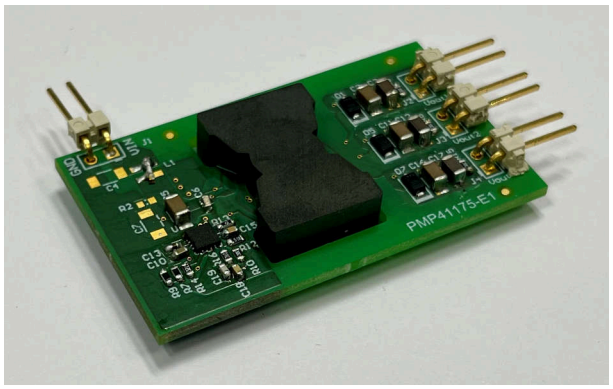
Test Report: PMP41175

Isolated Bias Supply Reference Design Using PSR Flyback Topology with Planar Transformer

Description

This reference design is a tiny three channel isolated bias supply based on Flyback topology. Providing the voltage supply for isolated gate drivers is a typically use case. The design integrates three 21V, 2W isolated outputs and one 7V non-isolated auxiliary output. The design uses a planar transformer integrated into the printed circuit board (PCB) to reduce the board height and system cost. The LM5158-Q1 converter supports primary-side regulation (PSR) by using an auxiliary winding on the primary side. The maximum efficiency is 88%.



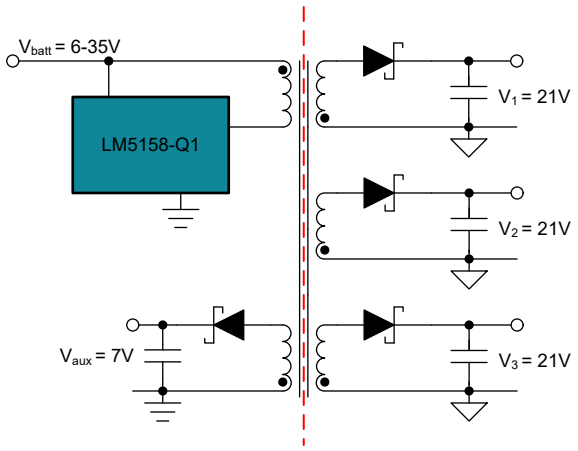
PCB View

Features

- Primary-side regulated flyback for three outputs (21V, 2W) with planar transformer
- Peak efficiency 88% at 6W full load
- Low transformer Parasitic capacitance (<10pF)
- Low height (9mm)
- Compact size in 50mm × 29mm

Applications

- Onboard Charger
- Traction inverter
- DC/DC converter system
- Automotive HVAC compressor module



Block Diagram

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Electrical	
Input voltage	6V–35V
Output voltage	3 × 21V
Output voltage (Aux)	7V
Output power	2W for each rail
Switching frequency	400kHz
Planar Transformer	
Primary inductance	5uH
Leakage inductance	120nH
Parasitic capacitance	10pF
Turn ratio	2 : 3 : 1 (pri : sec : aux)
Magnetic core	PC95PQI20/9Z-12
Creepage and clearance	4mm

1.2 Required Equipment

- Power supply, 0–40VDC, 2A
- 3× Active load, 21VDC, 0.1A
- Oscilloscope, 4CH

1.3 Dimensions

The board dimensions are 50mm (length) by 29mm (width) by 9mm (height).

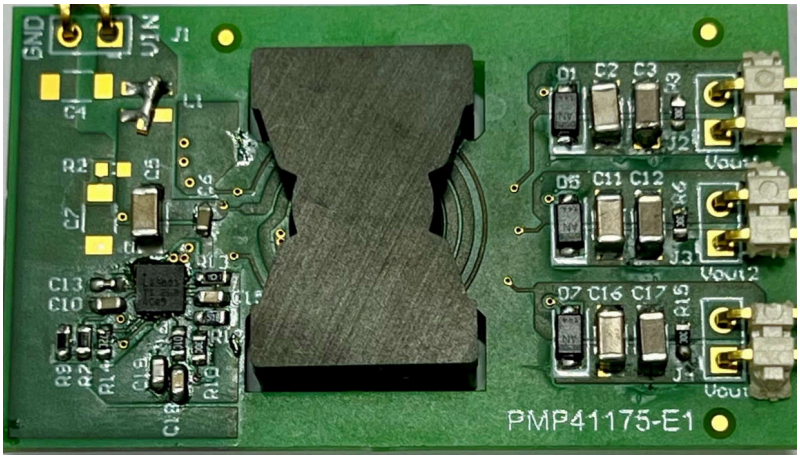


Figure 1-1. Board Top View

2 Testing and Results

2.1 Efficiency Graphs

Figure 2-1 show the efficiency graph.

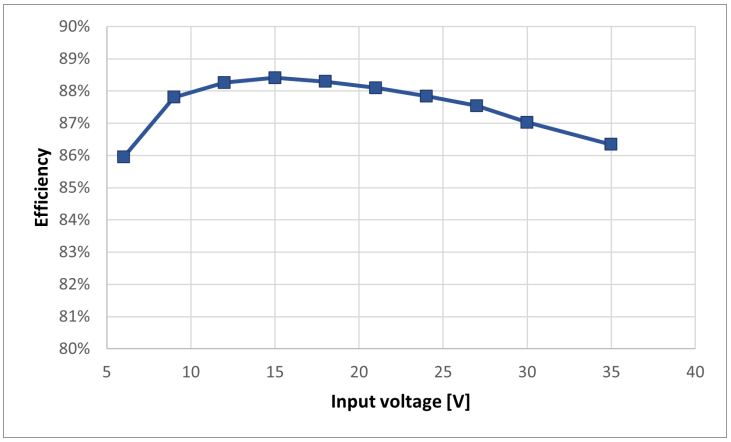


Figure 2-1. Efficiency Graph (3x100mA)

2.2 Load Regulation

Table 2-1. Load Regulation

Vo1 (V)	Io1 (A)	Vo2 (V)	Io2 (A)	Vo3 (V)	Io3 (A)
21.98	0	21.99	0	22.01	0
23.33	0	22.87	0	19.72	0.1
21.79	0	19.02	0.1	22.61	0
19.67	0.1	22.07	0	23.39	0
22.88	0	20.28	0.1	20.27	0.1
20.61	0.1	22.73	0	20.62	0.1
19.14	0.1	19.16	0.1	23.45	0
20.81	0.1	20.82	0.1	20.83	0.1

2.3 Thermal Images

Figure 2-2 and Figure 2-3 show thermal images.

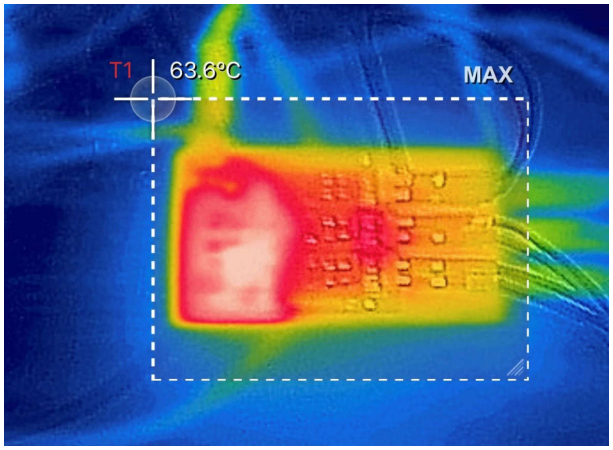


Figure 2-2. Thermal Image, 6V Input, Full Load

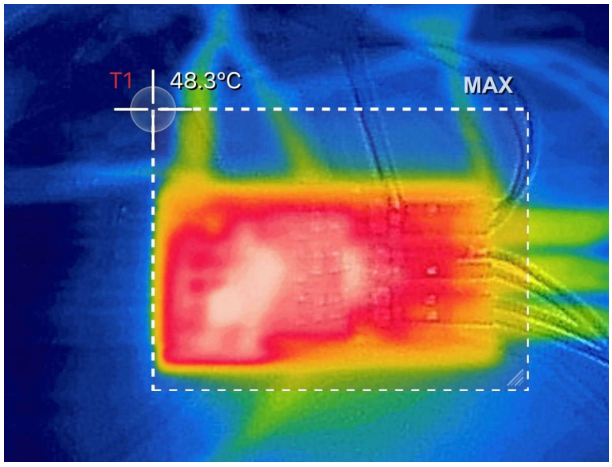


Figure 2-3. Thermal Image, 12V Input, Full Load

3 Waveforms

3.1 Switching

Figure 3-1, Figure 3-2, and Figure 3-3 show the switching behavior.

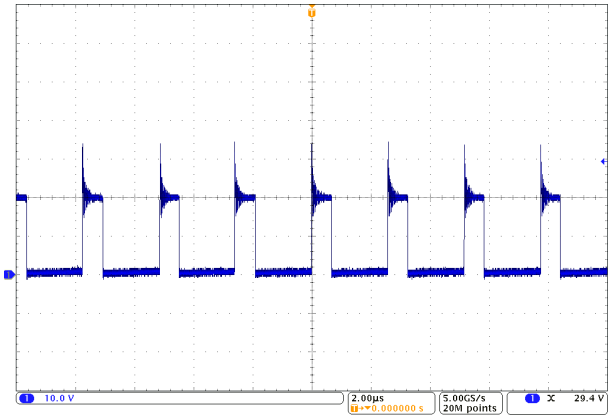


Figure 3-1. Switching, 6V Input, Full Load

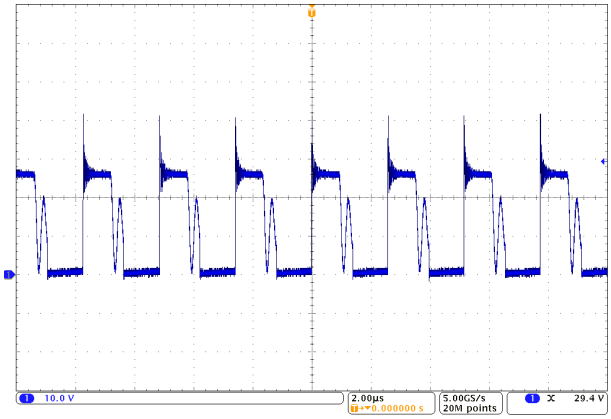


Figure 3-2. Switching, 12V Input, Full Load

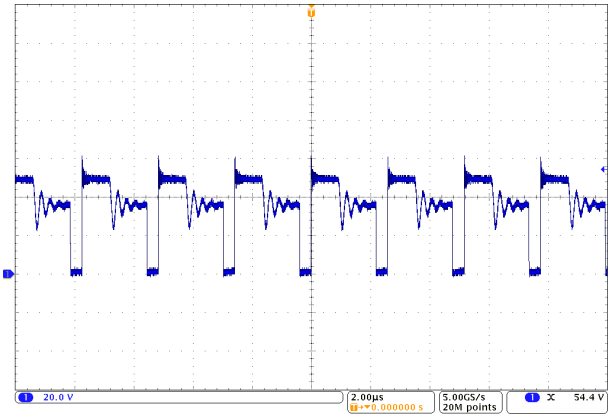


Figure 3-3. Switching, 35V Input, Full Load

3.2 Output Voltage Ripple

Figure 3-4 and Figure 3-5 show the output voltage ripple.

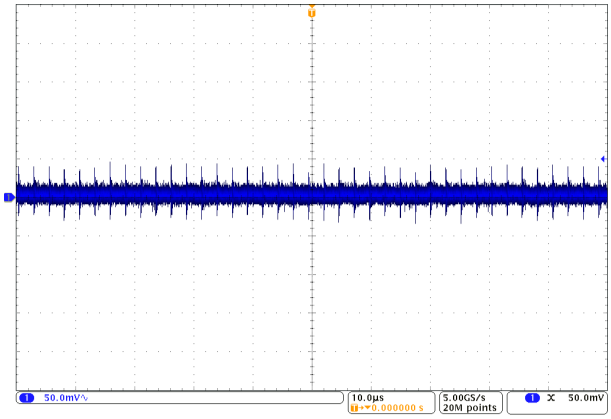


Figure 3-4. VOUT1 Output Voltage Ripple, 12V Input, No Load

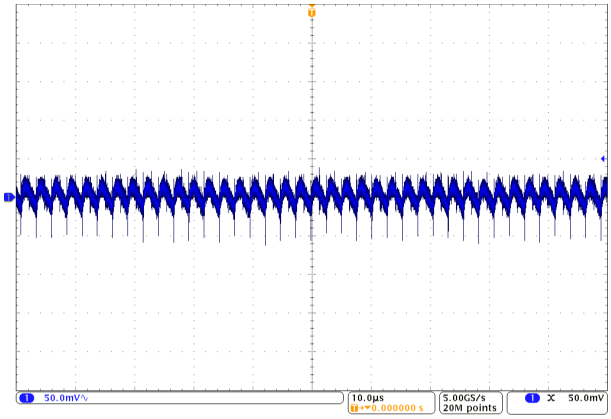


Figure 3-5. VOUT1 Output Voltage Ripple, 12V Input, Full Load

3.3 Load Transients

Figure 3-6, Figure 3-7, and Figure 3-8 show the load transient response.

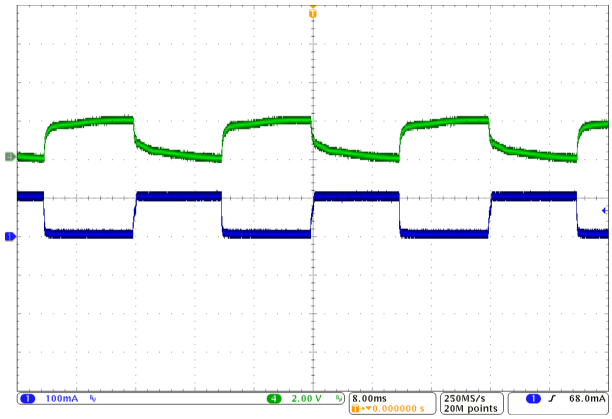


Figure 3-6. $V_{out}1$ Load Transient, 6V Input

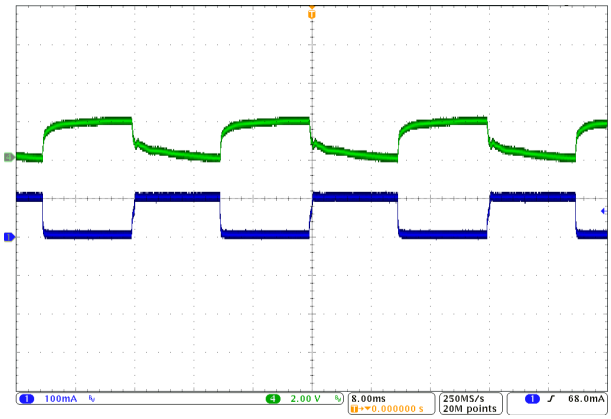


Figure 3-7. $V_{out}1$ Load Transient, 12V Input

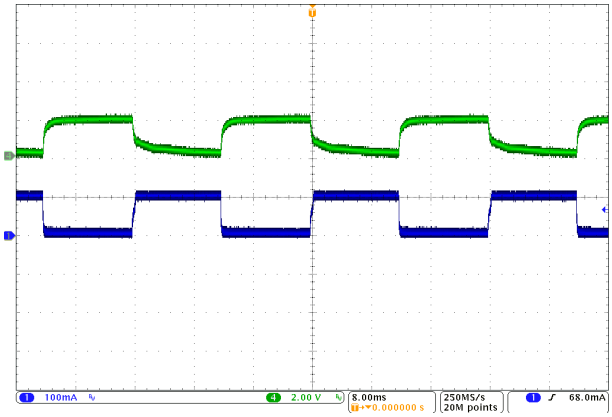


Figure 3-8. $V_{out}1$ Load Transient, 35V Input

3.4 Start-up Sequence

Figure 3-9 and Figure 3-10 show the start-up behavior.

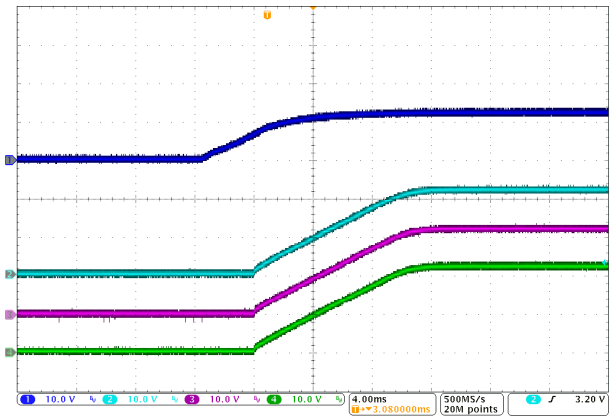


Figure 3-9. Start-Up Waveform, 12V Input, No Load

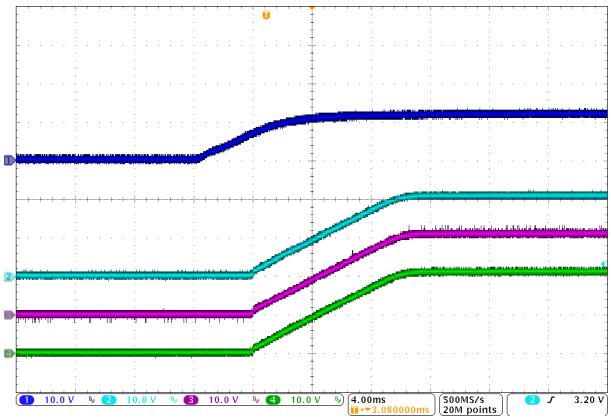


Figure 3-10. Start-Up Waveform, 12V Input, Full Load

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