



# ADP1829 and ADP1821 Reference Design

Preliminary Technical Data

FCDC 00081

## FEATURES

**Five Output Voltages: 1.2 V, 1.8 V, 3.3 V, 5 V, 12 V**

**Output Current: 1 A to 4.5 A**

**Input voltage: 15.2-16.8 V**

**Ripple 50 mV ppk**

**Transient step  $\pm 5\%$ , 50% max load**

## ADP1829 AND ADP1821 REFERENCE DESIGN DESCRIPTION

This ADP1829 and ADP1821 Reference Design uses 15.2 V to 16.8 V for the input voltage. The output voltages and currents are as follows:

- $V_{OUT1}$  = 1.2 V with a maximum output current of 3.5 A,
- $V_{OUT2}$  = 1.8 V with a maximum output current of 1.4 A,
- $V_{OUT3}$  = 3.3 V with a maximum output current of 2.2 A,
- $V_{OUT4}$  = 5.0 V with a maximum output current of 2.3 A,
- $V_{OUT5}$  = 12 V with a maximum output current of 1.2 A.

Design criteria are for coincidental tracking of  $V_{OUT1}$ ,  $V_{OUT2}$  and  $V_{OUT3}$  with  $V_{OUT4}$  for both turn on and turn off. The ripple and transient assumptions are 50 mV peak to peak voltage ripple and 5% deviation due to 50% instantaneous load step.

The switching frequency is fixed at 300 kHz for  $V_{OUT1}$ ,  $V_{OUT2}$ ,  $V_{OUT3}$ ,  $V_{OUT4}$  and  $V_{OUT5}$ .

### Rev. 1

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One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.

Tel: 781.329.4700

Fax: 781.461.3113

[www.analog.com](http://www.analog.com)

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## REVISION HISTORY

10/17/2007—Revision 0: Initial Version

10/19/2007—Revision 1: Updated Efficiency graphs to show comparison of Rohm SP8K3 dual. Added Sgnd to schematic.

## GENERAL DESCRIPTION

### ADP1829

The ADP1829 is a versatile, dual output, interleaved, synchronous PWM buck controller that generates two independent outputs from an input voltage of 3.0 V to 18 V. Each channel can be configured to provide output voltage from 0.6V to 85% of the input voltage. The two channels operate 180° out of phase, which reduces the current stress on the input capacitor and allows the use of a smaller and lower cost input capacitor.

The ADP1829 operates at a pin-selectable fixed switching frequency of either 300 kHz or 600 kHz. For some noise sensitive applications, it can also be synchronized to an external clock to achieve switching frequency between 300 kHz and 1 MHz. The switching frequency chosen is 300 kHz to get good efficiency over a wide range of input and output conditions.

The ADP1829 includes an adjustable soft start to limit input inrush current, voltage tracking for sequencing or DDR termination, independent power-good output, and a power enable pin. It also provides current-limit and short-circuit protection by sensing the voltage on the synchronous MOSFET.

### ADP1821

The ADP1821 is a versatile and inexpensive, synchronous, pulse width-modulated (PWM), voltage-mode, step-down controller. It drives an all N-channel power stage to regulate an output voltage as low as 0.6 V. The ADP1821 can be configured to provide output voltages from 0.6 V to 85% of the input voltage and is sized to handle large MOSFETs for point-of-load regulators. The ADP1821 is well suited for a wide range of high power applications, such as DSP and processor core power in telecom, medical imaging, high performance servers, and industrial applications. It operates from a 3.0 V to 5.5 V supply with a power input voltage ranging from 1.0 V to 24 V. The ADP1821 operates at a pin-selectable, fixed switching frequency of either 300 kHz or 600 kHz, minimizing external component size and cost. For noise-sensitive applications, it can be synchronized to an external clock to achieve switching frequencies between 300 kHz and 1.2 MHz. The ADP1821 includes soft start protection to limit the inrush current from the input supply during startup, reverse current protection during soft start for precharged outputs, as well as a unique adjustable lossless current-limit scheme utilizing external MOSFET sensing. The ADP1821 operates over the -40°C to +85°C temperature range and is available in a 16-lead QSOP.

## TYPICAL PERFORMANCE CHARACTERISTICS

Figure 1. Calculated efficiency of 1.2V output with 2xSi2304BDS high and 3xSi2304BDS low

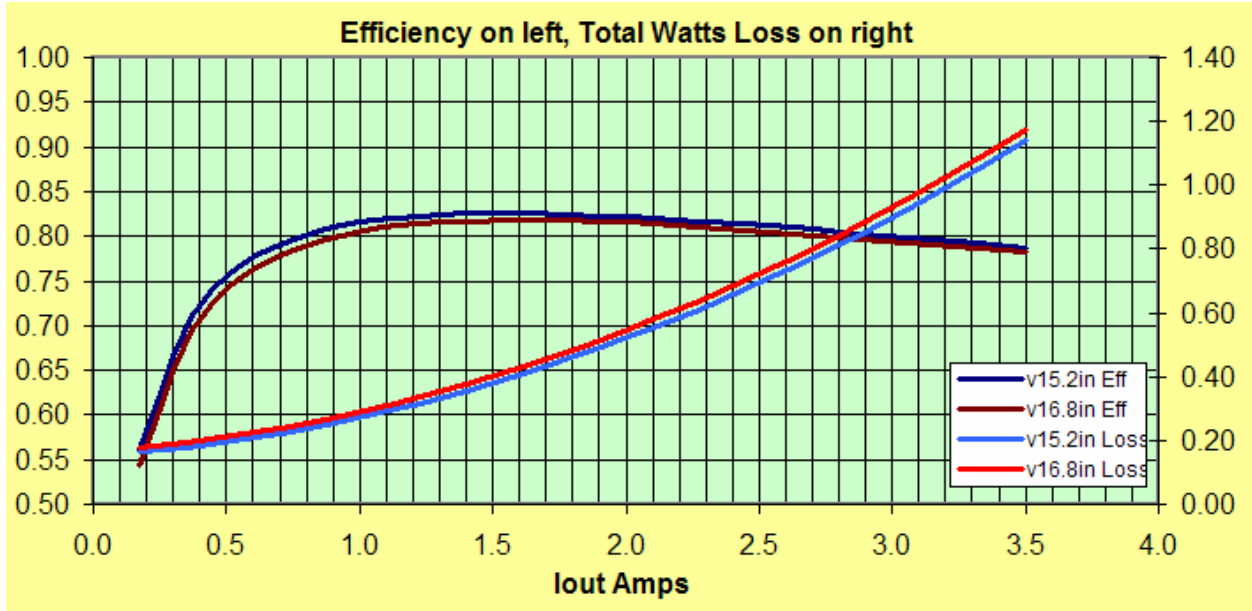


Figure 2. Calculated efficiency of 1.2V output with 1xSP8K3 dual

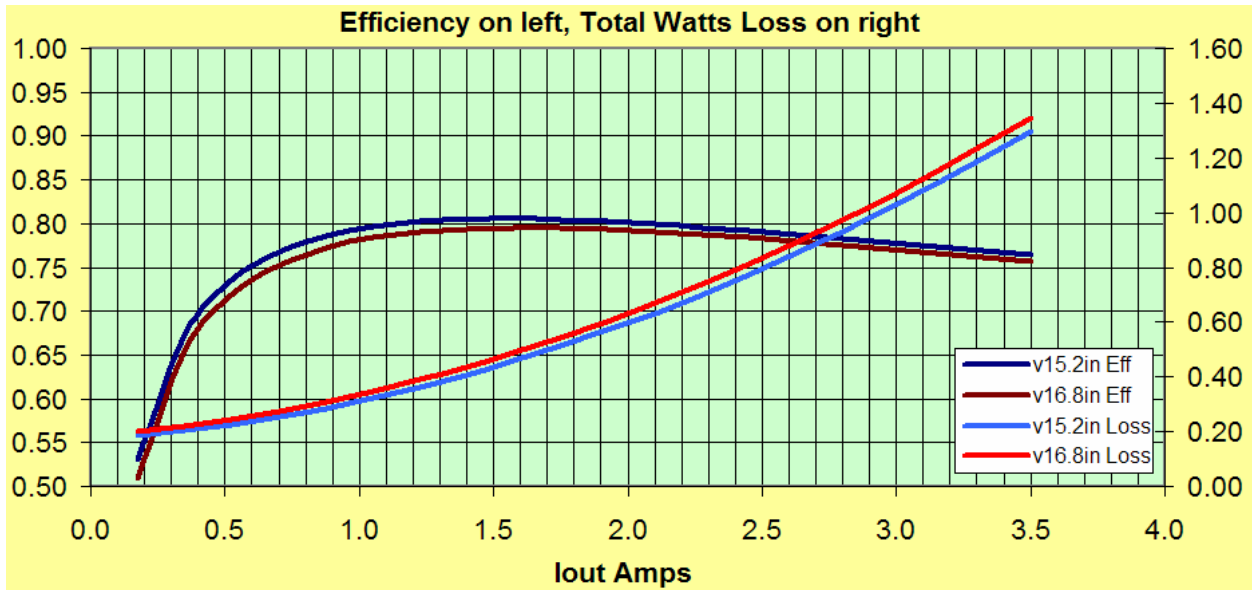


Figure 3. Calculated efficiency of 1.8V output with 1xSi2304BDS high and 2xSi2304BDS low

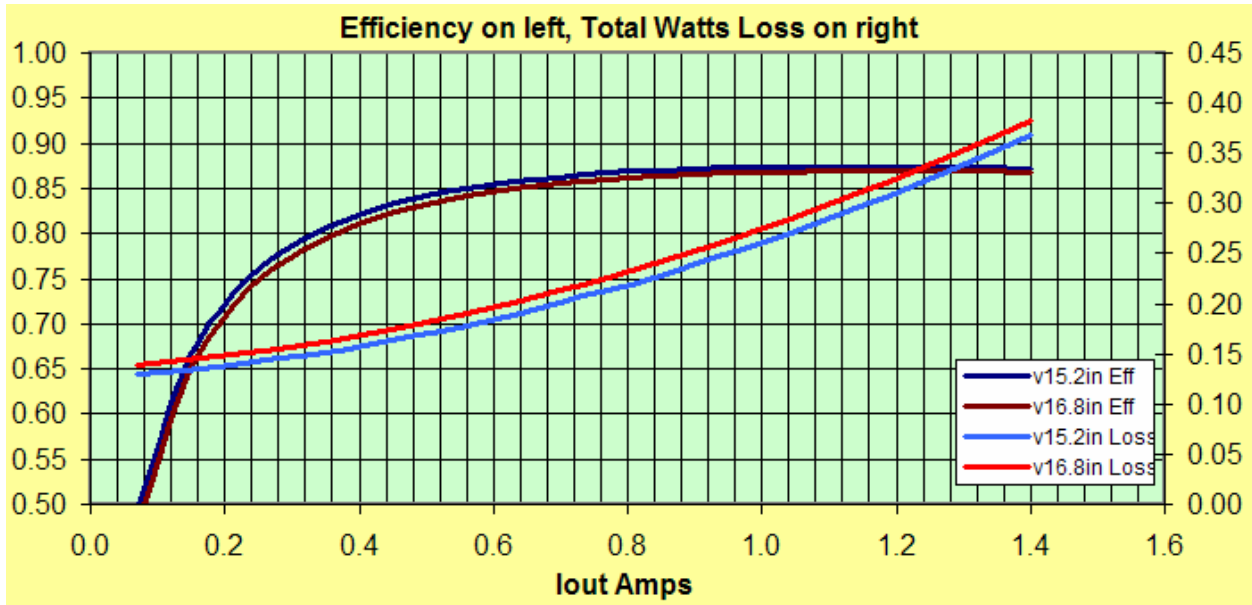


Figure 4. Calculated efficiency of 1.8V output with 1xSP8K3 dual

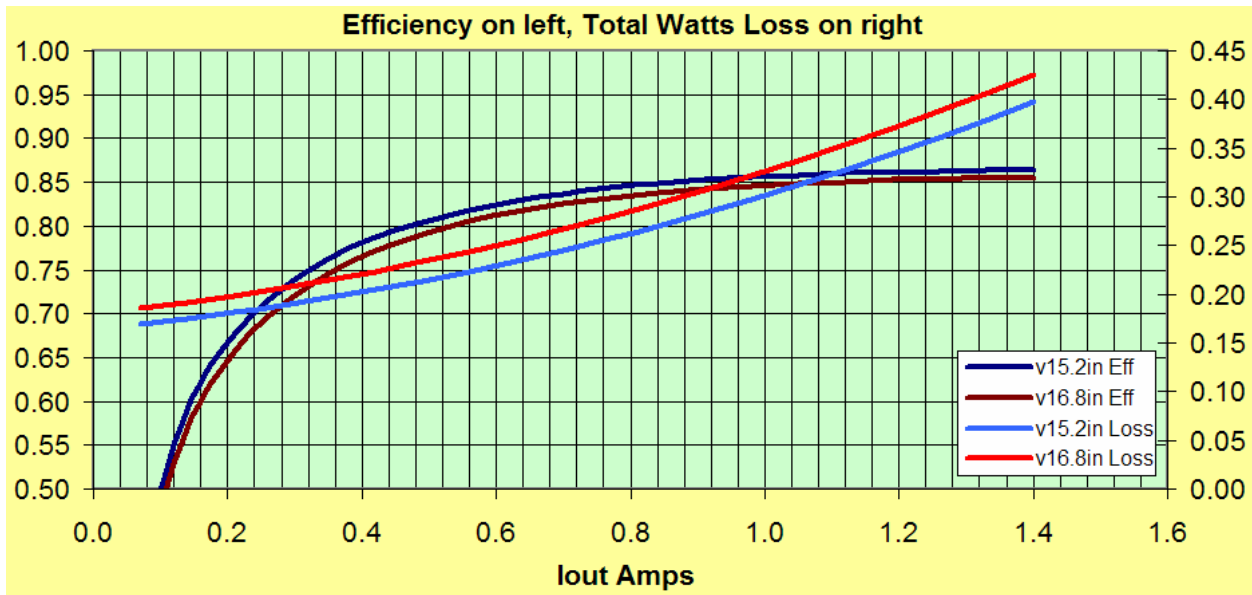


Figure 5. Calculated efficiency of 3.3V output with 2xSi2304BDS high and 2xSi2304BDS low

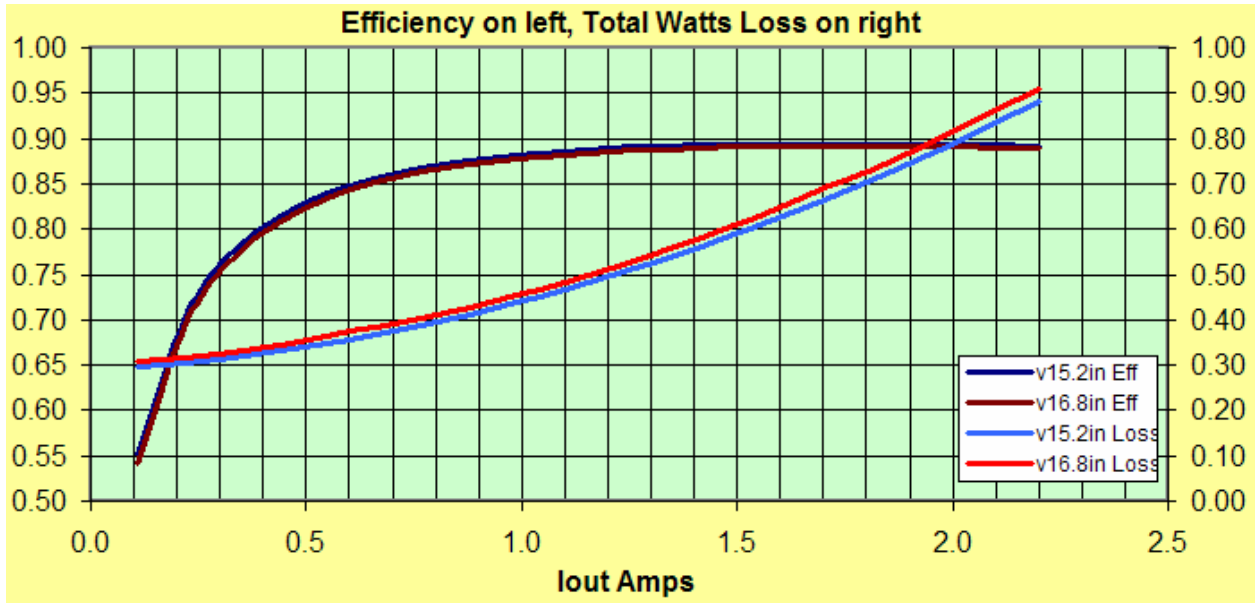


Figure 6. Calculated efficiency of 3.3V output with 1xSP8K3 dual

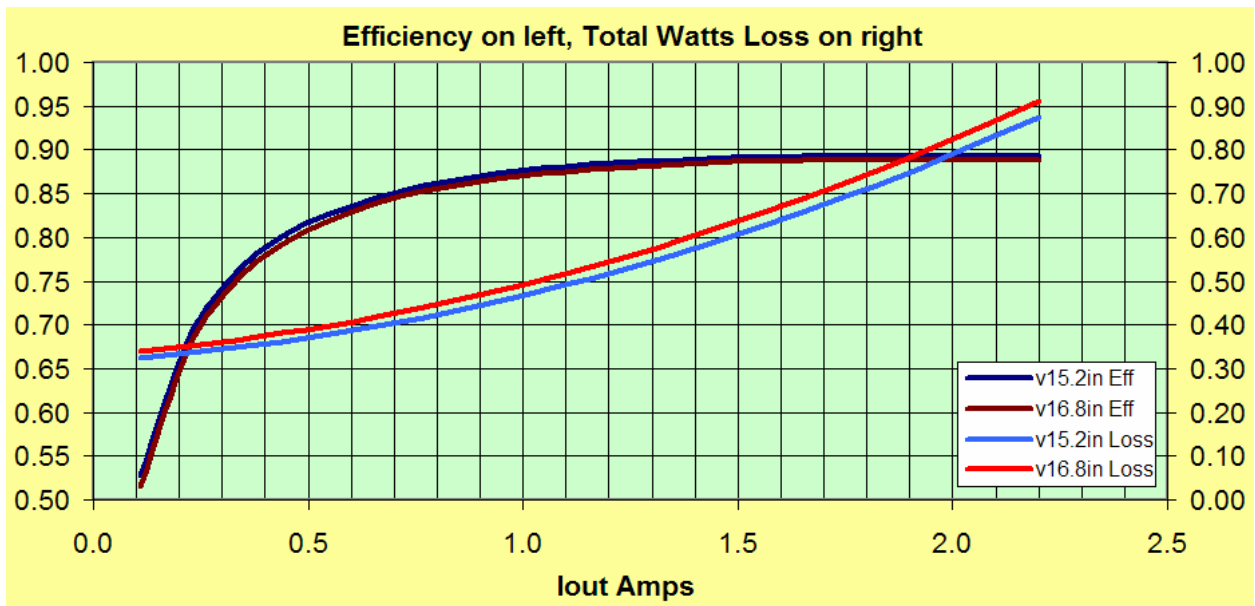


Figure 7. Calculated efficiency of 5.0V output with 2xSi2304BDS high and 2xSi2304BDS low

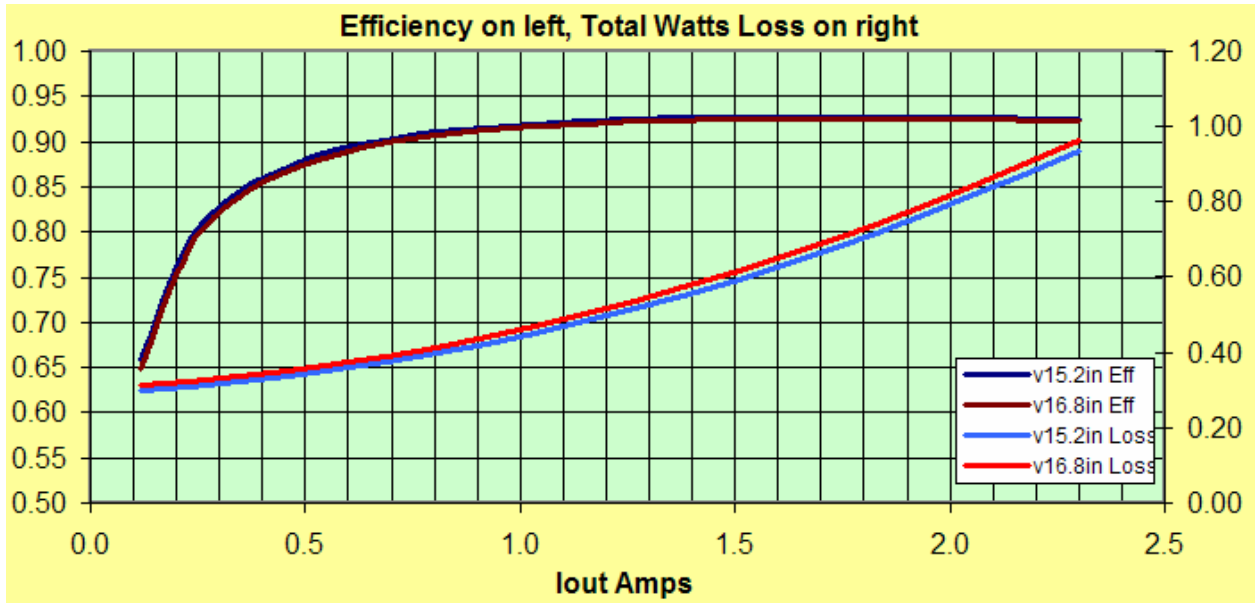


Figure 8. Calculated efficiency of 5.0V output with 1xSP8K3 dual

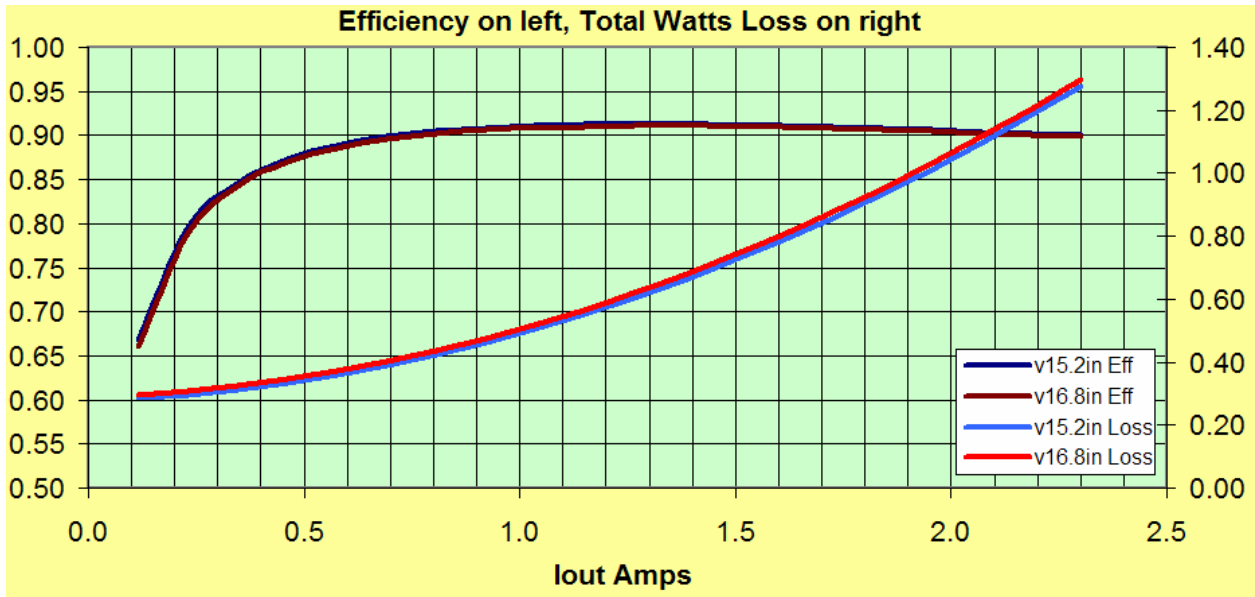
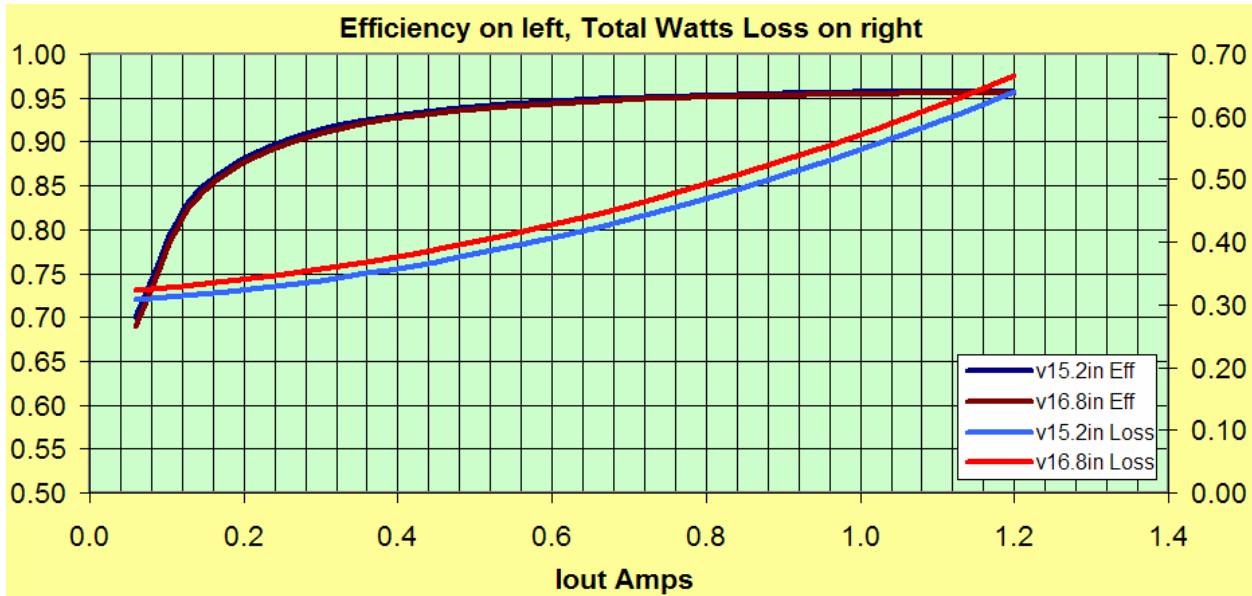


Figure 9. Calculated efficiency of 12.0V output with 1xSi2304BDS high and 1xSi2304BDS low



Figure 10. Calculated efficiency of 12.0V output with 1xSP8K3 dual





SCHEMATIC

Figure 11. Schematic:  $V_{OUT1}$  and  $V_{OUT2}$

1.2V at 3.5A and 1.8V at 1.4A

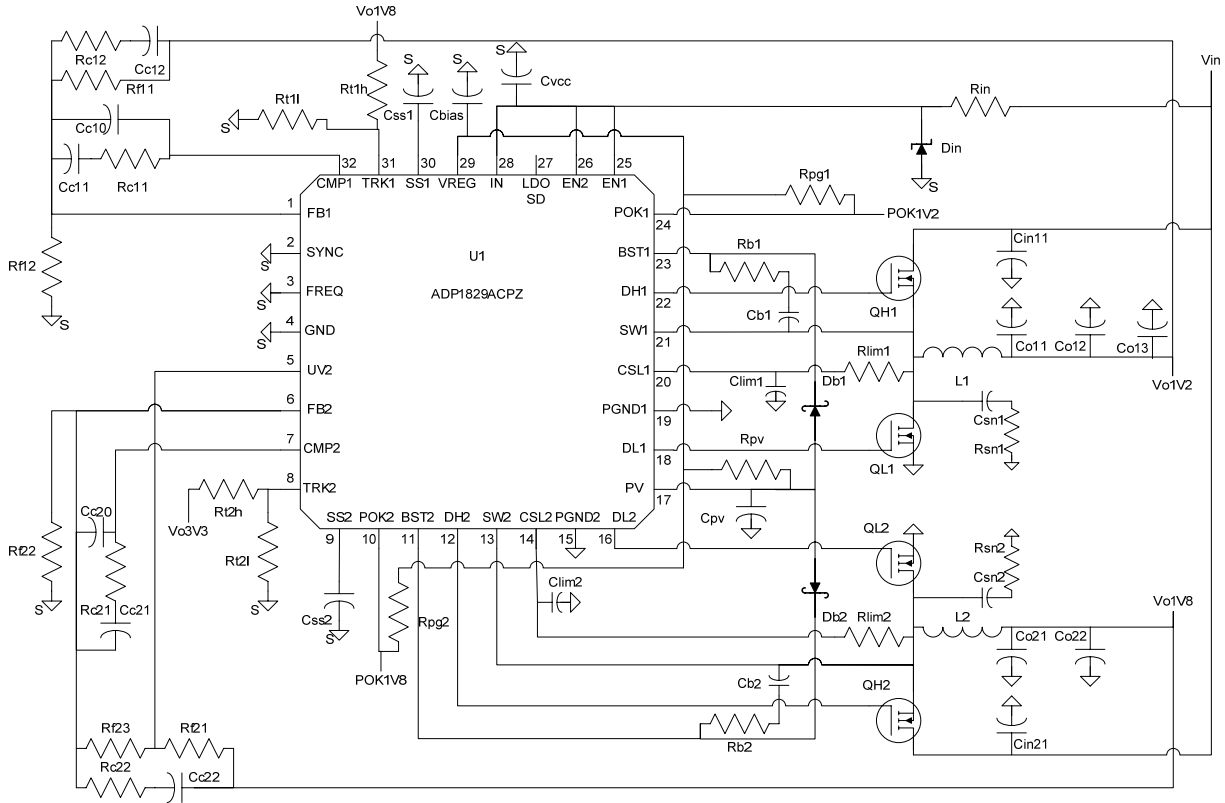


Figure 12. Schematic:  $V_{OUT3}$ ,  $V_{OUT4}$  and linear output

3.3V at 2.2A, 5.0V at 2.3A and 1.5V at 0.1A

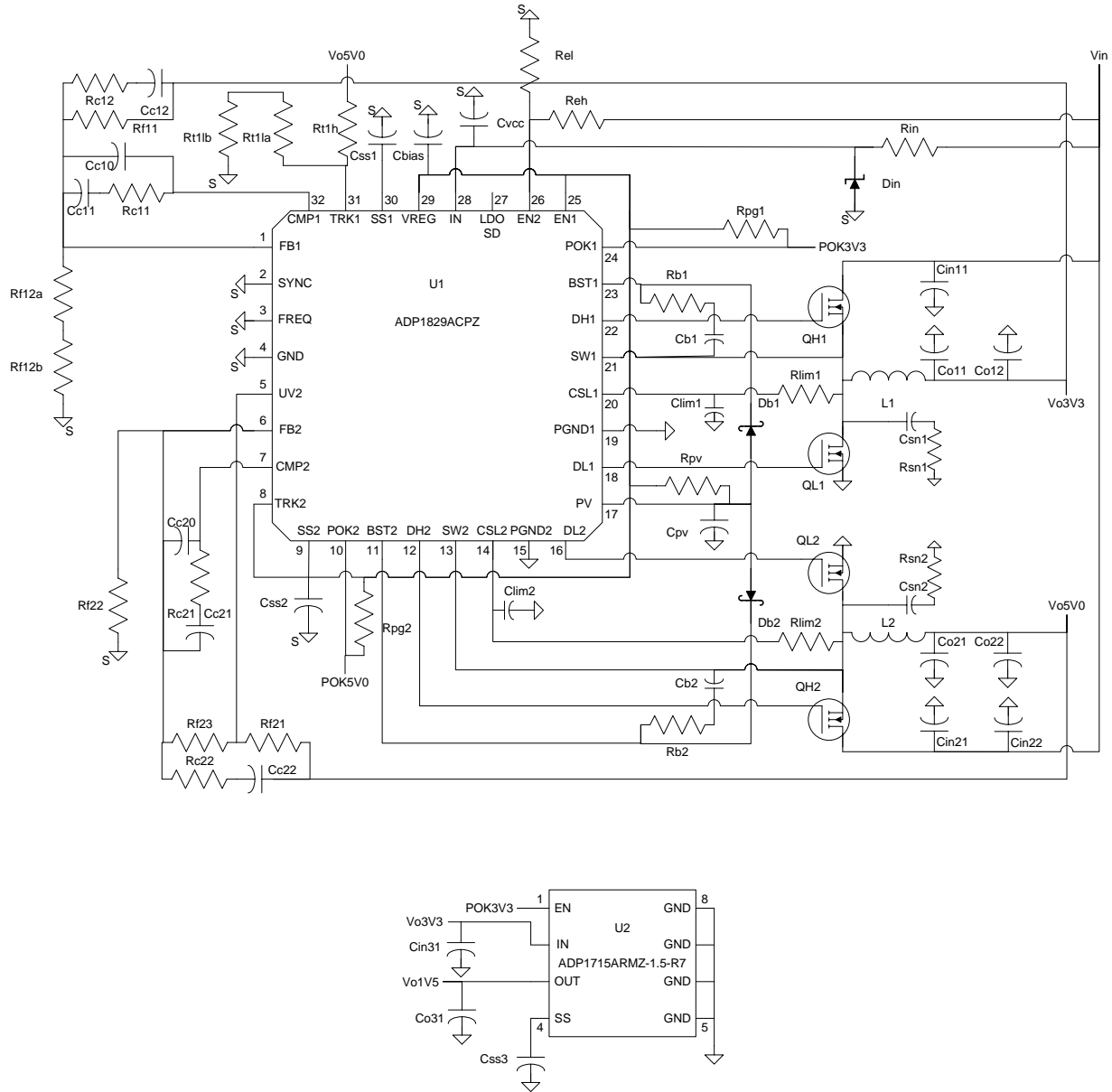
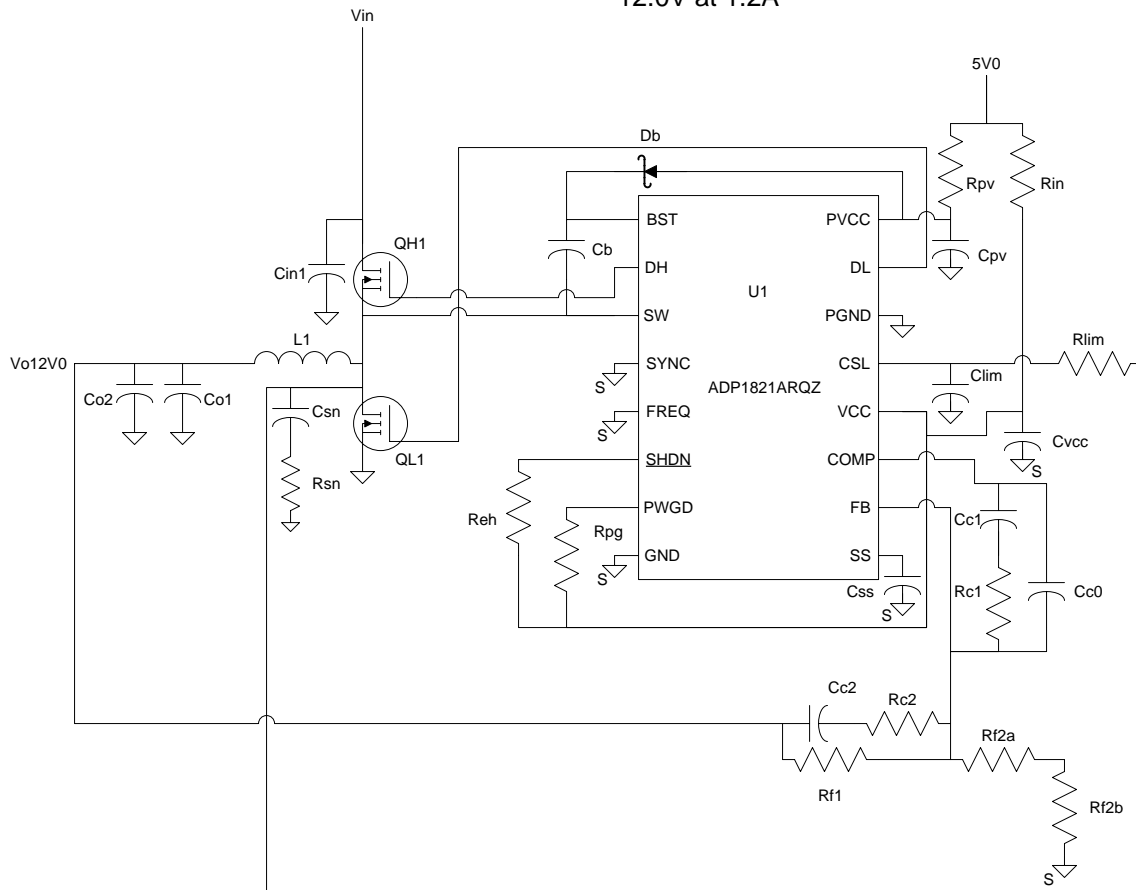


Figure 13. Schematic:  $V_{OUT5}$

12.0V at 1.2A



## BILL OF MATERIALS

Table 1. Vout1, and Vout2 Bill of Materials (1.2 V and 1.8 V)

Description	Designator	Quantity	Manufacturer	MFR#
Capacitor Ceramic COG 680p 0603 50V	Cc12, Cc22	2	Vishay	Generic
Capacitor Ceramic COG 100p 0603 50V	Cc10, Cc20	2	Vishay	Generic
Capacitor Ceramic X7R 1.5n 0603 50V	Cc11	1	Vishay	Generic
Capacitor Ceramic X7R 1u 0603 16V	Cbias, Cpv	2	Murata	GRM188R71C105KA12D
Capacitor Ceramic X7R 1u 0603 25V	Cvcc	1	Murata	GRM188R71E105KA12D
Capacitor Ceramic X7R 15n 0603 16V	Css1, Css2	2	Vishay	Generic
Capacitor Ceramic X7R 10u 1210 25V	Cin11, Cin21	2	Kyocera	CM32X7R106K25AT
Capacitor Ceramic X7R 100n 0603 16V	Cb1, Cb2	2	Vishay	Generic
Capacitor Ceramic COG 33p 0603 50V	Clim1, Clim2	2	Vishay	Generic
Capacitor Ceramic X7R 1.8n 0603 50V	Cc21	1	Vishay	Generic
Capacitor Ceramic X5R 22u 1210 6.3V	Co11, Co12, Co13, Co21	4	Taiyo-Yuden	JMK316BJ226KL-T
Diode Schottky 200mA SOD-323 30V	Db1, Db2	2	Diodes inc	BAT54WS
No Pop Zener 200mW SOD-323 18V	Din	0	Diodes inc	MMSZ5248BS
Inductor Ferrite 2.7uH 10.4mm x 10.4mm	L1	1	Toko	B966AS-2R7N
Inductor Ferrite 10uH 7.6mm x 7.6mm	L2	1	Toko	B1047AS-100M
Single N-Channel MOSFET SOT-23 30V	QL1a, QL1b, QL1c, QH1a, QH1b, QH2a, QL2a, QL2b	8	Vishay	Si2304BDS
1A Thick Film 0 Ohm jumper 0603	Rf23, Rb1, Rb2	3	Vishay	Generic
5% Thick Film 10 Ohms 0603	Rpv	1	Vishay	Generic
1% Thick Film 200 Ohms 0603	Rin	1	Vishay	Generic
1% Thick Film 10.0k 0603	Rpg1, Rpg2, Rf22, Rt2l	4	Vishay	Generic
1% Thick Film 20.0k 0603	Rf11, Rf21, Rt1h, Rt2h, Rf12, Rt1l	6	Vishay	Generic
1% Thick Film 82.0 Ohms 0603	Rc22	1	Vishay	Generic
1% Thick Film 5.10k 0603	Rlim1	1	Vishay	Generic
1% Thick Film 3.00k 0603	Rlim2	1	Vishay	Generic
1% Thick Film 100 Ohms 0603	Rc12	1	Vishay	Generic
1% Thick Film 8.20k 0603	Rc11, Rc21	2	Vishay	Generic
2 chan 300k to 600k PWM LFCSP-32	U1	1	Analog Devices	ADP1829ACPZ

Table 2. Vout3 and Vout4 Bill of Materials (3.3 V and 5.0 V)

Description	Designator	Quantity	Manufacturer	MFR#
Capacitor Ceramic COG 680p 0603 50V	Cc12	1	Vishay	Generic
Capacitor Ceramic X7R 1u 0603 16V	Cbias, Cpv	2	Murata	GRM188R71C105KA12D
Capacitor Ceramic X7R 1u 0603 25V	Cvcc	1	Murata	GRM188R71E105KA12D
Capacitor Ceramic X7R 47n 0603 16V	Css1	1	Vishay	Generic
Capacitor Ceramic X7R 220n 0603 16V	Css2	1	Vishay	Generic
Capacitor Ceramic COG 120p 0603 50V	Cc10, Cc20	2	Vishay	Generic
Capacitor Ceramic X7R 100n 0603 16V	Cb1, Cb2	2	Vishay	Generic
Capacitor Ceramic COG 33p 0603 50V	Clim1, Clim2	2	Vishay	Generic
Capacitor Ceramic X7R 2.7n 0603 50V	Cc11, Cc21	2	Vishay	Generic
Capacitor Ceramic COG 560p 0603 50V	Cc22	1	Vishay	Generic
Capacitor Ceramic X7R 10u 1210 25V	Cin11, Cin21	2	Kyocera	CM32X7R106K25AT
Capacitor Ceramic X5R 22u 1210 6.3V	Co11, Co21	2	Taiyo-Yuden	JMK316BJ226KL-T
Diode Schottky 200mA SOD-323 30V	Db1, Db2	2	Diodes inc	BAT54WS
No Pop Zener 200mW SOD-323 18V	Din	0	Diodes inc	MMSZ5248BS
Inductor Ferrite 10uH 10.4mm x 10.4mm	L1, L2	2	Toko	B966AS-100M
Single N-Channel MOSFET SOT-23 30V	QL1a, QL1b, QH1a, QH1b, QH2a, QH2b, QL2a, QL2b	8	Vishay	Si2304BDS
1A Thick Film 0 Ohm jumper 0603	Rf23, Rb1, Rb2	3	Vishay	Generic
5% Thick Film 10 Ohms 0603	Rpv	1	Vishay	Generic
1% Thick Film 200 Ohms 0603	Rin	1	Vishay	Generic
1% Thick Film 10.0k 0603	Rpg1, Rpg2	2	Vishay	Generic
1% Thick Film 22.0k 0603	Rf11, Rf21, Rt1h, Rel	4	Vishay	Generic
1% Thick Film 3.00k 0603	Rf22	1	Vishay	Generic
1% Thick Film 82.0 Ohms 0603	Rc22	1	Vishay	Generic
1% Thick Film 5.10k 0603	Rlim2	1	Vishay	Generic
1% Thick Film 4.70k 0603	Rlim1	1	Vishay	Generic
1% Thick Film 110k 0603	Reh	1	Vishay	Generic
1% Thick Film 1.00k 0603	Rf12a, Rt1la	2	Vishay	Generic
1% Thick Film 3.90k 0603	Rf12b, Rt1lb	2	Vishay	Generic
1% Thick Film 100 Ohms 0603	Rc12	1	Vishay	Generic
1% Thick Film 5.60k 0603	Rc11	1	Vishay	Generic
1% Thick Film 4.70k 0603	Rc21	1	Vishay	Generic
2 chan 300k to 600k PWM LFCSP-32	U1	1	Analog Devices	ADP1829ACPZ
Capacitor Ceramic X7R 10n 0603 16V	Css3	1	Vishay	Generic
Capacitor Ceramic X7R 2.2u 0805 16V	Cin31, Co31	2	Murata	GRM21BR71C225KA12L
500mA 1.5V Linear Reg MSOP-8	U2	1	Analog Devices	ADP1715ARMZ-1.5-R7

Table 3. Vout6 (12.0 V)

Description	Designator	Quantity	Manufacturer	MFR#
Capacitor Ceramic COG 100p 0603 50V	Cc0	1	Vishay	Generic
Capacitor Ceramic X7R 3.3n 0603 50V	Cc1	1	Vishay	Generic
Capacitor Ceramic X7R 1.0n 0603 50V	Cc2	1	Vishay	Generic
Capacitor Ceramic X7R 1.0u 0603 16V	Cpv	1	Murata	GRM188R71C105KA12D
Capacitor Ceramic X7R 100n 0603 16V	Cvcc, Cb, Css	3	Vishay	Generic
Capacitor Ceramic COG 33p 0603 50V	Clim	1	Vishay	Generic
Capacitor Ceramic X5R 10u 1210 25V	Cin1	1	Taiyo-Yuden	TMK325BJ106MN-T
Capacitor Ceramic X7R 22u 1210 16V	Co1	1	TDK	C3225X7R1C226M
No pop 6.3mm 16V SMT	Co2	0	Nippon	APXE160ARA101MF80G
Diode Schottky 200mA SOD-323 30V	Db	1	Diodes inc	BAT54WS
Inductor Ferrite 22uH 7.6mmx7.6mm	L1	1	Toko	B1047AS-220M
Single N-Channel MOSFET SOT-23 30V	QL1,QH1	2	Vishay	Si2304BDS
5% Thick Film 10 Ohms 0603	Rin, Rpv	2	Vishay	Generic
1% Thick Film 20.0k 0603	Rf1	1	Vishay	Generic
1% Thick Film 1.00k 0603	Rf2a	1	Vishay	Generic
1% Thick Film 56 Ohms 0603	Rf2b, Rc2	2	Vishay	Generic
1% Thick Film 4.70k Ohms 0603	Rlim	1	Vishay	Generic
1% Thick Film 6.80k 0603	Rc1	1	Vishay	Generic
1% Thick Film 10.0k 0603	Rpg, Reh	2	Vishay	Generic
1 chan 300k to 600k PWM QSOP-16	U1	1	Analog Devices	ADP1821ARQZ

## NOTES

Reference designators shown on the schematic but not listed on the Bill of Materials are place holders for possible design adjustments (snubbers, additional decoupling capacitors and clamp diodes). These components should be put in the layout, but not populated unless after testing it is deemed necessary.

If a different number, or different type of output capacitors are used on the switching outputs the loop compensation components may need adjustment.

Efficiency calculations are estimates and are not verified in actual hardware. Any shoot-through caused by  $dV/dt$  induced turn on of the lowside FET is not included in efficiency (likely present in Rohm low side FETs).

FETs with reference designators ending in a letter (i.e. a, b, or c) are connected in parallel with the other FETs of the same reference designator prefix. These FETs should be placed physically close together and have large power planes connecting all the drains together and large power planes connecting all the sources together. Gate drive resistors may be used if there is concern about possible paralleling issues.

Ground symbols with an S designator should be connected together with one small plane and tied to the power ground plane at one point near the IC. Each IC should have its own S ground pour.