Not Recommended for New Designs



28 Volt M-Grade PI31xx-00-HVMZ

RoHS

28V_{IN}, 3.3 to 15V_{OUT}, ZVS Isolated Converter Module Family

Product Description

The ZVS Isolated Converter Module Series consists of high-density isolated DC-DC converters implementing Zero-Voltage Switching topology.

The $28V_{IN}$ series operates over a wide range input of 16V to $50V_{DC}$, delivering 50W of output power, yielding an unprecedented power density of $334W/in^3$.

These converter modules are surface mountable and only ~0.5in square in area achieving ~50% space reduction versus conventional solutions.

| Device | Ou | I Max | |
|-----------------------|------|--------------|----------------------|
| Device | Set | Range | I _{OUT} Max |
| PI3108-00-HVMZ | 3.3V | 2.97 – 3.63V | 10A |
| <u>PI3109-00-HVMZ</u> | 5V | 4 – 5.5V | 10A |
| <u>PI3106-00-HVMZ</u> | 12V | 9.6 – 13.2V | 4.2A |
| <u>PI3111-00-HVMZ</u> | 15V | 12 – 16.5V | 3.33A |

The switching frequency of 900kHz allows for small input and output filter components which further reduces the total size and cost of the overall system solution. The output voltage is sensed and fed back to the internal controller using a high performance isolated magnetic feedback scheme which allows for high bandwidth and good common mode noise immunity.

The PI31xx-00-HVMZ series requires no external feedback compensation and offers a total solution with a minimum number of external components. A rich feature set is offered, including output voltage trim capability, output overvoltage protection, adjustable soft start, overcurrent protection with auto-restart, over and under input voltage lockout and a temperature monitoring and protection function that provides an analog voltage proportional to the die temperature as well as shut down and alarm capabilities.

Features & Benefits

- Efficiency up to 88%
- High switching frequency minimizes input filter requirements and reduces output capacitance
- Proprietary "Double-Clamped" ZVS Buck-Boost Topology
- Proprietary isolated magnetic feedback
- Small footprint (0.57in²) enables PCB area savings
- Very low profile (0.265in)
- Wide input voltage range operation (16 50V_{DC})
- On/Off Control, positive logic
- Wide trim range +10/-20% most models
- Temperature Monitor (TM) & Overtemperature Protection (OTP)
- Input UVLO & OVLO and output OVP
- Overcurrent protection with auto restart
- Adjustable soft start
- 2250V_{DC} input-to-output isolation

Applications

- Wide Temperature, Aerospace & Defense Applications
- Space-Constrained Systems
- Isolated Board-Level Power

Package Information

- Surface Mountable 0.87 x 0.65 x 0.265in package
- Weight = 7.8 grams



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Order Information

| Part Number | V _{IN} | V _{OUT} | I _{OUT} Max | Package | Transport Media |
|----------------|-----------------|------------------|----------------------|-----------------------|--------------------|
| PI3108-00-HVMZ | 16 – 50V | 3.3V | 10A | 0.87 x 0.65 x 0.265in | TRAY |
| PI3109-00-HVMZ | 16 – 50V | 5V | 10A | 0.87 x 0.65 x 0.265in | TRAY |
| PI3106-00-HVMZ | 16 – 50V | 12V | 4.2A | 0.87 x 0.65 x 0.265in | TRAY |
| PI3111-00-HVMZ | 16 – 50V | 15V | 3.33A | 0.87 x 0.65 x 0.265in | TRAY |
| | | · · | Also Available | | |
| PI3101-00-HVIZ | 36 – 75V | 3.3V | 18A | 0.87 x 0.65 x 0.265in | TRAY |
| PI3105-00-HVIZ | 36 – 75V | 12V | 5A | 0.87 x 0.65 x 0.265in | TRAY |
| PI3110-01-HVIZ | 41 – 57V | 18V | 3.3A | 0.87 x 0.65 x 0.265in | TRAY |
| PI3109-01-HVIZ | 18 – 36V | 5V | 10A | 0.87 x 0.65 x 0.265in | TRAY |
| PI3106-01-HVIZ | 18 – 36V | 12V | 4.2A | 0.87 x 0.65 x 0.265in | TRAY |



Absolute Maximum Ratings

| Name | Rating |
|---|---|
| +IN to –IN Max Operating Voltage | –1.0 to 50V _{DC} (operating) |
| +IN to –IN Max Peak Voltage | 55V _{DC} (non-operating, 12.5ms) |
| ENABLE to -IN | -0.3 to 6.0V _{DC} |
| TM to -IN | -0.3 to 6.0V _{DC} |
| TRIM/SS to –IN | -0.3 to 6.0V _{DC} |
| +OUT to -OUT | See relevant model output section |
| Isolation Voltage (+IN/–IN to +OUT/–OUT) | 2250V _{DC} |
| Continuous Output Current | See relevant model output section |
| Peak Output Current | See relevant model output section |
| Operating Junction Temperature | –55 to 125°C |
| Storage Temperature | –65 to 125°C |
| Case Temperature During Reflow | 245°C |
| Peak Compressive Force Applied to Case (Z-axis) | 3lbs (supported by J-lead only) |



Functional Block Diagram





Not Recommended for New Designs PI31xx-00-HVMZ

Pin Description

| Pin Name | Description |
|----------|---|
| +IN | Primary side positive input voltage terminals. |
| –IN | Primary side negative input voltage terminals. |
| ENABLE | Converter enable option, functions as 5V reference and on / off control pin. Pull low for off. |
| TRIM/SS | External soft-start pin and trim function. Connect to SGND or ENABLE through resistor for trim up or trim down. |
| TM | Temperature measurement output pin. |
| SGND | Signal ground, primary side referenced. |
| +OUT | Isolated secondary DC output voltage positive terminals. |
| -OUT | Isolated secondary DC output voltage negative terminals. |

Package Pinout





PI3108-00-HVMZ Electrical Characteristics

Unless otherwise specified: 16V < V_{IN} < 50V, 0A < I_{OUT} < 10A, $-55^{\circ}C$ < T_{CASE} < 100°C $^{\rm [a]}$

| Parameter | Symbol | Conditions | Min | Тур | Max | Unit |
|-----------------------------------|---------------------|---|------|-------|------|-------------------------|
| | | Input Specifications | | | | |
| Input Voltage Range | V _{IN} | input specifications | 16 | 28 | 50 | 1/ |
| Input dV/dt ^[a] | | $\mathcal{W} = FOW$ | 10 | 20 | 1.0 | V _{DC} V/µs |
| • | VINDVDT | $V_{\rm IN} = 50V$ | 14 E | 15.2 | | |
| Input Undervoltage Turn-on | V _{UVON} | $I_0 = 10A$ | 14.5 | 15.3 | 16 | V _{DC} |
| Input Undervoltage Turn-off | VUVOFF | $I_0 = 10A$ | 13.5 | 14.1 | 15.2 | V _{DC} |
| Input Undervoltage Hysteresis | V _{UVH} | $I_0 = 10A$ | FO | 1.2 | Γ4 | V _{DC} |
| Input Overvoltage Turn-on | V _{OVON} | $I_0 = 10A$ | 50 | 52.5 | 54 | V _{DC} |
| Input Overvoltage Turn-off | V _{OVOFF} | $I_0 = 10A$ | 51 | 53.7 | 55 | V _{DC} |
| Input Overvoltage Hysteresis | V _{OVH} | $I_0 = 10A$ | | 1.2 | | V _{DC} |
| Input Quiescent Current | Ι _Q | $V_{\rm IN} = 28V$, ENABLE = 0V | | 2 | | mA _{DC} |
| Input Idling Power | P _{IDLE} | $V_{\rm IN} = 28V$, $I_{\rm OUT} = 0A$ | | 2.6 | | W |
| Input Standby Power | P _{SBY} | $V_{IN} = 28V$, ENABLE = 0V | | 0.048 | | W |
| Input Current Full Load | I _{IN} | T_{CASE} = 100°C, I_{OUT} = 10A, η_{FL} = 86% typical, V_{IN} = 28V | | 1.37 | | A _{DC} |
| Input Reflected Ripple Current | I _{INRR} | L_{IN} = 0.47 μH C_{IN} = 100 μF 63V electrolytic + 2 x 4.7 μF 50V X7R ceramic | | 15 | | mApp |
| Recommended Ext Input Capacitance | C _{IN} | C_{IN} = 100µF 63V electrolytic + 2 x 4.7µF 50V X7R ceramic C_{IN} = Cbulk + Chf | | 109.4 | | μF |
| | | Output Specifications | | | | |
| Output Voltage Set Point | V _{OUT} | I _{OUT} = 5A | | 3.3 | | V _{DC} |
| | | $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ | -3 | | +3 | % |
| Total Output Accuracy | V _{OA} | -55°C < T _{CASE} < 0°C | -5 | | +3 | % |
| Output Voltage Trim Range | V _{OADJ} | | -10 | | 10 | % |
| Output Current Range | I _{OUT} | | | | 10 | A _{DC} |
| Overcurrent Protection | I _{OCP} | | 11.0 | 15 | 20 | A _{DC} |
| Efficiency – Full Load | η_{FL} | T _{CASE} = 100°C, V _{IN} = 28V | 84 | 86 | | % |
| Efficiency – Half Load | η _{ΗL} | T _{CASE} = 100°C, V _{IN} = 28V | 80 | 82 | | % |
| Output OVP Set Point | V _{OVP} | | 3.9 | 4.1 | 4.3 | V _{DC} |
| Output Ripple Voltage | VORPP | C _{OUT} = 6 x 10μF 10V X7R DC-20MHz | | 90 | | mVpp |
| Switching Frequency | f _{SW} | | | 900 | | kHz |
| Output Turn-on Delay Time | t _{ONDLY} | $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | | 80 | | ms |
| Output Turn-off Delay Time | t _{OFFDLY} | $V_{\rm IN} = V_{\rm UVOFF}$ to ENABLE < 2.35V | | 375 | | μs |
| Soft-Start Ramp Time | t _{ss} | ENABLE = 5V to 90% $V_{OUT} C_{REF} = 0$ | | 380 | | μs |
| Maximum Load Capacitance | C _{OUT} | $C_{REF} = 0.22 \mu F, C_{OUT} = AI Electrolytic$ | | | 4700 | μF |
| Load Transient Deviation | V _{ODV} | $I_{OUT} = 50\%$ step 0.1A/µS $C_{OUT} = 6 \times 10$ µF 10V X7R | | 145 | | mV |
| Load Transient Recovery Time | t _{ovr} | $I_{OUT} = 50\% \text{ step } 0.1\text{A}/\mu\text{S}$ $C_{OUT} = 5\% \text{ step } 0.1\text{A}/\mu\text{S}$ $C_{OUT} = 6 \times 10\mu\text{F} 10\text{V} \text{X7R}$ $V_{OUT} \le 1\%$ | | 100 | | μs |
| Maximum Output Power | P _{OUT} | | | 33 | | W |
| | | Absolute Maximum Output Ratings | | | | |
| Name | | Rating | | | | |
| +OUT to -OUT | | -0.5V to 6.8V _{DC} | | | | |
| Continuous Output Current | | 10A _{DC} | | | | |
| Peak Output Current | | 20A _{DC} | | | | |

^[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. Unless otherwise specified, ATE tests are completed at room temperature. ^[b] Current flow sourced by a pin has a negative sign.



PI3108-00-HVMZ Electrical Characteristics (Cont.)

| Parameter | Symbol | Conditions | Min | Тур | Мах | Unit |
|--|-------------------|--|------|-------|------|------------------|
| | | ENABLE | | | | |
| DC Voltage Reference Output | V _{ERO} | | 4.65 | 4.9 | 5.15 | V _{DC} |
| Output Current Limit ^[b] | I _{ECL} | ENABLE = 3.3V | -3.3 | -2.6 | -1.9 | mA _{DC} |
| Start Up Current Limit ^[b] | I _{ESL} | ENABLE = 1V | -120 | -90 | -60 | μΑ |
| Module Enable Voltage | V _{EME} | | 1.95 | 2.5 | 3.05 | V _{DC} |
| Module Disable Voltage | VEMD | | 1.8 | 2.35 | 2.9 | V _{DC} |
| Disable Hysteresis | V _{EDH} | | 1.0 | 150 | 2.5 | mV |
| Enable Delay Time | t _{EE} | | | 10 | | μs |
| Disable Delay Time | t _{ED} | | | 10 | | μs |
| Maximum Capacitance | C _{EC} | | | 10 | 1500 | pF |
| Maximum External Toggle Rate | f _{ext} | | | | 1 | Hz |
| | 'EXT | | | | 1 | 112 |
| | | TRIM/SS | | | | |
| Trim Voltage Reference | V _{REF} | | | 1.240 | | V _{DC} |
| Internal Capacitance | C _{REFI} | | | 10 | | nF |
| External Capacitance | C _{REF} | | | | 0.22 | μF |
| Internal Resistance | R _{REFI} | | | 10 | | kΩ |
| | | | | | | |
| | | TM (Temperature Monitor) | | | | |
| Temperature Coefficient ^[a] | TM _{TC} | | | 10 | | mV / °K |
| Temperature Full Range Accuracy [a] | TM _{ACC} | | -5 | | 5 | °К |
| Drive Capability | I _{TM} | | -100 | | | μΑ |
| TM Output Setting | V _{TM} | Ambient Temperature = 300°K | | 3.00 | | V |
| | | | | | | |
| | | Thermal Specification | | | | |
| Junction Temperature Shutdown ^[a] | T _{MAX} | | 130 | 135 | 140 | °C |
| Junction-to-Case Thermal Impedance | θ _{J-C} | | | 3 | | °C / W |
| Case-to-Ambient Thermal Impedance | θ _{C-A} | Mounted on 9in ² 1oz. Cu 6 layer PCB 25°C | | 9.6 | | °C / W |
| | | Soldering | | | | |
| | | MSL 5; time on floor = 48 hours | | | 225 | °C |
| Peak Temperature During Reflow | | MSL 5, time of floor = 4 hours MSL 6; time on floor = 4 hours | | | 225 | °C |
| | | | | | 245 | C |
| | | Regulatory Specification | | | | |
| IEC 60950-1:2005 (2nd Edition) | | | | | | |
| EN 60950-1:2006 | | | | | | |
| IEC 61000-4-2 | | | | | | |
| UL60950-1:2007 | | | | | | |
| CAN/CSA C22.2 NO. 60950-1-07 | | | | | | |
| Recommended Input Fuse Rating | I _{FUSE} | Fast acting LITTLEFUSE Nano ² Series Fuse | 4 | | 10 | А |
| 1 | TUSE | 5 | | I | - | |

^[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. ^[b] Current flow sourced by a pin has a negative sign.



PI3108-00-HVMZ Electrical Characteristics (Cont.)



Figure 1 — Conversion efficiency



Figure 2 — Load current vs. temperature (without heat sink)



Figure 3 — Load current vs. temperature (6.33mm heat sink)



Figure 4 — Load current vs. temperature (11mm heat sink)



Figure 5 — Start up, $C_{REF} = 0$ ($V_{IN} = 16V$, $I_{OUT} = 10A$, CR, $C_{OUT} = 6 \times 10 \mu F X7R$ ceramic)







PI3108-00-HVMZ Electrical Characteristics (Cont.)







Figure 8 — Transient response ($V_{IN} = 28V$, $I_{OUT} = 5 - 10A$, 0.1A/µs, $C_{OUT} = 6 \times 10 \mu F X7R$ ceramic)



Figure 9 — Output ripple ($V_{IN} = 28V$, $I_{OUT} = 10A$, CR, $C_{OUT} = 6 \times 10\mu F X7R$ ceramic)



Figure 10 — Thermal image $(V_{IN} = 28V, I_{OUT} = 10A, CR, OLFM evaluation PCB)$



PI3109-00-HVMZ Electrical Characteristics

Unless otherwise specified: $16V < V_{IN} < 50V$, $0A < I_{OUT} < 10A$, $-55^{\circ}C < T_{CASE} < 100^{\circ}C$ ^[a]

| Input SpecificationsInput Voltage Range V_{N} Input div/dt lai V_{NOVDT} $V_{N} = 50V$ Input Undervoltage Turn-on V_{UVOR} $l_0 = 10A$ 14.Input Undervoltage Turn-off V_{UVOR} $l_0 = 10A$ 13.Input Undervoltage Turn-off V_{UVOR} $l_0 = 10A$ 15.Input Overvoltage Turn-off V_{OVOR} $l_0 = 10A$ 50.Input Overvoltage Turn-off V_{OVOR} $l_0 = 10A$ 51.Input Overvoltage Turn-off V_{OVOR} $l_0 = 10A$ 51.Input Quescent Current l_0 $V_N = 28V$, ENABLE = 0V10.Input Guescent Current l_0 $V_N = 28V$, ENABLE = 0V10.Input Guescent Current l_0 $V_N = 28V$, ENABLE = 0V10.Input Guescent Current l_0 $V_N = 28V$, ENABLE = 0V10.Input Guescent Current Ful Load l_N $C_{CSS} = 100^{\circ}C$, $l_{OUT} = 10A$, $n_{FL} = 88\%$ typical, $V_N = 28V$, ENABLE = 0V10.Input Reflected Ripple Current l_{NRR} $L_0 = 0.47 \mu fC_N = 100\mu F 63V$ electrolytic + 2 x 4.7 μF 50% Z/R ceramicOutput Voltage Set Point V_{OUT} $l_{OUT} = 5A$ -0°C < T_{CASE} < 100°C-3Total Output Accuracy V_{OA} $T_{CASE} = 100^{\circ}C$, $V_N = 28V$ 88.Efficiency - Half Load η_{RL} T_{CASE} = 100^{\circ}C, $V_N = 28V$ 88.Output Urent Range l_{OUT} -102Output Urent Range l_{OUT} -2-2-2Output Reflected Ripple Voltage <t< th=""><th></th><th></th><th>Unit</th></t<> | | | Unit |
|---|-------|------|------------------|
| Input Voltage Range V_{IN} 16Input dV/dt $[n]$ V_{INOVDT} $V_{IN} = 50V$ 1Input Undervoltage Turn-on V_{UVORF} $I_0 = 10A$ 14.Input Undervoltage Turn-off V_{UVORF} $I_0 = 10A$ 13.Input Overvoltage Turn-on V_{UVH} $I_0 = 10A$ 50.Input Overvoltage Turn-off V_{OVORF} $I_0 = 10A$ 50.Input Overvoltage Turn-off V_{OVORF} $I_0 = 10A$ 51.Input Quescent Current I_0 $V_N = 28V, V_OT = 0A$ 51.Input Standby Power P_{DEL} $V_N = 28V, V_OT = 0A$ 51.Input Standby Power P_{SSY} $V_N = 28V, V_OT = 0A$ 51.Input Reflected Ripple Current I_{NN} $T_{CASE} = 100^{\circ}C, I_{OUT} = 10A, R_{E} = 88% typical, V_N = 28V50.Input Reflected Ripple CurrentI_{NNRR}I_N = 0.47\mu H_{CN} = 100\mu F 63V electrolytic + 2 x 4.7\muF50.CordT_{SAS} = 100^{\circ}C, I_{OUT} = 10A, R_{E} = 88% typical, V_N = 28V50.51.Input Voltage Set PointV_{OUT}I_{OUT} = 5A50.Output Voltage Trim RangeV_{OADI}-0^{\circ}C < T_{CASE} < 100^{\circ}C-3.Output Voltage Trim RangeV_{OADI}-0^{\circ}C < T_{CASE} < 100^{\circ}C-5.Output Voltage Trim RangeV_{OADI}-0^{\circ}C < T_{CASE} < 100^{\circ}C, V_N = 28V86.Efficiency - Hall Load\eta_{H_{L}}T_{CASE} = 100^{\circ}C, V_N = 28V83.Output Voltage ProintV_{OVP}-0^{\circ}C < 0^{\circ} = 5.50.Output Current$ | | | |
| Input dV/dt [a] V_{NNDVDT} $V_{N} = 50V$ Input Undervoltage Turn-off V_{UVON} $l_0 = 10A$ 14.Input Undervoltage Turn-off V_{UVOF} $l_0 = 10A$ 13.Input Overvoltage Turn-off V_{UVOH} $l_0 = 10A$ 50.Input Overvoltage Turn-off V_{OVOH} $l_0 = 10A$ 51.Input Overvoltage Turn-off V_{OVOH} $l_0 = 10A$ 51.Input Overvoltage Turn-off V_{OVOH} $l_0 = 10A$ 51.Input Quescent Current l_0 $V_N = 28V$, ENABLE = 0V51.Input dling Power P_{DLE} $V_N = 28V$, ENABLE = 0V51.Input Standby Power P_{SBY} $V_N = 28V$, ENABLE = 0V51.Input Current Full Load I_N $T_{CASE} = 100^{\circ}C$, $I_{OT} = 10A$, $\eta_{FL} = 88\%$ typical,52.Input Reflected Ripple Current I_{NRR} $L_N = 0.47\mu$ ($L_N = 100\mu$ F 63V electrolytic + 2 x 4.7\mu F50.Cutput Voltage Set Point V_{OA} $I_{OT} = 5A$ $O^{\circ}C < T_{CASE} < 100^{\circ}C$ -3 Total Output Accuracy V_{OA} $I_{OCP} < T_{CASE} < 100^{\circ}C$ -2 Output Voltage Trim Range V_{OAD} $I_{CASE} < 100^{\circ}C, V_{N} = 28V$ 83.Output Current Range I_{OUP} $T_{CASE} < 100^{\circ}C, V_{N} = 28V$ 83.Output Current Range I_{OUP} $T_{CASE} < 100^{\circ}C, V_{N} = 28V$ 83.Output Current Range V_{OAP} $T_{CASE} < 100^{\circ}C, V_{N} = 28V$ 83.Output Current Range I_{OUP} $T_{CASE} < 100^{\circ}C, V_{N} = 28V$ 83.< | 28 | 50 | V |
| Input Undervoltage Turn-onVUVONIg = 10A14.Input Undervoltage Turn-onVUVONFIg = 10A13.Input Undervoltage Turn-onVOVONFIg = 10A13.Input Overvoltage Turn-onVOVONFIg = 10A50.Input Overvoltage Turn-onVOVONFIg = 10A50.Input Overvoltage Turn-onVOVONFIg = 10A50.Input Overvoltage Turn-onVOVONFIg = 10A51.Input Overvoltage Turn-onVOVONFIg = 10A51.Input Overvoltage Turn-onIgVIN = 28V, ENABLE = 0V51.Input Varies ParkerPIDLEVIN = 28V, IABLE = 0V50.Input Standby PowerPSWVIN = 28V, IABLE = 0V50.Input Standby PowerIg10.TCASE = 100°C, Iour = 10A, nFL = 88% typical, VIN = 28VInput Reflected Ripple CurrentIgIg50.Nortal Output Standby PowerIgIg10.Votal Output AccuracyVOAIg-0°C < TCASE < 100°C | 28 | | V _{DC} |
| Input Undervoltage Turn-off V_{UVOFF} $I_0 = 10A$ 13.Input Undervoltage Turn-off V_{OVOR} $I_0 = 10A$ 50.Input Overvoltage Turn-off V_{OVOFF} $I_0 = 10A$ 51.Input Overvoltage Turn-off V_{OVOFF} $I_0 = 10A$ 51.Input Quescent Current I_0 $V_{IN} = 28V$, ENABLE = 0V51.Input Quescent Current I_0 $V_{IN} = 28V$, ENABLE = 0V51.Input Standby Power P_{DLE} $V_{IN} = 28V$, ENABLE = 0V51.Input Current Full Load I_{IN} $T_{CASE} = 100^{\circ}C$, $I_{OUT} = 10A$, $\eta_{FL} = 88%$ typical, $V_{IN} = 28V$ 50.Input Reflected Ripple Current I_{INRR} $T_{CASE} = 100^{\circ}C$, $I_{OUT} = 10A$, $\eta_{FL} = 88%$ typical, $V_{IN} = 28V$ 50.Curput Voltage St Point V_{OII} $I_{OUT} = 5A$ 50.Total Output Accuracy V_{OA} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ -3.Output Voltage Trim Range V_{OADJ} $-0^{\circ}C < T_{CASE} < 0^{\circ}C$ -5.Output Voltage Trim Range V_{OADJ} $T_{CASE} = 100^{\circ}C$, $V_{IN} = 28V$ 86.Efficiency - Full Load η_{FL} $T_{CASE} = 100^{\circ}C$, $V_{IN} = 28V$ 86.Efficiency - Full Load η_{FL} $T_{CASE} = 100^{\circ}C$, $V_{IN} = 28V$ 83.Output Ripple Voltage V_{ORP} $C_{OUT} = 6 X$ 6.Switching Frequency f_{SW} $T_{CASE} = 100^{\circ}C$, $V_{IN} = 28V$ 83.Output Turn-on Delay Time T_{ONDP} T_{OUNF} to ENABLE = 5V, V_{IN} rise time < 1ms | 45.5 | 1.0 | V/µs |
| $\begin{tabular}{ c $ | | | V _{DC} |
| Input Overvoltage Turn-on V_{OVON} $l_0 = 10A$ 50.Input Overvoltage Turn-off V_{OVOFF} $l_0 = 10A$ 51Input Quescent Current l_0 $V_{IN} = 28V$, ENABLE = 0V10Input Idling Power P_{IDLE} $V_{IN} = 28V$, ENABLE = 0V10Input Standby Power P_{SBY} $V_{IN} = 28V$, ENABLE = 0V10Input Current Full Load l_{IN} $T_{CASE} = 100^{\circ}C$, $l_{OUT} = 10A$, $\eta_{FL} = 88%$ typical, $V_{IN} = 28V$ 100µF 63V electrolytic + 2 x 4.7µFInput Reflected Ripple Current l_{INRR} $C_{IN} = 0.47µH C_{IN} = 100µF 63V electrolytic + 2 x 4.7µF 50V X7Rceramic C_{IN} = Cbulk + Chf10Output Voltage Set PointV_{OUT}l_{OUT} = 5A-3Total Output AccuracyV_{OA}-0^{\circ}C < T_{CASE} < 0^{\circ}C-3Output Voltage Trim RangeV_{OADJ}-2-20Output Voltage Trim RangeV_{OADJ}T_CASE = 100°C, V_{IN} = 28V88.Efficiency - Half Load\eta_{HL}T_{CASE} = 100^{\circ}C, V_{IN} = 28V88.Output OVP Set PointV_{OVF}6.0-2Output VIP Set PointV_{OVF}6.0-2Output Turn-on Delay Timet_{OHEP}V_{IN} = V_{UVON} to ENABLE = 5V; V_{IN} rise time < 1ms$ | | | V _{DC} |
| Input Overvoltage Turn-offVovor $l_0 = 10A$ 51Input Overvoltage Hysteresis V_{OVH} $l_0 = 10A$ 51Input Quiescent Current l_0 $V_{IN} = 28V$, ENABLE = 0V1Input Idling Power P_{DDE} $V_{IN} = 28V$, ENABLE = 0V1Input Standby Power P_{SBV} $V_{IN} = 28V$, ENABLE = 0V1Input Current Full Load I_{IN} $T_{CASE} = 100^{\circ}C$, $I_{OUT} = 10A$, $\eta_{FL} = 88%$ typical, $V_{IN} = 28V$ 1Input Reflected Ripple Current I_{INRR} $L_{IN} = 0.47\muH C_{IN} = 100\muF 63V$ electrolytic + 2 x 4.7 μ FRecommended Ext Input Capacitance C_{IN} $I_{OUT} = 5A$ 1Output Voltage Set Point V_{OUT} $I_{OUT} = 5A$ | 1.2 | | V _{DC} |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | V _{DC} |
| Input Quiescent CurrentIQ $V_{N} = 28V$, ENABLE = 0VInput Idling Power P_{IDLE} $V_{N} = 28V$, $I_{DUT} = 0A$ Input Standby Power P_{SBY} $V_{N} = 28V$, ENABLE = 0VInput Current Full Load I_{IN} $T_{CASE} = 100^{\circ}C$, $I_{OUT} = 10A$, $\eta_{FL} = 88\%$ typical, $V_{N} = 28V$ Input Reflected Ripple Current I_{INRR} $L_{N} = 0.47 \mu H C_{N} = 100 \mu F 63V$ electrolytic + 2 x 4.7 μF Recommended Ext Input Capacitance C_{IN} $C_{IN} = 100 \mu F 63V$ electrolytic + 2 x 4.7 μF 50V X7R ceramicOutput Voltage Set Point V_{OUT} $I_{OUT} = 5A$ Total Output Accuracy V_{OA} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ Output Voltage Trim Range V_{OADJ} $-0^{\circ}C < T_{CASE} < 0^{\circ}C$ Output Voltage Trim Range I_{OUT} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ Output Voltage Trim Range I_{OUT} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ Output Voltage Trim Range I_{OUT} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ Output Voltage Trim Range I_{OUT} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ Output Voltage Trim Range I_{OUT} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ Output Voltage Trim Range I_{OUT} $-0^{\circ}C < T_{CASE} < 100^{\circ}C < 0^{\circ}C$ Output Voltage Trim Range I_{OUT} $-0^{\circ}C < T_{CASE} < 100^{\circ}C < 0^{\circ}C < 0^{\circ}C$ Output Voltage V_{OADJ} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 86Efficiency - Full Load η_{FL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 83Output VOVP Set Point V_{OVP} $C_{OUT} = 6 \times 10\mu F 10V X7R DC-20MHz$ <t< td=""><td>53.7</td><td>55</td><td>V_{DC}</td></t<> | 53.7 | 55 | V _{DC} |
| $\begin{array}{ c c c c c c } \mbox{Input Idling Power} & P_{IDLE} & V_{IN} = 28V, I_{OUT} = 0A & & & & \\ \mbox{Input Standby Power} & P_{SBY} & V_{IN} = 28V, ENABLE = 0V & & & & \\ \mbox{Input Current Full Load} & I_{IN} & T_{CASE} = 100^\circ C, I_{OUT} = 10A, n_{FL} = 88\% typical, V_{VN} = 28V & & \\ \mbox{Input Reflected Ripple Current} & I_{INRR} & I_{IN} = 0.47 \mu H C_{IN} = 100 \mu F 63V electrolytic + 2 x 4.7 \mu F 50V X7R ceramic & & \\ \mbox{Source} C_{IN} & = 0.47 \mu H C_{IN} = 100 \mu F 63V electrolytic + 2 x 4.7 \mu F 50V X7R ceramic & & \\ \mbox{Current Full Load} & V_{OUT} & I_{OUT} = 5A & & \\ \mbox{Output Voltage Set Point} & V_{OA} & & -0^\circ C < T_{CASE} < 100^\circ C & -3 & \\ \mbox{Total Output Accuracy} & V_{OA} & & -0^\circ C < T_{CASE} < 00^\circ C & -5 & \\ \mbox{Output Voltage Trim Range} & I_{OUT} & & -2 & \\ \mbox{Output Current Range} & I_{OUT} & & & -2 & \\ \mbox{Output Voltage Trim Range} & I_{OUT} & & & & \\ \mbox{Overcurrent Protection} & I_{OCP} & & & & & \\ \mbox{Efficiency - Half Load} & \eta_{FL} & T_{CASE} = 100^\circ C, V_{IN} = 28V & & & & \\ \mbox{Source} & -2 & & & & & & \\ \mbox{Output VOP Set Point} & V_{OVP} & & & & & \\ \mbox{Output Ripple Voltage} & V_{ORPP} & C_{OUT} = 6 x 10 \mu F 10V X7R DC-20MHz & & & \\ \mbox{Switching Frequency} & f_{SW} & & & & \\ \mbox{Output Turn-on Delay Time} & t_{ONDLY} & V_{IN} = V_{UVON} to ENABLE = 5V; V_{IN} rise time < 1 ms & \\ \mbox{Output Turn-off Delay Time} & t_{OFDY} & V_{IN} = V_{UVON} to ENABLE = 5V; V_{IN} rise time < 1 ms & \\ \mbox{Output Turn-off Delay Time} & t_{SS} & & & \\ \mbox{ENABLE} = 5V to 90\% V_{OUT} C_{REF} = 0 & \\ \mbox{Mairmun Load Capacitance} & C_{OUT} & C_{REF} = 0.22\mu F, C_{OUT} = AI Electrolytic & \\ \mbox{Courr} = 6 x 10\mu F 10V X7R & \\ \mbox{Courr} = 6 x 10\mu F 10V X7R & \\ \mbox{Courr} = 50\% step 0.1A/\mu S & \\ $ | 1.2 | | V _{DC} |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | 2 | | mA _{DC} |
| $\begin{tabular}{ c c c c c } \hline T_{CASE} = 100^\circ C, \ I_{OUT} = 10A, \ \eta_{FL} = 88\% \ typical, \ V_{IN} = 28V \ V_{IN} = 28V \ V_{IN} = 28V \ V_{IN} = 28V \ V_{IN} = 0.47 \ \mu H \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ ceramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic + 2 \times 4.7 \ \mu F \ 50V \ X7R \ eramic \ C_{IN} = 100 \ \mu F \ 63V \ electrolytic \ elect$ | 3.5 | | W |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | 0.05 | 6 | W |
| $\begin{array}{ c c c c c c c c c c c c c c c c c c c$ | 2.03 | 3 | A _{DC} |
| Recommended Ext input CapacitativeCINceramic $C_{IN} = Cbulk + Chf$ Output SpecificationsOutput Voltage Set Point V_{OUT} $I_{OUT} = 5A$ -3Total Output Accuracy V_{OA} $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ -3Output Voltage Trim Range V_{OADJ} -55°C < $T_{CASE} < 0^{\circ}C$ -2Output Current Range I_{OUT} -2Output Current Protection I_{OCP} 10.Efficiency – Full Load η_{FL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 86Efficiency – Half Load η_{HL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 83.Output OVP Set Point V_{OVP} 6.0Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | 13 | | mApp |
| $ \begin{array}{c c} \mbox{Output Voltage Set Point} & V_{OUT} & I_{OUT} = 5A & & & & & & & & & & & & & & & & & & $ | 109.4 | 4 | μF |
| $\begin{array}{c c} -0^{\circ}\text{C} < \text{T}_{\text{CASE}} < 100^{\circ}\text{C} & -3 \\ -55^{\circ}\text{C} < \text{T}_{\text{CASE}} < 0^{\circ}\text{C} & -5 \\ \hline & -55^{\circ}\text{C} < \text{T}_{\text{CASE}} < 0^{\circ}\text{C} & -5 \\ \hline & & -55^{\circ}\text{C} < \text{T}_{\text{CASE}} < 0^{\circ}\text{C} & -5 \\ \hline & & -2 \\ \hline & & 0 \\ \text{Output Current Range} & I_{\text{OUT}} & & & & -2 \\ \hline & & 0 \\ \text{Overcurrent Protection} & I_{\text{OCP}} & & & 10 \\ \hline & & 0 \\ \text{Overcurrent Protection} & I_{\text{OCP}} & & & 10 \\ \hline & & 10 \\ \text{Efficiency} - \text{Full Load} & \eta_{\text{FL}} & \text{T}_{\text{CASE}} = 100^{\circ}\text{C}, \text{V}_{\text{IN}} = 28 \\ \hline & \text{Efficiency} - \text{Half Load} & \eta_{\text{HL}} & \text{T}_{\text{CASE}} = 100^{\circ}\text{C}, \text{V}_{\text{IN}} = 28 \\ \hline & \text{Output OVP Set Point} & V_{\text{OVP}} & & 6.0 \\ \hline & \text{Output Ripple Voltage} & V_{\text{ORPP}} & \text{C}_{\text{OUT}} = 6 \times 10 \\ \hline & \text{Output Turn-on Delay Time} & \text{t}_{\text{ONDLY}} & \text{V}_{\text{IN}} = \text{V}_{\text{UVON}} \text{ to ENABLE} = 5V; \\ \hline & \text{Output Turn-on Delay Time} & \text{t}_{\text{OHDLY}} & V_{\text{IN}} = V_{\text{UVOFF}} \text{ to ENABLE} < 2.35 \\ \hline & \text{Output Turn-on Delay Time} & \text{t}_{\text{SS}} & ENABLE = 5V \text{ to 90\% V}_{\text{OUT}} \\ \hline & \text{Gutput Turn-ondelay Time} & \text{t}_{\text{SS}} & ENABLE = 5V \text{ to 90\% V}_{\text{OUT}} \\ \hline & \text{Maximum Load Capacitance} & \text{C}_{\text{OUT}} & \text{C}_{\text{REF}} = 0.22 \\ \hline & \text{Load Transient Deviation} & V_{\text{ODV}} & \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text{I}_{\text{OUT}} = 50\% \text{ step 0.1A/\muS} \\ \hline & \text$ | | | |
| Iotal Output Accuracy V_{OA} $-55^{\circ}C < T_{CASE} < 0^{\circ}C$ -5 Output Voltage Trim Range V_{OADJ} -2 Output Current Range I_{OUT} -2 Overcurrent Protection I_{OCP} 10 .Efficiency – Full Load η_{FL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 86 Efficiency – Half Load η_{HL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 83 .Output OVP Set Point V_{OVP} 6.0 Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10\mu$ F $10V X7R DC-20MHz$ Switching Frequency f_{SW} 10 .Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = $5V$; V_{IN} rise time < 1ms | 5.0 | | V _{DC} |
| Output Voltage Trim Range V_{OADJ} -55°C < $T_{CASE} < 0°C$ -5Output Current Range I_{OUT} -2Output Current Range I_{OUT} 10.Efficiency – Full Load η_{FL} $T_{CASE} = 100°C, V_{IN} = 28V$ 86Efficiency – Half Load η_{HL} $T_{CASE} = 100°C, V_{IN} = 28V$ 83.Output OVP Set Point V_{OVP} 6.0Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10\mu$ F 10V X7R DC-20MHz7Switching Frequency f_{SW} 7Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | | +3 | % |
| Output Current Range I_{OUT} IOvercurrent Protection I_{OCP} 10.Efficiency – Full Load η_{FL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 86Efficiency – Half Load η_{HL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 83.Output OVP Set Point V_{OVP} 6.0Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10\mu F 10V X7R DC-20MHz$ Switching Frequency f_{SW} 0Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | | +3 | % |
| Output Current Range I_{OUT} IOvercurrent Protection I_{OCP} 10.Efficiency – Full Load η_{FL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 86Efficiency – Half Load η_{HL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 83.Output OVP Set Point V_{OVP} 6.0Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10\mu F 10V X7R DC-20MHz$ 7Switching Frequency f_{SW} 7Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms |) | 10 | % |
| Overcurrent Protection I_{OCP} 10.Efficiency – Full Load η_{FL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 86Efficiency – Half Load η_{HL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 83.Output OVP Set Point V_{OVP} 6.0Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10 \mu F 10V X7R DC-20MHz$ 6.0Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | | 10 | A _{DC} |
| Efficiency – Full Load η_{FL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 860Efficiency – Half Load η_{HL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 833Output OVP Set Point V_{OVP} 6.0Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10\mu F 10V X7R DC-20MHz$ 6.0Switching Frequency f_{SW} 7Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | 3 15 | 20 | A _{DC} |
| Efficiency – Half Load η_{HL} $T_{CASE} = 100^{\circ}C, V_{IN} = 28V$ 83.Output OVP Set Point V_{OVP} 6.0Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10\mu F 10V X7R DC-20MHz$ Switching Frequency f_{SW} 7Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | 88 | | % |
| Output OVP Set Point V_{OVP} 6.0Output Ripple Voltage V_{ORPP} $C_{OUT} = 6 \times 10 \mu F 10V X7R DC-20MHz$ 6.0Switching Frequency f_{SW} 0Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | 85.5 | | % |
| Output Ripple VoltageVORPP $C_{OUT} = 6 \times 10 \mu F 10V X7R DC-20MHz$ Switching Frequency f_{SW} Image: Control of the system of the | 6.3 | | V _{DC} |
| Switching Frequency f_{SW} Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1msOutput Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVOFF}$ to ENABLE = 5V; V_{IN} rise time < 1ms | 135 | | mVpp |
| Output Turn-on Delay Time t_{ONDLY} $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1msOutput Turn-off Delay Time t_{OFFDLY} $V_{IN} = V_{UVOFF}$ to ENABLE < 2.35V | 900 | | kHz |
| Output Turn-off Delay Time t_{OFFDLY} $V_{IN} = V_{UVOFF}$ to ENABLE < 2.35VSoft-Start Ramp Time t_{SS} ENABLE = 5V to 90% $V_{OUT} C_{REF} = 0$ Maximum Load Capacitance C_{OUT} $C_{REF} = 0.22 \mu F, C_{OUT} = AI ElectrolyticLoad Transient DeviationV_{ODV}I_{OUT} = 50\% step 0.1A/µSC_{OUT} = 6 \times 10 \mu F 10V X7R$ | 80 | | ms |
| Soft-Start Ramp Time t_{SS} ENABLE = 5V to 90% V_{OUT} C_{REF} = 0Maximum Load Capacitance C_{OUT} $C_{REF} = 0.22 \mu$ F, $C_{OUT} = AI$ ElectrolyticLoad Transient Deviation V_{ODV} $I_{OUT} = 50\%$ step 0.1A/ μ S $C_{OUT} = 6 \times 10\mu$ F 10V X7R $I_{OUT} = 50\%$ step 0.1A/ μ S $I_{OUT} = 50\%$ step 0.1A/ μ S | 375 | | μs |
| Maximum Load Capacitance C_{OUT} $C_{REF} = 0.22 \mu$ F, $C_{OUT} = AI$ ElectrolyticLoad Transient Deviation V_{ODV} $I_{OUT} = 50\%$ step $0.1A/\mu$ S $C_{OUT} = 6 x 10 \mu$ F 10V X7R $I_{OUT} = 50\%$ step $0.1A/\mu$ S | 230 | | μs |
| Load Transient Deviation V_{ODV} $I_{OUT} = 50\%$ step 0.1A/µS $C_{OUT} = 6 \times 10\mu$ F 10V X7R $I_{OUT} = 50\%$ step 0.1A/µS | 230 | 4700 | μF |
| I _{OUT} = 50% step 0.1A/μS | 90 | 4700 | mV |
| $V_{OUT} \le 1\%$ | 100 | | μs |
| Maximum Output Power P _{OUT} | 50 | | W |
| Absolute Maximum Output Ratings | | | |
| Name Rating | | | |
| +OUT to -OUT -0.5V to 6.8V _{DC} | | | |
| Continuous Output Current 10A _{DC} | | | |
| Peak Output Current 20A _{DC} | | | |

^[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. Unless otherwise specified, ATE tests are completed at room temperature. ^[b] Current flow sourced by a pin has a negative sign.



PI3109-00-HVMZ Electrical Characteristics (Cont.)

| Parameter | Symbol | Conditions | Min | Тур | Мах | Unit |
|--|-------------------|--|------|-------|------|------------------|
| | | ENABLE | | | | |
| DC Voltage Reference Output | V _{ERO} | | 4.65 | 4.9 | 5.15 | V _{DC} |
| Output Current Limit ^[b] | I _{ECL} | ENABLE = 3.3V | -3.3 | -2.6 | -1.9 | mA _{DC} |
| Start Up Current Limit ^[b] | I _{ESL} | ENABLE = 1V | -120 | -90 | -60 | μΑ |
| Module Enable Voltage | V _{EME} | | 1.95 | 2.5 | 3.05 | V _{DC} |
| Module Disable Voltage | VEMD | | 1.8 | 2.35 | 2.9 | V _{DC} |
| Disable Hysteresis | V _{EDH} | | 1.0 | 150 | 2.5 | mV |
| Enable Delay Time | t _{EE} | | | 10 | | μs |
| Disable Delay Time | t _{ED} | | | 10 | | μs |
| Maximum Capacitance | C _{EC} | | | 10 | 1500 | pF |
| Maximum External Toggle Rate | f _{EXT} | | | | 1 | Hz |
| | 'EXT | | | | 1 | 112 |
| | | TRIM/SS | | | | |
| Trim Voltage Reference | V _{REF} | | | 1.240 | | V _{DC} |
| Internal Capacitance | C _{REFI} | | | 10 | | nF |
| External Capacitance | C _{REF} | | | | 0.22 | μF |
| Internal Resistance | R _{REFI} | | | 10 | | kΩ |
| | | | | | | |
| | | TM (Temperature Monitor) | | | | |
| Temperature Coefficient ^[a] | TM _{TC} | | | 10 | | mV / °K |
| Temperature Full Range Accuracy [a] | TM _{ACC} | | -5 | | 5 | °К |
| Drive Capability | I _{TM} | | -100 | | | μΑ |
| TM Output Setting | V _{TM} | Ambient Temperature = 300°K | | 3.00 | | V |
| | | | | | | |
| | | Thermal Specification | | | | |
| Junction Temperature Shutdown ^[a] | T _{MAX} | | 130 | 135 | 140 | °C |
| Junction-to-Case Thermal Impedance | θ _{J-C} | | | 3 | | °C / W |
| Case-to-Ambient Thermal Impedance | θ _{C-A} | Mounted on 9in ² 1oz. Cu 6 layer PCB 25°C | | 9.1 | | °C / W |
| | | Soldering | | | | |
| | | MSL 5; time on floor = 48 hours | | | 225 | °C |
| Peak Temperature During Reflow | | MSL 5; time of floor = 4 hours MSL 6; time on floor = 4 hours | | | 245 | °C |
| | | | | | 243 | |
| | | Regulatory Specification | | | | |
| IEC 60950-1:2005 (2nd Edition) | | | | | | |
| EN 60950-1:2006 | | | | | | |
| IEC 61000-4-2 | | | | | | |
| UL60950-1:2007 | | | | | | |
| CAN/CSA C22.2 NO. 60950-1-07 | | | | | | |
| Recommended Input Fuse Rating | I _{FUSE} | Fast acting LITTLEFUSE Nano ² Series Fuse | 4 | | 10 | Α |
| , · · · · · J | 1 USE | , , , , , , , , , , | | | | |

^[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. ^[b] Current flow sourced by a pin has a negative sign.



PI3109-00-HVMZ Electrical Characteristics (Cont.)



Figure 11 — Conversion efficiency



Figure 12 — Load current vs. temperature (without heat sink)



Figure 13 — Load current vs. temperature (6.33mm heat sink)



Figure 14 — Load current vs. temperature (11mm heat sink)



Figure 15 — Start up, $C_{REF} = 0$ ($V_{IN} = 16V$, $I_{OUT} = 10A$, CR, $C_{OUT} = 6 \times 10 \mu F X7R$ ceramic)







PI3109-00-HVMZ Electrical Characteristics (Cont.)



Figure 17 — Start up, $C_{REF} = 0$ ($V_{IN} = 50V$, $I_{OUT} = 10A$, CR, $C_{OUT} = 6 \times 10 \mu F X7R$ ceramic)



Figure 18 — Transient response ($V_{IN} = 28V$, $I_{OUT} = 5 - 10A$, 0.1A/ μ s, $C_{OUT} = 6 \times 10\mu$ F X7R ceramic)



Figure 19 — Output ripple ($V_{IN} = 28V$, $I_{OUT} = 10A$, CR, $C_{OUT} = 6 \times 10 \mu F X7R$ ceramic)



Figure 20 — Thermal image ($V_{IN} = 28V$, $I_{OUT} = 10A$, CR, OLFM evaluation PCB)



PI3106-00-HVMZ Electrical Characteristics

Unless otherwise specified: $16V < V_{IN} < 50V$, $0A < I_{OUT} < 4.2A$, $-55^{\circ}C < T_{CASE} < 100^{\circ}C$ ^[a]

| Parameter | Symbol | Conditions | Min | Тур | Max | Unit |
|-----------------------------------|---------------------|---|------|-------|------|-------------------------|
| | | Input Specifications | | | | |
| Input Voltage Range | V _{IN} | input specifications | 16 | 28 | 50 | V |
| Input dV/dt ^[a] | | V _{IN} = 50V | 10 | 20 | 1.0 | V _{DC} V/µs |
| Input Undervoltage Turn-on | V _{INDVDT} | $V_{\rm IN} = 300$ $I_{\rm O} = 4.2$ A | 14.5 | 15.4 | 1.0 | V/µs V _{DC} |
| Input Undervoltage Turn-off | | | 14.5 | 13.4 | 15.2 | |
| Input Undervoltage Hysteresis | VUVOFF | $I_0 = 4.2A$ $I_0 = 4.2A$ | 15.5 | 14.4 | 15.2 | V _{DC} |
| Input Overvoltage Turn-on | V _{UVH} | $I_0 = 4.2A$ $I_0 = 4.2A$ | 50 | 52.3 | 54 | V _{DC} |
| Input Overvoltage Turn-off | V _{OVON} | | 50 | 53.5 | 55 | V _{DC} |
| | V _{OVOFF} | $I_0 = 4.2A$ | 51 | 1.2 | 55 | V _{DC} |
| Input Overvoltage Hysteresis | V _{OVH} | $I_0 = 4.2A$ | | | | V _{DC} |
| Input Quiescent Current | | $V_{\rm IN} = 28V$, ENABLE = 0V | | 2 | | mA _{DC} |
| Input Idling Power | P _{IDLE} | $V_{\rm IN} = 28V, I_{\rm OUT} = 0A$ | | 3.5 | | W |
| Input Standby Power | P _{SBY} | $V_{\rm IN} = 28V$, ENABLE = 0V | | 0.056 | | W |
| Input Current Full Load | I _{IN} | T_{CASE} = 100°C, I_{OUT} = 4.2A, η_{FL} = 88% typical, V_{IN} = 28V | | 2.045 | | A _{DC} |
| Input Reflected Ripple Current | I _{INRR} | L_{IN} = 0.47 μH C_{IN} = 100 μF 63V electrolytic + 2 x 4.7 μF 50V X7R ceramic | | 13 | | mApp |
| Recommended Ext Input Capacitance | C _{IN} | $C_{IN} = 100\mu F$ 63V electrolytic + 2 x 4.7 μ F 50V X7R ceramic $C_{IN} =$ Cbulk + Chf | | 109.4 | | μF |
| | | Output Specifications | | | | |
| Output Voltage Set Point | V _{OUT} | $I_{OUT} = 2.1A$ | | 12.0 | | V _{DC} |
| | | $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ | -3 | | +3 | % |
| Total Output Accuracy | V _{OA} | $-55^{\circ}\text{C} < \text{T}_{\text{CASE}} < 0^{\circ}\text{C}$ | -5 | | +3 | % |
| Output Voltage Trim Range | V _{OADJ} | | -20 | | 10 | % |
| Output Current Range | I _{OUT} | | | | 4.2 | A _{DC} |
| Overcurrent Protection | I _{OCP} | | 4.6 | 6.8 | 12 | A _{DC} |
| Efficiency – Full Load | η_{FL} | T _{CASE} = 100°C, V _{IN} = 28V | 86 | 88 | | % |
| Efficiency – Half Load | η _{HL} | T _{CASE} = 100°C, V _{IN} = 28V | 83 | 85 | | % |
| Output OVP Set Point | V _{OVP} | | 13.8 | 14.6 | 15.3 | V _{DC} |
| Output Ripple Voltage | V _{ORPP} | C _{OUT} = 6 x 2.2µF 16V X7R DC-20MHz | | 150 | | mVpp |
| Switching Frequency | f _{SW} | | | 900 | | kHz |
| Output Turn-on Delay Time | t _{ONDLY} | $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | | 80 | | ms |
| Output Turn-off Delay Time | t _{OFFDLY} | $V_{IN} = V_{UVOFF}$ to ENABLE < 2.35V | | 375 | | μs |
| Soft-Start Ramp Time | t _{ss} | ENABLE = 5V to 90% $V_{OUT} C_{REF} = 0$ | | 230 | | μs |
| Maximum Load Capacitance | C _{OUT} | $C_{REF} = 0.22 \mu$ F, $C_{OUT} = AI$ Electrolytic | | | 1000 | μF |
| Load Transient Deviation | V _{ODV} | $I_{OUT} = 50\%$ step 0.1A/µS C _{OUT} = 6 x 2.2µF 16V X7R | | 360 | | mV |
| Load Transient Recovery Time | t _{ovr} | $I_{OUT} = 50\%$ step 0.1A/µS $C_{OUT} = 6 \times 2.2\mu$ F 16V X7R $V_{OUT} \le 1\%$ | | 100 | | μs |
| Maximum Output Power | P _{OUT} | | | 50 | | W |
| | | Absolute Maximum Output Ratings | | | | |
| Name | | Rating | | | | |
| +OUT to -OUT | | -0.5V to 16V _{DC} | | | | |
| Continuous Output Current | | 4.2A _{DC} | | | | |
| Peak Output Current | | 12A _{DC} | | | | |

^[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. Unless otherwise specified, ATE tests are completed at room temperature. ^[b] Current flow sourced by a pin has a negative sign.



PI3106-00-HVMZ Electrical Characteristics (Cont.)

| Parameter | Symbol | Conditions | Min | Тур | Мах | Unit |
|--|------------------------------------|--|------|-------|------|------------------|
| | | ENABLE | | | | |
| DC Voltage Reference Output | V _{ERO} | | 4.65 | 4.9 | 5.15 | V _{DC} |
| Output Current Limit ^[b] | I _{ECL} | ENABLE = 3.3V | -3.3 | -2.6 | -1.9 | mA _{DC} |
| Start Up Current Limit ^[b] | I _{ESL} | ENABLE = 1V | -120 | -90 | -60 | μΑ |
| Module Enable Voltage | V _{EME} | | 1.95 | 2.5 | 3.05 | V _{DC} |
| Module Disable Voltage | V _{EMD} | | 1.8 | 2.35 | 2.9 | V _{DC} |
| Disable Hysteresis | V _{EDH} | | | 150 | | mV |
| Enable Delay Time | t _{EE} | | | 10 | | μs |
| Disable Delay Time | t _{ED} | | | 10 | | μs |
| Maximum Capacitance | C _{EC} | | | | 1500 | pF |
| Maximum External Toggle Rate | f _{EXT} | | | | 1 | Hz |
| | | TRIM/SS | | | | |
| Trim Voltage Reference | V _{REF} | | | 1.235 | | V _{DC} |
| Internal Capacitance | C _{REFI} | | | 10 | | nF |
| External Capacitance | C _{REF} | | | | 0.22 | μF |
| Internal Resistance | R _{REFI} | | | 10 | | kΩ |
| | | | | | | |
| Temperature Coefficient ^[a] | TM _{TC} | TM (Temperature Monitor) | | 10 | | mV / ºk |
| Temperature Full Range Accuracy ^[a] | TM _{ACC} | | 5 | 10 | 5 | °K |
| Drive Capability | | | -100 | | 5 | μΑ |
| TM Output Setting | I _{TM} V _{TM} | Ambient Temperature = 300°K | -100 | 3.00 | | μA V |
| The Output Setting | VTM | | | 5.00 | | V |
| | | Thermal Specification | | | | |
| Junction Temperature Shutdown [a] | T _{MAX} | | 130 | 135 | 140 | °C |
| Junction-to-Case Thermal Impedance | θ_{J-C} | | | 3 | | °C / W |
| Case-to-Ambient Thermal Impedance | θ _{C-A} | Mounted on 9in ² 1oz. Cu 6 layer PCB 25°C | | 8.2 | | °C / W |
| | | Soldering | | | | |
| | | MSL 5; time on floor = 48 hours | | | 225 | °C |
| Peak Temperature During Reflow | | MSL 6; time on floor = 4 hours | | | 245 | °C |
| | | Regulatory Specification | | | | |
| IEC 60950-1:2005 (2nd Edition) | | negative y specification | | | | |
| EN 60950-1:2006 | | | | | | |
| IEC 61000-4-2 | | | | | | |
| UL60950-1:2007 | | | | | | |
| CAN/CSA C22.2 NO. 60950-1-07 | | | | | | |
| Recommended Input Fuse Rating | I _{FUSE} | Fast acting LITTLEFUSE Nano ² Series Fuse | 4 | | 10 | Α |
| need input ruse nating | 'FUSE | rast acting Entrel OSE Hano Schost asc | т | | .0 | |

^[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. ^[b] Current flow sourced by a pin has a negative sign.



PI3106-00-HVMZ Electrical Characteristics (Cont.)



Figure 21 — Conversion efficiency



Figure 22 — Load current vs. temperature (without heat sink)



Figure 23 — Load current vs. temperature (6.3mm heat sink)



Figure 24 — Load current vs. temperature (11mm heat sink)



Figure 25 — Start up, $C_{REF} = 0$ ($V_{IN} = 16V$, $I_{OUT} = 4.2A$, CR, $C_{OUT} = 6 \times 2.2 \mu F X7R$ ceramic)







PI3106-00-HVMZ Electrical Characteristics (Cont.)







Figure 28 — Transient response ($V_{IN} = 28V I_{OUT} = 2.1 - 4.2A$, 0.1A/µs, $C_{OUT} = 6 \times 2.2\mu F X7R$ ceramic)







Figure 30 — Thermal image ($V_{IN} = 28V$, $I_{OUT} = 4.2A$, CR, OLFM evaluation PCB)



PI3111-00-HVMZ Electrical Characteristics

Unless otherwise specified: $16V < V_{IN} < 50V$, $0A < I_{OUT} < 3.3A$, $-55^{\circ}C < T_{CASE} < 100^{\circ}C$ ^[a]

| Parameter | Symbol | Conditions | Min | Тур | Мах | Unit |
|-----------------------------------|--|---|------|-------|------|-------------------------|
| | | Input Specifications | | | | |
| Input Voltage Range | V _{IN} | input specifications | 16 | 28 | 50 | \/ |
| Input dV/dt ^[a] | | $\mathcal{M} = FOW$ | 10 | 20 | 1.0 | V _{DC} V/µs |
| Input Undervoltage Turn-on | V _{INDVDT} V _{UVON} | $V_{\rm IN} = 50V$ $I_{\rm O} = 3.3A$ | 14.5 | 15.4 | 1.0 | V/µs V _{DC} |
| Input Undervoltage Turn-off | | | 13.5 | 14.3 | 15.2 | |
| Input Undervoltage Hysteresis | V _{UVOFF} V _{UVH} | I _O = 3.3A I _O = 3.3A | 15.5 | 14.5 | 15.2 | V _{DC} |
| Input Overvoltage Turn-on | | $I_0 = 3.3A$ $I_0 = 3.3A$ | 50 | 52.4 | 54 | V _{DC} |
| Input Overvoltage Turn-off | V _{OVON} | $I_0 = 3.3A$ $I_0 = 3.3A$ | 50 | 53.5 | 55 | V _{DC} |
| Input Overvoltage Hysteresis | V _{OVOFF} V _{OVH} | $I_0 = 3.3A$ | 51 | 1.1 | 55 | V _{DC} |
| Input Quiescent Current | | $V_{\rm IN} = 28V$, ENABLE = 0V | | 2 | | |
| Input Idling Power | l _Q | $v_{\rm IN} = 28V$, ENABLE = 0V $v_{\rm IN} = 28V$, $I_{\rm OUT} = 0A$ | | 4.1 | | mA _{DC} W |
| Input Standby Power | PIDLE | $V_{\rm IN} = 28V$, $r_{\rm OUT} = 0A$ $V_{\rm IN} = 28V$, ENABLE = 0V | | 0.056 | | W |
| | P _{SBY} | | | 0.050 | | VV |
| Input Current Full Load | I _{IN} | T_{CASE} = 100°C, I_{OUT} = 3.3A, η_{FL} = 87.5% typical, V_{IN} = 28V | | 2.039 | | A _{DC} |
| Input Reflected Ripple Current | I _{INRR} | L_{IN} = 0.47 μH C_{IN} = 100 μF 63V electrolytic + 2 x 4.7 μF 50V X7R ceramic | | 13 | | mApp |
| Recommended Ext Input Capacitance | C _{IN} | C_{IN} = 100µF 63V electrolytic + 2 x 4.7µF 50V X7R ceramic C_{IN} = Cbulk + Chf | | 109.4 | | μF |
| | | Output Specifications | | | | |
| Output Voltage Set Point | V _{OUT} | I _{OUT} = 1.65A | | 15.0 | | V _{DC} |
| | | $-0^{\circ}C < T_{CASE} < 100^{\circ}C$ | -3 | | +3 | % |
| Total Output Accuracy | V _{OA} | $-55^{\circ}C < T_{CASE} < 0^{\circ}C$ | -5 | | +3 | % |
| Output Voltage Trim Range | V _{OADJ} | | -20 | | 10 | % |
| Output Current Range | I _{OUT} | | | | 3.3 | A _{DC} |
| Overcurrent Protection | I _{OCP} | | 3.8 | 5.6 | 9.6 | A _{DC} |
| Efficiency – Full Load | η_{FL} | T _{CASE} = 100°C, V _{IN} = 28V | 85.5 | 87.5 | | % |
| Efficiency – Half Load | η _{HL} | T _{CASE} = 100°C, V _{IN} = 28V | 82.3 | 84.3 | | % |
| Output OVP Set Point | V _{OVP} | | 17.6 | 18.2 | 18.8 | V _{DC} |
| Output Ripple Voltage | V _{ORPP} | C _{OUT} = 6 x 2.2µF 16V X7R DC-20MHz | | 275 | | mVpp |
| Switching Frequency | f _{SW} | | | 900 | | kHz |
| Output Turn-on Delay Time | t _{ONDLY} | $V_{IN} = V_{UVON}$ to ENABLE = 5V; V_{IN} rise time < 1ms | | 80 | | ms |
| Output Turn-off Delay Time | t _{OFFDLY} | $V_{IN} = V_{UVOFF}$ to ENABLE < 2.35V | | 375 | | μs |
| Soft-Start Ramp Time | t _{ss} | ENABLE = 5V to 90% $V_{OUT} C_{REF} = 0$ | | 230 | | μs |
| Maximum Load Capacitance | C _{OUT} | $C_{REF} = 0.22 \mu$ F, $C_{OUT} = AI$ Electrolytic | | | 1000 | μF |
| Load Transient Deviation | V _{ODV} | I _{OUT} = 50% step 0.1A/μS C _{OUT} = 6 x 2.2μF 16V X7R | | 375 | | mV |
| Load Transient Recovery Time | t _{ovr} | $I_{OUT} = 50\%$ step 0.1A/µS $C_{OUT} = 6 \times 2.2\mu$ F 16V X7R $V_{OUT} \le 1\%$ | | 100 | | μs |
| Maximum Output Power | P _{OUT} | | | 50 | | W |
| | | Absolute Maximum Output Ratings | | | | |
| Name | | Rating | | | | |
| +OUT to -OUT | | -0.5V to 20V _{DC} | | | | |
| Continuous Output Current | | 3.3A _{DC} | | | | |
| Peak Output Current | | 9.6A _{DC} | | | | |
| | | | | | | |

^[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. Unless otherwise specified, ATE tests are completed at room temperature. ^[b] Current flow sourced by a pin has a negative sign.



PI3111-00-HVMZ Electrical Characteristics (Cont.)

| Parameter | Symbol | Conditions | Min | Тур | Max | Unit |
|--|-------------------|--|------|---------|------|------------------|
| | | ENABLE | | | | |
| DC Voltage Reference Output | V _{ERO} | | 4.65 | 4.9 | 5.15 | V _{DC} |
| Output Current Limit ^[b] | I _{ECL} | ENABLE = 3.3V | -3.3 | -2.6 | -1.9 | mA _{DC} |
| Start Up Current Limit ^[b] | I _{ESL} | ENABLE = 1V | -120 | -90 | -60 | μΑ |
| Module Enable Voltage | V _{EME} | | 1.95 | 2.5 | 3.05 | V _{DC} |
| Module Disable Voltage | V _{EMD} | | 1.8 | 2.35 | 2.9 | V _{DC} |
| Disable Hysteresis | V _{EDH} | | | 150 | | mV |
| Enable Delay Time | t _{EE} | | | 10 | | μs |
| Disable Delay Time | t _{ED} | | | 10 | | μs |
| Maximum Capacitance | C _{EC} | | | | 1500 | pF |
| Maximum External Toggle Rate | f _{EXT} | | | | 1 | Hz |
| | | | | | | |
| | N | TRIM/SS | | 1 2 2 0 | | N |
| Trim Voltage Reference | V _{REF} | | | 1.230 | | V _{DC} |
| Internal Capacitance | CREFI | | | 10 | 0.00 | nF |
| External Capacitance | C _{REF} | | | 10 | 0.22 | μF |
| Internal Resistance | R _{REFI} | | | 10 | | kΩ |
| | | TM (Temperature Monitor) | | | | |
| Temperature Coefficient ^[a] | TM _{TC} | | | 10 | | mV / °K |
| Temperature Full Range Accuracy ^[a] | TM _{ACC} | | -5 | | 5 | °K |
| Drive Capability | I _{TM} | | -100 | | | μΑ |
| TM Output Setting | V _{TM} | Ambient Temperature = 300°K | | 3.00 | | V |
| | | Thermal Specification | | | | |
| Junction Temperature Shutdown [a] | T _{MAX} | · | 130 | 135 | 140 | °C |
| Junction-to-Case Thermal Impedance | θ _{J-C} | | | 3 | | °C / W |
| Case-to-Ambient Thermal Impedance | θ _{C-A} | Mounted on 9in ² 1oz. Cu 6 layer PCB 25°C | | 9.4 | | °C / W |
| | | California a | | | | |
| | | Soldering | | | 225 | 0.5 |
| Peak Temperature During Reflow | | MSL 5; time on floor = 48 hours | | | 225 | °C |
| | | MSL 6; time on floor = 4 hours | | | 245 | °C |
| | | Regulatory Specification | | | | |
| IEC 60950-1:2005 (2nd Edition) | | | | | | |
| EN 60950-1:2006 | | | | | | |
| IEC 61000-4-2 | | | | | | |
| UL60950-1:2007 | | | | | | |
| CAN/CSA C22.2 NO. 60950-1-07 | | | | | | |
| Recommended Input Fuse Rating | I _{FUSE} | Fast acting LITTLEFUSE Nano ² Series Fuse | 4 | | 10 | А |

[a] These parameters are not production tested but are guaranteed by design, characterization and correlation with statistical process control. Unless otherwise specified, ATE tests are completed at room temperature.
 [b] Current flow sourced by a pin has a negative sign.



PI3111-00-HVMZ Electrical Characteristics (Cont.)



Figure 31 — Conversion efficiency



Figure 32 — Load current vs. temperature (without heat sink)



Figure 33 — Load current vs. temperature (6.33mm heat sink)



Figure 34 — Load current vs. temperature (11mm heat sink)



Figure 35 — Start up, $C_{REF} = 0$ ($V_{IN} = 16V$, $I_{OUT} = 3.3A$, CR, $C_{OUT} = 6 \times 2.2 \mu F X7R$ ceramic)





VIC

PI3111-00-HVMZ Electrical Characteristics (Cont.)







Figure 38 — Transient response ($V_{IN} = 28V$, $I_{OUT} = 1.65 - 3.3A$, 0.1A/ μ s, $C_{OUT} = 6 \times 2.2\mu$ F X7R ceramic)







Figure 40 — Thermal image ($V_{IN} = 28V$, $I_{OUT} = 3.33A$, CR, OLFM Evaluation PCB)



Functional Description



Figure 41 — PI31xx-00-HVMZ shown with system fuse, filter, decoupling and extended soft start

Input Power Pins IN(+) and IN(-)

The input power pins on the PI31xx-00-HVMZ are connected to the input power source which can range from $16 - 50V_{DC}$. Under surge conditions, the PI31xx-00-HVMZ can withstand up to $55V_{DC}$ for 12.5ms without incurring damage. The user should take care to avoid driving the input rails above the specified ratings. Since the PI31xx-00-HVMZ is designed with high reliability in mind, the input pins are continuously monitored. If the applied voltage exceeds the input overvoltage trip point (typically 53.5V) the conversion process shall be terminated immediately. The converter initiates soft start automatically within 80ms after the input voltage is reduced back to the appropriate value. The input pins do not have reverse-polarity protection. If the PI31xx-00-HVMZ is operated in an environment where reverse polarity is a concern, the user should consider using a polarity protection device such as a suitably rated diode. To avoid the high losses of using a diode, the user should consider the much higher efficiency family of intelligent Cool-ORing[®] solutions that can be used in reverse-polarity applications. Information is available at vicorpower.com.

The PI31xx-00-HVMZ will draw nearly zero current until the input voltage reaches the internal start up threshold. If the ENABLE pin is not pulled low by external circuitry, the output voltage will begin rising to its final output value about 80ms after the input UV lockout releases. This will occur automatically even if the ENABLE pin is floating.

To help keep the source impedance low, the input to the PI31xx-00-HVMZ should be bypassed with (2) 4.7µF 50V ceramic capacitors of X7R dielectric in parallel with a low Q 100µF 63V electrolytic capacitor. To reduce EMI and reflected ripple current, a series inductor of 0.2 – 0.47µH can be added. The input traces to the module should be low impedance configured in such a manner as to keep stray inductance minimized.

ENABLE

The ENABLE pin serves as a multi-function pin for the PI31xx-00-HVMZ. During normal operation, it outputs the on-board 4.9V regulator which can be used for trimming the module up. The ENABLE pin can also be used as a remote enable pin either from the secondary via an optocoupler and an external isolated bias supply or from the primary side through a small-signal transistor, FET, or any device that sinks 3.3mA, minimum. If the ENABLE pin is lower than 2.35V typical, the converter will be held off or shut down if already operating. A third feature is offered in that during a fault condition, such as output OVP, input UV or OV, or output current limit, the ENABLE pin is pulled low internally. This can be used as a signal to the user that a fault has occurred. Whenever the ENABLE pin is pulled low, the TRIM/SS pin follows, resetting the internal and external soft-start circuitry. All faults will pull ENABLE low including overtemperature. If increased turn-on delay is desired, the ENABLE pin can be bypassed with a small capacitor up to a maximum of 1500pF.

TRIM/SS Pin

The TRIM/SS pin serves as another multi-purpose pin. First, it is used as the reference for the internal error amplifier. Connecting a resistor from TRIM/SS to SGND allows the reference to be margined down by as much as -20%. Connecting a resistor from TRIM/ SS to ENABLE will allow the reference and output voltage to be margined up by 10%. If the user wishes a longer start up time, a small ceramic capacitor can be added to TRIM/SS to increase it. It is critical to connect any device between TRIM/SS and SGND and not –IN, otherwise high frequency noise will be introduced to the reference and possibly cause erratic operation. Referring to the figures below, the appropriate trim up or trim-down resistor can be calculated using the equivalent circuit diagram and the equations. When trimming up, the trim-down resistor is not populated. When trimming down, the trim-up resistor is not populated. The soft-start time is adjustable and has a default value of 500µs to reach steady state. The internal soft-start capacitor value is 10nF.





$$C_{REF} = \frac{T_{SS_DESIRED} - 230 \bullet 10^{-6}}{23000}$$

ТΜ

The TM pin serves as an output indicator of the internal package temperature which is within \pm 5°K of the hottest junction temperature. Because of this, it is a good indicator of a thermal overload condition. The output is a scaled, buffered analog voltage which indicates the internal temperature in degrees Kelvin. Upon a thermal overload, the TM pin is pulled low, indicating a thermal fault has occurred. Upon restart of the converter, the TM pin reverts back to a buffered monitor. The thermal shutdown function of the PI31xx-00-HVMZ is a fault feature which interrupts power processing if a certain maximum temperature is exceeded. TM can be monitored by an external microcontroller or circuit configured as an adaptive fan speed controller so that air flow in the system can be conveniently regulated.

SGND

The PI31xx-00-HVMZ SGND pin is the "quiet" control circuitry return. It is basically an extension of the internal signal ground. To avoid contamination and potential ground loops, this ground should NOT be connected to –IN since it is already star connected inside the package. Connect signal logic to SGND.

Output Power Pins +OUT and -OUT

The output power terminals OUT(+) and OUT(-) deliver the maximum output current from the PI31xx-00-HVMZ through the J-lead output pins. This configuration allows for a low impedance output and should be connected to multi-layer PCB parallel planes for best performance. Due to the high switching frequency, output ripple and noise can be easily attenuated by adding just a few high-quality X7R ceramic capacitors while retaining adequate transient response for most applications. The PI31xx-00-HVMZ does not require any feedback loop compensation nor does it require any opto-isolation. All isolation is contained within the package. This greatly simplifies the use of the converter and eliminates all outside influences of noise on the quality of the output voltage regulation and feedback loop. It is important for the user to minimize resistive connections from the load to the converter output and to keep stray inductance to a minimum for best regulation and transient response. The very small size footprint and height of the PI31xx-00-HVMZ allows the converter to be placed in the optimum location to allow for tight connections to the point-of-load.



Package Outline & Recommended PCB Land Pattern



Figure 43 — Package outline & recommended PCB land pattern

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