polarity protection circuit

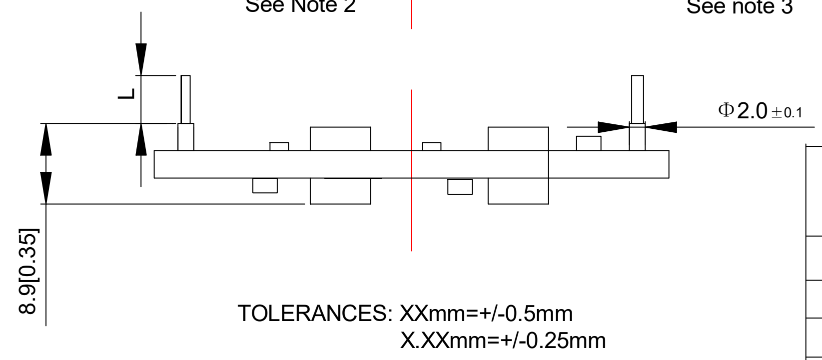
Over Temperature Protection (OTP)

The converter features an over-temperature protection circuit to safeguard against thermal damage. The converter will work on intermittent mode when the maximum device reference temperature is exceeded. When the over-temperature condition is removed, the converter will automatically restart.

MECHANICAL SPECIFICATIONS

Mechanical Outlines (unit: mm)





Pin Length Option

Device Code Suffix	L
-4	4.8mm+/-0.5mm
-6	3.8mm+/-0.5mm
-8	2.8mm+/-0.25mm
NONE	5.8mm+/-0.5mm

Pin Designations

Pin No	Name	Function
1	Vin+	Positive input voltage
2	CNT	Remote control
3	Vin-	Negative input voltage
4	Vo+	Positive output voltage
5	Sense+	Positive remote sense
6	Trim	Output voltage trim
7	Sense-	Negative remote sense
8	Vo-	Negative output voltage

Notes 1 - Un-dimensioned components are for visual reference only.
Notes 2 - Pins 1-3, 5-7 are 1.0mm diameter with 2.0mm diameter standoff shoulders.
Notes 3 - Pins 4, 8 are 1.5mm diameter with no standoff shoulders.

MECHANICAL SPECIFICATIONS

Weight

The AVO50 series weight is 30g typical.

ENVIRONMENTAL SPECIFICATIONS

EMC Test Conditions

Figure 79 shows the filter designed to reduce EMI effects for AVO50. The converter can meet EN55022 CLASS A.

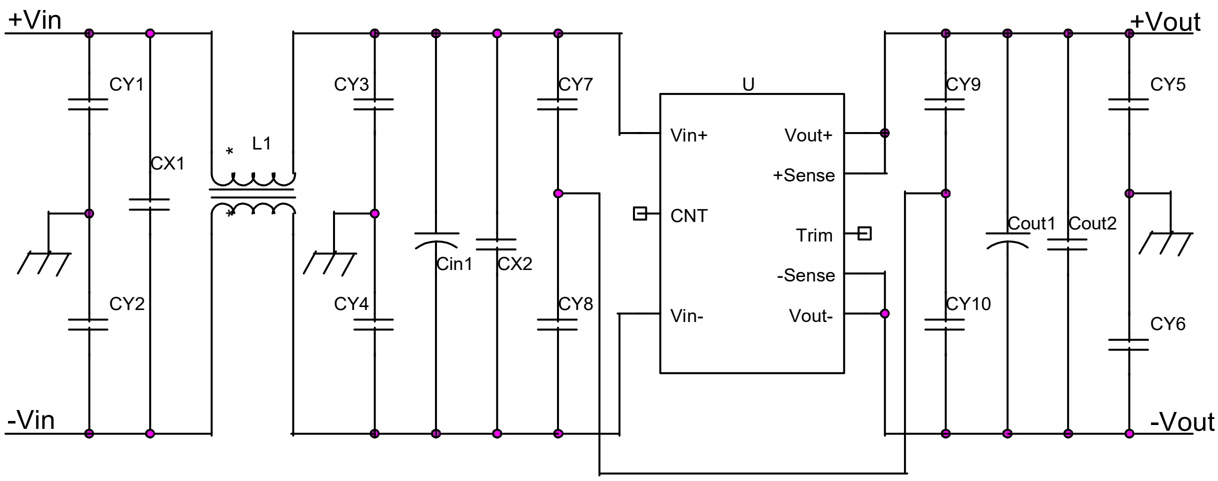


Figure 79 EMI reduction filter

Table 4. Recommended Values:	
Component	**Value/rating**
CY1, CY2, CY5, CY6	4700PF/250VAC
CX1	2.2μ/100V
CY7, CY8, CY9, CY10	1000PF/250VAC
CY3, CY4	0.47μ
Cin1	47μ/100V
CX2	1u/100V
Cout1	470μ/10V (low ESR capacitor)
Cout2	1μ/10V
L1	1.8mH

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The AVO50 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 5. Safety Certifications for AVO50 series module

Standard	Agency	Description
UL/CSA 60950	UL+CUL	US and Canada Requirements
EN62368	TUV	European Requirements
IEC60950	IEC	International Requirements
CE	CE	CE Mark
UKCA Mark		UK Requirements

For safety-agency approval of the system in which the converter is used, the converter must be installed in compliance with the spacing and separation requirements of the end-use safety agency standard, i.e., UL1950, CSA C22.2 No. 950-95, and EN60950. The input-to-output isolation is a basic insulation. The converter should be installed in end-use equipment, in compliance with the requirements of the ultimate application, and is intended to be supplied by an isolated secondary circuit. When the supply to the converter meets all the requirements for SELV (<60Vdc), the output is considered to remain within SELV limits (level 3). If connected to a 60Vdc power system, double or reinforced insulation must be provided in the converter that isolates the input from any hazardous voltages, including the AC mains. One input pin and one output pin are to be grounded or both the input and output pins are to be kept floating. Single fault testing in the converter must be performed in combination with the converter to demonstrate that the output meets the requirement for SELV. The input pins of the converter are not operator accessible.

Note: Do not ground either of the input pins of the converter, without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pin and ground.

To comply with the published safety standards, the following must be observed when using this built-in converter.

1. The converter is intended for use as a component part of other equipment. When installing the converter and marking input and output connections, the relevant safety standards e.g. UL 60950-1; IEC 60950-1/VDE 0805;EN60950-1; CAN/CSA-22.2NO.60950-1-03 must be complied with, especially the requirements for creepage distances, clearances and distance through insulation between primary and earth or primary and secondary.

2. The output power taken from the built-in converter must not exceed the rating given on the converter.

3. The converter is not intended to be repaired by service personnel in case of failure or component defect.

4. The maximum ambient temperature around the converter must not exceed 55 °C.

5. An external forced air cooling (CFM: 80.2, Speed: 1m/s, distance from the converter: 20cm) shall be used for converter operates with full load and ambient up to 55 °C.

6. The converter has no in-line fuse. For safety purpose, a fast acting UL listed fuse or UL recognized fuse rated 5A/250V needs to be connected to the input side as external protection.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature

The AVO50 series power supplies will start and operate within stated specifications at an ambient temperature from -40 ^{O}C to 85 ^{O}C under all load conditions. The storage temperature is -55 ^{O}C to 125 ^{O}C.

Thermal Consideration

Thermal management is an important part of the system design. AVO50 series modules have ultra high efficiency at full load, and the module exhibit good performance during pro-longed exposure to high temperatures. However, to ensure proper and reliable operation, sufficient cooling of the power module and power derating is needed over the entire temperature range of the module. Considerations includes ambient temperature, airflow and module power derating.

Measuring the thermal reference point of the module as the method shown in Fig. 80 can verify the proper cooling.

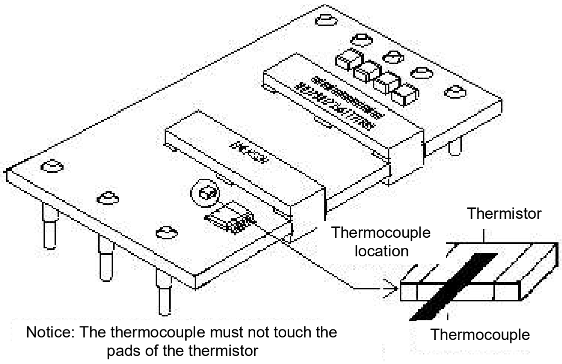


Figure 80 Temperature measurement location

Module Derating

With 48V input, 55 ^{O}C ambient temperature, and 200LFM airflow, AVO50 series are rated for full power. For operation above ambient temperature of 55 ^{O}C, the output power must be derated as shown in derating curves. Meantime, airflow at least 200LFM over the converter must be provided to make the module working properly. It is recommended that the temperature of the thermal reference point be measured using a thermocouple. Temperature on the PCB at the thermocouple location shown in Fig. 80 should not exceed 125 ^{O}C in order to operate inside the derating curve.

ENVIRONMENTAL SPECIFICATIONS

Qualification Testing

Parameter	Unit (pcs)	Test condition
HALT test	4-5	$T_{a,min}$-30 ^{O}C to $T_{a,max}$+25 ^{O}C, 10 ^{O}C step, V_{in} = min to max, 0 ~ 100% load
Vibration	3	Frequency range: 5Hz ~ 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0m^2/s^3, -3db/oct, axes of vibration: X/Y/Z. Time: 30min/axes
Mechanical Shock	3	30g, 6ms, 3axes, 6directions, 3time/direction
Thermal Shock	3	-55 ^{O}C to 125 ^{O}C, unit temperature 20cycles
Thermal Cycling	3	-40 ^{O}C to 85 ^{O}C, temperature change rate: 1^{O}C/min, cycles: 2cycles
Humidity	3	40 ^{O}C, 95%RH, 48h

APPLICATION NOTES

Typical Application

Below is the typical application of the AVO50 series power supply.

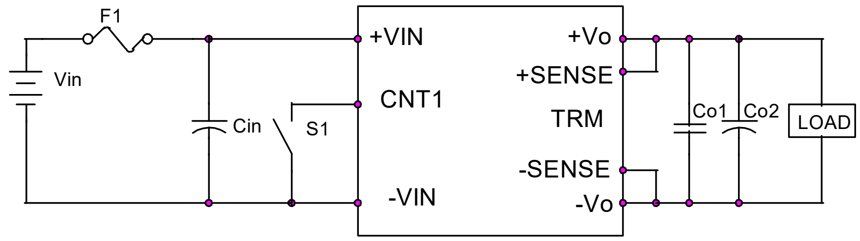


Figure 81 Typical application

F1: 5A, fast flow type fuse. (AVO50 series have no internal fuse. An external fuse must always be employed.)

Cin: 47µF/100V electrolytic type capacitor, high frequency low ESR

Co1: 1µF /10V ceramic capacitor

Co2: 470µF/10V electrolytic type capacitor, high frequency low ESR. (If Ta<-5^{O}C, use 220µF tantalum capacitor parallel with Co2.)

Note: AVO50 cannot be used in parallel mode directly.

APPLICATION NOTES

CNT Function

Two CNT logic options are available. The CNT logic, CNT voltage and the module working state are as the following table. For negative logic models the CNT pin should be connected directly to -Vin to ensure proper operation when no control signal will be used. The external simple CNT circuit is recommended as shown in figure 82.

Table 6. CNT logic Safety for AVO50B-48S3V3 series power supply system			
Model	Signal Logic		
	Low (-0.7V ≤ L ≤ 1.2V)	High (3.5V ≤ H ≤ 12V)	CNT pin open
Negative logic	Module ON	Module OFF	Module OFF
Positive logic	Module OFF	Module ON	Module ON

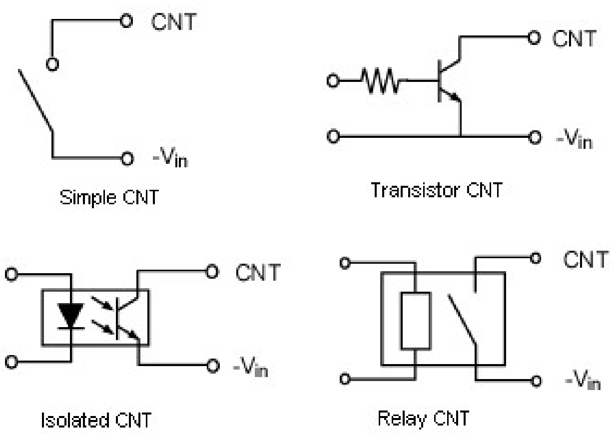


Figure 82 CNT Circuit

APPLICATION NOTES

Trim Characteristics

Connecting an external resistor between Trim pin and -Sense pin will decrease the output voltage. While connecting it between Trim and +Sense will increase the output voltage. The following equations determine the external resistance to obtain the trimmed output voltage.

$$R_{adj-down} = \frac{510}{\Delta} - 10.2(K\Omega)$$

$$R_{adj-up} = \frac{5.1 \times V_{nom} \times (100+\Delta)}{1.225 \times \Delta} - \frac{510}{\Delta} - 10.2(K\Omega)$$

△: Output e rate against nominal output voltage.

$$\Delta = \frac{100 \times (V_{nom} - V_0)}{V_{nom}}$$

V_{nom}: Nominal output voltage

V_{trim} tolerance: < ±2%

R_{adj} tolerance: ±1%

$$\Delta = \frac{100 \times (V_{nom} - V_0)}{V_{nom}} = \frac{100 \times (1.98 - 1.8)}{1.8} = 10$$

For example, to trim up the output of AVO75-48S1V8 to get 1.98V output, the trimming resistor is

$$R_{adj-up} = \frac{5.1 \times 1.8 \times (100+10)}{1.225 \times 10} - \frac{510}{10} - 10.2 = 21.23(K\Omega)$$

When trimming up, the output current should be decreased accordingly so as not to exceed the maximum output power and the minimum input voltage should be increased as shown in below figure.

The output voltage can be increased up to 110% of the V_{nom} or decreased down to 80% of the V_{nom}. Trimming up by more than 10% of the nominal output may activate the OVP or damage the converter. Trimming down more than 20% can cause the converter to regulate improperly. If the trim pin is not needed, it should be left open.

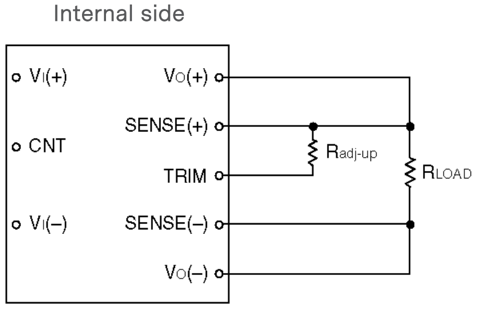


Figure 83 Trim up

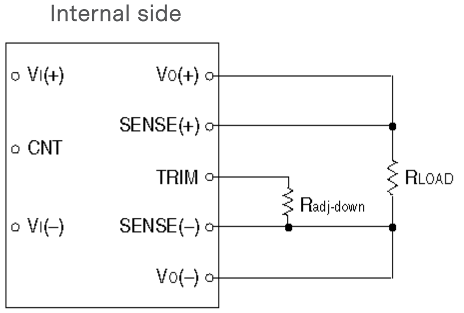


Figure 84 Trim down

APPLICATION NOTES

Output Capacitance

High output current transient rate of change (high di/dt) loads may require high values of output capacitance to supply the instantaneous energy requirement to the load. To minimize the output voltage transient drop during this transient, low ESR (Equivalent Series Resistance) capacitors may be required, since a high ESR will produce a correspondingly higher voltage drop during the current transient.

When the load is sensitive to ripple and noise, an output filter can be added to minimize the effects. A simple output filter to reduce output ripple and noise can be made by connecting a capacitor C1 across the output as shown in Figure 85. The recommended value for the output capacitor C1 is 470µF.

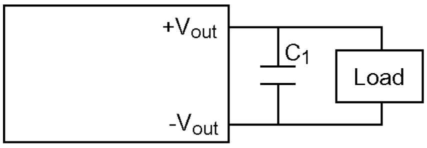


Figure 85 Output ripple filter

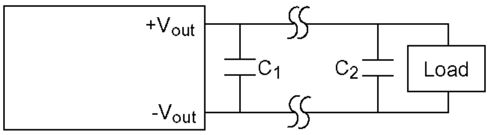


Figure 86 Output ripple filter for a distant load

Extra care should be taken when long leads or traces are used to provide power to the load. Long lead lengths increase the chance for noise to appear on the lines. Under these conditions C1 can be added across the load, with a 1µF ceramic capacitor C2 in parallel generally as shown in Figure 86.

Decoupling

Noise on the power distribution system is not always created by the converter. High speed analog or digital loads with dynamic power demands can cause noise to cross the power inductor back onto the input lines. Noise can be reduced by decoupling the load. In most cases, connecting a 10µF tantalum or ceramic capacitor in parallel with a 0.1µF ceramic capacitor across the load will decouple it. The capacitors should be connected as close to the load as possible.

APPLICATION NOTES

Sense Characteristics

If the load is far from the unit, or is used with undersized cabling, connect +Sense and -Sense to the terminals of the load respectively to compensate the voltage drop on the transmission line. As in the Figure 87, using twisted pair wire, or parallel pattern reduces noise effect.

If the sense compensation function is not necessary, connect +Sense to $+V_o$ and -Sense to $-V_o$ respectively.

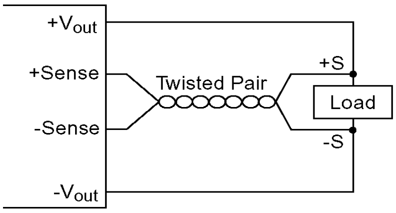


Figure 87 Sense connections

Ground Loops

Ground loops occur when different circuits are given multiple paths to common or earth ground, as shown in Figure 88. Multiple ground points have slightly different potential and cause current flow through the circuit from one point to another. This can result in additional noise in all the circuits. To eliminate the problem, circuits should be designed with a single ground connection as shown in Figure 89.

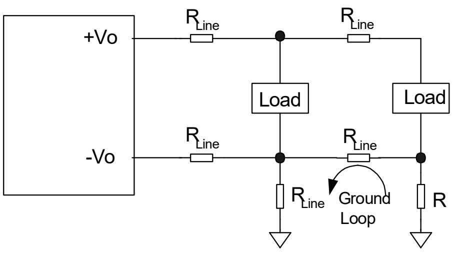


Figure 88 Ground loops

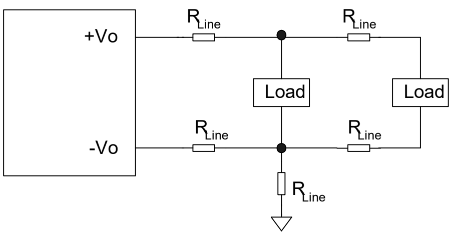


Figure 89 Single point ground

APPLICATION NOTES

Soldering

The converter is compatible with standard wave soldering techniques. When wave soldering, the converter pins should be preheated for 20~30 seconds at 110°C, and wave soldered at 260°C for less than 10 seconds.

When hand soldering, the iron temperature should be maintained at 425°C and applied to the converter pins for less than 5 seconds. Longer exposure can cause internal damage to the converter. Cleaning can be performed with cleaning solvent IPA or with water.

Installation

Although the converter can be mounted in any orientation, free airflow must be taken. Normally power components are always put at the end of airflow path or have separate airflow paths. This can keep other system equipment cooler and increase component life spans.

RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	08.11.2014	First Issue	K. Wang
1.1	03.13.2018	1.Add a note on page 5 that 40mS for AVO50-48S12-6L 2.Update the waveform for start up	K. Wang
1.2	02.25.2020	Update the RoHS information	A. Zhang
1.3	05.24.2022	Add UKCA Mark	J. Zhang

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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.

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