150W to 200W High-Voltage DC/DC Converter

Single or Dual Output
1500Vdc Isolation

Key Features

- Efficiency up to 92%
- 1500Vdc input-to-output isolation
- 2:1 input voltage range
- Input undervoltage protection
- Output overvoltage protection
- Soft start
- Adjustable output
- 160kHz switching frequency
- Thermal protection
- Six-sided shielding

Beta Dyne is protected under various patents, including but not limited to U.S. Patent numbers: 5,777,519; 6,188,276; 6,262,901; 6,452,818; 6,473,3171.

Applications

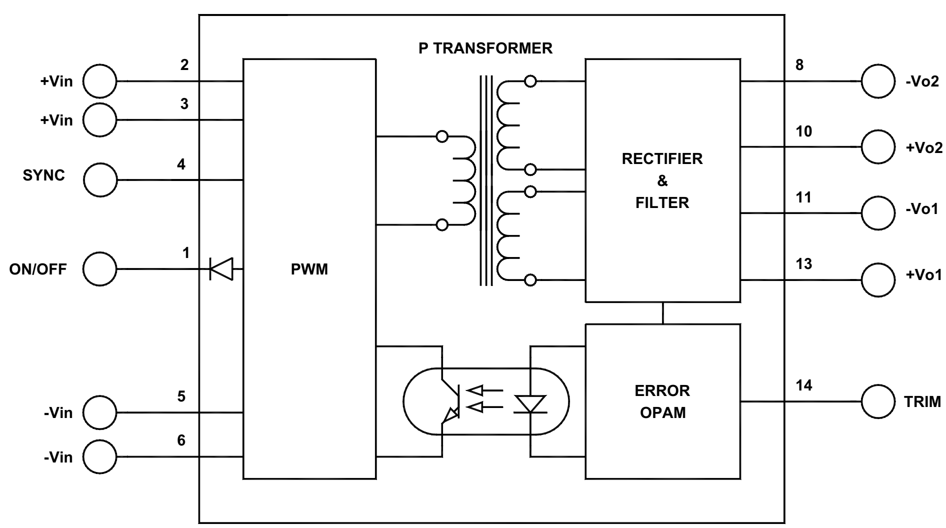
Base Stations

Computer Servers Tele-

com - 48V Supply

Functional Description

The 150W series of high-voltage isolated DC/DC converters accept an input voltage of 12, 24 or 48V_{IN}. The single output models offer an output voltage range from 12V_{OUT} to 75V_{OUT}, while the dual output models offer ±12, ±15, ±18, ±24 and ±37V_{OUT}. 200W models are available upon request and offer multiple output voltages with an input voltage of 48V_{IN} only. A high switching frequency of 160kHz, SMD design, and thermal management improve efficiency and reliability. The converters are designed and thoroughly tested for an input-to-output isolation of 1500Vdc.



Typical Block Diagram

Electrical Specifications

Unless otherwise specified, all parameters are given under typical +25°C with nominal input voltage and under full output load conditions.

INPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Input Voltage Range	See Model Selection Guide				
Input Startup Voltage		15			Vdc
Input Filter	C				
Reverse Polarity	External series-blocking diode				
Reflected Ripple	See Model Selection Guide				
No Load Input Current	See Model Selection Guide				
Full Load Input Current	See Model Selection Guide				
Input Surge Current (20µS Spike)				10	A
Short Circuit Current Limit			150		% I_{IN}
Off State Current			1		mA
Remote ON/OFF Control					
Supply ON	Pin 1 Open (Open circuit voltage: 13V max.)				
Supply OFF		0		0.8	Vdc
Logic Input Reference	-Input for ON/OFF				
Logic Compatibility for Reference	TTL Open Collector or CMOS Open Drain				
Sync Input	TTL	2.5		5	Vdc
Sync Input Frequency Range		310	320	360	kHz
Sync Input Minimum Pulse Width	See Figures 1, 2, 3, 4, 9	200			nS

OUTPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Output Voltage	See Model Selection Guide				
Output Voltage Accuracy			±1	±2	%
Output Current	See Model Selection Guide				
Ripple & Noise			1	2	$\%V_{PP}$ of V_{OUT}
Line Regulation			±0.5	±1	%
Load Regulation			±1	±2	%
Output Overvoltage Protection			120		% of V_{OUT}
Temperature Coefficient @ FL			0.02		%/°C
Transient Response Time (to within 1% of V)	50% FL to FL to 50% FL, See Figure 8		250		µS
Short Circuit Protection	By input current limiting				
Output Adjust Range	See Figures 1–4,		±5		%

GENERAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Efficiency	See Model Selection Guide				
Isolation Voltage (1 min.), Input to Output	100% Tested in production		1500		Vdc
Isolation Resistance			10^9		Ω
Isolation Capacitance			180		pF
Switching Frequency			160		kHz
Turn On Delay	See Figure 8		7	10	mS
Soft Start Time	See Figure 8		7	15	mS

ENVIRONMENTAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Operating Temperature Range (Ambient)*	See Figure 5	-40		+70	°C
Storage Temperature Range		-55		+125	°C
Thermal Resistance without Heat Sink	°C per watt internally dissipated		2.5	3	°C/W_{DISS}
Heat Sink Thermal Resistance	See Figure 6		5.6		°C/W_{DISS}
Thermal Resistance with Heat Sink			1.7		°C/W_{DISS}
Maximum Operating Case Temperature				110	°C
Derating	See Figure 5				
Cooling	Free air convection				
EMI/RFI	Six-sided continuous shielded metal case				
MTBF	per MIL-HNBK-217F (Ground benign, +25°C)		400,000		hours
Humidity	Up to 95% non-condensing				
Thermal Shutdown	Case Temperature		110	115	°C
Thermal Hysterisis			25	35	°C

* See footnotes 1 and 2.

PHYSICAL CHARACTERISTICS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Dimensions (L×W×H)	3.00×2.56×0.75 in. (76.20×65.02×19.05mm)				
Weight	7.87 oz. (223g)				
Case Material	Black coated copper				
Shielding Connection, 12, 24V_{IN}	-V_{IN} (Pins 5 & 6)				
Shielding Connection, 48V_{IN}	+V_{IN} (Pins 2 & 3)				

Model Selection Guide

MODEL NUMBER	INPUT					OUTPUT		
	Voltage (Vdc)		**Current** (mA)		**Reflected Ripple**[4] (mA_{PP})	**Voltage** (Vdc)	**Current** (mA)	**Efficiency Full Load** (%)
	Nominal	**Range**	**No Load**	**Full Load**[3]				
150S12/12	12	9–18	80	9920	150	12	8333	84
150S15/12	12	9–18	80	9780	150	15	6667	85
150S18/12	12	9–18	80	10345	150	18	6000	87
150S24/12[5]	12	10.5-18	80	10081	150	24	4166	82
150S48/12[5]	12	9–18	80	10120	150	48	2100	83
150S75/12[5]	12	9–18	80	9780	150	75	1330	85
150S12/24	24	18–36	40	7102	100	12	12500	88
150S15/24	24	18–36	40	7102	100	15	10000	88
150S18/24	24	18–36	40	7102	100	18	8333	88
150S48/24[5]	24	18–36	40	7184	100	48	3125	87
150S75/24[5]	24	18–36	40	7022	100	75	2000	89
150S12/48	48	36–72	15	3453	40	12	12500	91
150S15/48	48	36–72	15	3397	40	15	10000	92
150S18/48	48	36–72	15	3397	40	18	8333	92
150S48/48[5]	48	36–72	25	3551	60	48	3125	88
150S75/48[5]	48	36–72	25	3472	60	75	2000	90
150D9.5/12	12	9-18	80	9654	150	±9.5	5000	82
150D12/12 *	12	9–18	80	9920	150	±12	4167	84
150D15/12 *	12	9–18	80	9920	150	±15	3333	84
150D18/12 *	12	9–18	80	9920	150	±18	3000	84
150D24/12 *	12	9–18	80	10120	150	±24	2100	83
150D7/28 *[6]	28	18–36	66	4716	100	±7	+9000/-7000	85
150D12/24 *	24	18–36	40	7102	100	±12	6250	88
150D15/24 *	24	18–36	40	7102	100	±15	5000	88
150D18/24 *	24	18–36	40	7102	100	±18	4167	88
150D12/48 *	48	36–72	15	3434	40	±12	6250	91
150D15/48 *	48	36–72	15	3394	40	±15	5000	92
150D18/48 *	48	36–72	15	3394	40	±18	4167	92
150D24/48 *	48	36–72	15	3434	40	±24	1562	91

Contact factory for 200W models with $48V_{IN}$ or other custom input and output voltage combinations

* For dual isolated outputs, insert an **I** after the last digit (see Ordering Guide).
[1] Adequate insulation is to be provided to the converters at the end usage as per applicable requirements.
[2] Temperature rise on the case of the converters is to be considered during the end usage as per applicable requirements.
[3] The maximum input current at any given input range measured at minimum input voltage is given as $1.6{*}I_{NOMINAL}$. Nominal input current is the typical value measured at the input of the converter under full-load room temperature and nominal input voltage (24Vdc).
[4] Measured with 100µF capacitor at the input power pins.
[5] For single output converter models of 24,30, 48, and 75Vout models use the dual output configuration as shown in Figure 1.
[6] For 150D7/28, the converter is specified with the output load that is unbalanced,+7V@9A & -7V@7A.

ORDERING GUIDE

150 S 12/24 _ _ _ _

- Output Power (**150** = 150W, **200** = 200W)
- Number of Outputs (**S** = Single, **D** = Dual)
- Output Voltage
- Input Voltage
- Insert an **R** for RoHS models *(Optional)*
- Insert an **X** for -55 C to 85 C models *(Optional)*
- Insert an **I** for dual isolated outputs *(Optional)*
- Insert an H for Heatsink (*Optional*)

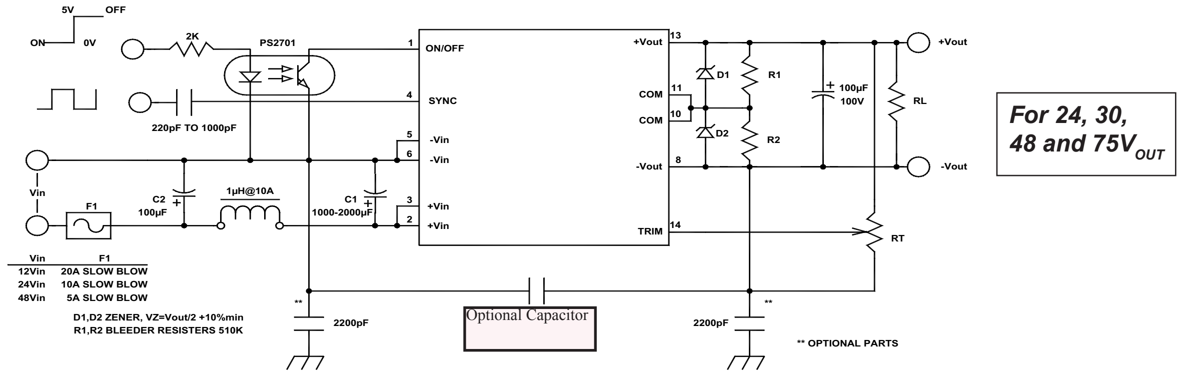


FIGURE 1. Typical connection diagram of single output converter for 24, 30, 48 and 75V$_{OUT}$ models

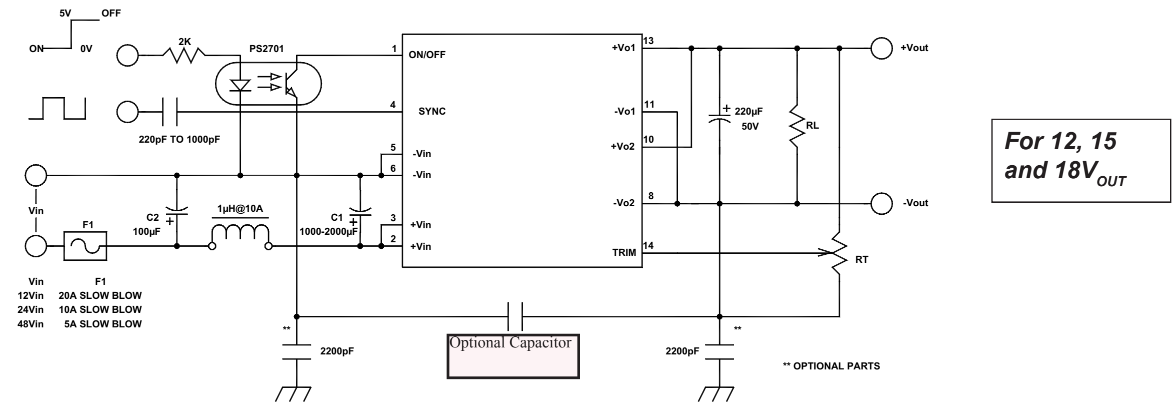


FIGURE 2. Typical connection diagram of single output converter for 12, 15 and 18V$_{OUT}$ models

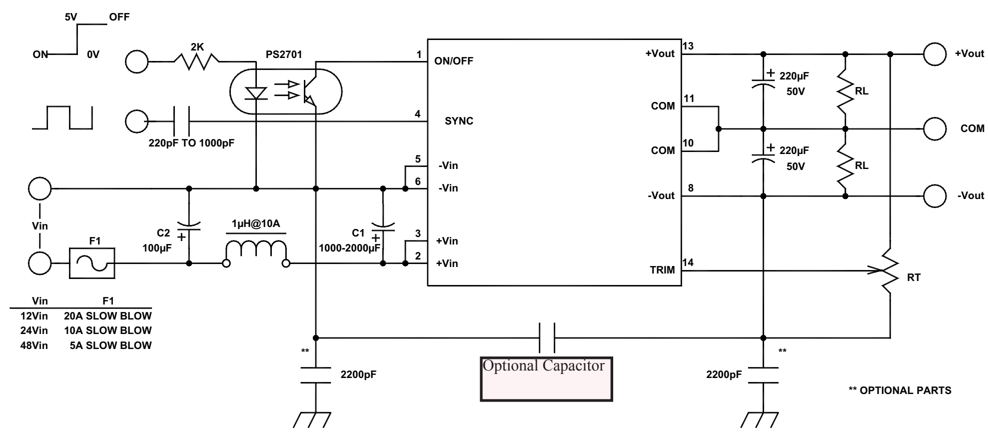


FIGURE 3. Typical connection diagram of dual output converter

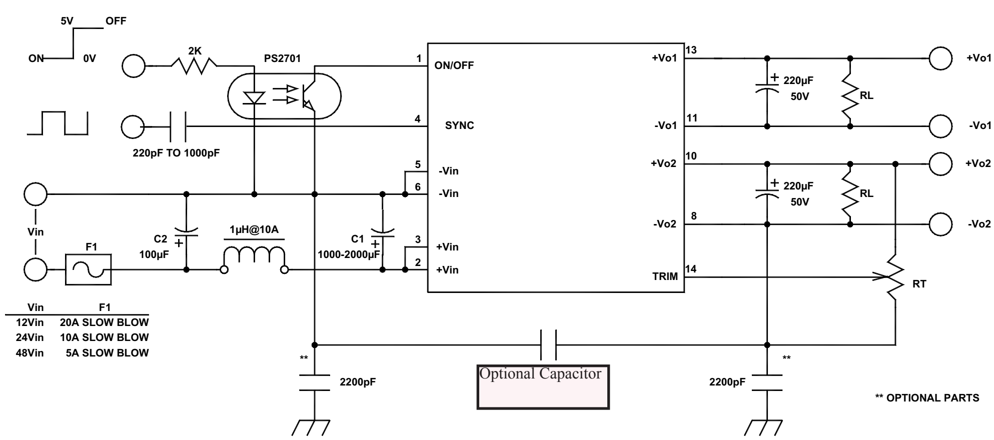


FIGURE 4. Typical connection diagram of isolated, dual output converter

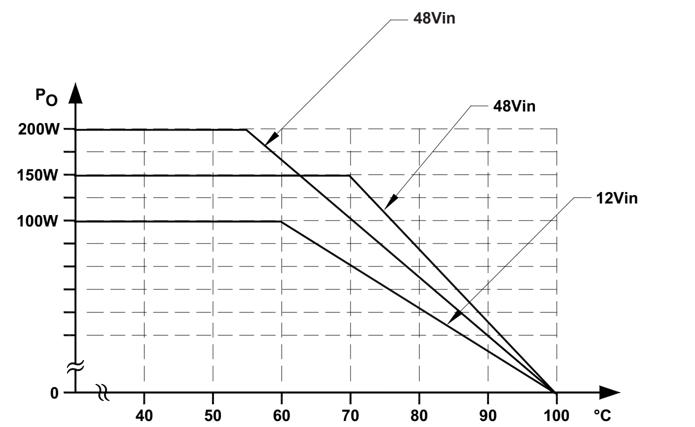


FIGURE 5. Typical derating curves of 150W series with free air cooling

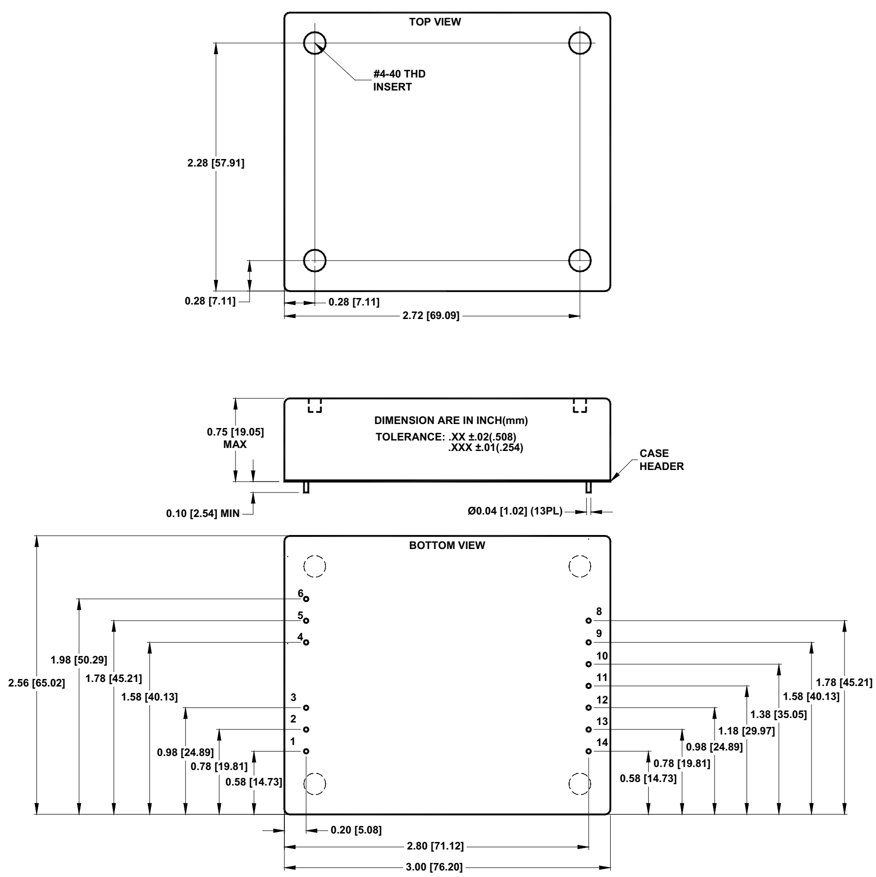
EXTERNAL TRIMMING OF OUTPUT VOLTAGES

To trim the output voltage DOWN, connect a 5% ¼W resistor between the $+V_{O1}$ output and trim pin of the converter. To trim the output voltage UP, connect a 5% ¼W resistor between the $-V_{O1}$ output and trim pins of the converter. For UP/DOWN trimming capability, connect a 20kΩ potentiometer between the + and - output pins, with the wiper arm connected to the trim pin.

The trim resistors/potentiometer can be connected at the converter output pins or the load. However, if connected at the load, the resistance of the runs becomes part of the feedback network which improves load regulation. If the load is some distance from the converter, the use of #20 gauge wire is recommended to avoid excessive voltage drop due to the resistance of the circuit paths.

See our application notes:
DC-001: Testing Transient Response in DC/DC Converters
DC-004: Thermal Consideration for DC/DC Converters

MECHANICAL SPECIFICATIONS



Pin	Function	
	SINGLE	***DUAL***
1	ON/OFF	ON/OFF
2	$+V_{IN}$	$+V_{IN}$
3	$+V_{IN}$	$+V_{IN}$
4	SYNC	SYNC
5	$-V_{IN}$	$-V_{IN}$
6	$-V_{IN}$	$-V_{IN}$
7	NOT USED	$-V_{OUT}$
8	$-V_{O2}$	$-V_{OUT}$
9	NOT USED	COM
10	$+V_{O2}$	COM
11	$-V_{O1}$	COM
12	NOT USED	$+V_{OUT}$
13	$+V_{O1}$	$+V_{OUT}$
14	V_{OUT} ADJ	V_{OUT} ADJ

MECHANICAL SPECIFICATIONS for HEAT SINK

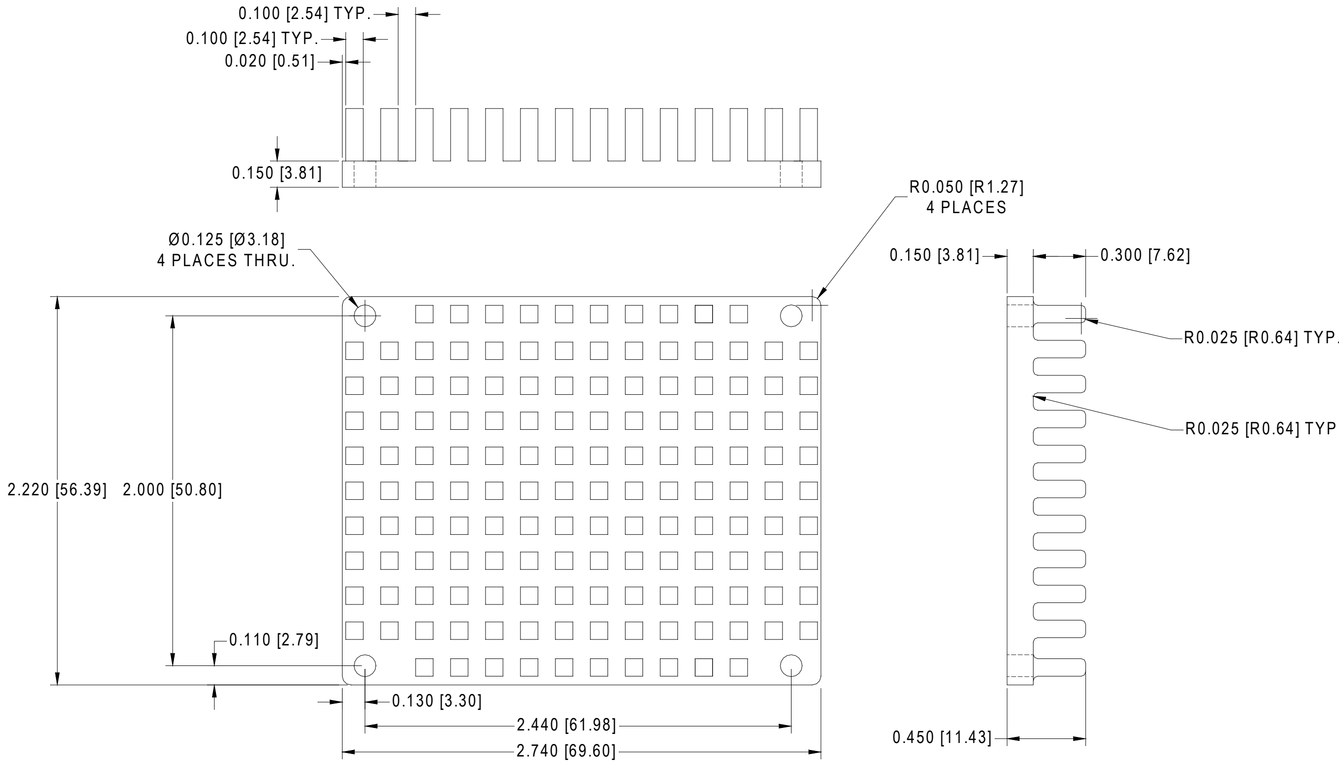


FIGURE 6. Optional Heat Sink for the 150W DC-DC Converter

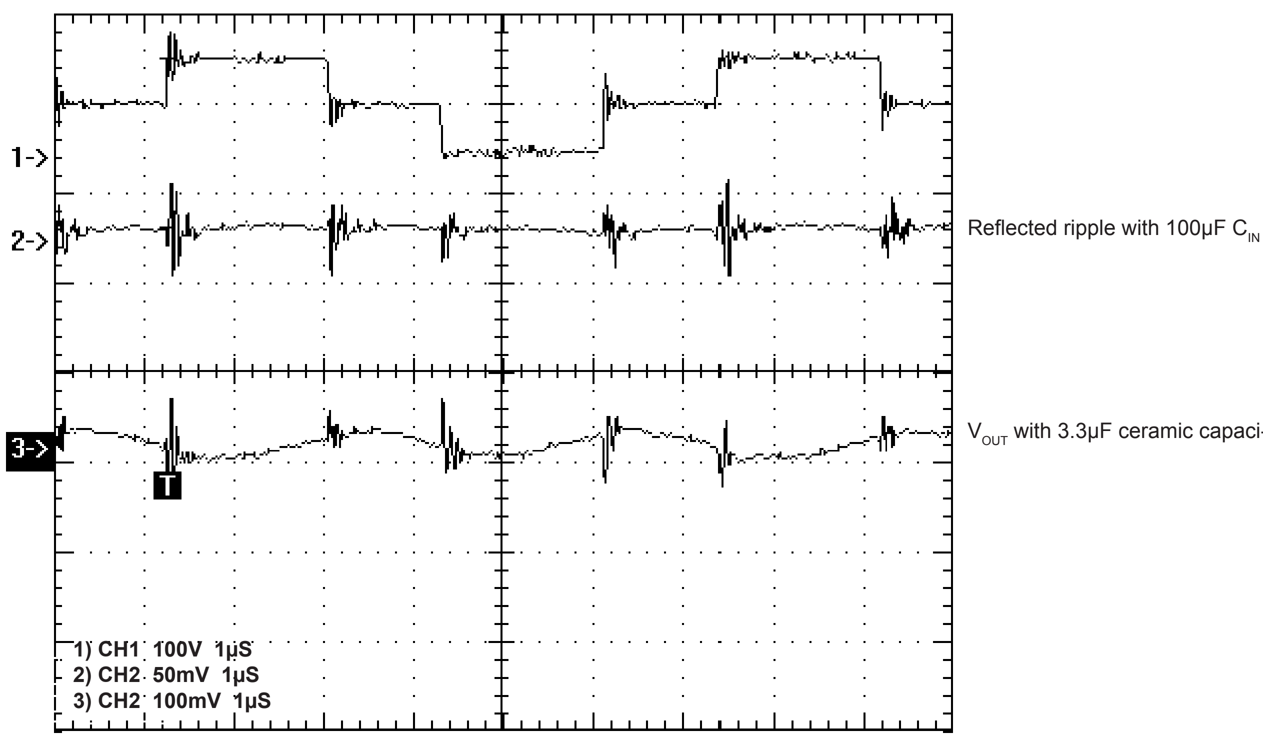


FIGURE 7. Reflected ripple and V_{OUT}

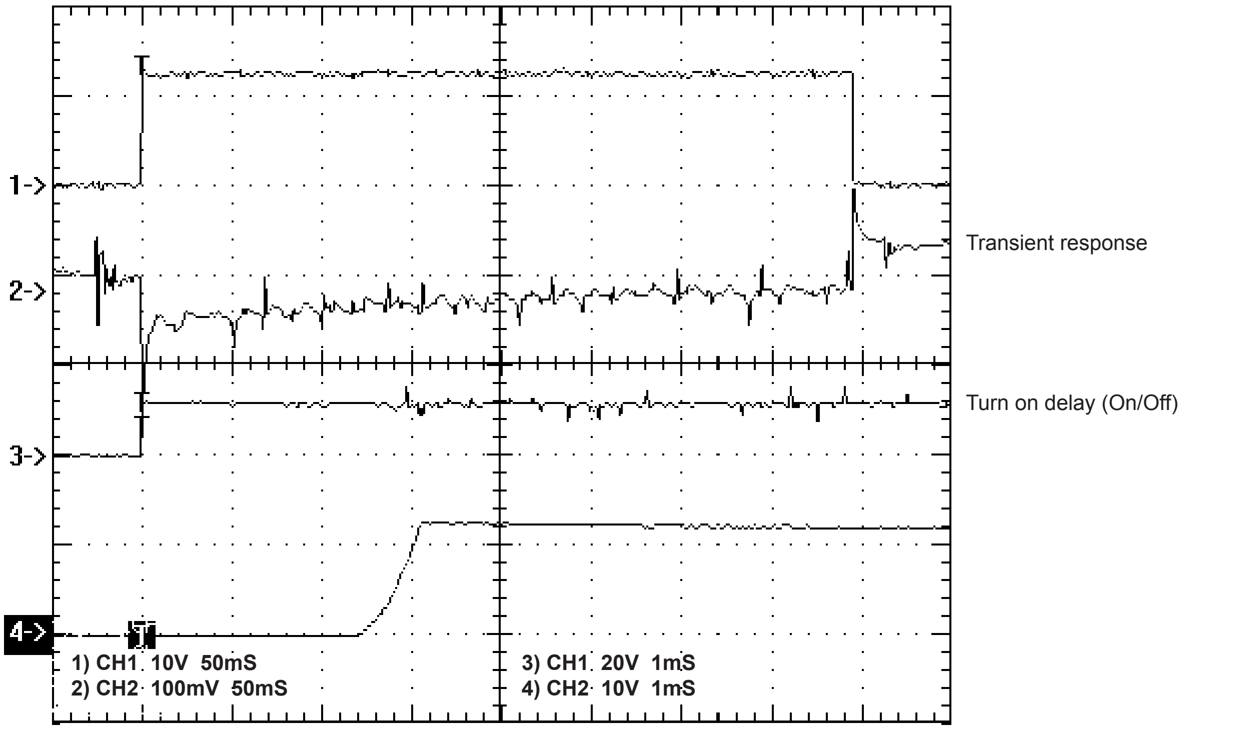


FIGURE 8. Transient response and turn on delay with soft start

EXTERNAL SYNCHRONIZATION

The converter can be synchronized to an external clock by driving the SYNC pin (pin 2) directly. The driving signal frequency must be 330kHz +5% (3% to 4% low, 96% to 97% high duty cycle). When the external clock is AC-coupled to the SYNC pin of the converter through a ceramic capacitor, connect a signal Schotky diode with the cathode connected to the SYNC pin and the anode to $-V_{IN}$ (See Figure 9). AC coupling reduces the power required for driving multiple converters and allows for continuous operation of the other synchronized converters in case the driving signal is missing or a short circuit develops at one of the sync inputs.

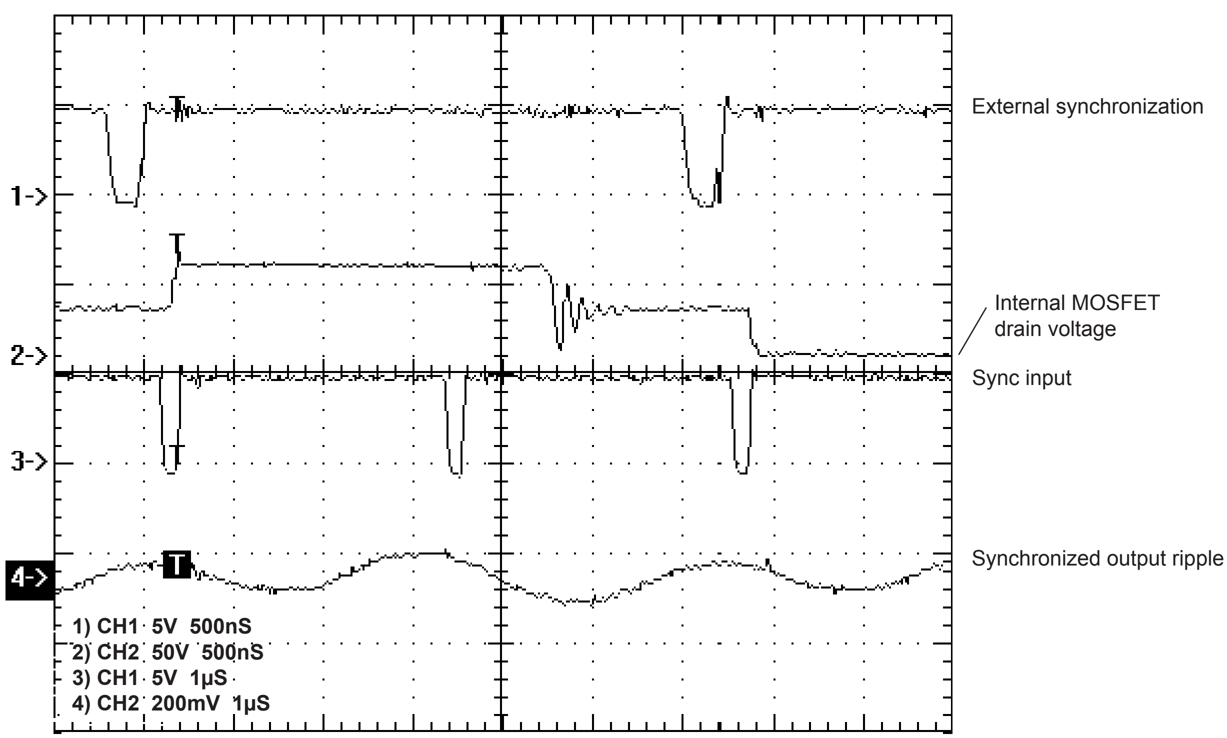
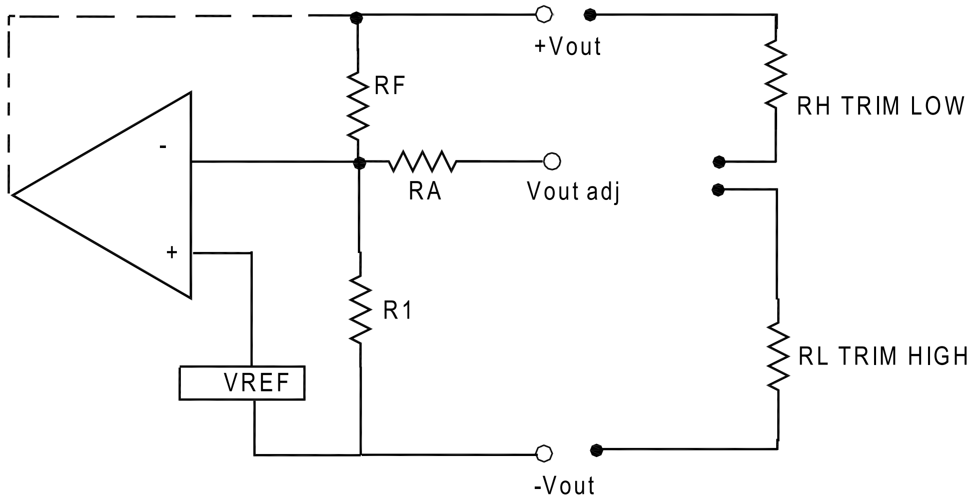


FIGURE 9. Synchronization waveforms



Vout(V)	R1(KOhms)	RF(KOhms)	RA(KOhms)	VREF(V)
12	4.99	19.1	30.1	2.50
15	4.22	21.5	30.1	2.50
18	4.42	27.4	30.1	2.50
(+/-12)24	3.83	33.2	30.1	2.50
(+/-15)30	4.64	51.1	30.1	2.50
(+/-24)48	4.99	90.9	30.1	2.50
(+/-37.5)75	4.99	147	30.1	2.50

FIGURE 10. Output voltage trim table for 150W series

To calculate RH adjust for higher Vout use

RH= {[R1*RF*Vref]/[(R1*Vout)-Vref(R1+RF)]} - RA

To calculate RL for lower Vout use

RL= {[R1*RF(Vout-Vref)]/[Vref(RF+R1)-R1Vout]} - RA

where Vout is the new desired ouput voltage.