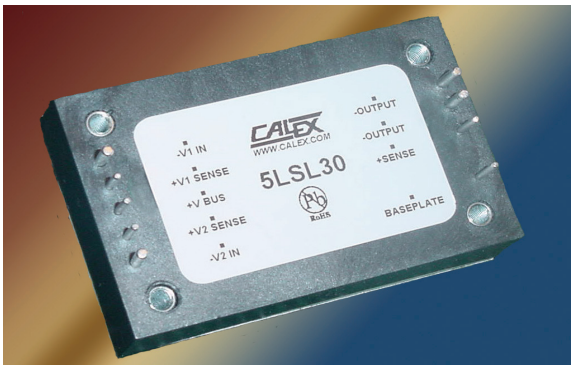
CBAM™ Load Share (LSL) Series



Features

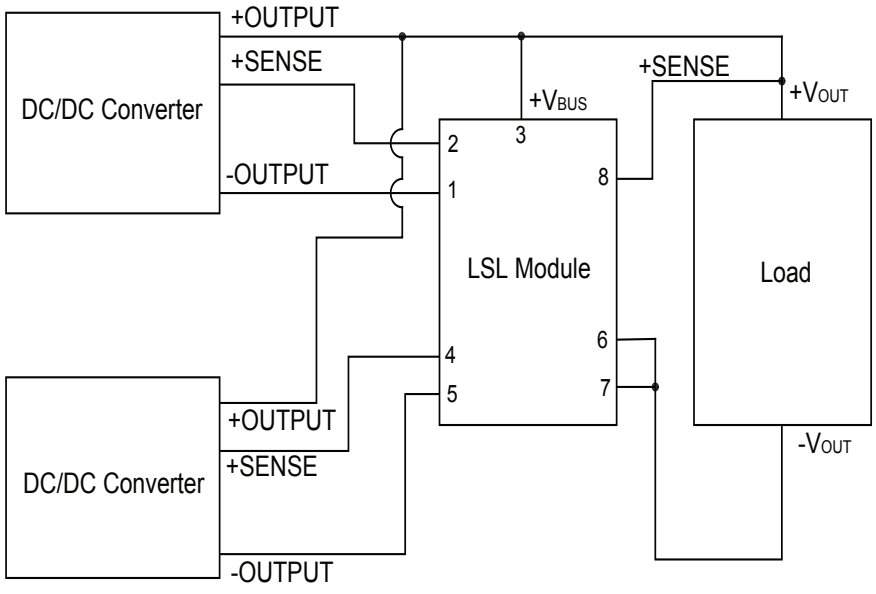
- Dual input/single output load share module
- Six module voltages 3.3V, 5V, 12V, 15V, 24V, and 48V
- Small package design (1.45” x 2.28” x 0.50”)
- Rated up to 60 amps on the output
- Aluminum substrate technology
- All applicable materials used are a minimum of UL94V-0 rated. Designed to meet UL60950.
- Five year warranty
- Available with RoHS compliant construction, simply add “(RoHS)” after the part number i.e 5LSL30 (RoHS)
- Excellent MTBF

Description

Calex’s LSL Series provide an easy and reliable way to parallel DC/DC Converters. The LSL module uses the positive sense pin for accurate load sharing, leaving the trim function unaffected. See application section for layout recommendations.

Selection Chart

Model	Input Voltage Range VDC		Output Current Range ADC	
	Min	Max	Min	Max
3R3LSL30	3.0	4.0	0	60
5LSL30	4.0	10.0	0	60
12LSL12	10.0	14.0	0	24
15LSL10	14.0	18.0	0	20
24LSL6	18.0	36.0	0	12
48LSL6	36.0	50.0	0	12



Load Share Module Connected in System

CBAM™ Load Share (LSL) Series

Input Parameters								
Model		**3R3LSL30**	**5LSL30**	**12LSL12**	**15LSL10**	**24LSL6**	**48LSL6**	**Units**
Input Voltage Range	MIN TYP MAX	3.0 3.3 4.0	4.0 5.0 10.0	10.0 12.0 14.0	14.0 15.0 18.0	18.0 24.0 36.0	36.0 48.0 50.0	VDC
Input Current, No Load	TYP	40	40	40	40	40	40	mA
Input Current Per Pin	MIN MAX	0 30.0	0 30.0	0 12.0	0 10.0	0 6.0	0 6.0	A
Current Share Ratio (3)	TYP	±3						%
Output Parameters								
Rated Load Range	MIN MAX	0 60	0 60	0 24	0 20	0 12	0 12	A
Load Regulation (4)	TYP MAX	1.0 2.0						%
Short Term Drift (5)	TYP	<0.1						%
Temperature Coefficient	TYP MAX	50 150						ppm/ºC
Isolation								
Baseplate to Ground	MIN	700						VDC
Environmental								
Baseplate Operating Temperature Range	MIN MAX	-40 100						ºC
Storage Temperature Range	MIN MAX	-40 105						ºC
Baseplate Thermal Impedance (6)	TYP	9						ºC/Watt
MTBF MIL-HDBK-217F (10)	MIN	530,329						h

Notes:

(1) All parameters measured at $T_{Baseplate}$=25ºC, V_{in}=$V_{Nominal}$, and rated output current unless otherwise noted. Refer to the CALEX Application Notes for the definition of terms, measurement circuits, and other information.

(2) Refer to the CALEX Application Notes for information on fusing.

(3) The current share ratio is defined as the percentage of the individual converter currents entering the LSL module divided by 50% of the current exiting the LSL module. The latter being the theoretical optimum load sharing current. This is measured at full load.

(4) Load regulation is defined as the output voltage change when changing load current from minimum to maximum.

(5) Short Term drift is specified after a 30 minute warm-up at full load, constant line, load and ambient conditions.

(6) The baseplate thermal impedance is defined as the baseplate temperature rise over ambient per package watt dissipated.

(7) Calex CBAM™ modules are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. The CBAM™ modules are not hermetically sealed.

(8) Units are not short circuit or thermally protected.

(9) Torque fasteners into threaded mounting inserts at 12 in. oz. or less. Greater torque may result in damage to unit and void the warranty.

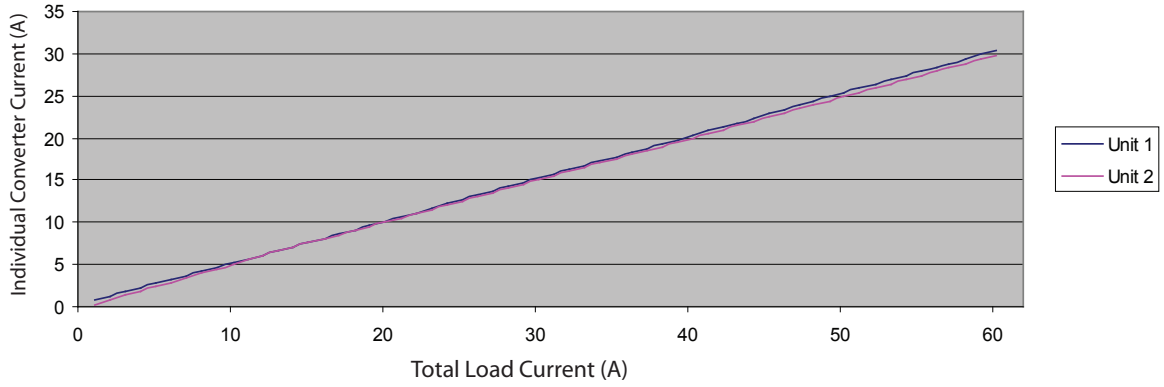
(10) MTBF is calculated based on MIL-HDBK-217F under the following conditions:
Reliability prediction method = Part Stress Analysis
Baseplate temperature = 40ºC
Environment = Ground, Benign

(11) Available with RoHS and Non-RoHS construction, contact factory for details.
See Calex Website www.calex.com/RoHS.html for the complete RoHS Compliance statement.
The RoHS marking is as follows.

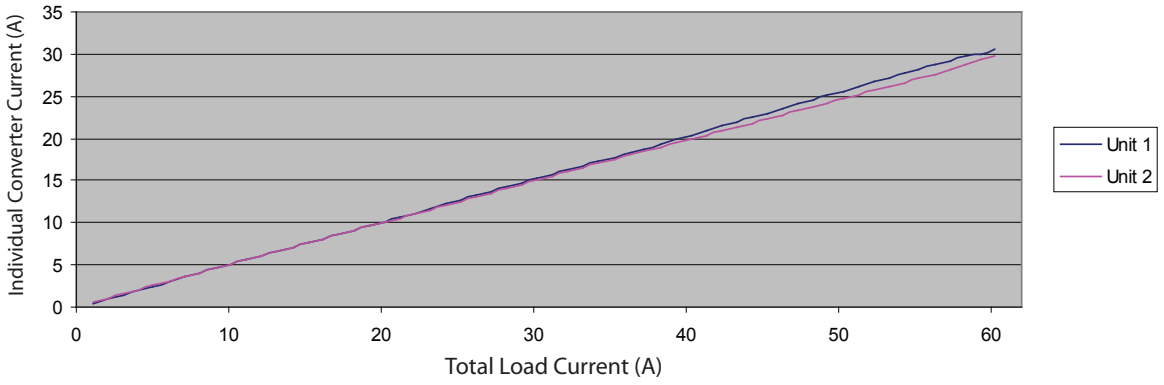
Load Sharing Characteristics

The actual level of load sharing depends on the converter modules used in the setup (see application section). However, with most DC/DC converters the load sharing accuracy should be relatively high. Calex's HEW series of DC/DC converters and the corresponding LSL modules were used to obtain the following load share data:

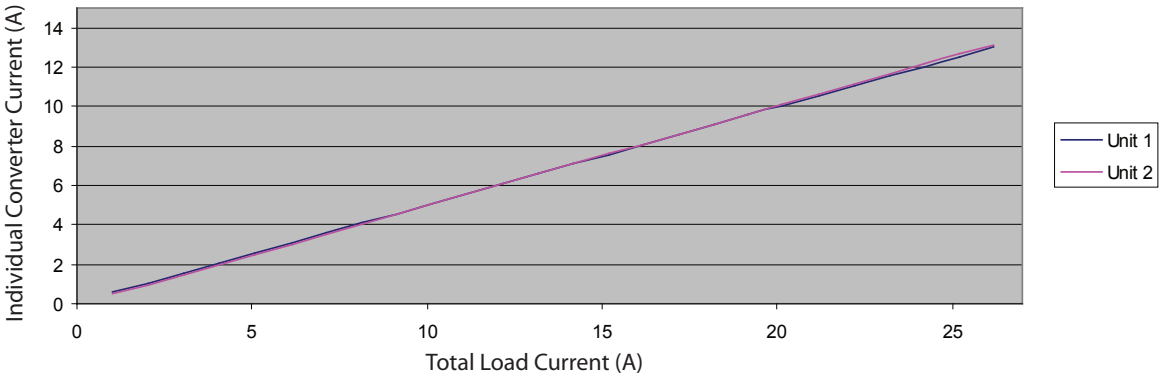
3R3LSL30 Load Sharing:
2 x 24S3.30HEW



5LSL30 Load Sharing:
2 x 24S5.30HEW

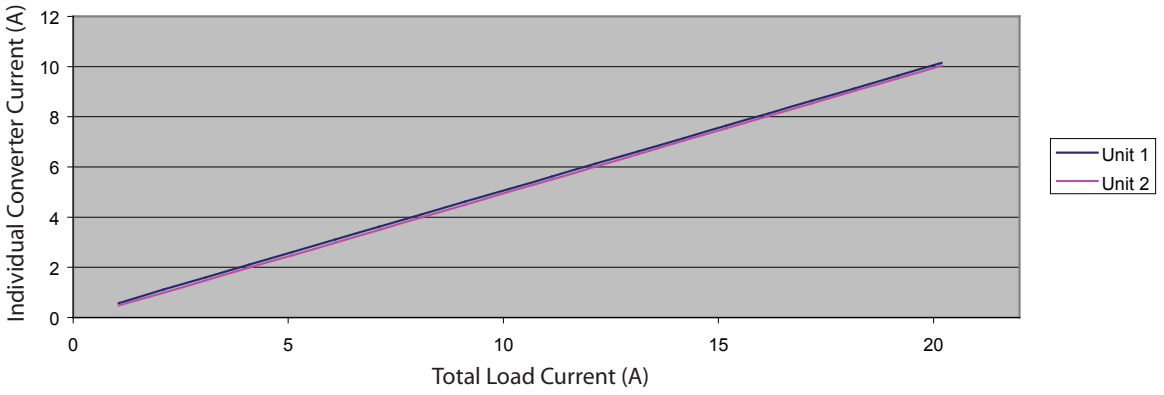


12LSL12 Load Sharing:
2 x 24S12.12HEW

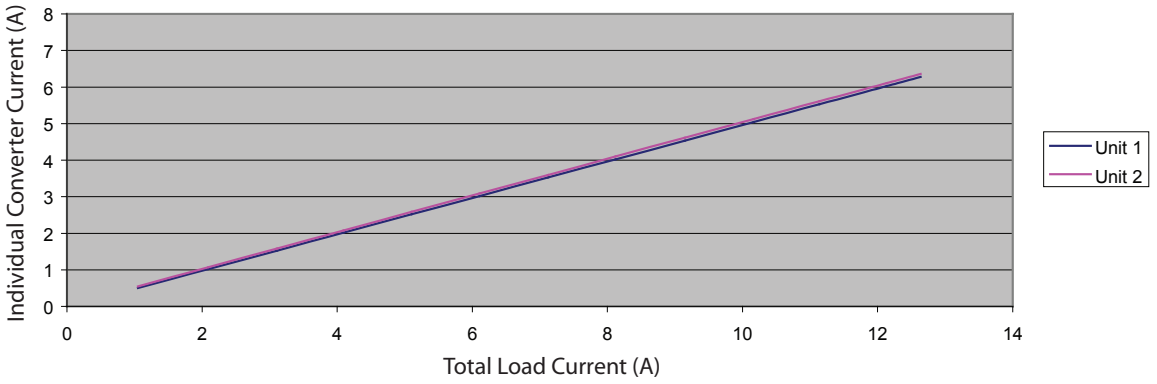


CBAM™ Load Share (LSL) Series

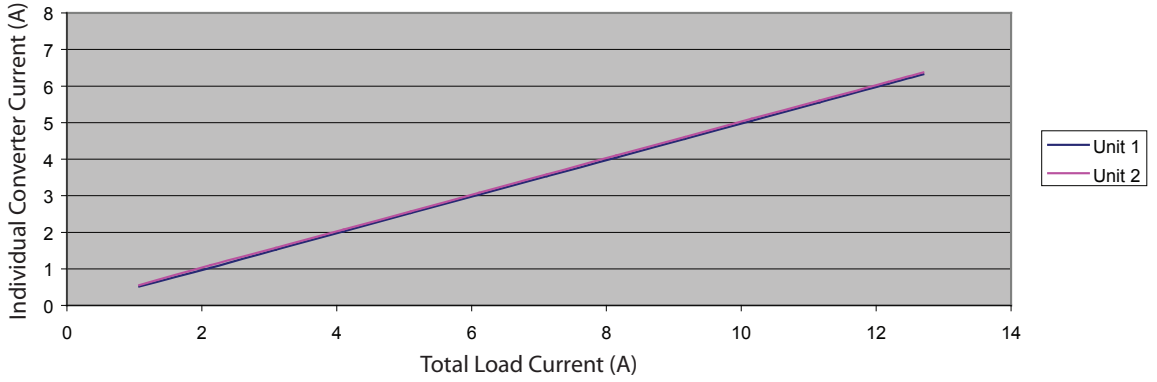
15LSL10 Load Sharing:
2 x 24S15.10HEW



24LSL6 Load Sharing:
2 x 24S24.6HEW

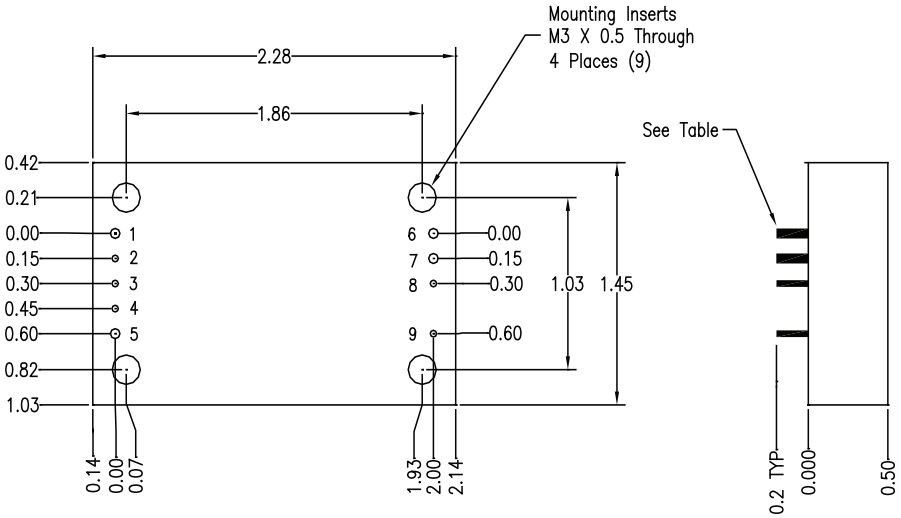


48LSL6 Load Sharing:
2 x Two Series-Connected 24S24.6HEW*



*Contact the Factory for Connection Diagram

CBAM™ Load Share (LSL) Series



Pin	Pin Dia	Name
1	0.060”	-V1 IN
2	0.040”	+V1 SENSE
3	0.040”	+V BUS
4	0.040”	+V2 SENSE
5	0.060”	-V2 IN
6	0.060”	-VOUT
7	0.060”	-VOUT
8	0.040”	+SENSE
9	0.040”	BASEPLATE

Mechanical tolerances unless otherwise noted:
X.XX dimensions: ±0.020 inches
X.XXX dimensions: ± 0.005 inches

ALL GROUNDS ARE DC COMMON

Load Share Application Section

This application note highlights the capabilities and limitations of the Load Share series of modules from Calex.

Load Sharing:

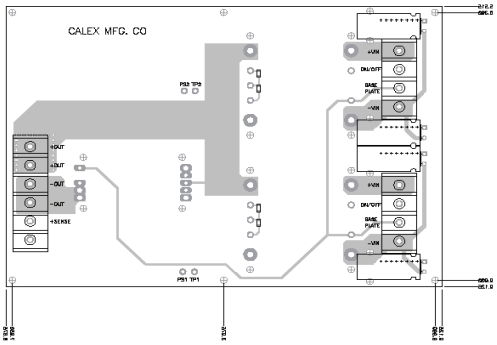
While load sharing can be accomplished in a number of ways the load sharing scheme implemented in Calex's LSL modules is the so-called "active load sharing" with low-side sensing. This means that very accurate load sharing with minimal load regulation issues is obtainable. The low line current sensing allows for lower noise measurements, which improves system load sharing. In addition, the offset errors typically associated with differential measurements in the presence of high common mode voltages are avoided, which in turn improves the overall load sharing.

The control circuitry inside the LSL module communicates via a differential load share bus. This technique provides a higher level of noise immunity than a comparable single-ended communication bus. Whether or not the individual DC/DC converters can operate in a noisy environment has to be evaluated on a case-by-case basis.

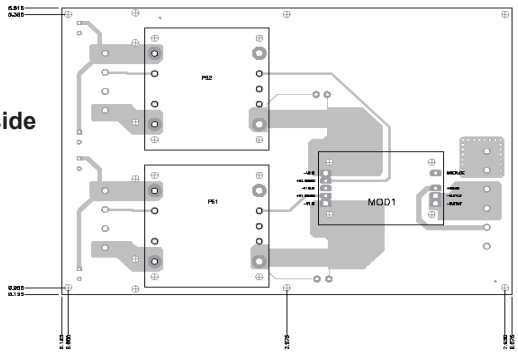
Recommended Layout:

The following layout is recommended for all dual converter systems. This becomes especially critical when dealing with higher voltage converters (such as 24S24.6HEWs) since these have a tendency to generate more RF noise, thus becoming more susceptible to cross talk. Cross talk will not affect the performance of the LSL module, but might affect the performance of the converters.

Top-side View



Bottom-side View



Most DC/DC converters are capable of correcting for voltage drops in PCB traces or wires between the DC/DC converter output and the load. The amount of correction is typically somewhere between 300mV and 500mV. This feature has been maintained in the load share module, which means that voltage drops across load wires in low-voltage high-current DC/DC converters can still be compensated for.

Stability:

Most DC/DC converters have relatively high bandwidths. The LSL modules are optimized for Calex's HEW series of DC/DC converters. If the LSL module is used with other DC/DC converters it is recommended that the crossover frequency (0dB frequency) is verified to be at least 5kHz. If the crossover frequency is below this limit the overall system might become unstable. The reason being that the external current loop in the LSL modules will interact with the DC/DC converter control. Calex's DC/DC converters operate with a high crossover frequency for optimized dynamic response.

Please contact the factory for technical assistance and/or samples of modified LSL modules for 24 and 48 volt applications.

Performance Curves:

On the following pages is a series of typical performance curves for the different LSL models. The layout recommendations shown above have been followed throughout the data gathering process. To assess the load sharing accuracy in percentage of total theoretical converter current the data has been processed through the following equation:

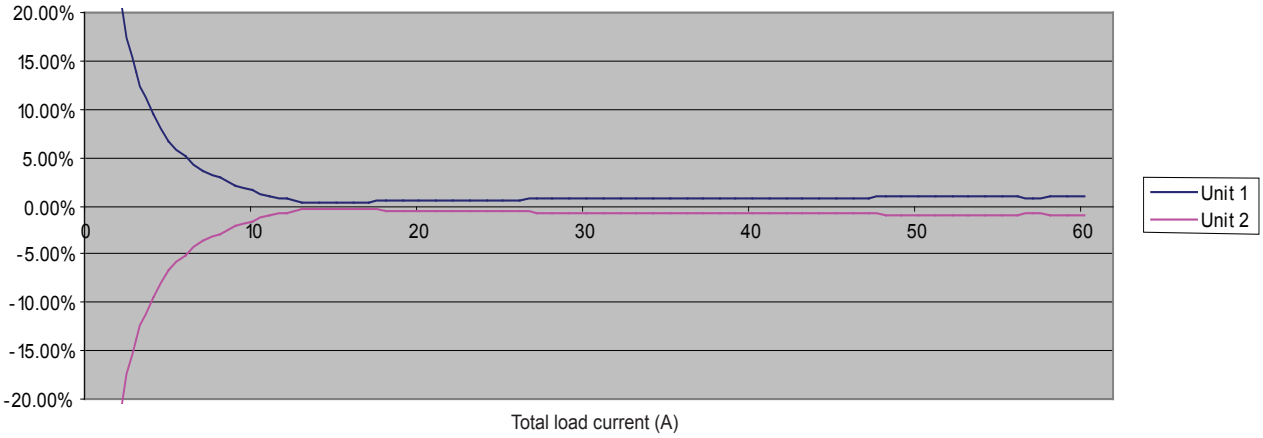
$$\text{Load sharing accuracy (deviation)} = \frac{I_{Converter} - \frac{I_{Load,Total}}{2}}{\frac{I_{Load,Total}}{2}} \cdot 100$$

$I_{CONVERTER}$ = Individual converter currents at the given total load current

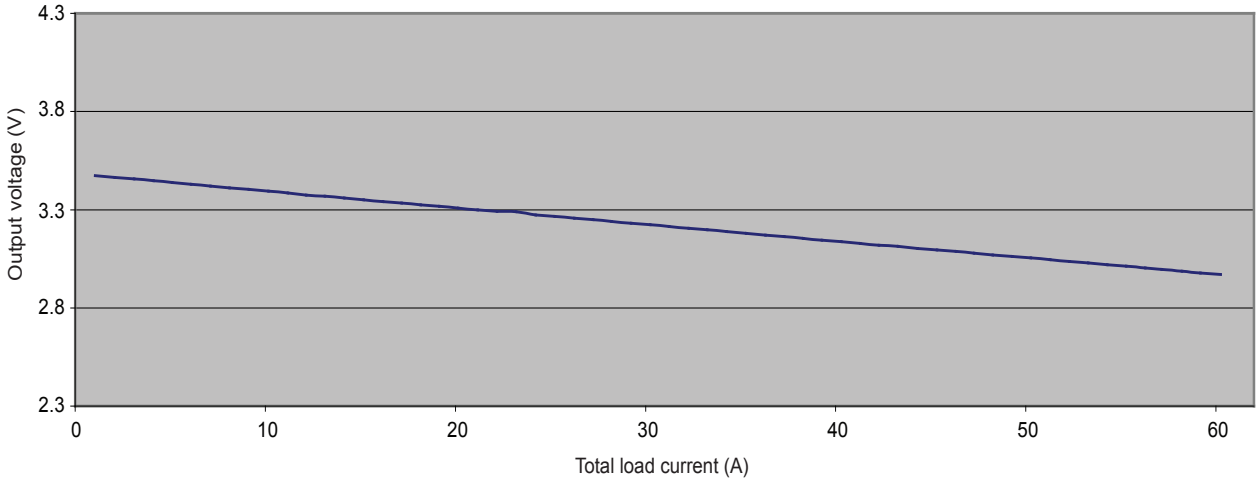
$I_{LOAD,TOTAL}$ = Total load current

The result is a deviation in percent of the optimum theoretical load sharing of 50% of total load current. It should be noted that the following data has been gathered using a parallel-combination of four very high precision current sense resistors R_S with a total resistance of 12.5mΩ.

3R3LSL30 with two 24S3.30HEW's



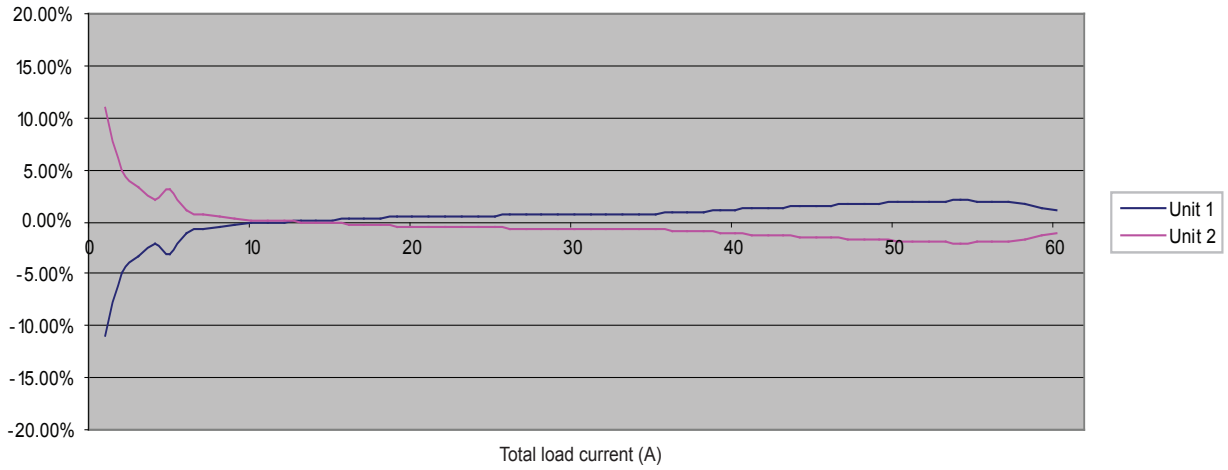
Load sharing accuracy (deviation)



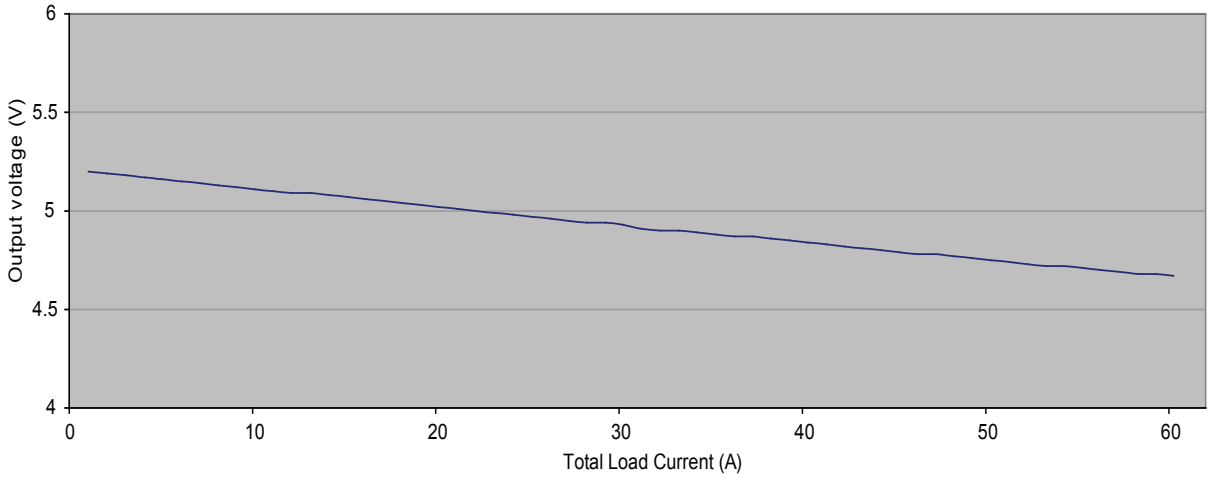
Load regulation

Deviation (%) at full load:	0.92%
Deviation (A) at full load:	0.27A
Load regulation over entire load range:	0.50V
Voltage drop across Rs (included in load regulation above):	0.38V

5LSL30 with two 24S5.30HEW's



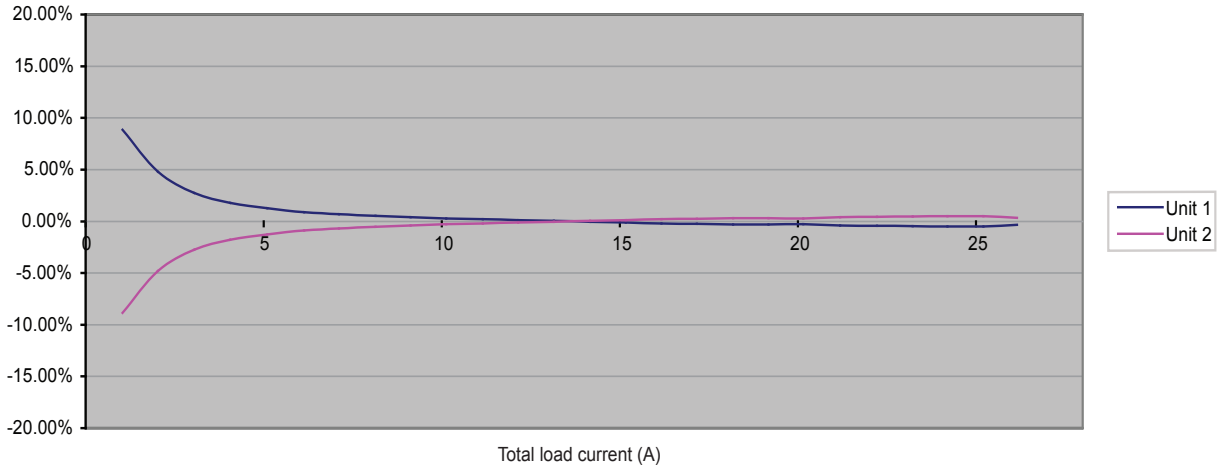
Load sharing accuracy (deviation)



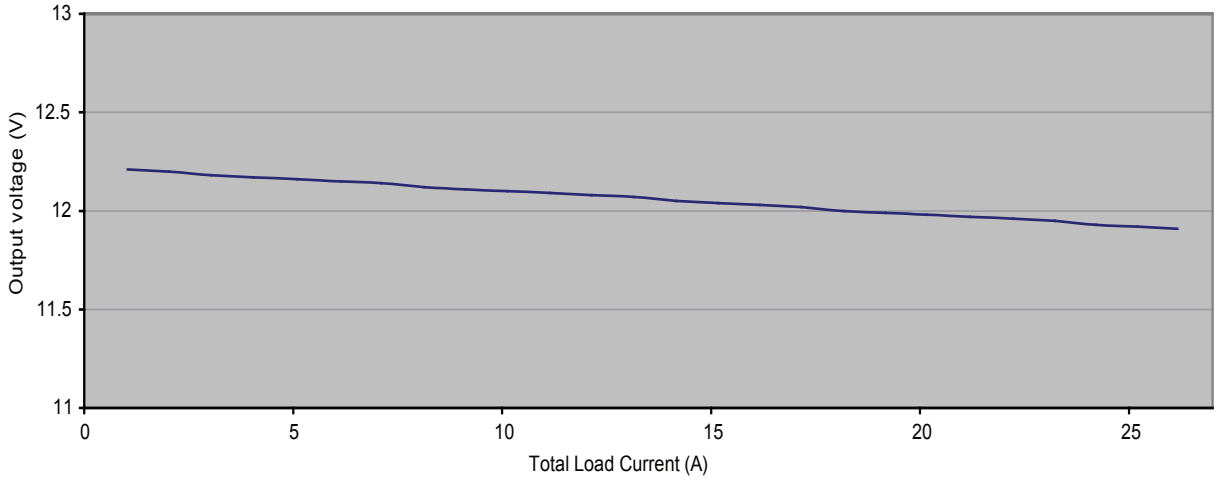
Load regulation

Deviation (%) at full load:	1.20%
Deviation (A) at full load:	0.36A
Load regulation over entire load range:	0.53V
Voltage drop across Rs (included in load regulation above):	0.38V

12LSL12 with two 24S12.12HEW's



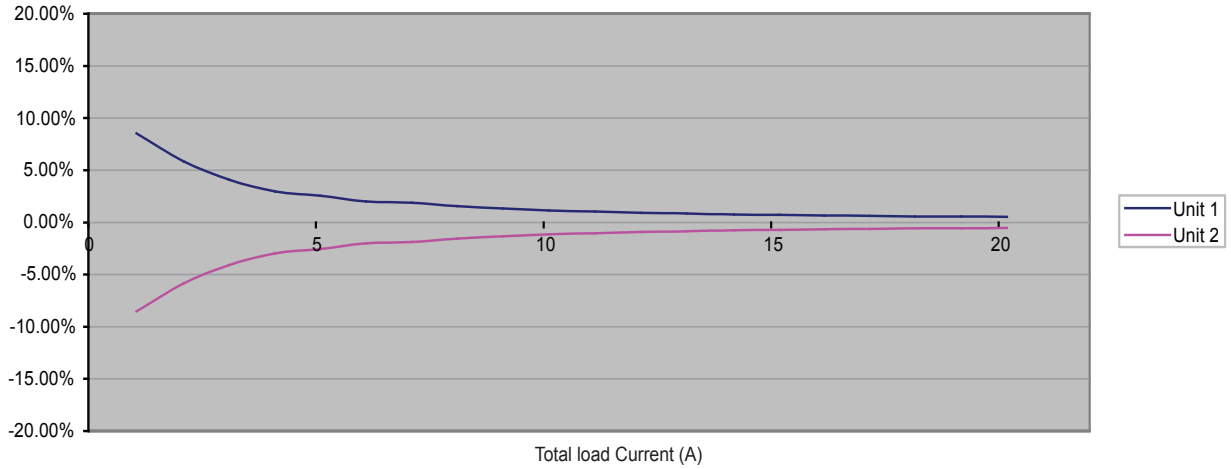
Load sharing accuracy (deviation)



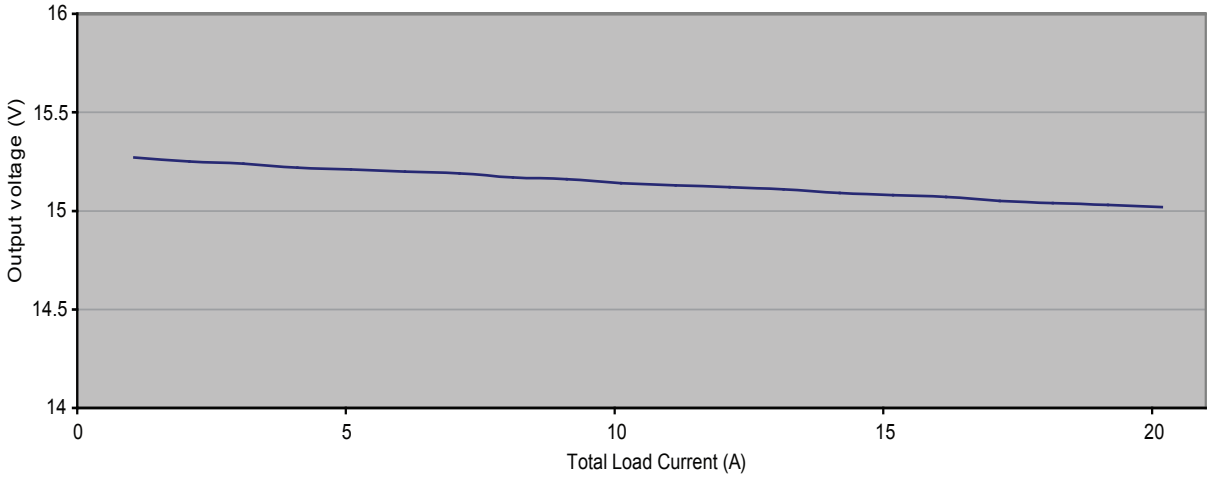
Load regulation

Deviation (%) at full load:	0.35%
Deviation (A) at full load:	0.04A
Load regulation over entire load range:	0.30V
Voltage drop across Rs (included in load regulation above):	0.15V

15LSL10 with two 24S15.10HEW's



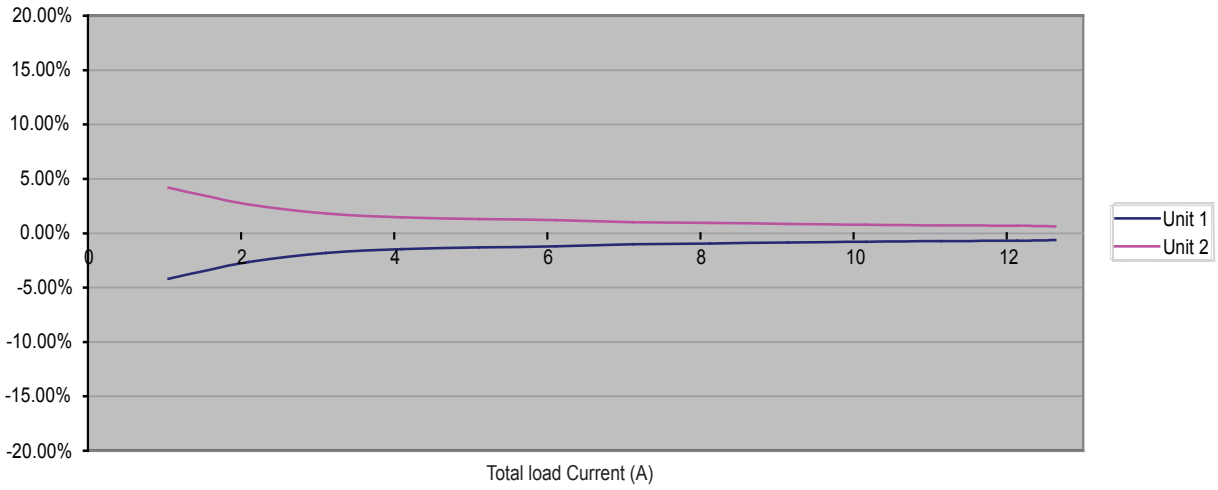
Load sharing accuracy (deviation)



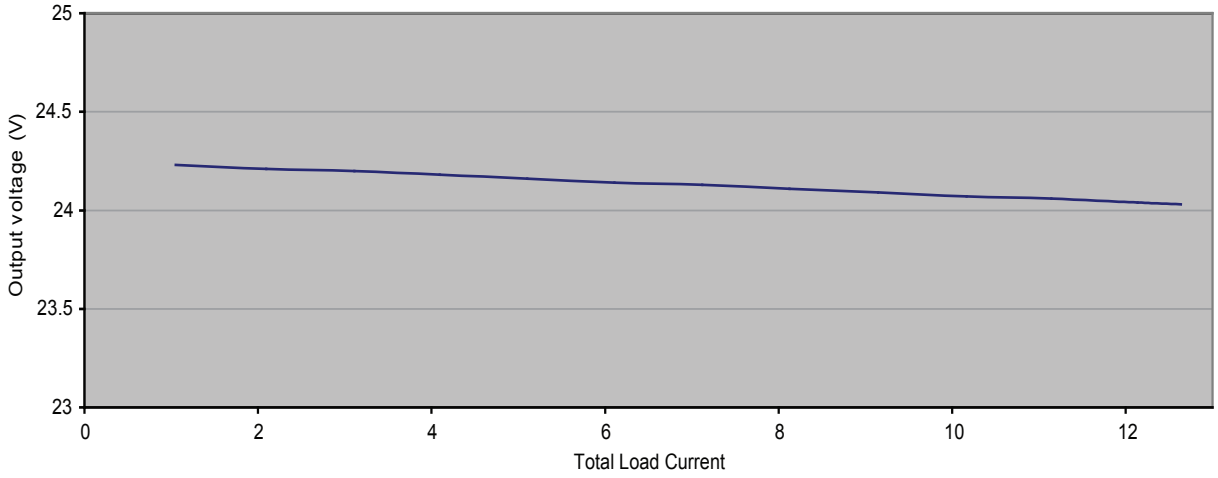
Load regulation

Deviation (%) at full load:	0.35%
Deviation (A) at full load:	0.04A
Load regulation over entire load range:	0.30V
Voltage drop across Rs (included in load regulation above):	0.15V

24LSL6 with two 24S24.6HEW's



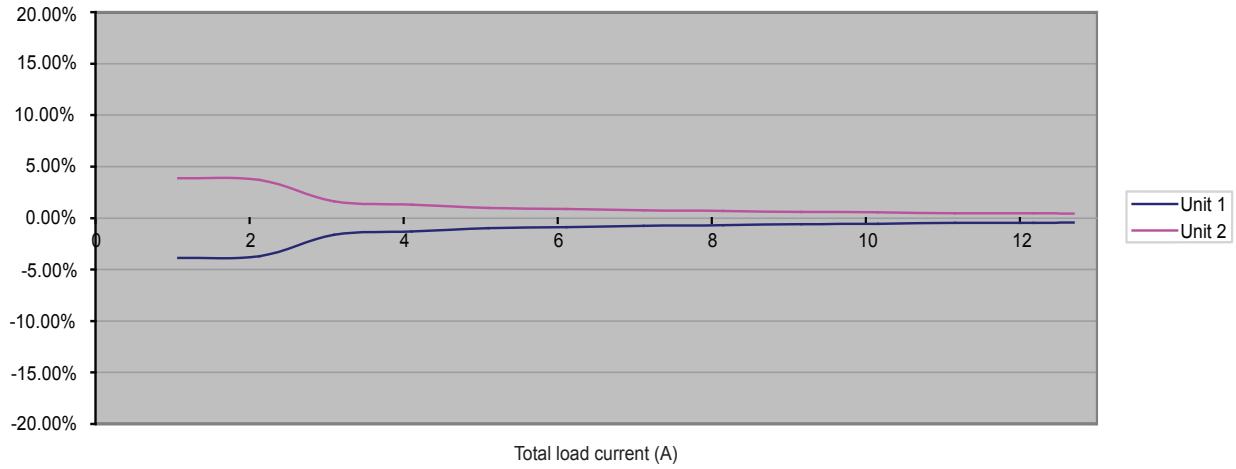
Load sharing accuracy (deviation)



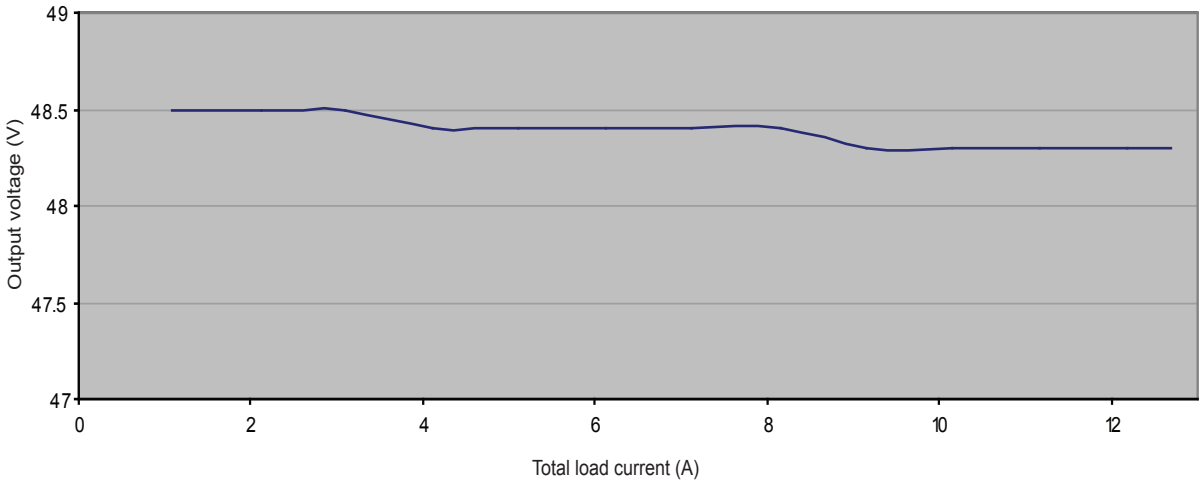
Load regulation

Deviation (%) at full load:	0.64%
Deviation (A) at full load:	0.04A
Load regulation over entire load range:	0.20V
Voltage drop across Rs (included in load regulation above):	0.08V

48LSL6 with four 24S24.6HEW's *



Load sharing accuracy (deviation)



Load regulation

Deviation (%) at full load:	0.43%
Deviation (A) at full load:	0.03A
Load regulation over entire load range:	0.20V
Voltage drop across Rs (included in load regulation above):	0.08V

* Contact the factory for connection diagram