

750kHz Isolated Flyback Converter (24V, 0.7A) with Opto-emulator Reference Design



Description

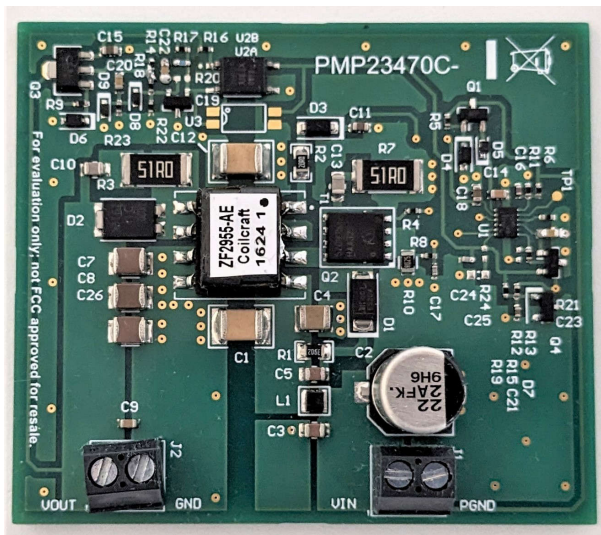
This reference design is an isolated, high frequency (750kHz) flyback converter with a 48V input and a 24V/0.7A output. A LM51561 provides PWM control for the flyback converter and an ISOM8110 opto-emulator is used for feedback isolation.

Features

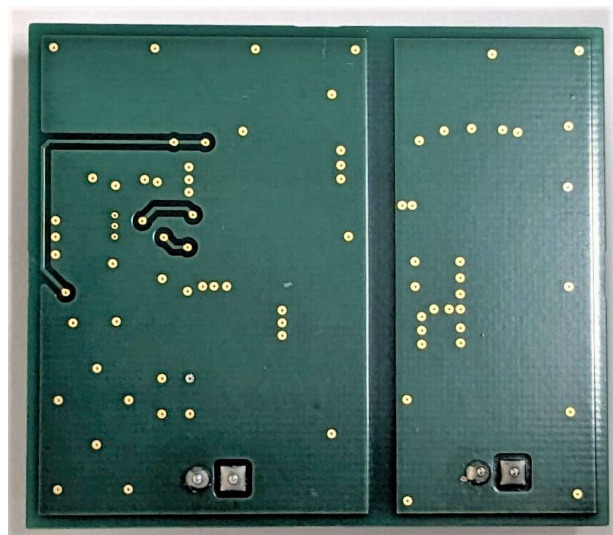
- 750kHz switching frequency - small size
- ISOM8110 opto-emulator feedback isolation
- Wide bandwidth improves transient performance
- Higher reliability versus optocoupler
- 48V input for Industrial/PoE/Telecom applications

Applications

- HVAC controller
- WLAN/Wi-Fi access point
- Macro remote radio unit (RRU)



Top Photo



Bottom Photo

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input Voltage	42VDC - 57VDC
Output Voltage	24V
Output Current	0.7A
Switching Frequency	750kHz

1.2 Required Equipment

- Power supply, 0-60VDC, 1A
- Active load, 24VDC, 1A

1.3 Considerations

- All testing performed at 25C ambient temperature unless otherwise noted
- All testing performed with 48VDC input and 700mA load unless otherwise noted
- All waveforms and test data are using the ISOM8110 opto-emulator unless otherwise noted

1.4 Dimensions

The board measures 51mm × 59mm × 12mm.

2 Testing and Results

2.1 Efficiency Graph

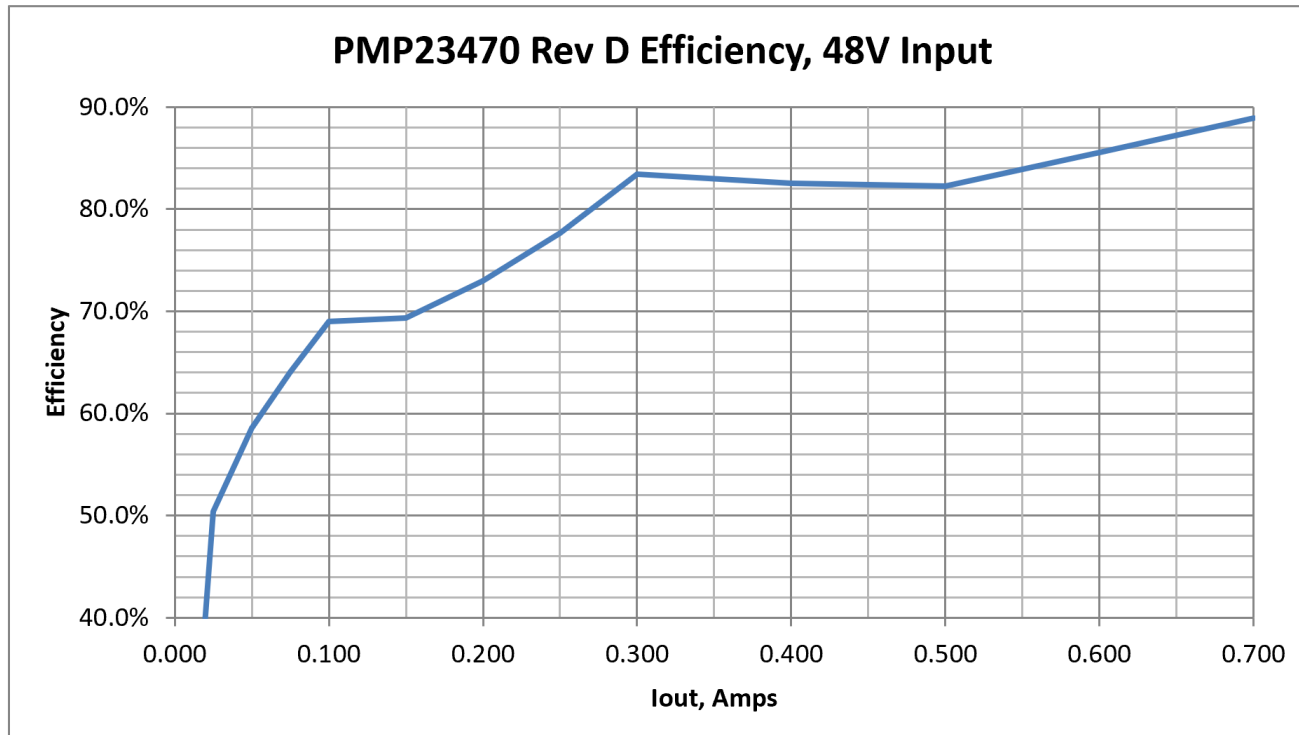


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

Table 2-1. Efficiency Data

V_{IN} (V)	I_{IN} (mA)	V_{OUT} (V)	I_{OUT} (mA)	Efficiency (%)
48.01	6	24.187	0	0
48.01	25	24.186	25	50.4
48.01	43	24.185	50	58.6
48.00	59	24.184	75	64.0
48.00	73	24.181	100	69.0
48.00	109	24.179	150	69.3
48.03	138	24.178	200	73.0
48.03	162	24.178	250	77.7
48.03	181	24.177	300	83.4
48.03	244	24.173	400	82.5
48.02	306	24.172	500	82.3
48.01	353	24.173	600	85.6
48.04	396	24.174	700	89.0

2.3 Thermal Image

Measurements

Sp1	41.8 °C
Sp2	46.2 °C
Sp3	50.8 °C
Sp4	50.8 °C
Sp5	63.7 °C
Sp6	62.2 °C
Sp7	58.4 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

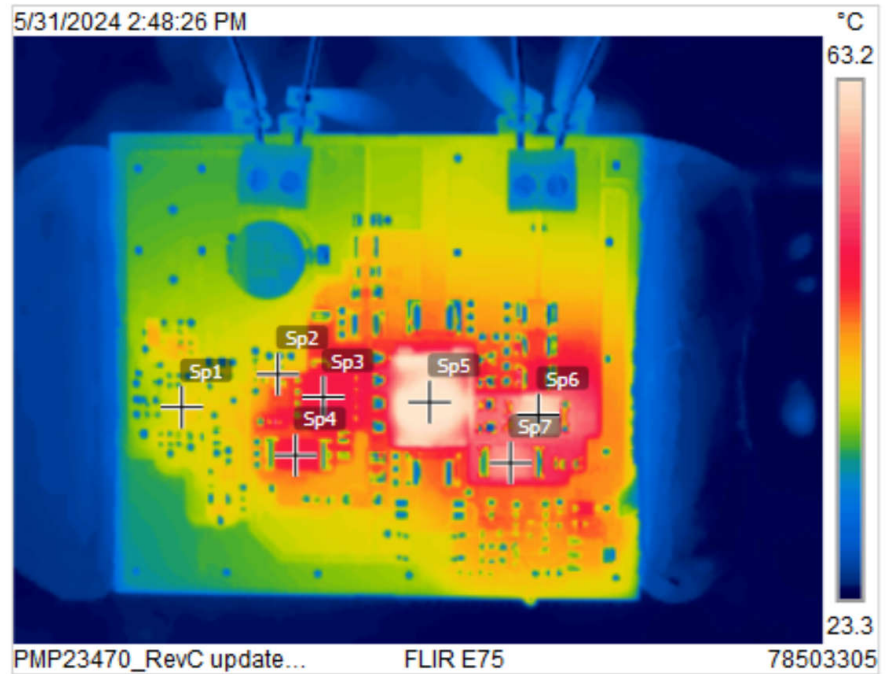


Figure 2-2. Thermal Image, Top Side of Board

2.4 Bode Plots

Bode plots of control loop for ISOM8110 versus optocoupler. ISOM8110 shows significantly wider bandwidth than optocoupler.

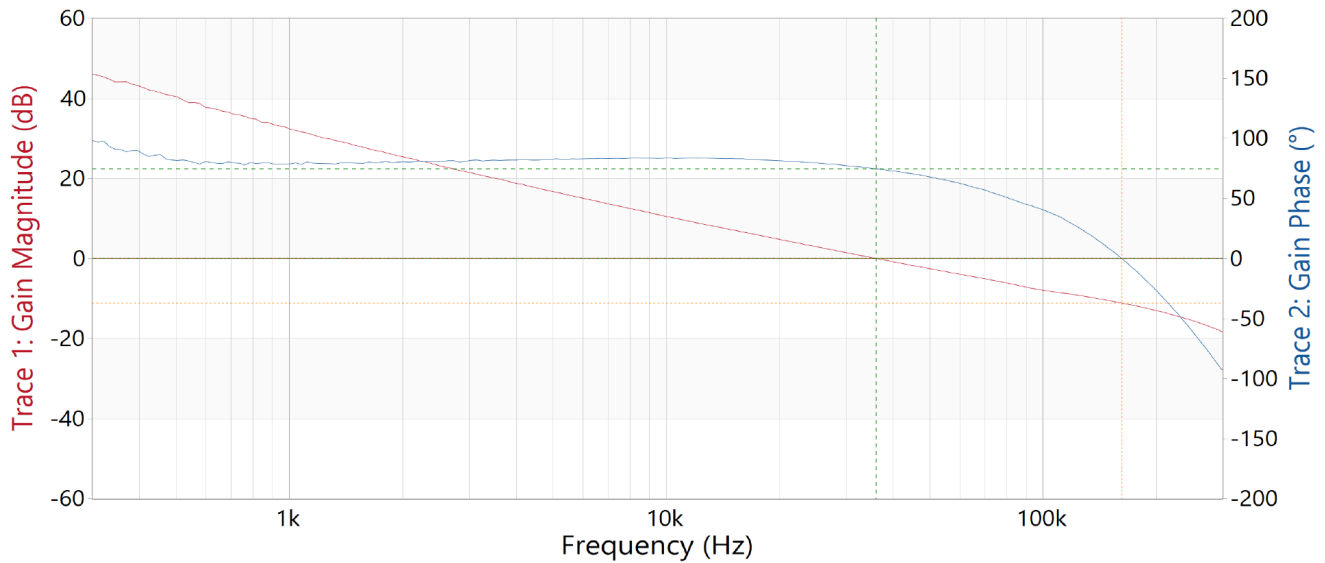


Figure 2-3. Bode Plot of Control Loop With ISOM8110

Bandwidth = 36.0kHz; Phase margin = 74.7 degrees; Gain margin = 11.1dB

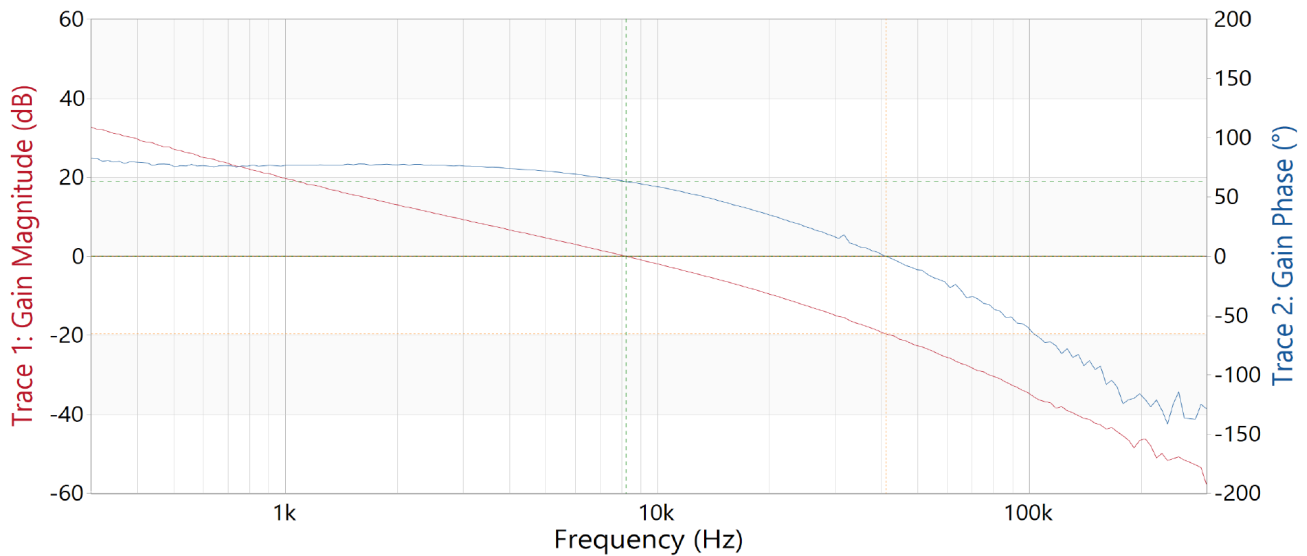


Figure 2-4. Bode Plot of Control Loop With Optocoupler

Bandwidth = 8.2kHz; Phase margin = 63.0 degrees; Gain margin = 19.6dB

3 Waveforms

3.1 Switching

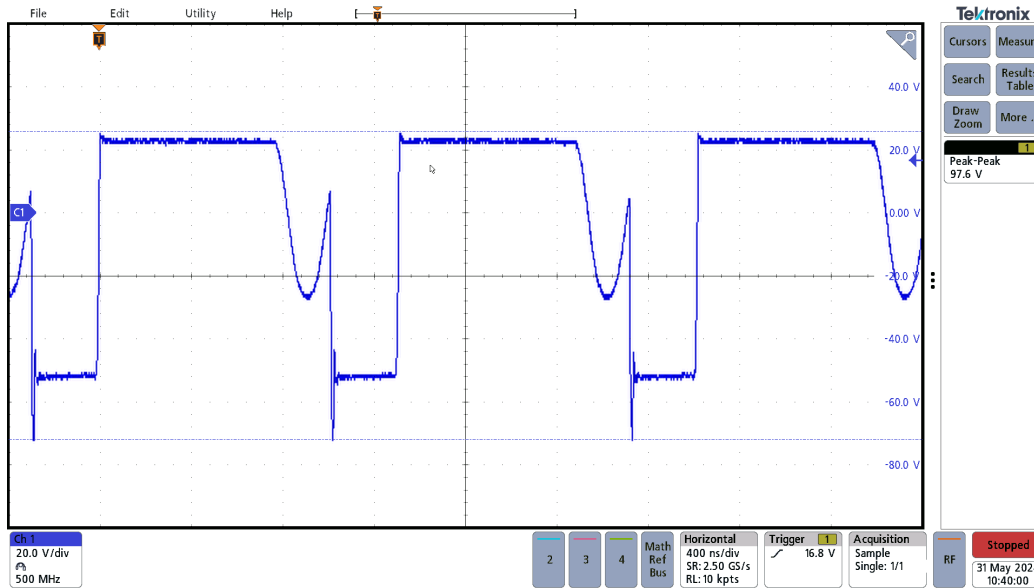


Figure 3-1. Diode D2 Voltage

Anode to GND voltage, 57V input

20V/div; 400ns/div; 500MHz bandwidth

Measured 97.6Vpeak-to-peak

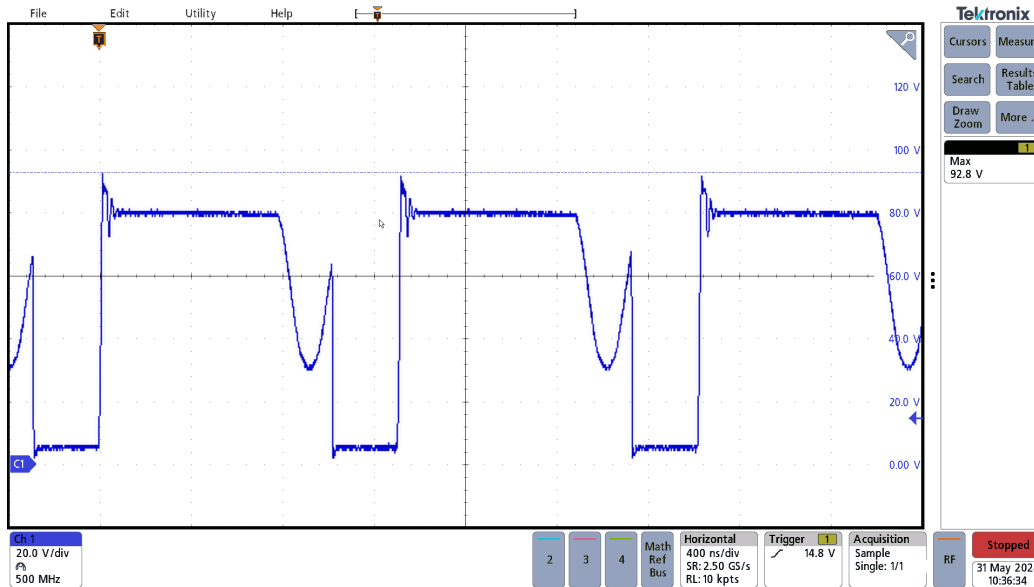


Figure 3-2. MOSFET Q2 Voltage

Drain to PGND voltage, 57V input

20V/div; 400ns/div; 500MHz bandwidth

Measured 92.8Vpeak

3.2 Voltage Ripple

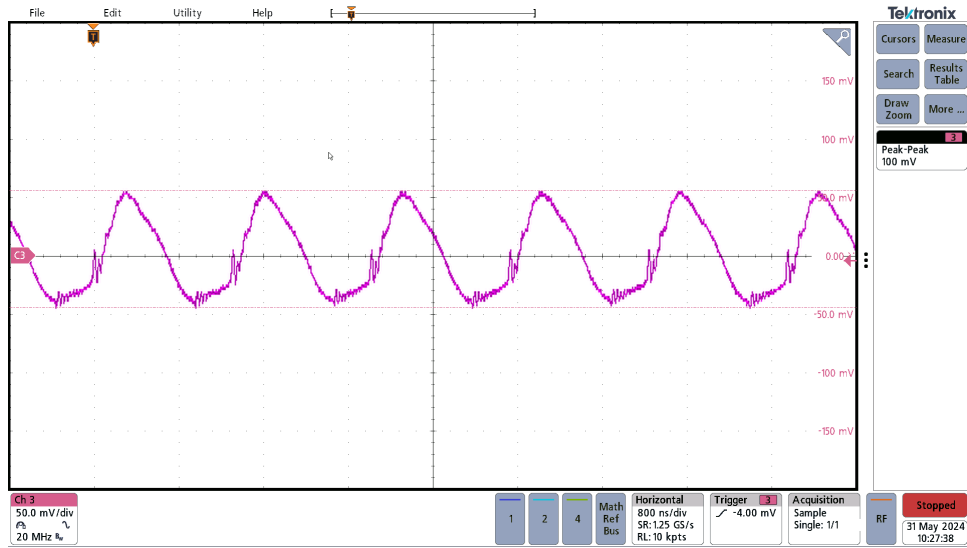


Figure 3-3. Output Ripple Voltage

Output ripple voltage, 48V input, 700mA load, measured across C26

50mV/div; 800ns/div; 20MHz bandwidth

Measured 100mVpeak-to-peak

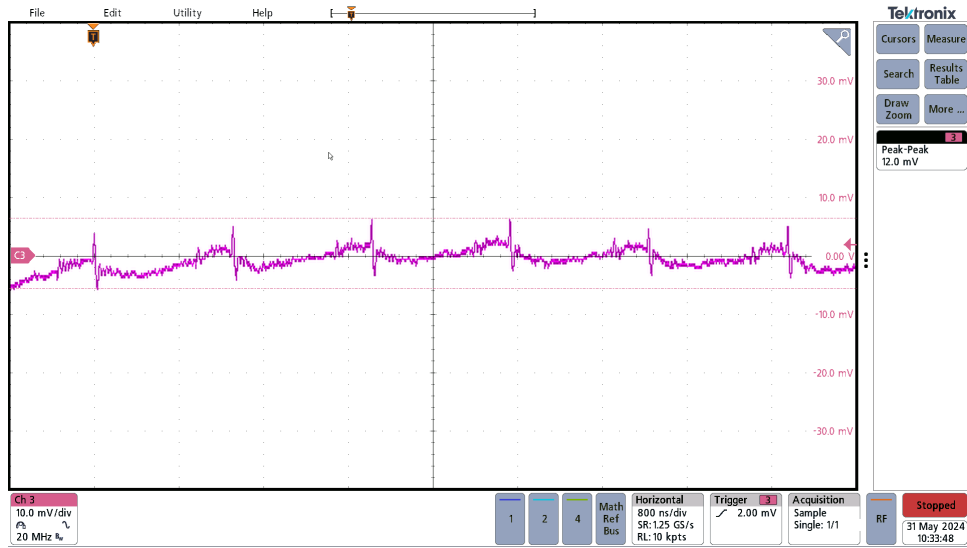


Figure 3-4. Input Ripple Voltage

Input ripple voltage, 48V input, 700mA output, measured across J1

10mV/div; 800ns/div; 20MHz bandwidth

Measured 12mVpeak-to-peak

3.3 Load Transients

Load transient response of ISOM8110 versus optocoupler. Wider bandwidth of ISOM8110 provides improved transient performance with same output capacitance. Note the difference in scales for the output voltage: 200mV/div for the ISOM8110 and 500mV/div for the optocoupler.

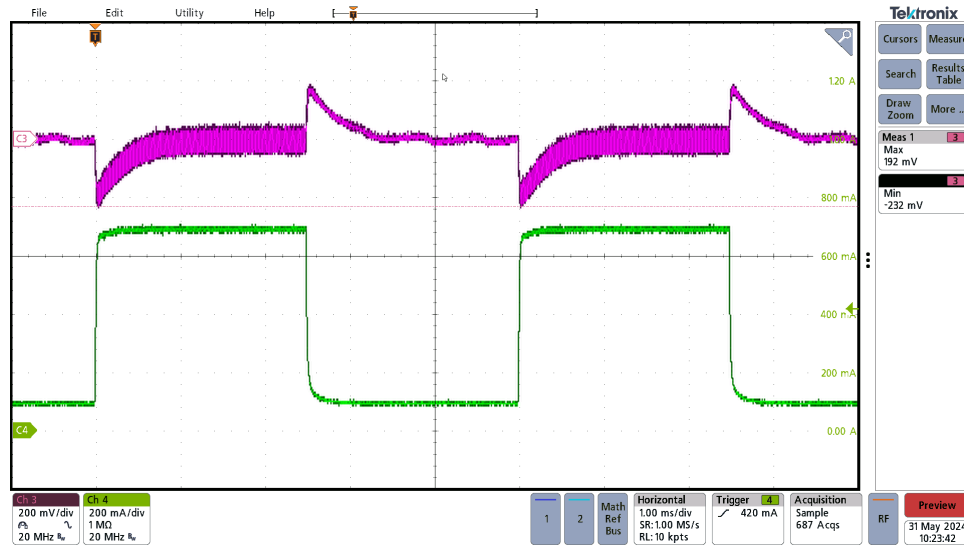


Figure 3-5. Load Transient Response With ISOM8110

100mA to 700mA load step, 250mA/us slew rate

CH3: Output voltage, AC coupled, 200mV/div, 20MHz bandwidth

CH4: Output current, 200mA/div, 20MHz bandwidth

Measured +192mV and -232mV

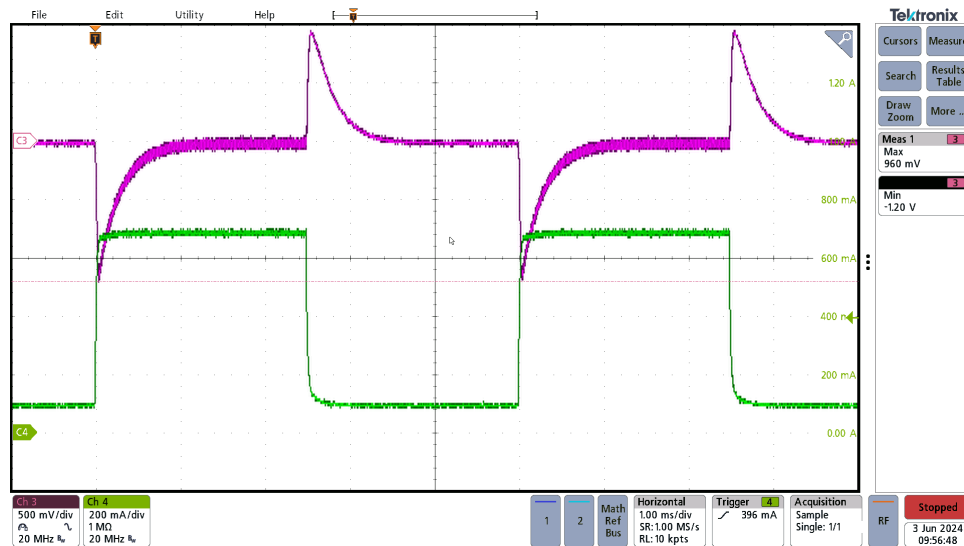


Figure 3-6. Load Transient Response With Optocoupler

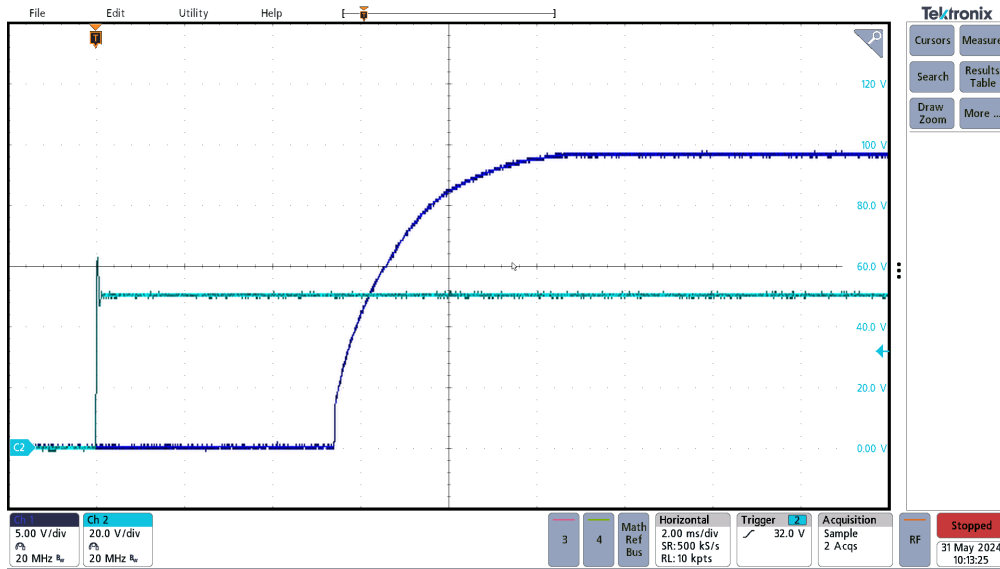
100mA to 700mA load step, 250mA/us slew rate

CH3: Output voltage, AC coupled, 200mV/div, 20MHz bandwidth

CH4: Output current, 500mA/div, 20MHz bandwidth

Measured +960mV and -120mV

3.4 Turn-on Response



Turn-on, 0A load, 2ms/div, 250mA/us slew rate
 CH1: Output voltage, 5V/div, 20MHz bandwidth
 CH2: Input voltage, 20V/div, 20MHz bandwidth

Figure 3-7. Turn-On Response, 0A Load

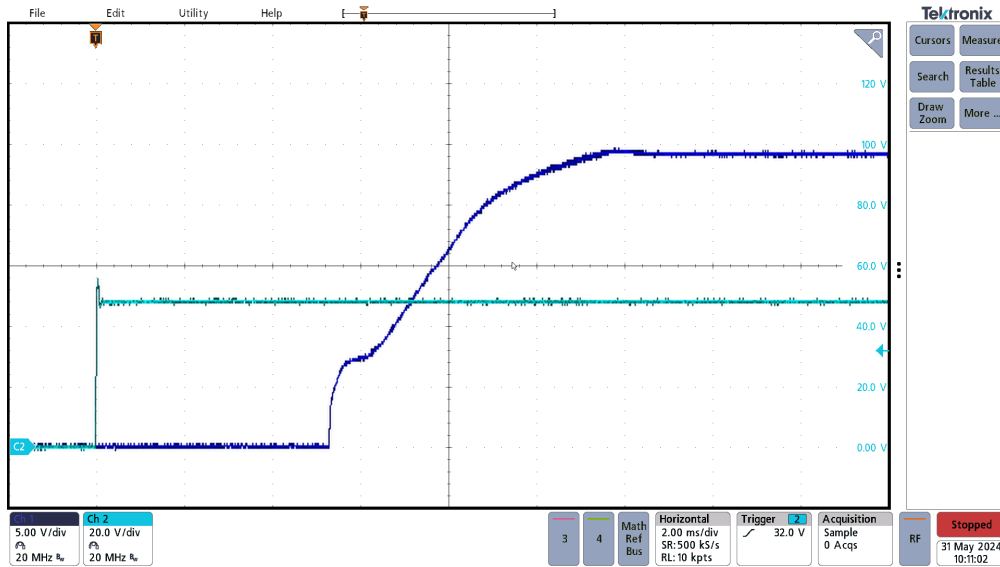


Figure 3-8. Turn-On Response, 700mA Load

Turn-on, 700mA load, 2ms/div, 250mA/us slew rate
 CH1: Output voltage, 5V/div, 20MHz bandwidth
 CH2: Input voltage, 20V/div, 20MHz bandwidth

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