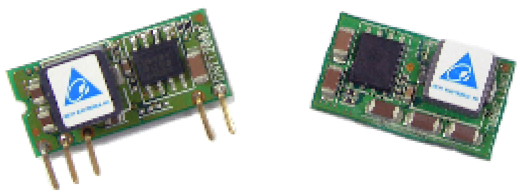
DELPHI SERIES



FEATURES

- High Efficiency: 93%@ 5Vin, 3.3V/5A out
- Small size and low profile:
  0.80” x 0.45” x 0.27” (SMD)
  0.90” x 0.40” x 0.25” (SIP)
- Standard footprint and pinout
- Resistor-based trim
- Output voltage programmable from 0.75V to 3.63V via external resistors
- Pre-bias startup
- No minimum load required
- Fixed frequency operation
- Input UVLO, OCP
- Remote ON/OFF
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS 18001 certified manufacturing facility
- UL/cUL 60950 (US & Canada) Recognized

Delphi DNT04, Non-Isolated Point of Load

DC/DC Power Modules: 2.4~5.5Vin, 0.75~3.63Vo, 5A out

The Delphi Series DNT04, 2.4-5.5V 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 DNT04 series provides a programmable output voltage from 0.75V to 3.63V via external resistors. This product family is available in surface mount or SIP package and provides up to 5A of output current in an industry standard footprint. 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. The DNT04, 5A modules have excellent thermal performance and can provide full output current at up to 85℃ ambient temperature with no airflow.

OPTIONS

- Positive On/Off logic
- SMD or SIP package

APPLICATIONS

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

Delta Electronics, Inc.

TECHNICAL SPECIFICATIONS

(T_A = 25°C, airflow rate = 300 LFM, V_{in} = 2.4Vdc and 5.5Vdc, nominal Vout unless otherwise noted.)

PARAMETER	NOTES and CONDITIONS	DNT04S0A0R05NFA			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage (Continuous)		0		5.8	Vdc
Operating Temperature		-40		85	°C
Storage Temperature		-55		125	°C
INPUT CHARACTERISTICS					
Operating Input Voltage	Vo ≦ Vin –0.5V	2.4		5.5	V
Input Under-Voltage Lockout					
Turn-On Voltage Threshold			2.1		V
Turn-Off Voltage Threshold			2.0		V
Maximum Input Current	Vin=4.5V Vo=3.3V, Io=Io,max			4.1	A
No-Load Input Current			30	45	mA
Off Converter Input Current			1		mA
Inrush Transient	Vin=2.4V to 5.5V, Io=Io,min to Io,max			0.1	A^2S
Recommended Input Fuse		7			A
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=5V, Io=Io, max	-2.0	Vo,set	+2.0	% Vo,set
Output Voltage Adjustable Range		0.7525		3.63	V
Output Voltage Regulation					
Over Line	Vin=2.4V to 5.5V		0.3		% Vo,set
Over Load	Io=Io,min to Io,max		0.4		% Vo,set
Over Temperature	Ta=-40℃ to 85℃		0.4		% Vo,set
Total Output Voltage Range	Over sample load, line and temperature	-3.0		+3.0	% Vo,set
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth				
Peak-to-Peak	Full Load, 1µF ceramic, 10µF tantalum		40	60	mV
RMS	Full Load, 1µF ceramic, 10µF tantalum		10	15	mV
Output Current Range		0		5	A
Output Voltage Over-shoot at Start-up				5	% Vo,set
Output DC Current-Limit Inception			220		% Io
Output Short-Circuit Current (Hiccup Mode)	Io,s/c		3		Adc (rms)
DYNAMIC CHARACTERISTICS					
Dynamic Load Response	10µF Tantalum & 1µF Ceramic load cap, 2.5A/µs				
Positive Step Change in Output Current	50% Io, max to 100% Io, max		220		mV
Negative Step Change in Output Current	100% Io, max to 50% Io, max		220		mV
Setting Time to 10% of Peak Devitation			25		µs
Turn-On Transient	Io=Io.max				
Start-Up Time, From On/Off Control	Von/off, Vo=10% of Vo,set		7		ms
Start-Up Time, From Input	Vin=Vin,min, Vo=10% of Vo,set		7		ms
Maximum Output Startup Capacitive Load	Full load; ESR ≧1mΩ			1000	µF
	Full load; ESR ≧10mΩ			3000	µF
EFFICIENCY					
Vo=3.3V	Vin=5V, 100% Load		93.0		%
Vo=2.5V	Vin=5V, 100% Load		90.5		%
Vo=1.8V	Vin=5V, 100% Load		87.5		%
Vo=1.5V	Vin=5V, 100% Load		86.0		%
Vo=1.2V	Vin=5V, 100% Load		83.5		%
Vo=0.75V	Vin=5V, 100% Load		77.5		%
FEATURE CHARACTERISTICS					
Switching Frequency			300		kHz
ON/OFF Control, (Negative logic)					
Logic Low Voltage	Module On, Von/off	-0.2		0.3	V
Logic High Voltage	Module Off, Von/off	2.5		Vin.max	V
Logic Low Current	Module On, Ion/off			10	µA
Logic High Current	Module Off, Ion/off		0.2	1	mA
GENERAL SPECIFICATIONS					
MTBF	Io=100% of Io, max; Ta=25°C		19.3		M hours
Weight			2.3		grams

ELECTRICAL CHARACTERISTICS CURVES

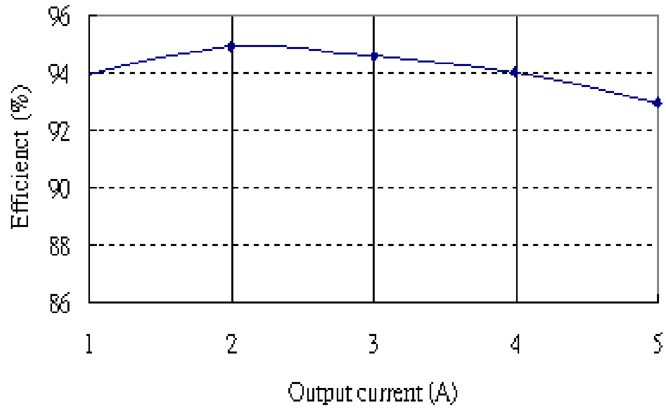


Figure 1: *Converter efficiency vs. output current (5Vin/3.3Vout)*

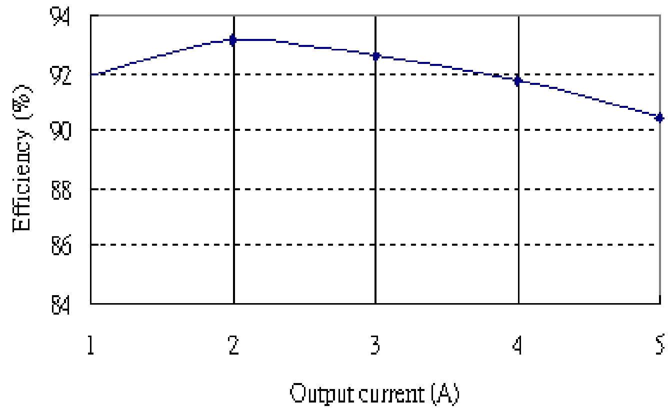


Figure 2: *Converter efficiency vs. output current (5Vin/2.5Vout)*

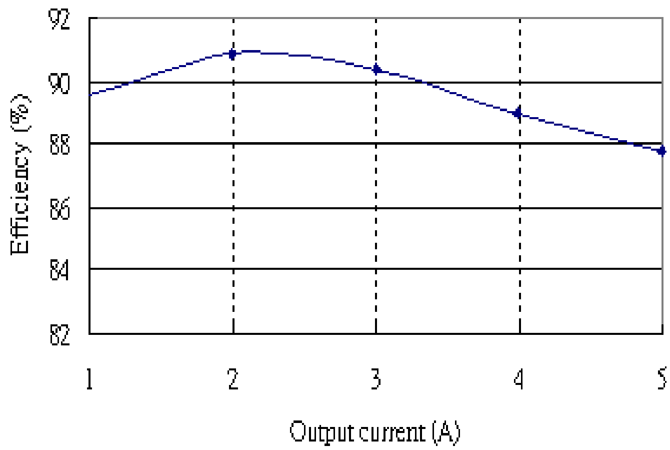


Figure 3: *Converter efficiency vs. output current (5Vin/1.8Vout)*

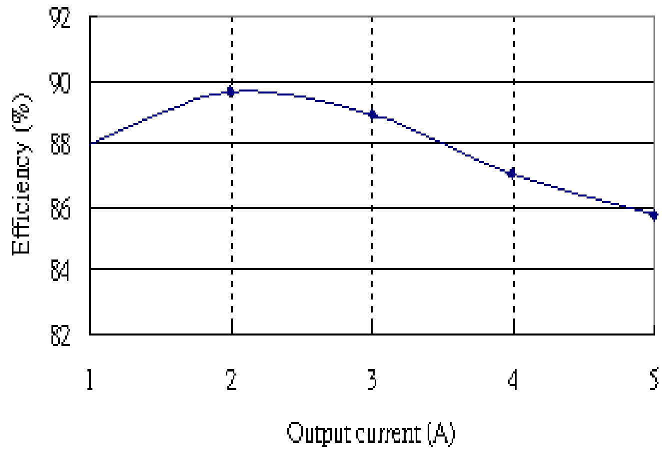


Figure 4: *Converter efficiency vs. output current (5Vin/1.5Vout)*

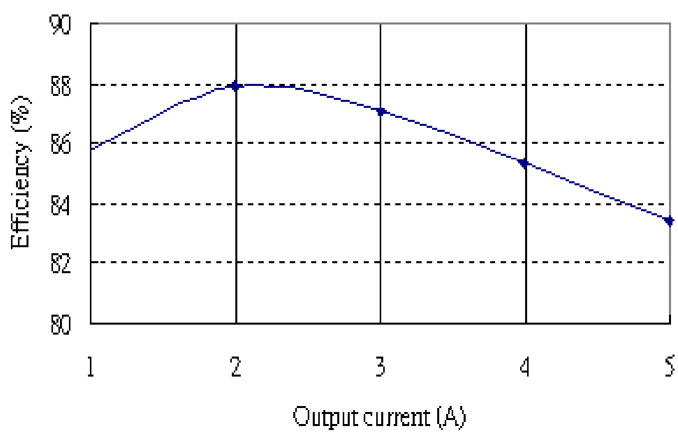


Figure 5: *Converter efficiency vs. output current (5Vin/1.2Vout)*

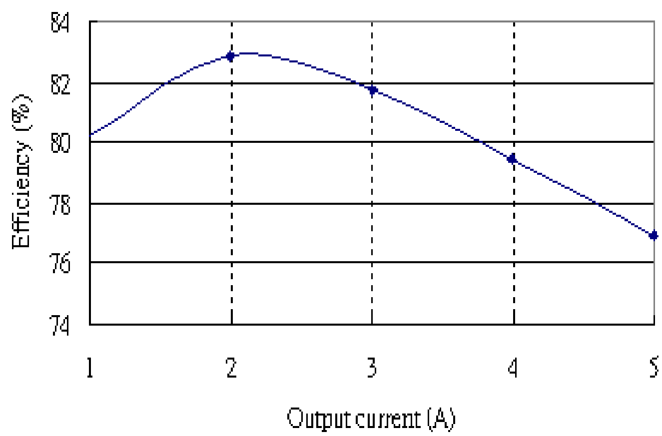


Figure 6: *Converter efficiency vs. output current (5Vin/0.75Vout)*

ELECTRICAL CHARACTERISTICS CURVES (CON.)

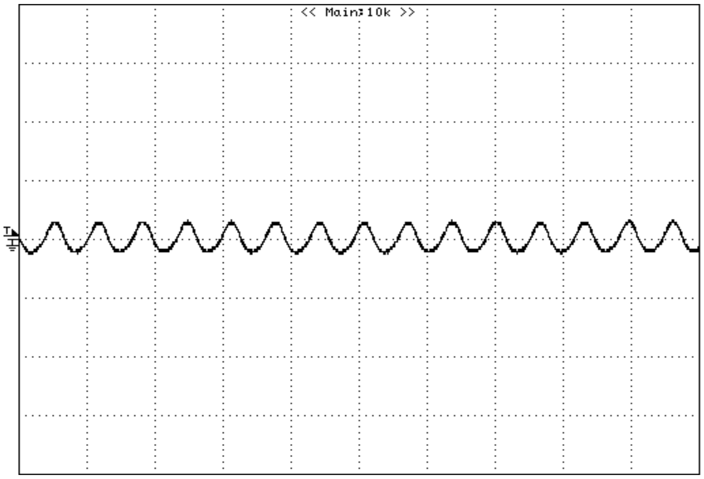


Figure 7: *Output ripple & noise at 5Vin, 3.3V/5A out, 50mV/div*

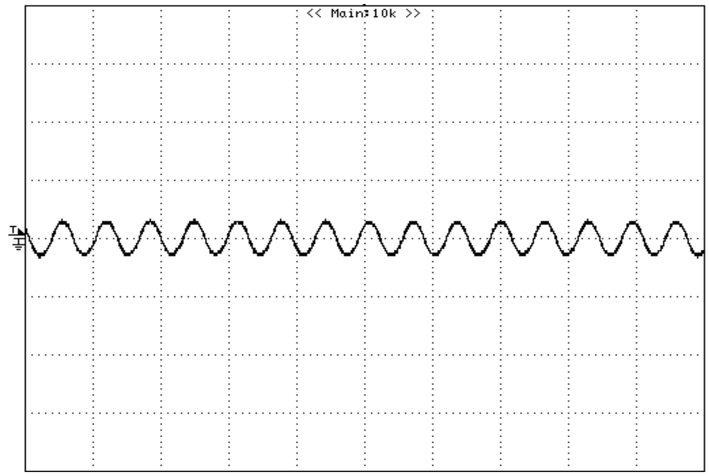


Figure 8: *Output ripple & noise at 5Vin, 2.5V/5A out, 50mV/div*

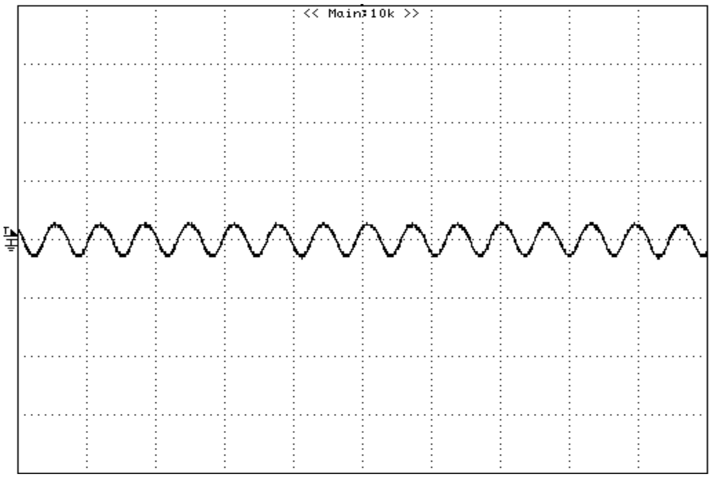


Figure 9: *Output ripple & noise at 5Vin, 1.8V/5A out, 50mV/div*

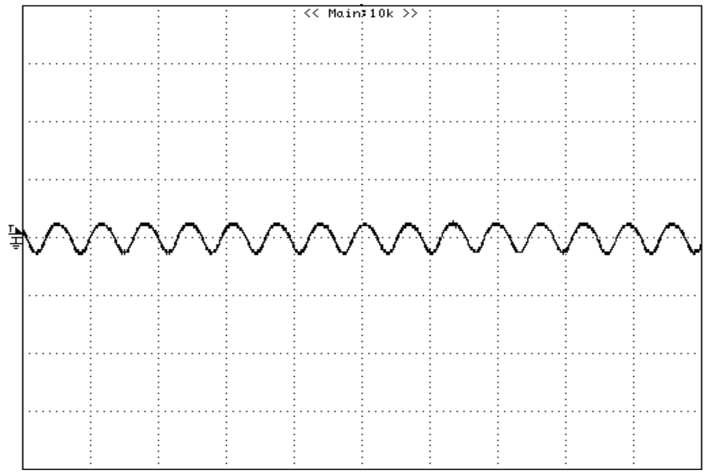


Figure 10: *Output ripple & noise at 5Vin, 1.5V/5A out, 50mV/div*

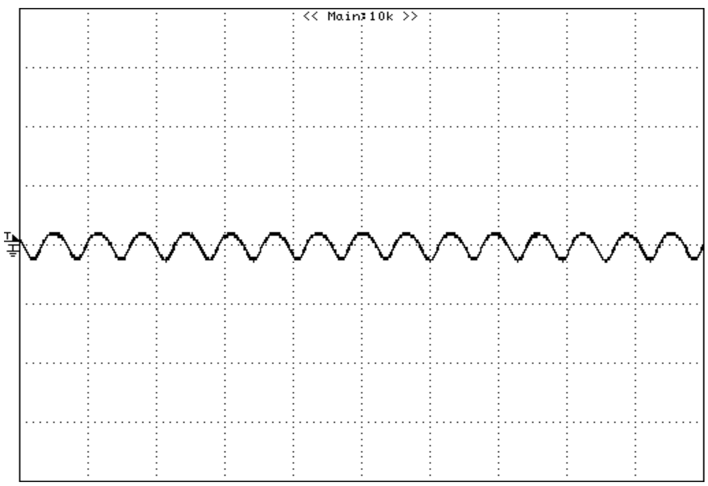


Figure 11: *Output ripple & noise at 5Vin, 1.2V/5A out, 50mV/div*

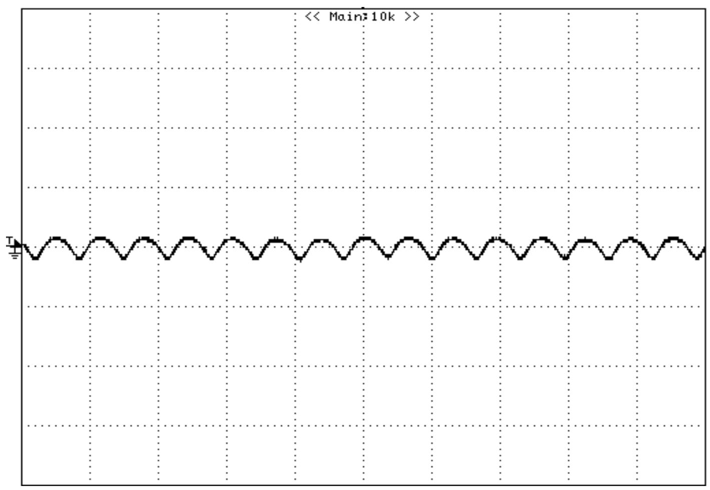


Figure 12: *Output ripple & noise at 5Vin, 0.75V/5A out, 50mV/div*

ELECTRICAL CHARACTERISTICS CURVES (CON.)

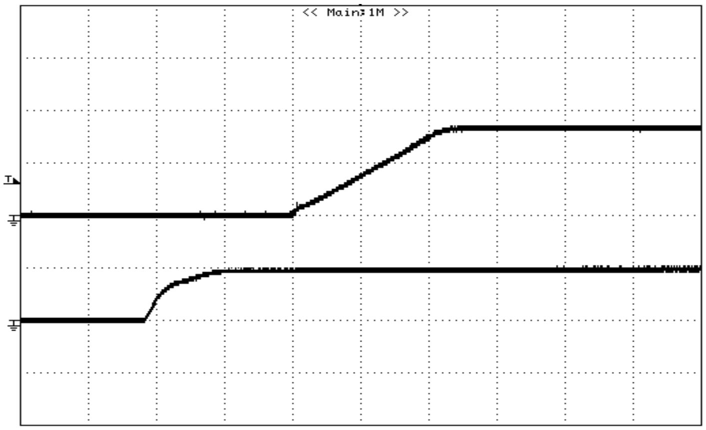


Figure 13: *Turn on delay time at 5Vin, 3.3V/5A out*
Top: Vout, 2V/div, Bottom: Vin, 5V/div; 2mS/div

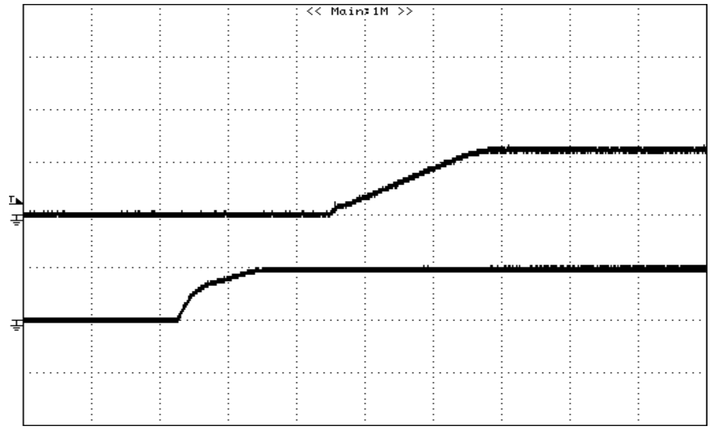


Figure 14: *Turn on delay time at 5Vin, 2.5V/5A out*
Top: Vout, 2V/div, Bottom: Vin, 5V/div; 2mS/div

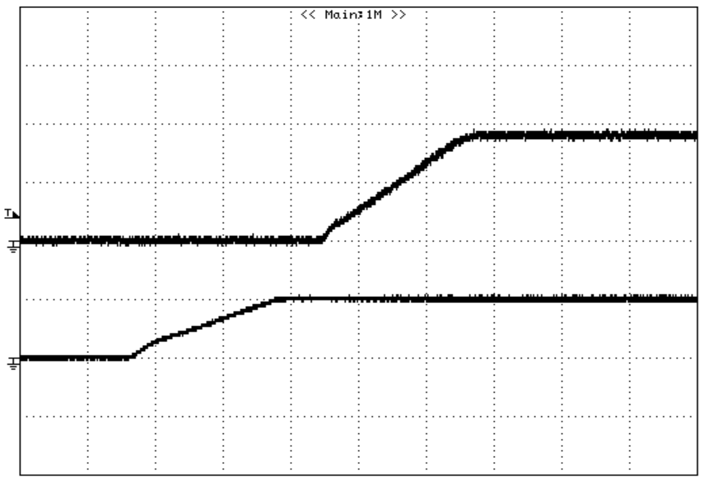


Figure 15: *Turn on delay time at 5Vin, 1.8V5A out*
Top: Vout, 1V/div, Bottom: Vin, 5V/div; 2mS/div

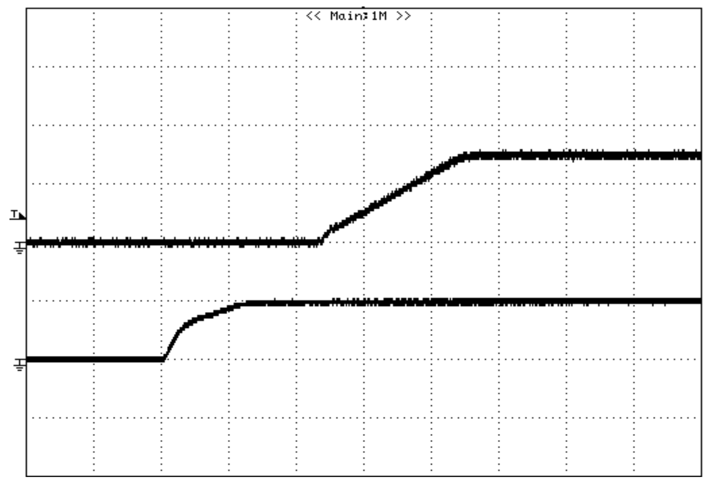


Figure 16: *Turn on delay time at 5Vin, 1.5V/5A out*
Top: Vout ,1V/div, Bottom: 5V/div; 2mS/div

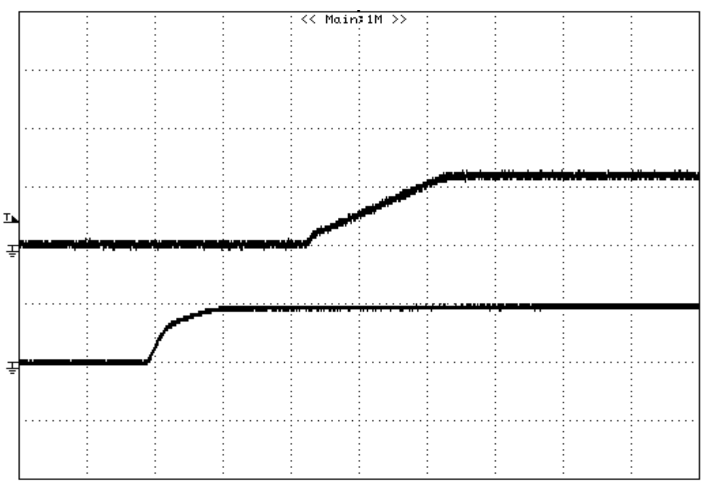


Figure 17: *Turn on delay time at 5Vin, 1.2V/5A out*
Top: Vout , 1V/div, Bottom: Vin, 5V/div; 2mS/div

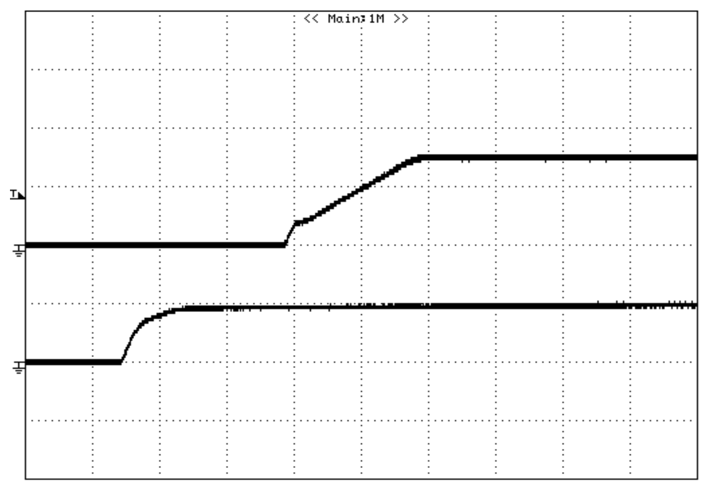


Figure 18: *Turn on delay time at 5Vin, 0.75V/5A out*
Top: Vout, 0.5V/div, Bottom: Vin ,5V/div; 2mS/div

ELECTRICAL CHARACTERISTICS CURVES

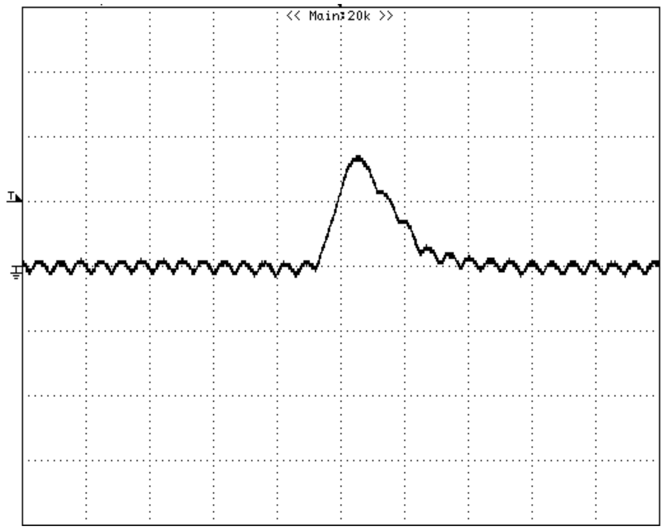


Figure 19: *Typical transient response to step load change at 2.5A/µS from 100% to 50% of Io, max at 5Vin, 3.3Vout (Cout = 1uF ceramic, 10µF tantalum), 0.1V/div*

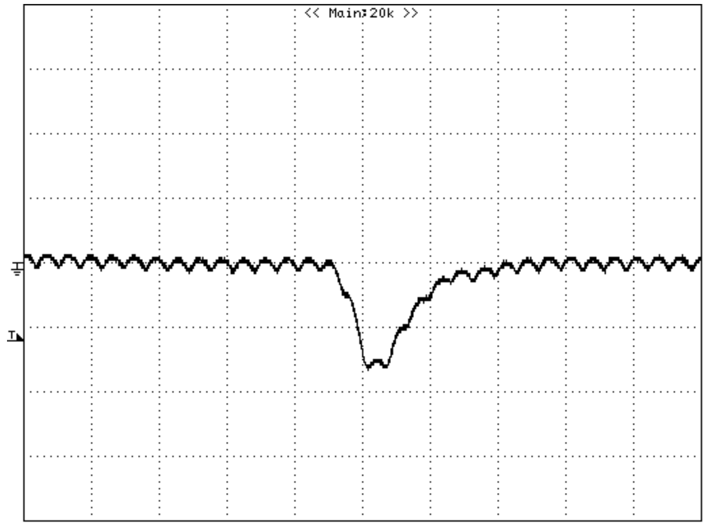


Figure 20: *Typical transient response to step load change at 2.5A/µS from 50% to 100% of Io, max at 5Vin, 3.3Vout (Cout =1uF ceramic, 10µF tantalum), 0.1V/div*

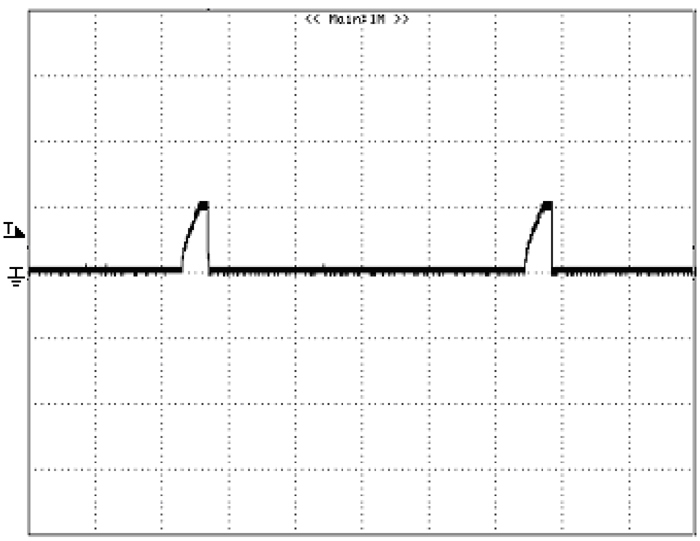


Figure 21: *Output short circuit current 5Vin, 0.75Vout 20A/div, 10mS/div*

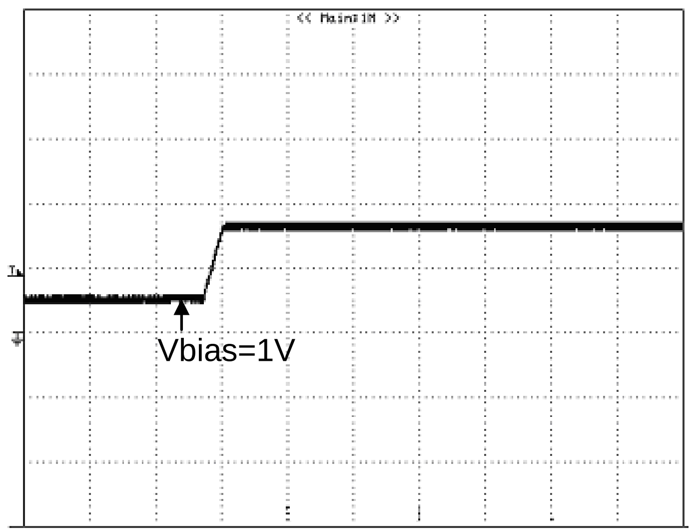
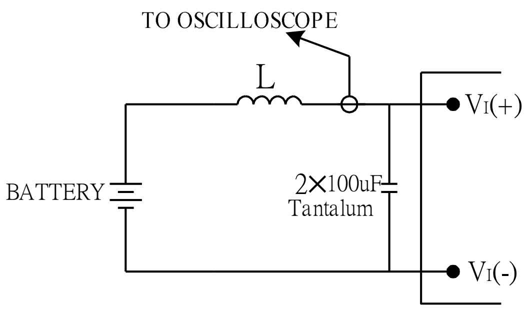


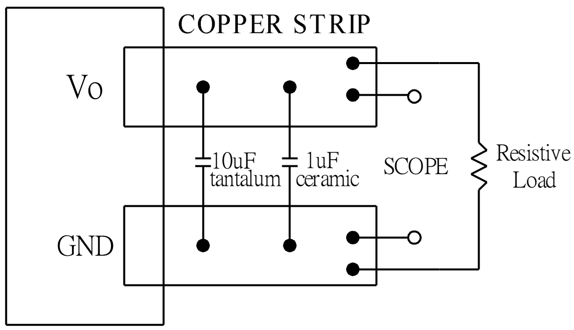
Figure 22:*Turn on with Prebias 5Vin, 3.3V/0A out, Vbias =1.0Vdc 2V/div, 10mS/div*

TEST CONFIGURATIONS



Note: Input reflected-ripple current is measured with a simulated source inductance. Current is measured at the input of the module.

Figure 23: *Input reflected-ripple test setup*



Note: Use a 10µF tantalum and 1µF capacitor. Scope measurement should be made using a BNC connector.

Figure 24: *Peak-peak output noise and startup transient measurement test setup.*

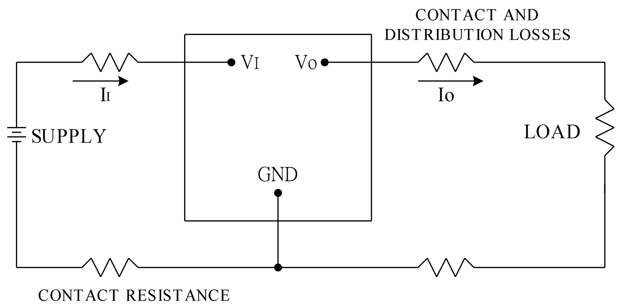


Figure 25: *Output voltage and efficiency measurement test setup*

Note: All measurements are taken at the module terminals. When the module is not soldered (via socket), place Kelvin connections at module terminals to avoid measurement errors due to contact resistance.

$$\eta = \left(\frac{Vo \times Io}{Vi \times Ii}\right) \times 100 \quad \%$$

DESIGN CONSIDERATIONS

Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the module. An input capacitance must be placed close to the modules input pins to filter ripple current and ensure module stability in the presence of inductive traces that supply the input voltage to the module.

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 adequate time-delay fuse in the ungrounded lead.

FEATURES DESCRIPTIONS

Remote On/Off

The DNT series power modules have an On/Off pin for remote On/Off operation. Both positive and negative On/Off logic options are available in the DNT series power modules.

For positive logic module, connect an open collector (NPN) transistor or open drain (N channel) MOSFET between the On/Off pin and the GND pin (see figure 26). Positive logic On/Off signal turns the module ON during the logic high and turns the module OFF during the logic low. When the positive On/Off function is not used, leave the pin floating or tie to Vin (module will be On).

For negative logic module, the On/Off pin is pulled high with an external pull-up resistor (see figure 27). Negative logic On/Off signal turns the module OFF during logic high and turns the module ON during logic low. If the negative On/Off function is not used, tie the pin to GND. (module will be On)

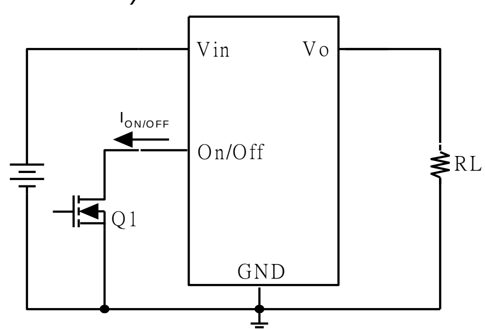


Figure 26: *Positive remote On/Off implementation*

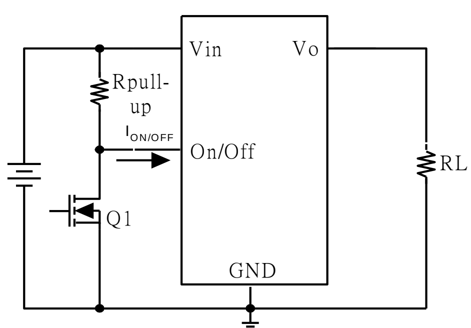


Figure 27: *Negative remote On/Off implementation*

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.

FEATURES DESCRIPTIONS (CON.)

Output Voltage Programming

The output voltage of the DNT can be programmed to any voltage between 0.75Vdc and 3.63Vdc by connecting one resistor (shown as Rtrim in Figure 28) between the TRIM and GND pins of the module. Without this external resistor, the output voltage of the module is 0.7525 Vdc. To calculate the value of the resistor Rtrim for a particular output voltage Vo, please use the following equation:

$$Rtrim = \left[\frac{21070}{Vo - 0.7525} - 5110\right]\Omega$$

For example, to program the output voltage of the DNS module to 1.8Vdc, Rtrim is calculated as follows:

$$Rtrim = \left[\frac{21070}{1.8 - 0.7525} - 5110\right]\Omega = 15K\Omega$$

DNT can also be programmed by apply a voltage between the TRIM and GND pins (Figure 29). The following equation can be used to determine the value of Vtrim needed for a desired output voltage Vo:

$$Vtrim = 0.7 - 0.1698 \times (Vo - 0.7525)$$

For example, to program the output voltage of a DNT module to 3.3 Vdc, Vtrim is calculated as follows

$$Vtrim = 0.7 - 0.1698 \times (3.3 - 0.7525) = 0.267V$$

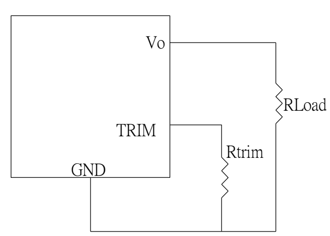


Figure28: *Circuit configuration for programming output voltage using an external resistor*

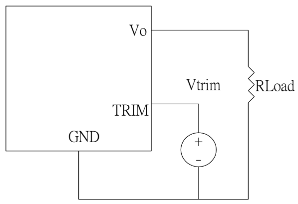


Figure 29: *Circuit Configuration for programming output voltage using external voltage source*

The amount of power delivered by the module is the voltage at the output terminals multiplied by the output current. When using the trim feature, the output voltage of the module can be increased, which at the same output current would increase the power output of the module. Care should be taken to ensure that the maximum output power of the module must not exceed the maximum rated power ($V_{o.set} \times I_{o.max} \leq P_{max}$).

Voltage Margining

Output voltage margining can be implemented in the DNT modules by connecting a resistor, $R_{margin\text{-}up}$, from the Trim pin to the ground pin for margining-up the output voltage and by connecting a resistor, $R_{margin\text{-}down}$, from the Trim pin to the output pin for margining-down. Figure 30 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 $R_{margin\text{-}up}$ and $R_{margin\text{-}down}$ for a specific output voltage and margin percentage.

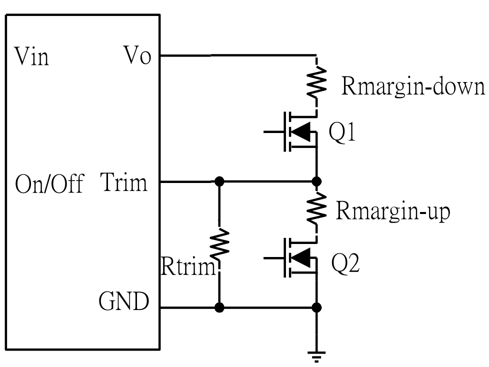


Figure 30: *Circuit configuration for output voltage margining*

THERMAL CONSIDERATIONS

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.

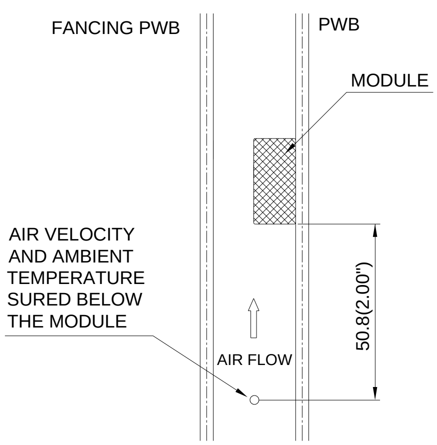
Thermal Testing Setup

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 height of this fan duct is constantly kept at 25.4mm (1'').

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 31: *Wind tunnel test setup*

THERMAL CURVES

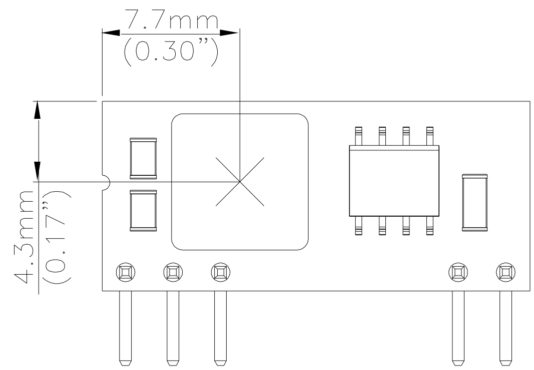


Figure 32: *Temperature measurement location*
The allowed maximum hot spot temperature is defined at 125℃

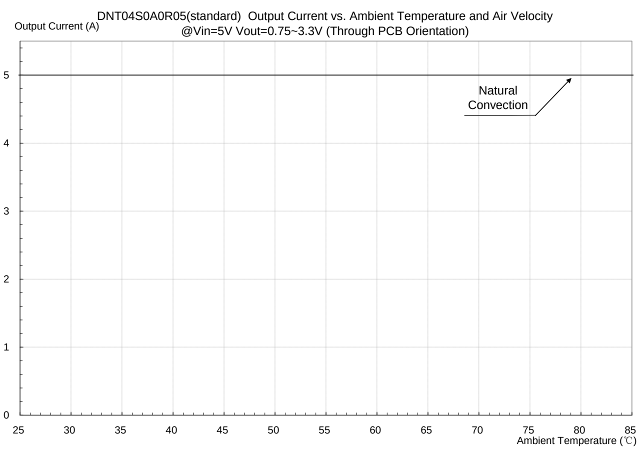
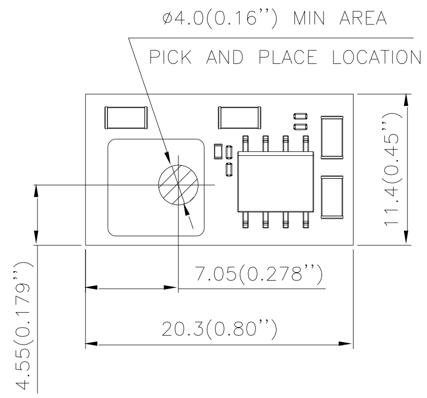


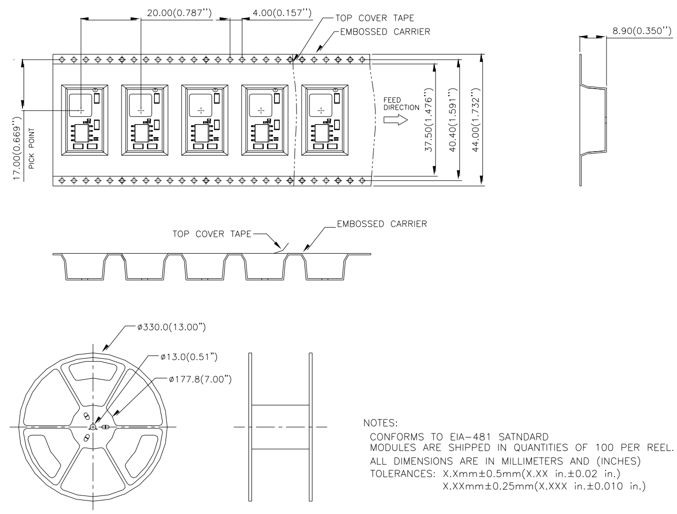
Figure 33: *Output current vs. ambient temperature and air velocity @ Vin=5V, Vout=0.75V~3.3V(Through PCB Orientation)*

PICK AND PLACE LOCATION



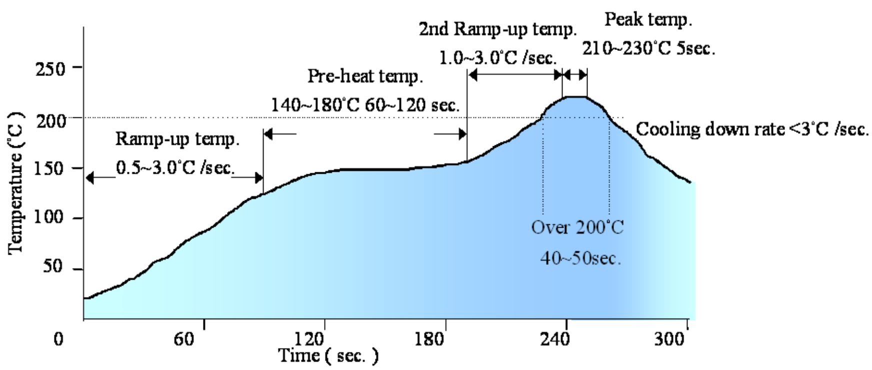
NOTES:
ALL DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

SURFACE- MOUNT TAPE & REEL

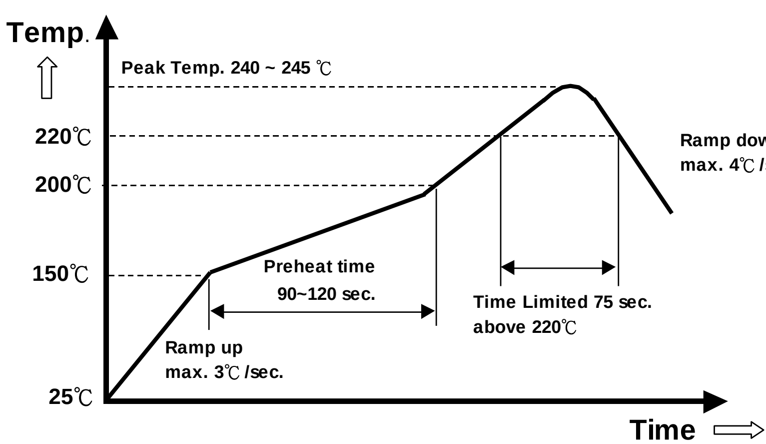


NOTES:
CONFORMS TO EIA-481 SATNDARD
MODULES ARE SHIPPED IN QUANTITIES OF 100 PER REEL.
ALL DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

LEAD (Sn/Pb) PROCESS RECOMMEND TEMP. PROFILE



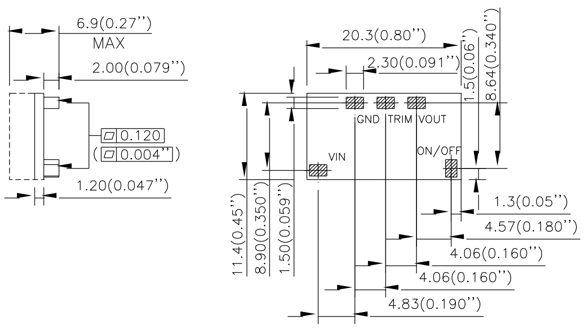
LEAD FREE (SAC) PROCESS RECOMMEND TEMP. PROFILE



Note: All temperature refers to assembly application board, measured on the land of assembly application board.

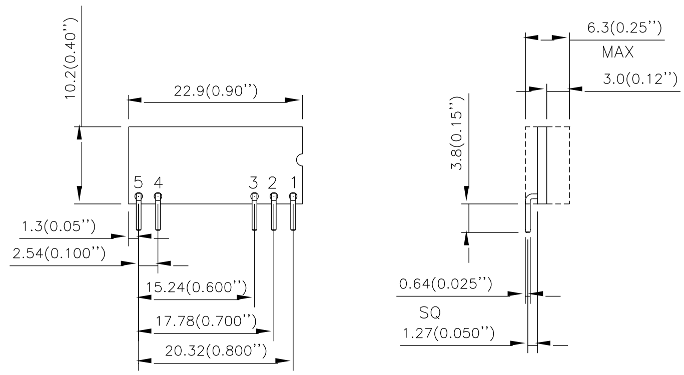
MECHANICAL DRAWING

SMD PACKAGE (OPTIONAL)

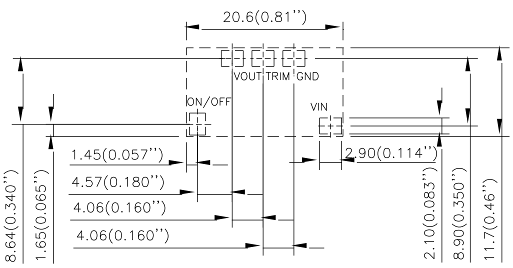


SIDE VIEW BOTTOM VIEW

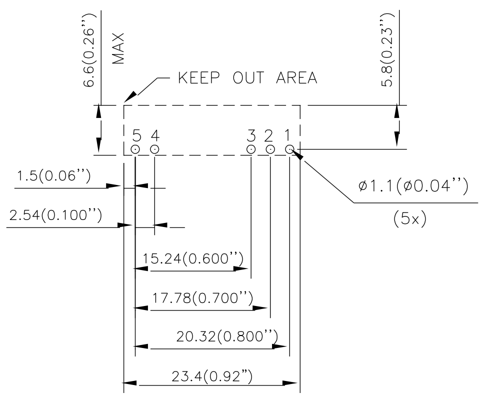
SIP PACKAGE



BACK VIEW SIDE VIEW



RECOMMAND PWB PAD LAYOUT



RECOMMAND PWB PAD LAYOUT

PIN#	FUNCTION
1	Vout
2	TRIM
3	GND
4	Vin
5	On/Off

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.)

Note: All pins are copper alloy with matte tin(Pb free) plated over Nickel under-plating.

PART NUMBERING SYSTEM

DNT	04	S	0A0	R	05	N	F	A
Product Series	Input Voltage	Numbers of Outputs	Output Voltage	Package Type	Output Current	On/Off logic		Option Code
DNT- 3A/5A	04 - 2.4V~5.5V	S - Single	0A0 - Programmable	R - SIP S- SMD	05 - 5A	N- negative (Default) P- positive	F- RoHS 6/6 (Lead Free)	A - Standard Function

MODEL LIST

Model Name	Package	Input Voltage	Output Voltage	Output Current	Efficiency 5Vin, 3.3Vdc full load
DNT04S0A0S03NFA	SMD	2.4V ~ 5.5Vdc	0.75V ~ 3.63Vdc	3A	93.5%
DNT04S0A0R03NFA	SIP	2.4V ~ 5.5Vdc	0.75V ~ 3.63Vdc	3A	94%
DNT04S0A0S05NFA	SMD	2.4V ~ 5.5Vdc	0.75V ~ 3.63Vdc	5A	94%
DNT04S0A0R05NFA	SIP	2.4V ~ 5.5Vdc	0.75V ~ 3.63Vdc	5A	93%

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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.