

## LT8316 High $V_{IN}$ No Opto Synchronous Flyback Converter

### DESCRIPTION

Demonstration circuit 2793A is a high  $V_{IN}$  no-opto synchronous flyback converter featuring the [LT<sup>®</sup>8316](#). The demo board outputs 5V and maintains tight regulation with a load current from 70mA to 7A. It is optimized to operate over a wide 140V to 450V DC input voltage range. Output voltage accuracy stays within  $\pm 5\%$  over the entire input voltage and load range.

On the secondary side, the LT8309 synchronous rectifier driver senses the synchronous MOSFET drain-to-source voltage to determine its turn-on period. By replacing the diode rectifier with an N-Channel MOSFET, the efficiency and thermal performance is greatly improved.

The LT8316 is a 600V flyback controller. No opto-isolator is needed for regulation. The part samples the output voltage from the isolated flyback waveform appearing across a third winding on the transformer. Quasi-resonant

boundary mode operation improves load regulation. At start-up, the  $INTV_{CC}$  capacitor is charged via a high voltage current source; during normal operation, the current source turns off to save power consumption.

DC2793A features an option to turn on standby mode by simply changing the position of a jumper from “DIS” to “EN”. Standby mode reduces the minimum switching frequency to 220Hz for ultralow quiescent power consumption.

The LT8316 and LT8309 data sheets give a complete description of the parts, and operation and application information. The data sheets must be read in conjunction with this quick start guide for demo circuit 2793A.

**[Design files for this circuit board are available.](#)**

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### PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage		140		450	V
Output Voltage	$I_{OUT} = 70\text{mA to } 7\text{A}$	4.75	5	5.25	V
Maximum Output Current		7			A
Output Voltage AC Ripple (Peak-to-Peak)	$V_{IN} = 140\text{V}, I_{OUT} = 7\text{A}$ $V_{IN} = 450\text{V}, I_{OUT} = 7\text{A}$		80 20		mV <sub>p-p</sub> mV <sub>p-p</sub>
Typical Switching Frequency	$V_{IN} = 140\text{V}, I_{OUT} = 7\text{A}$ $V_{IN} = 450\text{V}, I_{OUT} = 7\text{A}$		45 75		kHz kHz
Efficiency	$V_{IN} = 140\text{V}, I_{OUT} = 7\text{A}$ $V_{IN} = 450\text{V}, I_{OUT} = 7\text{A}$		89 88		% %

## QUICK START PROCEDURE

### IMPORTANT NOTE TO CUSTOMERS:

**HIGH VOLTAGES ARE PRESENTED ON THE DEMO CIRCUIT, AND CAN LEAD TO LETHAL INJURIES TO HUMAN BODY. ONLY QUALIFIED PERSONNEL SHOULD OPERATE IT. IT IS STRONGLY RECOMMENDED TO USE SAFETY GLASSES AND AN ISOLATION TRANSFORMER.**

**NOTE: IMPROPER COMPONENT REPLACEMENT ON THE DEMO CIRCUIT CAN CAUSE PERFORMANCE DETERIORATIONS, CIRCUIT MALFUNCTION, PROPERTY DAMAGE, AND EVEN LIFE-THREATENING INJURIES. CONTACT ANALOG DEVICES APPLICATIONS ENGINEERS FOR PROPER COMPONENT REPLACEMENT.**

Demonstration circuit 2793A is easy to set up to evaluate the performance of the LT8316. Refer to Figure 1 for proper measurement equipment setup and follow the procedure:

1. Set an input power supply that is capable of 140V to 450V to 140V adjustments. Then turn off the supply.
2. With power off, connect the DC input power supply to the board through +VIN and –VIN terminals. Connect the load to the terminals +VOUT and –VOUT on the board.

3. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed 450V.

4. Check for the proper output voltages. The output should be regulated at 5V ( $\pm 5\%$ ).

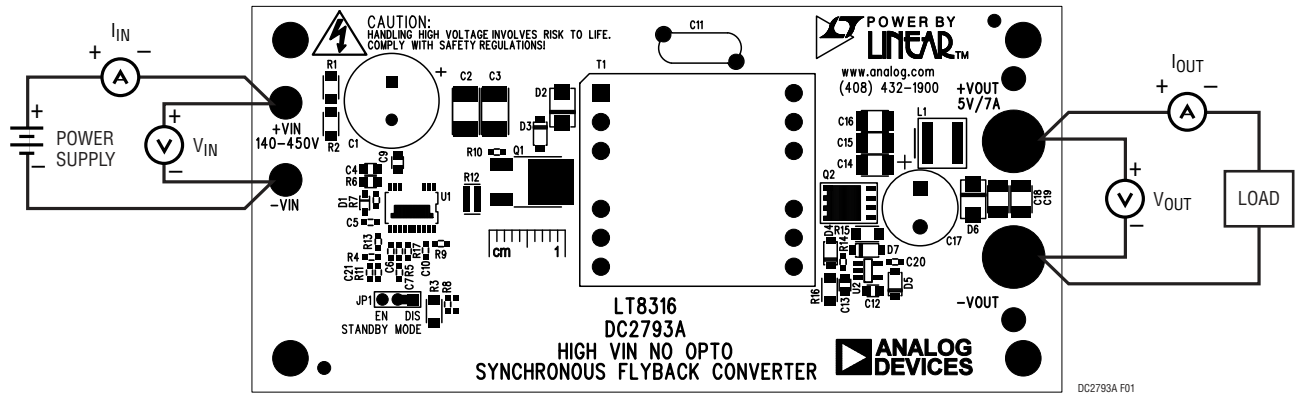
NOTE: The LT8316 requires very small minimum load to maintain good output voltage regulation. A Zener diode is placed on the output to clamp the voltage to 5.6V. This Zener can be replaced with a 75 $\Omega$  resistor at the trade-off of lower efficiency.

5. Once the proper output voltage is established, adjust the input voltage and load current within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

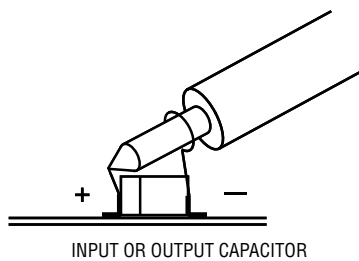
NOTE: When measuring the input or output voltage ripples, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip directly across the +VOUT and –VOUT terminals. See Figure 2 for proper scope probe technique.

Figure 3 and Figure 4 provide additional demo board performance information.

**QUICK START PROCEDURE**



**Figure 1. Proper Measurement Equipment Setup**



**Figure 2. Proper Scope Probe Placement for Measuring Input or Output Ripple**

## QUICK START PROCEDURE

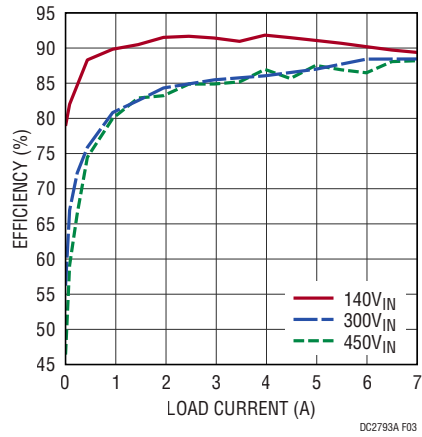
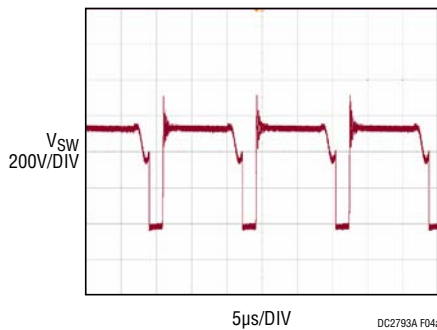
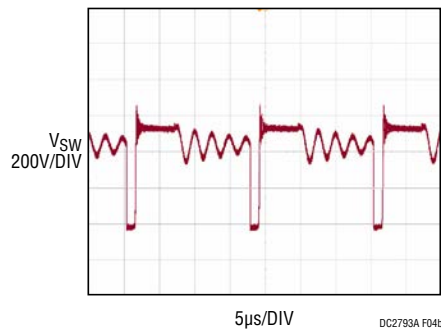


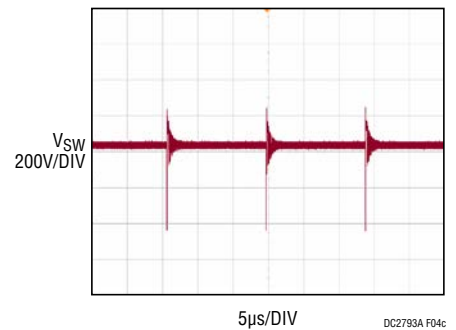
Figure 3. Typical Efficiency Curve



a)



b)



c)

Figure 4. Switch Node Voltage Waveform at Different Load Conditions

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C1	CAP, ALUM., 10µF, 500V, 20%	NICHICON, UCY2H100MHD
2	2	C2, C3	CAP, X7T, 0.22µF, 630V, 10%, 1812	TDK, C4532X7T2J224K200KC
3	3	C4, C9, C13	CAP, X5R, 4.7µF, 50V, 10%, 0805	MURATA, GRM21BR61H475KE51L
4	1	C5	CAP, NP0, 47pF, 50V, 5%, 0603	MURATA, GRM1885C1H470JA01D
5	1	C6	CAP, NP0, 100pF, 50V, 5%, 0603	MURATA, GRM1885C1H101JA01D
6	1	C7	CAP, X7R, 0.22µF, 25V, 10%, 0603	MURATA, GRM188R71E224KA88D
7	1	C10	CAP, X7R, 1000pF, 25V, 10%, 0603	MURATA, GRM188R71E102KA01D
8	1	C11	CAP, Y5U, 2200pF, 400VAC, 20%	VISHAY, 440LD22-R
9	1	C12	CAP, X7S, 1µF, 100V, 10%, 0805	MURATA, GRM21BC72A105KE01L
10	5	C14, C15, C16, C18, C19	CAP, X5R, 100µF, 10V, 20%, 1210	MURATA, GRM32ER61A107ME20L
11	1	C17	CAP, ALUM., 1500µF, 6.3V, 20%	PANASONIC, 6SEPC1500M
12	1	C20	CAP, NP0, 120pF, 100V, 10%, 0603	AVX, 06031A121KAT2A
13	1	D1	DIODE, 200V, SOD323	DIODES INC., BAV21WS-7-F
14	1	D2	DIODE, TVS, 324VC, SMA	BOURNS INC., SMAJ200A
15	1	D3	DIODE, 800V, SOD123F	CENTRAL SEMI., CMMR1U-08
16	1	D4	DIODE, 150V, SOD123	DIODES INC., BAV20W-7-F
17	1	D5	DIODE, ZENER, 36V, SOD123	CENTRAL SEMI., CMHZ5258B
18	1	D6	DIODE, ZENER, 5.6V, SMA	CENTRAL SEMI., CMZ5919B TR13
19	1	D7	DIODE, 100V, SOD123F	DIODES INC., 1N4148W-7-F
20	1	L1	IND., 1µH, 20%	COILCRAFT, XAL6030-102ME
21	1	Q1	MOSFET, N-CH, 800V, DPAK	INFINEON, IPD80R450P7ATMA1
22	1	Q2	MOSFET, N-CH, 80V, PG-TDSON-8	INFINEON, BSC052N08NS5ATMA1
23	3	R1, R2, R3	RES., 243k, 1/4W, 1%, 1206	VISHAY, CRCW1206243KFKEA
24	1	R4	RES., 61.9k, 1/10W, 1%, 0603	VISHAY, CRCW060361K9FKEA
25	1	R5	RES., 6.04k, 1/10W, 1%, 0603	VISHAY, CRCW06036K04FKEA
26	1	R6	RES., 100 , 1/8W, 1%, 0805	VISHAY, CRCW0805100RFKEA
27	1	R7	RES., 10k, 1/10W, 1% 0603	VISHAY, CRCW060310K0FKEA
28	1	R8	RES., 6.98k, 1/10W, 1% 0603	VISHAY, CRCW06036K98FKEA
29	1	R9	RES., 100Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
30	1	R10	RES., 10Ω, 1/10W, 1%, 0603	VISHAY, CRCW060310R0FKEA
31	1	R11	RES., 4.99k, 1/10W, 1% 0603	VISHAY, CRCW06034K99FKEA
32	1	R12	RES., 0.062Ω, 1W, 1%, 1206 WIDE	SUSUMU, PRL1632-R062-F-T1
33	1	R14	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
34	1	R15	RES., 3.32k, 1/4W, 1%, 1206	VISHAY, CRCW12063K32FKEB
35	1	R16	RES., 3Ω, 1/2W, 5%, . 1206	VISHAY, CRCW12063R00JNEA
36	1	R17	RES., 68.1k, 1/10W, 1%, 0603	VISHAY, CRCW060368K1FKEA
37	1	T1	TRANSFORMER, PQ2620	SUMIDA, PQ2620, 11328-T060
38	1	U1	I.C., LT8316EFE, TSSOP20FE(16)	ANALOG DEVICES, LT8316EFE#PBF
39	1	U2	I.C., RECTIFIER DRIVER, TSOT23-S5	ANALOG DEVICES, LT8309ES5#PBF

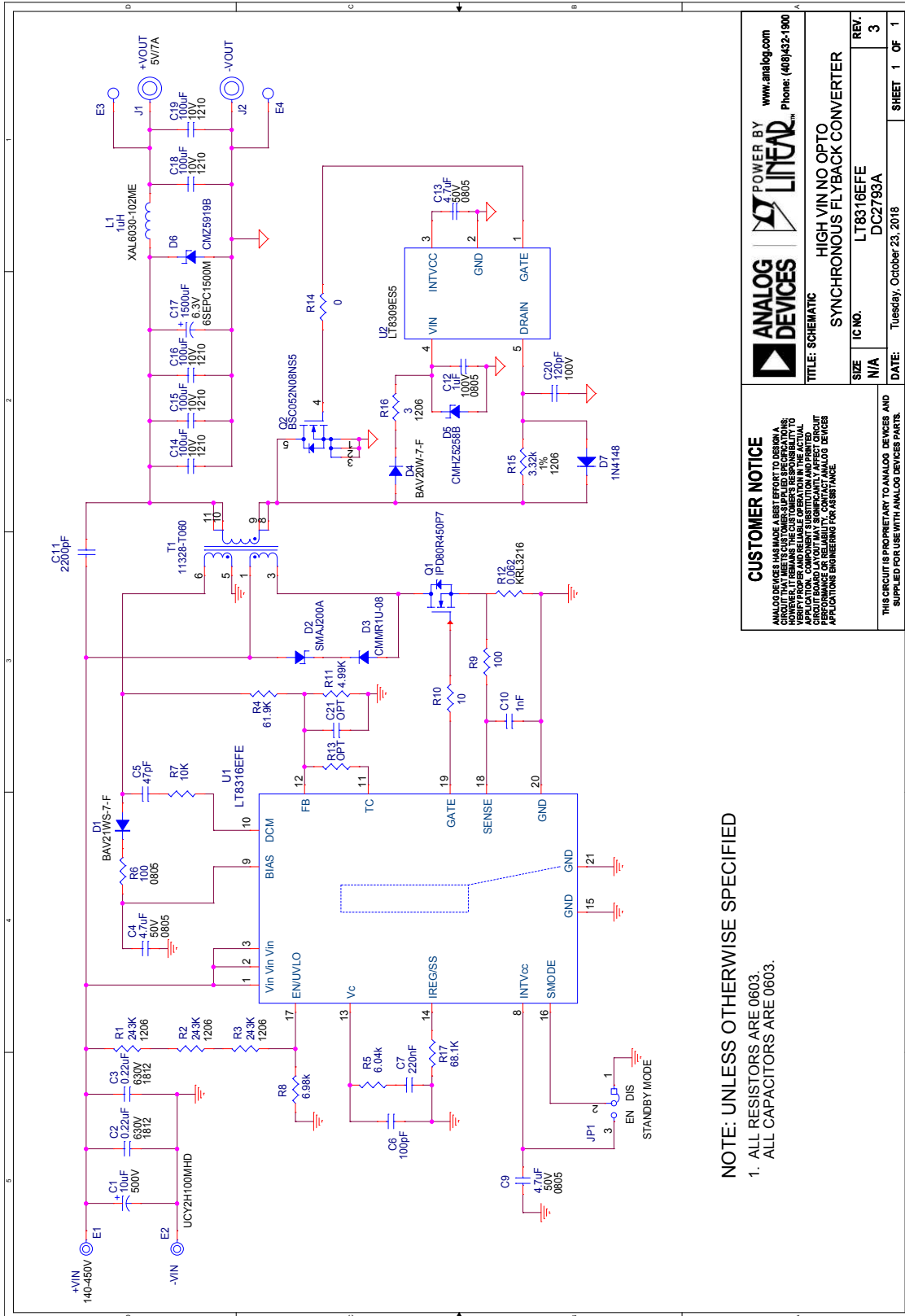
# DEMO MANUAL DC2793A

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## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Additional Demo Board Circuit Components</b>				
1	2	E1, E2	TESTPOINT, TURRET, .094" MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	2	E3, E4	TESTPOINT, TURRET, .061" MTG. HOLE	MILL-MAX, 2308-2-00-80-00-00-07-0
3	1	JP1	HEADER 3 PIN 0.079 SINGLE ROW	WURTH ELEKTRONIK , 62000311121
4	2	J1, J2	JACK BANANA	KEYSTONE, 575-4
5	4	MH1-MH4	STAND-OFF, NYLON 0.375"	WURTH ELEKTRONIK, 702933000
<b>Hardware: For Demo Board Only</b>				
1	0	C21	CAP., OPTION, 0603	
2	0	R13	RES., OPTION, 0603	

**SCHEMATIC DIAGRAM**



**NOTE: UNLESS OTHERWISE SPECIFIED**

1. ALL RESISTORS ARE 0603.
2. ALL CAPACITORS ARE 0603.

**CUSTOMER NOTICE**  
 ANALOG DEVICES MAKES NO REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, REGARDING THE SUITABILITY OF THIS CIRCUIT BOARD LAYOUT FOR ANY PARTICULAR APPLICATION. COMPONENT SELECTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE. CUSTOMERS ARE ADVISED TO CONSULT WITH AN ANALOG DEVICES APPLICATIONS ENGINEERING FOR ASSISTANCE.

		POWER BY www.analog.com Phone: (408)432-1900
	TITLE: SCHEMATIC HIGH VIN NO OPTO SYNCHRONOUS FLYBACK CONVERTER	
SIZE	IC NO.	REV.
N/A	LT8316EFE	3
DATE:	Tuesday, October 23, 2018	SHEET 1 OF 1

THIS CIRCUIT IS PROPRIETARY TO ANALOG DEVICES AND SUPPLIED FOR USE WITH ANALOG DEVICES PARTS.



## ESD Caution

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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