PRELIMINARY

ACC1200

12W Adjustable Output Current or Voltage DC/DC Converter

Key Features

Efficiencey up to 76%
Wide input range (2:1)
Six-sided shielding
Soft Start
Adjustable output current or voltage
Short circuit and thermal protection
Output overvoltage protection
Output over current flag
Input to Output Isolation

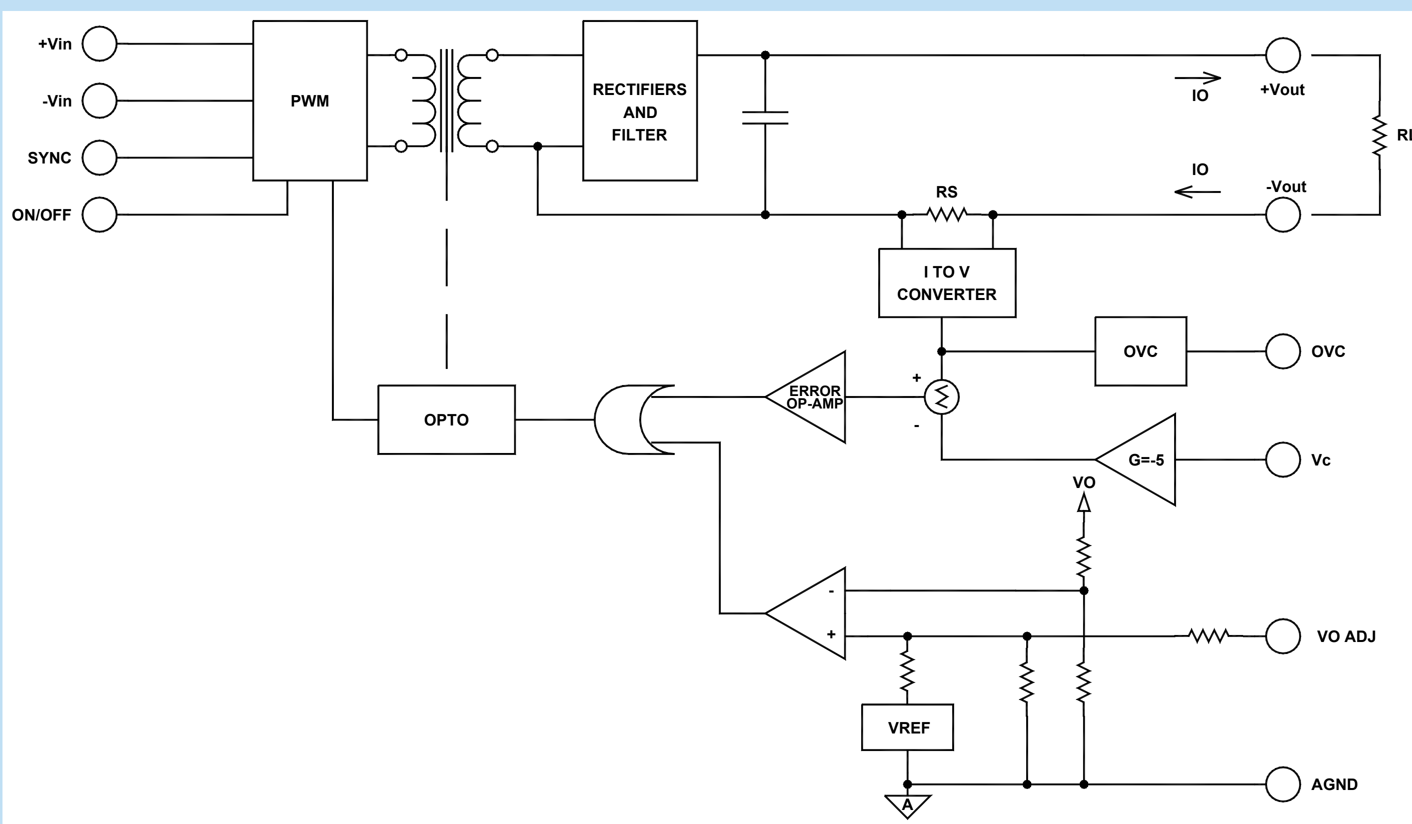
Beta Dyne is protected under various patents, including but not limited to U.S. Patent numbers: 5,777,519; 6,188,276; 6,262,901; 6,452,818; 6,473,3171.

Applications

Adjustable LED power supply
Instrumentation
Test & Measurement
Telcom

Functional Description

The AC1200 is a 12 watt isolated DC/DC converter with adjustable output current or voltage. The converter accepts 0 to 10V at it's V_C control input and generates an output current from 0 to 2A. Additional features includes output over voltage protection, output over current flag, 2:1 input voltage range and optional +/- 12V supply.



Typical Block Diagram of ACC1200

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

Electrical Specifications

INPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Input Voltage Range		9.5	12	18	Vdc
Startup Voltage for Bias Converter					Vdc
Input Startup Voltage, $12V_{IN}$		9.5			Vdc
Input Overvoltage Protection, $12V_{IN}$			19	21	Vdc
					Vdc
Input Filter	LC				
Reverse Polarity	Internal parasitic shunt diodes				
Reflected Ripple	V_{IN} =12V, I_{OUT}=Full Output Load		25		mA
No Load Input Current	V_{IN} =12V, I_{OUT}=Full Output Load		80		mA
Input Surge Current (20µS Spike)			10		A
Short Circuit Current Limit			150		% I_{IN}
Short Circuit Current Limit for Bias Converter			150		% I_{IN}
Off State Current			1000		µA
Remote ON/OFF Control					
Supply ON	Pin 1 Open (Open circuit voltage: 13V max.)				
Supply OFF		0	.8		Vdc
Logic Input Reference	To $-V_{IN}$ for ON/OFF and SYNC				
Logic Compatibility for Reference	TTL Open Collector or CMOS Open Drain				
Sync, High	See External Synchronization Notes in Application Info				Vdc
Sync, Low	See External Synchronization Notes in Application Info				Vdc

OUTPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Output Voltage		0	6.5	12	V
Output Current		0		2	A
Output Voltage Accuracy			1		%
Ripple & Noise			.5	2	% of V_{OUT}
Line Regulation			.5		%
Load Regulation			.5		%
Temperature Coefficient @ FL			.01		%/°C
Transient Response Time	50% FL to FL to 50% FL, see Figure 14		1		mS
Short Circuit Protection	By input current limiting hick-up		1.1	1.4	% of I_{OUT}
V_O ADJ (Pin 12), $0V_C$, V_C, V_{OADJ}	Reference to Analog Ground (Pin 9)				

DO NOT CONNECT I_O RETURN AND A_{GND} ON YOUR PCB, THEY ARE CONNECTED INSIDE THE CONVERTER

GENERAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Efficiency			76		%
Isolation Voltage (1 min.), Input to Output			1000		Vdc
Isolation Resistance			TBD		MΩ
Isolation Capacitance			TBD		pF
Switching Frequency, internal	For Bias Converter +/-V_{CC}		200		kHz
Switching Frequency, internal	For Power Converter		200		kHz
External Synchronization Frequency	Duty Cycle of 5% min. to 45% max. See Figure 13		420		kHz
Turn On Delay	See Figure 4,5		12		mS
Soft Start Time	See Figure 4,5		3		mS

ENVIRONMENTAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Operating Temperature, Industrial (Ambient)*		-25		+71	°C
Storage Temperature Range		-55		+125	°C
Thermal Turn Off, Case Temperature			90		°C
Thermal Hysterisis			20		°C
Derating	None				
Humidity	Up to 95% non-condensing				
Cooling	Free-air convection				
EMI/RFI	Six-sided continuous shielded metal case				
MTBF	per MIL-HNBK-217F (Ground benign, +25°C)		1.0×10^6		hours

PHYSICAL CHARACTERISTICS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Dimensions (L×W×H)	2.00 x 2.00 x 0.50 in. (50.80 x 50.80 x 12.70mm)				
Weight	2.60 ozs (73.70g)				
Case Material	Tin Plated Steel				
Shielding Connection	-Input (Pin 3)				

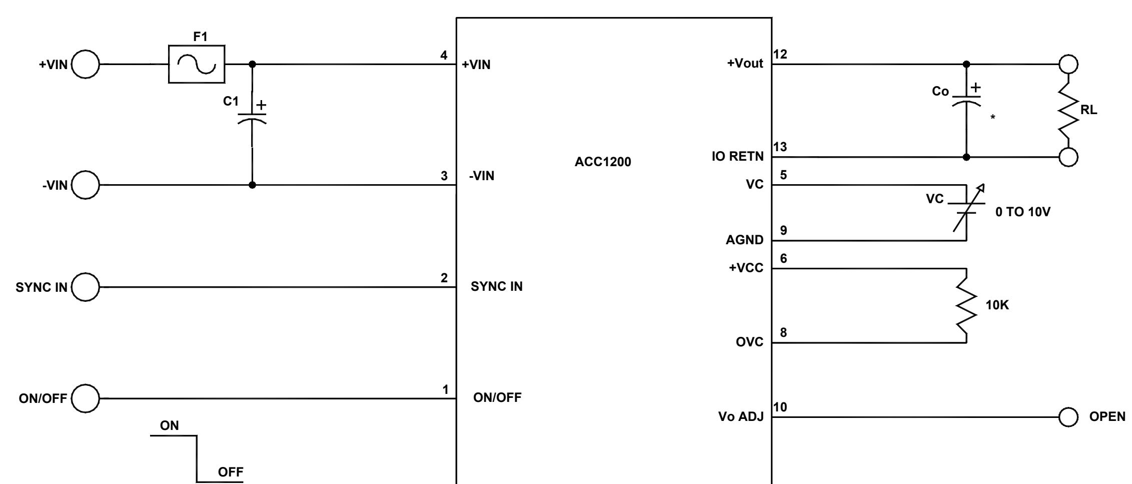


FIGURE 1. Typical connection diagram of ACC1200 for adjustable output current $I_O=0.2V_C$, $V_O=I_O*R_L$

*** Optional Parts**

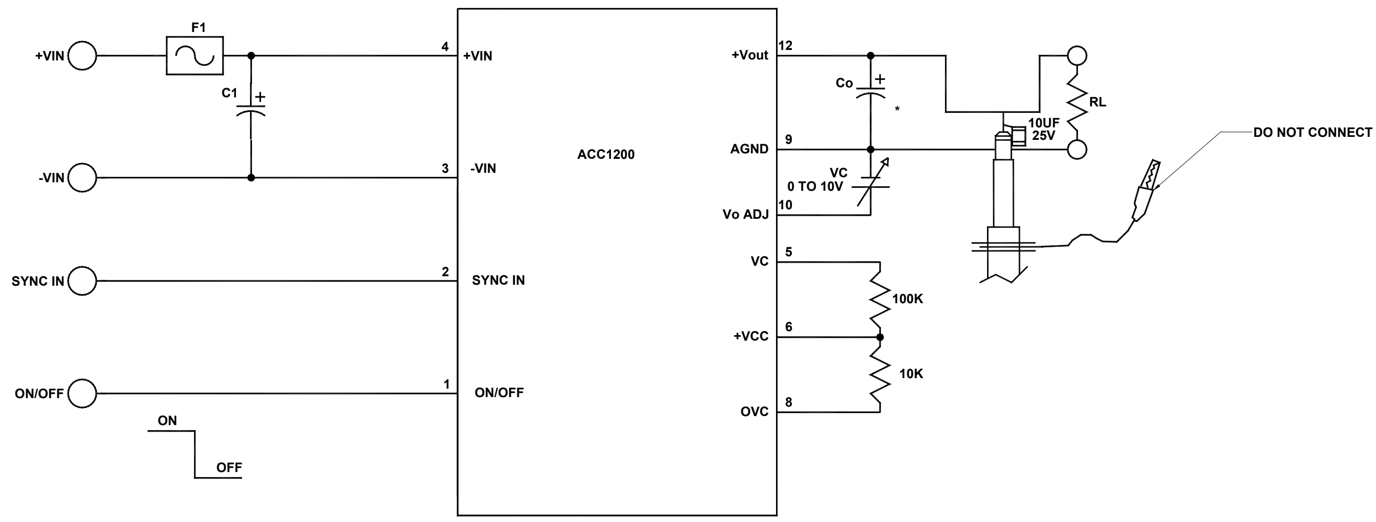


FIGURE 2. Typical connection diagram of ACC1200 for adjustable output voltage. $V_O=2.82*V_{O\,ADJ}$, $V_O=6V$ Oscilloscope probe shown on how to measure output ripple

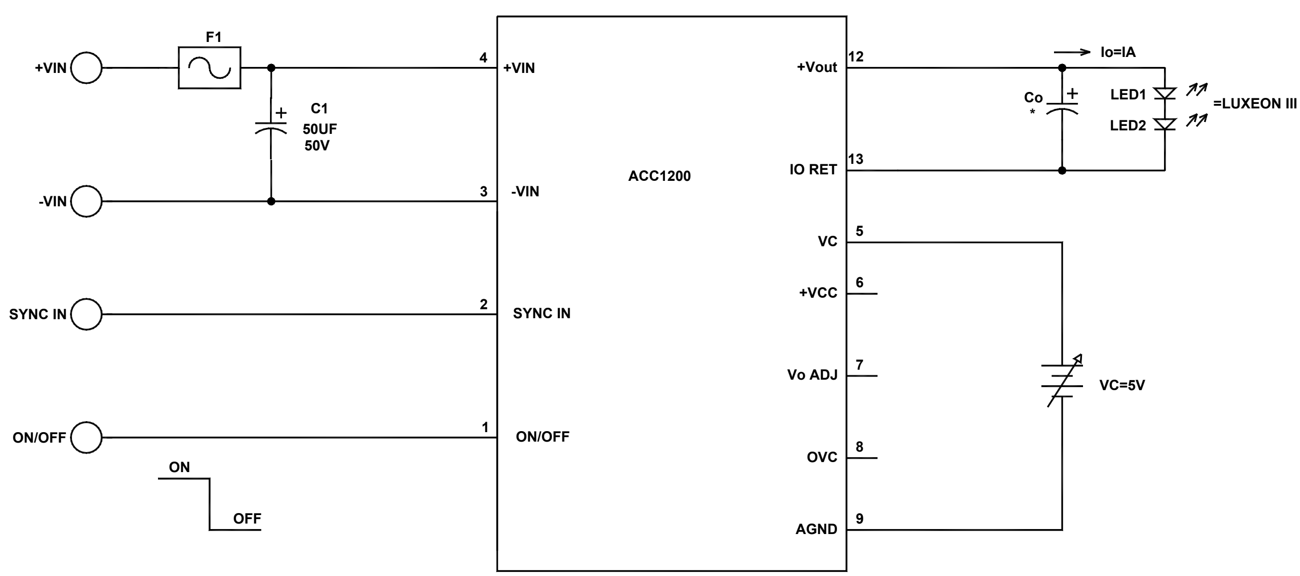


FIGURE 3. Typical connection diagram of ACC1200 drives 2 Luxeon III LED with analog dimming capability

*** Optional Parts**

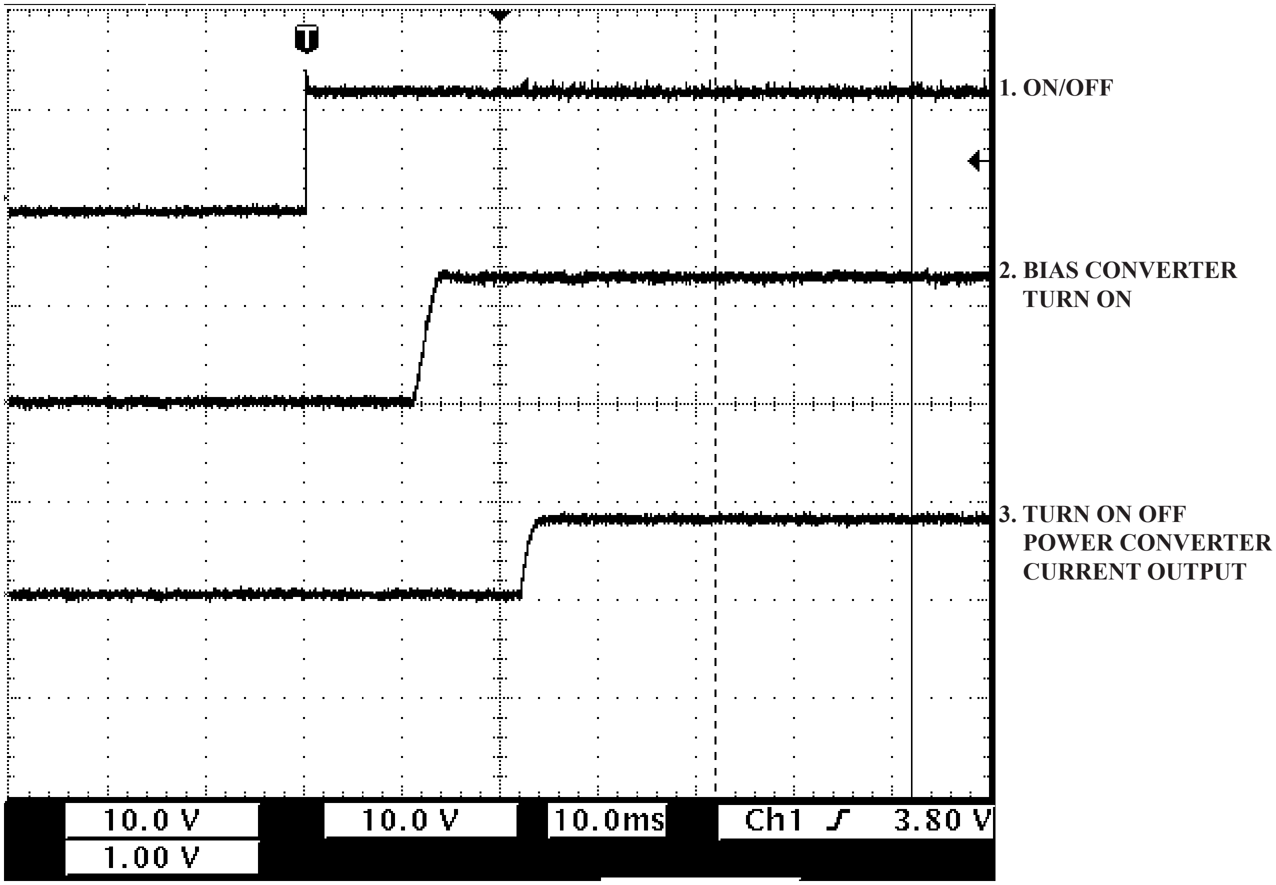


FIGURE 4. Power converter output current, bias converter and ON/OFF waveforms

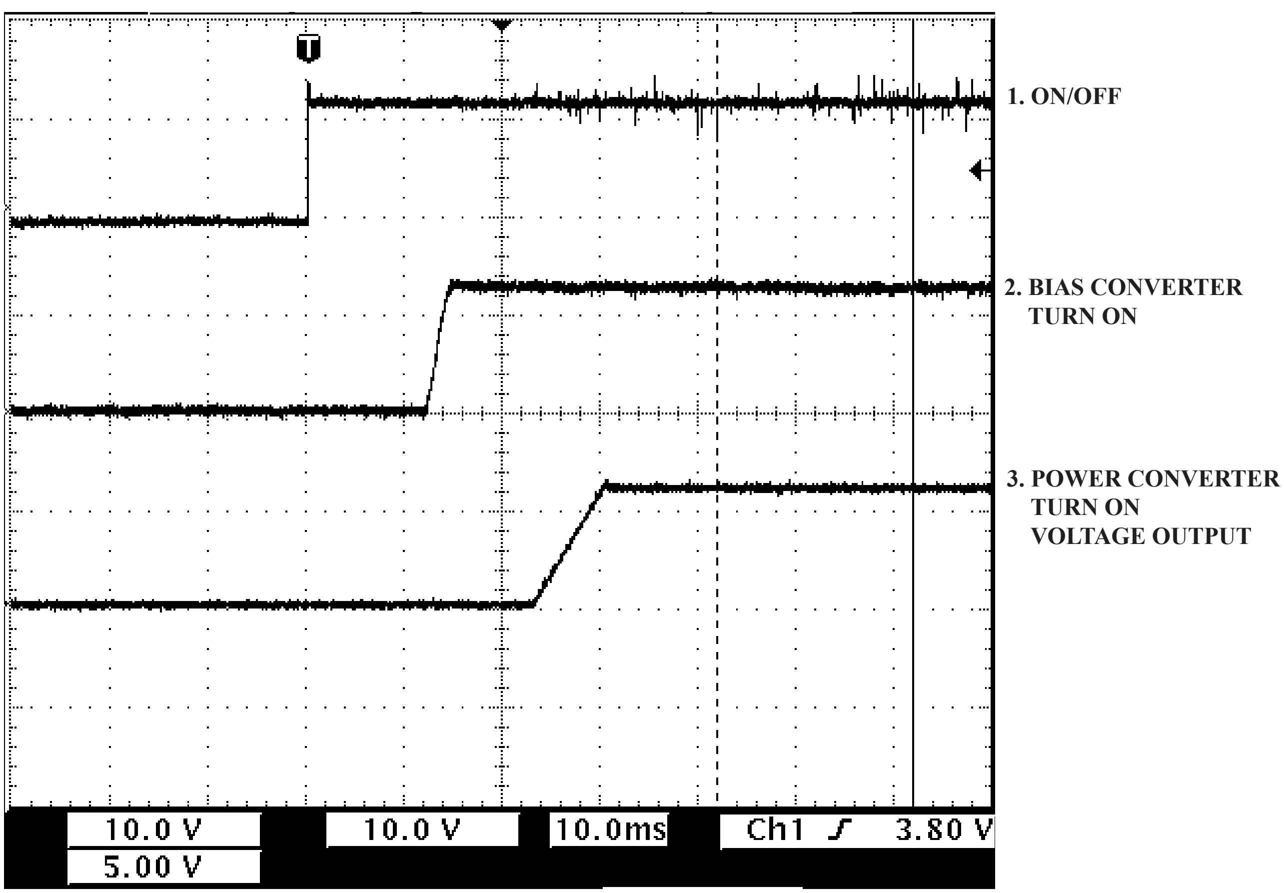


FIGURE 5. Power converter output voltage, bias converter and ON/OFF waveforms

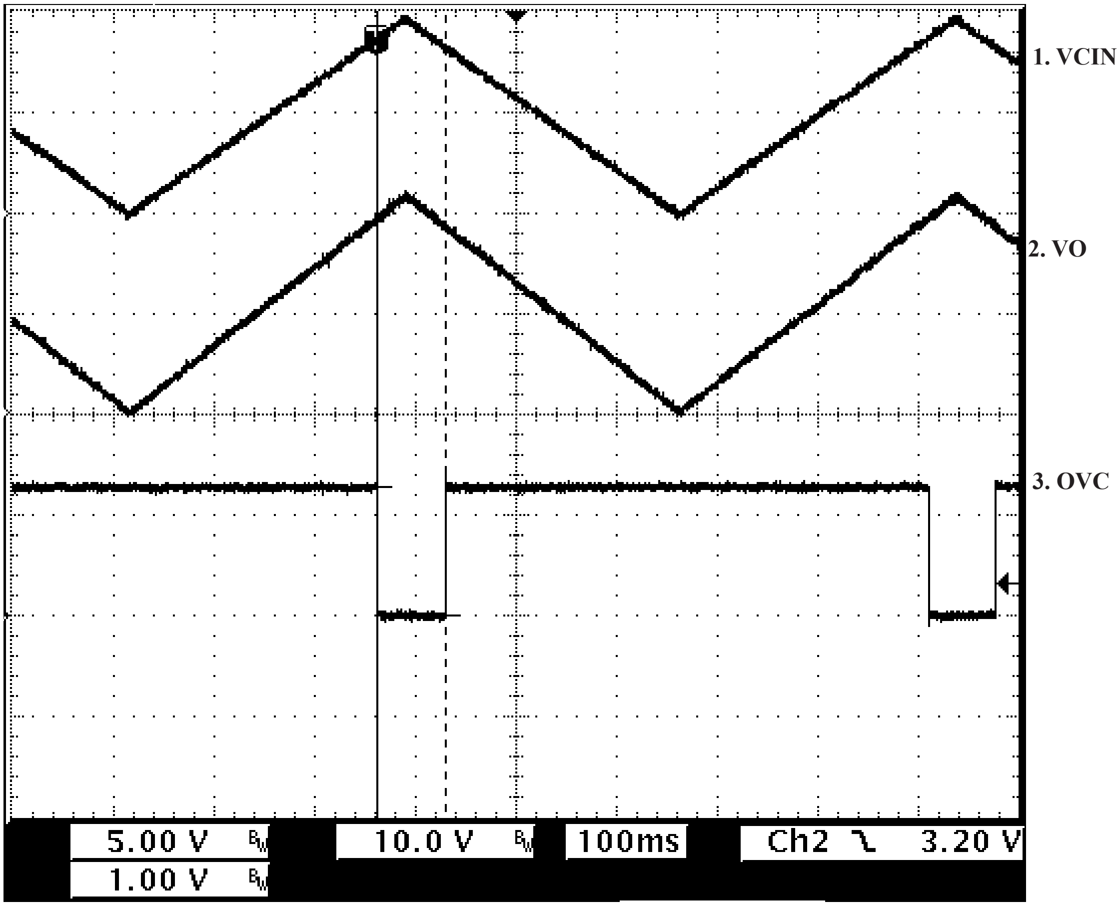


FIGURE 6. Output voltage and output current flag voltage with control voltage waveforms of ACC1200

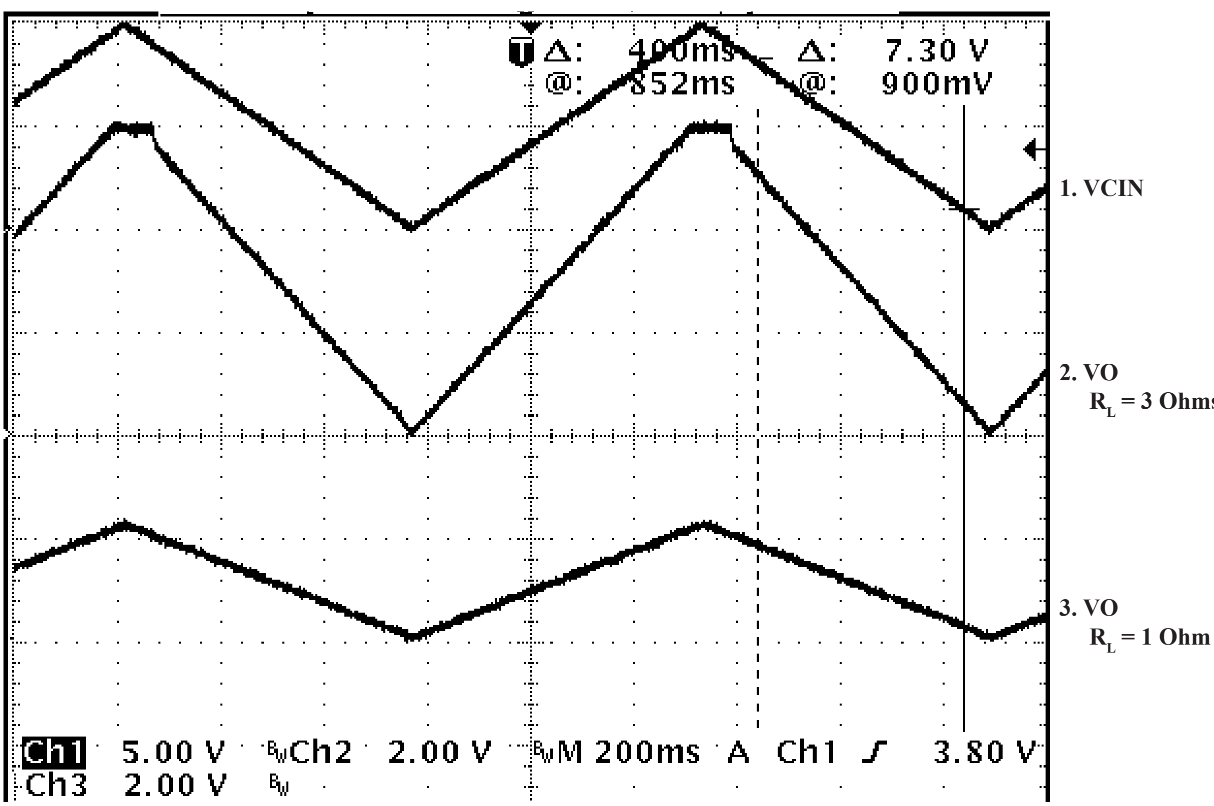
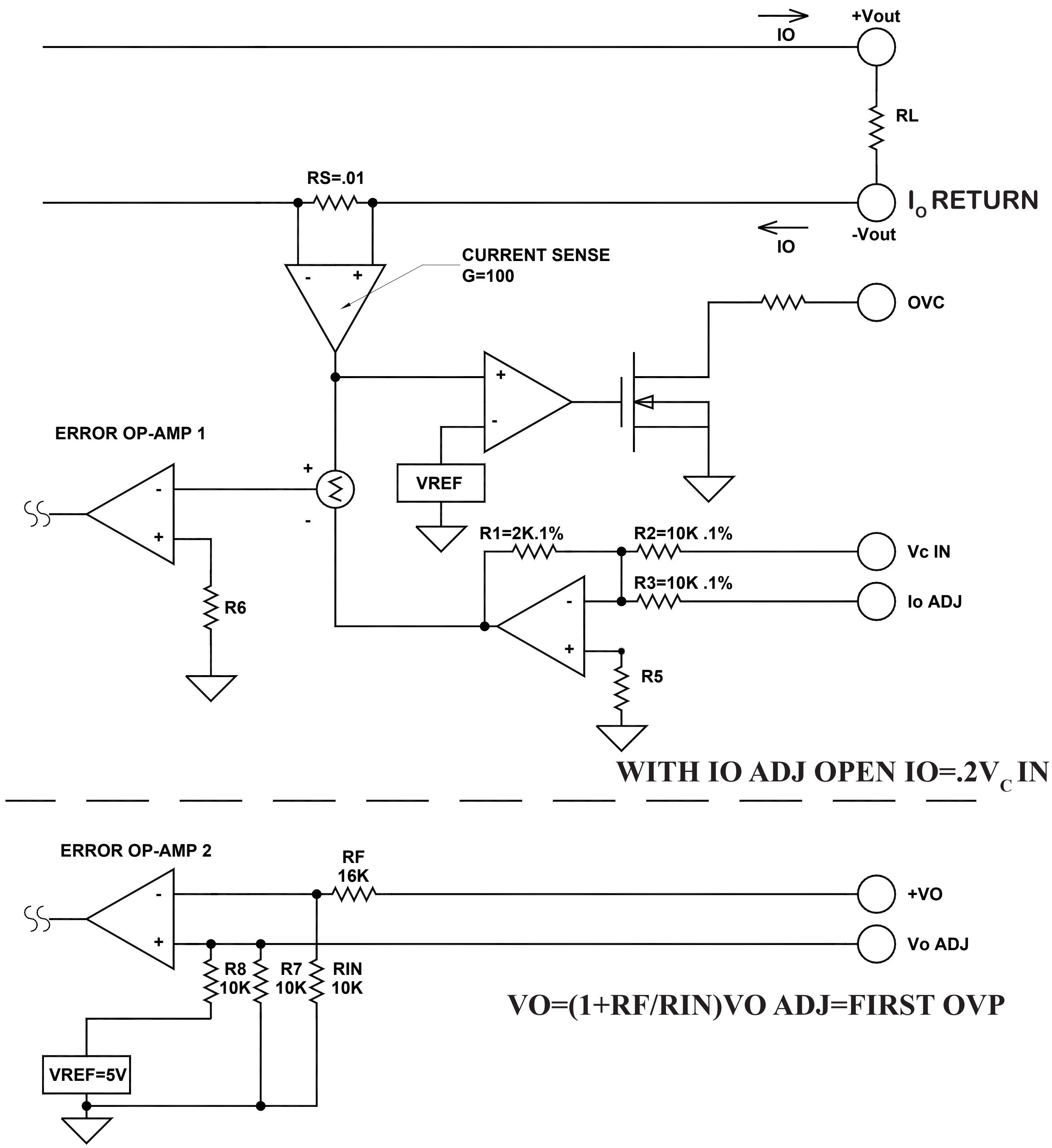


FIGURE 7. Output voltage with different loads with control voltage waveforms of ACC1200

Current Mode Control



Voltage Mode Control

FIGURE 8. Output section of ACC1200

DO NOT CONNECT IO RETURN AND AGND ON YOUR PCB, THEY ARE CONNECTED INSIDE THE CONVERTER.

OUTPUT CURRENT ADJUSTMENT

The accuracy of the output current depends only on the accuracy and the stability of the component used in the internal circuitry, specifically the current sense resistor which has a .5% accuracy and TC of 50ppm/C°, all other resistors have .1% accuracy and 25pmm/C °.
The OPAMP used in this mode of operation is a precision OPAMP with minimum open loop gain of 130db.
The output current is trimmed at the factory of Io accuracy of +/-5% of Io set from 0 to 2A. If additional trim is required use a calibrated current meter, or a current shunt or even an electronic load, as shown in Figure# 9.

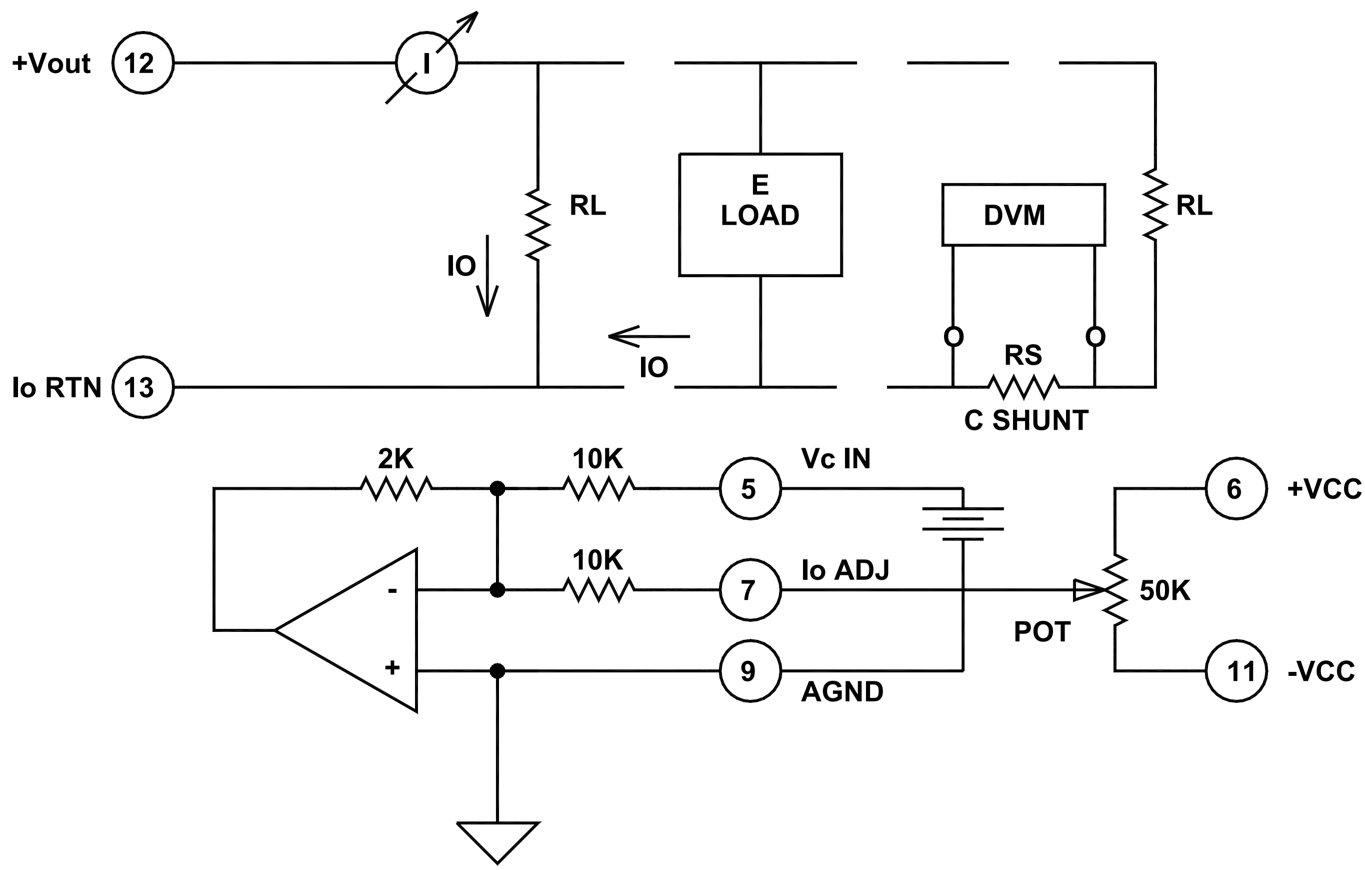


FIGURE 9. I_O adjust of ACC1200

To avoid any erroneous measurements the series resistance of the current meter, E.L., RS must be added to RL such that RL total = RL + Series Resistance of the instrument.
For the RS, a small value 4 terminal resistor with a high power rating can be used to minimize any thermal effect from the power dissipation. Set VC for required Io (Io =.2Vc), then monitoring Io, adjust the potentiometer for the required Io value on the meter.
If a resistor will be used for the Io adjustment, select a 1% metal film resistor and connect it between Io adjust (Pin 7) and –VCC (Pin 11) to reduce Io or between Pin 7 and +VCC to increase Io.
In this mode of operation, all analog signals are referenced to analog ground Pin 9. In the voltage mode either Pin 9 or Pin 13 Io RTN can be used. In this case, use a separate trace to connect the signal return to AGND (Pin 9) as close as possible to the pin. When Io RTN is used as –Vo = Io RTN (Pin 13) make sure the current mode is disabled (by forcing VC in high or connect it to +VCC.

Also, additional power is dissipated Io * RS => Pd = Io^2 RS = .01 I^2 W. For Io = 2A and Pd = 40mW. Please note the OVC function is enabled, in the voltage mode where Pin 9 AGND is used for –Vo, the current mode circuitry is disabled such as the OVC, differential OPAMP and the current limiting function is accomplished by the PWM in the input section of the converter.

OUTPUT OVERCURRENT MONITOR (OVC)

A voltage comparator compares the output of the current sense amplifier (C.S.A.) to a fixed voltage reference set for maximum Io. When the CSA output exceeds the reference voltage the OVC output (Pin 8), goes low, flagging the outside world for an OVC occurrence. The OVC is connected through a 560Ω resistor to the drain of an "N" mosfet with 50VDS max.

APPLICATION INFORMATION

A) Assuming that the applied Vin is within UVP ≤ Vin ≤ OVP in approximately 14ms, the bias converter is turned on (See FIG 4) and powers the input and output control circuitry, PWM 1 is ON. At this point, a power "good" signal allows the soft start capacitor of PWM 2 which was held low during the first 14ms to go through its turn on delay and soft start to deliver power to the output under the direction of the output control. The total turn on delay and soft start for the PWM 2 is approximately 24 to 30ms (See FIG 4, 5 of datasheet). Depending on the output configuration, the ACC1200 can operate as a constant current or constant control converter.

The output current Io is set by the control voltage VC from 0 to 10V which produces and Io from 0 to 2A for Io to remain constant (VC = Constant) the converter sets the output voltage such that Io=VO/RL =CONSTANT. In the constant Io mode, the converter monitors Io and compares it to scale down VC, the difference of the two signals is then fed back to the PWM on the input side which in turn, adjusts the output voltage to keep Io constant or VO/RL constant. Any change in RL (ΔRL) is proportional to ΔVO whereas VO =.2VCRL or VC = 5*VO/RL VO = IO.RL

B) By monitoring the changes on the output voltage over time ΔV, the changes on a remote load can be monitored such as LEDs with -2mv/C° or the temperature of an inductive load.
For RL →∞ (Open Circuit) VO →∞ , in this case the output of the converter will reach the output value given by VO = (1+RF/Rin)VA(See Figure 8 of datasheet).
In case the OVP#1 is lower than the required VO max the VO adjust (Pin 10) can be used to get the output voltage.
The second OVP#2 is set for 12Vout max to protect the output component of the converter in case an accidental positive over voltage is applied to VO adjust Pin 10.

EXTERNAL SYNCHRONIZATION

The oscillator frequency is generally selected in conjuction with the rest of the system. Each output of the pulse width modulator switches at one half the oscillator frequecy. When the converter needs to be synchronized to an external clock, apply a 0 to 5V pulse on Pin 2 with a 15 to 150 ns pulse width with a frequency 5% greater than the internal free running frequecy of the converter. This results in 2X switching frequency of the power converter or bias converter. For the ACC1200 the external synchronization will be around 420kHz, since the internal switching frequency of the converter is 200kHz.

DRIVING INDUCTIVE LOADS

Referring to Figure 10 and Figure 11, the output of the converter drives a 2mH load and a 6mH load. The inductors have 1.3Ω and 3.9Ω DC resistance respectively.
The control voltage VC is an offset square wave switching from 2V to 6V corresponding to an output current Io=.4A and 1.2A respectively, VO = 1.3X.4 =.52V Low and 1.56V High (See Fig 10).

The overshoot at both the positive or negative edge is due to the limited response time of the feedback loop. If the amplitude of the square wave was 0V to 10V the overshoot voltage will exceed the #1 OVP and will force the output to remain at 6V steady state (See Fig 11). In Figure 10 if the offshoot causes problems in the application, a 1000μF in parallel with L will reduce the overshoot as it shows in (See Fig 10).
A large external output capacitor will reduce even more the current ripple (switching noise).
Referring to Figure 11 , point A shows the overshoot and OVP #1 taking over the control of the output voltage for the rest of the ON period.
The clamping of the output voltage at 6V is due to the VC switching from 0V to 10V.
Given the 6mH inductor has a 3.9Ω resistance the full scale VO = 2*3.9 = 7.8V. Therefore, the OVP 1 for the 6mH load must be set to 7.8V or higher especially if the T.C. of the inductor resistance is high.
In Figure 11 the OVP is set through the VO adjust (Pin 10) to 8.4V.

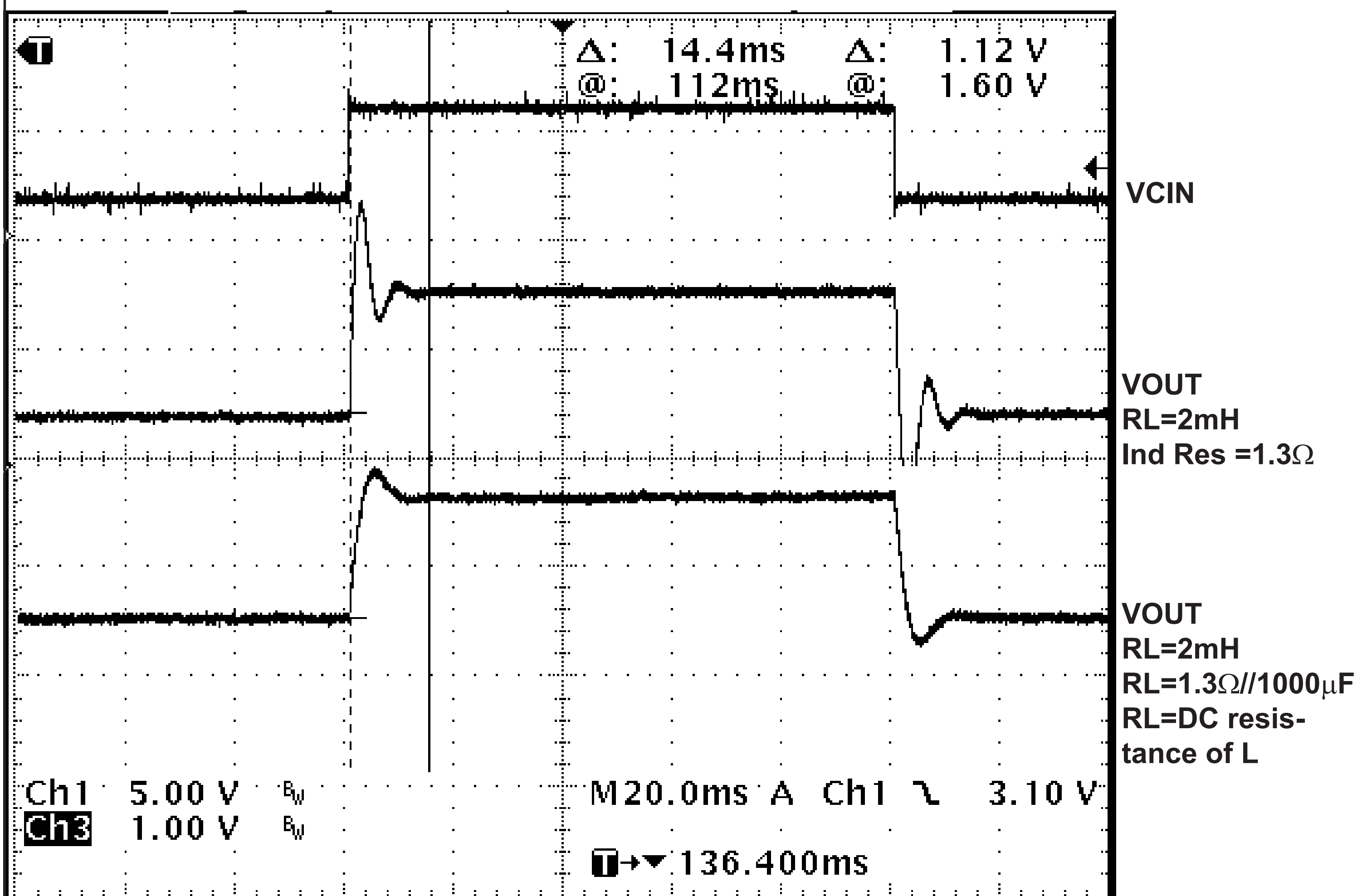


FIGURE 10. Output waveforms of ACC1200 with inductive loads

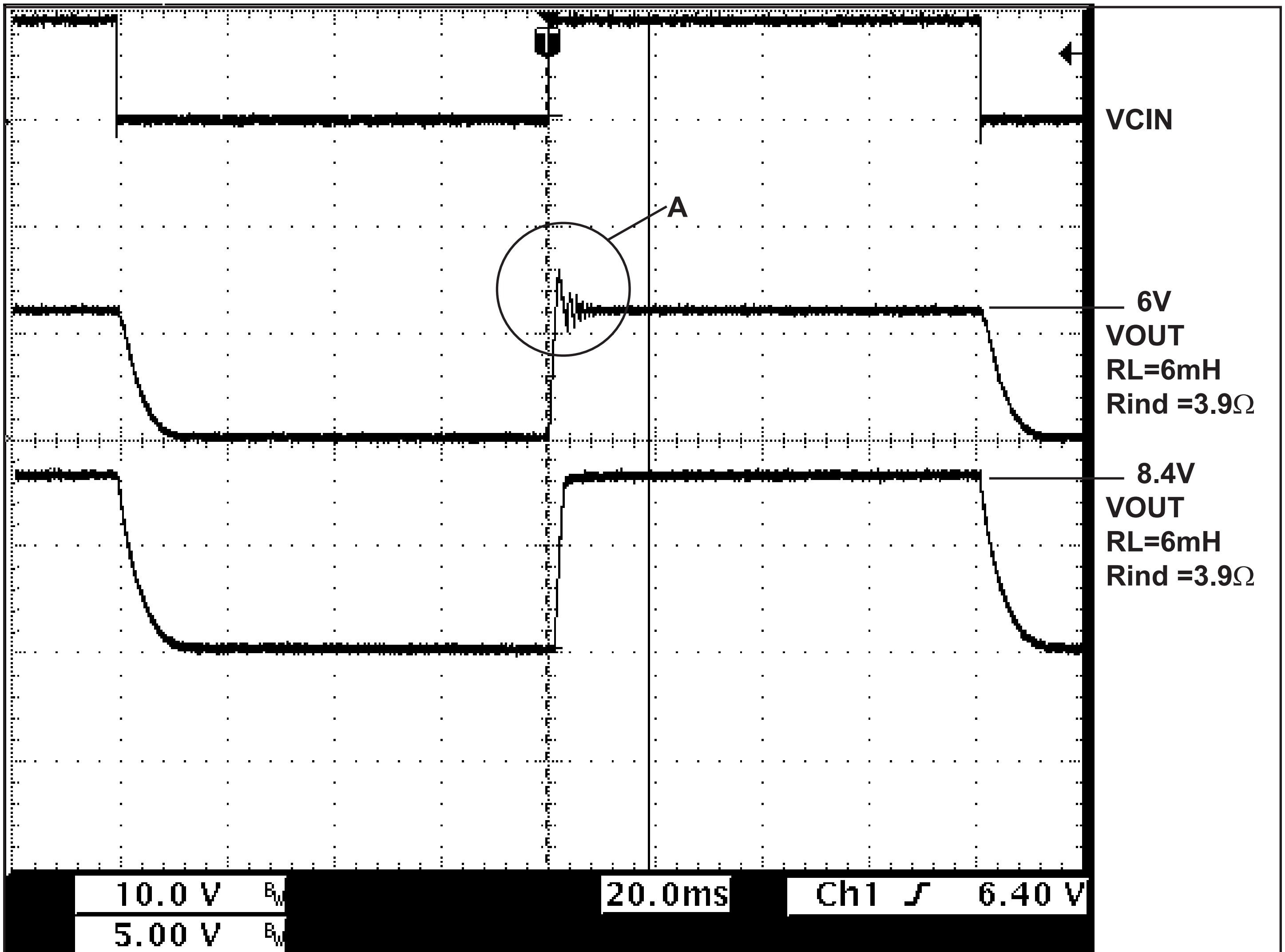


FIGURE 11. Output waveforms of ACC1200 with inductive loads
A: OVP #1 threshold, also shows the switch over from current control to voltage control

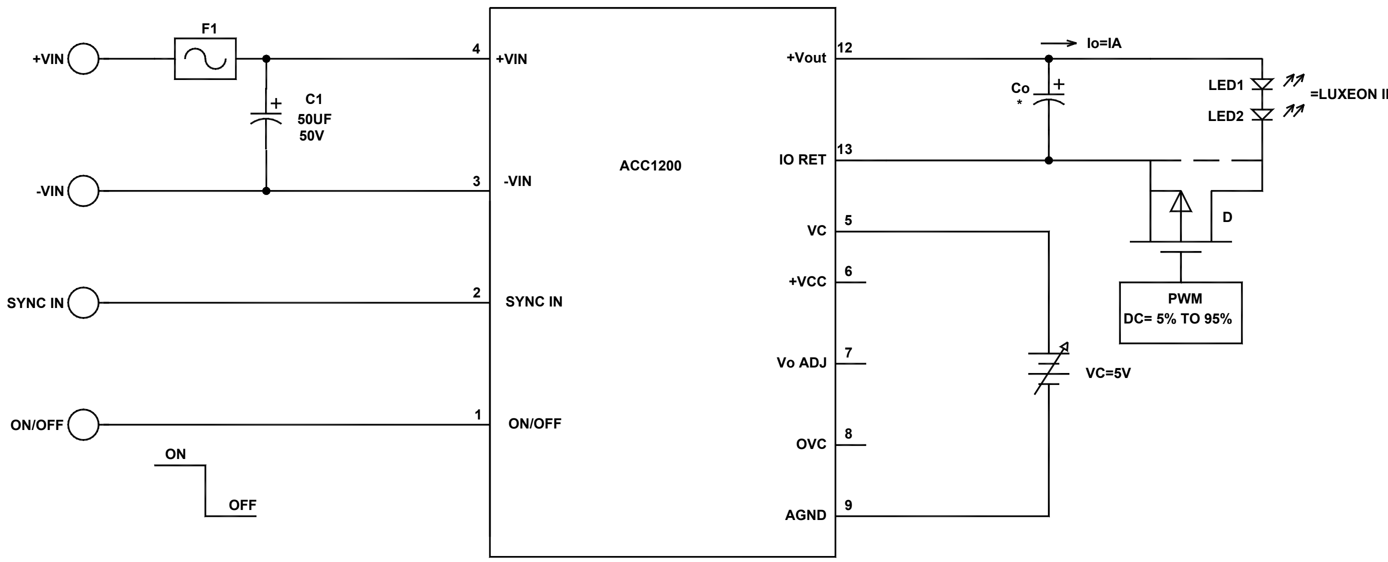


FIGURE 12. ACC1200 drives 2 Luxeon III LED, with dimming capability
***Optional parts: LED1,LED2 are Luxeon III with VF@1A=2.4 and -2mV/C**
PWM frequecy = 80Hz and duty cycle 5% to 95%

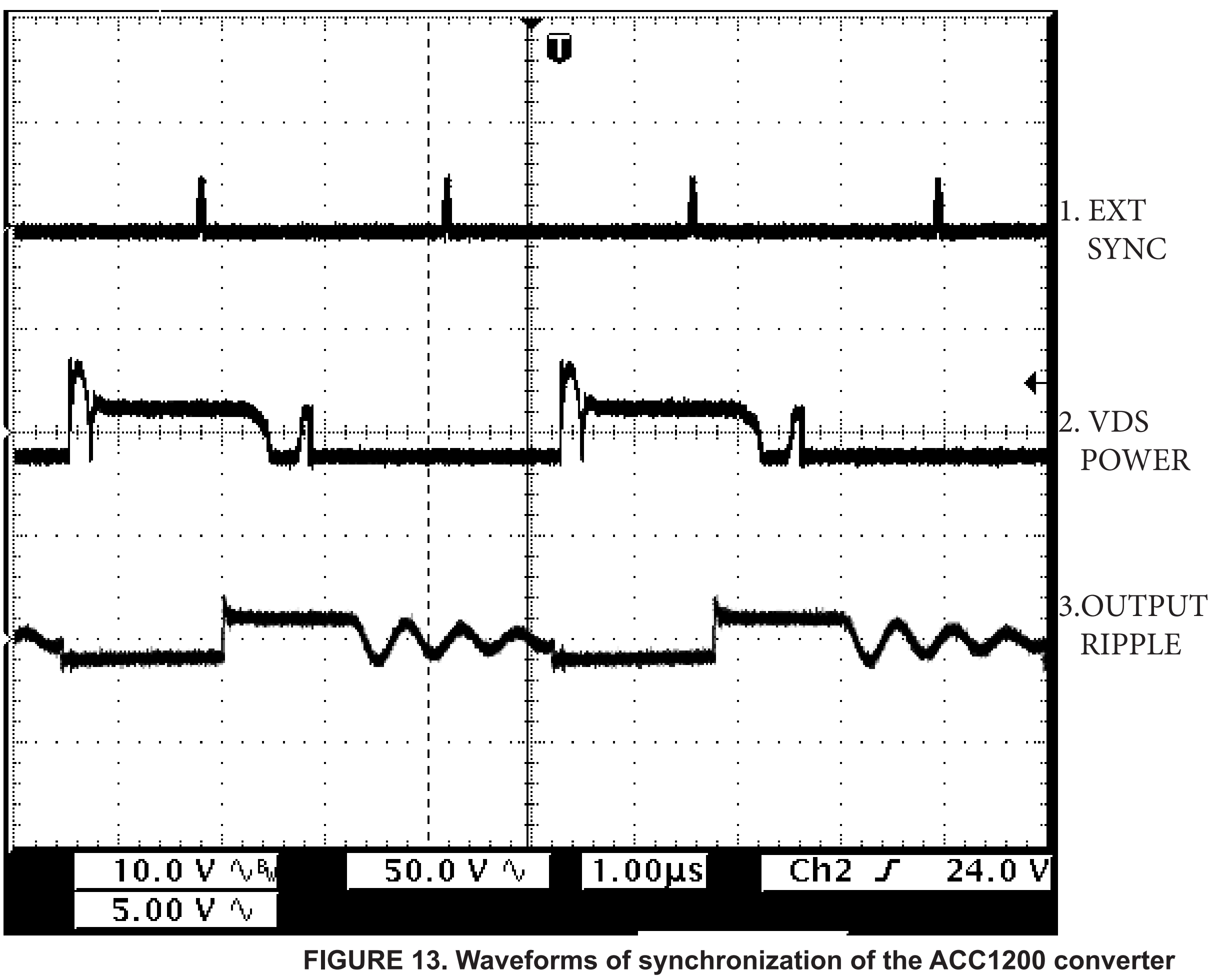


FIGURE 13. Waveforms of synchronization of the ACC1200 converter

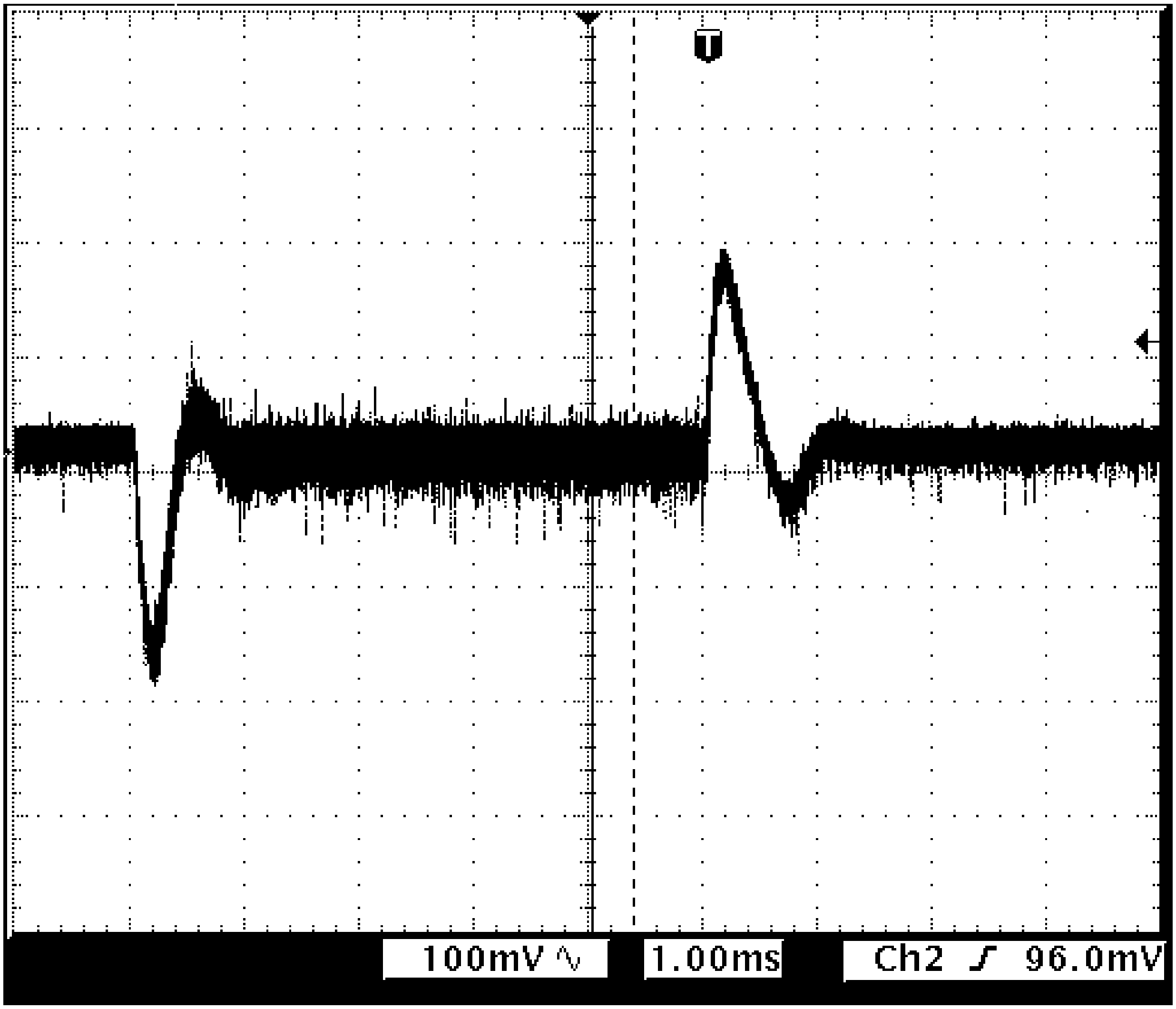
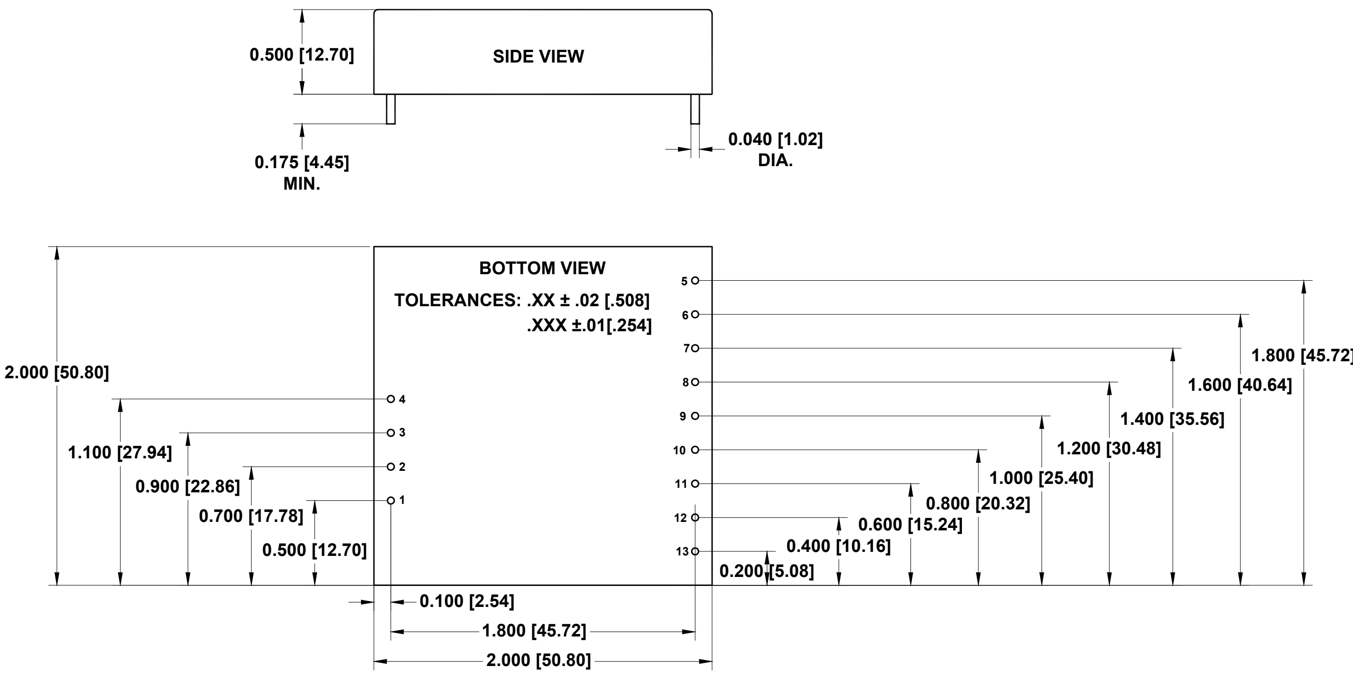


FIGURE 14. Transient response of ACC1200 converter switching from 50% FL to FL to 50% FL



MECHANICAL SPECIFICATIONS

Pin	Function
1	ON/OFF
2	SYNC
3	$-V_{IN}$
4	$+V_{IN}$
5	VCIN Input for Output Current Control
6	+VCC Positive Bias Supply (Optional)
7	IOCA Input for Output Current Adjust
8	OVC Output Over Current Flag
9	AGND Analog Ground
10	VOADJ Output Ajustable
11	-VCC Negative Bias Supply (Optional)
12	VO Output Voltage
13	IO Output Return