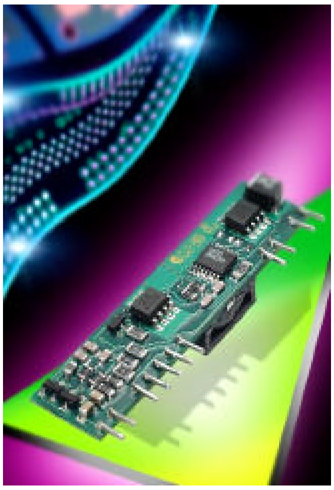
PL10S-12 Non Isolated DC/DC Converters
Long Form Datasheet

Features



- Synchronous Rectification
- Non-Isolated
- Fixed Frequency
- Nominal Input Voltage Range from (5-12V)
- Output Voltage Adjustable with the Trim Function (0.9 to 5V)
- Current Limit and Short-Circuit Protection using Hiccup Mode and Auto-Restart
- Over Temperature Protection
- Up to 97% efficiency at 5V output
- Input Logic Shutdown
- Positive and Negative Remote Sense Pins (optional)
- Wide Operation Temperature Range –40°C to 85°C
- UL/BSI EN60950 approved

Description

Lambda’s 12V SIP power modules are non-isolated dc-dc converters that can deliver up to 10A of output current with full load efficiency of 95% at 5V output.
Lambda’s PL10 Series offers designers the choice of models with either customer selectable output voltages or factory set output voltage.
With the customer selectable model the output is set by a fixed value resistance (see section 1.70, 1.71, 1.72) This model is identified with a suffix C on the part number description, as donated in the nomenclature and its output voltage is set to 0.9V (see page 30).
The factory set voltage model requires identification on the part number description, eg. PL10S-12-3V3-K (see page 30).
For the purpose of this Application Note, values of 0.9V, 1.5V, 2.5V, 3.3V and 5.0V have been used to illustrate the parameters and the characteristics at these voltages.
For details of other output voltage parameters please contact Lambda UK.

Applications

- Distributed power architectures
- Communication equipment
- Computer equipment
- Workstations and Servers
- Latest generation IC’S (DSP, FPGA, ASIC) and Microprocessor powered applications

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

Input / Output Selection table

Input Voltage	Output Voltage	Max. Output current	Max. Output Power	Min Efficiency 5V I/P@10A O/P	Min Efficiency 12V I/P@10A O/P	Typical Efficiency 5V I/P @ 10A O/P (for typ values at 12V I/P see efficiency graphs)
5-12Vdc	0.9V	10A	9W	82.76%	79%	84.76%
5-12Vdc	1.2V	10A	12W	86%	83%	88%
5-12Vdc	1.5V	10A	15W	88%	85%	90%
5-12Vdc	1.8V	10A	18W	89.7%	87%	91.7%
5-12Vdc	2.5V	10A	25W	91.8%	89%	93.8%
5-12Vdc	3.3V	10A	33W	93.44%	91%	95.44%
7-12Vdc	5V	10A	50W		93%	96.9%

Note: All the measurements are taken at +25°C ambient temperature

Absolute Maximum Ratings

Parameter	Symbol	Min	Typical	Max	Unit
Input Voltage (Peak)	Vin			15	V
ON/OFF Terminal Voltage	Von/off			13.4	V
Operating Ambient Temperature	Tamb	-40		85	°C
Storage Temperature	Tstor	-65		150	°C

Note: Use beyond the maximum ratings may cause a reliability degradation of the DC/DC converter or may permanently damage the device.

General Specifications

Parameter	Symbol	Min	Typical	Max	Units
Efficiency at full output power			See the table above		%
Switching Frequency	Fosc		200		KHZ
Output Voltage Trim Range (See section 1.7)		0.9		5	V
Calculated MTBF Calculated using Bellcore (V3.1-BELL4 or V3.1-BELL3) ,Ta= 25°C, full power.			4.8		Mhours
Remote Sense Compensation			0.5		V
Turn On Voltage Threshold		4.0	4.3	4.6	V
Turn Off Voltage Threshold		3.8	4.1	4.4	V
Duty Cycle Ratio	D			72	%
Weight			9		g

1.1) Vo=0.9V

Input Specifications
Vo=0.9V

Parameter	Symbol	Min	Typical	Max	Units
Operating Input Voltage	Vin	4.6	12	13.4	V
Input Current	Iin			2.2	A
Output voltage trim	Vo	0.9		5	V
No Load Input Current			50		mA
Remote Off Input Current			3.9		mA
Input Reflected Ripple Current			8.167		m A_{rms}
Input Reflected Ripple Current (P-P)			24		mApk
Inrush Current Transient			0.007		A^2s

Note: All the measurements are taken at +25°C ambient temperature

Output Specifications
Vo=0.9V

Parameter	Module	Symbol	Min	Typical	Max	Units
Output Voltage adjustment		Vout	0.9		5	V
Load Regulation				10		mV
Line Regulation (at full load)				1.4		mV
Output Ripple and Noise Vin=12V, (20MHZ BW)				22	30	mVp-p
Output Current Range		Iout	0		10	A
Output DC Current Limit		Ilim	11		20	A
Turn on Time				128.8		ms
Overshoot at Turn On				0		%
Output Capacitance					3900	uF

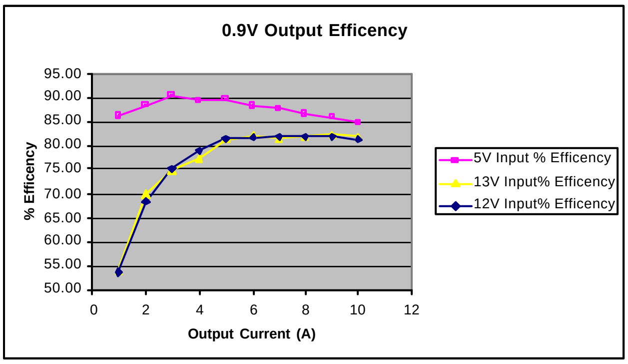
Note: All the measurements are taken at +25°C ambient temperature

Transient Response
Vo=0.9V

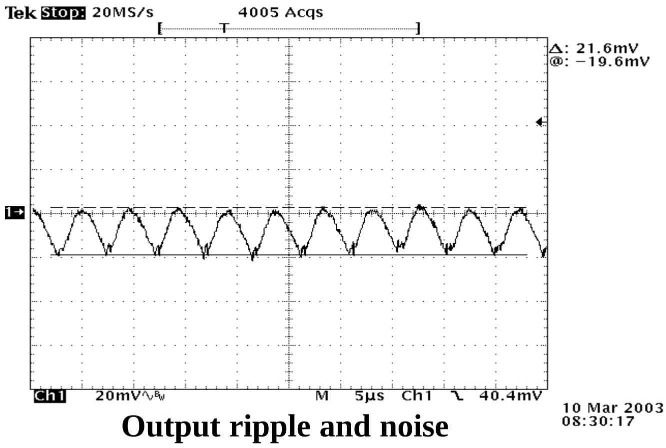
Parameter	Symbol	Min	Typical	Max	Units
ΔV 50% to 100% of Max Load, di/dt=0.1A/us Vin=5V Vin=12V	- Vdynamic Vdynamic	- - -	- 124 82	- - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 122 38	 - -	 us us
ΔV 100% to 50% of Max Load, di/dt=0.1A/us Vin=5V Vin=12V	 Vdynamic Vdynamic	 - -	 130 82	 - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 160 40	 - -	 us us

Note: All the measurements are taken at +25°C ambient temperature

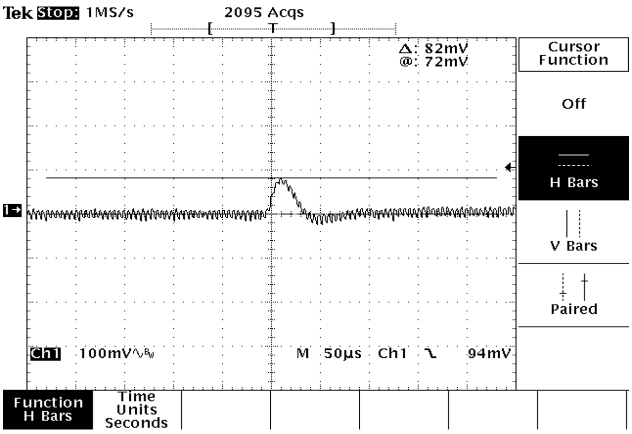
Characteristic Curves - 0.9V Model



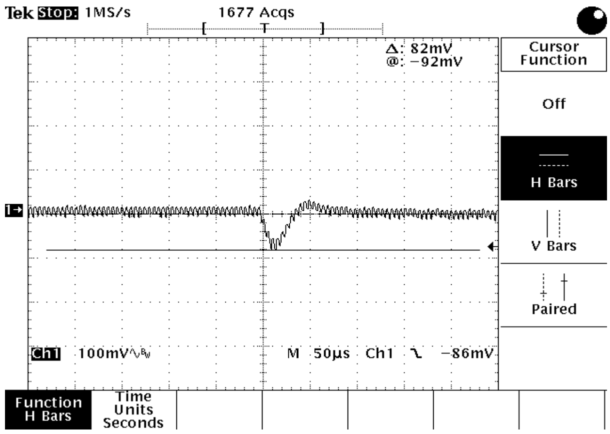
Efficiency vs Line Voltage and Load Current



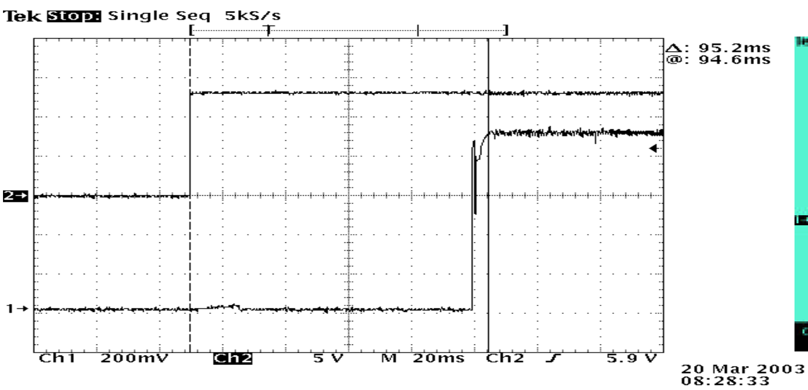
Output ripple and noise
(Vin=12V, Vo=0.9V, Io=10A)



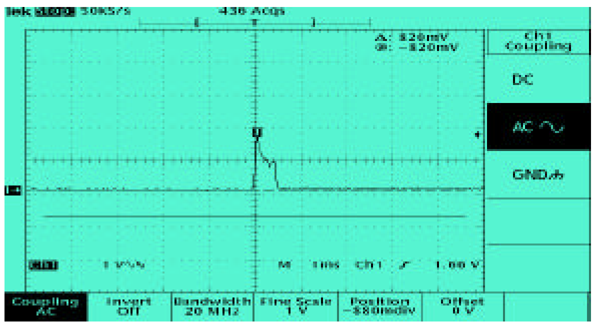
Dynamic Load Response
(Vin=12V, Vo=0.9V 50 to 100% Load step)



Dynamic Load Response
(Vin=12V, Vo=0.9V 100 to 50% Load step)



Start-Up From Vin
(Vin=12V, Vo=0.9V, Io= 10A)



Short Circuit (Output Hiccup)
(Vin 12V, Vo Short)

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

1.3) Vo=1.5V

Input Specifications
Vo=1.5V

Parameter	Symbol	Min	Typical	Max	Units
Operating Input Voltage	Vin	4.6	12	13.4	V
Input Current	Iin			3.5	A
Output voltage trim	Vo	0.9		5	V
No Load Input Current			62		mA
Remote Off Input Current			3.9		mA
Input Reflected Ripple Current			10.73		m A_{rms}
Input Reflected Ripple Current (P-P)			30.8		mApk
Inrush Current Transient			0.00425		A^2s

Note: All the measurements are taken at +25°C ambient temperature

Output Specifications
Vo=1.5V

Parameter	Module	Symbol	Min	Typical	Max	Units
Output Voltage adjustment		Vout	0.9		5	V
Load Regulation				13		mV
Line Regulation (at full load)				3		mV
Output Ripple and Noise Vin=12V, (20MHZ BW)				35	45	mVp-p
Output Current Range		Iout	0		10	A
Output DC Current Limit		Ilim	11		20	A
Turn on Time				156		ms
Overshoot at Turn On				0		%
Output Capacitance					3300	uF

Note: All the measurements are taken at +25°C ambient temperature

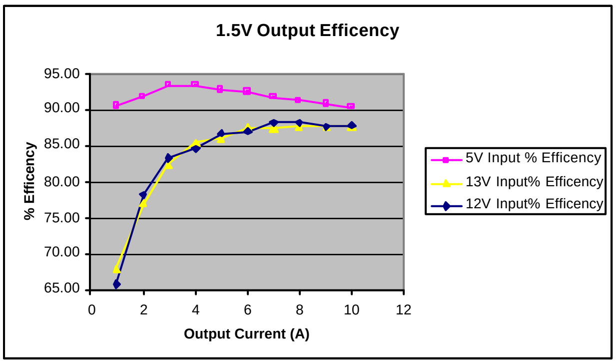
Transient Response
Vo=1.5V

Parameter	Symbol	Min	Typical	Max	Units
ΔV 50% T0 100% of Max Load , di/dt=0.1A/us Vin=5V Vin=12V	 Vdynamic Vdynamic	 - -	 134 86	 - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 40 110	 - -	 us us
ΔV 100% T0 50% of Max Load, di/dt=0.1A/us Vin=5V Vin=12V	 Vdynamic Vdynamic	 - -	 142 94	 - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 124 40	 - -	 us us

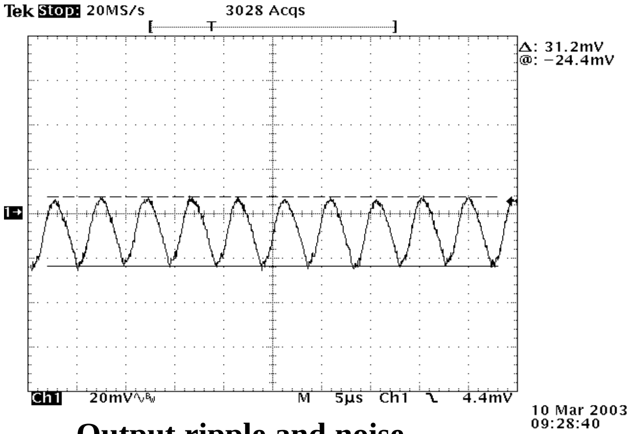
Note: All the measurements are taken at +25°C ambient temperature

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

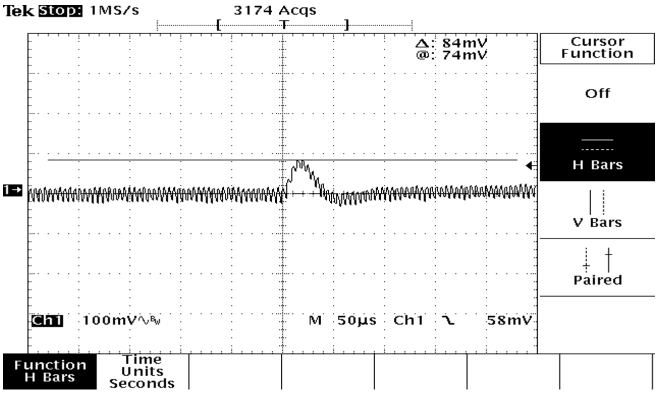
Characteristic Curves - 1.5V Model



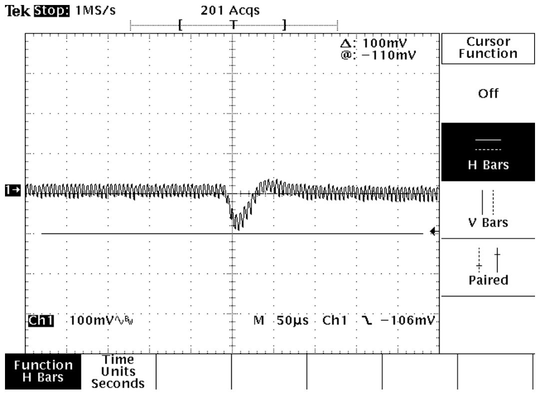
Efficiency vs Line Voltage and Load current



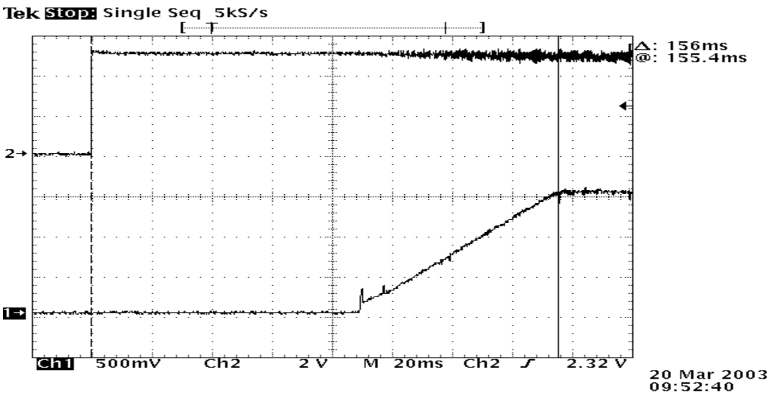
Output ripple and noise
(Vin=12V, Vo=1.5V, Io=10A)



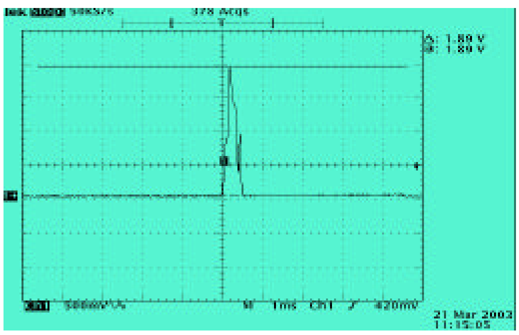
Dynamic Load Response
(Vin=12V, Vo=1.5V 50 to 100% Load step)



Dynamic Load Response
(Vin=12V, Vo=1.5V 100 to 50% Load step)



Start-Up From Vin
(Vin=12V, Vo=1.5V, Io= 10A)



Short Circuit (Output Hiccup)
(Vin 12V, Vo Short)

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

1.4) Vo=2.5V

Input Specifications
Vo=2.5V

Parameter	Symbol	Min	Typical	Max	Units
Operating Input Voltage	Vin	4.6	12	13.4	V
Input Current	Iin			5.5	A
Output voltage set point	Vo	0.9		5	V
No Load Input Current			79		mA
Remote Off Input Current			3.9		mA
Input Reflected Ripple Current			11.82		m A_{rms}
Input Reflected Ripple Current (P-P)			33.6		mApk
Inrush Current Transient			0.006		A^2 s

Note: All the measurements are taken at +25°C ambient temperature

Output Specifications
Vo=2.5V

Parameter	Module	Symbol	Min	Typical	Max	Units
Output Voltage adjustment		Vout	0.9		5	V
Load Regulation				18		mV
Line Regulation (at full load)				3		mV
Output Ripple and Noise Vin=12V, (20MHZ BW)				56	72	mVp-p
Output Current Range		Iout	0		10	A
Output DC Current Limit		Ilim	11		20	A
Turn on Time				202		ms
Overshoot at Turn On				0		%
Output Capacitance					3300	uF

Note: All the measurements are taken at +25°C ambient temperature

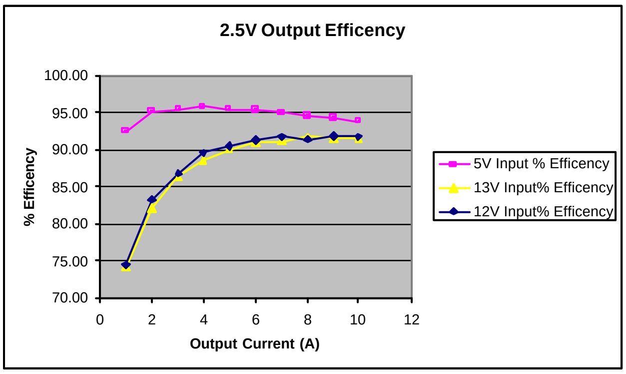
Transient Response
Vo=2.5V

Parameter	Symbol	Min	Typical	Max	Units
ΔV 50% To 100% of Max Load, di/dt=0.1A/us Vin=5V Vin=12V	 Vdynamic Vdynamic	 - -	 150 86	 - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 150 35	 - -	 us us
ΔV 100% To 50% of Max Load, di/dt=0.1A/us Vin=5V Vin=12V	 Vdynamic Vdynamic	 - -	 150 100	 - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 150 40	 - -	 us us

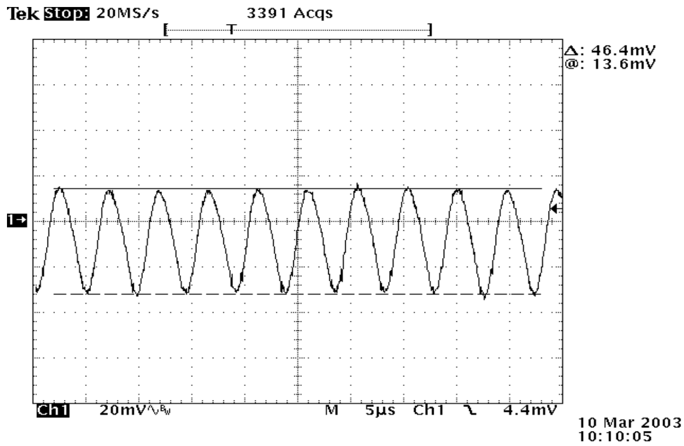
Note: All the measurements are taken at +25°C ambient temperature

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

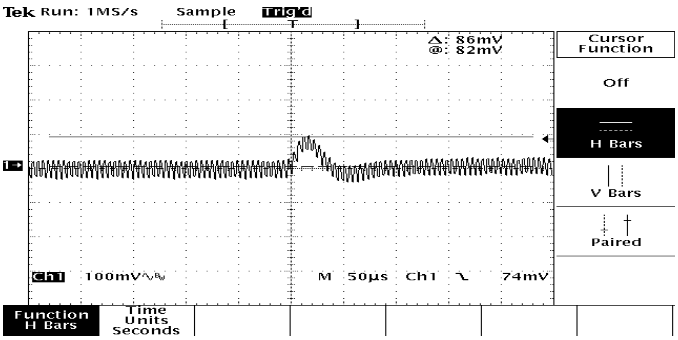
Characteristic Curves - 2.5V Model



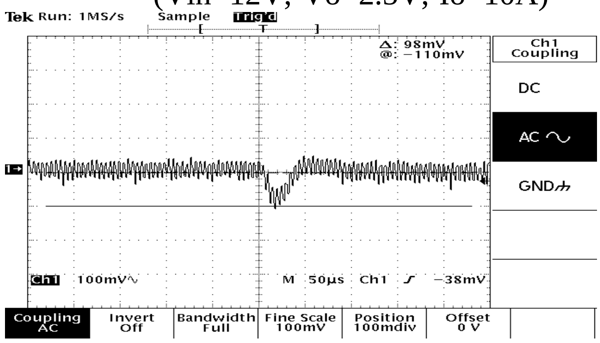
Efficiency vs Line Voltage and Load current



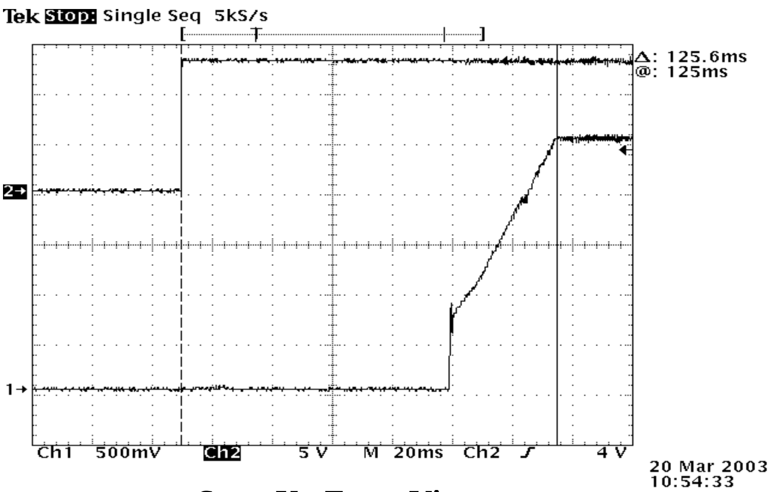
Output ripple and noise
(Vin=12V, Vo=2.5V, Io=10A)



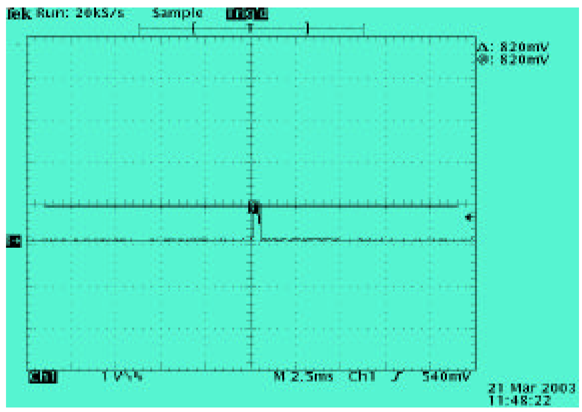
Dynamic Load Response
(Vin=12V, Vo=2.5V 50 to 100% Load step)



Dynamic Load Response
(Vin=12V, Vo=2.5V 100 to 50% Load step)



Start-Up From Vin
(Vin=12V, Vo=2.5V, Io= 10A)



Short Circuit (Output Hiccup)
(Vin 12V, Vo Short)

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

1.5) Vo=3.3V

Input Specifications
Vo=3.3V

Parameter	Symbol	Min	Typical	Max	Units
Operating Input Voltage	Vin	4.6	12	13.4	V
Input Current	Iin			7	A
Output voltage trim	Vo	0.9V		5V	V
No Load Input Current			93		mA
Remote Off Input Current			3.9		mA
Input Reflected Ripple Current			11.6		m A_{rms}
Input Reflected Ripple Current (P-P)			33.6		mApk
Inrush Current Transient			0.0066		A^2 s

Note: All the measurements are taken at +25°C ambient temperature

Output Specifications
Vo=3.3V

Parameter	Module	Symbol	Min	Typical	Max	Units
Output Voltage adjusment		Vout	0.9		5	V
Load Regulation				18		mV
Line Regulation (at full load)				3		mV
Output Ripple and Noise Vin=12V, (20MHZ BW)				76	98	mVp-p
Output Current Range		Iout	0		10	A
Output DC Current Limit		Ilim	11		20	A
Turn on Time				245		ms
Overshoot at Turn On				0		%
Output Capacitance					3300	uF

Note: All the measurements are taken at +25°C ambient temperature

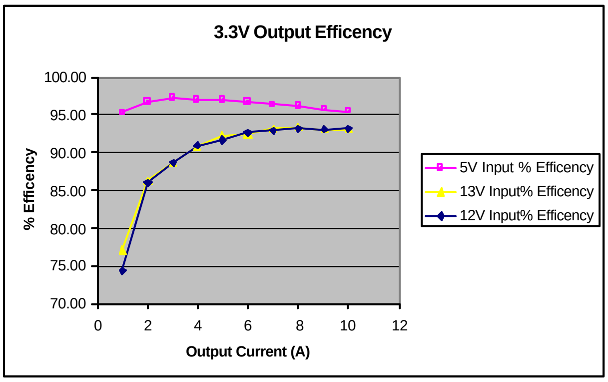
Transient Response
Vo=3.3V

Parameter	Symbol	Min	Typical	Max	Units
ΔV 50% To 100% of Max Load, di/dt=0.1A/us Vin=5V Vin=12V	 Vdynamic Vdynamic	 - -	 190 114	 - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 150 100	 - -	 us us
ΔV 100% To 50% of Max Load, di/dt=0.1A/us Vin=5V Vin=12V	 Vdynamic Vdynamic	 - -	 192 132	 - -	 mV mV
Settling Time to within 1% of output set point Vin=5V Vin=12V	 Ts Ts	 - -	 150 100	 - -	 us us

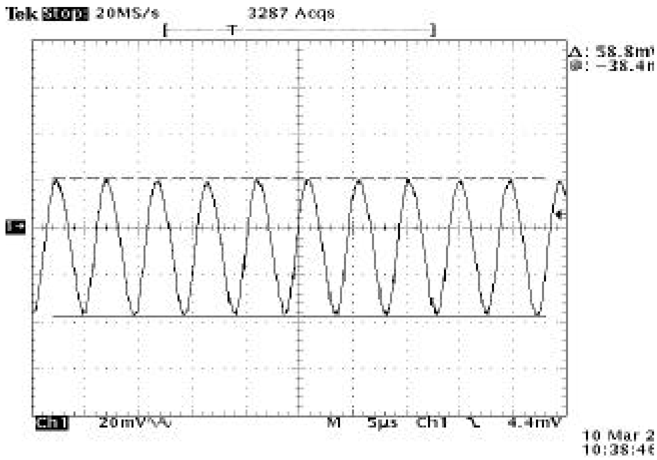
Note: All the measurements are taken at +25°C ambient temperature

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

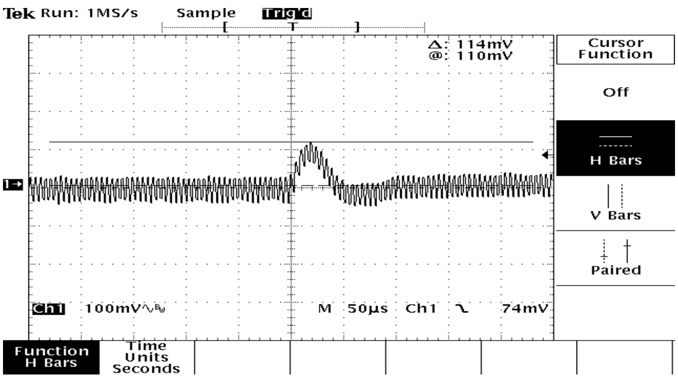
Characteristic Curves – 3.3V Model



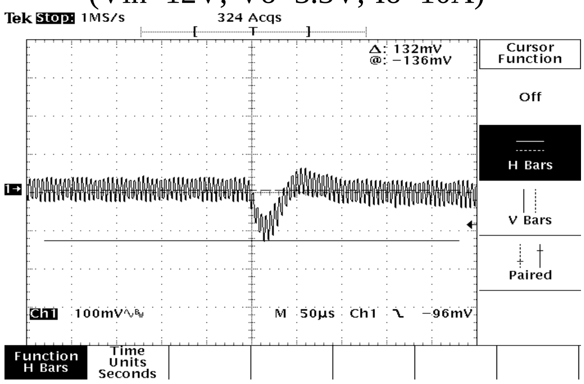
Efficiency vs Line Voltage and Load current



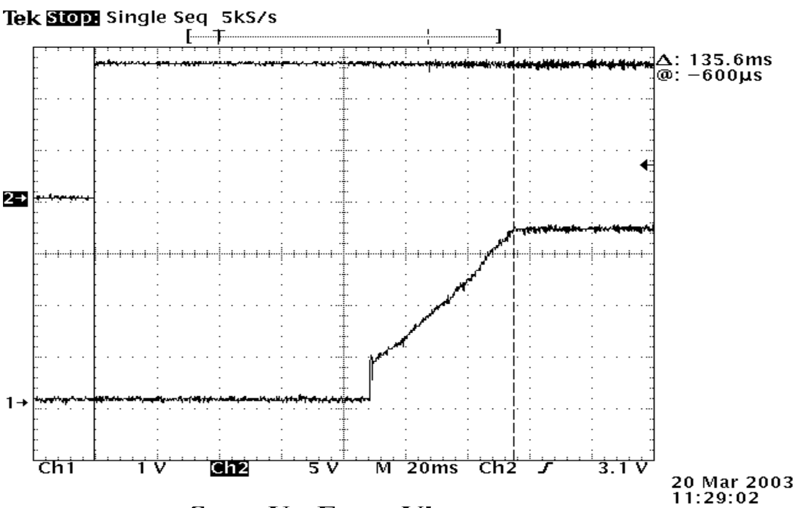
Output ripple and noise
(Vin=12V, Vo=3.3V, Io=10A)



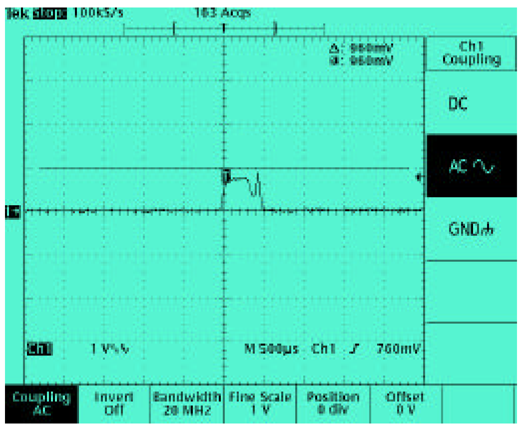
Dynamic Load Response
(Vin=12V, Vo=3.3V 50 to 100% Load step)



Dynamic Load Response
(Vin=12V, Vo=3.3V 100 to 50% Load step)



Start-Up From Vin
Vin=12V, Vo=3.3V, Io= 10A)



Short Circuit (Output Hiccup)
(Vin 12V, Vo Short)

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

1.6) Vo=5V

Input Specifications

Vo=5V

Parameter	Symbol	Min	Typical	Max	Units
Operating Input Voltage	Vin	7	12	13.4	V
Input Current	Iin			7.5	A
No Load Input Current			124		mA
Remote Off Input Current			3.9		mA
Input Reflected Ripple Current			14.91		m A_{rms}
Input Reflected Ripple Current (P-P)			43.91		mApk
Inrush Current Transient			0.0099		A^2 s

Note: All the measurements are taken at +25°C ambient temperature

Output Specifications

Vo=5V

Parameter	Module	Symbol	Min	Typical	Max	Units
Output Voltage adjustment		Vout	0.9		5	V
Load Regulation				25		mV
Line Regulation				7		mV
Output Ripple and Noise Vin=12V, (20MHZ BW)				94	122	mVp-p
Output Current Range		Iout	0		10	A
Output DC Current Limit		Ilim	11		20	A
Turn on Time				251		ms
Overshoot at Turn On				0		%
Output Capacitance					3300	uF

Note: All the measurements are taken at +25°C ambient temperature

Transient Response

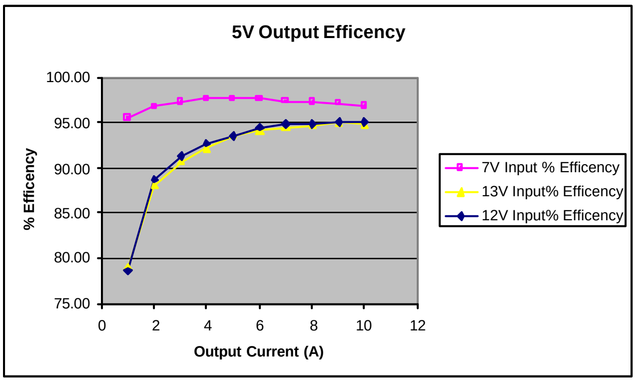
Vo=5V

Parameter	Symbol	Min	Typical	Max	Units
ΔV 50% To 100% of Max Load, di/dt=0.1A/us					
Vin=7V	Vdynamic	-	172	-	mV
Vin=12V	Vdynamic	-	132	-	mV
Settling Time to within 1% of output set point					
Vin=7V	Ts	-	128	-	us
Vin=12V	Ts	-	100	-	us
ΔV 100% To 50% of Max Load, di/dt=0.1A/us					
Vin=7V	Vdynamic	-	152	-	mV
Vin=12V	Vdynamic	-	146	-	mV
Settling Time to within 1% of output set point					
Vin=7V	Ts	-	128	-	us
Vin=12V	Ts	-	100	-	us

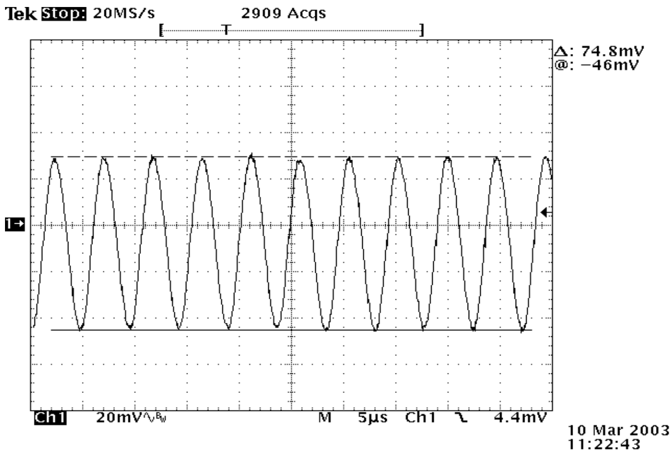
Note: All the measurements are taken at +25°C ambient temperature

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

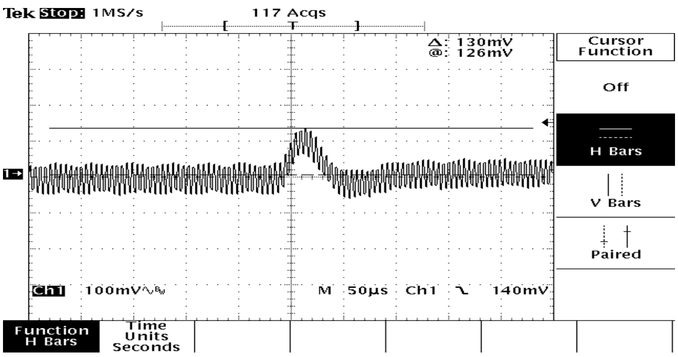
Characteristic Curves – 5V Model



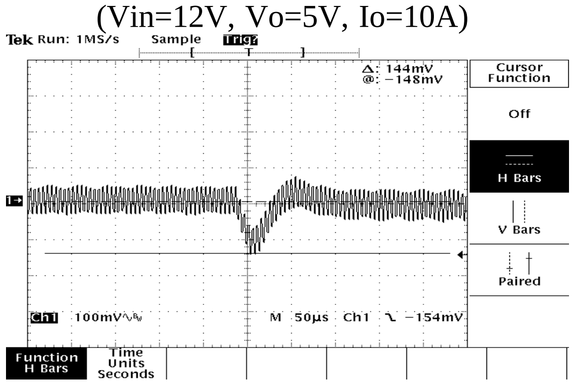
Efficiency vs Line Voltage and Load current



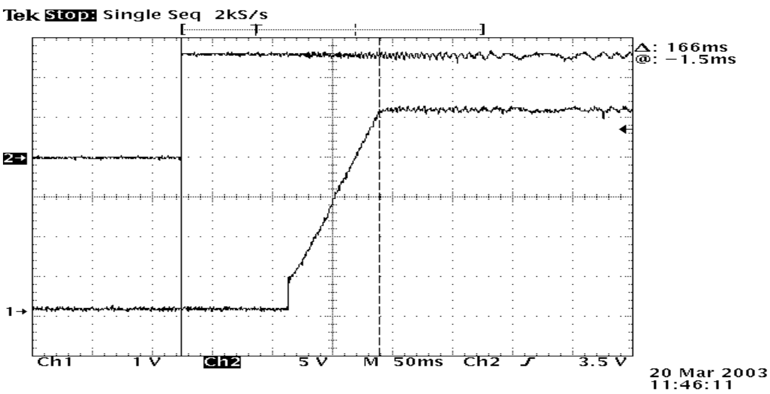
Output ripple and noise
(Vin=12V, Vo=5V, Io=10A)



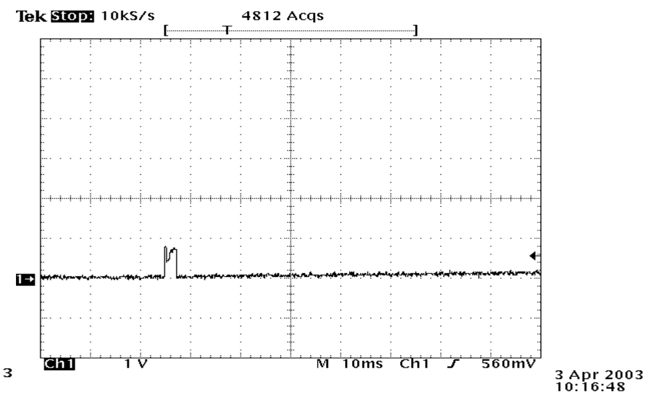
Dynamic Load Response
(Vin=12V, Vo=5V 50 to 100% Load step)



Dynamic Load Response
(Vin=12V, Vo=5V 100 to 50% Load step)



Start-Up From Vin
(Vin=12V, Vo=5V, Io= 10A)



Short Circuit (Output Hiccup)
(Vin 12V, Vo Short)

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

(1.7) ***Output Voltage Trim Resistor (PL10S-12-TR) FOR 11 PIN MODEL***

To set the output voltage, connect the Trim resistor between the trim pin (pin 10) and the –ve sense pin (pin 6). (See outline drawing)

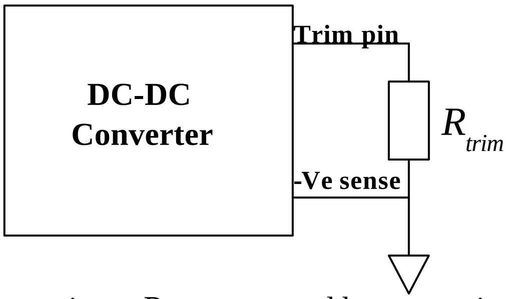


Diagram: shows the trim resistor R_{trim} connected between trim pin and the –ve sense pin.

To calculate the value of the trim resistor R_{trim} use the following equation.

$$R_{trim} = \frac{4710}{(\frac{V_0}{0.9} - 1)}$$

Where V_o is the desired output Voltage.
Eg: If the desired output voltage is 1.5V, then R_{trim} is calculated as the following

$$R_{trim} = \frac{4710}{(\frac{1.5}{0.9} - 1)} = 7072\Omega$$

The table below gives the calculated values of R_{trim} for some desired output voltages.

Vo (V)	**0.9**	**1.5**	**2.5**	**3.3**	**5**
$R_{trim}(\Omega)$	**Not Fitted**	**7072**	**2661**	**1770**	**1035**

Note: Don't leave the negative sense pin floating. If not used connect it to the ground at the load.

(1.71) *Output Voltage Trim Resistor (PL10S-12V-T) FOR 9 PIN MODEL*

To set the output voltage, connect the Trim resistor between the trim pin (pin 8) and the ground pin (pin 4). (See outline drawing)

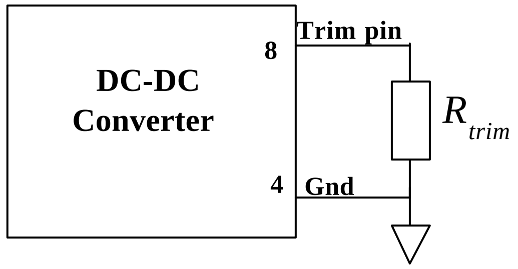


Diagram: shows the trim resistor R_{trim} connected between trim pin and the ground pin.

To calculate the value of the trim resistor R_{trim} use the following equation.

$$R_{trim} = \frac{4700}{(\frac{V_0}{0.9} - 1)}$$

Where V_o is the desired output voltage
Eg: If the desired output voltage is 1.5V, then R_{trim} is calculated as the following

$$R_{trim} = \frac{4700}{(\frac{1.5}{0.9} - 1)} = 7136\Omega$$

The table below gives the calculated values of R_{trim} for some desired output voltages.

Vo (V)	0.9	1.5	2.5	3.3	5
$R_{trim}(\Omega)$	Not Fitted	7050	2645	1767	1033

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

1.72) ***Output Voltage Trim Resistor (PL10S-12V-TP) FOR 10 PIN MODEL***

To set the output voltage, connect the Trim resistor between the trim pin (pin 9) and the ground pin (pin 5). (See outline drawing)

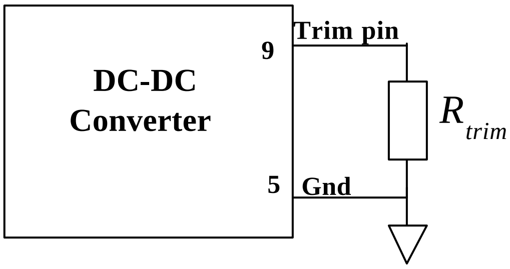


Diagram: shows the trim resistor R_{trim} connected between trim pin and the ground pin.

To calculate the value of the trim resistor R_{trim} use the following equation.

$$R_{trim} = \frac{4710}{(\frac{V_0}{0.9} - 1)}$$

Where V_o is the desired output voltage
Eg: If the desired output voltage is 1.5V, then R_{trim} is calculated as the following

$$R_{trim} = \frac{4710}{(\frac{1.5}{0.9} - 1)} = 7072\Omega$$

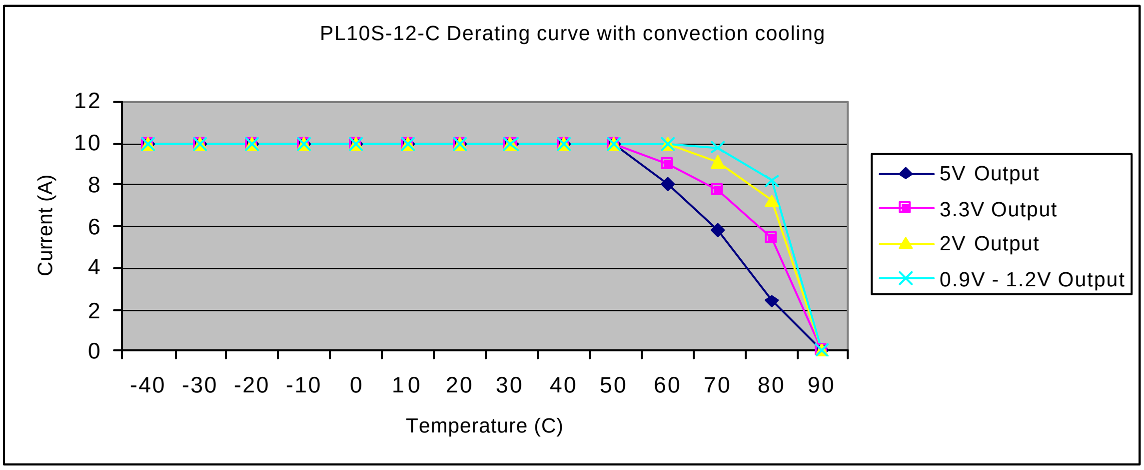
The table below gives the calculated values of R_{trim} for some desired output voltages.

Vo (V)	**0.9**	**1.5**	**2.5**	**3.3**	**5**
$R_{trim}(\Omega)$	**Not Fitted**	**7072**	**2661**	**1770**	**1035**

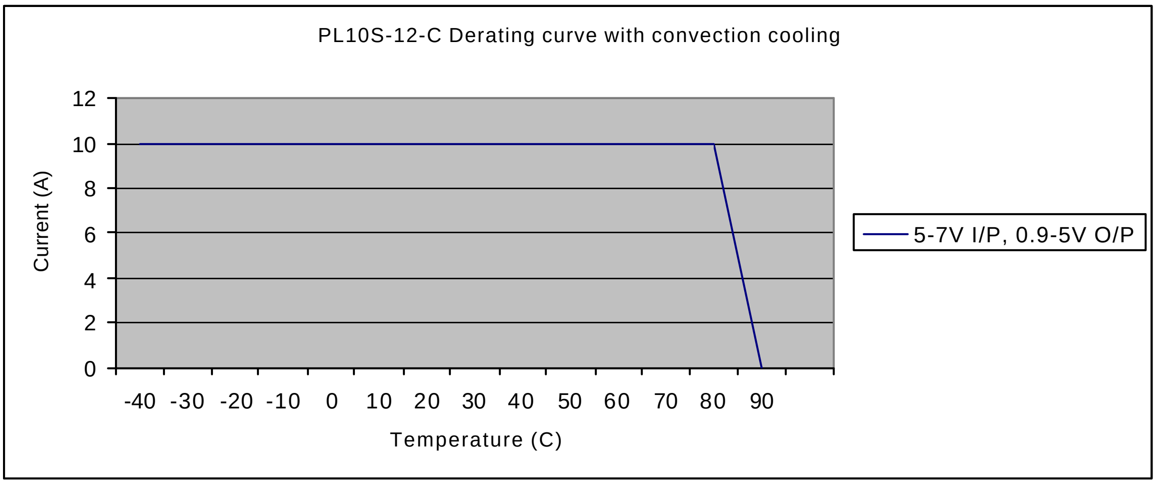
Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

1.8 Derating Curves

Derating Curves with convection cooling



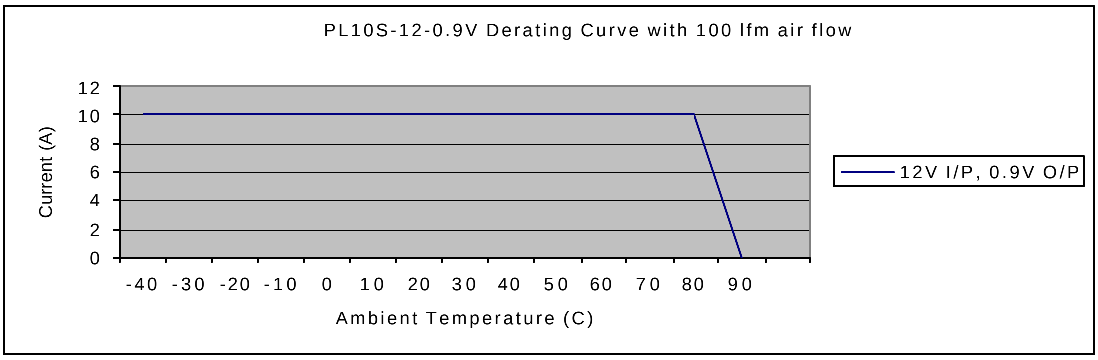
Vin =12V, Vo =0.9-5V with convection cooling



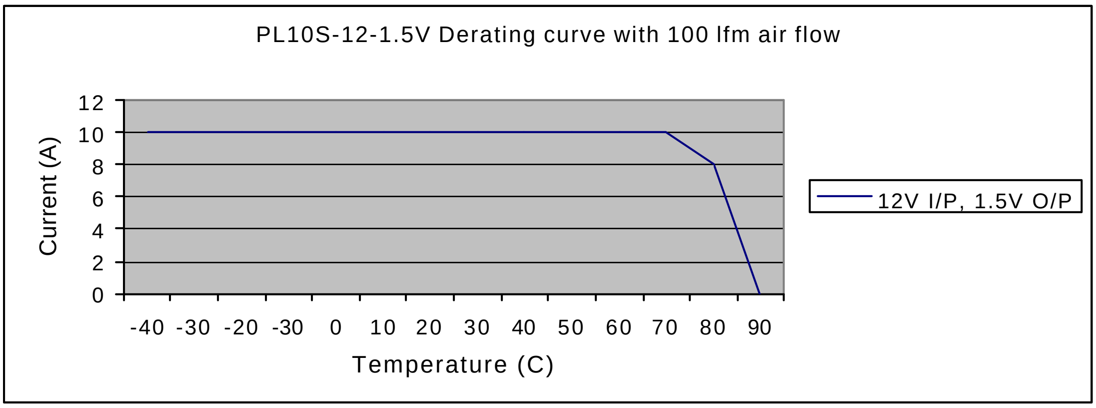
Vin = 5 -7V, Vo = 0.9-5V with convection cooling

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

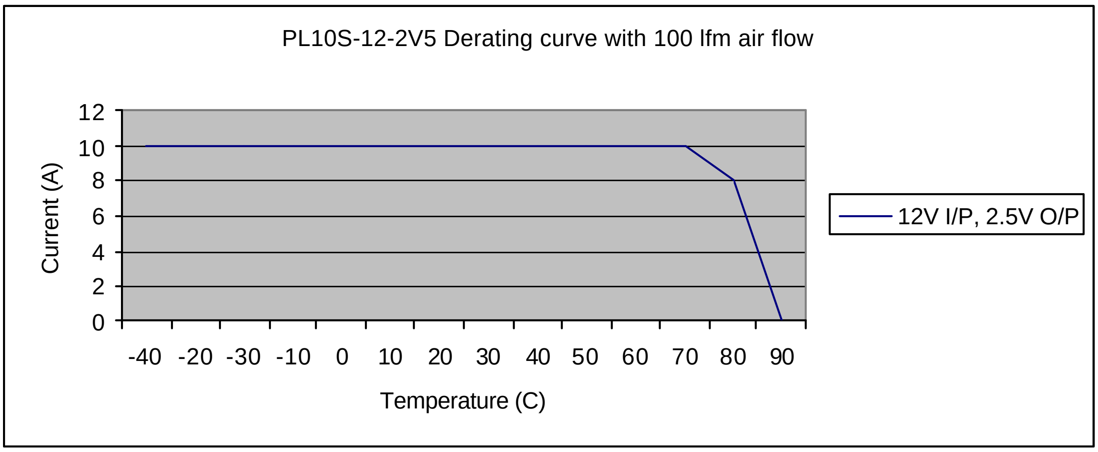
Derating Curves with 100lfm air flow



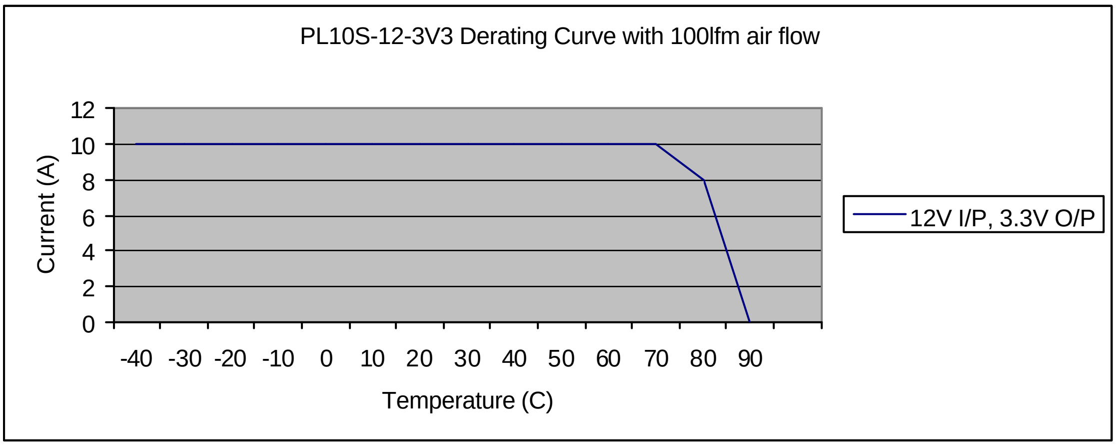
Vin = 12V, Vo = 0.9V with 100 lfm air flow



Vin = 12V, Vo = 1.5V with 100 lfm air flow

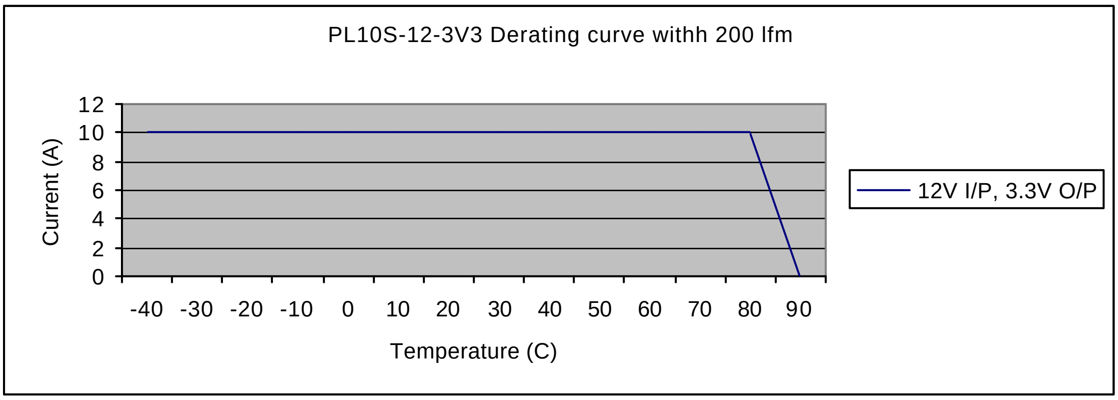


Vin = 12V, Vo = 2.5V with 100 lfm air flow

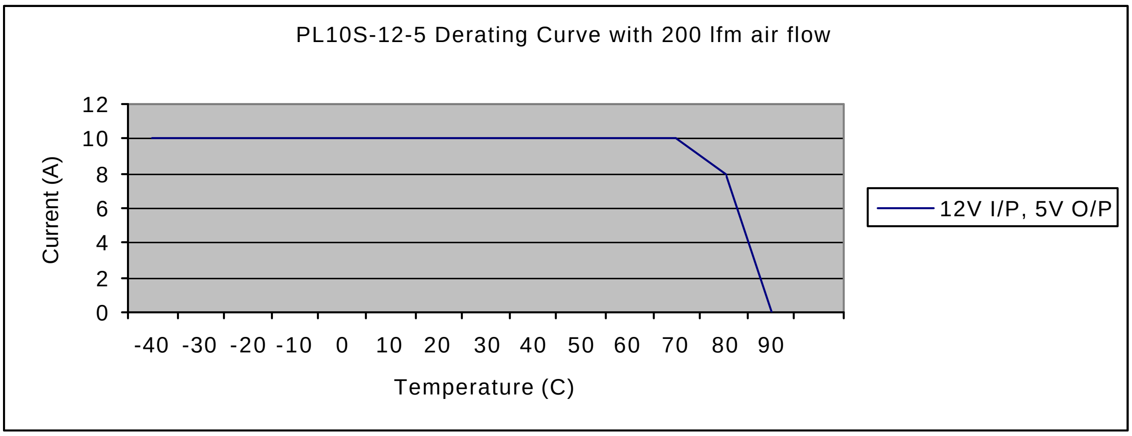


Vin = 12V, Vo = 3.3V with 100 lfm air flow

Drating Curves with 200 lfm air flow

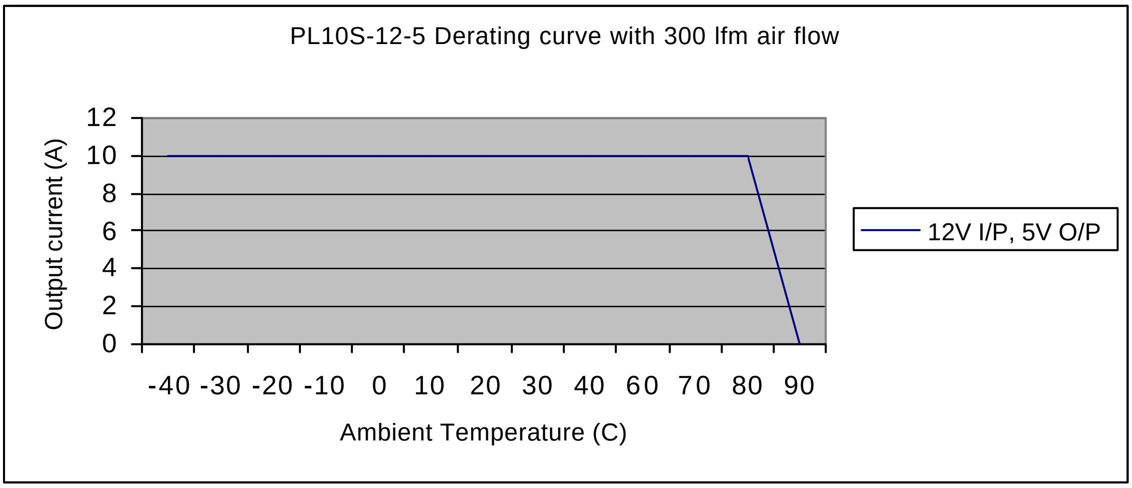


Vin = 12V, Vo = 3.3V with 200 lfm air flow



Vin = 12V, Vo = 5V with 200 lfm air flow

Derating Curves with 300 lfm air flow



Vin = 12V, Vo = 1.5V with 100 lfm air flow

Note: All curves were generated with the PL10S-12 mounted on two layers PCB with power and ground planes.

1.81 Thermal Considerations

The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by monitoring XQ3, XQ4 and XU1 and maintaining a maximum temperature of 120°C on these devices. The output power of the module should not exceed the rated power for the module as listed in the electrical specifications. The thermal derating charts represent the unit in vertical or horizontal orientation. For forced air cooling charts the module is placed horizontally.

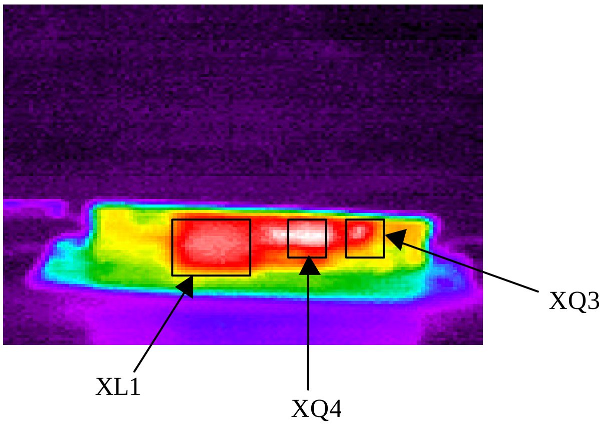


Figure 1.81: A thermal image of the PL10S-12 with the hottest components marked as XL1, XQ3, and XQ4

.

1.9) Design Considerations

1.91 Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedance's can affect the stability of the power module. It is recommended to fit 100µF capacitor mounted close to the power module input. Its also recommended to use short and thick input and output leads or tracks to eliminate the occurrence of triggering the under voltage lockout at turn on and turn off, when switching from Vin. Otherwise its recommended to switch the unit on and off from the ON/OFF pin.

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

1.92 Fusing Considerations

CAUTION: This power module is not internally fused. An input line fuse must always be used.
Type:
Time-delay, high breaking capacity (HBC), ceramic, 250V minimum, 20A maximum rating. (20A is the maximum current rating, the same type of fuse with a lower current rating may be used but testing in application is recommended to ensure no nuisance blowing results)

1.93 Remote Sense

The PL10S-12-*-TR series has a positive and negative remote sense pins option, While the PL10S-12-*-TP has a positive sense pin only. The purpose of the remote sense pins is to compensate for any IR drop in conductors and cabling. The remote sense connections don't require heavy cabling because of the little current they carry. Therefore, a minimal cross-sectional area conductor could be used. The remote sense pins are capable of compensating for voltage drops between the output and the sense pins that do not exceed 0.5V.

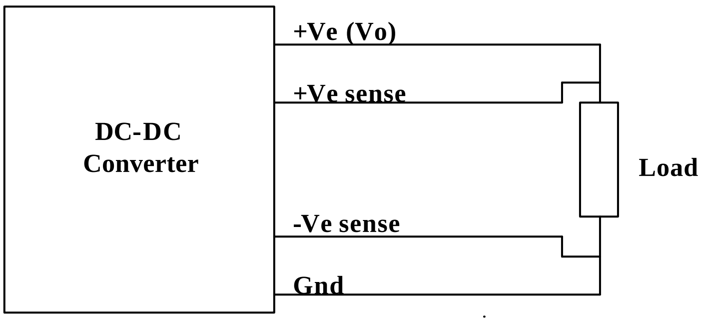


Figure 1.931 Typical negative and positive remote sense connections (PL10S-12-*-TR)

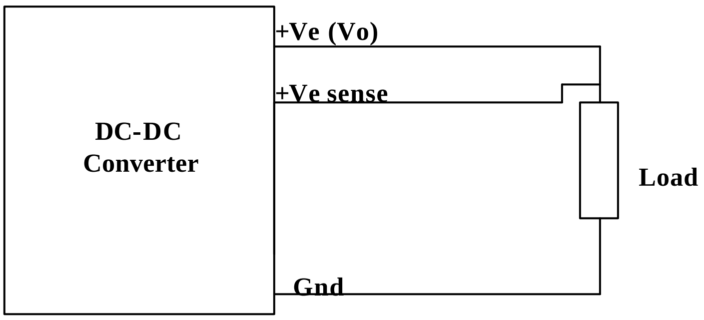


Figure 1.932 Typical positive remote sense connections (PL10S-12-*-TP)

When using remote sense, attention should be paid to the duty cycle ratio. E.g. If the input voltage is 7V and the output voltage is set at 5V and the remote sense is set to compensate for 500mV, then the output voltage at the unit terminals will rise to 5.5V. Therefore, the minimum input voltage should be raised by 740mv (7.74V) to give a duty cycle ratio less than 72%, therefore:

$$D = \frac{V_O}{V_{IN}}$$

$$\frac{V_O\, pins}{V_{IN}} \leq 72\%$$

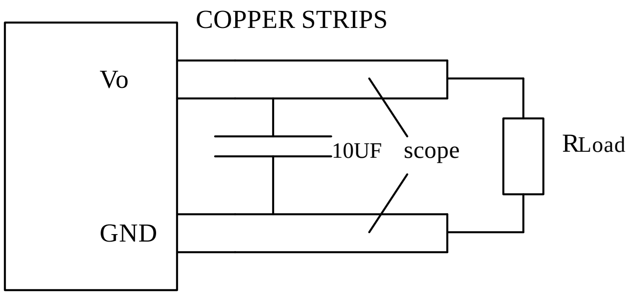
The output power of the unit should not exceed the specified power rating of the unit.
E.g. If the output voltage is set to provide 5V at the load and the load is drawing 10A and there is 0.5V drop in the connections between the unit terminals and the load, the output voltage at the unit terminals would rise to 5.5V. This would cause the output power to exceed the power rating of the unit. Therefore,

Vout at terminals x Iout ≤ power rating.

Note: Do not leave the negative sense pin floating. If not used connect it to ground at the load.

1.94) Output Filtering

The PL10 meets the output voltage ripple and transient response specifications without the need for additional output capacitance. However additional output capacitance may be required to reduce the output ripple or to improve the transient response performance. Low ESR (3300UF max, 20mΩ ESR minimum) polymer capacitor is recommended to improve both the ripple and the transient response performance.



Output Ripple and noise Test Setup

2) Feature Descriptions

2.1) Current Limit

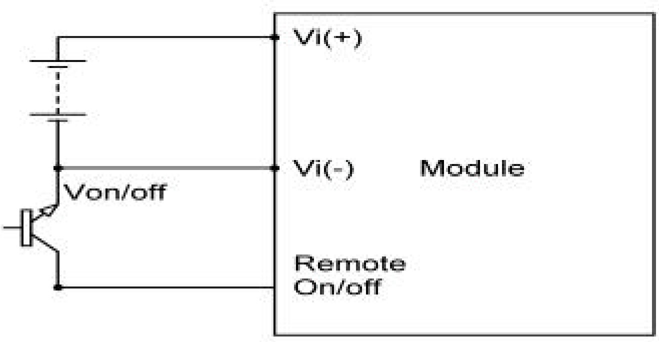
To provide protection in a fault (output overload) condition, the unit is equipped with internal current-limiting circuitry. At the point of current-limit inception, the unit goes into hiccup mode. The unit operates normally once the output current is brought back into its specified range.

2.2) Over Temperature Protection

If the temperature of the high side Fet exceeds 125°C the unit will go into Hiccup mode and the output voltage will fall. Reducing the output power until the Fet temperature drops below 125°C.

2.3) Remote On/Off

To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the Vo(-) terminal. The switch may be an open collector or equivalent (see the figure below). A logic low is Von/off = 0 V to +0.4 V. The maximum Ion/off during logic low is 3.9mA. The switch should maintain a logic-low voltage while sinking 3.9 mA.



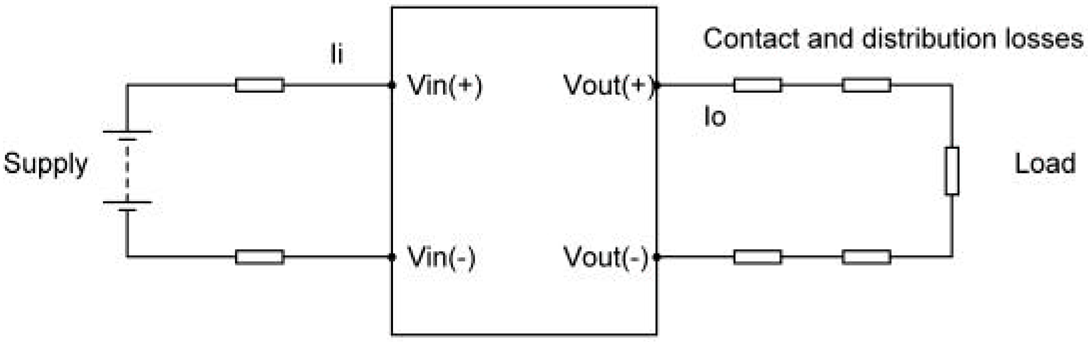
Remote on/off	Unit Condition
Logic low	Unit Off
Logic high or open circuit	Unit On

Function	PL10S-12-*-T	PL10S-12-*-TP	PL10S-12-*-TR
Vo(-)	Pin 4	Pin 5	Pin 4
ON/OFF	Pin 9	Pin 10	Pin 11

Remote On/Off Implementation

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

2.4) Efficiency Measurement



$$h = \left(\frac{[Vo(+) - Vo(-)]Io}{Vi(+) - (Vi(-)Ii} \right) \times 100$$

Output Voltage and Efficiency Measurement Test Setup

Note: All measurements are taken at the module terminals. When socketing, place Kelvin connections at module terminals to avoid measurement errors due to socket contact resistance.
The table below summaries the functionality of each pin on the PL10S series.

Function	PL10S-12-C-TR Pin	PL10S-12-C-TP Pin	PL10S-12-C-T Pin
Vin(+)	8,9	7,8	6,7
Vin(-)	7	6	5
Vout(+)	1,2,3	1,2,4	1,2,3
Vout(-)	4	5	4

3) EMI Radiated Emissions

All PL10S-12 models meet the requirements of EN55022 Radiated Emissions to Class A.
Full EMC data and result is on request, please contact Coutant Lambda for more information.

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

4) Paralleling PL10 with the ST L6615 Current Share Controller

The PL10 range of non-isolated DC-DC converters is capable of parallel operation for current share. Paralleling two or more PL10s requires a small circuit including a load share controller and a small amount of external components. Whilst there are a number of load share controllers on the market Lambda recommend the ST L6615 current share IC for accurate and stable load sharing.

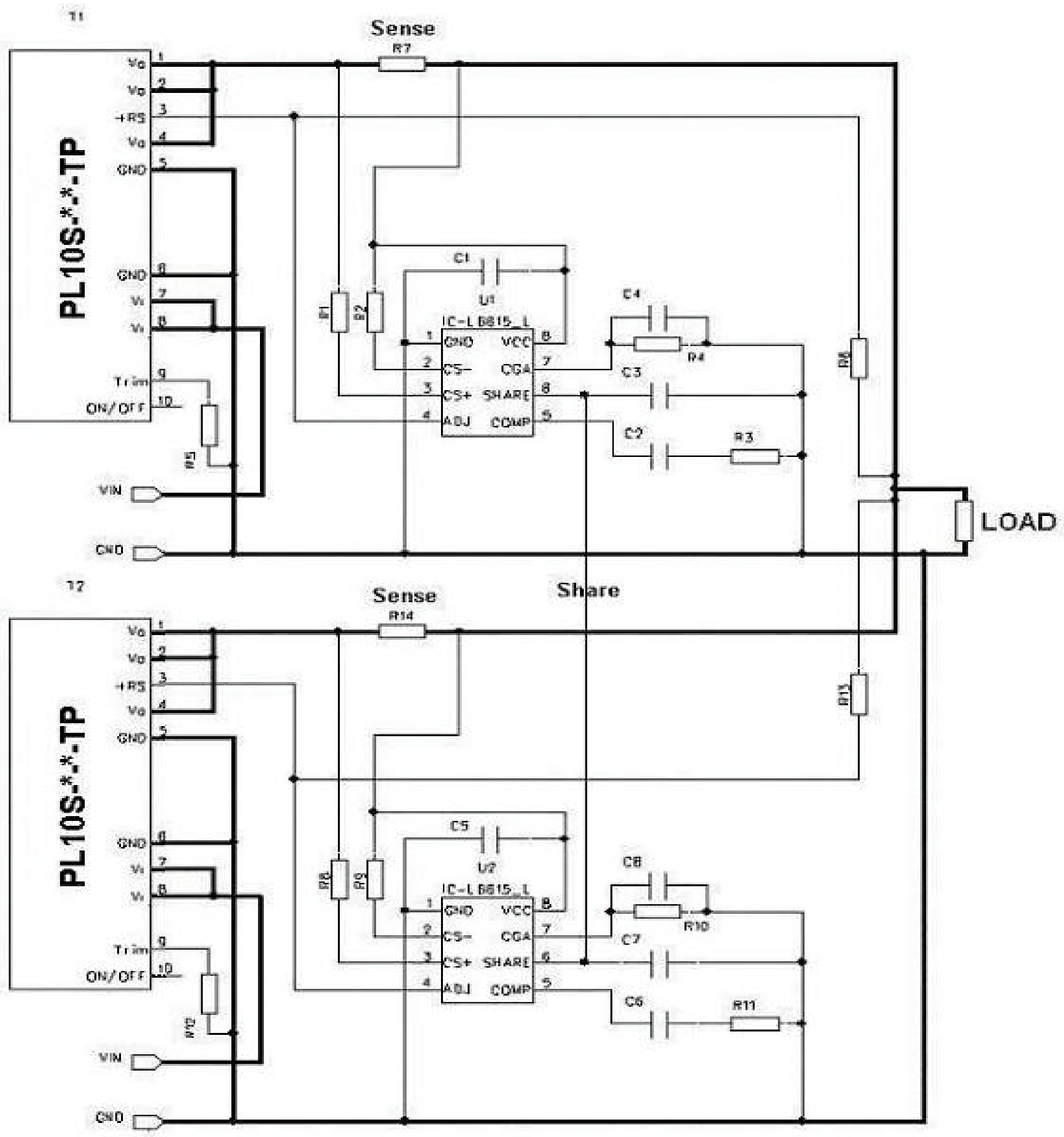


Figure 4.1: The PL10 Current Share Circuit

Table 1. Component List

Resistors

Circ. Ref.	Value/Ohms
R7,R14	0.0015
R1,R2,R8,R9	200
R5,R12	Trim Value
R10,R4	7K5
R3,R11	100
R6,R13	82

Capacitors

Circ. Ref.	Value/F
C1,C5	100n
C3,C7,C4,C8	10n
C2,C6	1u

Integrated Circuits

U1,U2	L6615

Figure 4.1 shows the circuit used to parallel two PL10-*-* TP units and Table 1 lists the components used. Figure 4.2 shows the connections for the TR model PL10. The circuit itself remains the same as figure 4.1.

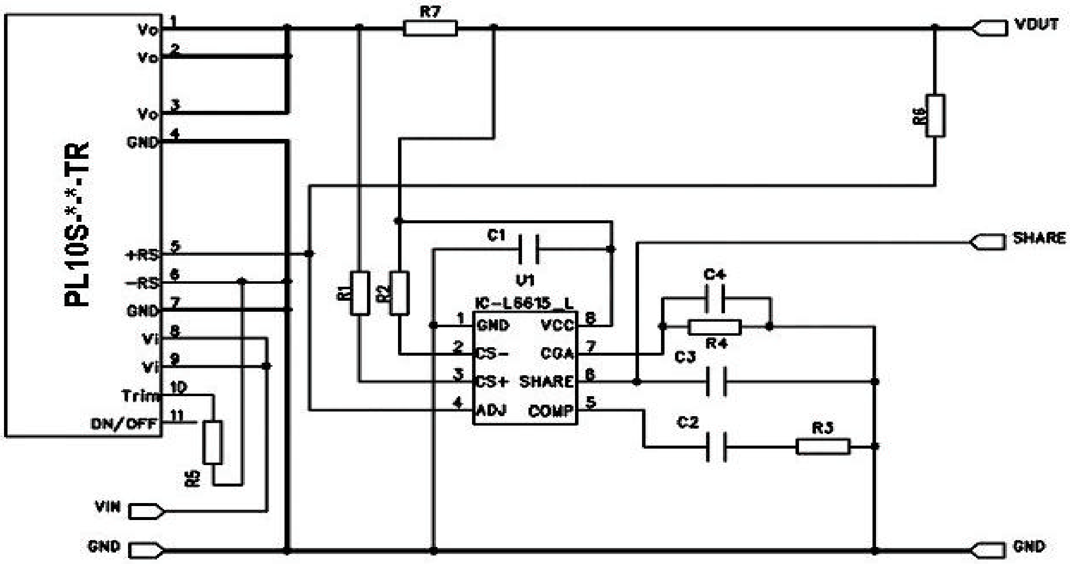


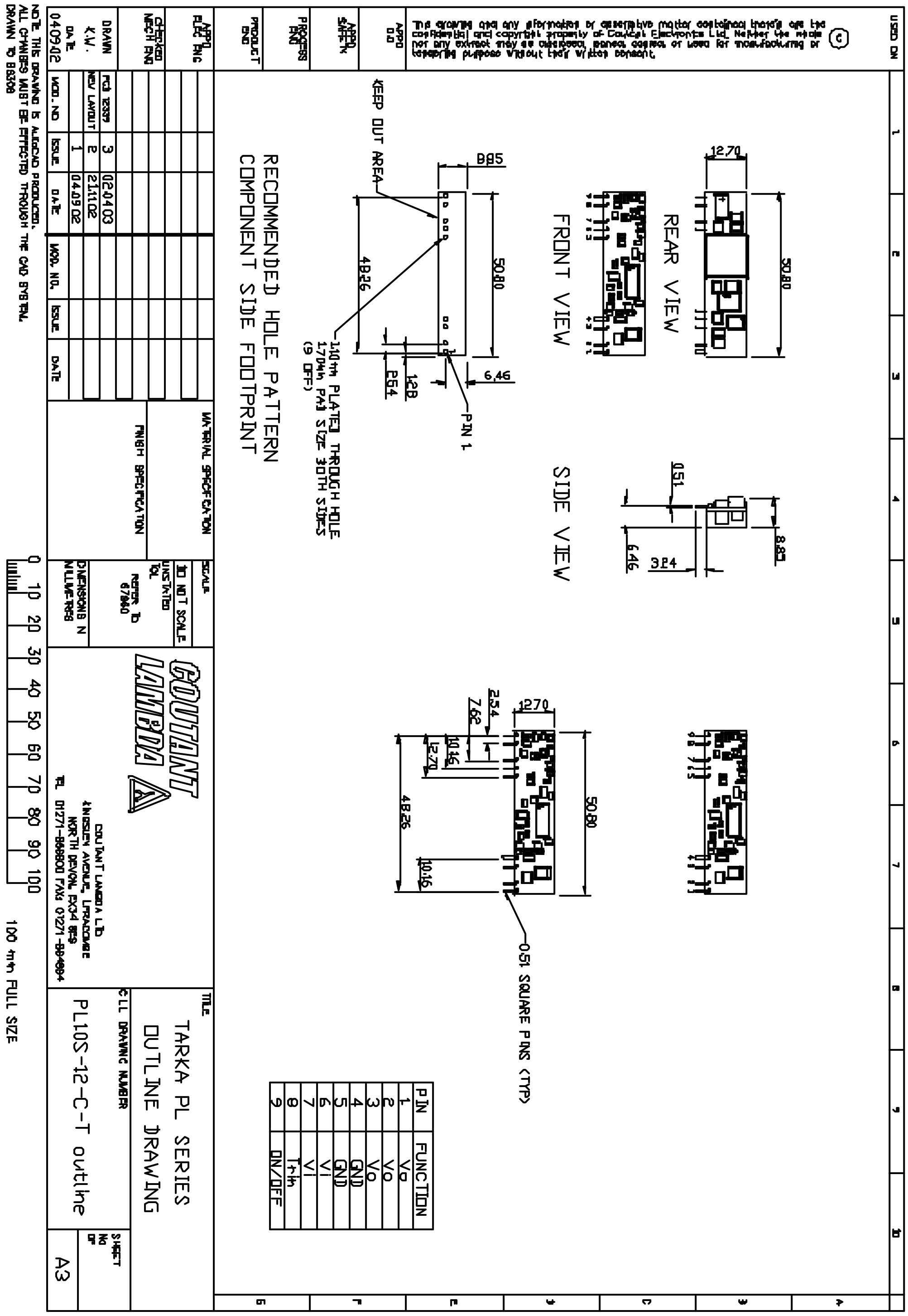
Figure 4.2: The PL10-12-*-TR Model Connections

The trim resistors R5, R12 used to set the output voltage of the PL10S should be selected according to the PL10 Series Datasheet. The power dissipated in the sense resistors R7 and R14 is 1.5W under normal operation and the resistors should be chosen accordingly.

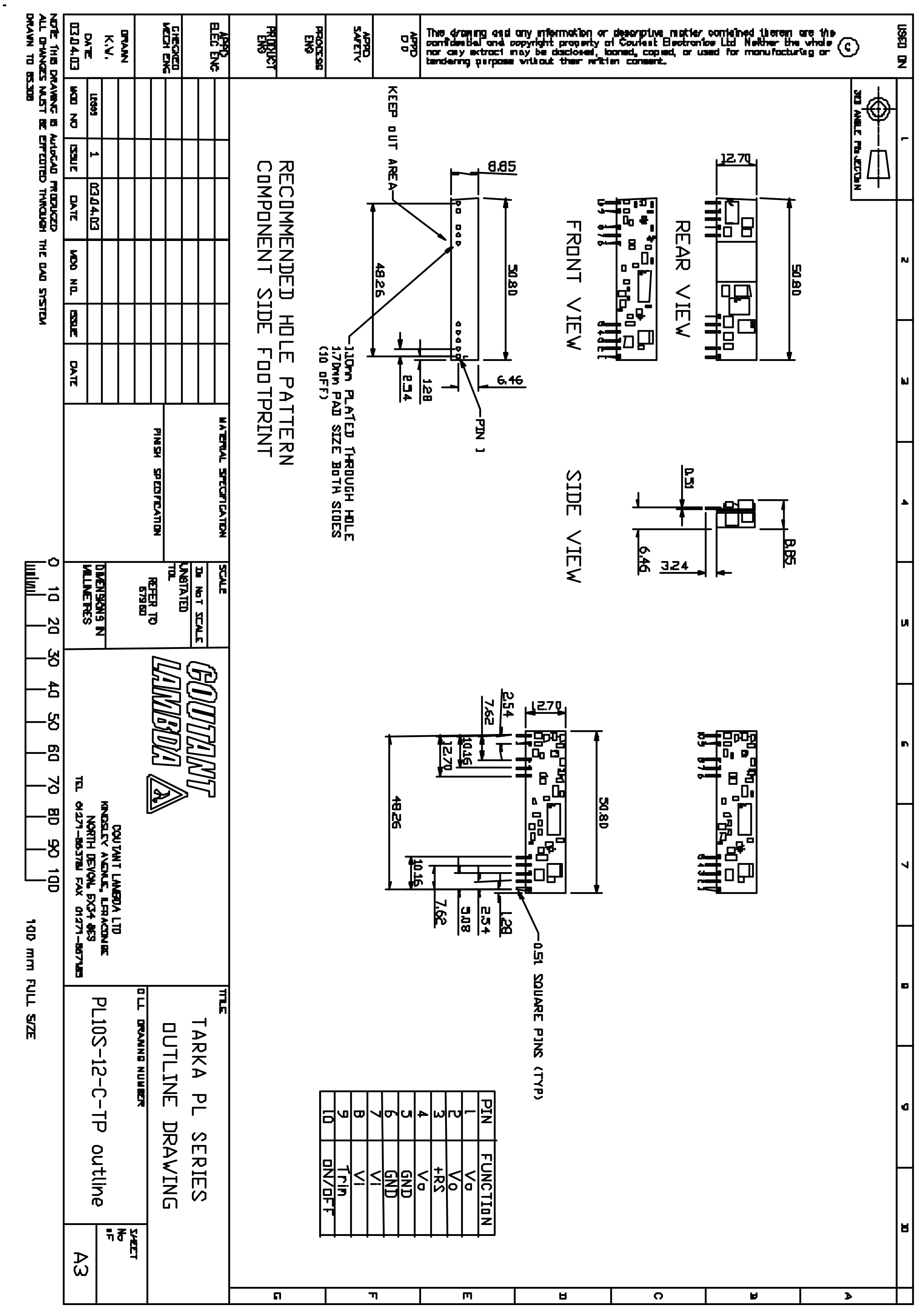
$$\begin{aligned} P_{Sense} &= I^2 R_{Sense} \\ &= 10^2 \times 0.015 \\ &= 1.5W \end{aligned}$$

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

Outline Drawing
PL10S-12-*-T

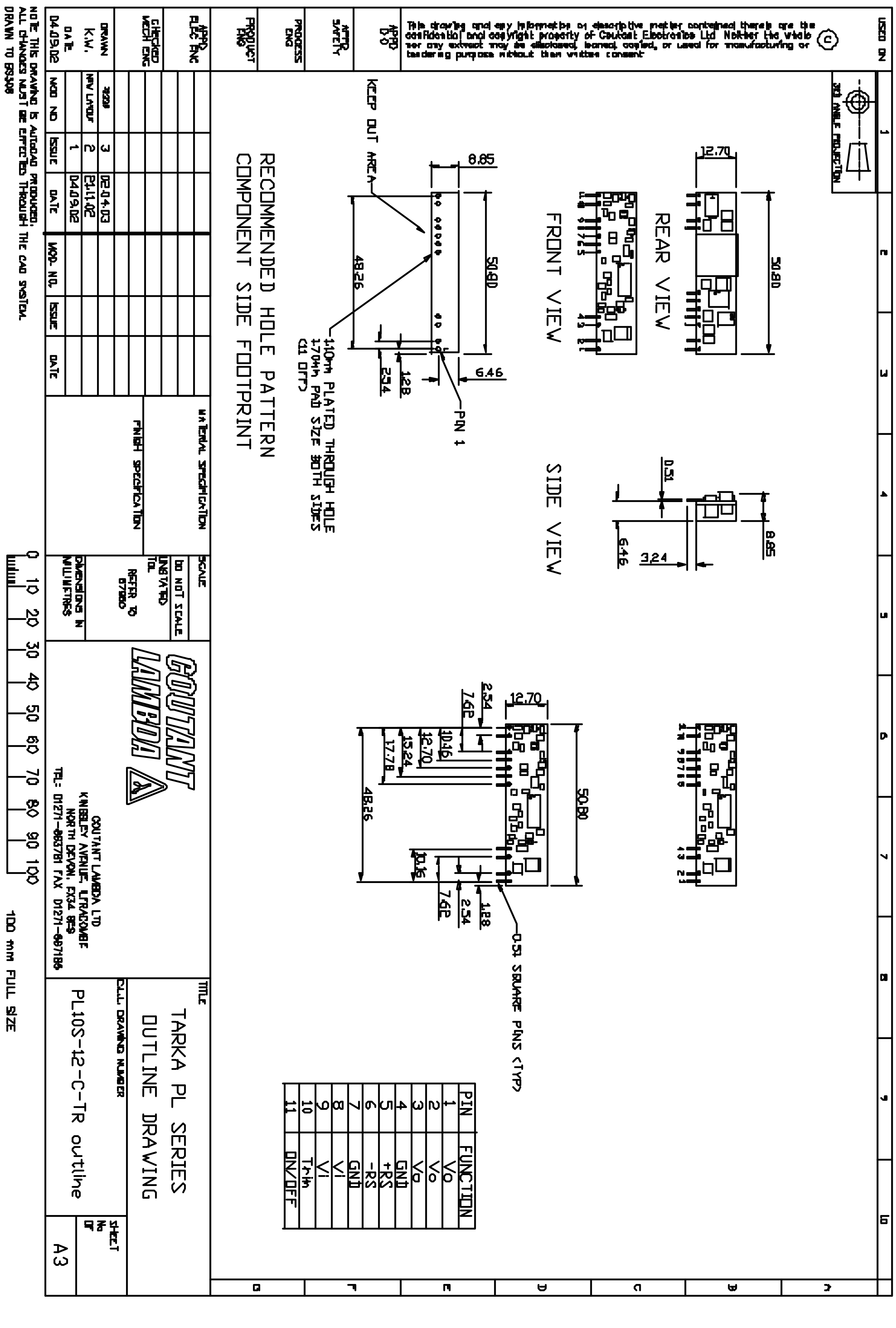


Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894



Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

Outline Drawing
PL10S-12-C-TR



Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894

TARKA Series
Non Isolated DC-DC Converter

Nomenclature

PL	10	S	- 05	- C	- *	- *
Prefix PL = Point of Load	maximum output current	S = Single output	input voltage e.g. **05** or **12**	**C** = Customer selectable output or e.g. 1v2 or 2v5 or 3 or 3v3 whereby customer has requested factory set output	Either **T** "Thru Hole" **TP** "Positive sense only" or **TR** "Thru hole with positive and negative Remote sense pins"	Package option **K -** Box Tray

e.g

PL10S-05-C-TR-K
PL10S-12-3v3-T-K
PL10S-05-C-SR-K

Web: www.lambda-gb.com
E-Mail: intouch@lambdaeu.com
Tel: +44 (0) 1271 856666
Fax: +44 (0) 1271 864894