ALO20F36 Single Output 8th Brick: 3.3V at 20A output
Wide Range (19V – 60V Input Range)

The ALO20F36 series is Astec's latest addition to its 8th brick standard products offering. It operates from an input range of 19V to 60V suited for wireless/base station applications that are configured for a 24V or 48V input voltages. The ALO20F36 series is designed to provide 3.3V output and handle up to 20A of load current. It comes with industry standard features such as Input UVLO; Output Enable; non-latching OCP, OVP and OTP; Output Trim; Differential Remote Sense pins.

Special Features

- **Industry Standard 8th Brick Footprint**
- **Low Ripple and Noise**
- **Regulation to zero load**
- **High Capacitive Load Start-up**
- **Fixed Switching Frequency**
- **Industry standard features: Input UVLO; Enable; non-latching OVP, OCP and OTP; Output Trim, Differential Remote Sense**
- **Meets Basic Insulation**

Electrical Parameters

Input

Input Range	**19-60 VDC**
Input Surge	**100V / 100ms**

Control

Enable	**TTL compatible**
(Positive or Negative Logic Enable Options)	

Output

Load Current	**Up to 20A max**
Line/Load Regulation	**0.1% V_O Typical**
Ripple and Noise	**50mV_{P-P} typical**
Output Voltage Adjust Range	**±10% V_O**
Transient Response	**3% Typical deviation 50% to 75% Load Change 120µs settling time (Typ)**
Remote Sense	**+10%V_O**
Over Current Protection	**125% Io,max**
Over Voltage Protection	**125% Vo, nom**
Over Temperature Protection	**110 °C**

Environmental Specifications

- **-40ºC to 85ºC Operating Temperature**
- **-40ºC to 125ºC Storage Temperature**
- **MTBF > 1 million hours**

Safety

UL + cUL 60950-1, Recognized
EN60950-1 through TUV-PS

Electrical Specifications

ABSOLUTE MAXIMUM RATINGS

Stresses in excess of the absolute maximum ratings can cause permanent damage to the converter. Functional operation of the device is converter is not implied at these or any other conditions in excess of those given in the operational section of the specs. Exposure to absolute maximum ratings for extended period can adversely affect device reliability.

Parameter	Device	Symbol	Min	Typical	Max	Unit
Input Voltage Continuous Transient (100ms)	All	Vin Vin_{trans}	-0.3 -	- -	60 100	Vdc
I/O Isolation Input-to-Output	All	-	1500	-	-	Vdc
Operating Temperature	All	T_A	-40	-	85	ºC
Storage Temperature	All	T_{STG}	-55	-	125	ºC
Operating Humidity	All	-	10	-	85	%
Max Voltage at Enable Pin	All		-0.6	-	25	Vdc
Max Output Power	F (3.3V)	$P_{O,MAX}$	-	-	66	W

INPUT SPECIFICATION

Parameter	Device	Symbol	Min	Typical	Max	Unit
Operating Input Voltage Range	All	V_{IN}	19	24/48	60	Vdc
Input Under-Voltage Lock-out T_ON Threshold T_OFF Threshold	All		18.5 16.0	- -	20 18.4	Vdc
Max Input Current[1]	F (3V3)	Iin_{max}	-	-	4.5	A
Standing Loss	All		-	1.5	3	W
Input Ripple Current[2]	All	I_{I1}	-	10	30	mAp-p
External Input Bypass Cap	All	C_{IN}		220		µF

Note: 1. Module is not internally fused. External fuse is recommended (e.g. Littlefuse® 465 Series / 1.5 x $I_{IN,MAX}$ typical).
2. See Figure 1 for the input ripple current test setup.

Electrical Specifications (*continued)*

OUTPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typical	Max	Unit
Output Voltage Set point $V_{IN} = V_{IN,MIN}$ to $V_{IN,MAX}$ $I_O = I_{O,MAX}$	F (3V3)	$V_{O,SET}$	3.2	3.30	3.36	Vdc
Output Regulation Line $V_{IN} = V_{IN,MIN}$ to $V_{IN,MAX}$ Load $V_{IN} = V_{IN,NOM}$ $I_O = I_{O,MIN}$ to $I_{O,MAX}$ Temp $V_{IN} = V_{IN,NOM}$; $I_O = I_{O,MAX}$ T_a = -40 ºC to 85 ºC	All	- - -	- - -	0.1 0.1 0.25	0.5 0.5 0.5	%
Output Ripple and Noise[3] Peak-to-Peak $I_O = I_{O,MAX}$; $V_{IN} = V_{IN,NOM}$; BWL = 20 MHz; T_A =25 ºC	F (3V3)	-	-	50	100	mVp-p
Output Current[4]	F (3V3)	I_O	0	-	20	A
Output Current-limit Inception[5] V_O = 90% $V_{O,NOM}$; T_A = 25 ºC $V_{IN} = V_{IN,NOM}$ Non-latching / auto-recovery	F (3V3)	$I_{O,OCP}$	22	-	30.5	A
External Load Capacitance $I_O = I_{O,MAX}$, resistive load ESR	F (3V3)	C_{EXT}	- 8	- -	10,000 -	µF mΩ
Efficiency $V_{IN} = V_{IN,NOM}$; $I_O = I_{O,MAX}$ T_A = 25 ºC;	F (3.3V)	η	88.5	91		%
Output Over Voltage Protection[5] Non-latching / autorecovery	F (3.3V)	$V_{O,OVP}$	3.9	4.1	4.7	V
Over Temperature Protection Autorecovery	All		110	-	120	°C
Input to Output Turn-On Delay $V_{IN} = V_{IN,NOM}$, $I_O = I_{O,MAX}$	All	-	-	-	15	ms
Enable to Output Turn-On Delay $V_{IN} = V_{IN,NOM}$, $I_O = I_{O,MAX}$	All	-	-	-	15	ms
Switching Frequency	All	F_{SW}	340	400	460	kHz
Output Voltage Remote Sensing[6]	All	-	-	-	10	%V_O
Output Voltage Trim Range[7]	All		90		110	%V_O

Electrical Specifications (*continued)*

OUTPUT SPECIFICATIONS

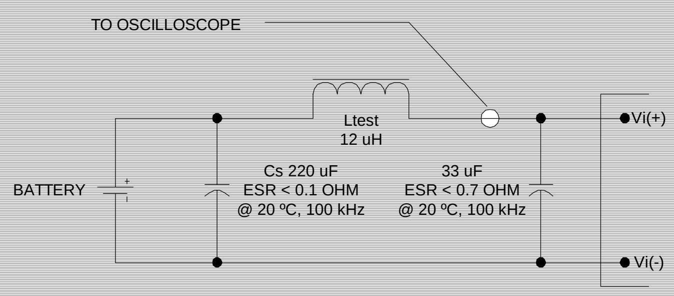
Parameter	Device	Symbol	Min	Typical	Max	Unit
Dynamic Response di/dt = 0.1 A/µs Peak Deviation ΔI_O = 50% to 75% of Io_{max}	All	-	-	3	4	%
Settling Time Vref = Vo_{nom}	All	-	-	-	200	µs
Peak Deviation ΔI_O = 50% to 25% of Io_{max}	All	-	-	3	4	%
Settling Time Vref = Vo_{nom}	All	-	-	-	200	µs
Output Enable ON/OFF Open collector TTL compatible						
Positive Enable: Mod-ON	All	-	2.95	-	20	V
Mod-OFF	All	-	-0.50	-	1.20	V
Negative Enable: Mod-ON	All	-	-0.50	-	1.20	V
Mod-OFF	All	-	2.95	-	20	V

Note:
3. See Figure 2 for the Output Ripple and Noise Test Measurement Setup.
4. Output derating applies at elevated temperature. See Figures 16 and 17.
5. OCP and OVP are both auto-recovery. The converter will shutdown and attempt to restart until the fault is removed. There is a 25ms lockout period between restart attempts. Note also that the OCP threshold will be reduced proportionally with output voltage trim up and/or remote sense compensation. The percent rise in output voltage will be proportional to the reduction in OCP current limit inception.
6. The sense pins can be used to compensate for any voltage drops (per indicated max limits) that may occur along the connection between the output pins to the load. Pin 7 (+Sense) and Pin 5 (-Sense) should be connected to Pin 8 (+Vout) and Pin 4 (Return) respectively at the point where regulation is desired.
7. See Equation 1 and 2 for the output trim function. The combination of remote sense and trim adjust cannot exceed 100% Vo. Whenever the output voltage is increased, the output current must be derated so as not to exceed the maximum output power.
8. Minimum Enable pin disable time is 100ms. Shorter disable durations may cause output to overshoot beyond specification upon restart (Enable On).

SAFETY AGENCY / MATERIAL RATING / ISOLATION

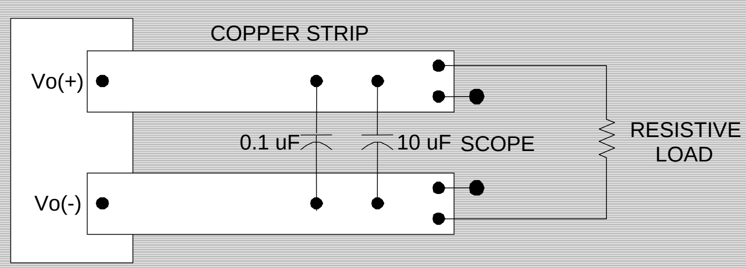
Parameter	Device					
Safety Approval	All	UL/cUL 60950-1, 3rd Edition – Recognized EN 60950-1 through TUV				
Material Flammability Rating	All	UL94V-0				
Parameter	**Device**	**Symbol**	**Min**	**Typical**	**Max**	**Unit**
Input to Output Capacitance	All		-	1000	-	pF
Input to output Resistance	All		-	10	-	Mohms
Input to Output Insulation Type	All		-	Basic	-	-

Electrical Specifications (*continued*)



Measure input reflected-ripple current with a simulated source inductance (Ltest) of 12 uH. Capacitor Cs offsets possible battery impedance. Measure current as shown above.

Figure 1. Input Reflected Ripple Current Measurement Setup.



Use a 0.1µF @50V X7R ceramic capacitor (connected an inch away from the output terminals of the UUT) and a 10µF @ 25V tantalum capacitor (2 inches away from the output terminals of the UUT). Scope measurement should be made using a BNC socket, positioned 3 inches away from output terminals of the converter.

Figure 2. Peak to Peak Output Noise Measurement Setup.

Basic Operation and Features

INPUT UNDER VOLTAGE LOCKOUT

To prevent any instability to the converter, which may affect the end system, the converter have been designed to turn-on once V_{IN} is in the voltage range of 18.5-20.0 VDC. Likewise, it has also been programmed to turn-off when V_{IN} drops down to 16.0-18.4 VDC.

OUTPUT VOLTAGE ADJUST/TRIM

The converter comes with a TRIM pin (PIN 6), which is used to adjust the output by as much as 90% to 110% of its set point. This is achieved by connecting an external resistor as described below.

To **INCREASE** the output, external R_{adj_up} resistor should be connected between TRIM PIN (Pin6) and +SENSE PIN (Pin 7). Please refer to Equation (1) for the required external resistance and output adjust relationship.

Equation (1a):

$$R_{adj\_up} = \left[\frac{5.1 \times Vo_{set} \times (100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{510}{\Delta\%} - 10.2 \right] \quad K\Omega$$

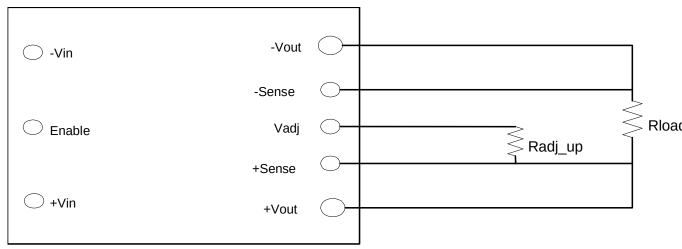


Figure 3. External resistor configuration to increase the outputs

To **DECREASE** the output, external R_{adj_down} resistor should be connected between TRIM pin (Pin 6) and
-SENSE PIN (Pin 5). Please refer to Equation (2) for the required external resistance and output adjust relationship.

Equation (2):

$$Radj\_down = \left(\frac{510}{\Delta\%} - 10.2 \right) \cdot k\Omega$$

Where: Δ% = percent change in output voltage:

$$\Delta\% = \left(\frac{Vo_{desired} - Vo_{set}}{Vo_{set}} \right) \times 100$$

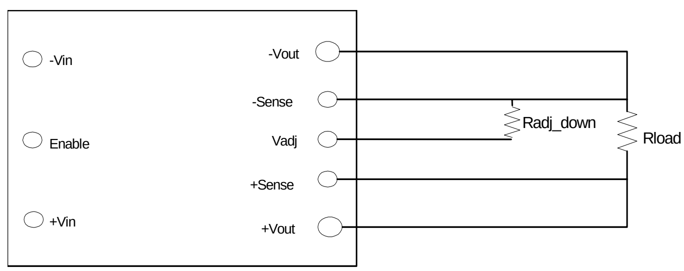


Figure 4. External resistor configuration to increase the outputs

OUTPUT ENABLE

The converter comes with an Enable pin (PIN 2), which is primarily used to turn ON/OFF the converter. Both a Positive (no "N" suffix required) and a Negative (suffix "N" required) Enable Logic options are being offered. Please refer to Table 2 for the Part Numbering Scheme.

For Positive Enable, the converter is turned on when the Enable pin is at logic HIGH or left open. The unit turns off when the Enable pin is at logic LOW or directly connected to $-V_{IN}$. On the other hand, the Negative Enable version turns unit on when the Enable pin is at logic LOW or directly connected to $-V_{IN}$. The unit turns off when the Enable pin is at Logic HIGH.

Basic Operation and Features *(continued)*

OUTPUT OVER VOLTAGE PROTECTION (OVP)

The Over Voltage Protection circuit is non-latching - auto recovery mode. The output of the converter is terminated under an OVP fault condition (Vo > OVP threshold). The converter will attempt to restart until the fault is removed. There is a 25ms lockout period between restart attempts.

OVER CURRENT PROTECTION (OCP)

The Over Current Protection is non-latching - auto recovery mode. The converter shuts down once the output current reaches the OCP range. The converter will attempt to restart until the fault is removed. There is a 25ms lockout period between restart attempts.

OVER TEMPERATURE PROTECTION (OTP)

The Over Temperature Protection circuit will shutdown the converter once the average PCB temperature (See Figure 90B for OTP reference sense point) reaches the OTP range. This feature prevents the unit from overheating and consequently going into thermal runaway, which may further damage the converter and the end system. Such overheating may be an effect of operation outside the given power thermal derating conditions. Restart is possible once the temperature of the sensed location drops to less than 110°C.

REMOTE SENSE

The remote sense pins can be used to compensate for any voltage drops (per indicated max limits) that may occur along the connection between the output pins to the load. Pin 7 (+Sense) and Pin 5 (-Sense) should be connected to Pin 8 (+Vout) and Pin 4 (Return) respectively at the point where regulation is desired. The combination of remote sense and trim adjust cannot exceed 110% of V_O. When output voltage is trimmed up (through remote sensing and/or trim pin), output current must be derated and maximum output power must not be exceeded.

Performance Curves

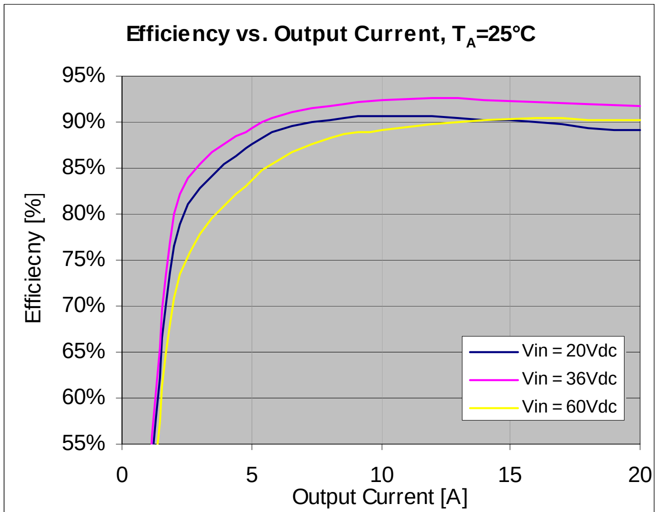


Figure 6. Efficiency vs. Load current at various line voltages, T_A = 25°C.

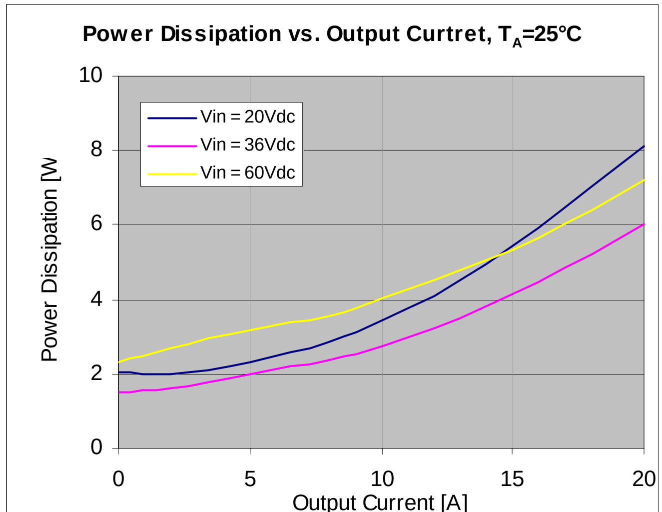


Figure 7. Power Dissipation vs. Load current at various line voltages, T_A = 25°C.

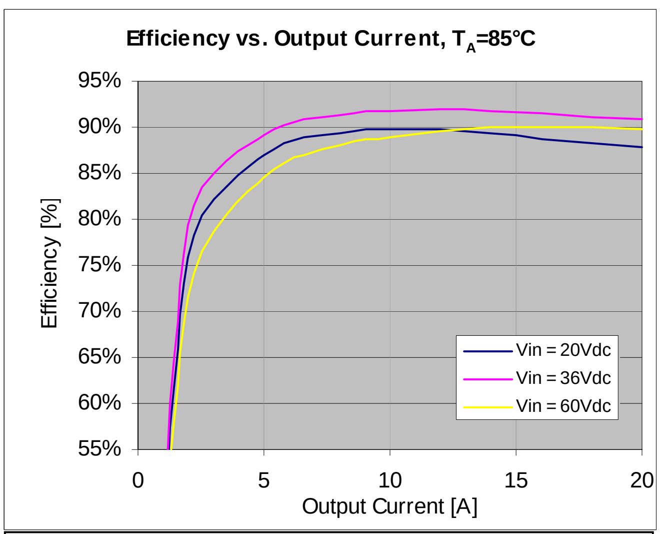


Figure 8. Efficiency vs. Load current at various line voltages, T_A = 85°C.

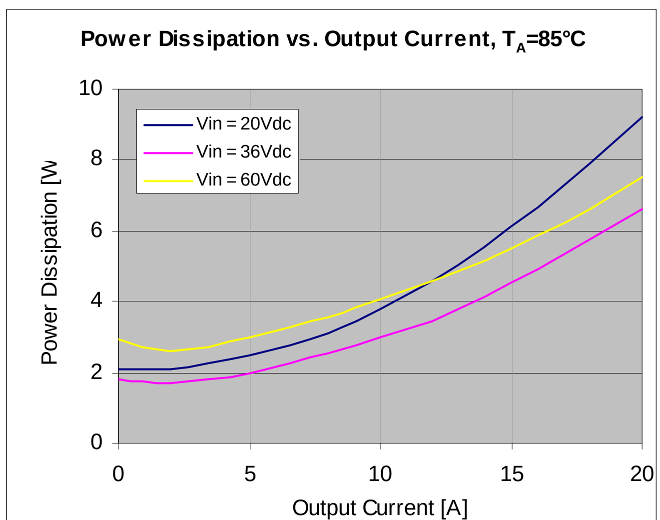


Figure 9. Power Dissipation vs. Load current at various line voltages, T_A = 85°C.

Performance Curves

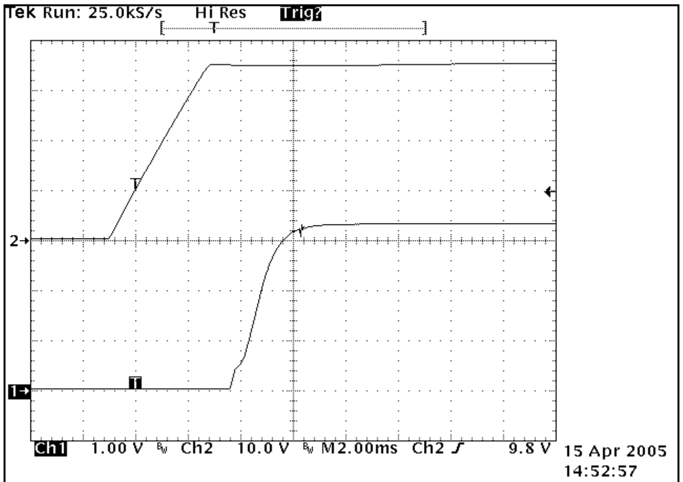


Figure 10. Output startup (CH1) at V_{IN} = 36Vdc, I_O = 20A, C_O = 10µF, T_A = 25°C.

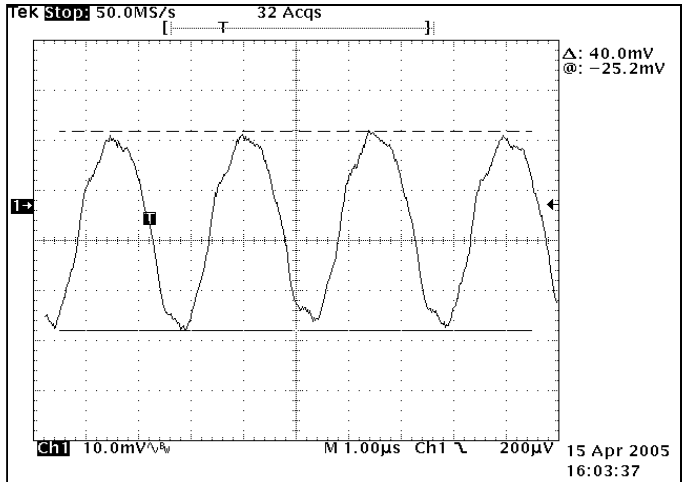


Figure 11. Output ripple at V_{IN} = 36Vdc, I_O = 20A, T_A = 25°C. See Fig 2 for test setup.

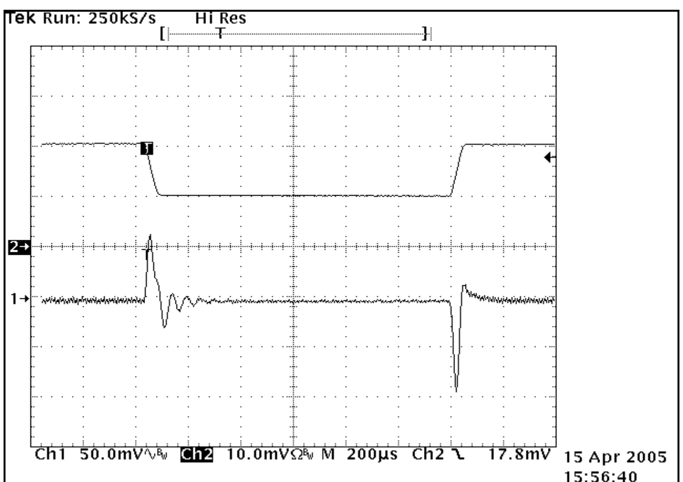


Figure 12. Output transient response (CH1) at V_{IN} = 36Vdc, 25% to 50% step change, T_A = 25°C, C_O = 10µF.

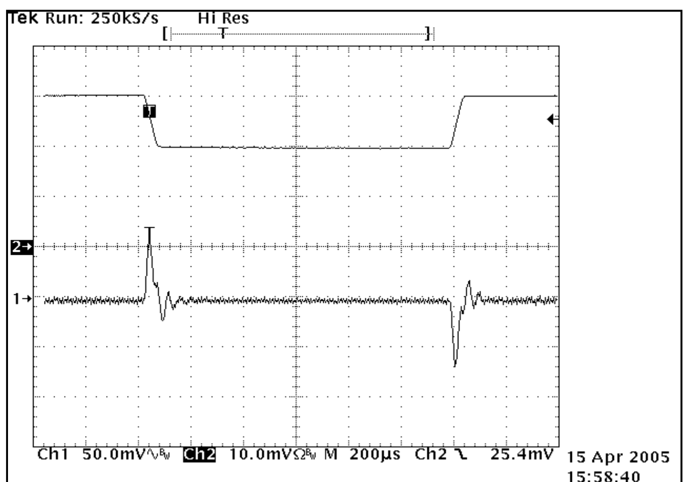


Figure 13. Output transient response (CH1) at V_{IN} = 36Vdc, 25% to 50% step change, T_A = 25°C, C_O = 10µF.

Performance Curves

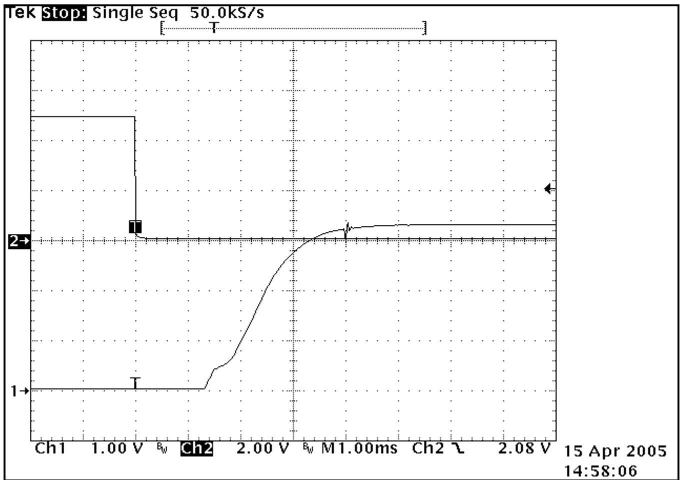


Figure 14. Enable to output turn on characteristic. V_{IN} = 36V, T_A = 25°C.

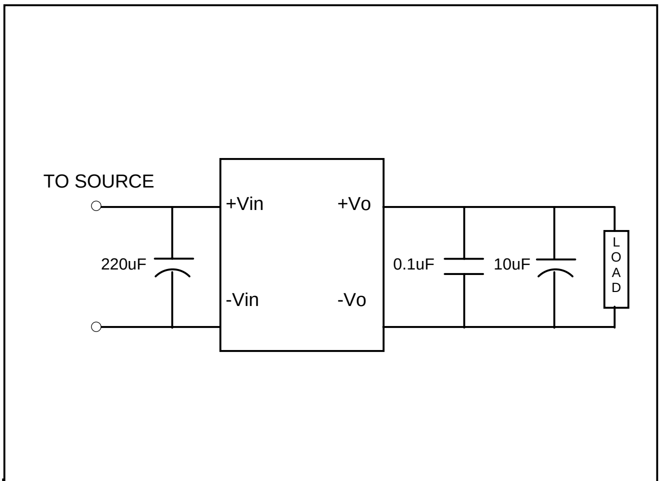


Figure 15. Typical application circuit.

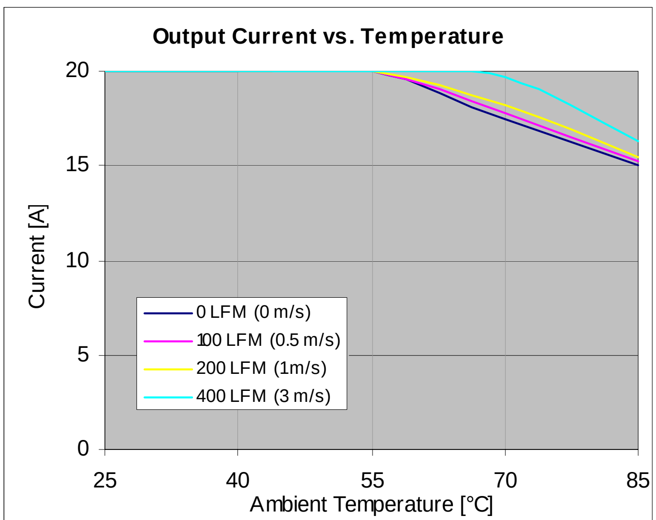


Figure 16. Output current vs. ambient temperature, V_{IN} = 24Vdc ($T_J \leq$ 120°C).

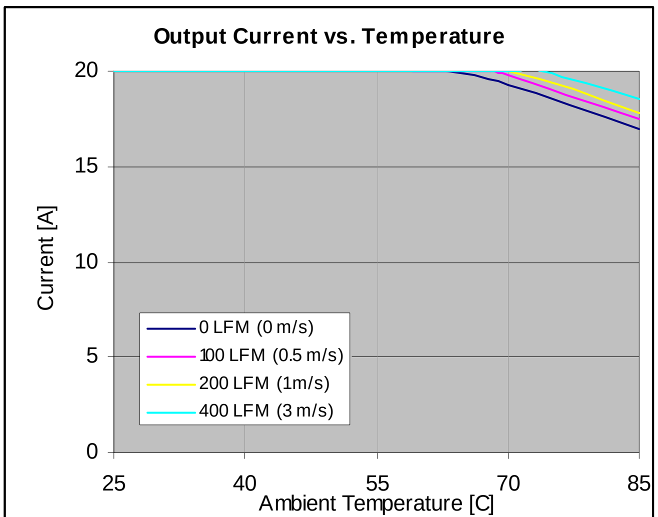


Figure 17. Output current vs. ambient temperature, V_{IN} = 48Vdc ($T_J \leq$ 120°C).

Input Filter for FCC Class B Conducted Noise

A reference design for an input filter that can provide FCC Class B conducted noise levels is shown below (See Figure 18). Two common mode connected inductors are used in the circuit along with balanced bypass capacitors to shunt common mode currents into the ground plane. Shunting noise current back to the converter reduces the amount of energy reaching the input LISN for measurement.

The application circuit shown has an earth ground (frame ground) connected to the converter output (-) terminal. Such a configuration is common practice to accommodate safety agency requirements. Grounding an output terminal results in much higher conducted emissions as measured at the input LISN because a hard path for common mode current back to the LISN is created by the frame ground. "Floating" loads generally result in much lower measured emissions. The electrical equivalent of a floating load, for EMI measurement purposes, can be created by grounding the converter output (load) through a suitably sized inductor(s) while maintaining the necessary safety bonding.

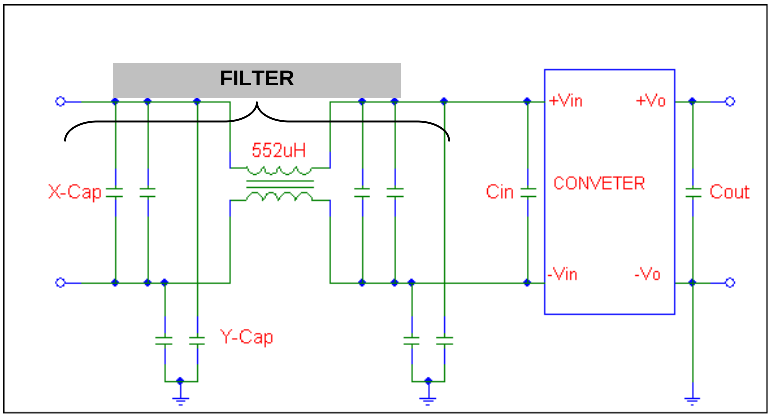


Figure 18: Class B Filter Circuit

PARTS LIST

CKT CODE	DESCRIPTION
Common Mode Choke	CTX01-15091 Cooper Electronic Technologies
X-Cap	0.47 µF X 4pcs
Y-Cap	22 nF X 4 pcs
C_{IN}	220 uF

Mechanical Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Dimension	All	L W H	2.28 [57.91] 0.88 [22.35] 0.38 [9.65]	2.30 [58.4] 0.90 [22.9] 0.40 [10.1]	2.32 [58.9] 0.92 [23.36] 0.42 [10.66]	in [mm] in [mm] in [mm]
Weight	All		-	22.68 [0.8]	-	g [oz]

PIN ASSIGNMENT

1	$+V_{IN}$	5	-SENSE
2	ENABLE	6	TRIM
3	$-V_{IN}$	7	+SENSE
4	-Vo	8	+Vo

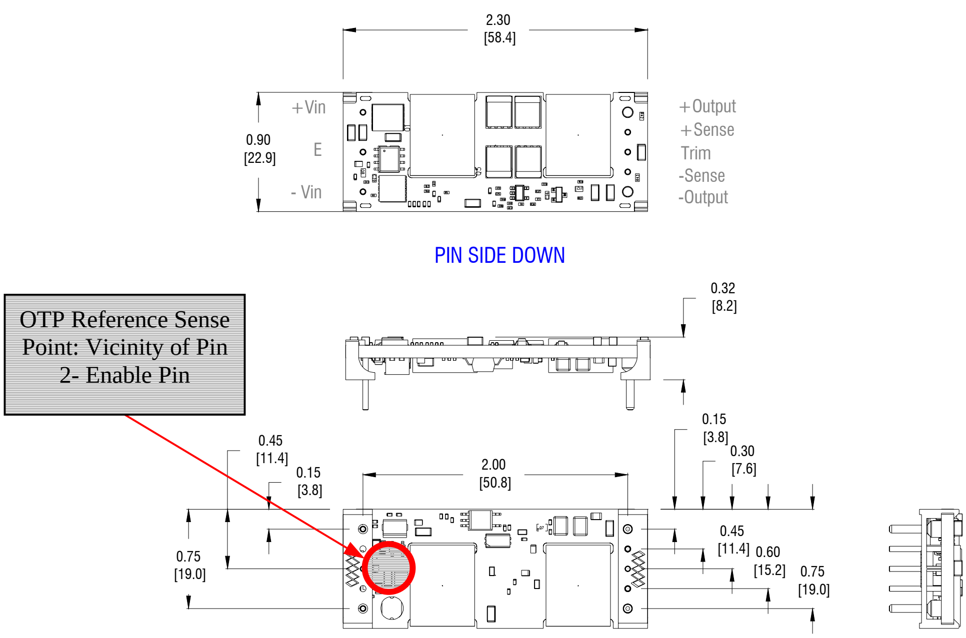


Figure 19. Mechanical Outline

Mechanical Specifications

SOLDERING CONSIDERATIONS

The RoHS-compliant terminal pin finish of the converter are compatible with both Pb and Pb-free wave soldering techniques. The modules are recommended to be preheated for 20-30 sec at 110°C and wave soldered at 260°C for Pb solder and 270°C max for Pb-free solder, for less than 10 sec.

TABLE 2: PART NUMBERING SCHEME

	O/P Current	O/P Voltage	I/P Voltage	Enable Logic		PIN Length	RoHS
ALO	20	F	36	N	-	6	L
	20 A	F = 3.3 V	19 – 60 Vdc	**N** = Negative Logic **BLANK** = Positive Logic		**6** = 3.7mm nom **Blank** = 5mm nom (default)	**L** = RoHS 6 **Blank** = RoHS 5

Note: 1) For Through Hole termination:
- Std pin length is 5mm nominal (min: 0.189 [4.8]; max: 0.205 [5.2] / in [mm])
- "-6" option is 3.7mm nominal (min: 0.137 [3.5]; max: 0.152 [3.9] / in [mm])
- Pins 4&8 diameter: ∅ = 0.062 [1.57], others: ∅ = 0.04 [1.0] (6X)

For further inquiries, please contact:

techincalsupport@astec.com
techinicalsupport@artesyn.com

USA: 1-888-41-ASTEC
EUROPE: (44) 0800-0321546