DELPHI SERIES

FEATURES

- High efficiency:
  94% @ 12Vin, 5V/40A out
- Size:
  36.8mm x 32.2mm x 13.0mm (Vertical)
  (1.45"x1.27"x0.51")
  36.8mm x 32.2mm x 14.0mm (Horizontal)
  (1.45"x1.27"x0.55")
- Resistor-based trim
- No minimum load required
- Output voltage programmable from 0.9-5.0V via external resistors
- Fixed frequency operation
- Input UVLO, output OVP (non-latch) and OCP (non-latch)
- Remote ON/OFF (default: positive)
- Remote sense
- Power good function
- ISO 9001, TL 9000, ISO 14001, QS9000, OHSAS18001 certified manufacturing facility
- UL/cUL 60950-1 (US & Canada) Recognized, and TUV (EN60950-1) Certified
- CE mark meets 73/23/EEC and 93/68/EEC directives

Delphi ND Series Non-Isolated Point of Load DC/DC Modules: 8.0V~13.8Vin, 0.9V~5.0Vout, 40A

The Delphi ND40 Series, 8.0V~13.8V input, single output, non-isolated point of load DC/DC converters are the latest offering from a world leader in power systems technology and manufacturing - Delta Electronics, Inc. The ND40 series provides up to 40A of power in a vertical mounted through-hole package and the output can be resistor-trimmed from 0.9Vdc to 5.0Vdc. ND40 provides a very cost effective point of load solution. With creative design technology and optimization of component placement, these converters possess outstanding electrical and thermal performance, as well as extremely high reliability under highly stressful operating conditions.

APPLICATIONS

- DataCom
- Distributed power architectures
- Servers and workstations
- LAN / WAN applications
- Data processing applications

DATASHEET
DS_ND40A_08072008

Delta Electronics, Inc.

TECHNICAL SPECIFICATIONS

(Ambient Temperature=25°C, minimum airflow=300LFM, nominal V_{in}=12Vdc unless otherwise specified.)

PARAMETER	NOTES and CONDITIONS	ND12S0A0V40 (standard)			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage (Continuous)		0		13.8	Vdc
Operating Temperature	Refer to Figure 30 for the measuring point	0		+120	°C
Storage Temperature		-40		+125	°C
INPUT CHARACTERISTICS					
Operating Input Voltage		8.0	12	13.8	Vdc
Input Under-Voltage Lockout	Io= 50% of Io,max				
Turn-On Voltage Threshold			7.8		Vdc
Turn-Off Voltage Threshold			6.2		Vdc
Lockout Hysteresis Voltage			1.6		Vdc
Maximum Input Current	Vin= 8V, Vo=5V, 100%Load			40	Adc
Inrush Current					
Peak Inrush Current				**200**	Apk
Recovery Time	Inrush Decay to Normal			100	mS
External Input Capacitance	The dielectric of ceramic capacitance shell be X5R or X7R	22		100	μF
Load Transient Effects on Input Current	Refer to dynamic step load			**2**	A/μS
Vo Peak Deviation of Input Step Response	Vin step change of ±1.8V , dv/dt of Vin =0.2V/μS			100	mV
OUTPUT CHARACTERISTICS					
Output Voltage Adjustable Range	Selected by an external resistor	0.9		5.0	Vdc
Output Voltage Set Point	Io=Io,max ,Rtrim:±0.1% tolerance , Tc=±25ppm	-1		+1	% Vo,set
Stability, Long Term Voltage Drift	Vin=12V,Io=Io,max, record over 24hours	-0.1		+0.1	% Vo,set
Output Voltage Regulation					
Over Line	Vin=Vin,min to Vin,max			**0.2**	% Vo,set
Over Load	Io=Io,min to Io,max			**0.5**	% Vo,set
Over Temperature	Ta=-5℃ to 60℃			0.75	% Vo,set
Total Output Voltage Range	Over all operation input voltage, resistive load, and temperature conditions until end of life	-3.0		+3.0	% Vo,set
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth, 10μF tantalum // 1μF ceramic, Vin=min to max, Io=min to max				
Peak-to-Peak	0.9≦Vo,set＜1.5V			30	mVp-p
Peak-to-Peak	1.5≦Vo,set＜3.5V			40	mVp-p
Peak-to-Peak	3.5≦Vo,set≦5.0V			**85**	mVp-p
Output Current Range		0		40	Adc
External output capacitance Load					
Minimum Output capacitance	ESR≧2mΩ	300			μF
Maximum Output capacitance	ESR≧0.2mΩ			2000	μF
Loop Stability	Cout from 300μF to 2000μF				
Phase Margin			45		Degree
Gain Margin			10		dB
Output Voltage Over-shoot at Start-up			0	5	% Vo,set
Output Current-Limit Inception	Hiccup mode	110		200	%Io,max
Output Over Voltage Protection	Hiccup mode	110			% Vo,set
DYNAMIC CHARACTERISTICS					
Dynamic Load Response	5Hz to 20MHz bandwidth, 10μF tantalum // 1μF ceramic, dIo/dt=2.5A/Us, Step load Freq.=200Hz~ 2.5KHz				
Positive Step Change in Output Current	50% Io, max to 100% Io, max		150	**200**	mVpk
Negative Step Change in Output Current	100% Io, max to 50% Io, max		150	**200**	mVpk
Setting Time	Vout＜1% of final steady value			100	μs
Turn-On Transient	Io=Io,max				
Start-up Time, From On/Off Control	From Enable High to 90% of Vo			7	ms
Start-Up Time, From Input	From Vin to 90% of Vo			7	ms
EFFICIENCY					
Vo,set=0.9V	Vin=12V, Io=Io,max, Ta=25℃	**80**	**82**		%
Vo,set=1.0V	Vin=12V, Io=Io,max, Ta=25℃	82	84		%
Vo,set=1.2V	Vin=12V, Io=Io,max, Ta=25℃	83	86		%
Vo,set=1.8V	Vin=12V, Io=Io,max, Ta=25℃	84	89		%
Vo,set=2.5V	Vin=12V, Io=Io,max, Ta=25℃	84	90		%
Vo,set=3.3V	Vin=12V, Io=Io,max, Ta=25℃	86	92		%
Vo,set=5.0V	Vin=12V, Io=Io,max, Ta=25℃	89	94		%
FEATURE CHARACTERISTICS					
Switching Frequency	500kHz operation for 2.2V≦Vo,set≦5.0V		500/220		kHz
ON/OFF Control, (Logic High-Module ON)					
Logic High Voltage	Module On	2.7			Vdc
Logic Low Voltage	Module Off			0.44	Vdc
Logic High Current				125	μA
Logic Low Current				250	μA
Power Good					
PG Delay Time from Vin	Vin=Vin,min, Vo is between 95% - 105% of Vo,set			15	mS
PG Delay Time from Enable	Enable=H, Vo is between 95% - 105% of Vo,set			15	mS
Remote Sense Range					
Compensation Voltage		50			mV
Vo,max When Remote Sense Line Open				105	%Vo,set
GENERAL SPECIFICATIONS					
MTBF	Io=80%Io, max, Ta=25℃		3.6		M hours
Weight			20.5		grams

ELECTRICAL CHARACTERISTICS CURVES

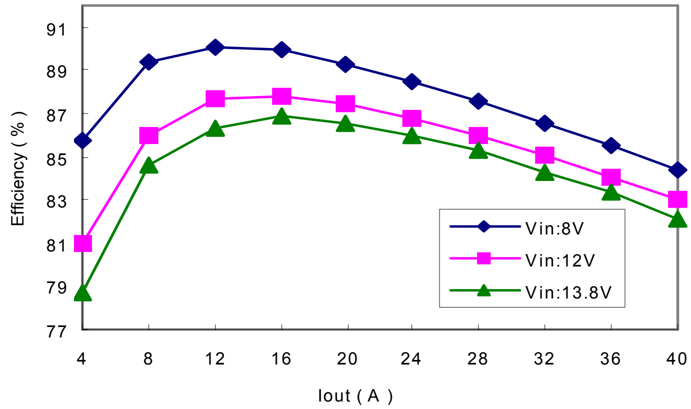


Figure 1: *Converter efficiency vs. output current (0.9V output voltage)*

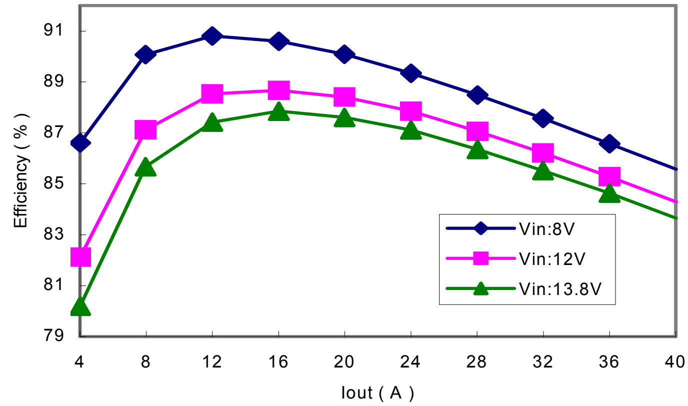


Figure 2: *Converter efficiency vs. output current (1.0V output voltage)*

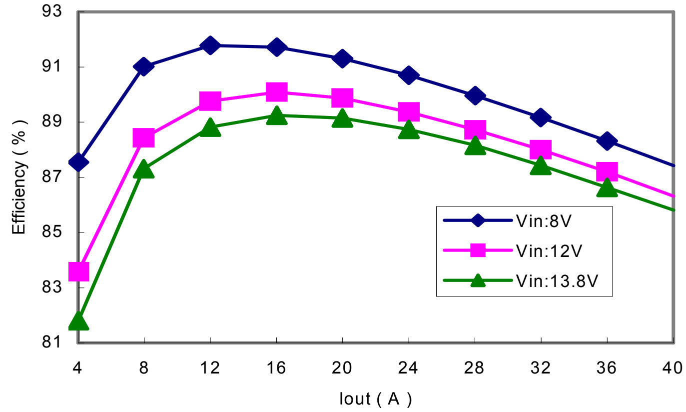


Figure 3: *Converter efficiency vs. output current (1.2V output voltage)*

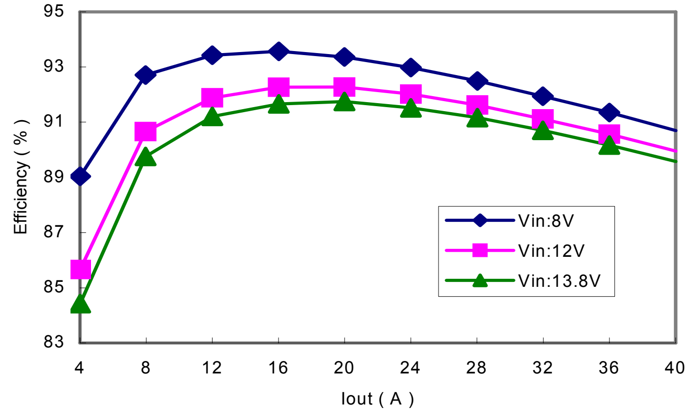


Figure 4: *Converter efficiency vs. output current (1.8V output voltage)*

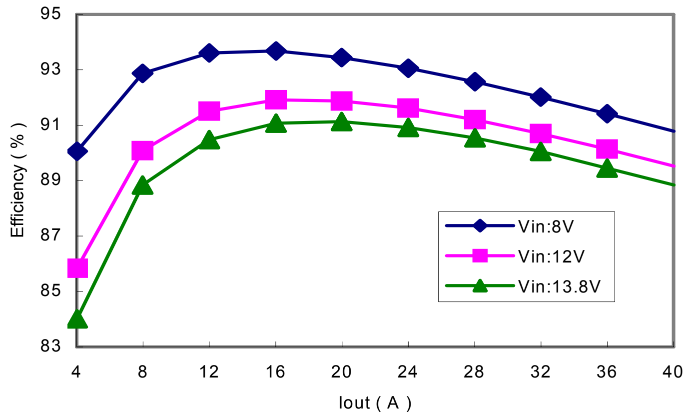


Figure 5: *Converter efficiency vs. output current (2.5V output voltage)*

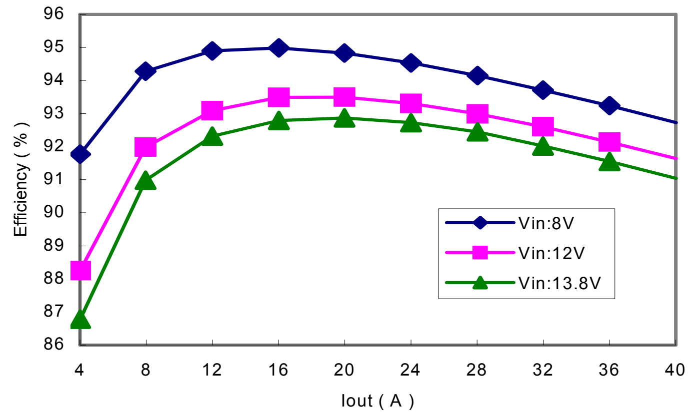


Figure 6: *Converter efficiency vs. output current (3.3V output voltage)*

ELECTRICAL CHARACTERISTICS CURVES

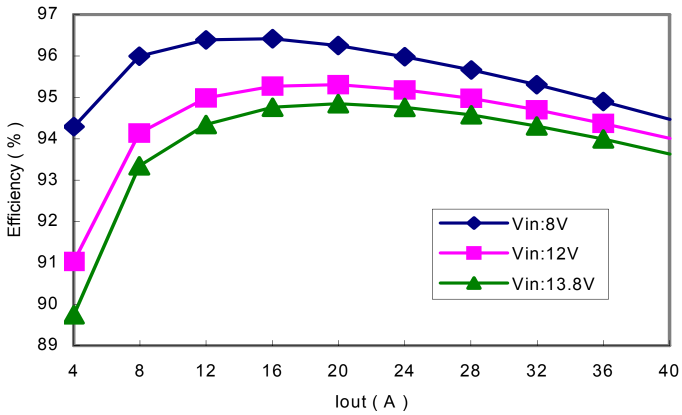


Figure 7: *Converter efficiency vs. output current (5.0V output voltage)*

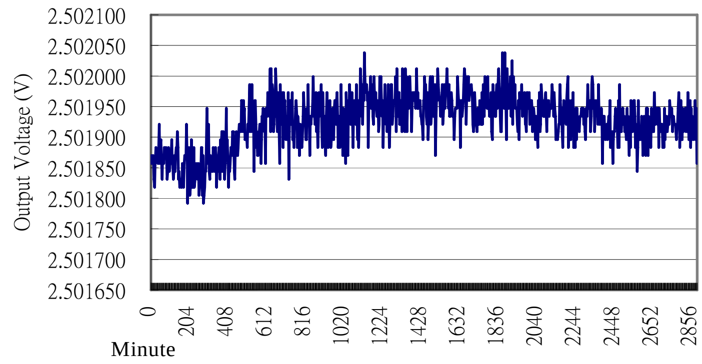


Figure 8: *Long term voltage drift over 24hr at 2.5V/40A out*

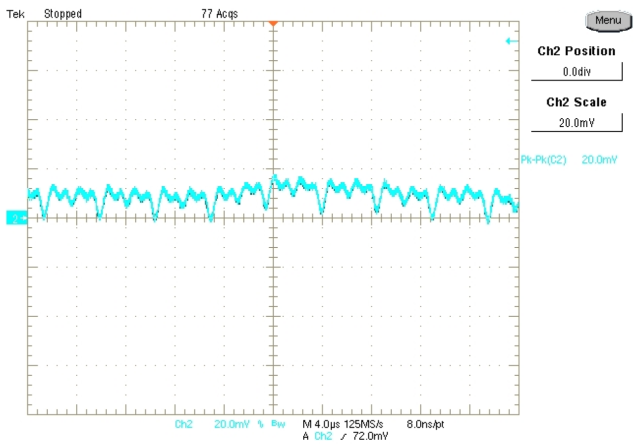


Figure 9: *Output ripple & noise at 12Vin, 1.2V/40A out*

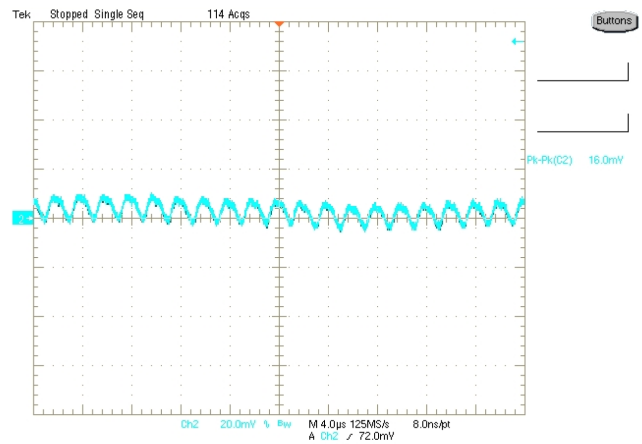


Figure 10: *Output ripple & noise at 12Vin, 5.0V/40A out*

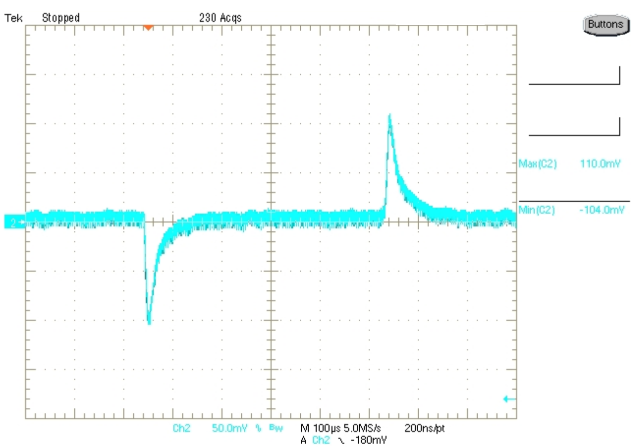


Figure 11: *Typical transient response to step load change at 2.5A/μS between 50% and 100% of Io, max at 12Vin, 1.2V out (Cout = 300uF ceramic, 1uF ceramic, 10μF tantalum)*

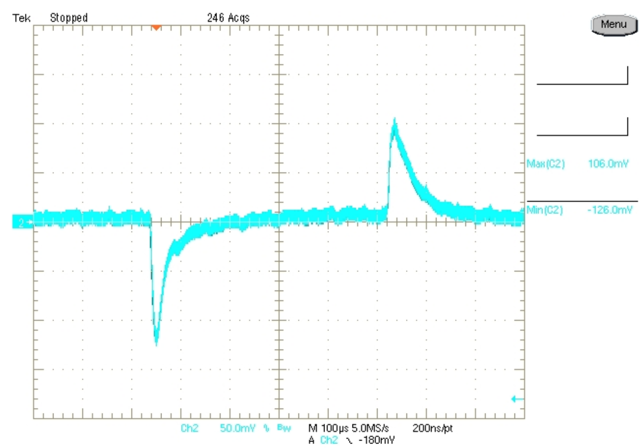


Figure 12: *Typical transient response to step load change at 2.5A/μS between 50% and 100% of Io, max at 12Vin, 5.0V out (Cout = 300uF ceramic, 1uF ceramic, 10μF tantalum)*

ELECTRICAL CHARACTERISTICS CURVES

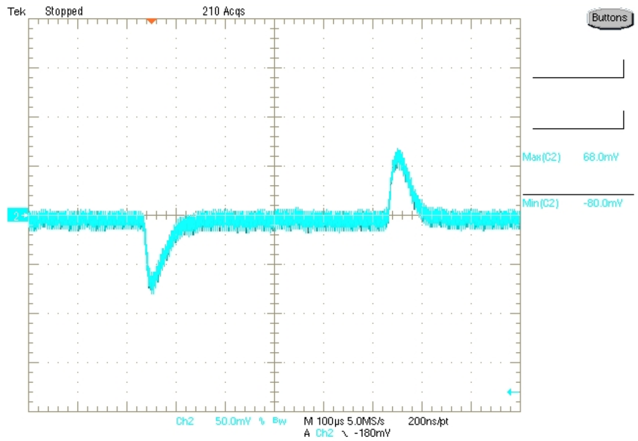


Figure 13: *Typical transient response to step load change at 2.5A/µS between 50% and 100% of Io, max at 12Vin, 1.2V out (Cout = 2000uF ceramic, 1uF ceramic, 10µF tantalum)*

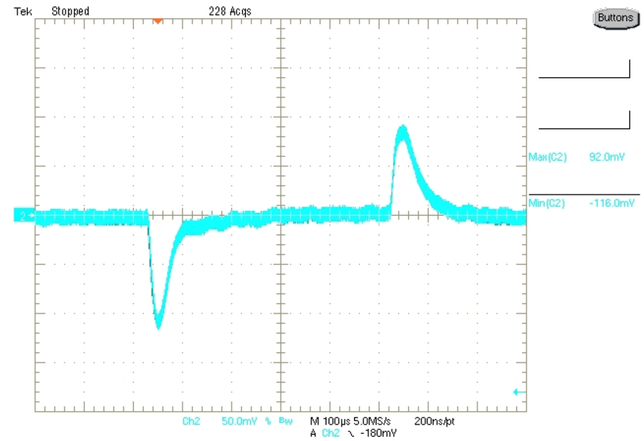


Figure 14: *Typical transient response to step load change at 2.5A/µS between 50% and 100% of Io, max at 12Vin, 5.0V out (Cout = 2000uF ceramic, 1uF ceramic, 10µF tantalum)*

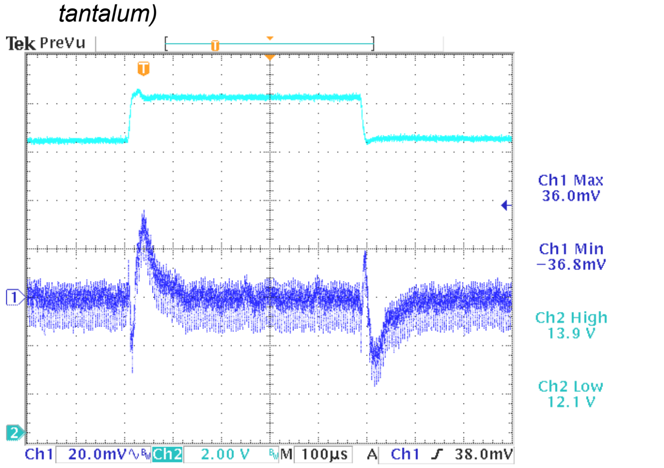


Figure 15: *Typical transient response to step input voltage change at 0.2V/µS between 12Vin and 13.8Vin at 1.2V/0A out (Cout = 300uF ceramic, 1uF ceramic, 10µF tantalum) Ch1: Vin, Ch2: Vo*

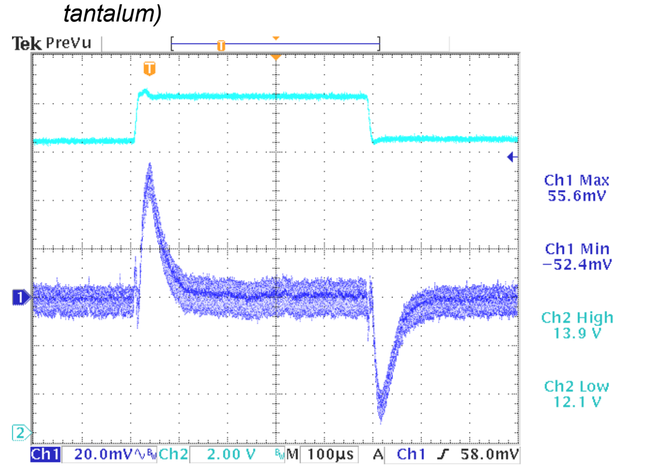


Figure 16: *Typical transient response to step input voltage change at 0.2V/µS between 12Vin and 13.8Vin at 5.0V/0A out (Cout = 300uF ceramic, 1uF ceramic, 10µF tantalum) Ch1: Vin, Ch2: Vo*

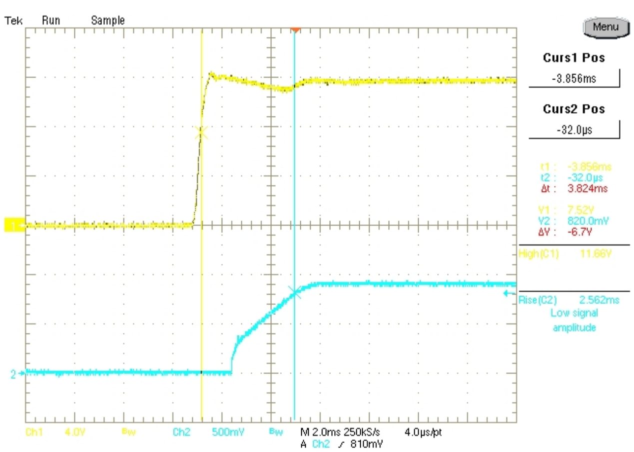


Figure 17: *Turn on delay time at 12vin, 0.9V/40A out Ch1: Vin, Ch2: Vo*

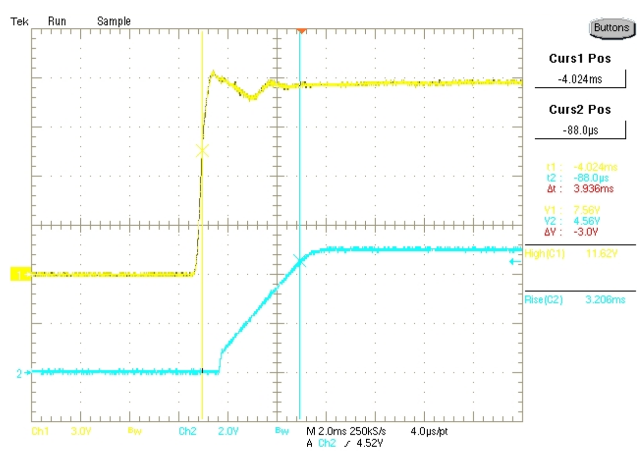


Figure 18: *Turn on delay time at 12vin, 5.0V/40A out Ch1: Vin, Ch2: Vo*

ELECTRICAL CHARACTERISTICS CURVES

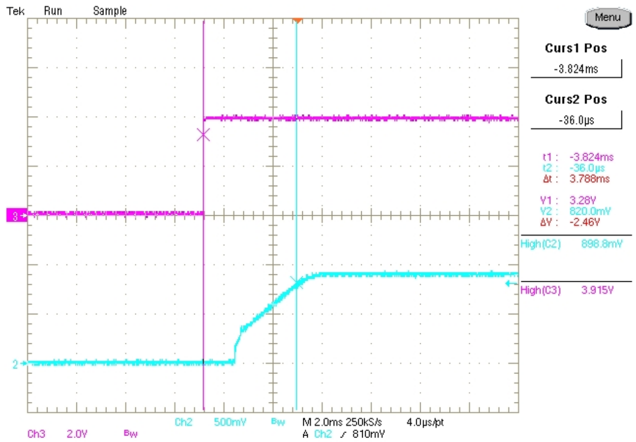


Figure 19: *Turn on delay time at Remote On/Off, 0.9V/40A out Ch1: Enable pin, Ch2: Vo*

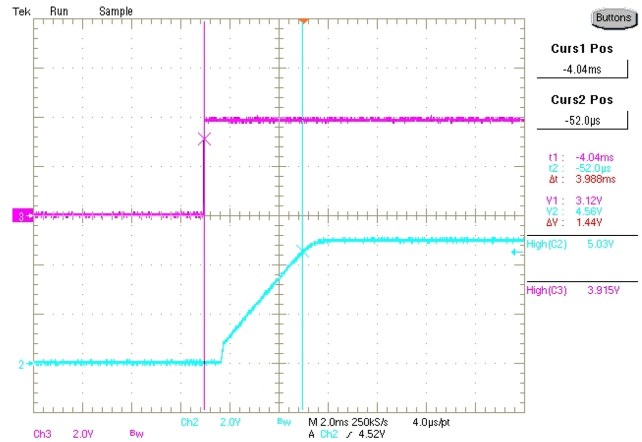


Figure 20: *Turn on delay time at Remote On/Off, 5.0V/40A out Ch1: Enable pin, Ch2: Vo*

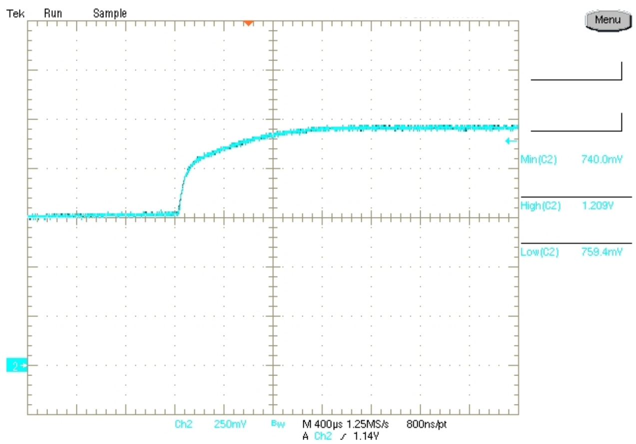


Figure 21: *Turn on with Prebias 12Vin,1.2V/0A out, Vbias =0.84Vdc*

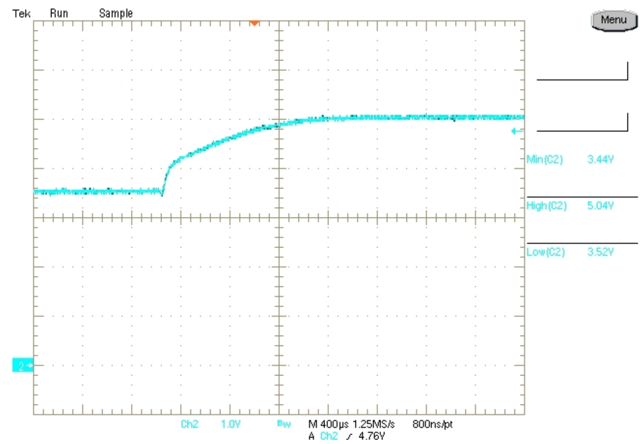


Figure 22: *Turn on with Prebias 12Vin, 5V/0A out, Vbias =3.5Vdc*

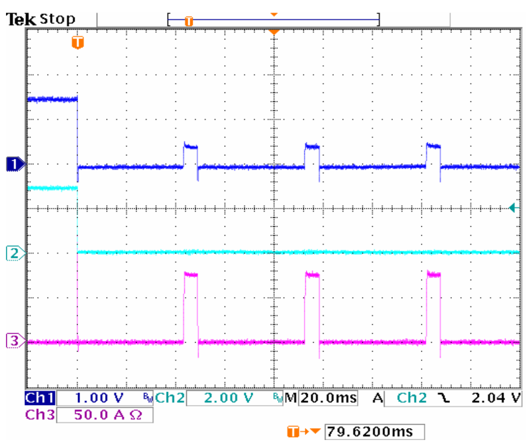


Figure 23: *Output short circuit current at 12Vin, 1.2Vout Ch1: Vo, Ch2: PG, C3: Io*

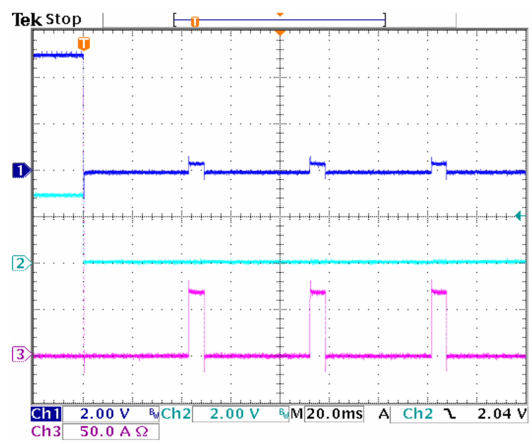


Figure 24: *Output short circuit current at 12Vin, 5.0Vout Ch1: Vo, Ch2: PG, C3: Io*

DESIGN CONSIDERATIONS

The ND 40A uses two phase and peak current mode controlled buck topology. The output can be trimmed in the range of 0.9Vdc to 5.0Vdc by a resistor between Trim+ pin and Trim– pin.

The module can be turned ON/OFF by remote control with positive on/off logic to ENABLE pin. The converter DC output is disabled when the signal is driven low (below 0.44V).

The module can protect itself by entering hiccup mode against over current, short circuit, over voltage condition.

Safety Considerations

For safety-agency approval the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards.

For the converter output to be considered meeting the requirements of safety extra-low voltage (SELV), the input must meet SELV requirements. The power module has extra-low voltage (ELV) outputs when all inputs are ELV.

The input to these units is to be provided with a maximum 40A or two paralleled 20A of fast-acting fuses in the ungrounded lead.

FEATURES DESCRIPTIONS

Enable On/Off

The module can be turned ON/OFF by remote control with positive on/off logic to ENABLE pin.

For positive logic module, the On/Off pin is pulled high with an external pull-up resistor, $R_{pull-up}$, (see figure 25) Positive logic On/Off signal turns the module ON during logic high and turns the module OFF during logic low. If the positive On/Off function is not used, connect ENABLE pin to Vin with $R_{pull-up}$. (The module will be On) $R_{pull-up}$ of 100kohm is recommended.

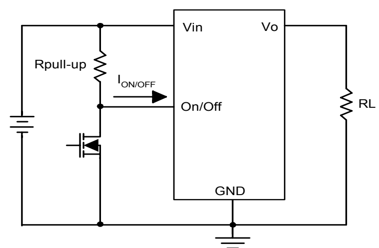


***Fig. 25**. Positive remote On/Off implementation*

Over-Current Protection

To provide protection in an output over load fault condition, the unit is equipped with internal over-current protection. When the over-current protection is triggered, the unit enters hiccup mode. The units operate normally once the fault condition is removed.

Over-Temperature Protection

ND40 converter does not have built-in over-temperature protection. Hence, to ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Please refer page.9 for detail information.

Output Voltage Programming

The output voltage of the ND40 converter can be programmed to any voltage between 0.9Vdc and 5.0Vdc by connecting one resistor (shown as Rtrim in Figure 26) between the TRIM+ and Trim– pins of the module. Without this external resistor, the output voltage of the module is 0.6 Vdc. To calculate the value of the resistor Rtrim for a particular output voltage Vout, please use the following equation:

$$Rs(\Omega) = \frac{1200}{Vout - 0.6}$$

Rtrim is the external resistor in Ω
Vout is the desired output voltage

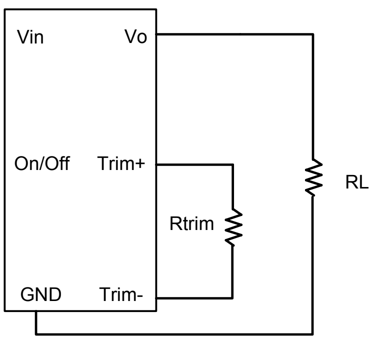


Figure 26: *Circuit configuration for programming output voltage using an external resistor*

Table 1 provides Rtrim values required for some common output voltages. By using a trim resistor with 0.1% tolerance and TCR of ±25ppm, set point tolerance of ±1% can be achieved as specified in the electrical specification.

Table 1

Vout (V)	Rtrim (Ω)
0.9	4K
1.0	3K
1.2	2K
1.5	1.333K
1.8	1K
2.5	631.579
3.3	444.444
5.0	272.727

Voltage Margining

Output voltage margining can be implemented in the ND40 converter by connecting a resistor, $R_{margin-up}$, between Trim+ pin and Trim– pin for margining-up the output voltage, and by connecting a resistor, $R_{margin-down}$, between the Trim+ pin and the output pin for margining-down. Figure 27 shows the circuit configuration for output voltage margining. If unused, leave the trim pin unconnected. A calculation tool is available from the evaluation procedure which computes the values of $R_{margin-up}$ and $R_{margin-down}$ for a specific output voltage and margin percentage.

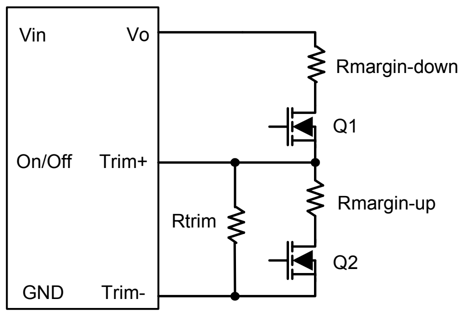
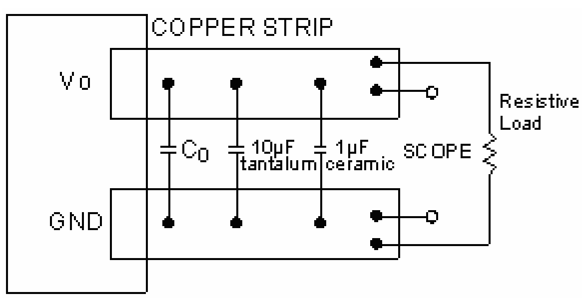


Figure 27: *Circuit configuration for output voltage margining*

Test Setup of Output Ripple and Noise, and Start-up Transient

The measurement set-up outlined in Figure 28 has been used for output voltage ripple and noise measurement on NE40 series converters.



Note: Use a 10μF tantalum and 1μF capacitor. Scope measurement should be taken by using a BNC connector. Co,min=300μF ceramic capacitors

Figure 28: *output ripple and noise, start-up transient test setup*

THERMAL CONSIDERATION

Thermal management is an important part of the system design. To ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Convection cooling is usually the dominant mode of heat transfer.

Hence, the choice of equipment to characterize the thermal performance of the power module is a wind tunnel.

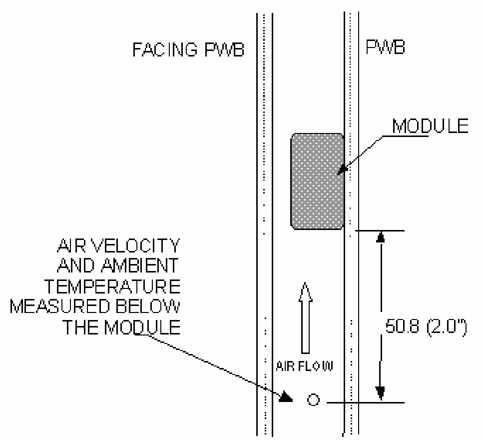
Thermal Testing Setup

Delta's DC/DC power modules are characterized in heated vertical wind tunnels that simulate the thermal environments encountered in most electronics equipment. This type of equipment commonly uses vertically mounted circuit cards in cabinet racks in which the power modules are mounted.

The following figure shows the wind tunnel characterization setup. The power module is mounted on a test PWB and is vertically positioned within the wind tunnel. The space between the neighboring PWB and the top of the power module is constantly kept at 6.35mm (0.25'').

Thermal Derating

Heat can be removed by increasing airflow over the module. To enhance system reliability, the power module should always be operated below the maximum operating temperature. If the temperature exceeds the maximum module temperature, reliability of the unit may be affected.



Note: Wind tunnel test setup figure dimensions are in millimeters and (Inches)

Figure 29: *Wind tunnel test setup*

THERMAL CURVES (ND12S0A0V40)

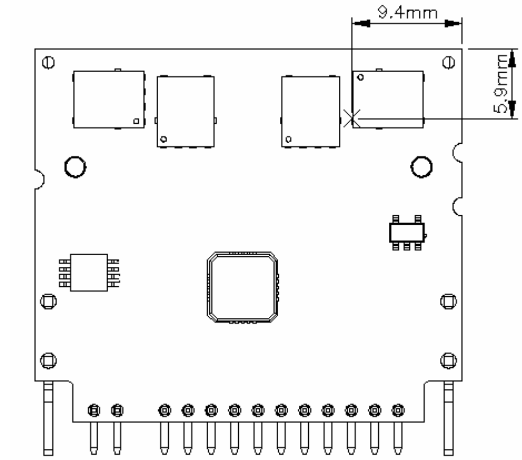


Figure 30: *Temperature measurement location* The allowed maximum hot spot temperature is defined at 120℃*

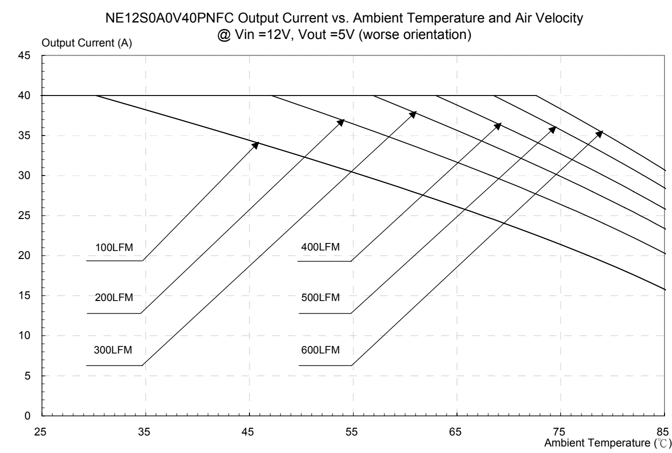


Figure 31: *Output current vs. ambient temperature and air velocity @Vin=12V, Vout=5.0V (Worse Orientation)*

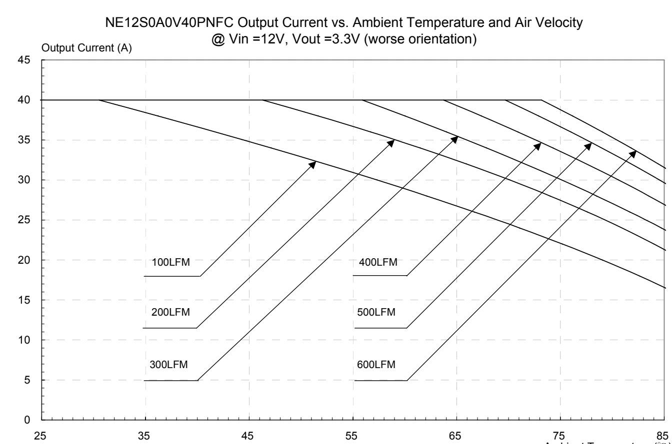


Figure 32: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=3.3V (Worse Orientation)*

THERMAL CURVES (NE12S0A0V40)

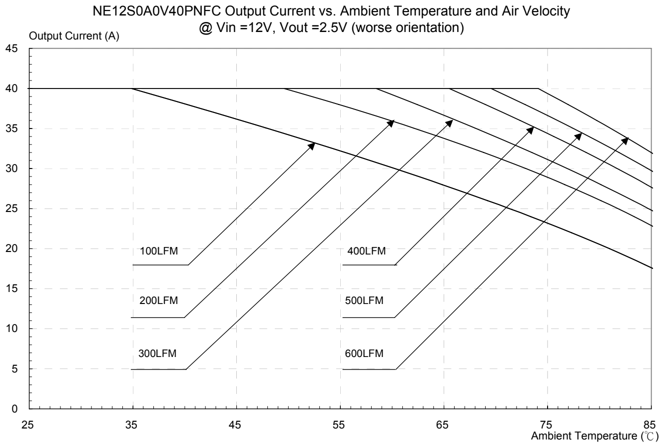


Figure 33: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=2.5V (Worse Orientation)*

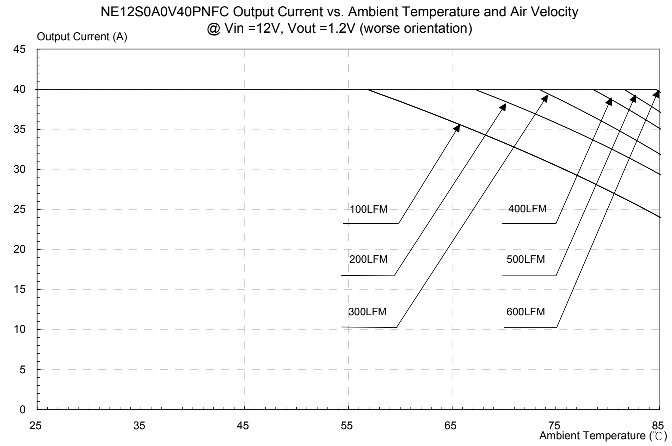


Figure 36: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=1.2V (Worse Orientation)*

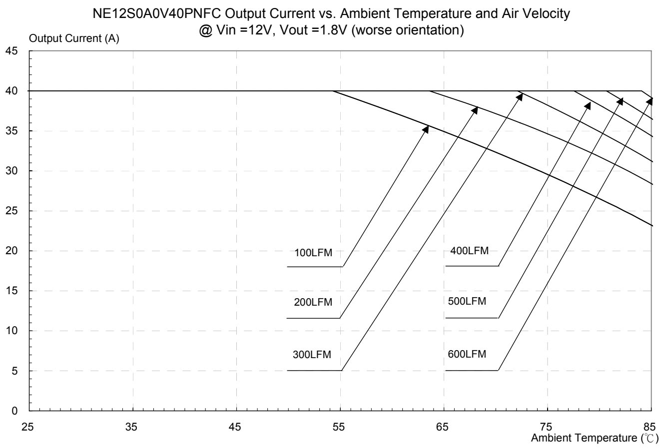


Figure 34: *Output current vs. ambient temperature and air velocity @Vin=12V, Vout=1.8V (Worse Orientation)*

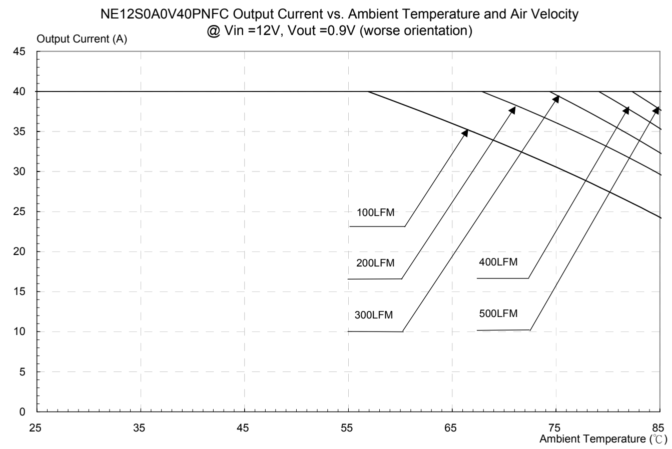


Figure 37: *Output current vs. ambient temperature and air velocity @Vin=12V, Vout=0.9V (Worse Orientation)*

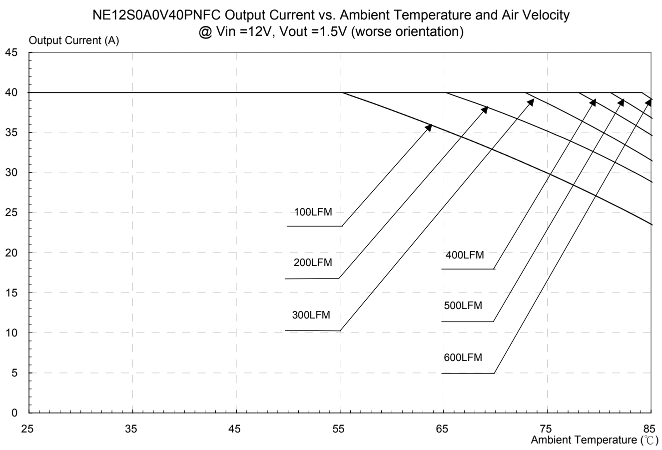


Figure 35: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=1.5V (Worse Orientation)*

THERMAL CURVES (ND12S0A0H40)

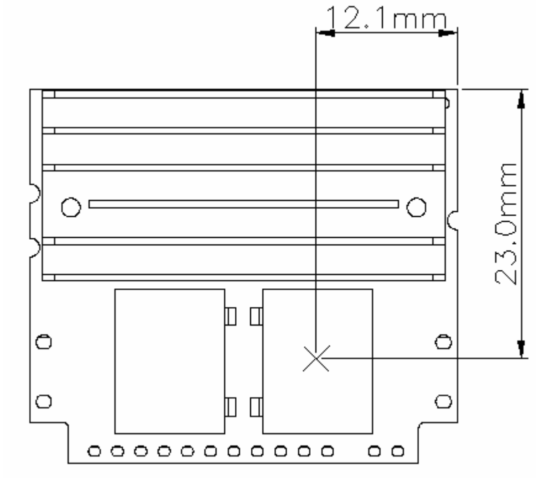


Figure 38: *Temperature measurement location* The allowed maximum hot spot temperature is defined at 110℃*

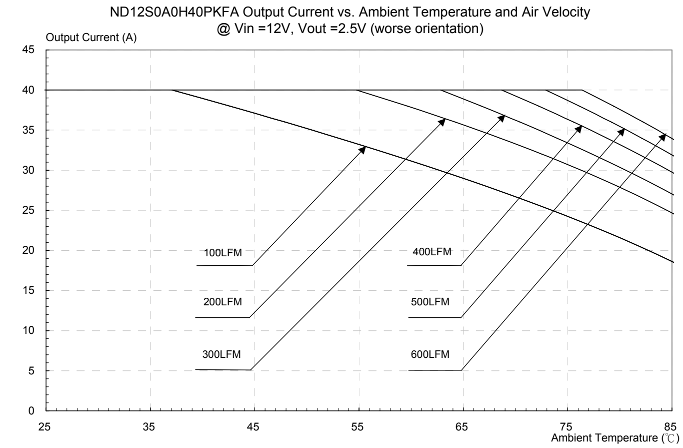


Figure 41: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=2.5V (Worse Orientation)*

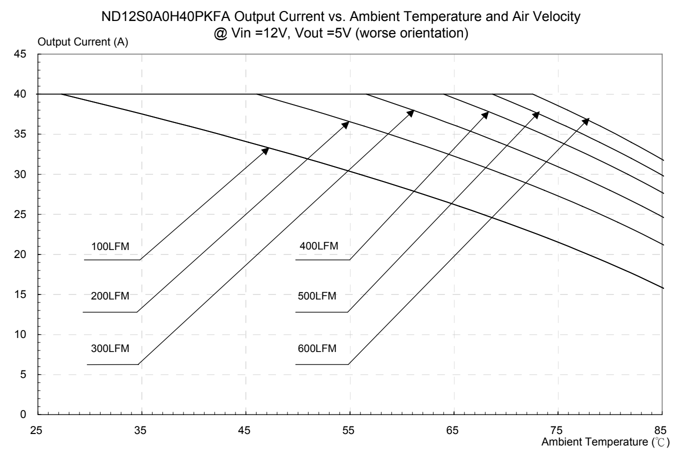


Figure 39: *Output current vs. ambient temperature and air velocity @Vin=12V, Vout=5.0V (Worse Orientation)*

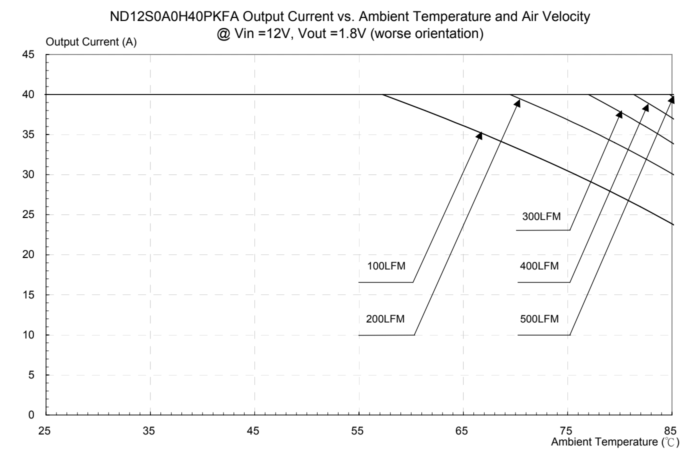


Figure 42: *Output current vs. ambient temperature and air velocity @Vin=12V, Vout=1.8V (Worse Orientation)*

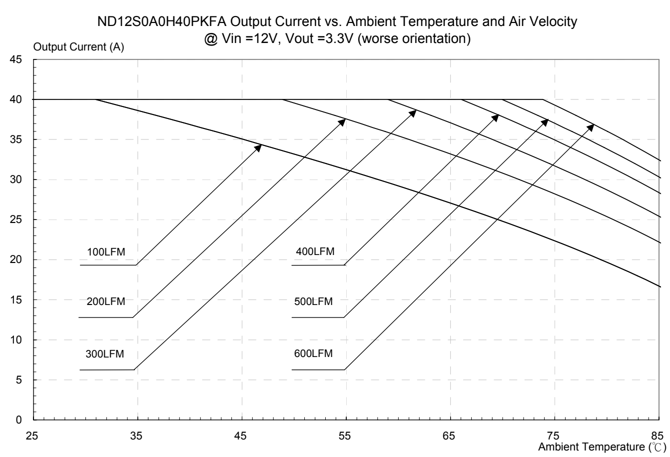


Figure 40: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=3.3V (Worse Orientation)*

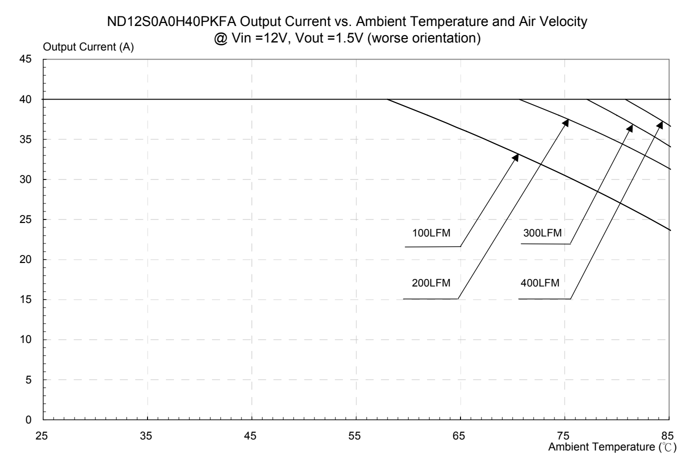


Figure 43: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=1.5V (Worse Orientation)*

THERMAL CURVES (ND12S0A0H40)

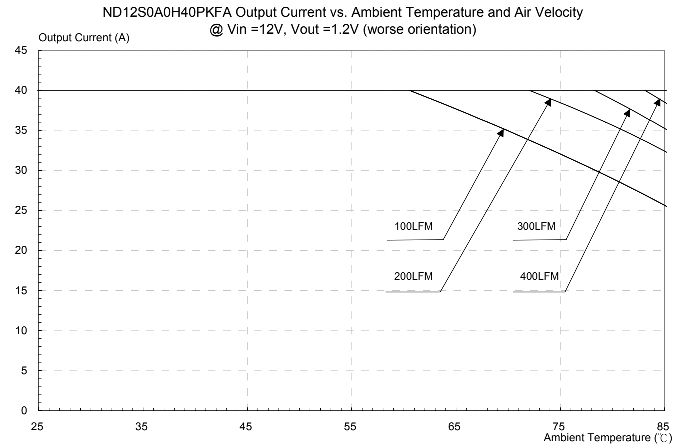


Figure 44: *Output current vs. ambient temperature and air velocity@ Vin=12V, Vout=1.2V (Worse Orientation)*

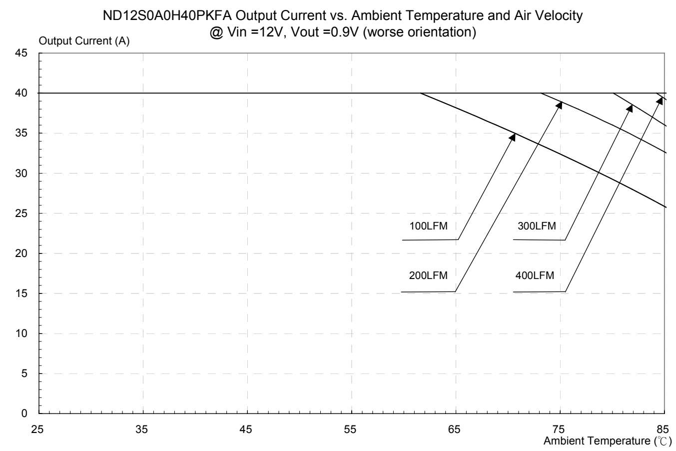
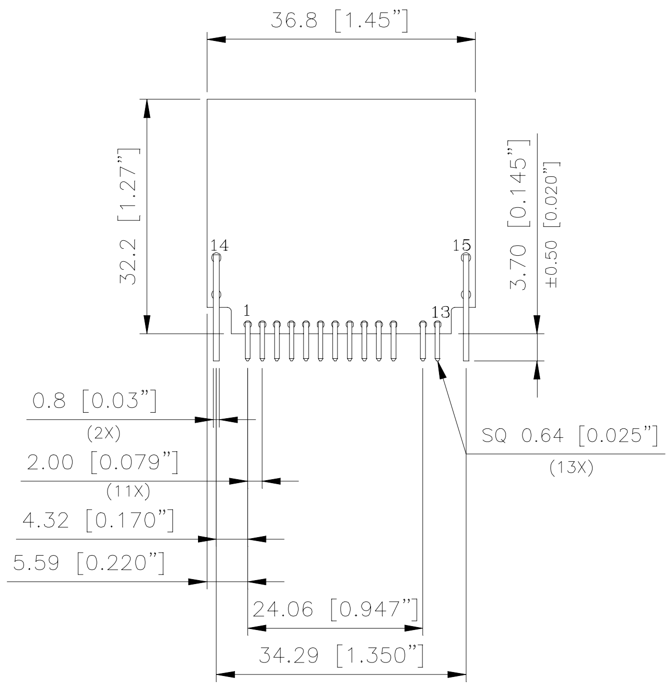
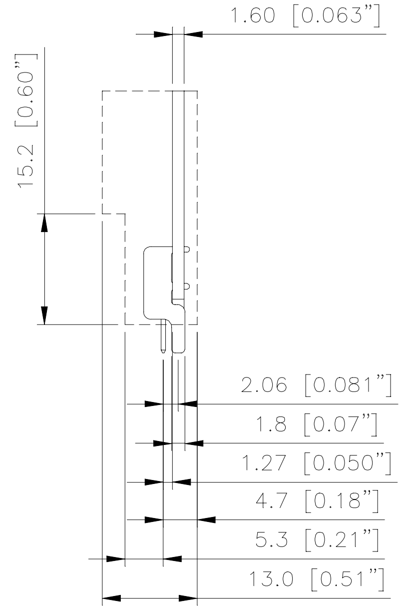


Figure 45: *Output current vs. ambient temperature and air velocity @Vin=12V, Vout=0.9V (Worse Orientation)*

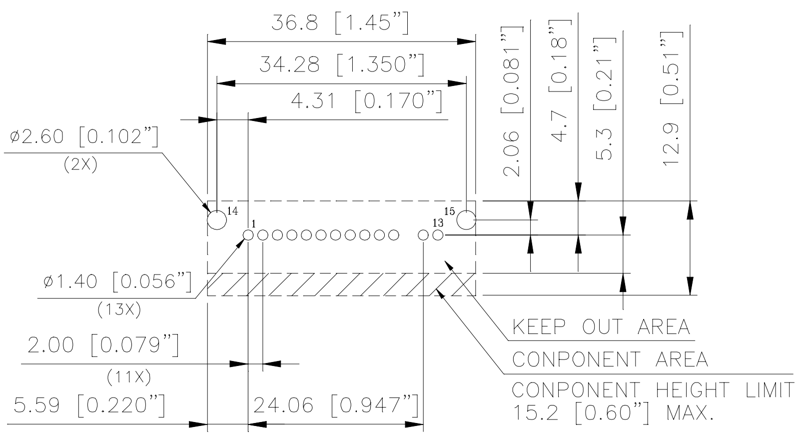
MECHANICAL DRAWING (VERTICAL)



BACK VIEW



SIDE VIEW

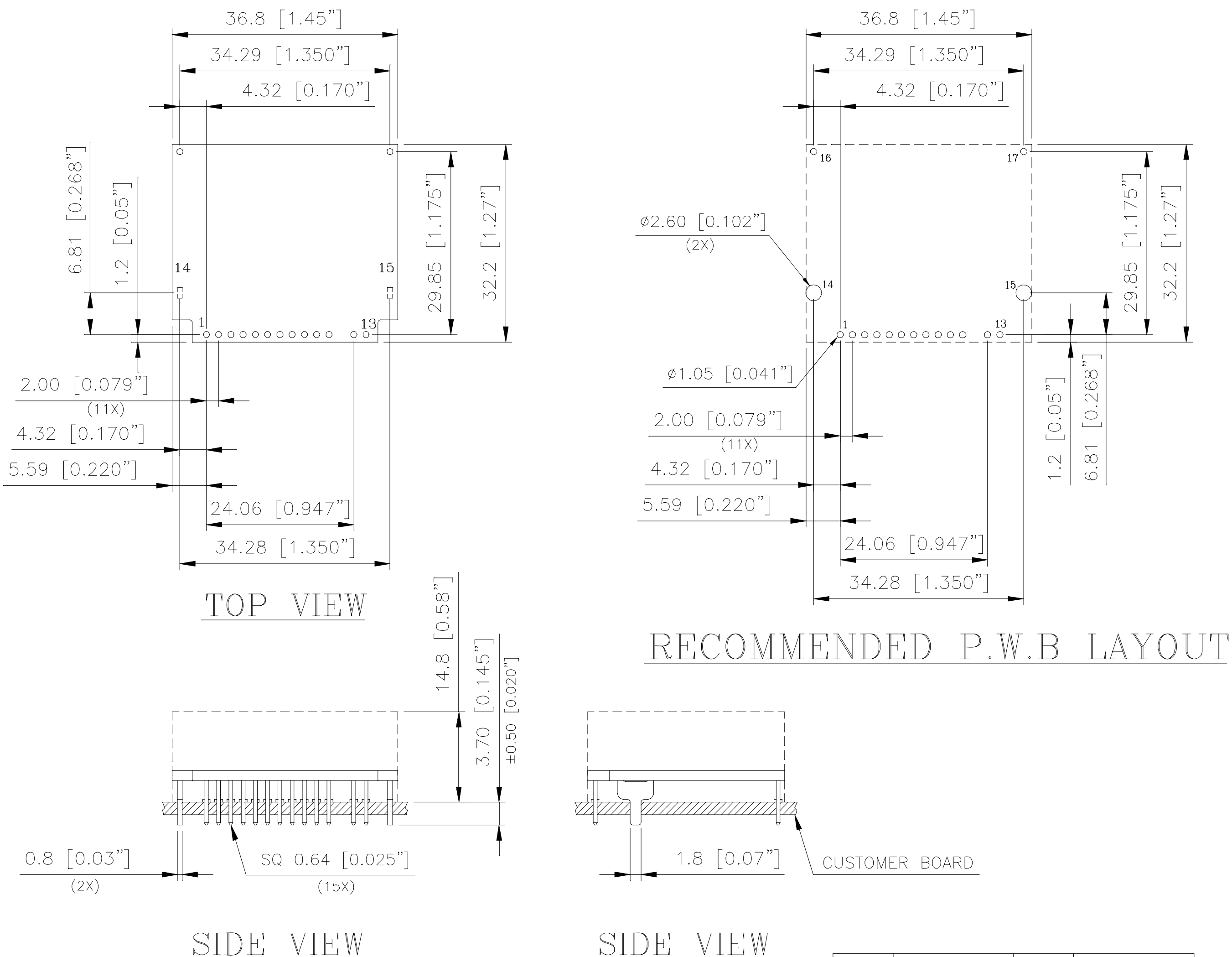


RECOMMENDED P.W.B LAYOUT

PIN#	Function	PIN#	Function
1	Vout	9	PG
2	Vout	10	SENSE(−)
3	Vout	11	SENSE(+)
4	GND	12	Vin
5	GND	13	Vin
6	ENABLE	14	GND
7	TRIM(−)	15	GND
8	TRIM(+)		

NOTES:
DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

MECHANICAL DRAWING (HORIZONTAL)



PIN#	Function	PIN#	Function
1	Vout	10	SENSE(−)
2	Vout	11	SENSE(+)
3	Vout	12	Vin
4	GND	13	Vin
5	GND	14	GND
6	ENABLE	15	GND
7	TRIM(−)	16	NC
8	TRIM(+)	17	NC
9	PG		

NOTES:
DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

PART NUMBERING SYSTEM

ND	12	S	0A0	V	40	P	N	F	A
Product Series	**Input Voltage**	**Number of outputs**	**Output Voltage**	**Mounting**	**Output Current**	**ON/OFF Logic**	**Pin Length**		**Option Code**
ND - Non-isolated Series	12 - 8.0~13.8V	S - Single Output	0A0 - Programmable	V - Vertical H - Horizontal	40 - 40A	P- Positive	N - 0.145"	F- RoHS 6/6 (Lead Free)	A- Standard Function

MODEL LIST

Model Name	Packaging	Input Voltage	Output Voltage	Output Current	Efficiency 12Vin @ 5Vo Full load
ND12S0A0V40PNFA	Horizontal	8.0V ~ 13.8Vdc	0.9V ~ 5.0V	40A	94%
ND12S0A0H40PNFA	Horizontal	8.0V ~ 13.8Vdc	0.9V ~ 5.0V	40A	94%

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WARRANTY

Delta offers a two (2) year limited warranty. Complete warranty information is listed on our web site or is available upon request from Delta.