

2.4W Multi-Output PSR Flyback Reference Design for Bias Supplies



Description

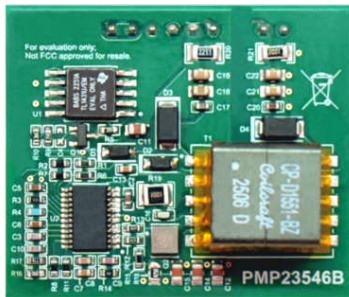
This reference design uses TPS7H5020-SEP as a primary-side regulated (PSR) flyback converter. The input accepts a 22V to 36V range to generate a 12V bias referenced to primary ground and another 12V output that can be referenced to another return. This reference design can be used to provide bias power for isolated reference designs, like PMP23391. In this design the controller, half-bridge drivers and GaN field-effect transistors (FET) are chosen to meet radiation for geostationary orbit (GEO). These components can be swapped out to meet other mission specifications.

Features

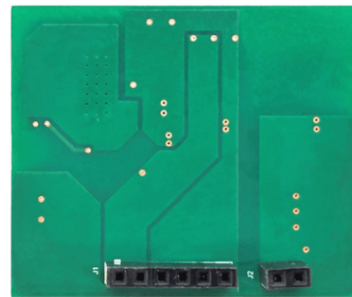
- GEO class radiation performance components
- Greater than 5% output regulation across loading conditions
- Generates two 12V bias voltages
 - One referenced to primary ground
 - One isolated from primary ground
- Less than 1% ripple on each output

Applications

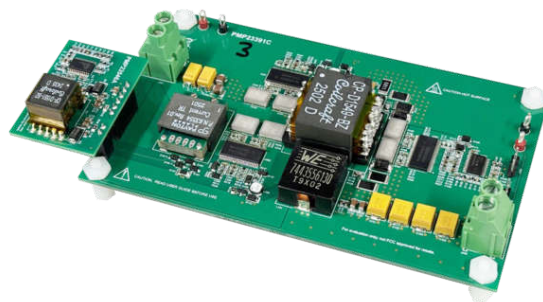
- [Command and data handling \(C and DH\)](#)
- [Optical imaging payload](#)
- [Radar imaging payload](#)



Top of Board



Bottom of Board



PMP23546 Attached to Full-Bridge Reference Design Board

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input voltage	22V to 36V, 28V nominal
Primary output voltage	12V \pm 2.5%
Primary output maximum load current	100mA
Secondary output voltage	12V \pm 5%
Secondary output maximum load current	100mA

1.2 Considerations

Testing was conducted with a resistive load on each 12V output voltage. No airflow was present, board was placed in open air environment.

When using as a daughter card, we recommend adding additional bypass capacitors on bias voltage nets of the board being powered.

1.3 Dimensions

The dimensions of the board are 1.725in \times 1.45in PCB, single-side assembly.

2 Testing and Results

2.1 Load Regulation and Efficiency Data

Table 2-1. Nominal Input Voltage

Input			Primary-Side Output			Secondary-Side Output			Total		
Voltage (V)	Current (mA)	Power (W)	Voltage (V)	Current (mA)	Power (W)	Voltage (V)	Current (mA)	Power (W)	Output (W)	Losses (W)	Efficiency (%)
27.98	28.80	0.81	12.10	0	0.00	12.06	0	0.00	0.00	0.81	0.00
27.96	48.07	1.34	11.95	33	0.39	12.09	0	0.00	0.39	0.95	29.34
27.95	65.36	1.83	11.89	67	0.80	12.15	0	0.00	0.80	1.03	43.59
27.94	80.91	2.26	11.85	100	1.18	12.21	0	0.00	1.18	1.08	52.40
27.96	48.10	1.35	12.09	0	0.00	11.85	33	0.39	0.39	0.95	29.07
27.95	64.89	1.81	11.94	33	0.39	11.94	33	0.39	0.79	1.03	43.44
27.94	81.30	2.27	11.89	67	0.80	11.96	33	0.39	1.19	1.08	52.44
27.93	97.50	2.72	11.85	100	1.19	11.97	33	0.39	1.58	1.14	58.03
27.95	64.48	1.80	12.09	0	0.00	11.67	67	0.78	0.78	1.02	43.40
27.94	81.44	2.28	11.93	33	0.39	11.87	67	0.80	1.19	1.09	52.24
27.93	97.87	2.73	11.88	67	0.80	11.88	67	0.80	1.59	1.14	58.25
27.92	113.39	3.17	11.84	100	1.18	11.89	67	0.80	1.98	1.18	62.58
27.94	79.24	2.21	12.10	0	0.00	11.52	100	1.15	1.15	1.06	52.02
27.93	96.52	2.70	11.91	33	0.39	11.80	100	1.18	1.57	1.12	58.37
27.92	113.93	3.18	11.86	67	0.79	11.83	100	1.18	1.98	1.20	62.18
27.91	128.88	3.60	11.83	100	1.18	11.84	100	1.18	2.37	1.23	65.81

Table 2-2. Minimum Input Voltage

Input			Primary-Side Output			Secondary-Side Output			Total		
Voltage (V)	Current (mA)	Power (W)	Voltage (V)	Current (mA)	Power (W)	Voltage (V)	Current (mA)	Power (W)	Output (W)	Losses (W)	Efficiency (%)
21.98	33.58	0.74	12.08	0	0.00	12.03	0	0.00	0.00	0.74	0.00
21.96	55.48	1.22	11.94	33	0.39	12.08	0	0.00	0.39	0.82	32.35
21.95	75.73	1.66	11.89	67	0.80	12.13	0	0.00	0.80	0.87	47.92
21.93	96.97	2.13	11.84	100	1.18	12.20	0	0.00	1.18	0.94	55.69
21.96	54.94	1.21	12.08	0	0.00	11.84	33	0.39	0.39	0.82	32.39
21.95	76.10	1.67	11.94	33	0.39	11.93	33	0.39	0.79	0.88	47.16
21.93	96.88	2.12	11.89	67	0.80	11.95	33	0.39	1.19	0.93	56.04
21.92	117.31	2.57	11.85	100	1.18	11.96	33	0.39	1.58	0.99	61.43
21.95	75.18	1.65	12.08	0	0.00	11.67	67	0.78	0.78	0.87	47.38
21.93	96.52	2.12	11.92	33	0.39	11.86	67	0.79	1.19	0.93	56.14
21.92	116.85	2.56	11.87	67	0.80	11.88	67	0.80	1.59	0.97	62.14
21.90	137.22	3.01	11.84	100	1.18	11.89	67	0.80	1.98	1.03	65.89
21.93	94.26	2.07	12.09	0	0.00	11.50	100	1.15	1.15	0.92	55.64
21.92	115.97	2.54	11.91	33	0.39	11.80	100	1.18	1.57	0.97	61.88
21.90	136.56	2.99	11.86	67	0.79	11.83	100	1.18	1.98	1.01	66.11
21.89	156.86	3.43	11.83	100	1.18	11.84	100	1.18	2.37	1.07	68.93

Table 2-3. Maximum Input Voltage

Input			Primary-Side Output			Secondary-Side Output			Total		
Voltage (V)	Current (mA)	Power (W)	Voltage (V)	Current (mA)	Power (W)	Voltage (V)	Current (mA)	Power (W)	Output (W)	Losses (W)	Efficiency (%)
35.98	24.68	0.89	12.14	0	0.00	12.09	0	0.00	0.00	0.89	0.00
35.96	42.79	1.54	11.96	33	0.39	12.10	0	0.00	0.39	1.14	25.64
35.96	56.36	2.03	11.89	67	0.80	12.15	0	0.00	0.80	1.23	39.32
35.95	69.11	2.48	11.84	100	1.18	12.21	0	0.00	1.18	1.30	47.66
35.97	42.66	1.53	12.10	0	0.00	11.86	33	0.39	0.39	1.14	25.52
35.96	55.78	2.01	11.95	33	0.39	11.94	33	0.39	0.79	1.22	39.31
35.95	68.94	2.48	11.89	67	0.80	11.96	33	0.39	1.19	1.29	48.06
35.94	81.74	2.94	11.85	100	1.19	11.97	33	0.40	1.58	1.36	53.80
35.96	55.65	2.00	12.10	0	0.00	11.69	67	0.78	0.78	1.22	39.15
35.95	68.69	2.47	11.93	33	0.39	11.86	67	0.79	1.19	1.28	48.13
35.94	81.89	2.94	11.88	67	0.80	11.89	67	0.80	1.59	1.35	54.11
35.93	94.47	3.39	11.85	100	1.18	11.90	67	0.80	1.98	1.41	58.38
35.95	67.25	2.42	12.10	0	0.00	11.52	100	1.15	1.15	1.27	47.63
35.94	80.93	2.91	11.91	33	0.39	11.81	100	1.18	1.57	1.33	54.11
35.93	94.20	3.38	11.87	67	0.80	11.83	100	1.18	1.98	1.41	58.45
35.92	106.20	3.81	11.83	100	1.18	11.84	100	1.18	2.37	1.45	62.05

2.2 Load Regulation

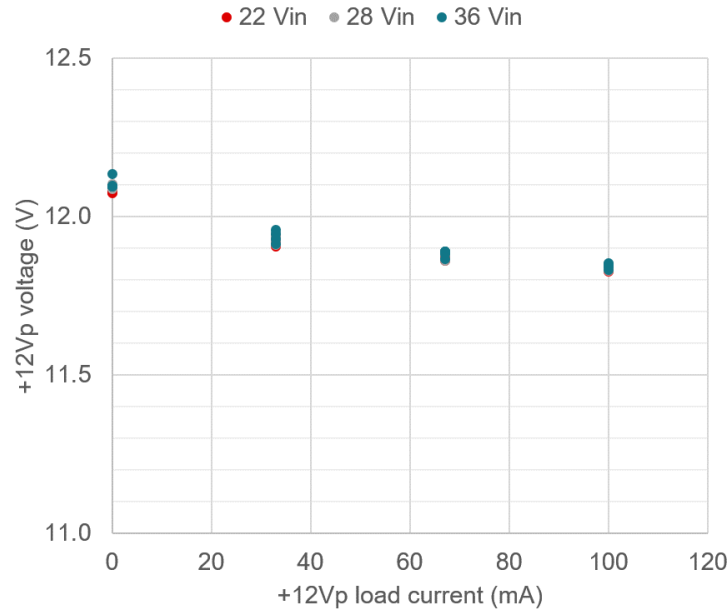


Figure 2-1. +12Vp Voltage Versus Loading Conditions

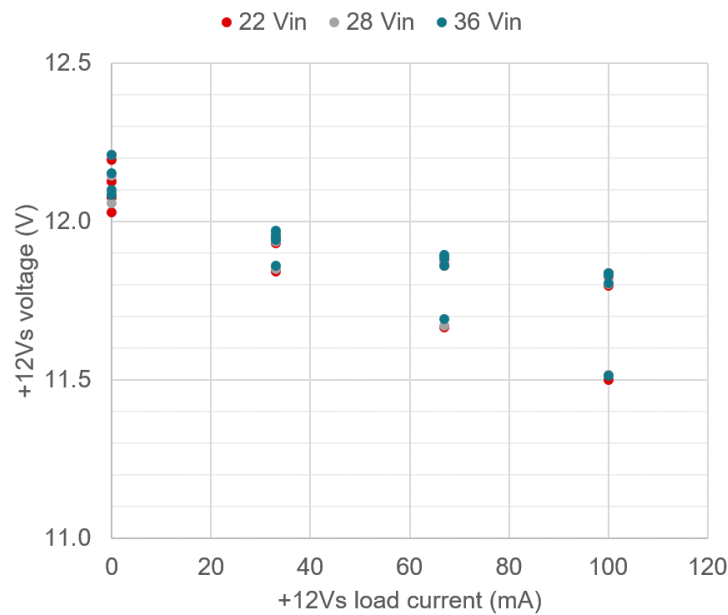


Figure 2-2. +12Vs Voltage Versus Loading Conditions

2.3 Efficiency Graphs

Efficiency is shown in [Figure 2-3](#) and [Figure 2-4](#).

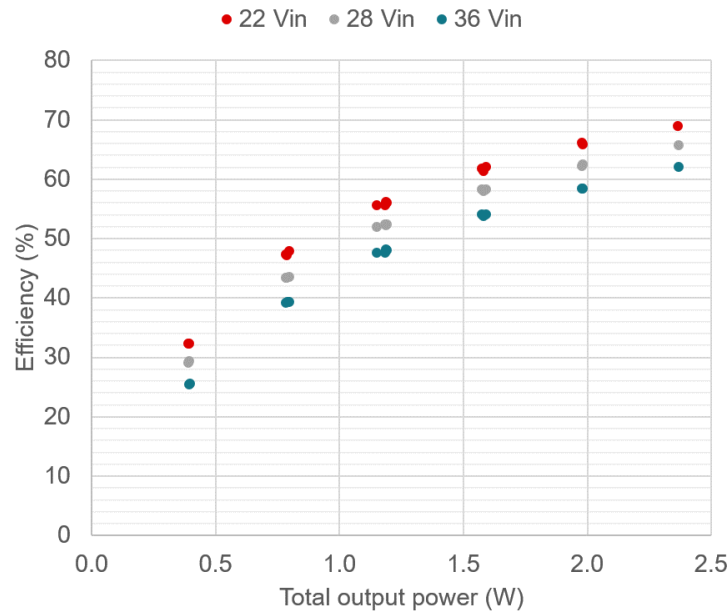


Figure 2-3. Efficiency Graph

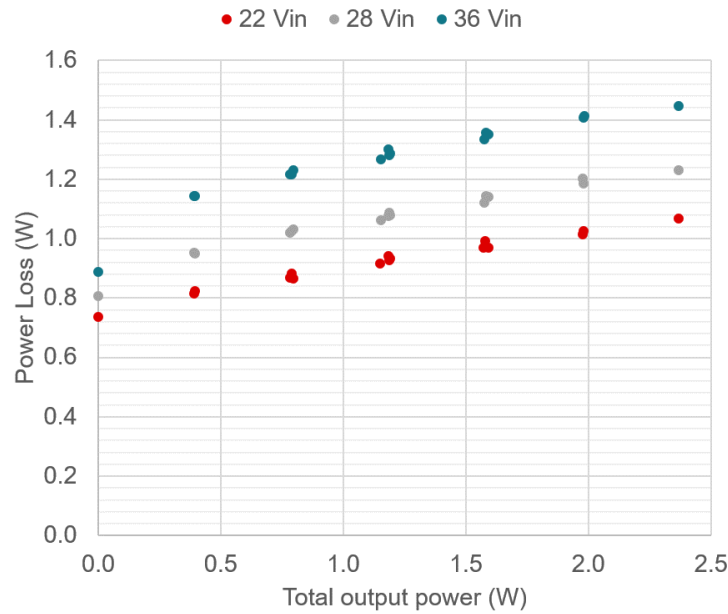


Figure 2-4. Power Loss Graph

2.4 Thermal Images

Thermal image is shown in [Figure 2-5](#).

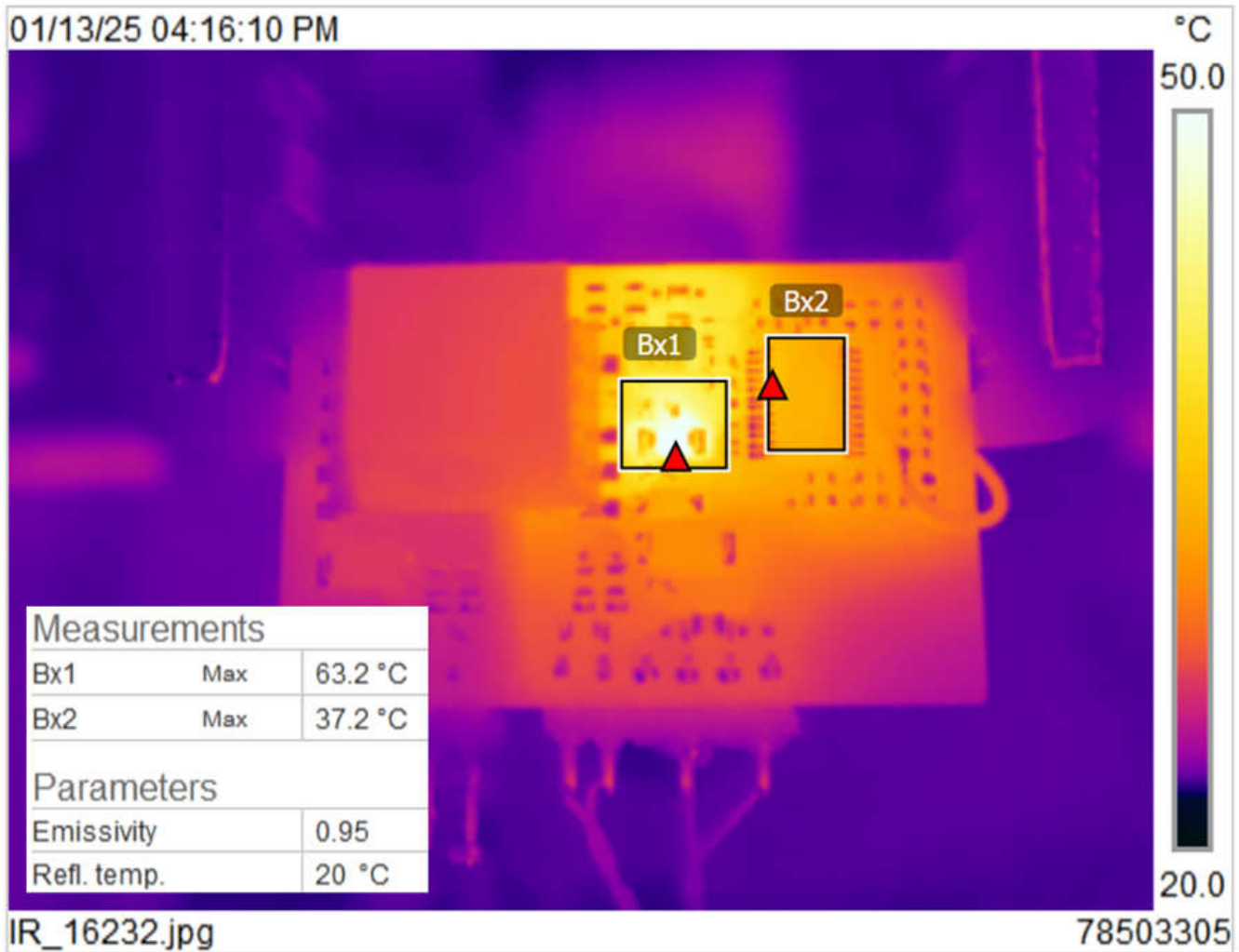


Figure 2-5. Thermal Image

3 Waveforms

3.1 Switching

Switching behavior is shown in [Figure 3-1](#).

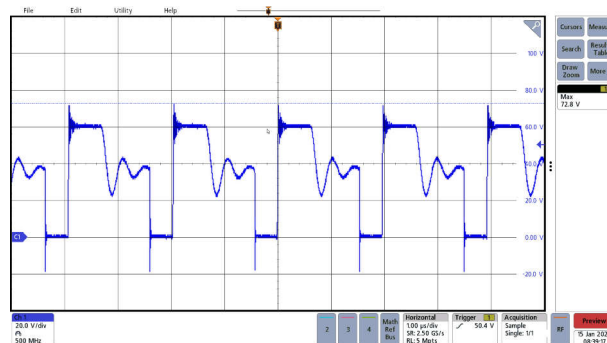


Figure 3-1. Switching 1

3.2 Output Voltage Ripple

Output voltage ripple is shown in [Figure 3-2](#) and [Figure 3-3](#).

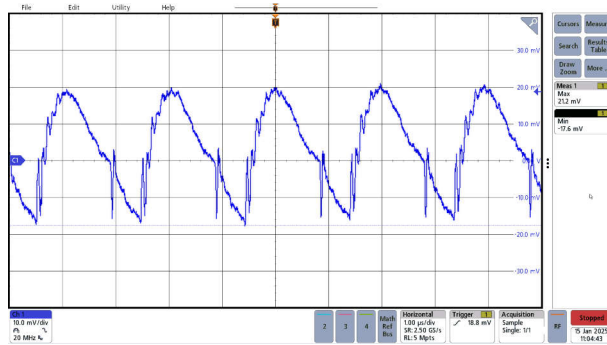


Figure 3-2. Output Voltage Ripple 1

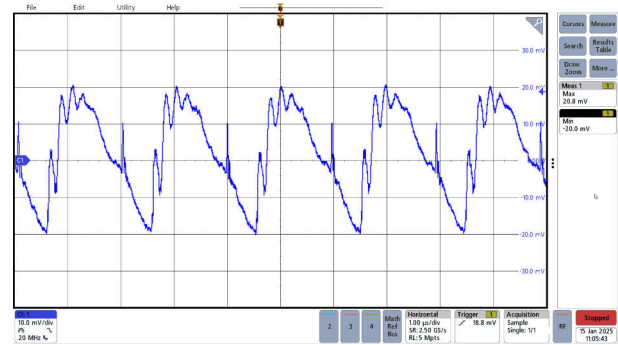


Figure 3-3. Output Voltage Ripple 2

3.3 Start-up Sequence

Start-up behavior is shown in [Figure 3-4](#).

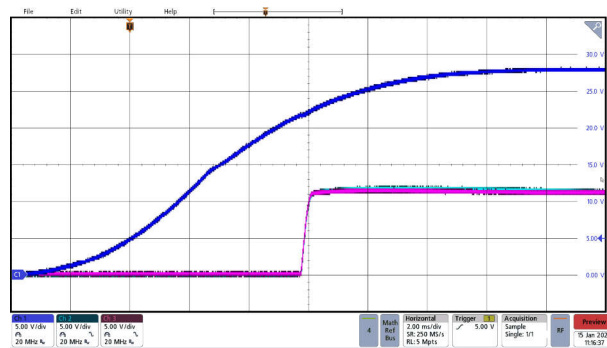


Figure 3-4. Start-up 1

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