WDELPHI SERIES



Delphi Series V36SE, 1/16th Brick DC/DC Power Modules: 18~75Vin, up to 50W

The Delphi Series V36SE, 1/16th Brick, 18~75V wide input, single output, isolated DC/DC converter, is the latest offering from a world leader in power systems technology and manufacturing - Delta Electronics, Inc. This product family provides up to 50 watts of power in the industry standard 1/16th brick form factor (1.30"x0.90") and pinout. 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. For the 5.0V output module, it delivers 50W(10A) output with 36 to 75V input and delivers 40W (8.0A) output while the input is 18 to 36V to the same module. Typical efficiency of the 5.0V/10A module is greater than 91%. All modules are protected from abnormal input/output voltage, current, and temperature conditions. For lower power needs, but in a similar small form factor, please check out Delta S48SP (36W or 10A) and S36SE (17W or 5A) series standard DC/DC modules.

FEATURES

- High efficiency: 91%@5V/10A,48Vin 90%@5V/8A,24Vin
- Size: 33.0x22.8x9.3mm (1.30"x0.90"x0.37")
- Industry standard 1/16th brick size & pinout
- Input UVLO
- OTP and output OCP, OVP (default is auto-recovery)
- Output voltage trim: -20%, +10%
- Monotonic startup into normal and pre-biased loads
- 2250V isolation and basic insulation
- No minimum load required
- SMD and Through-hole versions
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS 18001 certified manufacturing facility
- UL/cUL 60950-1 (US & Canada) Recognized

OPTIONS

- SMD pins
- Positive remote On/Off
- OTP and output OVP, OCP mode (Auto-restart or latch)

APPLICATIONS

- Optical Transport
- Data Networking
- Communications
- Servers



DS_V36SE05010_03032011



TECHNICAL SPECIFICATIONS

(T_A=25°C, airflow rate=300 LFM, V_{in}=48Vdc, nominal Vout unless otherwise noted.)

ASSOLUTE MAXIMUM RATINGS Input Voltage Continuous Transient (100ms) Gorading Emperature Continuous Transient Continuous Transient Continuous Transient Continuous Transient Continuous Content Con	in. Typ.		V36SE05010(Standard)			
Input Voltage and Set Point Continuous 100ms 00000000000000000000000000000000	п. тур.	Units				
Continuous 100ms Transient (100ms) 100ms Operating Temperature Refer to figure 19 for measuring point -40 Strage Temperature -55 Put/Output Isolation Voltage 18 Input Under Voltage Intreshold 16 Turn-On Voltage Threshold 16 Turn-On Voltage Threshold 16 Turn-On Voltage Threshold 16 Turn-On Voltage Threshold 10 To-Load Input Current 100% Load, 18Vin No-Load Input Gurent 100% Load, 18Vin No-Load Input Gurent 120 Hz Ortput Voltage Ste Point Vin=48V, Io=Io.max, To=25°C Output Voltage Regleation 120 Hz Unput Reflected-Rippic Rejection 120 Hz Unput Voltage Regleaten Noise 58 Hz to 20MHz bandwidth Over Line Vin=38V to 75V Output Voltage Rippie Rejection Full Load, Ipfe caramic, 100,P Tantalum Peak-to-Peak Full Load, Ipfe caramic, 100,P Tantalum </td <td></td> <td></td> <td>Vdc</td>			Vdc			
Transient (100ms) 100ms Norage Temperature Refer to figure 19 for measuring point -40 Norage Temperature -55 optifUting to Isolation Voltage -55 NEUT CHARACHERISTICS -55 Operating Topy Voltage Interability 18 Turn-OT Voltage Interability 18 Turn-OT Voltage Threability 0.5 Maximum Topy Current 100% Load, 18Vin No-Load Input Current 100% Load, 18Vin Input Notage Ripple Rejection 120 Hz VIPUT CHARACTERISTICS 4.95 Output Voltage Regulation Vin=340V to 75V Over Load Vin=340V to 75V Over Temperature Full Load, 1µF ceramic, 100µF tantalum RMS Full Load, 1µF ceramic, 100µF tantalum RMS Full Load, 1µF ceramic, 100µF tantalum Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum		80	Vdc			
Storage Temperature -55 PNUT OLVDUE Isolation Voltage -55 NPUT OLARAACTERISTICS -55 Operating Input Voltage 18 Input Under-Voltage Lockout 16 Turn-Or Voltage Threshold 05 Dickout Hysteresis Voltage 05 Maximum Input Current 100% Load, 18Vin No-Load Input Current 100% Load, 18Vin Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Voltage Ripple Rejlection 10=lo, min to lo, max Over Load Vin=48V, 100 To 75V Over Load Over and temperature Over Load Over and temperature Over Temperature Te=40°C to 85°C Output Voltage Ripple and Noise 5Hz to 20MHz bandvildh Peak-to-Peak Full Load, 1µE ceramic, 100µF tantalum RMS		100	Vdc			
oput/Output Isolation Voltage Input Voltage (EXC) 18 Operating Input Voltage (Exclud) 16 Input Under-Voltage (Exclud) 16 Tum-Ont Voltage Threshold 15 Lockout Hysteresis Voltage 0.05 Maximum Input Current 100% Load, 18Vin No-Load input Current 100% Load, 18Vin Off Converter Input Current 120 Hz Input Notage Ripple Rejection 120 Hz Output Voltage Regulation 100% Load, 18Vin Over Load 100% Load, 100 max Over Load 120 Hz Output Voltage Regulation 120 Hz Over Load Vin=48V, loois max, Tc=25°C Over Load Vin=36V to 75V Over Temperature Tc=40°C to 85°C Output Voltage Range Over sample load, line and temperature Over Load, Up Cerrent, 100µF tantalum Full Load, Up Cerrent, 100µF tantalum RMS Full Load, Up Cerrentic, 100µF tantalum RMS Full Load, UP Cerrentic, 100µF tantalum RMS Full Load, UP Cerrentic, 100µF tantalum Output Voltage Current Pratiset 25% lo max to 50% lo max </td <td></td> <td></td> <td>°C</td>			°C			
NPUT CHARACTERISTICS 18 Input Under-Voltage Lockout 18 Turn-Oft Voltage Threshold 16 Turn-Oft Voltage Threshold 15 Lockout Hysteresis Voltage 0.5 Maximum Input Current 100% Load, 18Vin No-Load Input Current 100% Load, 18Vin Input Reflect-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflect-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflect-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Voltage Ripple Registron 120 Hz UPUT OF HARACTERISTICS 0 Output Voltage Regulation 0 Over Load Io=Io, min to Io, max Over Load Over sample load, line and temperature Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth Peak-to-Peak Full Load, Ju F Ceramic, 100µF tantalum RMS Full Load, Ju F Ceramic, 100µF tantalum RMS Full Load, Ju F Ceramic, 100µF tantalum Operating Output Current Range Vim=8V-35V 0 Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth Positive Step Change in Output Current Range Vim=8V-36V	55		°C			
Operating Input Voltage 18 Input Under-Voltage Lockout 16 Turn-Ont Voltage Threshold 16 Turn-Ont Voltage Threshold 16 Lockout Hysteresis Voltage 005 Maximum Input Current 100% Load, 18Vin No-Load Input Current 100% Load, 18Vin Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Voltage Ripple Rejection 120 Hz Output Voltage Replet Rejection 120 Hz Output Voltage Regulation 10elo, min to lo, max Over Load Vin=48V, lo=lo max, Tc=25°C 4.95 Output Voltage Regulation 10elo, min to lo, max 00er Over Teme Over Sample load, line and temperature 4.85 Over Teme Over Sample load, line and temperature 4.85 Output Voltage Ripple and Noise 5Hz to 20MHz bandwith 5 Operating Output Current Range Vin=38V, 100F Tan & 100F tantalum 0 Operating Output Current Range Vin=38V, 100F Tan & 100F tantalum 10 Over Load Vin=48V, 100F Tan & 10F Caranic back ang, 11/Vis 10 Out		2250	Vdc			
Input Under-Voltage Enreshold 16 Turn-Off Voltage Threshold 15 Lockout Hysteresis Voltage 0.5 Maximum Input Current 100% Load, 18VIn No-Load Input Current 100% Load, 18VIn Input Reflect-Ripple Current 120 Hz Input Reflect-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Voltage Ripple Rejection 120 Hz Output Voltage Set Point Vin=48V, lo=lo.max, Tc=25°C Output Voltage Regulation Vin=36V to 75V Over Load Io=lo, min to Io, max Over Load Vor asmple load, line and temperature Over Load Over sample load, line and temperature Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth Peak-to-Peak Full Load, Jup Ceramic, 100µF tantalum RMS Full Load, Jup Ceramic, 100µF tantalum Operating Output Current Range Vin=38V-75V 0 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1Alyis Positive Step Change in Output Current 25% lo.max 100 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1Alyis <t< td=""><td>0 40</td><td>0 40 75</td><td></td></t<>	0 40	0 40 75				
Turn-On Voltage Threshold 16 Turn-On Voltage Threshold 15 Lockout Hysteresis Voltage 0.5 Maximum Input Current 100% Load, 18Vin Off Converter Input Current 100% Load, 18Vin Insus Current (I') P-P thru 12µH inductor, 5Hz to 20MHz Input Noltage Ripple Rejection 120 Hz Output Voltage Regulation 100-Inmax Over Load Io=Io, min to Io, max Over Ione Vin=38V to 75V Over Ione Vin=38V to 75V Over Ione Full Load, 1µE ceramic, 100µE tantalum RMS Full Load, 1µE ceramic, 100µE tantalum RMS Vin=48V-36V 0 Output Voltage Current Transient 48V, 10µE Tan & 1µE Ceramic load cap, 0.14µS Positive Step Change in Output Current	8 48	8 48 75	Vdc			
Turn-Off Voltage Threshold 15 Lockout Hysteresis Voltage 0.5 Maximum Input Current 100% Load, 18Vin Na-Load Input Current 100% Load, 18Vin Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Voltage Rejection 120 Hz Other Voltage Reglection 120 Hz Output Voltage Reglection 120 Hz Over Load Io=Io, min to Io, max Over Load Over Sample load, line and temperature Over Load Over Sample load, line and temperature Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth Peak-Io-Peak Full Load, IµF ceramic, 100µF tantalum RMS Output Voltage 10% Low 110 Output Voltage Ion Noise SHz to 20% Io max 100 Output Voltage Ion Noise SHz to 20% Io max 100 Output Voltage Ion Noise SHz	6 17	6 17 18	Vdc			
Lockout Hysteresis Voltage 0.5 Maximum Input Current 100% Load, 18Vin 0 No-Load Input Current 100% Load, 18Vin 0 Inrush Current (1') P-P thru 12µH inductor, 5Hz to 20MHz 0 Input Netlace Ripple Rejection 120 Hz 0 Output Voltage Ripple Rejection 120 Hz 0 Output Voltage Set Point Vin=48V, Io=Io, max, To=25°C 4.95 Over Load Io=Io, min to Io, max 0 Over Load Over sample load, line and temperature 4.85 Output Voltage Range Over sample load, line and temperature 4.85 Output Voltage Ripple and Noise Full Load, IJF ceramic, 100µE tantalum 10 Peak-to-Peak Full Load, IJF ceramic, 100µE tantalum 10 Operating Output Current Range Vin=36V-75V 0 Output Voltage Curent Transient 48V, 10µE Tan & 1µE Cerami			Vdc			
No-Laad Input Current Imput Part Current Off Converter Input Current P-P thru 12µH inductor, 5Hz to 20MHz Input Notage Ripple Rejection 120 Hz Output Voltage Ripple Rejection 120 Hz Output Voltage Set Point Vin=48V, lo=Io.max, Tc=25°C Output Voltage Regulation Io=Io, min to Io, max Over Load Io=Io, min to Io, max Over Line Vin=38V to 75V Over Temperature Tc=-40°C to 85°C Output Voltage Range Over sample load, line and temperature Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth Peak-to-Peak Full Load, 1µF ceramic, 100µF fantalum RMS Full Load, 1µF ceramic, 100µF fantalum Operating Output Current Range Vin=38V-75V 0 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 100 NhAMIC CHARACTERISTICS Output Voltage Current Transient 25% lo.max 50% lo.max Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 100 Natific CHARACTERISTICS Output Voltage Current Transient 50% lo.max to 55% lo.max 50% lo.max <		.5 1 1.8	Vdc			
Off Converter Input Current Innush Current (i't) Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Voltage Ripple Rejection 120 Hz Output Voltage Reput Rejection 120 Hz Output Voltage Regulation 10=lo, min to lo, max Over Line Vin=38V to 75V Over Load Io=lo, min to lo, max Over Load Io=lo, min to lo, max Over Line Vin=38V to 75V Over Line To=a-40°C to 85°C Output Voltage Range Over sample load, line and temperature Peak-to-Peak Fuil Load, 1µF ceramic, 100µF tantalum RMS Fuil Load, 1µF ceramic, 100µF tantalum Operating Output Current Range Vin=38V to 10% Low Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs Positive Step Change in Output Current 25% lo.max to 25% lo.max Negative Step Change in Output Current 50% lo.max to 25% lo.max Start-Up Time, From On/Off Control Start-Up Time, From On/Off Control Start-Up Time, From On/Off Control Vin=48V Start-Up Time, From Input Maximum Output Capacitance (note1) FEFICIENCY Vin=48V O0% Load Vin=48V Start-Up Time, From Input Vin=48V Solation Capacitance 10 <td></td> <td>3.9</td> <td>A</td>		3.9	A			
Inrush Current (i th) P-P thru 12µH inductor, 5Hz to 20MHz Input Neiflected-Ripple Rejection 120 Hz DUTPUT CHARACTERISTICS Vin=48V, Io=Io.max, Tc=25°C 4.95 Output Voltage Replation Io=20, min to Io, max 0 Over Load Io=20, min to Io, max 0 Over Load Io=36V to 75V 0 Over Load Over sample load, line and temperature 4.85 Output Voltage Range Over sample load, line and temperature 4.85 Output Voltage Ripple and Noise Full Load, 1µF ceramic, 100µF tantalum 0 Operating Output Current Range Vin=36V-75V 0 0 Output Voltage Current Range Vin=36V-75V 0 0 0 Output Voltage Current Range Vin=36V-75V 0 0 0 Output Voltage Current Range Vin=36V-75V 0 0 0 0 0 0 0 0 0 <td< td=""><td>40</td><td></td><td>mA</td></td<>	40		mA			
Input Reflected-Ripple Current P-P thru 12µH inductor, 5Hz to 20MHz Input Voltage Ripple Rejection 120 Hz Output Voltage Replation Vin=48V, lo=lo.max, Tc=25°C Over Load lo=lo,min to lo,max Over Load lo=lo,min to lo,max Over Load Vin=36V to 75V Over Line Tc=40°C to 85°C Over Temperature Tc=40°C to 85°C Total Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum RMS Full Load, 1µF ceramic, 100µF tantalum Operating Output Current Range Vin=18V-36V 0 Output Voltage Current Transient Output Voltage 10% Low 110 YNAMIC CHARACTERISTICS Start-Up Time, From On/Off Control 1 Start-Up Time, From On/Off Control Start-Up Time, From On/Off Control 1 Start-Up Time, From On/Off Control Start-Up Time, From Input Maximum Output Capacitance (note1) 10 FFIC	8	8	mA			
Input Voltage Ripple Rejection 120 Hz OUTPUT CHARACTERISTICS 0 Output Voltage Regulation 10=10, min to 10, max Over Load 10=10, min to 10, max Over Line Vin=340 V 75V Over Temperature Tc=-40°C to 85°C Total Output Voltage Range Over sample load, line and temperature 4.85 Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth 4 Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum 6 Operating Output Current Range Vin=38V-75V 0 Output Output Current Range Output Voltage 10% Low 110 Oynthile CHARACTERISTICS 0 0 0 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 110 Positive Step Change in Output Current 25% lo.max to 50% lo.max 50% lo.max Start-Up Time, From On/Off Control 1 1 1 Start-Up Time, From Input 1 1 1 Maximum Output Current Raster 1 1 1 Solation Rapsitance 1 1 1	10	1	A ² s			
DUTPUT CHARACTERISTICS Vin=48V, Io=Io.max, Tc=25°C 4.95 Output Voltage Regulation Io=Io, min to Io, max 4.95 Over Load Io=Io, min to Io, max 10 Over Line Vin=36V to 75V 4.95 Over Line Tc=40°C to 85°C 4.85 Output Voltage Rapge Over sample load, line and temperature 4.85 Output Voltage Ripple and Noise 6Hz to 20MHz bandwidth 9 Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum 8 Operating Output Current Range Vin=18V-36V 0 Operating Output Current Range Vin=18V-36V 0 Output Voltage Current Protection Output Voltage 10% Low 110 VMAIC CHARACTERISTICS 0 0 110 ONAUC Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs Positive Step Change in Output Current 25% lo.max to 50% lo.max Negative Step Change in Output Current 50% lo.max to 50% lo.max 10 Start-Up Time, From Input Full load; 5% overshoot of Vout at startup 10 100% Load Vin=48V 10 10 <t< td=""><td>10 50</td><td>-</td><td>mA dB</td></t<>	10 50	-	mA dB			
Output Voitage Set Point Vin=48V, lo=lo.max, Tc=25°C 4.95 Output Voitage Regulation Io=lo, min to lo, max Io Over Load Io=lo, min to lo, max Io Over Line Vin=36V to 75V Io Over Temperature Tc=-40°C to 85°C Io Total Output Voitage Range Over sample load, line and temperature 4.85 Output Voitage Ripple and Noise 5Hz to 20MIz bandwidth Io Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum Io Operating Output Current Range Vin=36V-75V 0 Output Over Current Protection Output Voitage 10% Low 110 NMAMIC CHARACTERISTICS Output Voitage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs Positive Step Change in Output Current 25% lo.max to 50% lo.max Io Negative Step Change in Output Current 50% lo.max to 50% lo.max Io Start-Up Time, From Input Maximum Output Capacitance (note1) Full load; 5% overshoot of Vout at startup EFFICEINCY Io Io Io 100% Load Vin=48V Io Io			UB			
Output Voltage Regulation Io=lo, min to lo, max Over Line Vin=36V to 75V Over Temperature Tc=-40°C to 85°C Total Output Voltage Range Over sample load, line and temperature 4.85 Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth 100°F tantalum Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum 100°F tantalum Operating Output Current Range Vin=18V-36V 0 Output Voltage Current Transient Full Load, 1µF ceramic, 100µF tantalum 100°F tantalum Vin=18V-36V 0 0 Output Voltage Current Transient Output Voltage 10% Low 110 VIn=18V-36V 0 0 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 100 Positive Step Change in Output Current 25% Io.max to 50% Io.max 10 Negative Step Change in Output Current 25% Io.max to 50% Io.max 10 Start-Up Time, From On/Off Control 10 10 Start-Up Time, From Input 10 10 Maximum Output Capacitance (note1) Full load; 5% overshoot of Vout at startup 10 FFICIENCY 100% Load Vin=48V 10 Ion% Load Vin=24V 10 10 Isolation Resistance 10 1	95 5.00	95 5.00 5.05	Vdc			
Over Load Io=lo, min to Io, max Over Line Vin=36V to 75V Over Temperature Tc=-40°C to 85°C Total Output Voltage Range Over sample load, line and temperature Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum RMS Full Load, 1µF ceramic, 100µF tantalum Operating Output Current Range Vin=36V-75V 0 Output Over Current Protection Output Voltage 10% Low 110 Ontput Over Current Protection Output Voltage 10% Low 110 Ontput Over Current Protection Output Voltage 10% Low 110 Ontput Over Experime (within 1% Vout nominal) 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 100 Positive Step Change in Output Current 25% lo.max to 50% lo.max 100 Negative Step Change in Output Current 25% lo.max to 50% lo.max 100 Start-Up Time, From On/Off Control 100 10 10 Start-Up Time, From Input Full load; 5% overshoot of Vout at startup 10 FFICIENCY 100% Load Vin=48V 10 Solation Resistance 10 10 10 Isol	0.00	0.00				
Over Temperature Tc=-40°C to 85°C Total Output Voltage Range Over sample load, line and temperature 4.85 Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth 4.85 Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum 7 RMS Full Load, 1µF ceramic, 100µF tantalum 0 Operating Output Current Range Vin=18V-36V 0 Operating Output Current Range Vin=36V-75V 0 Output Voltage Current Protection Output Voltage 10% Low 110 VNAMIC CHARACTERISTICS 0 0 0 Output Voltage Step Change in Output Current 25% lo.max to 50% lo.max 0 Negative Step Change in Output Current 50% lo.max to 25% lo.max 0 Start-Up Time, From On/Off Control Start-Up Time, From Input 10 Maximum Output Capacitance (note1) Full load; 5% overshoot of Vout at startup 10 FFICIENCY 100% Load Vin=48V 10 100% Load Vin=48V 10 10 Isolation Resistance 10 10 10 Isolation Resistance 10	±3	±3 ±10	mV			
Total Output Voltage Range Over sample load, line and temperature 4.85 Output Voltage Ripple and Noise Full Load, 1µF ceramic, 100µF tantalum Peak-to-Peak Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum 0 Operating Output Current Range Vin=18V-36V 0 Operating Output Current Range Vin=36V-75V 0 Output Voltage Current Protection Output Voltage 10% Low 110 VNNAIC CHARACTERISTICS 0 0 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs Positive Step Change in Output Current 25% lo.max to 50% lo.max Negative Step Change in Output Current 50% lo.max to 25% lo.max 0 0 Start-Up Time, From Input Full load; 5% overshoot of Vout at startup 0 0 Maximum Output Capacitance (note1) Full load; 5% overshoot of Vout at startup 0 0 EFFICIENCY 00% Load Vin=48V 0 0 0 100% Load Vin=48V 0 0 0 0 0 0 Input to Output Isolation Resistance 10 10 10 10 0 0 0	±3	±3 ±10	mV			
Output Voltage Ripple and Noise 5Hz to 20MHz bandwidth Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum RMS Full Load, 1µF ceramic, 100µF tantalum Operating Output Current Range Vin=18V-36V 0 Output Over Current Protection Output Voltage 10% Low 110 YNAMIC CHARACTERISTICS 0 0 0 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 110 Positive Step Change in Output Current 25% Io.max to 50% Io.max 0 Negative Step Change in Output Current 50% Io.max to 25% Io.max 0 Start-Up Time, From On/Off Control Start-Up Time, From Input 10 Maximum Output Capacitance (note1) Full Ioad; 5% overshoot of Vout at startup 100% Load 100% Load Vin=48V 10 Solation Capacitance 10 10 Isolation Capacitance 10 <td< td=""><td>±50</td><td></td><td>mV</td></td<>	±50		mV			
Peak-to-Peak Full Load, 1µF ceramic, 100µF tantalum RMS Full Load, 1µF ceramic, 100µF tantalum Operating Output Current Range Vin=18V-36V 0 Output Over Current Protection Output Voltage 10% Low 110 DYNAMIC CHARACTERISTICS Output Voltage 10% Low 110 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs Positive Step Change in Output Current Positive Step Change in Output Current 50% lo.max to 50% lo.max Start-Up Time, From On/Off Control Start-Up Time, From Input Maximum Output Capacitance (note1) Full load; 5% overshoot of Vout at startup EFFICIENCY Imput to Output Vin=48V 100% Load 100% Load Vin=48V 100% Load Vin=48V Solation Capacitance Imput to Output Imput to Output Isolation Resistance 10 10 Isolation Resistance 10 Von/off 2.4 ON/OFF Control, Negative Remote On/Off logic Von/off 2.4 2.4 ON/OFF Control, Negative Remote On/Off logic Von/off 2.4 2.4 ON/OFF Control, Negative Remote On/Off logic Von/offf 2.4 2.4	85 5.00	85 5.00 5.15	V			
RMS Full Load, 1µF ceramic, 100µF tantalum Operating Output Current Range Vin=18V-36V 0 Output Over Current Protection Output Voltage 10% Low 110 DVNAMIC CHARACTERISTICS 0 0 Output Voltage Current Transient 48V, 10µF Tan 8 1µF Ceramic load cap, 0.1A/µs 110 Positive Step Change in Output Current 25% lo.max to 50% lo.max 0 Negative Step Change in Output Current 50% lo.max to 25% lo.max 0 Start-Up Time, From On/Off Control 5tart-Up Time, From On/Off Control 5 Start-Up Time, From Input Full load; 5% overshoot of Vout at startup 100% Load 100% Load Vin=48V 0 00% Load Vin=24V 60% Load 10 Isolation Resistance 10 10 10 Isolation Resistance 10 10 10 Isolation Resistance 10 10 10 Logic Low (Module Off) Von/off 2.4 0 ON/OFF Control, Negative Remote On/Off logic Von/off 2.4 Logic Low (Module Off) Von/off 2.4 0 ON/OFF Current (for both remote on/off log	60	60				
Operating Output Current Range Vin=18V-36V 0 Operating Output Current Range Vin=36V-75V 0 Output Over Current Protection Output Voltage 10% Low 110 Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 110 Positive Step Change in Output Current 25% lo.max to 50% lo.max 110 Negative Step Change in Output Current 50% lo.max to 50% lo.max 110 Settling Time (within 1% Vout nominal) 110 110 111 Turn-On Transient 110 110 111 <td< td=""><td>60 10</td><td></td><td>mV mV</td></td<>	60 10		mV mV			
Operating Output Current RangeVin=36V-75V0Output Over Current ProtectionOutput Voltage 10% Low110OVNAMIC CHARACTERISTICSOutput Voltage Current Transient48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µsPositive Step Change in Output Current25% lo.max to 50% lo.max100Negative Step Change in Output Current50% lo.max to 25% lo.max100Settling Time (within 1% Vout nominal)Turn-On Transient100Turn-On TransientFull load; 5% overshoot of Vout at startup100% LoadStart-Up Time, From InputFull load; 5% overshoot of Vout at startup100% LoadInput to Output CurrentStart-Up Time, From Input100% LoadMaximum Output Capacitance (note1)Full load; 5% overshoot of Vout at startupEFFICIENCY100% LoadVin=48V100% LoadVin=48V100% LoadSolLation CHARACTERISTICS100Input to Output100Isolation Capacitance100EACTOR CHARACTERISTICS100Switching Frequency0N/OFFON/OFF Control, Negative Remote On/Off logic100Logic Low (Module Off)Von/offLogic			A			
Output Over Current Protection Output Voltage 10% Low 110 ONTAMIC CHARACTERISTICS 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs 0 Positive Step Change in Output Current 25% lo.max to 50% lo.max 0 Negative Step Change in Output Current 50% lo.max to 25% lo.max 0 Settling Time (within 1% Vout nominal)			A			
Output Voltage Current Transient 48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs Positive Step Change in Output Current 25% lo.max to 50% lo.max Negative Step Change in Output Current 50% lo.max to 25% lo.max Settling Time (within 1% Vout nominal) 50% lo.max to 25% lo.max Turn-On Transient 6 Start-Up Time, From On/Off Control 5 Start-Up Time, From Input 7 Maximum Output Capacitance (note1) Full load; 5% overshoot of Vout at startup FFICIENCY 7 100% Load Vin=48V 100% Load Vin=48V 100% Load Vin=48V Solation Resistance 10 Isolation Resistance 10 Isolation Resistance 10 Solation Capacitance 10 Isolation Resistance 10 ON/OFF Control, Negative Remote On/Off logic 10 Logic Low (Module Off) Von/off Logic Low (Module Off) 2.4 ON/OFF Control, Positive Remote On/Off logic 10 Logic Low (Module Off) Von/off Logic Low (Module Off) 2.4	10		%			
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		. <u>4 18</u> 1	mA			
			ШA			
Output Voltage Trim Range Pout max rated power, lo lo.max -20	20	20 10	%			
Output Voltage Remote Sense Range Pout max rated power,lo lo.max	.~	10	%			
Output Over-Voltage Protection Over full temp range; % of nominal Vout 115	15		%			
Selected SpecificAtions			,0			
MTBF Io=80% of Io, max; Ta=25°C, airflow rate=300FLM	5.1	5.1	M hou			
Weight		12.1	grams			

Note1: For applications with higher output capacitive load, please contact Delta



ELECTRICAL CHARACTERISTICS CURVES

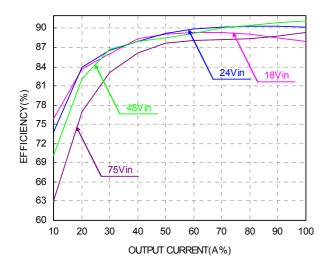


Figure 1: Efficiency vs. load current for minimum, nominal, and maximum input voltage at 25°C 18V~36VIN, Iomax is 8A, 36V~75VIN, Iomax is 10A

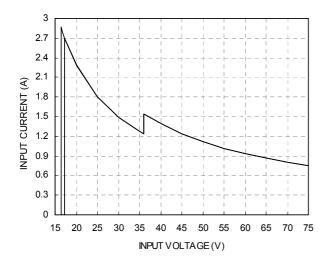


Figure 3: Typical full load input characteristics at room temperature

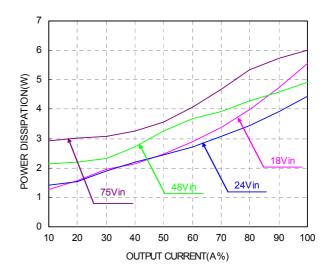


Figure 2: Power dissipation vs. load current for minimum, nominal, and maximum input voltage at 25°C. 18V~36VIN, Iomax is 8A, 36V~75VIN, Iomax is 10A



ELECTRICAL CHARACTERISTICS CURVES

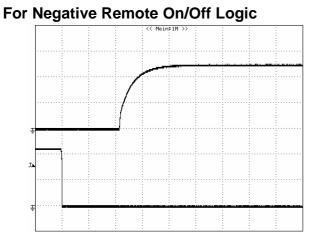


Figure 4: Turn-on transient at full rated load current (resistive load) (10 ms/div). Vin=48V. Top Trace: Vout, 2.0V/div; Bottom Trace: ON/OFF input, 2V/div

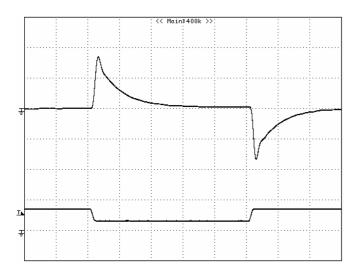


Figure 6: Output voltage response to step-change in load current (50%-25%-50% of lo, max; di/dt = $0.1A/\mu$ s; Vin is 24v). Load cap: 10μ F tantalum capacitor and 1μ F ceramic capacitor. Top Trace: Vout (50mV/div, 200us/div), Bottom Trace: lout (5A/div). Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module

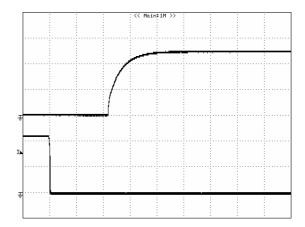


Figure 5: Turn-on transient at zero load current (10 ms/div). Vin=48V. Top Trace: Vout: 2.0V/div, Bottom Trace: ON/OFF input, 2V/div

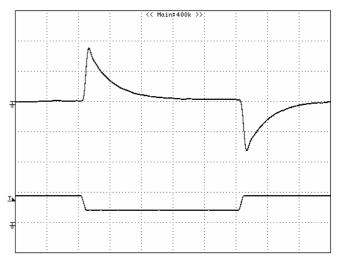


Figure 7: Output voltage response to step-change in load current (50%-25%-50% of lo, max; di/dt = $0.1A/\mu$ s; Vin is 48v). Load cap: 10μ F tantalum capacitor and 1μ F ceramic capacitor. Top Trace: Vout (50mV/div, 200us/div), Bottom Trace: lout (5A/div). Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module



ELECTRICAL CHARACTERISTICS CURVES

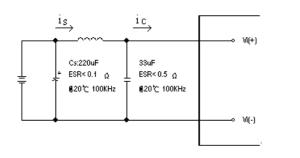


Figure 8: Test set-up diagram showing measurement points for Input Terminal Ripple Current and Input Reflected Ripple Current.

Note: Measured input reflected-ripple current with a simulated source Inductance (L_{TEST}) of 12 µH. Capacitor Cs offset possible battery impedance. Measure current as shown above

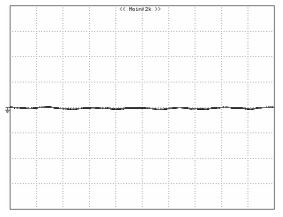


Figure 10: Input reflected ripple current, i_s , through a 12µH source inductor at nominal input voltage (vin=48v) and rated load current (20 mA/div, 1us/div)

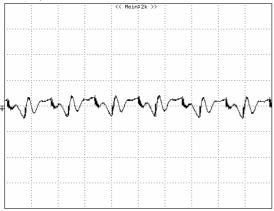


Figure 12: Output voltage ripple at nominal input voltage (vin=48v) and rated load current (lo=10A) (50 mV/div, 1us/div).Load capacitance: 1μ F ceramic capacitor and 100μ F tantalum capacitor. Bandwidth: 20 MHz. Scope measurements should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module

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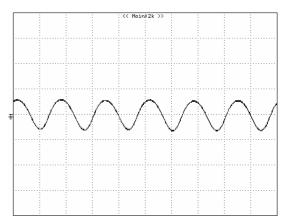


Figure 9: Input Terminal Ripple Current, i_c, at full rated output current and nominal input voltage (Vin=48v) with 12 μ H source impedance and 33 μ F electrolytic capacitor (200 mA/div, 1us/div)

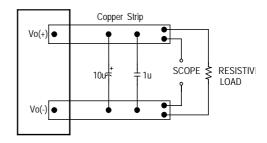


Figure 11: Output voltage noise and ripple measurement test setup

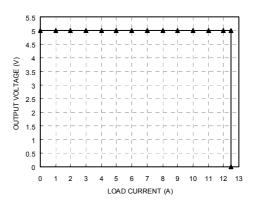


Figure 13: Output voltage vs. load current showing typical current limit curves and converter shutdown points (Vin=48v)

5

DESIGN CONSIDERATIONS

Input Source Impedance

The impedance of the input source connecting to the DC/DC power modules will interact with the modules and affect the stability. A low ac-impedance input source is recommended. If the source inductance is more than a few μ H, we advise adding a 10 to 100 μ F electrolytic capacitor (ESR < 0.7 Ω at 100 kHz) mounted close to the input of the module to improve the stability.

Layout and EMC Considerations

Delta's DC/DC power modules are designed to operate in a wide variety of systems and applications. For design assistance with EMC compliance and related PWB layout issues, please contact Delta's technical support team. An external input filter module is available for easier EMC compliance design. Application notes to assist designers in addressing these issues are pending release.

Safety Considerations

The power module must be installed in compliance with the spacing and separation requirements of the end-user's safety agency standard, i.e., UL60950-1, CAN/CSA-C22.2, No. 60950-1 and EN60950-1+A11 and IEC60950-1, if the system in which the power module is to be used must meet safety agency requirements.

Basic insulation based on 75 Vdc input is provided between the input and output of the module for the purpose of applying insulation requirements when the input to this DC-to-DC converter is identified as TNV-2 or SELV. An additional evaluation is needed if the source is other than TNV-2 or SELV.

When the input source is SELV circuit, the power module meets SELV (safety extra-low voltage) requirements. If the input source is a hazardous voltage which is greater than 60 Vdc and less than or equal to 75 Vdc, for the module's output to meet SELV requirements, all of the following must be met:

- The input source must be insulated from the ac mains by reinforced or double insulation.
- The input terminals of the module are not operator accessible.
- If the metal baseplate is grounded, one Vi pin and one Vo pin shall also be grounded.
- A SELV reliability test is conducted on the system where the module is used, in combination with the module, to ensure that under a single fault, hazardous voltage does not appear at the module's output.

When installed into a Class II equipment (without grounding), spacing consideration should be given to the end-use installation, as the spacing between the module and mounting surface have not been evaluated.

The power module has extra-low voltage (ELV) outputs when all inputs are ELV.

This power module is not internally fused. To achieve optimum safety and system protection, an input line fuse is highly recommended. The safety agencies require a normal-blow fuse with 5A maximum rating to be installed in the ungrounded lead. A lower rated fuse can be used based on the maximum inrush transient energy and maximum input current.

Soldering and Cleaning Considerations

Post solder cleaning is usually the final board assembly process before the board or system undergoes electrical testing. Inadequate cleaning and/or drying may lower the reliability of a power module and severely affect the finished circuit board assembly test. Adequate cleaning and/or drying is especially important for un-encapsulated and/or open frame type power modules. For assistance on appropriate soldering and cleaning procedures, please contact Delta's technical support team.

FEATURES DESCRIPTIONS

Over-Current Protection

The modules include an internal output over-current protection circuit, which will endure current limiting for an unlimited duration during output overload. If the output current exceeds the OCP set point, the modules will automatically shut down, and enter hiccup mode or latch mode, which is optional.

For hiccup mode, the module will try to restart after shutdown. If the over current condition still exists, the module will shut down again. This restart trial will continue until the over-current condition is corrected.

For latch mode, the module will latch off once it shutdown. The latch is reset by either cycling the input power or by toggling the on/off signal for one second.

Over-Voltage Protection

The modules include an internal output over-voltage protection circuit, which monitors the voltage on the output terminals. If this voltage exceeds the over-voltage set point, the module will shut down, and enter in hiccup mode or latch mode, which is optional.

For hiccup mode, the module will try to restart after shutdown. If the over voltage condition still exists, the module will shut down again. This restart trial will continue until the over-voltage condition is corrected.

For latch mode, the module will latch off once it shutdown. The latch is reset by either cycling the input power or by toggling the on/off signal for one second.

Over-Temperature Protection

The over-temperature protection consists of circuitry that provides protection from thermal damage. If the temperature exceeds the over-temperature threshold the module will shut down, and enter in hiccup mode or latch mode, which is optional.

For hiccup mode, the module will try to restart after shutdown. If the over temperature condition still exists, the module will shut down again. This restart trial will continue until the over-temperature condition is corrected.

For latch mode, the module will latch off once it shutdown. The latch is reset by either cycling the input power or by toggling the on/off signal for one second.

Remote On/Off

The remote on/off feature on the module can be either negative or positive logic. Negative logic turns the module on during a logic low and off during a logic high. Positive logic turns the modules on during a logic high and off during a logic low.

Remote on/off can be controlled by an external switch between the on/off terminal and the Vi(-) terminal. The switch can be an open collector or open drain.

For negative logic if the remote on/off feature is not used, please short the on/off pin to Vi(-). For positive logic if the remote on/off feature is not used, please leave the on/off pin floating.

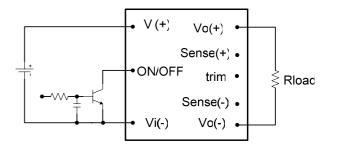


Figure 14: Remote on/off implementation

Remote Sense

Remote sense compensates for voltage drops on the output by sensing the actual output voltage at the point of load. The voltage between the remote sense pins and the output terminals must not exceed the output voltage sense range given here:

$$[Vo(+) - Vo(-)] - [SENSE(+) - SENSE(-)] \le 10\% \times Vout$$

This limit includes any increase in voltage due to remote sense compensation and output voltage set point adjustment (trim).

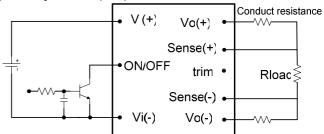


Figure 15: Effective circuit configuration for remote sense operation



FEATURES DESCRIPTIONS (CON.)

If the remote sense feature is not used to regulate the output at the point of load, please connect SENSE(+) to Vo(+) and SENSE(-) to Vo(-) at the module.

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

When using remote sense and trim, the output voltage of the module is usually increased, which increases the power output of the module with the same output current.

Care should be taken to ensure that the maximum output power does not exceed the maximum rated power.

Output Voltage Adjustment (TRIM)

To increase or decrease the output voltage set point, connect an external resistor between the TRIM pin and either the SENSE(+) or SENSE(-). The TRIM pin should be left open if this feature is not used.

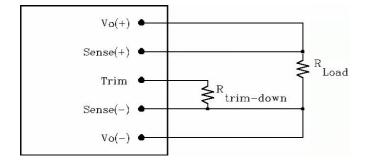


Figure 16: Circuit configuration for trim-down (decrease output voltage)

If the external resistor is connected between the TRIM and SENSE (-) pins, the output voltage set point decreases (Fig. 18). The external resistor value required to obtain a percentage of output voltage change % is defined as:

$$Rtrim - down = \left[\frac{511}{\Delta} - 10.22\right] (K\Omega)$$

Ex. When Trim-down -20% (5.0V×0.8=4.0V)

$$Rtrim - down = \left[\frac{511}{20} - 10.22\right] (K\Omega) = 15.33 (K\Omega)$$

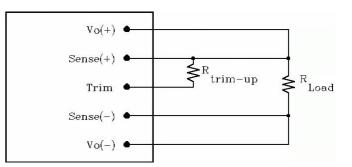


Figure 17: Circuit configuration for trim-up (increase output voltage)

If the external resistor is connected between the TRIM and SENSE (+) the output voltage set point increases (Fig. 19). The external resistor value required to obtain a percentage output voltage change % is defined as:

$$Rtrim - up = \frac{5.11 \text{Vo} (100 + \Delta)}{1.24 \Delta} - \frac{511}{\Delta} - 10.22 (K\Omega)$$

Ex. When Trim-up +10% (5.0V×1.1=5.5V)

$$Rtrim - up = \frac{5.11 \times 5.0 \times (100 + 10)}{1.24 \times 10} - \frac{511}{10} - 10.22 = 165.33(K\Omega)$$

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

When using remote sense and trim, the output voltage of the module is usually increased, which increases the power output of the module with the same output current.

Care should be taken to ensure that the maximum output power of the module remains at or below the maximum rated power.

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THERMAL CONSIDERATIONS

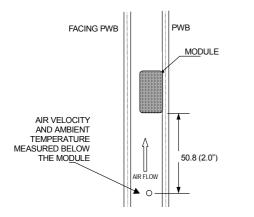
Thermal management is an important part of the system design. To ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Convection cooling is usually the dominant mode of heat transfer.

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 space between the neighboring PWB and the top of the power module is constantly kept at 6.35mm (0.25").



Note: Wind Tunnel Test Setup Figure Dimensions are in millimeters and (Inches)

Figure 18: Wind tunnel test setup

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.

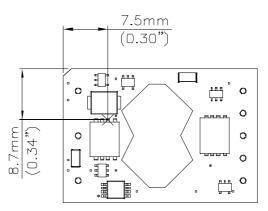


Figure 19: Temperature measurement location * The allowed maximum hot spot temperature is defined at 119 .

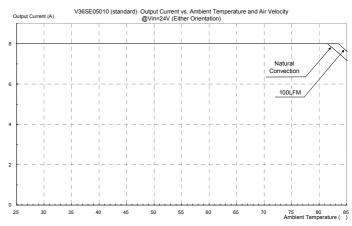


Figure 20: Output current vs. ambient temperature and air velocity $@V_{in}=24V$ (Either Orientation)

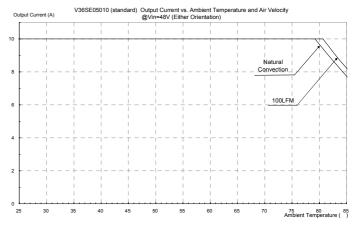
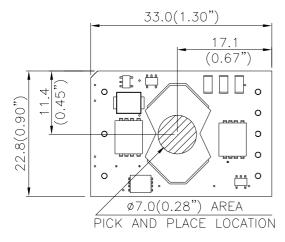


Figure 21: Output current vs. ambient temperature and air velocity $@V_{in}=48V$ (Either Orientation)



PICK AND PLACE LOCATION

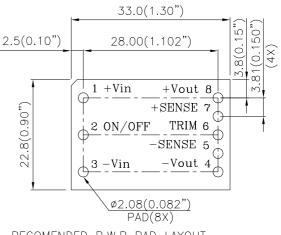


NOTES:

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.)

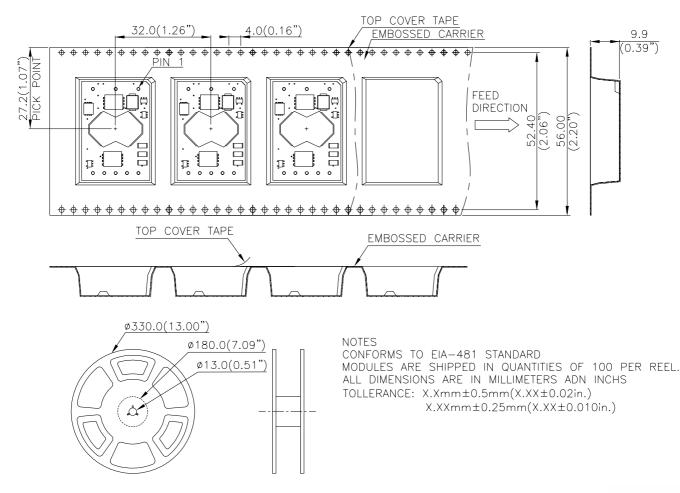
SURFACE-MOUNT TAPE & REEL

RECOMMENDED PAD LAYOUT (SMD)



RECOMENDED P.W.B PAD LAYOUT NOTES:

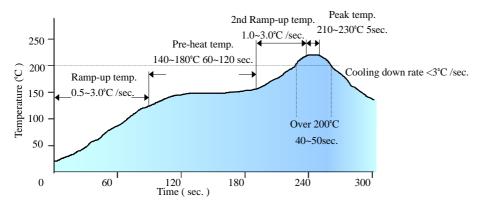
DIMENSIONS ARE IN MILLIMETERS AND (INCHES) TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.) X.XXmm±0.25mm(X.XXX in.±0.010 in.)



V36SE05010_03032011



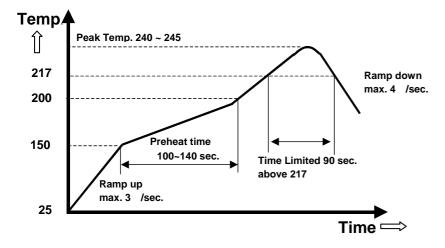
LEADED (Sn/Pb) PROCESS RECOMMEND TEMPERATURE PROFILE



Note: The temperature refers to the pin of V36SE, measured on the pin +Vout joint.

LEAD FREE (SAC) PROCESS RECOMMEND TEMPERATURE PROFILE

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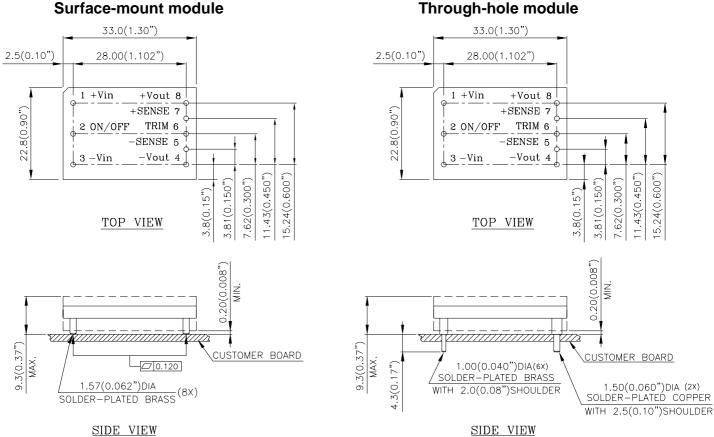


Note: The temperature refers to the pin of V36SE, measured on the pin +Vout joint.

V36SE05010_03032011



MECHANICAL DRAWING



SIDE VIEW

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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.)

<u>Pin No.</u>	<u>Name</u>	Function		
1	+Vin	Positive input voltage		
2	ON/OFF	Remote ON/OFF		
3	-Vin	Negative input voltage		
4	-Vout	Negative output voltage		
5	-SENSE	Negative remote sense		
6	TRIM	Output voltage trim		
7	+SENSE	Positive remote sense		
8	+Vout	Positive output voltage		



PART NUMBERING SYSTEM

v	36	S	E	050	10	Ν	R	F	Α
Type of Product	Input Voltage	Number of Outputs	Product Series	Output Voltage	Output Current	ON/OFF Logic	Pin Length/Type		Option Code
V - 1/16 Brick	36 - 18V~75V	S - Single	E - Regular	050 - 5V	10 - 10A	N- Negative P- Positive	N - 0.145" R - 0 170"	Space - RoHS 5/6 F - RoHS 6/6 (Lead Free)	A - Standard Functions

MODEL LIST

MODEL NAME	INPUT			OUTPUT	EFF @ 100% LOAD
V36SE05010NRFA	18V~75V	3.9A	5V	8A (18~36Vin) & 10A(36~75Vin)	90.0% @ 24Vin, 91.0% @ 48Vin

Default remote on/off logic is negative and pin length is 0.170"

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