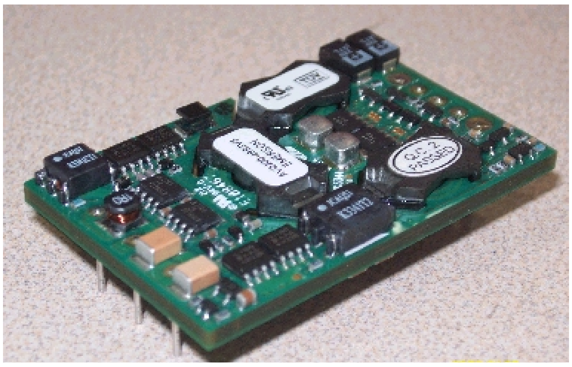
ALQ Isolated DC/DC Converter Module

Industry Standard Quarter Brick : 36~75V Input, 1.2V, 1.5V, 1.8V, 2.5V and 3.3V single Output



Industry Standard Quarter Brick :
2.28"X 1.45" X 0.38"

Features

- **Delivers up to 40A output current**
- **Industry Standard Quarter Brick 57.9mm X 36.8mm X 9.60mm （2.28"X 1.45" X 0.38"）**
- **Basic isolation**
- **Ultra High efficiency**
- **Improved thermal performance: 28A at 55ºC at 1ms-1（200LFM）for 3.3Vo**
- **High power density**
- **Low output noise**
- **Industry standard pinout**
- **2:1 wide input voltage of 36-75V**
- **CNT function**
- **Remote sense**
- **Trim function: +10%/-20%**
- **Input under-voltage lockout**
- **Output over-current protection**
- **Output over-voltage protection**
- **Over-temperature protection**

Options

- Choice of positive logic or negative logic for CNT function
- Choice of short pins or long pins

Description

The ALQ series is a new open frame DC-DC converter for optimum efficiency and power density. The ALQ series provide up to 40A output current in an industry standard quarter brick, which makes it an ideal choice for small space, high current and low voltage applications. The ALQ series uses an industry standard quarter brick: 57.9mm X 36.8mm X 9.60mm (2.28"x1.45"x0.38") and standard pinout configuration, provides CNT and trim functions. ALQ series can provide 3.3V@35A, 2.5V@40A, 1.8V@40A, 1.5V@40A and 1.2V@40A single output, outputs are isolated from inputs. The series can achieve ultra high efficiency, for most applications a heat sink is not required.

Contents

Module Numbering

ALQ		—	35	F	48	N	- 7
1	2		3	4	5	6	7

Explanation:

1－Low profile (open frame, No case-isolated)

2－Quarter Brick

3－Output current: 35=35Amps

4－Output voltage: F=3.3V; G=2.5V; Y=1.8V; M=1.5V; K=1.2V

5－Input voltage: 48=36~75V

6－CNT logic: N＝Negative logic, Omit for positive logic

7—Pin length: Omit for 4.8 mm±0.5mm (0.189in.±0.02in.)

6=3.80mm±0.25mm(0.150in.±0.010in.)

8=2.80mm±0.25mm(0.110in.±0.010in.)

7=5.8 mm±0.5mm (0.228in.±0.02in.)

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage and temperature conditions. Standard test condition on a single unit is as following:

Tc (board):	25°C
+Vin:	48V +/ –2%
–Vin:	return pin for +Vin
CNT:	connect to -Vin
+Vout:	connect to load
–Vout:	connect to load (return)
+Sense:	connect to +Vout
-Sense:	connect to -Vout
Trim(Vadj):	Open

Input Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V_I	36	48	75	V_{DC}
Maximum Input Current (V_I = 0 to $V_{I,max}$, Io = Io,max)	All	$I_{I,max}$	-	-	4.5	A
Input Reflected-ripple Current (5Hz to 20MHz: 12uH source impedance: T_A = 25 ºC.)	All	I_I	-	-	20	mAp-p
Supply voltage rejection (1kHz)	All	-	50	-	-	dB

CAUTION: This power module is not internally fused. An input line fuse must always be used.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the IPS. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	**Device**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Input Voltage: Continuous: Transient (100ms)	 All All	 V_I $V_{I,\ trans}$	 0 0	 - -	 75 100	 Vdc Vdc
Operating Ambient Temperature （See Thermal Consideration）	All	Ta	-40	-	55	ºC
Operating Board Temperature	All	Tc	-	-	100	ºC
Storage Temperature	All	T_{STG}	-55	-	125	ºC
Operating Humidity	All	-	-	-	85	%
Basic Isolation (Conditions: 50µA for 5 sec, slew rate of 1500V/10sec) Input-Output	All	-	-	-	1500	Vdc
Output Power	3.3V 2.5V 1.8V 1.5V 1.2V	Po,max Po,max Po,max Po,max Po,max	- - - - -	- - - - -	115.5 100 72 60 48	W W W W W

Output Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Ripple and Noise (Across 1μF @10V, X7R ceramic capacitor & 1000μF @10V LOW ESR Aluminum capacitor) Peak-to-Peak (5 Hz to 20 MHz)	3.3V	-	-	-	120	mVp-p
	2.5V	-	-	-	100	mVp-p
	1.8V	-	-	-	100	mVp-p
	1.5V	-	-	-	100	mVp-p
	1.2V	-	-	-	80	mVp-p
External Load Capacitance	All	-	-	-	15000	μF
Output Voltage Setpoint (V_I = $V_{I,min}$ to $V_{I,max}$: Io = Io,max; Ta = 25 ºC)	3.3V	$V_{o,set}$	3.25	3.3	3.35	Vdc
	2.5V	$V_{o,set}$	2.46	2.5	2.54	Vdc
	1.8V	$V_{o,set}$	1.77	1.8	1.83	Vdc
	1.5V	$V_{o,set}$	1.48	1.5	1.52	Vdc
	1.2V	$V_{o,set}$	1.18	1.2	1.22	Vdc
Output Regulation:						
Line ($V_{i,min}$ to $V_{i,max}$)	All	-	-	0.1	0.3	%
Load (Io = Io,min to Io,max)	All	-	-	0.2	0.5	%
Temperature (Tc = -40 ºC to +100ºC)	All	-	-	-	0.02	%Vo/ºC
		-	-	-		
Rated Output Current	3.3V	Io	0	-	35	A
	2.5V	Io	0	-	40	A
	1.8V	Io	0	-	40	A
	1.5V	Io	0	-	40	A
	1.2V	Io	0	-	40	A
Output Current-limit Inception (Hiccup)	3.3V	Io	38.5	-	49	A
	2.5V	Io	44	-	56	A
	1.8V	Io	44	-	56	A
	1.5V	Io	44	-	56	A
	1.2V	Io	44		56	A
Efficiency (V_I = $V_{I,nom}$; $I_{o,max}$; T_A = 25°C)	3.3V	-	88	90	-	%
	2.5V	-	86.5	88.5	-	%
	1.8V	-	85	87	-	%
	1.5V	-	84	86	-	%
	1.2V	-	83	85	-	%

Output Specifications (Cont)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Dynamic Response : ($\Delta Io/\Delta t$ = 1A/10µs ; $V_I = V_{I,nom}$; TA = 25°C)						
Load Change from Io = 50% to 75% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	3.3V (2.5V、1.8V)	- -	- -	- -	5 400	%Vo µsec
Load Change from Io = 50% to 75% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	1.5V （1.2V）	- -	- -	- -	6 400	%Vo µsec
Load Change from Io = 50% to 25% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	3.3V (2.5V、1.8V)	- -	- -	- -	5 400	%Vo µsec
Load Change from Io = 50% to 25% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	1.5V （1.2V）	- -	- -	- -	6 400	%Vo µsec
Dynamic Response: ($\Delta Io/\Delta t$ = 1A/1µs ; $V_I = V_{I,nom}$; TA = 25°C，additional 220µF load capacitor)						
Load Change from Io = 50% to 75% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	3.3V (2.5V、1.8V、1.5V)	- -	- -	- -	200 400	mv µsec
Load Change from Io = 50% to 75% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	1.2V	- -	- -	- -	180 400	mv µsec
Load Change from Io = 50% to 25% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	3.3V (2.5V、1.8V、1.5V)	- -	- -	- -	200 400	mv µsec
Load Change from Io = 50% to 25% of Io,max :Peak Deviation Settling Time (to $V_{o,nom}$)	（1.2V）	- -	- -	- -	180 400	mv µsec

Output Specifications (Cont)

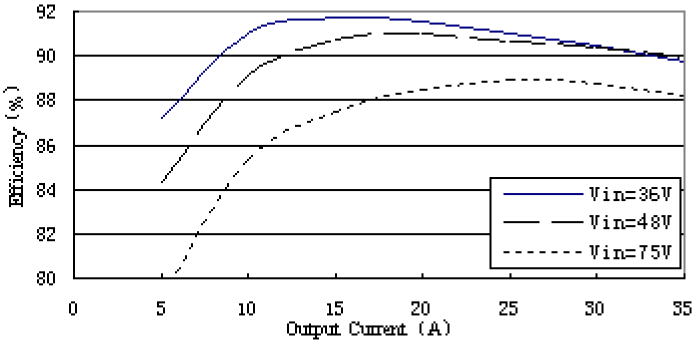
Parameter	Device	Symbol	Min	Typ	Max	Unit
Turn-On Time (Io = Io,max ; Vo within 1%)	All	-	-	-	20	msec
Output Voltage Overshoot (Io = Io,max ; T_A = 25°C)	All	-	-	-	5	%Vo
Switching Frequency	All	-		200		KHz

Feature Specifications

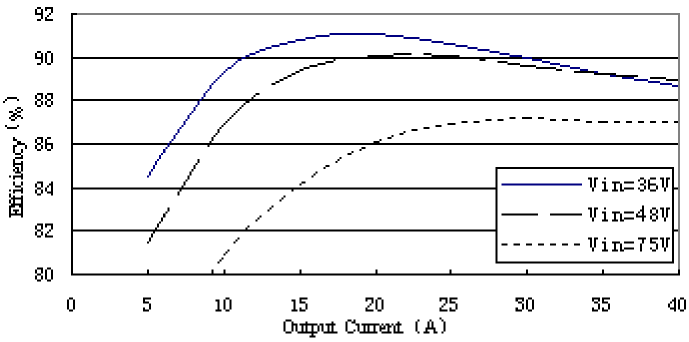
Parameter	Device	Symbol	Min	Typ	Max	Unit
Enable pin voltage: Logic Low Logic High	 All All		 -0.7 3.5	 - -	 1.2 12	 V V
Enable pin current: Logic Low Logic High (leakage current, @10V)	 All All		 - -	 - -	 1.0 -	 mA μA
Output Voltage Adjustment Range	All	-	80	-	110	%Vo
Output Over-voltage (Hiccup)	3.3V 2.5V 1.8V 1.5V 1.2V	Vo_{clamp} Vo_{clamp} Vo_{clamp} Vo_{clamp} Vo_{clamp}	3.75 3.00 2.20 1.80 1.40	- - - - -	5.00 3.80 3.00 2.50 2.00	V V V V V
Under-voltage Lockout Turn-on Point Turn-off Point	 All All	 - -	 31 30	 34 33	 36 35	 V V
Isolation Capacitance	All	-	-	1000	-	PF
Isolation Resistance	All	-	10	-	-	MΩ
Calculated MTBF (Io = Io,max ; Tc = 25°C)	All	-	-	2,000,000	-	Hours
Weight	All	-	-	-	60	g(oz.)

Characteristic Curves

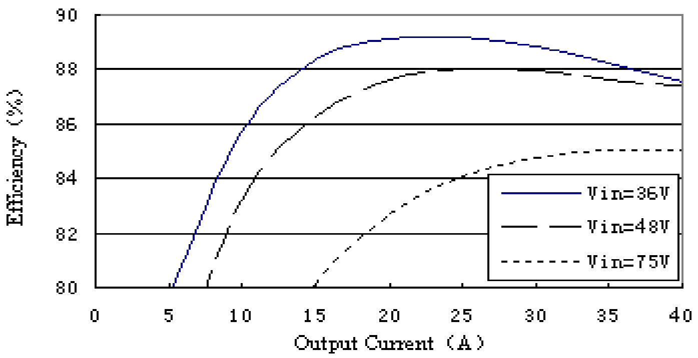
Performance Curves – Efficiency



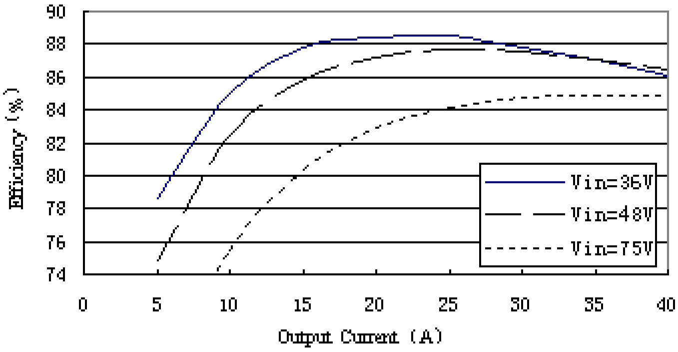
Typical Efficiency ALQ-35F48N



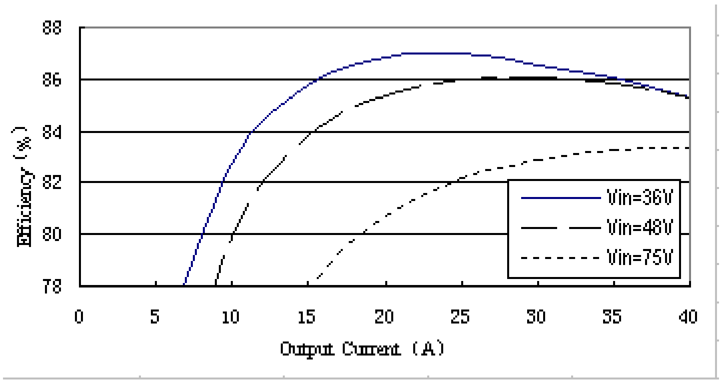
Typical Efficiency ALQ-40G48N



Typical Efficiency ALQ-40Y48N

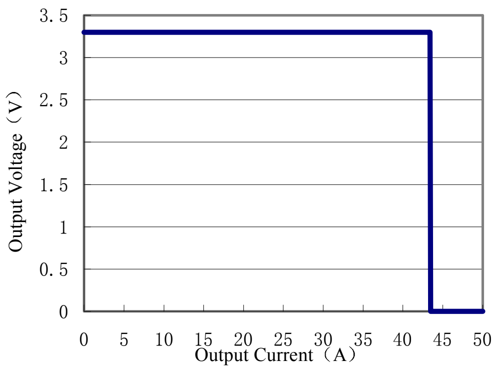


Typical Efficiency ALQ-40M48N

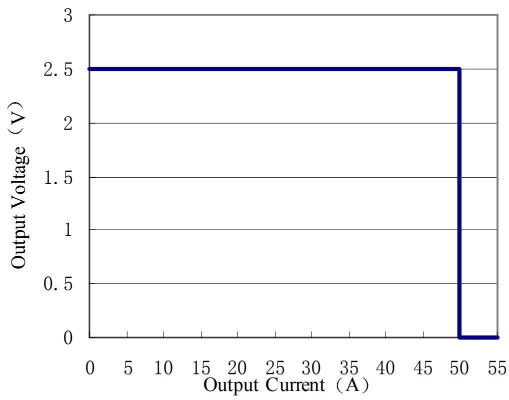


Typical Efficiency ALQ-40K48N

Performance Curves – Output Performance Curves



ALQ-35F48N Typical Output Over-current Curves



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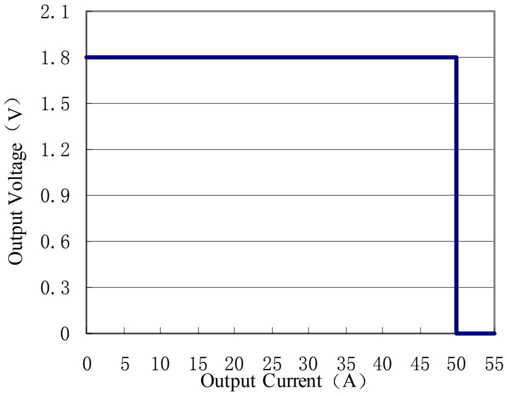

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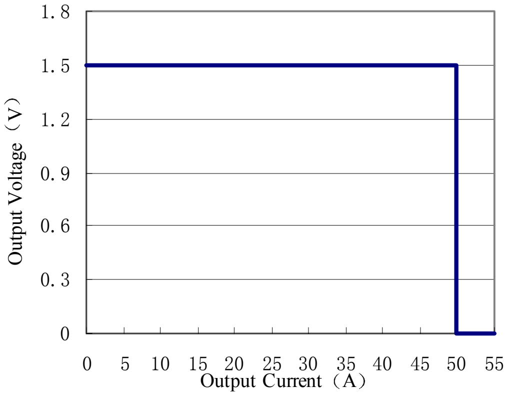

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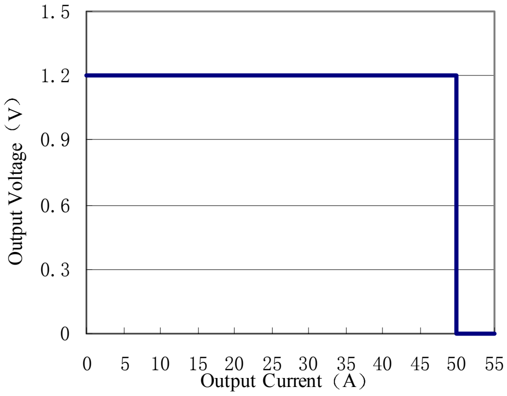

ALQ-40K48N Typical Output Over-current Curves

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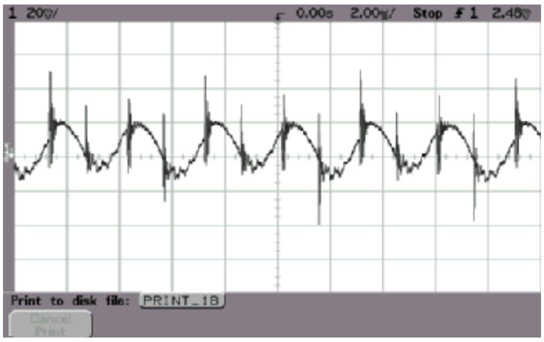
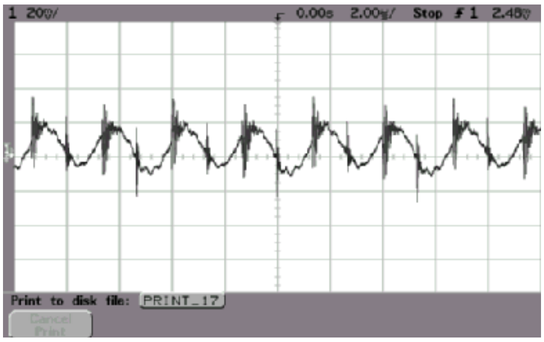


ALQ-35F48N Typical Output Ripple Voltage

Room Temperature, Io = Io,max



ALQ-40G48N Typical Output Ripple Voltage

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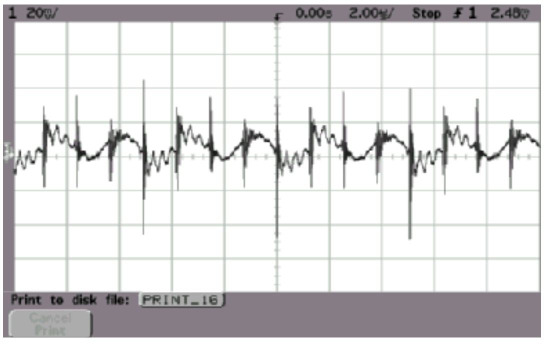
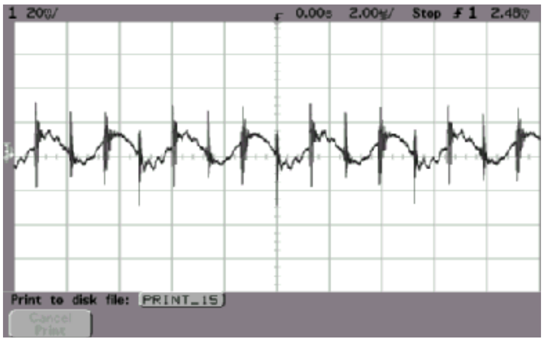


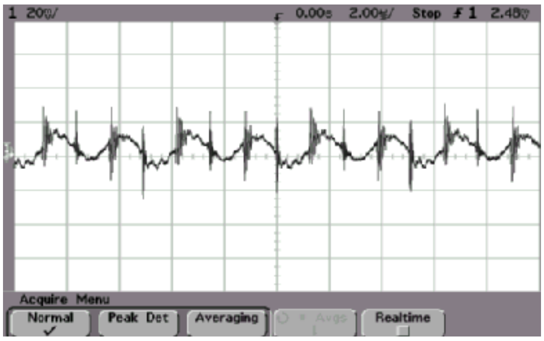
ALQ-40Y48N Typical Output Ripple Voltage

Room Temperature, Io = Io,max



ALQ-40M48N Typical Output Ripple, Voltage

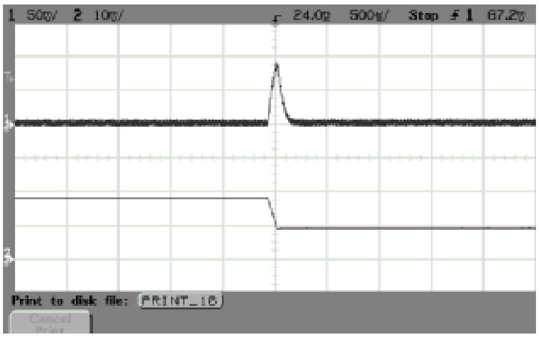
Room Temperature, Io = Io,max



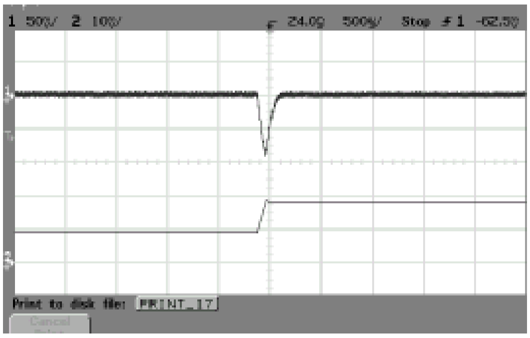
ALQ-40K48N Typical Output Ripple Voltage

Room Temperature, Io = Io,max

Performance Curves – Transient Response



ALQ-35F48N Typical Transient Response to
Step Decrease in Load from 50% to 25%
of Full Load, Room Temperature, 48Vdc Input
（ΔIo/Δt = 0.1A/1μs）



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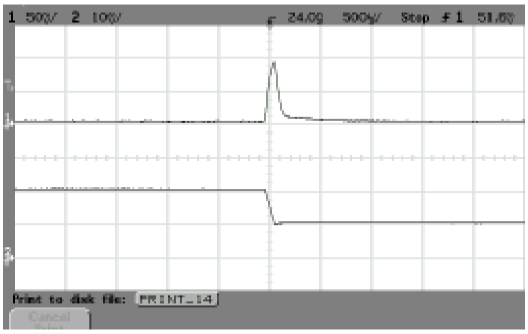

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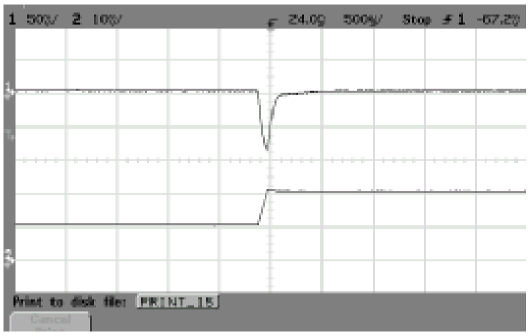

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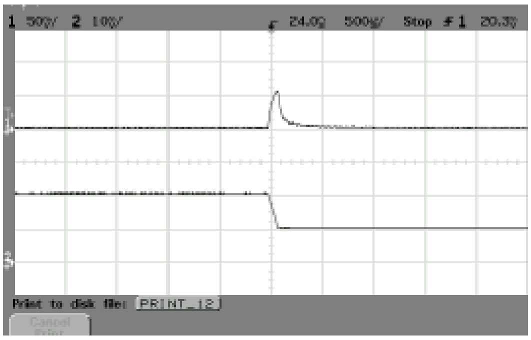
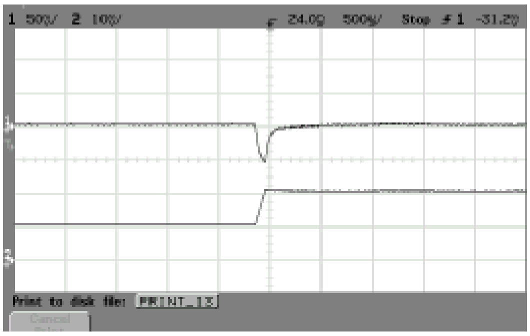


ALQ-40Y48N Typical Transient Response to
Step Decrease in Load from 50% to 25%
of Full Load, Room Temperature, 48Vdc Input
（ΔIo/Δt = 0.1A/1μs）



ALQ-40Y48N Typical Transient Response to
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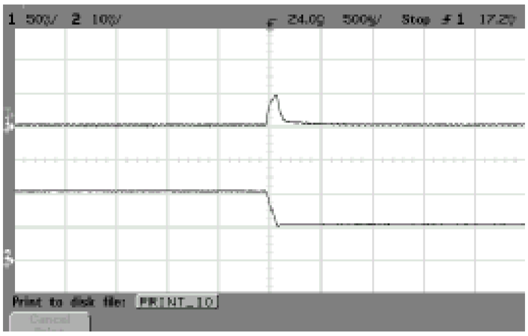
（ΔIo/Δt = 0.1A/1μs）

Performance Curves – Transient Response (Cont)



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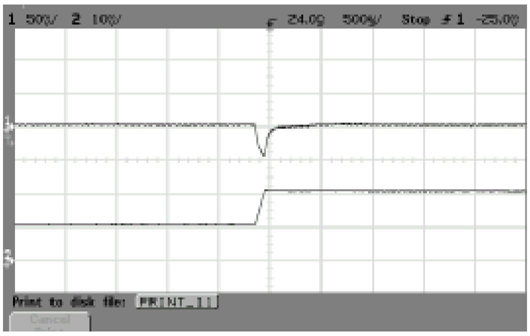

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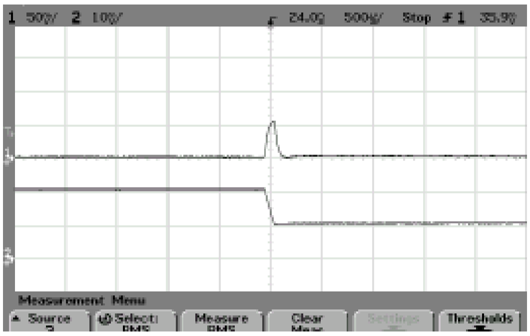
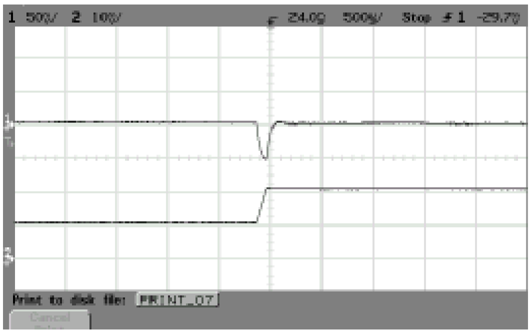
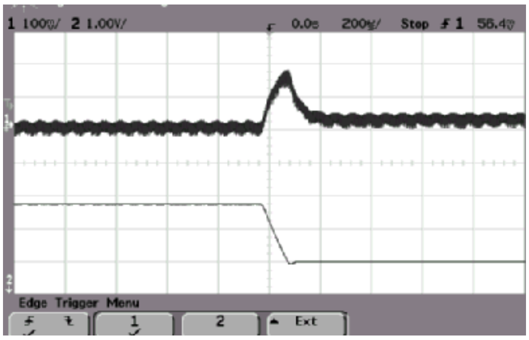


ALQ-40K48N Typical Transient Response to Step Decrease in Load from 50% to 25% of Full Load, Room Temperature, 48Vdc Input （ΔIo/Δt = 0.1A/1μs）

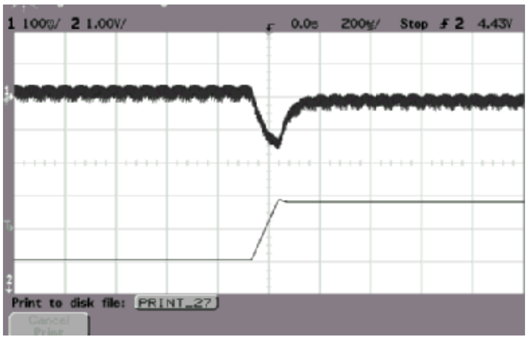


ALQ-40K48N Typical Transient Response to Step Increase in Load from 50% to 75% of Full Load, Room Temperature, 48Vdc Input （ΔIo/Δt = 0.1A/1μs）

Performance Curves – Transient Response(Cont)



ALQ-35F48N Typical Transient Response to
Step Decrease in Load from 50% to 25%
of Full Load, Room Temperature, 48Vdc Input
(ΔIo/Δt = 1A/1µs)



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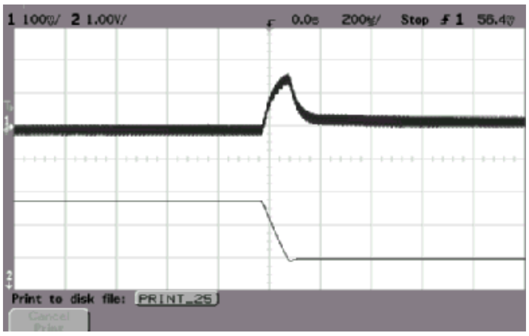

ALQ-40G48N Typical Transient Response to
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of Full Load, Room Temperature, 48Vdc Input
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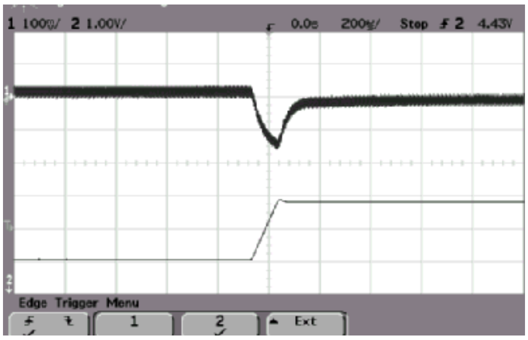

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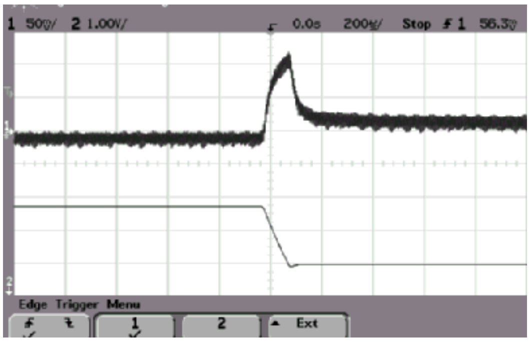
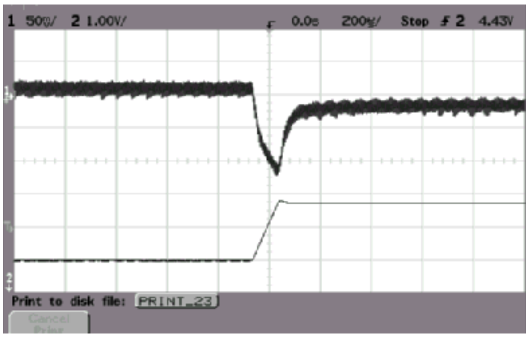


ALQ-40Y48N Typical Transient Response to
Step Decrease in Load from 50% to 25%
of Full Load, Room Temperature, 48Vdc Input
(ΔIo/Δt = 1A/1µs)



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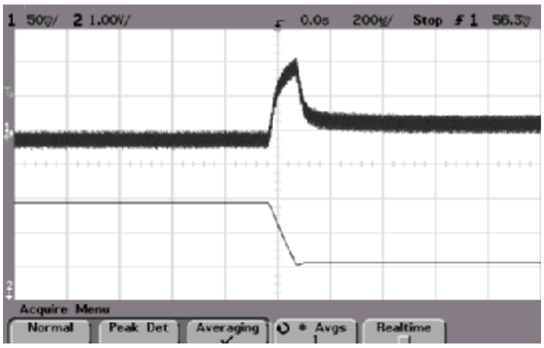
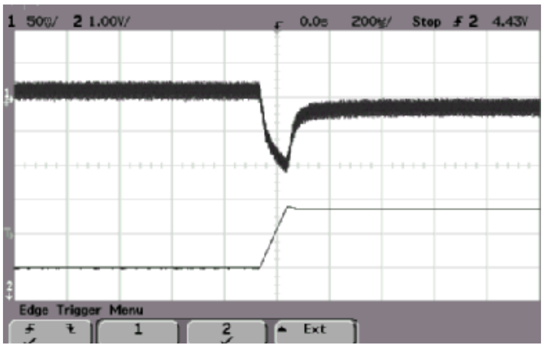
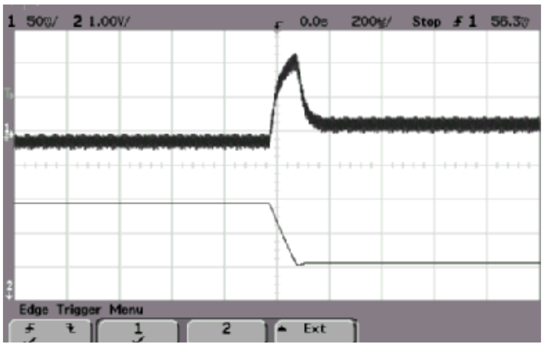
Performance Curves – Transient Response (Cont)



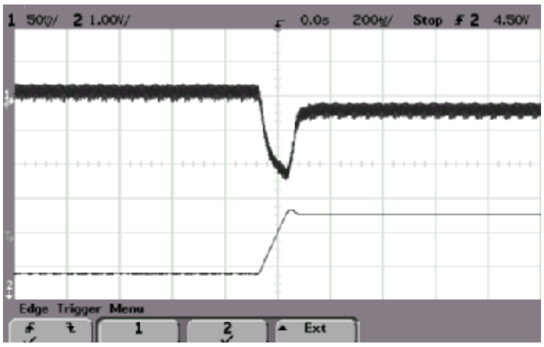
ALQ-40M48N Typical Transient Response to Step Decrease in Load from 50% to 25% of Full Load, Room Temperature, 48Vdc Input （$\Delta Io/\Delta t$ = 1A/1μs）



ALQ-40M48N Typical Transient Response to Step Increase in Load from 50% to 75% of Full Load, Room Temperature, 48Vdc Input （$\Delta Io/\Delta t$ = 1A/1μs）

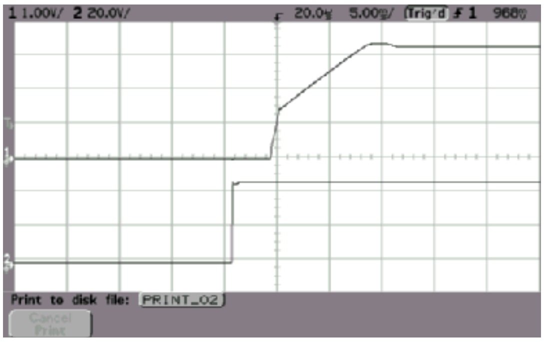


ALQ-40K48N Typical Transient Response to Step Decrease in Load from 50% to 25% of Full Load, Room Temperature, 48Vdc Input （$\Delta Io/\Delta t$ = 1A/1μs）

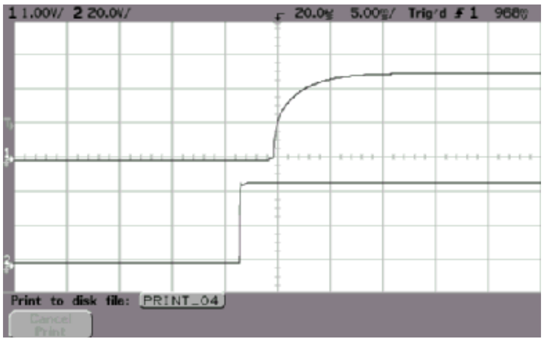


ALQ-40K48N Typical Transient Response to Step Increase in Load from 50% to 75% of Full Load, Room Temperature, 48Vdc Input （$\Delta Io/\Delta t$ = 1A/1μs）

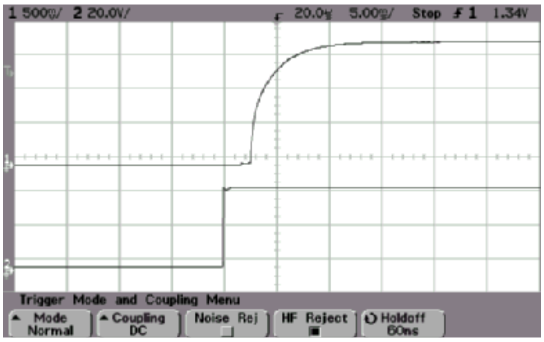
Performance Curves – Startup Characteristics



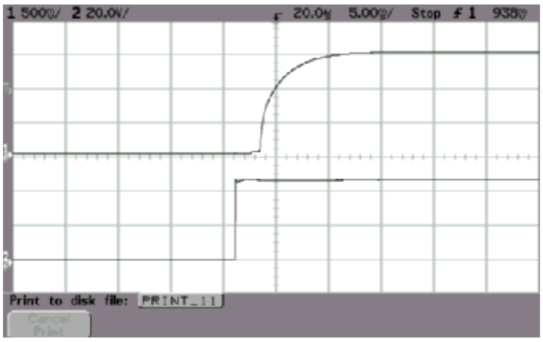
ALQ-35F48N Typical Start-up from Power On



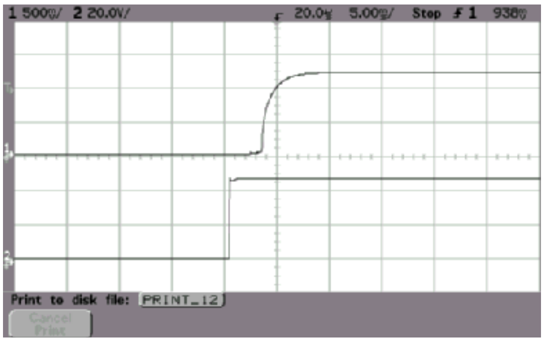
ALQ-40G48N Typical Start-up from Power On



ALQ-40Y48N Typical Start-up from Power On

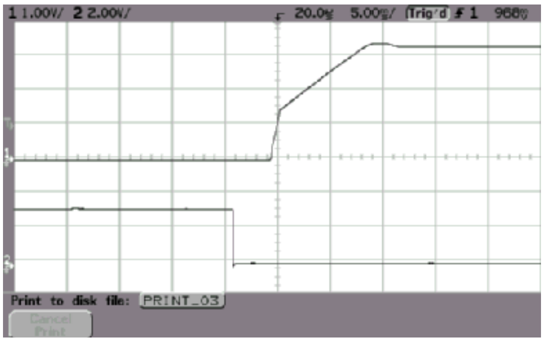


ALQ-40M48N Typical Start-up from Power On

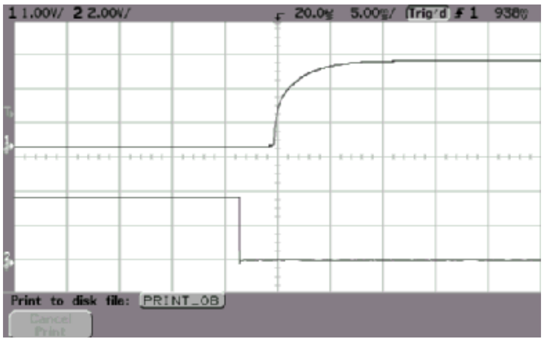


ALQ-40K48N Typical Start-up from Power On

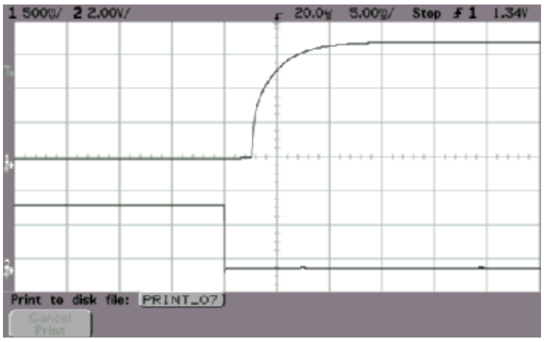
Performance Curves – Startup from CNT Control



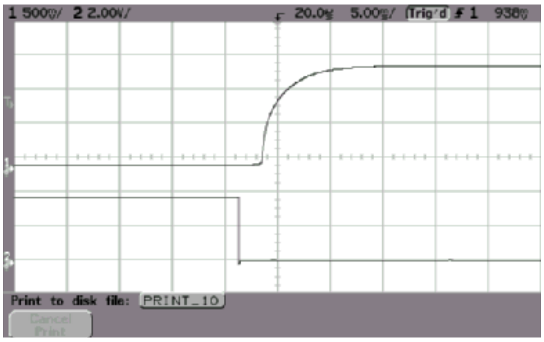
ALQ-35F48N Typical Start-up from CNT On



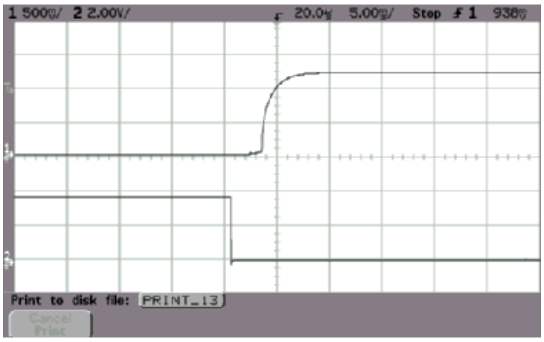
ALQ-40G48N Typical Start-up from CNT On



ALQ-40Y48N Typical Start-up from CNT On



ALQ-40M48N Typical Start-up from CNT On



ALQ-40K48N Typical Start-up from CNT On

Feature Description

CNT Function

Two CNT logic options are available. The CNT logic, CNT voltage and the module working state are as the following Table 1.

	L	H	OPEN
N	**ON**	**OFF**	**OFF**
P	**OFF**	**ON**	**ON**

Table 1

N--- means “Negative Logic”

P--- means “Positive Logic”

L--- means “Low Voltage”, -0.7V⩽L⩽1.2V

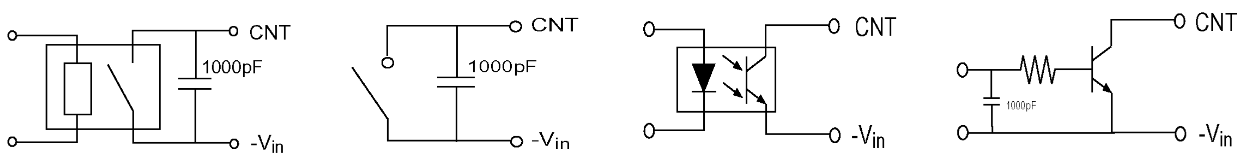
H--- means “High Voltage”, 3.5V⩽H⩽12V

ON--- means “Module is on”, OFF--- means “Module is off”

Open--- means “CNT pin is left open “

Note: Normally, V_{CNT} ⩽12V.

The following Figure shows a few simple CNT circuits.



Relay CNT　　Simple CNT　　Isolated CNT　　Transistor CNT

Remote Sense

The ALQ converter can remotely sense both lines of its output which moves the effective output voltage regulation point from the output terminals of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the ALQ in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load.

When the converter is supporting loads far away, or is used with undersized cabling, significant voltage drop can occur at the load. The best defense against such drops is to locate the load close to the converter and to ensure adequately sized cabling is used. When this is not possible, the converter can compensate for a drop of up to 10%Vo, through use of the sense leads.

When used, the + Sense and - Sense leads should be connected from the converter to the point of load as shown in Figure 1, using twisted pair wire, or parallel pattern to reduce noise effect. The converter will then regulate its output voltage at the point where the leads are connected. Care should be taken not to reverse the sense leads. If reversed, the converter will trigger OVP protection .

When not used, the +Sense lead must be connected with +Vo, and -Sense with -Vo. Although the output voltage can be increased by both the remote sense and by the trim, the maximum increase for the output voltage is not the sum of both.

The maximum increase is the larger of either the remote sense or the trim.

Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.

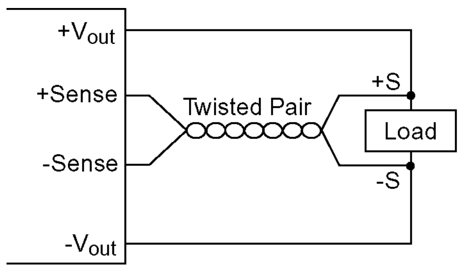


Fig. 1 Sense Connections

Trim

The +Vo output voltage of the ALQ series can be trimmed using the trim pin provided. Applying a resistor to the trim pin through a voltage divider from the output will cause the +Vo output to increase by up to 10%or decrease by up to 20%. Trimming up by more than 10% of the nominal output may activate the OVP circuit 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.

Trim up

With an external resistor connected between the TRIM and +SENSE pins, the output voltage set point increases (see Figure 2).

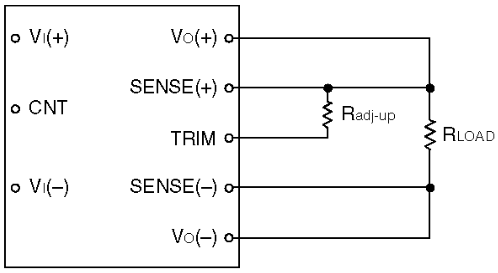


Fig.2 Trim up circuit

The following equation determines the required external-resistor value to obtain a percentage output voltage change of %.

For Output Voltage: 1.5V – 3.3V

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

For Output Voltage: 1.2V

$$R_{adj-up} = \frac{5.1 \times V_o \times (100 + \Delta\%)}{0.6 \times \Delta\%} - \frac{510}{\Delta\%} - 10.2(K\Omega)$$

Trim down

With an external resistor between the TRIM and -SENSE pins, the output voltage set point decreases (see Figure 3).

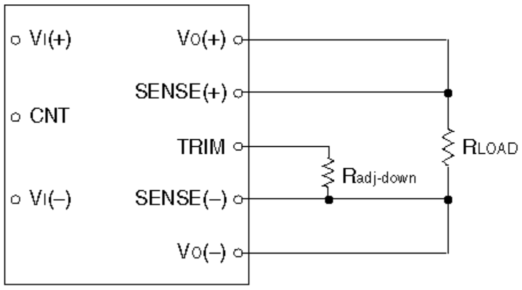


Fig.3 Trim down circuit

The following equation determines the required external-resistor value to obtain a percentage output voltage change of %.

For Output Voltage: 1.2V – 3.3V

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

Although the output voltage can be increased by both the remote sense and by the trim, the maximum increase for the output voltage is not the sum of both. The maximum increase is the larger of either the remote sense or the trim.

Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.

Minimum Load Requirements

There is no minimum load requirement for the ALQ series modules.

Parameter	Device	Symbol	Typ	Unit
Minimum Load	3.3V	I_{MIN}	0	A
	2.5V	I_{MIN}	0	A
	1.8V	I_{MIN}	0	A
	1.5V	I_{MIN}	0	A
	1.2V	I_{MIN}	0	A

Output Over-current Protection

ALQ series DC/DC converters 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 module will work on intermittent mode, also can tolerate short circuit conditions indefinitely. When the over-current condition is removed, the converter will automatically restart.

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 E.S.R. (equivalent series resistance) capacitors may be required, since a high E.S.R. 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 4. The recommended value for the output capacitor C1 is 1000 μF

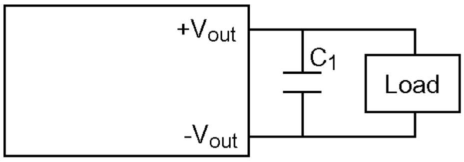


Fig.4 Output Ripple Filter

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 C2 can be added across the load, with a 1 μF ceramic capacitor C3 in parallel generally as shown in Figure 5.

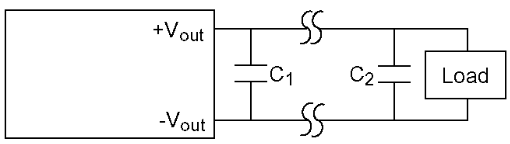


Fig.5 Output Ripple Filter for a Distant Load

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 10 µ F tantalum or ceramic capacitor in parallel with a 0.1 µ F ceramic capacitor across the load will decouple it. The capacitors should be connected as close to the load as possible.

Ground Loops

Ground loops occur when different circuits are given multiple paths to common or earth ground, as shown in Figure 6. Multiple ground points can 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 7.

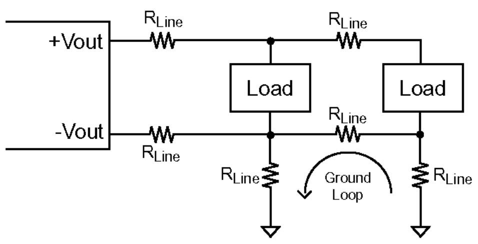


Fig.6 Ground Loops

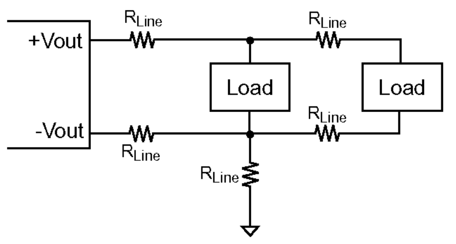


Fig.7 Single Point Ground

Output Over-Voltage Protection

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 module will work on intermittent mode. When the over-voltage condition is removed, the converter will automatically restart.

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

Over-Temperature Protection

These modules feature an over-temperature protection circuit to safeguard against thermal damage. The module 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.

Design Consideration

Typical Application

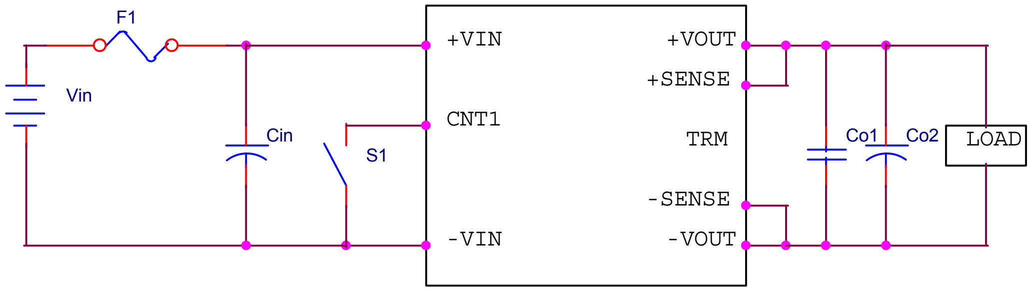


Fig.8 Typical application

F1: Fuse*: Use external fuse (fast blow type) for each unit.

For 3.3V output: **10A** (Pout=115.5W)
For 2.5V output: **10A** (Pout=100W)
For 1.8V output: **8A** (Pout=75W)
For 1.5V output: **8A** (Pout=60W)
For 1.2V output: **5A** (Pout=48W)

Cin: Recommended input capacitor

100 μ F/100V high frequency low ESR electrolytic type capacitor .

Co1: Recommended 1 μ F /10V ceramic capacitor

Co2: Recommended output capacitor

Recommended 1000 μ F/10V high frequency low ESR electrolytic type capacitor.

If Ta<-5℃: use 2 X 220 μ F tantalum capacitor parallel with a 1000 μ F/ 10V high
frequency low ESR electrolytic capacitor.

Note: The ALQ modules can not be used in parallel mode directly!

Fusing

The ALQ power modules have no internal fuse. An external fuse must always be employed! To meet international safety requirements, a 250 Volt 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 fuse ratings for the ALQ Series are are shown as following list.

For 3.3V output: **10A** (Pout=115.5W)

For 2.5V output: **10A** (Pout=100W)

For 1.8V output: **8A** (Pout=75W)

For 1.5V output: **8A** (Pout=60W)

For 1.2V output: **5A** (Pout=48W)

Note: the fuse is fast blow type.

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 9. 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.

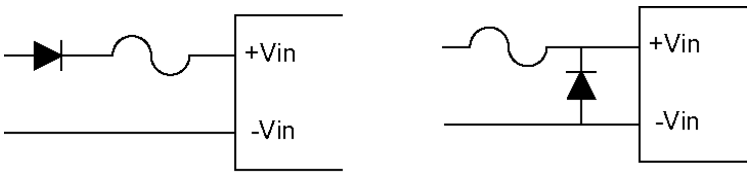


Fig.9 Reverse Polarity Protection Circuit

EMC

For conditions where EMI is a concern, a different input filter can be used. Figure 10 shows a filter designed to reduce EMI effects. ALQ series can meet EN55022 CLASS A with Figure 10.

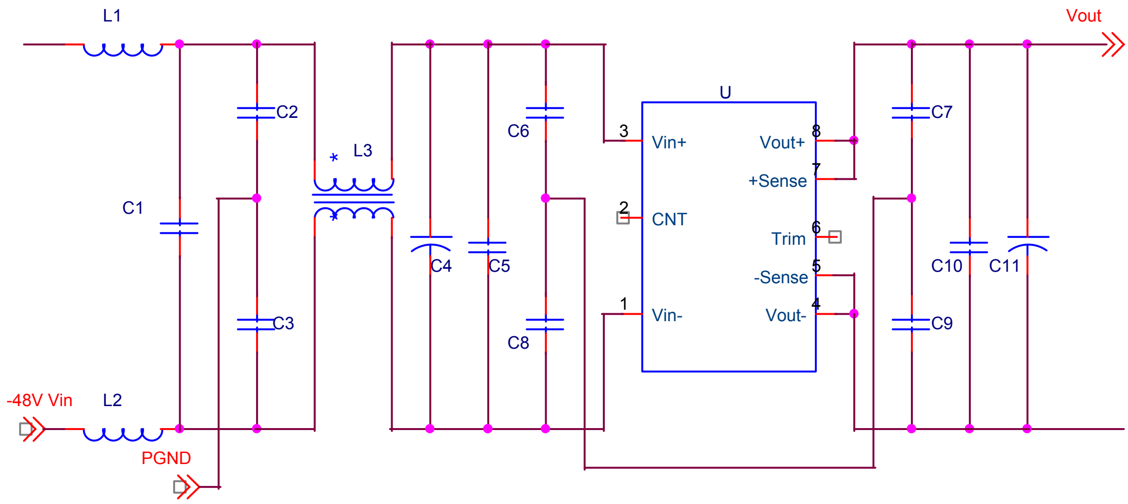


Fig.10 EMI Reduction Filter

Recommended values:

C1	1uF/100V
C2,C3	0.22uF
C4	100uF/100V
C5	1uF/100V
C6,C7	3300P/2KV
C8,C9	1000P/2KV
C10	22uF/6.3V
C11	1000uF/10V
L1,L2	H5B SMB
L3	1.8mH

Safety Consideration

For safety-agency approval of the system in which the power module is used, the power module 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 ALQ series input-to-output isolation is an basic insulation. The DC/DC power module 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 DC/DC power module 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 power supply 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 power supply must be performed in combination with the DC/DC power module to demonstrate that the output meets the requirement for SELV. The input pins of the module are not operator accessible.

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

Thermal Consideration

Technologies

ALQ modules have ultra high efficiency at full load. With less heat dissipation and temperature-resistant components such as ceramic capacitors, these modules exhibit good behavior during pro-longed exposure to high temperatures. Maintaining the operating board temperature within the specified range help keep internal component temperatures within their specifications which in turn help keep MTBF from falling below the specified rating. Proper cooling of the power modules is also necessary for reliable and consistent operation.

Basic Thermal Management

Measuring the board temperature of the module as the method shown in Figure 11 can verify the proper cooling.

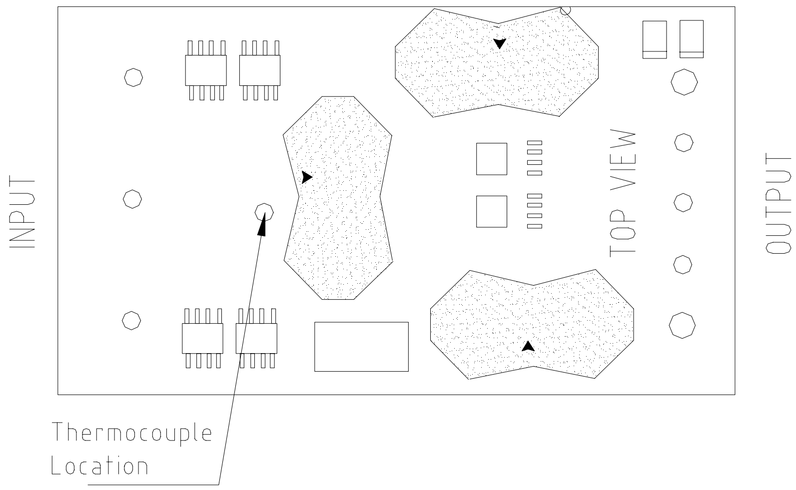


Fig.11 Temperature Measurement Location

The module should work under 55°C ambient for the reliability of operation and the board temperature must not exceed 100°C while operating in the final system configuration. The measurement can be made with a surface probe after the module has reached thermal equilibrium. No heat sink is mounted, make the measurement as close as possible to the indicated position. It makes the assumption that the final system configuration exists and can be used for a test environment. Note that the board temperature of module must always be checked in the final system configuration to verify proper operation due to the variation in test conditions. Thermal management acts to transfer the heat dissipated by the module to the surrounding environment. The amount of power dissipated by the module as heat (PD) is got by the equation below:

PD = PI - PO

where : PI is input power; PO is output power; PD is dissipated power.

Also, module efficiency（η）is defined as the following equation:

η = PO / PI

If eliminating the input power term, from two above equations can yield the equation below:

PD = PO (1- η) / η

The module power dissipation then can be calculated through the equation.

Because each power module output voltage has a different power dissipation curve, a plot of

power dissipation versus output current over three different line voltages is given in the following figures. The typical power dissipation curve of ALQ series are shown as following figure 12 to 16.

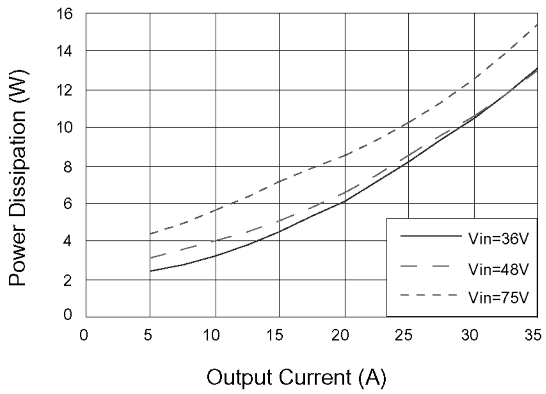


Fig.12 Typical power dissipation curve of ALQ-35F48N

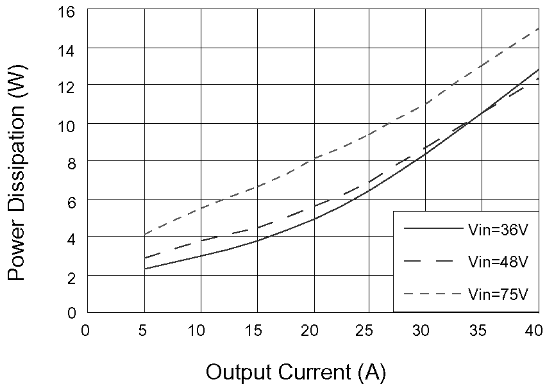


Fig.13 Typical power dissipation curve of ALQ-40G48N

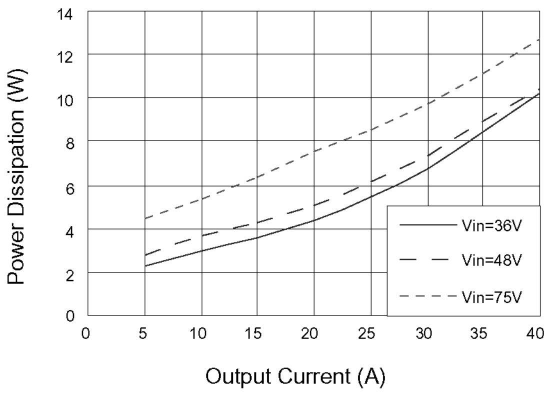


Fig.14 Typical power dissipation curve of ALQ-40Y48N

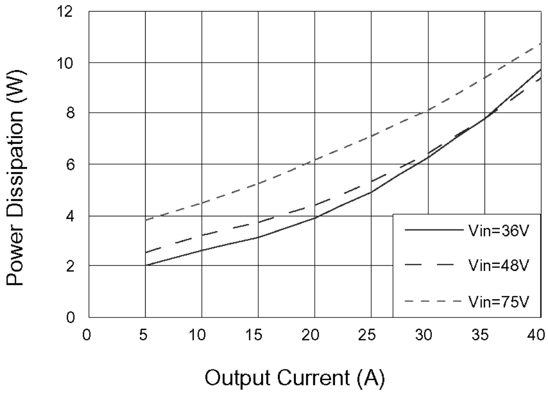


Fig.15 Typical power dissipation curve of ALQ-40M48N

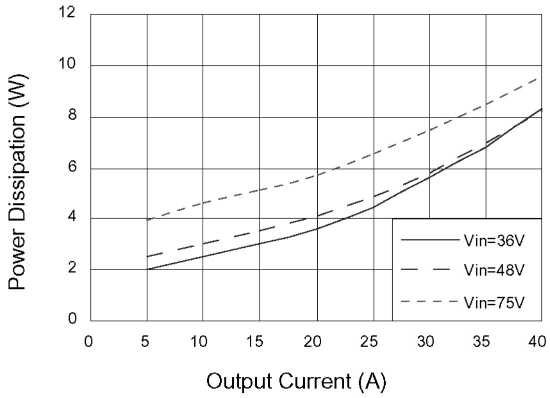


Fig.16 Typical power dissipation curve of ALQ-40K48N

Module Derating

When 48V input, 25℃ ambient temperature, and 200LFM airflow, ALQ series are rated for full power, and in this condition the board temperature can reach 100℃. For operation above ambient temperature of 55℃, output power must be derated as shown in Figures of ''Output Power Derating'', meantime, airflow at least 200LFM over the converter must be provided to make the module working properly. The board temperature should be used to determine maximum temperature limits. The minimum operating temperature for the ALQ is -40℃.

Increasing airflow over the module enhances the heat transfer via convection. Figures 17 through 26 shows the maximum current that can be delivered by the corresponding module without exceeding the maximum board temperature versus local ambient temperature (Ta) for natural convection（0 m/s）through 2 m/s (400 ft./min.).

The use of output power derating curve is shown in the following example.

Example

What is the minimum airflow necessary for a ALQ-35F48N operating at VI = 48 V, an output current of 28A, and a maximum ambient temperature of 55℃?

Solution

Given: VI = 48V, Io = 28A, Ta = 55℃

Determine airflow (v) (Use Figure 17): v = 1m/sec. (200ft./min.)

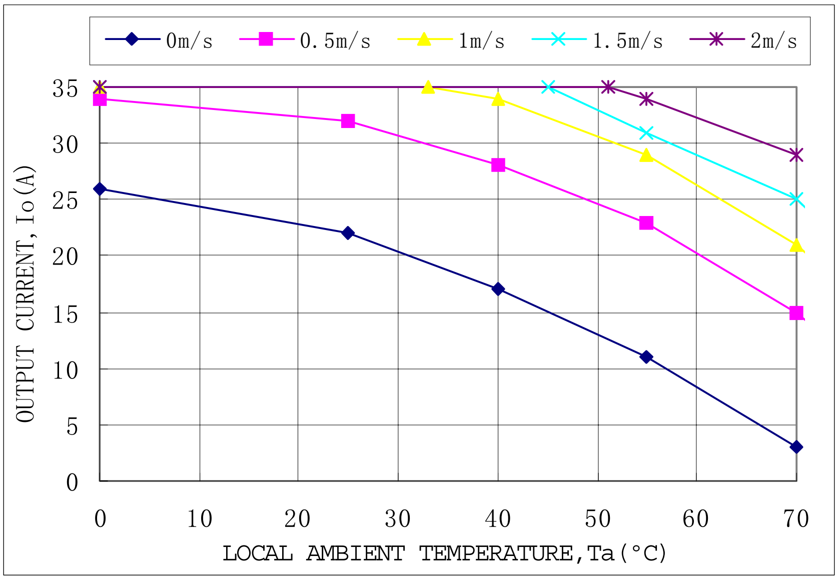


Fig.17 Output Power Derating for ALQ-35F48N (Vo = 3.3V)

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

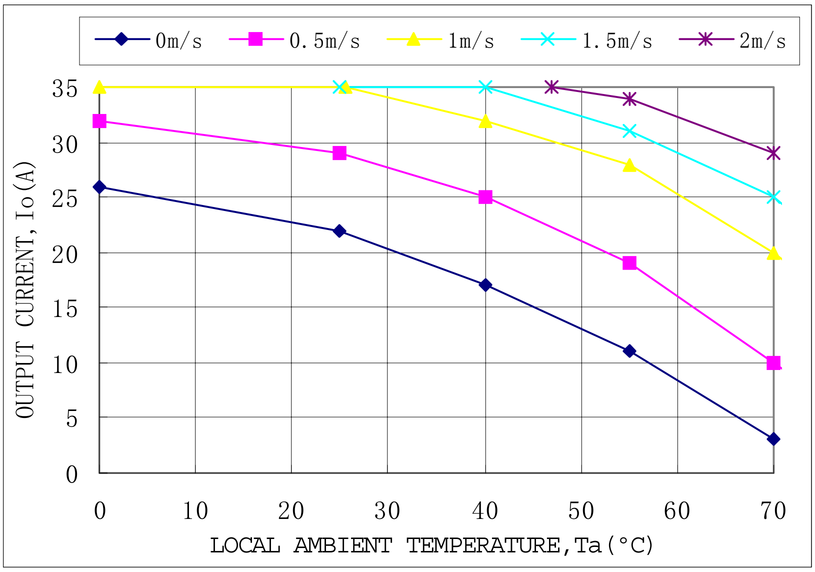


Fig.18 Output Power Derating for ALQ-35F48N (Vo = 3.3V)

Airflow direction from output to input ; VIN = 48V

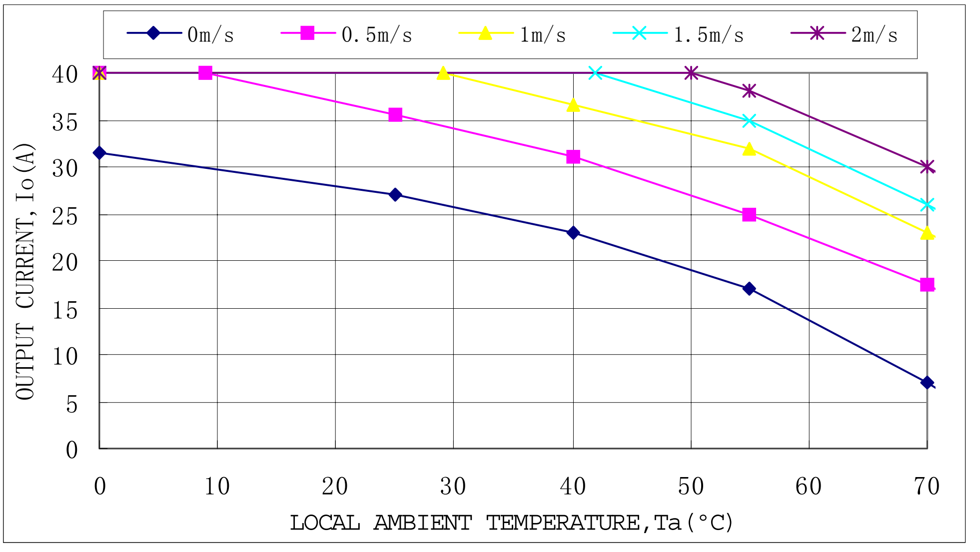


Fig.19 Output Power Derating for ALQ-40G48N (Vo = 2.5V)

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

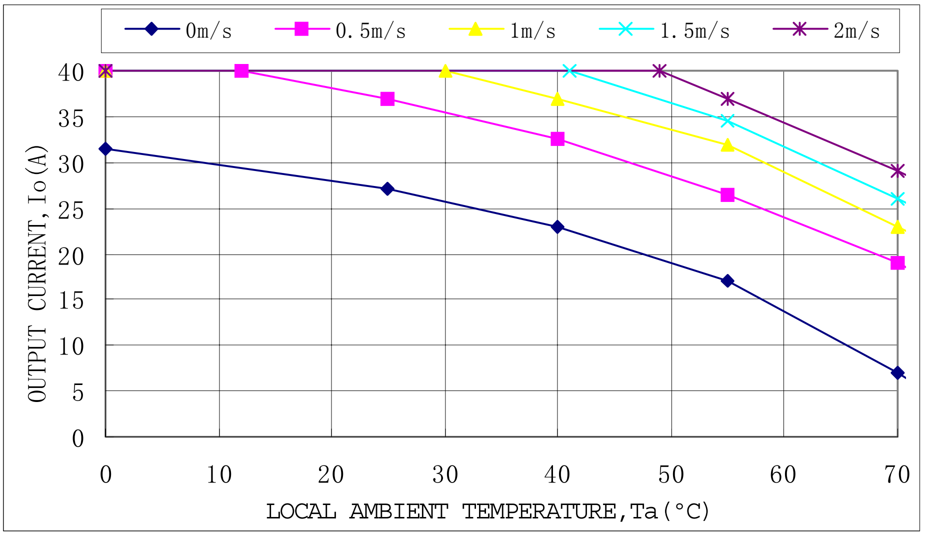


Fig.20 Output Power Derating for ALQ-40G48N (Vo = 2.5V)

Airflow direction from output to input ; VIN = 48V

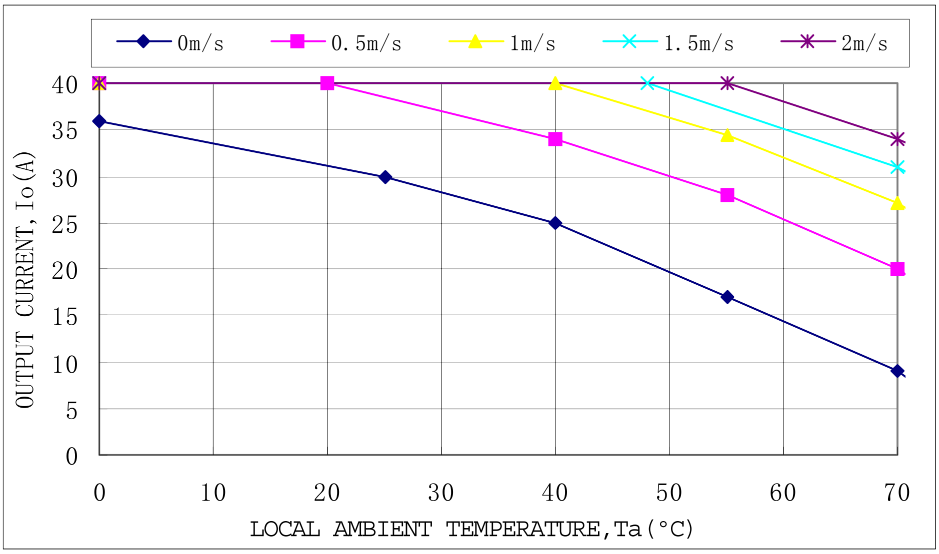


Fig.21 Output Power Derating for ALQ-40Y48N (Vo = 1.8V)

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

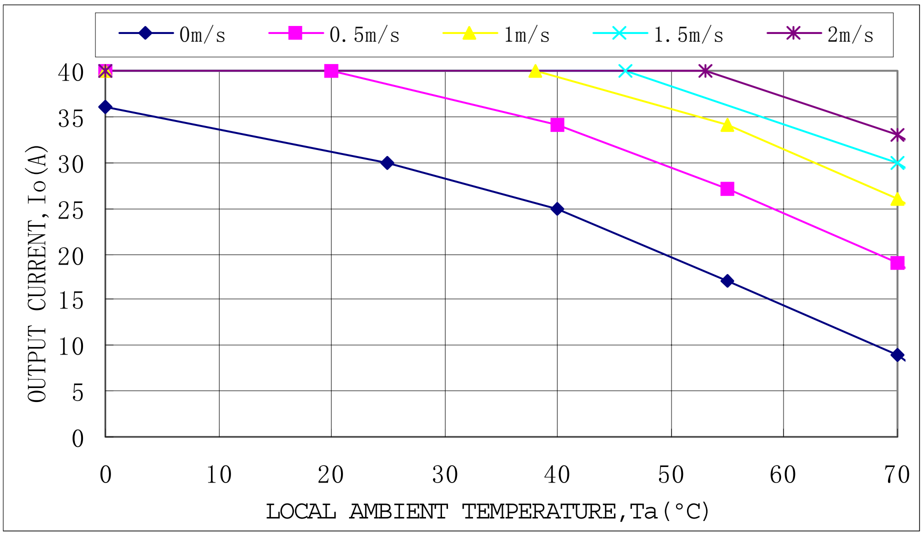


Fig.22 Output Power Derating for ALQ-40Y48N (Vo = 1.8V)

Airflow direction from output to input ; VIN = 48V

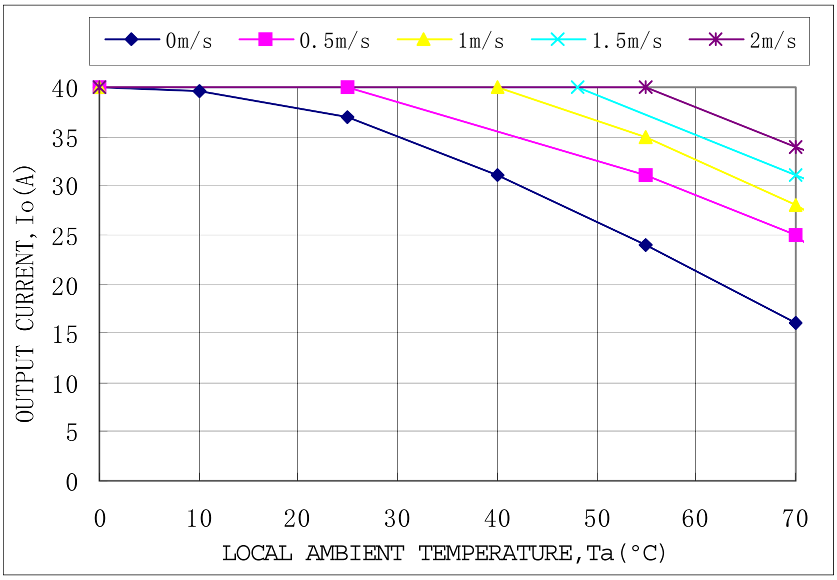
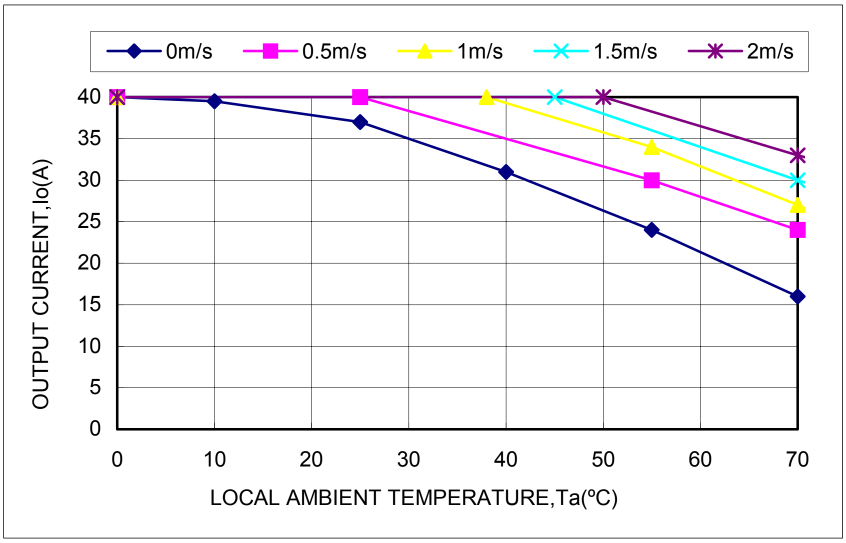


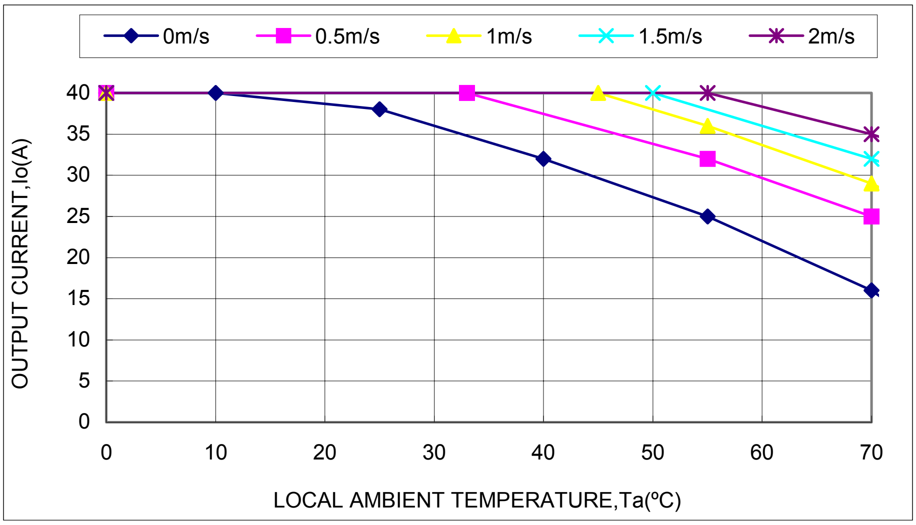
Fig.23 Output Power Derating for ALQ-40M48N (Vo = 1.5V)

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



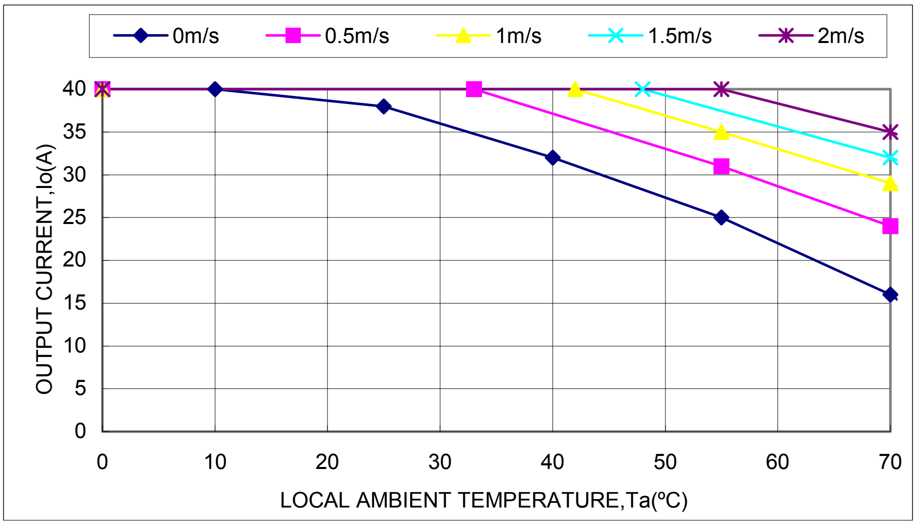
Figures24 Output Power Derating for ALQ-40M48N (Vo = 1.5V)

Airflow direction from output to input ; VIN = 48V



Figures 25 Output Power Derating for ALQ-40K48N (Vo = 1.2V)

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



Figures 26 Output Power Derating for ALQ-40K48N (Vo = 1.2V)

Airflow direction from output to input ; VIN = 48V

MTBF

The MTBF, calculated in accordance with Bellcore TR-NWT-000332 is 2,000,000 hours. Obtaining this MTBF in practice is entirely possible. If the board temperature is expected to exceed +25℃, then we also advise an oriented for the best possible cooling in the air stream.

Emerson Network Power can supply replacements for converters from other manufacturers, or offer custom solutions. Please contact the factory for details.

Mechanical Considerations

Installation

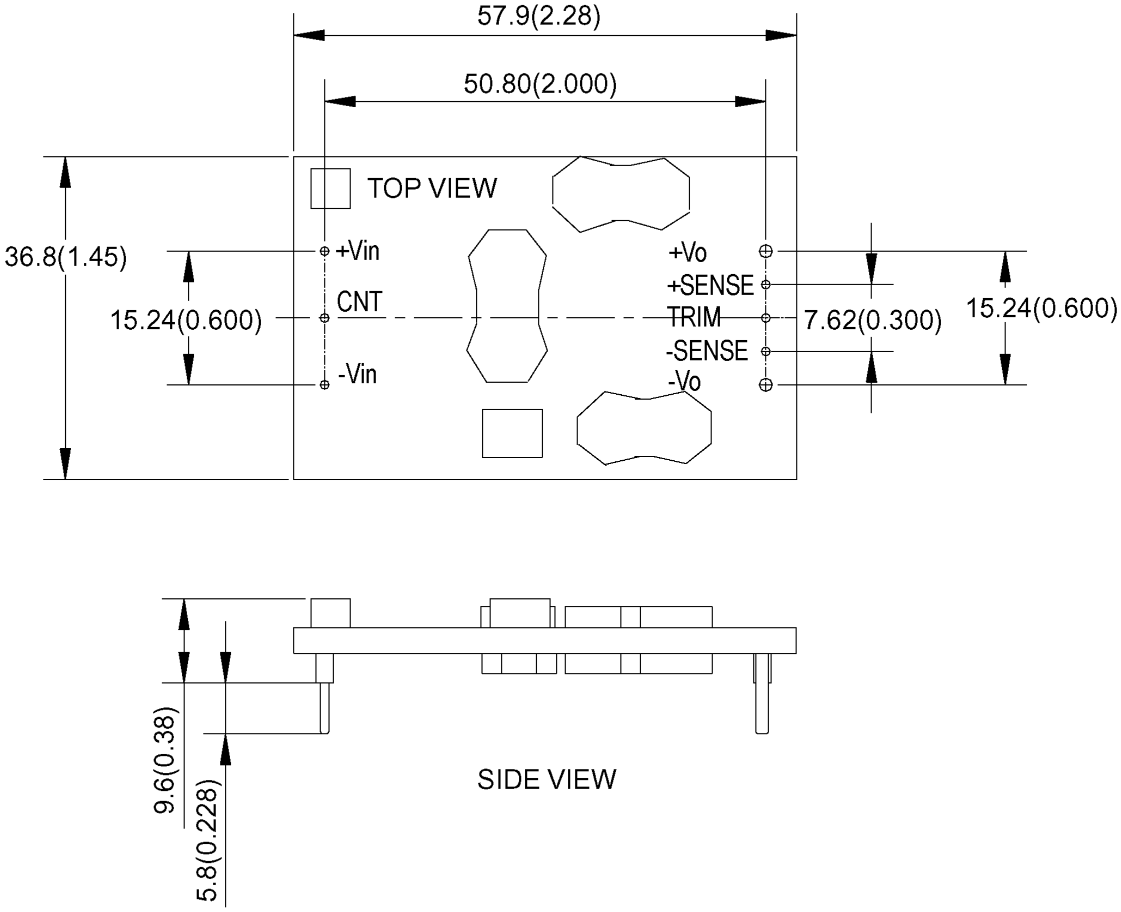
Although ALQ series converters can be mounted in any orientation, free air-flowing must be taken. Normally power components are always put at the end of the airflow path or have the separate airflow paths. This can keep other system equipment cooler and increase component life spans.

Soldering

ALQ series converters are compatible with standard wave soldering techniques. When wave soldering, the converter pins should be preheated for 20-30 seconds at 110℃, and wave soldered at 260℃ for less than 10 seconds.

When hand soldering, the iron temperature should be maintained at 425℃ 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.

Mechanical Chart (pin side view)



Unit: mm(inch)

Tolerances:

Inches	Millimeters
.xx ±0.020	.x ±0.5
.xxx ±0.010	.xx ±0.25

Pin length:

>4mm	±0.02inch (±0.5mm)
<4mm	±0.01inch (±0.25mm)

Notes: Un-dimensioned components are for visual reference only.

Ordering Information

Model Number	Input Voltage (V)	Output Voltage (V)	Output Current (A)	Ripple and Noise (mV pp) Typ.	Max.	Efficiency (%) Typ.
ALQ-35F48N	36-75	3.3	35	80	120	90
ALQ-40G48N	36-75	2.5	40	60	100	88.5
ALQ-40Y48N	36-75	1.8	40	60	100	87
ALQ-40M48N	36-75	1.5	40	60	100	86
ALQ-40K48N	36-75	1.2	40	50	80	85