1 Description

TIDA-00512 (3138ALLCEVM-150) together with 3138ACC32EVM-149 is an EVM of LLC resonant half-bridge DC-DC power converter with digital control using UCD3138A device. UCD3138A device is located on the board of 3138ACC32EVM-149. 3138ACC32EVM-149 is a daughter card and serves all LLC resonant converter required control functions with preloaded firmware. For details of firmware please contact TI. TIDA-00512 accepts DC line input from 350Vdc to 400Vdc, and outputs nominal 12Vdc with full load output power 340W, or full output current 29A.

2 Performance Specification

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<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
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<td>Voltage operation range</td>
<td>350</td>
<td>400</td>
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<td>Input UVLO On</td>
<td>325</td>
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<td>VDC</td>
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<td>Input UVLO Off</td>
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<td>VDC</td>
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<td>Input current Input = 350VDC, Full Load = 29A</td>
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<td>Input current Input = 380VDC, Full Load = 29A</td>
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<td><strong>Output Characteristics</strong></td>
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<td>Output voltage, VOUT No Load to Full Load</td>
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<td>Output voltage ripple 380VDC and Full Load = 29A</td>
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<td>Output over current Operation 10s then latch-off shutdown</td>
<td>30</td>
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<td><strong>Systems Characteristics</strong></td>
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<td>Switching frequency Resonant Mode</td>
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<td>150</td>
<td>kHz</td>
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<td>PWM Mode</td>
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<td>Peak efficiency 380VDC, Full Load = 20A</td>
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<tr>
<td>Full load efficiency 380VDC, Load = 29A</td>
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<td>Operating temperature Natural Convection</td>
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<td><strong>Firmware</strong></td>
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3 Test Setup

3.1 Test Equipment

**DC Voltage Source:** capable of 350 to 400Vdc, adjustable, with minimum power rating 400W, or current rating not less than 2A, with current limit function. The DC voltage source to be used should meet IEC60950 reinforced insulation requirement.

**DC Multimeter:** 1 unit capable of 0 to 400VDC input range, four digits display preferred; and 1 unit capable of 0 to 15VDC input range, four digits display preferred.

**Output Load:** DC load capable of receiving 0 to 15VDC, 0 to 30A, and 0 to 360W or greater, with display such as load current and load power.

**Current-meter, DC:** optional in case the load has no display, 1 unit, capable of 0 to 30A.

**Oscilloscope:** capable of 500MHz full bandwidth, digital or analog, if digital 5Gs/s or better

**Fan:** 200 to 400 LFM forced air cooling is recommended, but not a must

**Recommended Wire Gauge:** capable of 30A, or better than #14 AWG, with the total length of wire less than 8 feet (4 feet input and 4 feet return).

4 Performance Data and Typical Characteristic Curves

Figure 1 through 14 present typical performance curves for TIDA-00512.

4.1 Efficiency

![Figure 1. TIDA-00512 Efficiency](image)
4.2 Load Regulation

Figure 2. TIDA-00512 Load Regulation

4.3 Switching Frequency Control

Figure 3. Switching Frequency Control in LLC Mode
4.4 Load Operation with LLC and PWM

Figure 4. LLC Resonant Mode Operation at Full Load

(Ch1 = Vgs of Q7, Ch2 = Current in Resonant Network, 2A/div, Ch3 = Vds of Q7, Ch4 = Vo Ripple)

Figure 5. PWM Mode Operation after Fsw = 150kHz

(Ch1 = Vgs of Q7, Ch2 = Vgs of Q6, Ch3 = Vgs of SR2, Ch4 = Vgs of SR3)
4.5 Very Light Load Operation at High Line of Input

(Ch1 = Vgs, Q7, Ch2 = Vgs, Q6, Ch3 = Vgs, SR1, Ch4 = Vgs, SR2)

Figure 6. PWM Control at 400VDC Input and Light Load (SR off)

Figure 7. PWM Control with SR Off and Pulse Skipping
4.6 Output Voltage Ripple

Figure 8. Output Voltage Ripple 380VDC and Full Load

Figure 9. Output Voltage Ripple 380VDC and Half Load
4.7 Output Turn On

Figure 10. Output Turn On 380VDC with Load Range

Figure 11. Output Turn On 350VDC with Load Range
4.8 Other Waveforms

Figure 12. 380VDC and 30A before OCP Latch-off Shutdown
(Ch1 = Vds of Q7, Ch2 = Current of Resonant Network, Ch3 = Vo Ripple)

Figure 13. Control Loop Bode Plots at 380VDC and Full Load
Figure 14. Control Loop Bode Plots at 400VDC and Full Load
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