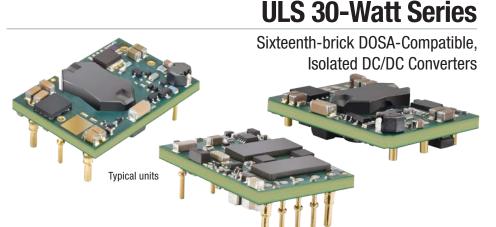


### **FEATURES**

- Small footprint DC/DC converter, ideal for embedded applications
- 1.30" x 0.90" x 0.36" open frame package
- Industry standard DOSA "brick" format and pinout with surface mount option
- 2:1 Input Voltage Range (36V-75V, D48)
- 2250 Volt Basic input/output isolation (48V models)
- Up to 30 Watts total output power with overtemperature shutdown
- High efficiency synchronous rectifier forward topology
- Stable no-load operation with no required external components
- Operating temperature range -40 to +85°C with derating
- Certified to UL/EN/IEC 60950-1, CAN/CSA C22.2 No. 60950-1, EN60950-1 safety approvals, 2nd Edition
- Extensive self-protection shut down features



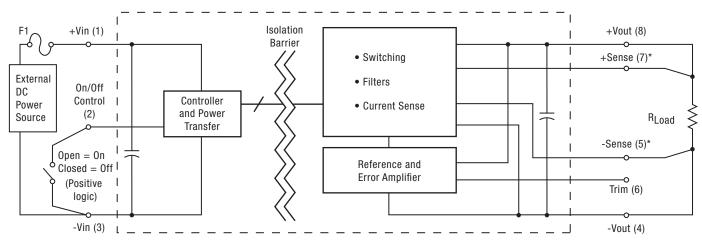
### **PRODUCT OVERVIEW**

The world of "brick" DC/DC converters has seen a steady size reduction. The ULS series makes another dramatic size shrink down to a "sixteenthbrick" width (0.91 inches) while still retaining up to 30 Watt output and full 2250 Volt DC isolation. The PC-board mount converter family accepts 36 to 75 Volts DC inputs and delivers fixed outputs regulated to within  $\pm 0.125\%$ . The ULS converters are ideal for datacom and telecom applications, cell phone towers, data centers, server farms and network repeaters.

ULS outputs may be trimmed within -20% to +10% of nominal output while delivering fast settling to current step loads and no adverse effects from higher capacitive loads. Excellent ripple and noise specifications assure compatibility to circuits using CPU's, ASIC's, programmable logic and FPGA's. No minimum load is required. For systems requiring controlled startup/shutdown, an external remote On/Off control may use a switch, transistor or digital logic.

Many self-protection features on the ULS series avoid both converter and external circuit hazards. These include input undervoltage lockout and overtemperature shutdown. The outputs current limit using the "hiccup" autorestart technique and the outputs may be short-circuited indefinitely. Additional features include output overvoltage and reverse conduction elimination.

The synchronous rectifier forward topology yields high efficiency for minimal heat buildup and "no fan" operation.

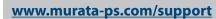


\*Sense is included on the ULS-3.3/8-D48 and ULS-5/6-D48 only.

Figure 1. Simplified Block Diagram

Typical topology is shown





For full details go to w.murata-ps.com/rohs

## **ULS 30-Watt Series**

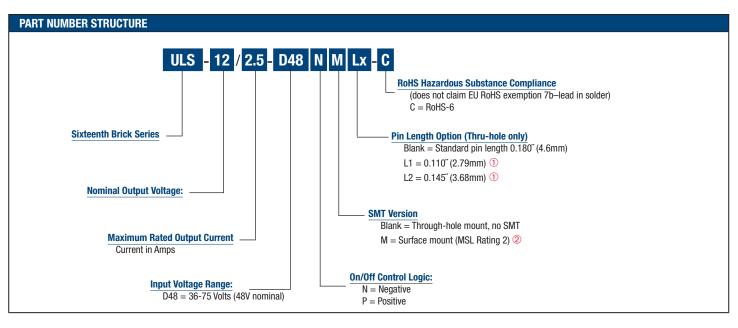
Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

PERFORMANCE SF	PECIFICAT	TIONS SUM	MARY AN	D ORDERI	NG GUIDE	0								
	Output						Input			Efficiency				
Root Model ①	Vout	Іоит	Power	R/N (m\	/ pk-pk)	Regulatio	n (max.) ③	VIN Nom.	Range	lin, no load	lın, full	EIIIC	lency	Case (inches)
	(۷)	(A, max.)	(W)	Тур.	Max.	Line	Load	(∀)	(V)	(mA)	load (A)	Min.	Тур.	
ULS-3.3/8-D48	3.3	8	26.5	90	130	±0.1%	±0.1%	48	36-75	75	0.58	89%	90%	1.30x0.90x0.36
ULS-5/6-D48	5	6	30	75	100	±0.125%	±0.1%	48	36-75	20	0.69	89%	91%	1.30x0.90x0.36
ULS-12/2.5-D48	12	2.5	30	130	150	±0.125%	±0.125%	48	36-75	25	0.71	86%	87.7%	1.30x0.90x0.36
ULS-15/2-D48	15	2	30	115	125	±0.125%	±0.125%	48	36-75	25	0.70	87.5%	89%	1.30x0.90x0.36

 $\ensuremath{\textcircled{}}$   $\ensuremath{\textcircled{}}$  Please refer to the Part Number Structure when ordering.

② All specifications are typical at nominal line voltage and full load, +25°C unless otherwise noted. See detailed specifications. Output capacitors are 1 µF ceramic multilayer in parallel with 10 µF electrolytic. I/O caps are necessary for our test equipment and may not be needed for your application.

③ Regulation specifications describe output voltage deviations from a nominal/midpoint value to either extreme (50% load step).



① Special quantity order is required; samples available with standard pin length only.

- **②** SMT (M) versions not available in sample quantities.
- ③ Some model number combinations may not be available. See website or contact your local Murata sales representative.

# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-3.3/8-D48

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous		0		80	Vdc
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output, continuous			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		Vdc
On/Off Remote Control	Power on, referred to -Vin	0		15	Vdc
Output Power		0		26.66	W
Output Current	Current-limited, no damage, short-circuit protected	0		8	A
Storage Temperature Range	Vin = Zero (no power)	-55		125	0°
	e of devices to greater than any of these conditions ma	y adversely affect long	j-term reliability. Proper oper	ation under conditions	other than those
listed in the Performance/Functional Specificati	ons Table is not implied or recommended.				
INPUT	Conditions ① ③				
Operating voltage range		36	48	75	Vdc
Recommended External Fuse	Fast blow			1.5	A
Start-up threshold	Rising input voltage	34	35.2	36	Vdc
Undervoltage shutdown	Falling input voltage	32	34	35.2	Vdc
Turn-On/Turn-Off Hysteresis			1.5		Vdc
Overvoltage shutdown			None		Vdc
Reverse Polarity Protection	None, install external fuse		None		Vdc
Internal Filter Type			LC		
Input current					
Full Load Conditions	Vin = nominal		0.58	0.63	Α
Low Line	Vin = minimum		0.77	0.83	A
Inrush Transient			0.05		A <sup>2</sup> -Sec.
Output in Short Circuit			50	100	mA
No Load	lout = minimum, unit = ON		75	100	mA
Shut-Down Input Current (Off, UV, OT)			1	2	mA
Reflected (back) ripple current 2	Measured at input with specified filter		30		mA, p-p
GENERAL and SAFETY					
Efficiency	Vin = 48V, full load	89	90		%
	Vin = 48V, full load Vin = min., full load	89 89.5	90 90.5		%
Efficiency					
Efficiency Isolation	Vin = min., full load	89.5			%
Efficiency Isolation Isolation Voltage	Vin = min., full load	89.5	90.5		%
Efficiency Isolation Isolation Voltage Insulation Safety Rating	Vin = min., full load	89.5 2250	90.5		% Vdc
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance	Vin = min., full load	89.5 2250	90.5		% Vdc ΜΩ
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance	Vin = min., full load Input to output, continuous Certified to UL-60950-1, CSA-C22.2 No. 60950-1,	89.5 2250	90.5		% Vdc ΜΩ
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground	89.5 2250	90.5 basic 1000 Yes		% Vdc MΩ pF
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground	89.5 2250	90.5 basic 1000 Yes	380	% Vdc MΩ pF
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground	89.5 2250 10	90.5 basic 1000 Yes 2	<u>380</u> 50	% Vdc 
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C	89.5 2250 10	90.5 basic 1000 Yes 2		% Vdc MΩ pF Hours x 10 <sup>6</sup>
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated	89.5 2250 10	90.5 basic 1000 Yes 2	50	% Vdc pF Hours x 10 <sup>6</sup> KHz mS
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within	89.5 2250 10	90.5 basic 1000 Yes 2 350	50 50	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout	89.5 2250 10	90.5 basic 1000 Yes 2 350 100	50 50 150	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout	89.5 2250 10	90.5 basic 1000 Yes 2 350 100	50 50 150	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (®)	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout	89.5 2250 10	90.5 basic 1000 Yes 2 350 100	50 50 150	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5) "N" suffix:	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout         same as above	89.5         2250         10         320	90.5 basic 1000 Yes 2 350 100	50 50 150 ±100	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control ⑤ "N" suffix: Negative Logic, ON state	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout         same as above         ON = Ground pin or external voltage	89.5 2250 10 320 -0.7	90.5 basic 1000 Yes 2 350 100	50 50 150 ±100	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5) "N" suffix: Negative Logic, ON state Negative Logic, OFF state	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage	89.5         2250         10         320	90.5 basic 1000 Yes 2 350 100 ±30	50 50 150 ±100	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (©) "N" suffix: Negative Logic, ON state Negative Logic, OFF state Control Current	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout         same as above         ON = Ground pin or external voltage	89.5 2250 10 320 -0.7	90.5 basic 1000 Yes 2 350 100	50 50 150 ±100	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, OFF state Control Current "P" suffix:	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 2% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         Open collector/drain	89.5 2250 10 320 -0.7 10	90.5 basic 1000 Yes 2 350 100 ±30	50 50 150 ±100 1.2 15	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, ON state Control Current "P" suffix: Positive Logic, ON state	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         S0-75-50% load step, settling time to within 2% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage         ON = Pin open or external voltage	89.5 2250 10 320 -0.7 10 10	90.5 basic 1000 Yes 2 350 100 ±30	50 50 150 ±100 1.2 15 15	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (©) "N" suffix: Negative Logic, ON state Negative Logic, OFF state Control Current "P" suffix: Positive Logic, ON state Positive Logic, OFF state	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Starter         Power on to Vout regulated         Starter         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage	89.5 2250 10 320 -0.7 10	90.5 basic 1000 Yes 2 350 100 ±30	50 50 150 ±100 1.2 15	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V V V
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (®	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         S0-75-50% load step, settling time to within 2% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage         ON = Pin open or external voltage	89.5 2250 10 320 -0.7 10 10	90.5 basic 1000 Yes 2 350 100 ±30	50 50 150 ±100 1.2 15 15	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V

# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-3.3/8-D48 (CONT.)

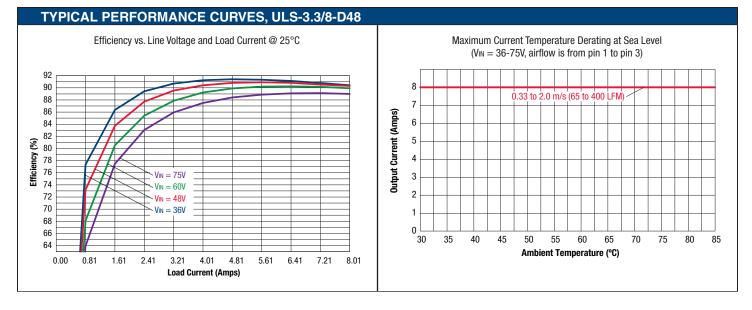
OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power	See Derating	2.61	25	26.66	W
Voltage					
Nominal Output Voltage	No trim	3.2674	3.3	3.333	Vdc
Setting Accuracy	At 50% load, no trim	-1		1	% of Vnom
Output Voltage Range	User-adjustable	-10		10	% of Vnom.
Overvoltage Protection	Via magnetic feedback	4.2	5	5.7	Vdc
Current					
Output Current Range		0.8	8	8	A
Minimum Load					
Current Limit Inception	98% of Vnom., after warmup	8.5	10	11.3	A
Short Circuit			1		
Short Circuit Current	Hiccup technique, autorecovery within ±1.25% of Vout			0.3	mA
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Current limiting				
Regulation ©			1		1
Line Regulation	Vin = min. to max., Vout = nom., lout = nom.			±0.1	% of Vout
Load Regulation	lout = min. to max., Vin = 48V			±0.1	% of Vout
Ripple and Noise	5 Hz- 20 MHz BW		90	130	mV pk-pk
Temperature Coefficient	At all outputs		±0.02	100	% of Vout./°C
Maximum Capacitive Loading	Low ESR, resistive load only		_0.02	2000	μF
MECHANICAL (Through Hole Models)	Conditions ① ③			2000	P.
Outline Dimensions			1.30x0.90x0.36		Inches
(Please refer to outline drawing)	LxWxH		33.02x22.86x9.144		mm
Weight	LAWAII		0.58		Ounces
weight			16.4		Grams
Through Hole Pin Diameter			0.04 & 0.062		Inches
Through hole Fill Diameter			1.016 & 1.575		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
The Fine Fialing Metal and Thickness	Gold overplate		5		μ-inches
ENVIRONMENTAL			J		μ-πιοπέδ
Operating Ambient Temperature Range	With Derating	-40		85	°C
Operating Ambient Temperature Range	No derating, full power, 200lfm, Vertical mount	-40		70	<u> </u>
Storage Temperature	Vin = Zero (no power)	-40		125	0°
Thermal Protection/Shutdown	Measured in center	110	115	125	<u> </u>
Electromagnetic Interference	External filter is required	1 IU	611	120	U
Conducted, EN55022/CISPR22			В		Class
Radiated, EN55022/CISPR22			B		Class
Relative humidity, non-condensing	To +85°C	10	D	90	%RH
Altitude	must derate -1%/1000 feet	-500		10.000	feet
Alutuue					
		-152	D-110.0	3048	meters
RoHS rating ④			RoHS-6		

#### **Performance Specification Notes**

- ① Unless otherwise noted, all specifications are typical at nominal input voltage, nominal output voltage and full load. General conditions are +25° Celsius ambient temperature, near sea level altitude, natural convection airflow. All models are tested and specified with external parallel 1 µF and 10 µF multi-layer ceramic output capacitors. The external input capacitor is 22 µF ceramic. All capacitors are low-ESR types wired close to the converter. These capacitors are necessary for our test equipment and may not be needed in the user's application.
- ② Input (back) ripple current is tested and specified over 5 Hz to 20 MHz bandwidth. Input filtering is Cbus = 220 µF/100V, Cin = 33 µF/100V and Lbus = 12 µH.
- ③ All models are stable and regulate to specification under no load.
- ④ Reduction of Hazardous Substances (RoHS) compliance is to RoHS-6 (six substances restricted including lead). See specifications.
- 5 The Remote On/Off Control is referred to -Vin.
- ⑥ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme.

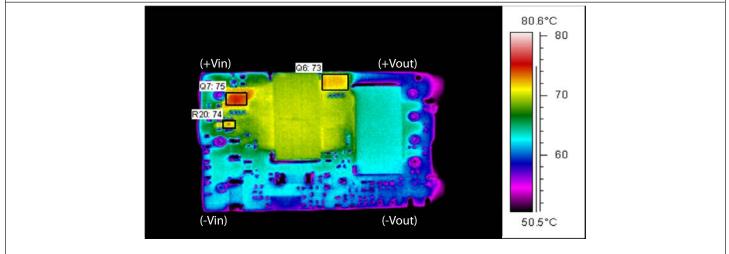
## **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



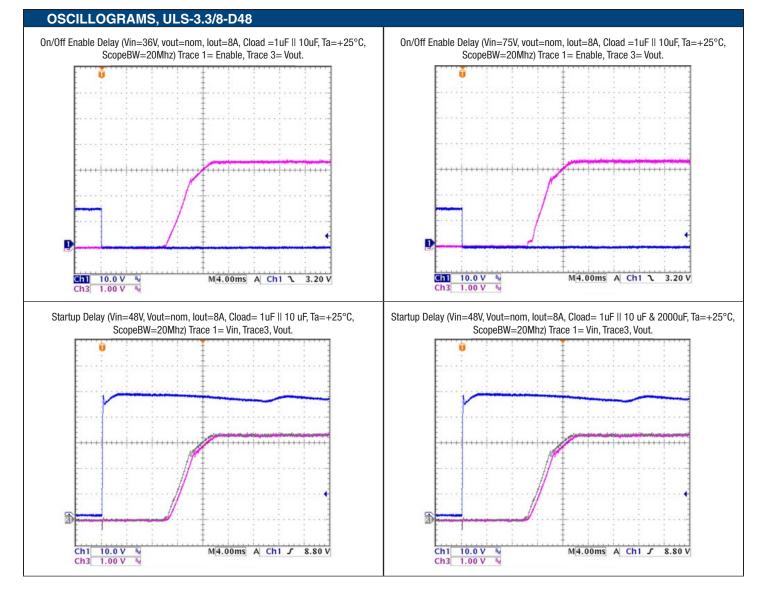
### **INFRARED THERMAL IMAGE, ULS-3.3/8-D48**

Thermal image with hot spot at full load current with 25°C ambient temperature. Natural convention is used with no forced airflow. Identifiable and recommended maximum value to be verified in application. Vin=48V, Q7 max temp=120°C/IPC9592 guidelines.



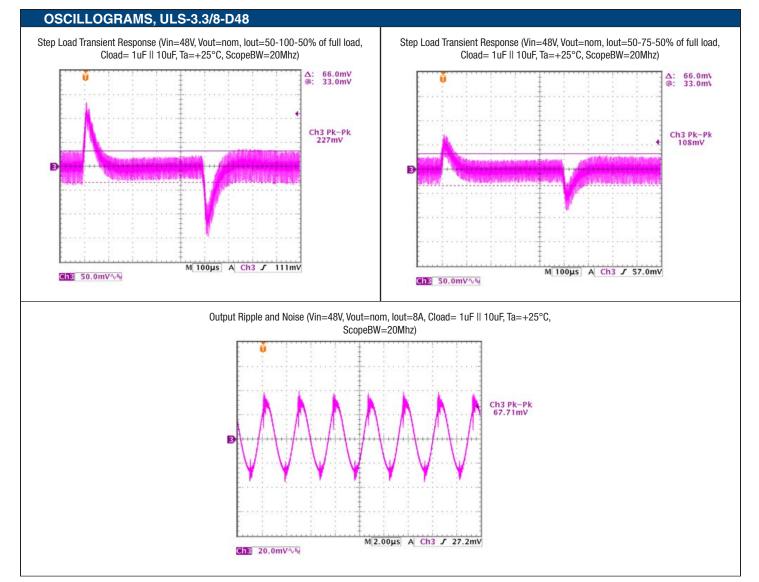


# **ULS 30-Watt Series**





# **ULS 30-Watt Series**



# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-5/6-D48

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous		0		80	Vdc
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output, continuous			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		Vdc
On/Off Remote Control	Power on, referred to -Vin	0		15	Vdc
Output Power		0		30.3	W
Output Current	Current-limited, no damage, short-circuit protected	0		6	А
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
	re of devices to greater than any of these conditions may	y adversely affect long	-term reliability. Proper opera	ation under conditions	other than those
isted in the Performance/Functional Specificati	ons Table is not implied or recommended.				
INPUT	Conditions ① ③				
Operating voltage range		36	48	75	Vdc
Recommended External Fuse	Fast blow			2	A
Start-up threshold	Rising input voltage	32.5	35	35.9	Vdc
Undervoltage shutdown	Falling input voltage	31	33.5	34	Vdc
Turn-On/Turn-Off Hysteresis		1.62	1.67	1.72	Vdc
Overvoltage shutdown			None		Vdc
Reverse Polarity Protection	None, install external fuse		None		Vdc
Internal Filter Type			LC		
Input current					
Full Load Conditions	Vin = nominal		0.69	0.71	A
Low Line	Vin = minimum		0.92	0.95	A
Inrush Transient			0.05		A <sup>2</sup> -Sec.
Output in Short Circuit			10	100	mA
No Load	lout = minimum, unit = ON		20	60	mA
Shut-Down Input Current (Off, UV, OT)			1	3	mA
Reflected (back) ripple current ②	Measured at input with specified filter		30		mA, p-p
GENERAL and SAFETY					
	Vin = 48V, full load	89	91		%
	Vin = 48V, full load Vin = min., full load	89 89	91 91		%
Efficiency	· · · · · ·				
Efficiency	· · · · · ·				
Efficiency Isolation	Vin = min., full load	89			%
Efficiency Isolation Isolation Voltage	Vin = min., full load	89	91		%
Efficiency Isolation Isolation Voltage Insulation Safety Rating	Vin = min., full load	89	91 basic		% Vdc
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance	Vin = min., full load	89	91 basic 10		% Vdc ΜΩ
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground	89	91 basic 10 3300		% Vdc ΜΩ
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety	Vin = min., full load Input to output, continuous Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition	89	91 basic 10 3300 Yes		% Vdc MΩ pF
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground	89 2250	91 basic 10 3300 Yes TBD	385	% Vdc MΩ pF Hours x 10 <sup>6</sup>
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C	89	91 basic 10 3300 Yes TBD 355	<u>385</u> 40	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time	Vin = min., full load         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated	89 2250	91 basic 10 3300 Yes TBD 355 10	40	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz mS
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within	89 2250	91 basic 10 3300 Yes TBD 355		% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout	89 2250	91 basic 10 3300 Yes TBD 355 10 10 10 75	40 40	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within	89 2250	91 basic 10 3300 Yes TBD 355 10 10	40 40	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz mS mS
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout	89 2250	91 basic 10 3300 Yes TBD 355 10 10 10 75	40 40	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz mS mS mS μSec
Efficiency Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5)	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout	89 2250	91 basic 10 3300 Yes TBD 355 10 10 10 75	40 40	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz mS mS mS μSec
Efficiency  solation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety  Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5) "N" suffix:	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above	89 2250 325	91 basic 10 3300 Yes TBD 355 10 10 10 75	40 40 100	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz mS mS mS μSec mV
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety  Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5)  "N" suffix: Negative Logic, ON state	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage	89 2250 325 -0.1	91 basic 10 3300 Yes TBD 355 10 10 10 75	40 40 100	% Vdc MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety  Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5)	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage	89 2250 325	91 basic 10 3300 Yes TBD 355 10 10 10 75 ±150	40 40 100	%       Vdc       MΩ       pF       Hours x 10 <sup>6</sup> KHz       mS       μSec       mV       V
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety  Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (©)	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage	89 2250 325 -0.1	91 basic 10 3300 Yes TBD 355 10 10 10 75	40 40 100	%       Vdc       MΩ       pF       Hours x 10 <sup>6</sup> KHz       mS       mS       μSec       mV
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety  Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control ©	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         Open collector/drain	89 2250 325 -0.1 2.5	91 basic 10 3300 Yes TBD 355 10 10 10 75 ±150	40 40 100 0.8 15	% Vdc pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, OFF state Control Current "P" suffix: Positive Logic, ON state	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         S0-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage         ON = Pin open or external voltage	89 2250 325 -0.1 2.5 10	91 basic 10 3300 Yes TBD 355 10 10 10 75 ±150	40 40 100 0.8 15 15	%           Vdc           MΩ           pF           Hours x 10 <sup>6</sup> KHz           mS           μSec           mV           V           V           V           V           V           V           V           V           V           V           V           V           V           V           V
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety  Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control ©	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Starter         Power on to Vout regulated         Starter         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage	89 2250 325 -0.1 2.5	91 basic 10 3300 Yes TBD 355 10 10 75 ±150 1 1	40 40 100 0.8 15	%           Vdc           MΩ           pF           Hours x 10 <sup>6</sup> KHz           mS           μSec           mV           V           V           V           V           V           V           V           V           V           V           V           V           V           V           V           V           V           V
Efficiency  Isolation Isolation Voltage Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, OFF state Control Current "P" suffix: Positive Logic, ON state	Vin = min., full load         Input to output, continuous         Input to output, continuous         Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         S0-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage         ON = Pin open or external voltage	89 2250 325 -0.1 2.5 10	91 basic 10 3300 Yes TBD 355 10 10 10 75 ±150	40 40 100 0.8 15 15	%           Vdc           MΩ           pF           Hours x 10 <sup>6</sup> KHz           mS           μSec           mV           V           V           V           V           V           V           V           V           V           V

# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-5/6-D48 (CONT.)

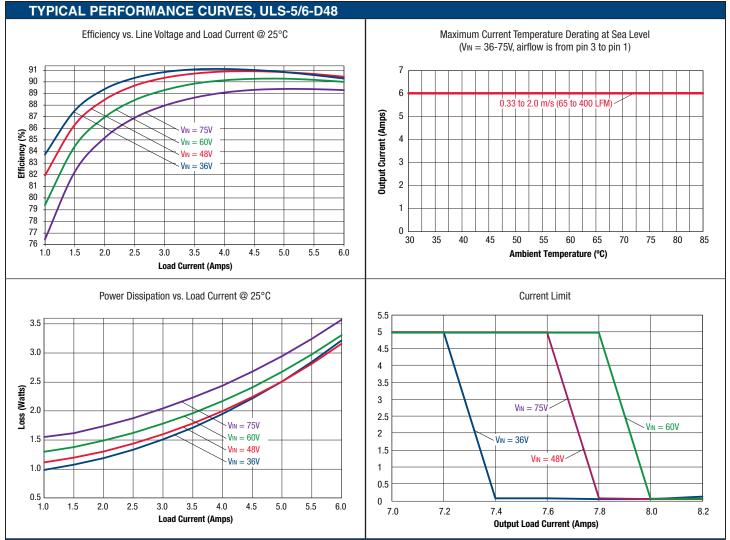
OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power		0	30	30.3	W
Voltage					
Nominal Output Voltage	No trim	4.95	5	5.05	Vdc
Setting Accuracy	At 50% load, no trim	-1		1	% of Vnom
Output Voltage Range	User-adjustable	-10		10	% of Vnom.
Overvoltage Protection	Via magnetic feedback	6	6.5	7.2	Vdc
Current	· · · · · · · · · · · · · · · · · · ·				
Output Current Range		0	6	6	Α
Minimum Load					
Current Limit Inception	98% of Vnom., after warmup	6.5	7.5	8.25	A
Short Circuit					
Short Circuit Current	Hiccup technique, autorecovery within ±1.25% of Vout			0.3	A
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Current limiting				
Regulation 6					
Line Regulation	Vin = min. to max., Vout = nom., lout = nom.			±0.125	% of Vout
Load Regulation	lout = min. to max., Vin = 48V			±0.1	% of Vout
Ripple and Noise	5 Hz- 20 MHz BW		75	100	mV pk-pk
Temperature Coefficient	At all outputs		±0.02		% of Vout./°C
Maximum Capacitive Loading	Low ESR, resistive load only			2000	μF
MECHANICAL (Through Hole Models)	Conditions ① ③				
Outline Dimensions			1.30x0.90x0.36		Inches
(Please refer to outline drawing)	LxWxH		33.02x22.86x9.144		mm
Weight			0.58		Ounces
			16.4		Grams
Through Hole Pin Diameter			0.04 & 0.062		Inches
			1.016 & 1.575		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range	With Derating	-40		85	°C
Operating Case Temperature Range	No derating, full power, 200lfm, Vertical mount	-40		70	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Thermal Protection/Shutdown	Measured in center	110	115	120	°C
Electromagnetic Interference	External filter is required	-		-	
Conducted, EN55022/CISPR22			В		Class
Radiated, EN55022/CISPR22			B		Class
RoHS rating @			RoHS-6		

#### **Performance Specification Notes**

- ① Unless otherwise noted, all specifications are typical at nominal input voltage, nominal output voltage and full load. General conditions are +25° Celsius ambient temperature, near sea level altitude, natural convection airflow. All models are tested and specified with external parallel 1 µF and 10 µF multi-layer ceramic output capacitors. The external input capacitor is 22 µF ceramic. All capacitors are low-ESR types wired close to the converter. These capacitors are necessary for our test equipment and may not be needed in the user's application.
- ② Input (back) ripple current is tested and specified over 5 Hz to 20 MHz bandwidth. Input filtering is Cbus = 220 µF/100V, Cin = 33 µF/100V and Lbus = 12 µH.
- ③ All models are stable and regulate to specification under no load.
- ④ Reduction of Hazardous Substances (RoHS) compliance is to RoHS-6 (six substances restricted including lead). See specifications.
- 5 The Remote On/Off Control is referred to -Vin.
- ⑥ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme.

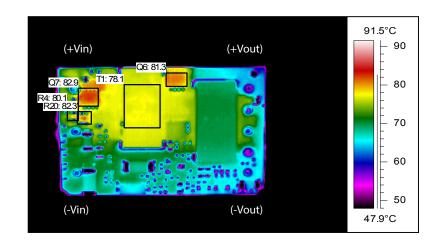
## **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

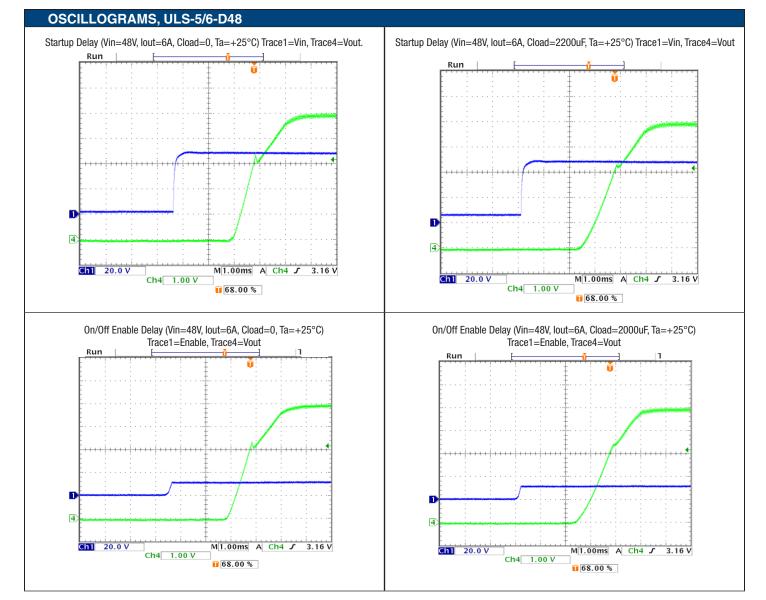


### **INFRARED THERMAL IMAGE, ULS-5/6-D48**

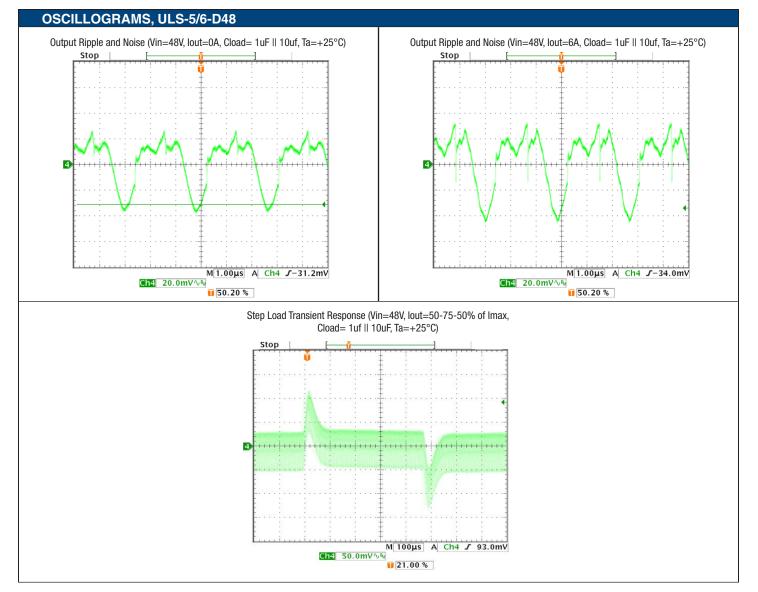
Thermal image with hot spot at full current with 25°C ambient temperature. Natural convention is used with no forced airflow. Identifiable and recommended maximum value to be verified in application. Vin=48V, Q7 max temp=120°C/IPC9592 guidelines.



# **ULS 30-Watt Series**



# **ULS 30-Watt Series**



# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-12/2.5-D48

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous		0		80	Vdc
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output, continuous			2250	Vdc
Input Reverse Polarity	None, install external fuse		None		Vdc
On/Off Remote Control	Power on, referred to -Vin	0		15	Vdc
Output Power		0		30	W
Output Current	Current-limited, no damage, short-circuit protected	0		2.5	A
Storage Temperature Range	Vin = Zero (no power)	-55		125	0°
	e of devices to greater than any of these conditions may	y adversely affect long	j-term reliability. Proper opera	ation under conditions	other than those
listed in the Performance/Functional Specificati	ons Table is not implied or recommended.				
INPUT	Conditions ① ③				
Operating voltage range		36	48	75	Vdc
Recommended External Fuse	Fast blow			2	A
Start-up threshold	Rising input voltage	32.5	33.5	35.5	Vdc
Undervoltage shutdown	Falling input voltage	31	32	33	Vdc
Turn-On/Turn-Off Hysteresis		1.40	1.46	1.52	Vdc
Overvoltage shutdown			None		Vdc
Reverse Polarity Protection	None, install external fuse		None		Vdc
Internal Filter Type			Capacitive		
Input current	. ,				
Full Load Conditions	Vin = nominal		0.71	0.73	A
Low Line	Vin = minimum		0.95	0.97	A
Inrush Transient			0.05		A <sup>2</sup> -Sec.
Output in Short Circuit			100	200	mA
No Load	lout = minimum, unit = ON		25	50	mA
Shut-Down Input Current (Off, UV, OT)			5	10	mA
Reflected (back) ripple current @	Measured at input with specified filter		15	30	mA, p-p
GENERAL and SAFETY					7111
Efficiency	Vin = 48V, full load	86.0	87.7		%
	Vin = min., full load	85.5	87.5		%
Isolation					
Isolation Voltage	Input to output, continuous	2250			Vdc
			basic		
Insulation Safety Rating			basic 100		
Insulation Safety Rating Isolation Resistance			100		MΩ
Insulation Safety Rating	Certified to UL-60950-1, CSA-C22.2 No. 60950-1,				
Insulation Safety Rating Isolation Resistance Isolation Capacitance			100 1600		ΜΩ
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition Per Telcordia SR332, issue 1, class 3, ground		100 1600 Yes		MΩ pF
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition Per Telcordia SR332, issue 1, class 3, ground	260	100 1600 Yes	310	MΩ pF
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition Per Telcordia SR332, issue 1, class 3, ground		100 1600 Yes 3	<u>310</u> 30	MΩ pF Hours x 10 <sup>6</sup> KHz
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C		100 1600 Yes 3	30	MΩ pF Hours x 10 <sup>6</sup> KHz mS
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C		100 1600 Yes 3		MΩ pF Hours x 10 <sup>6</sup> KHz
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within		100           1600           Yes           3           285	30 30	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout		100           1600           Yes           3           285           200	30 30 300	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout		100           1600           Yes           3           285           200	30 30 300	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5)	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout		100           1600           Yes           3           285           200	30 30 300	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5) "N" suffix:	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above	260	100           1600           Yes           3           285           200	30 30 300 ±300	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (5) "N" suffix: Negative Logic, ON state	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage	260	100           1600           Yes           3           285           200	30 30 300 ±300	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS mS μSec mV
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, ON state Negative Logic, OFF state	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         State         Power on to Vout regulated         State         State         Image: State         Power on to Vout regulated         State         State         ON = Ground pin or external voltage         OFF = Pin open or external voltage	260	100       1600       Yes       3       285       200       ±250	30 30 300 ±300 0.8 15	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, ON state Negative Logic, OFF state Control Current	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         Remote ON to Vout regulated         50-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage	260	100           1600           Yes           3           285           200	30 30 300 ±300	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS mS μSec mV
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, ON state Negative Logic, OFF state Control Current "P" suffix:	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         So-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         Open collector/drain		100       1600       Yes       3       285       200       ±250	30 30 300 ±300 0.8 15 2	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Response Dynamic Load Response Comrol Courter Safety Negative Logic, ON state Negative Logic, OFF state Control Current "P" suffix: Positive Logic, ON state	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         S0-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage         ON = Pin open or external voltage	-0.1 2.5 10	100       1600       Yes       3       285       200       ±250	30 30 300 ±300 0.8 15 2 15	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix: Negative Logic, OFF state Control Current "P" suffix: Positive Logic, OFF state Positive Logic, OFF state	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         S0-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage         ON = Pin open or external voltage         ON = Fin open or external voltage         OFF = Ground pin or external voltage		100       1600       Yes       3       285       200       ±250	30 30 300 ±300 0.8 15 2 15 0.7	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V V V V
Insulation Safety Rating Isolation Resistance Isolation Capacitance Safety Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Response Dynamic Load Response Dynamic Load Response Comrol Courter Safety Negative Logic, ON state Negative Logic, OFF state Control Current "P" suffix: Positive Logic, ON state	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, IEC/EN60950-1, 2nd edition         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         Power on to Vout regulated         S0-75-50% load step, settling time to within 1% of Vout         same as above         ON = Ground pin or external voltage         OFF = Pin open or external voltage         ON = Pin open or external voltage         ON = Pin open or external voltage	-0.1 2.5 10	100       1600       Yes       3       285       200       ±250	30 30 300 ±300 0.8 15 2 15	MΩ pF Hours x 10 <sup>6</sup> KHz mS mS μSec mV V V V V

# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-12/2.5-D48 (CONT.)

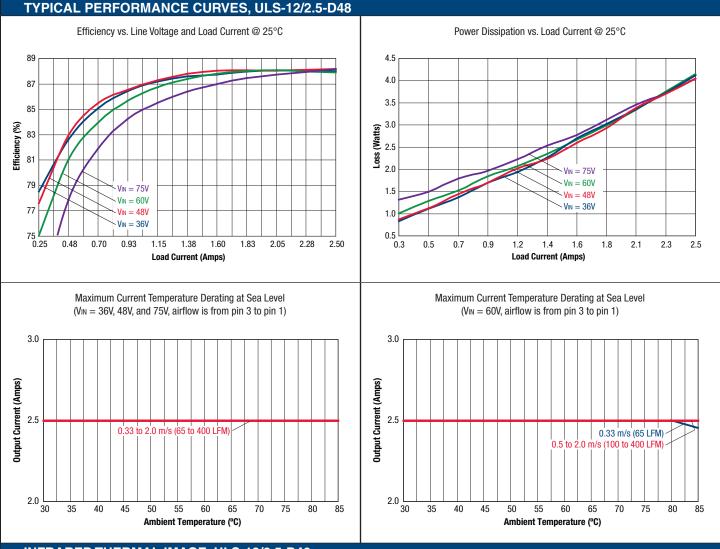
OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power	See Derating	0	30	30	W
Voltage	· · ·		· · ·		
Nominal Output Voltage	No trim	11.88	12.00	12.12	Vdc
Setting Accuracy	At 50% load, no trim	-1		+1	% of Vnom
Output Voltage Range	User-adjustable	-20		+10	% of Vnom.
Overvoltage Protection	Via magnetic feedback	13.3	15	18	Vdc
Current	· · · · ·				
Output Current Range		0.0	2.5	2.5	A
Minimum Load			No minimum load		
Current Limit Inception	98% of Vnom., after warmup	3.3	3.5	4.5	A
Short Circuit					
Short Circuit Current	Hiccup technique, autorecovery within ±1.25% of Vout			40	mA
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Current limiting				
Regulation ©	· · · · ·		1		
Line Regulation	Vin = min. to max., Vout = nom., lout = nom.			±0.125	% of Vout
Load Regulation	lout = min. to max., Vin = 48V			±0.125	% of Vout
Ripple and Noise	5 Hz- 20 MHz BW		130	150	mV pk-pk
Temperature Coefficient	At all outputs		±0.02		% of Vout./°C
Maximum Capacitive Loading	Low ESR, resistive load only	0	2200		μF
MECHANICAL (Through Hole Models)	Conditions ① ③				
Outline Dimensions			1.30x0.90x0.36		Inches
(Please refer to outline drawing)	LxWxH		33.02x22.86x9.144		mm
Weight			0.58		Ounces
			16.4		Grams
Through Hole Pin Diameter			0.04 & 0.062		Inches
			1.016 & 1.575		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
······································	Gold overplate		5		µ-inches
ENVIRONMENTAL					, p
Operating Ambient Temperature Range	With Derating	-40		85	°C
Operating Case Temperature Range	No derating, full power	-40		105	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Thermal Protection/Shutdown	Measured in center	115	125	130	°C
Electromagnetic Interference	External filter is required	-	-		
Conducted, EN55022/CISPR22			В		Class
Radiated, EN55022/CISPR22			B		Class
Relative humidity, non-condensing	To +85°C	10	_	90	%RH
Altitude	must derate -1%/1000 feet	-500		10,000	feet
		-152		3048	meters
RoHS rating ④		.01	RoHS-6		

#### **Performance Specification Notes**

- ① Unless otherwise noted, all specifications are typical at nominal input voltage, nominal output voltage and full load. General conditions are +25° Celsius ambient temperature, near sea level altitude, natural convection airflow. All models are tested and specified with external parallel 1 µF and 10 µF multi-layer ceramic output capacitors. The external input capacitor is 22 µF ceramic. All capacitors are low-ESR types wired close to the converter. These capacitors are necessary for our test equipment and may not be needed in the user's application.
- ② Input (back) ripple current is tested and specified over 5 Hz to 20 MHz bandwidth. Input filtering is Cbus = 220 μF/100V, Cin = 33 μF/100V and Lbus = 12 μH.
- ③ All models are stable and regulate to specification under no load.
- ④ Reduction of Hazardous Substances (RoHS) compliance is to RoHS-6 (six substances restricted including lead). See specifications.
- 5 The Remote On/Off Control is referred to -Vin.
- ⑥ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme.

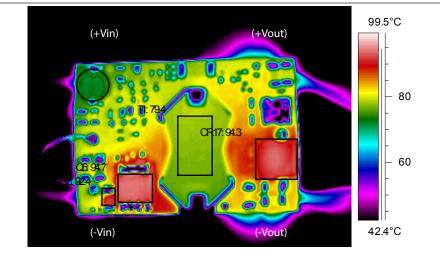
## **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



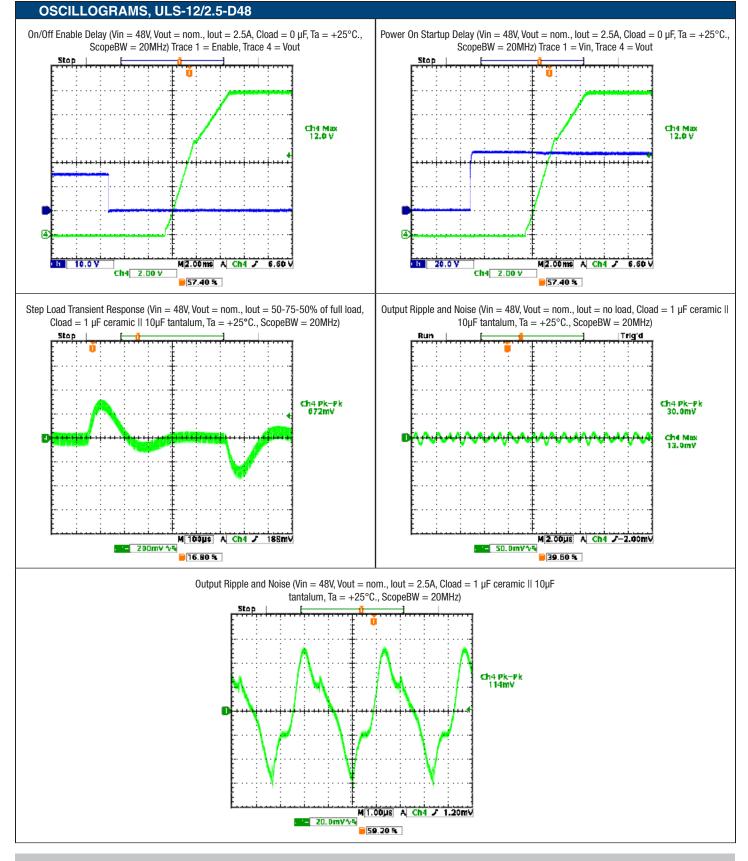
INFRARED THERMAL IMAGE, ULS-12/2.5-D48

Thermal image with hot spot at full load current with 25 °C ambient temperature. Natural convention is used with no forced airflow. Identifiable and recommended maximum value to be verified in application. Vin=48V, Q6 max Temp=120 °C/IPC9592 guidelines.





# **ULS 30-Watt Series**



# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-15/2-D48

Input Voltage, Transfert         100 mS max. duration         Input Reverse Polarity         100 mS max. duration         250 mS	ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
siskaltan Vistage         Intut to output, continuous         None         2200         Woo           Dury IP Nevers 0, referred 15 Vin         0         15         Victor Victor 00           Dury IP Nevers 0, referred 15 Vin         0         300         Wittor 00           Dury ID Power 0n, referred 15 Vin         0         2         A           Storage Temperature Range         Current-Imited, no damage, stort-circut         0         2         A           Storage Temperature Range         Vin = Zero (in power)         -55         12         2         A           Storage Temperature Range         Constitutions 0         -55         12         3         Victor 0           Marcel Notage Temperature Range         Constitutions 0         25         3.5         2.5         5         5         Victor 0         None         Non	Input Voltage, Continuous		0		80	Vdc
Input Reverse Polarity         None, Install actemnal Lose         None         15         Wood           Durput Overrent         Proven or, Inferrant Lose         0         30         W           Dotapt Current         Proven or, Inferrant Lose         0         30         W           Strange Temperature Range         Vin = 200 (in power)         -35         125         °C           Storage Temperature Range         Vin = 200 (in power)         -35         128         °C           Storage Temperature Range         Or and youthess or adversely after toog-term reliability. Proper operation under constatures or their than Inder or ecommended.         128         °C           INPUT         Conditions Or 0         36         48         75         Vdo           Operating voltage range         Field ingoin (input voltage         31         32         33         Vdo           Recommended External Fuse         Failing (input voltage         31         32         33         Vdo           Operating voltage shutdown         Failing (input voltage         31         32         33         Vdo           Operating voltage shutdown         Failing (input voltage         31         32         33         Vdo           Deverse Voltary Protecoin         I.42         1.43 <t< td=""><td>Input Voltage, Transient</td><td>100 mS max. duration</td><td></td><td></td><td>100</td><td>Vdc</td></t<>	Input Voltage, Transient	100 mS max. duration			100	Vdc
DrivOT Renote Control         Power or, referred to -Vin         0         15         Wot           Output Power         0         30         W           Output Current         protected         0         30         W           Strage Femperture Range         Vm = Zero (kp power)         -55         125         -5C           Strage Femperture Range         Vm = Zero (kp power)         -55         125         -5C           Strage Femperture Range         Vm = Zero (kp power)         -55         125         -7C           Strade Temperture Range         Vm = Zero (kp power)         -55         125         -7C           More Temperture Range         Vm = Zero (kp power)         -55         125         7C         Vc           Renote Control         Strade temperture relability, Proper operation and volt temperture relability, Proper operation under controls studiotom         -7C         A         A           Renote Rande Temperture Range         Fat Islow         1.42         1.48         1.52         Vc           Renote Rande Temperture Range         Fat Islow         1.42         1.48         1.52         Vc           Renote Rande Temperture Range         Fat Islow         1.42         1.48         1.52         Vc           Renote Rand	Isolation Voltage	Input to output, continuous			2250	Vdc
Dutput Power         0         30         W           Doubput Current         Current-limited, no damage, short-circuit protected         0         2         A           Storage Tomparture Range         Win – Zaro (inp opwer)         -55         125         -C           Masolde mainturns are stress ratings. Exposure of elevies to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditions of their than tho isolation the Profromance-Functional Specifications. Table is not implied or recommended.         36         48         75         Vdc           Recommended External Fuse         Fast blow         32.5         33.5         35.5         Vdc           Binder Pottershold         Reling input voltage         31         32.2         33         Vdc           Outro-furn.off Pristersis         Falling input voltage         31         32.5         33.5         Xdc         Vdc         Vdc<	Input Reverse Polarity	None, install external fuse		None		Vdc
Dutp Current         Current-Initied, no demage, short-fourt, protected         0         2         A           Storage Temperature Range         Vin = 2 ror (no power)         -55         125         *C           Storage Temperature Range         Vin = 2 ror (no power)         -55         125         *C           Storage Temperature Range         Vin = 2 ror (no power)         -55         125         *C           Storage Temperature Range         Conditions mere adversely affect (nog-term reliability, Proper operation under conditions of these conditions mere adversely affect (nog-term reliability, Proper operation under conditions of these conditions mere adversely affect (nog-term reliability, Proper operation under conditions of these conditions mere adversely affect (nog-term reliability, Proper operation under conditions of these conditions mere adversely affect (nog-term reliability, Proper operation under conditions of these conditions mere adversely affect (nog-term reliability, Proper operation under conditions of these conditions of these conditions of a storage of the second time of these conditions of these conditions of the second time of these conditions of these condithese condithese conditions of these condithese conditions of th	On/Off Remote Control	Power on, referred to -Vin	0		15	Vdc
Dutput current         protected         U         Z         A           Storage Temperature Range         Win = Zero (topower)         -55         125         °C2           Absolute maximums are stress ratings. Exposure of devices to greater than any of these conclinos may adversely affect long-term reliability. Proper operation under conclinos other than the isse in the Informance-Functional Specifications Table is on inplied or recommended.         ************************************	Output Power		0		30	W
Uncluster maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than the iteration to hear thomacon exponential specifications Table is not implied or recommended.           UPUT         Conditions         Operating values of the exponential specifications Table is not implied or recommended.           INPUT         Conditions         36         43         7.5         Moto           Recommended External Fasis         Fast blow         31         32         33         Wdo           Binding part values and the physics is in the physics is internal fusion in part values and the physics is internal fusion in the physin physics is internal fusion in the physics is inte	Output Current		0		2	А
listed in the Performance/Functional Specifications Table is not implied or recommended.	Storage Temperature Range					-
INPUT         Conditions (0:6)           Portaling values range         Fast blow         2         A           Recommended External Fuse         Fast blow         2         33.5         95.5         Vdc.           Start-up threshold         Bising input voltage         21.3         32.3         Vdc.			y adversely affect long	g-term reliability. Proper ope	ration under conditions	other than those
Operating value range         Descense         38         48         75         Vdc           Start-up threshold         Rising input voltage         32.5         33.5         35.5         Vdc           Start-up threshold         Rising input voltage         31         32         33         Vdc           Undervoltage shutdown         Pailing input voltage         31         32         33         Vdc           Overvoltage shutdown         None, install external fuse         None         Vdc         Vdc           Overvoltage shutdown         None, install external fuse         None         Vdc         Vdc           Overvoltage shutdown         None, install external fuse         None         Vdc         Vdc           Intrush Transient         Un = minimum         0.34         0.55         A           Inrush Transient         0.05         M*-Soc.         No Load         No Load         No Load         No Load         No Load         Sol         MA         Sol         M*-Soc.         Moc         Sol         MA         Sol         Moc         Sol         MA         Sol         Moc         Sol         Sol         Sol         MA         Sol         Sol         Sol         Sol         Sol         Sol	listed in the Performance/Functional Specification	ons Table is not implied or recommended.				
Recommended External Puse         Fast blow         C         2         A           Bising input voltage         32.5         33.5         32.5         Vide           Undervoltage shutdown         Failing input voltage         31         32         33.5         Vide           Undervoltage shutdown         Failing input voltage         31         32         33.5         Vide           Undervoltage shutdown         None         1.42         1.48         1.52         Vide           Internal Filter Type         None, install external fuse         None         Vide         Vide           Internal Filter Type         0.7         0.714         A         A           Low Line         Vin = nominal         0.7         0.74         A           Low Line         0.06         A'Sec.         Octast         A'Sec.           Output in short Growit         Iou = minimum, unit = ON         25         GO         mA           Shut-Down Input Current (0ft, UV, OT)         Measured at input with specified filter         15         30         mA, p.p           Effected (back) figue current 2         Input to utput, continuous         2250         Wide         %           Isolation Step Rating         Input to uutput, continuous         22	INPUT	Conditions ① ③				
Start-up threshold         Rising input voltage         32.5         33.5         35.5         Vdo           Turn-Off Hysteresis	Operating voltage range		36	48		Vdc
Indervoltage shutdown     Falling input voltage     31     32     33     Vdc.       Undervoltage shutdown     1.42     1.48     1.52     Vdc.       Nerense Polarity Protection     None, install external fuse     None     Vdc.       Internal Filter Type     Capacitive     Vdc.     Vdc.       Ingut Carrent     Capacitive     Capacitive     Vdc.       Insush Transient     0.94     0.95     A       Insush Transient     0.05     A*Sec.     Output in Short Circuit     0.01     200     mA       Shut-Down Input Current (Off, UV, OT)     Iotal = minimum, unit = 0N     25     50     mA       Shut-Down Input Current (Off, UV, OT)     Wn = atki, full load     87.5     88.0     %       Efficiency     Vin = 48V, full load     87.5     88.0     %       Solation     Vin = min, full load     87.5     88.0     %       Solation     Vin = min, full load     87.5     88.0     %       Solation     Vin = min, full load     87.5     88.0     %       Solation     Vin = min, full load     87.5     88.0     %       Solation     Vin = min, full load     87.5     88.0     %       Solation     Vin = min, full load     87.5     89.0     %	Recommended External Fuse	Fast blow			2	A
Turn-Orf, Turn-Off Hysteresis         Turn-Or, Turn-Off Hysteresis         Vdc           Dervoltage studiown         None         None         Vdc           Dervoltage studiown         None         Vdc         None         Vdc           Dervoltage studiown         None         None         Vdc         None         Vdc           Dervoltage studiown         None         None         Vdc         None         None         Vdc         None         Vdc         None	Start-up threshold	Rising input voltage				Vdc
Over-ordege shufdown         None, install external fuse         None         Vdc           Internal Filter Type         Capacitive         Capacitive         Vdc           Input Carrent	Undervoltage shutdown	Falling input voltage		32	33	Vdc
Reverse Fularity ProtectionNone, install external fuseNoneVdcInternal Filter TypeCapacitiveInternal Filter Type0.70.714ALow LineWin = nominal0.70.714ALow LineWin = minimum0.9440.95AInrush Transient0.050.75A*-Sec.Output in Short CircuitIout = minimum, unit = 0N2550mANo LoadIout = minimum, unit = 0N2550mAShut-Down Input Current (2)Measured at input with specified filter1530mA, p-pCEVERAL and SAFETYFilterFilterFilterFilterIsolation VoltageInput to output, continuous2250%%Isolation Resistance100MOMOMOIsolation ResistanceInput to output, continuous22501600MOIsolation ResistancePer Telocridia SR32, siguet 1, dass 3, ground3Hours x 10OrMAMIC CHARACTERISTICSPer Telocridia SR32, siguet 1, dass 3, ground3Hours x 10OrMAMIC CHARACTERISTICSPer Telocridia SR32, siguet 1, dass 3, ground30mSStartup TimePerver on to vout regulated200300µSecOynamic Load Response50-75-50% logien or external voltage-0.10.8VOpen collector/drain12mAThe Character or transmit or external voltage-0.10.8VOpen collector/drain00-2515V <td>Turn-On/Turn-Off Hysteresis</td> <td></td> <td>1.42</td> <td>1.48</td> <td>1.52</td> <td>Vdc</td>	Turn-On/Turn-Off Hysteresis		1.42	1.48	1.52	Vdc
Internal Filter Type (Capacitive Capacitive ) Input current  Input current  Input current  Input current  Input for a noninal  Input for a nonina  Input for a noninal  Input for a noninal  Input fo	Overvoltage shutdown			None		Vdc
Input current         Image Conditions         Vin = nominal         0.7         0.714         A           Full Load Conditions         Vin = minimum         0.94         0.95         A           Inrush Transient         0.05         CM         A^2-Sec.         A           Output in Stort Circuit         0.01         200         mA           No Load         lout = minimum, unit = 0N         25         50         mA           Shut-Down Input Current (Off, UV, OT)         Measured at input with specified filter         15         30         mA, p-p           CENERAL and SAFETY         Vin = min, full load         87.5         89.0         %           Filciatency         Vin = 48V, full load         87.5         89.0         %           Isolation Voltage         Input to output, continuous         2250         Vdc         Vdc           Insulation Safety Rating         Isolation Capacitance         1000         MMO         MO           Isolation Capacitance         Certified to UL-60650-1, CSA-C22.2 No.60650-1, Ves         Yes         Vdc           Safety         Certified to UL-60650-1, CSA-C22.2 No.60650-1, Ves         3         Hours x 10           Safety         Certified to UL-60650-1, CSA-C22.2 No.60650-1, Ves         30         mS	Reverse Polarity Protection	None, install external fuse		None		Vdc
Full Load Conditions         Vin = mnininal         0.7         0.714         A           Low Line         Vin = mninimum         0.94         0.95         A           Inrush Transint         0.05         A*Sec.         0.05         A*Sec.           Output in Short Circuit         0.01         0.020         mA           No Load         lout = minimum, unit = 0N         25         50         mA           Shut-Down Input Current (0ft, UV, 07)         Measured at input with specified filter         15         30         mA, p-p           CERERAL and SAFETY         Vin = 48V, full load         87.5         89.0         %           Efficiency         Vin = 48V, full load         87.5         89.0         %           Insulation Safety Rating         Input to output, continuous         2250         Vdc         MO           Isolation Otagae         Input to output, continuous         2250         MO         %           Isolation Safety Rating         Isolation Capacitance         1000         MO         pF           Isolation Capacitance         Por Telocodia SR32; Issue 1, class 3; ground fixed, Tambient = +25°C         3         Hours x 10           DYMAMIC CHARACTERISTICS         Power on to Vout regulated         30         mS         Safety <td>Internal Filter Type</td> <td></td> <td></td> <td>Capacitive</td> <td></td> <td></td>	Internal Filter Type			Capacitive		
Low Line         Vin = minimum         0.94         0.95         A           Inrush Transient         0.05         0.05         A         A<-Sec.	Input current					
Inrush Transient         0.05         A <sup>2</sup> -Sec.           Dutput in Short Circuit         100         200         mA           No Load         lout = minimum, unit = 0N         25         50         mA           Shut-Down Input Current (0ft, UV, 0T)         Measured at input with specified filter         15         30         mA p.p.           GENERAL and SAFETY         Measured at input with specified filter         15         30         mA p.p.           GENERAL and SAFETY         Vin = 48V, full load         87.5         89.0         %           Stolation         Vin = min., full load         87.5         89.0         %           Isolation Resistance         Input to output, continuous         2250         Vic         Vic           Isolation Resistance         100         MΩ         Isolation Resistance         Vic         MΩ           Isolation Resistance         1000         MΩ         Isolation Resistance         Vic         MΩ           Safety         Certified to IU-60050-1, CSA-C222 No60050-1, ICAA C222 No60050-1, ICAA C22 No 00050-1, ICAA C22 NO 000         MΩ           Safety	Full Load Conditions	Vin = nominal		0.7	0.714	A
Output in Short Circuit         Incload         Incload         100         200         mA           No Load         Iout = minimum, unit = 0N         25         50         mA           Shul-Down input Current (Off, UV, OT)         Measured at input with specified filter         5         10         mA           Reflected (back) ripple current ⊗         Measured at input with specified filter         15         30         mA, p-p           GEXUEFAL and SAFETY         Vin = 48V, full load         87.5         89.0         %           Isolation         Vin = min, full load         87.5         89.0         %           Isolation Voltage         Input to output, continuous         2250         Vic         Vic           Isolation Resistance         100         MΩ         MΩ         Isolation Capacitance         100         MΩ           Isolation Capacitance         1000         MΩ         Isolation Sas2, issue 1, class 3, ground fues as 3, ground fue as 3, groun	Low Line	Vin = minimum		0.94	0.95	A
No Load     lout = minimum, unit = 0N     25     50     mA       Shut-Down Input Current (Off, UV, OT)     Measured at input with specified filter     15     30     mA, p.p.       GENERAL and SAFETY     Measured at input with specified filter     15     30     mA, p.p.       GENERAL and SAFETY     Filtered (back) rippie current ②     Measured at input with specified filter     15     30     mA, p.p.       GENERAL and SAFETY     Efficiency     Vin = 48V, full load     87.5     89.0     %       Solation     Uin = min, full load     87.5     89.0     %       Isolation Notage     Input to output, continuous     2250     Vdc.       Isolation Resistance     100     MO     MO       Isolation Capacitance     100     PF       Calculated MTBF     Per Teloordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C     3     Hours x 10       DYNAMIC CHARACTERISTICS     Power on to Vout regulated     30     mS       Startup Time     Power on to Vout regulated     30     mS       Dynamic Load Response     50-75-50% load step, settling time to within 12     200     300     gksc       Dynamic Load Response     50-75-50% load step, settling time to within 12     200     300     mS       Dynamic Load Response     50-75-50% load step, settling time	Inrush Transient			0.05		A <sup>2</sup> -Sec.
Shut-Down Input Current (Off, UV, OT)         Measured at input with specified filter         5         10         mA           Reflected (back) ripple current @         Measured at input with specified filter         15         30         mA, p-p           GENERAL and SAFETY         Efficiency         Vin = 48V, full load         87.5         89.0         %           Solation         87.5         89.0         %         %           Isolation Voltage         Input to output, continuous         2250         Vdc.         %           Isolation Capacitance         100         MQ.         MG.         %           Safety         Certified to UL-60950-1, CSA-C22.2 No.60950-1, 100         Yes         %         MG.           Safety         Certified to UL-60950-1, CSA-C22.2 No.60950-1, Yes         Yes         Meours x 10         MC.           DVNAMIC CHARACTERISTICS         IEC/EN60950-1, 2nd edition         Yes         Meours x 10         Mox x 10           DVNAMIC CHARACTERISTICS         Startup Time         Power on to Vout regulated         30         mS           Startup Time         Remote ON to Vout regulated         30         mS         So/-75-50% load step, settling time to within 12 0         30         mS           Upnamic Load Response         50-75-50% load step, settling time to w	Output in Short Circuit				200	mA
Reflected (back) ripple current ()     Measured at input with specified filter     15     30     mA, p-p       GENERAL and SAFETY     Vin = 48V, full load     87.5     89.0     %       Ficiency     Vin = min, full load     87.5     89.0     %       Isolation     isolation     87.5     89.0     %       Isolation Safety Rating     Input to output, continuous     2250     Vdc     Vdc       Isolation Capacitance     100     MA     MO     MO       Isolation Capacitance     Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, IEC/EN60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, IEC/EN60950-1, SA-C22.2 No.60950-1, IEC/EN60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, IEC/EN60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, IEC/EN60950-1, IEC/EN60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, IEC		lout = minimum, unit = $ON$		25	50	mA
GENERAL and SAFETY     Vin = 48V, full load     87.5     89.0     %       Efficiency     Vin = min, full load     87.5     89.0     %       isolation     87.5     89.0     %       isolation Notage     Input to output, continuous     2250     Vdc       Isolation Resistance     100     MQ       Isolation Capacitance     100     MQ       Isolation Capacitance     100     MQ       Isolation Capacitance     100     MQ       Isolation Capacitance     100     MQ       Calculated MTBF     Per Telocordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C     3       DYNAMIC CHARACTERISTICS     Fixed Switching Frequency     3       Startup Time     Power on to Vout regulated     30       Startup Time     Remote ON to Vout regulated     30       Dynamic Load Response     50-75-50% load step, setting time to within 1% of Vout     200       Dynamic Load Response     50-75-50% load step, setting time to within 1% of Vout     200     300       Wariffk:     Negative Logic, ON state     OFF = Pin open or external voltage     2.5     15       Wiffk:     Open collector/drain     1     2     mA	Shut-Down Input Current (Off, UV, OT)			5	10	mA
EfficiencyVin = 48V, full load87.589.0%Vin = min., full load87.589.0%Isolation87.589.0%Isolation VoltageInput to output, continuous2250VdcInsulation Safety Rating00.00MΩIsolation Capacitance100MΩMΩIsolation Capacitance1600PFPrSafetyCertified to UL-60950-1, CSA-C22.2 No.6050-1, 1 IEC/EN60950-1, 2nd editionYesPerCalculated MTBFPer Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C3Hours x 10DYNAMIC CHARACTERISTICSPer relcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C30mSDynamic Load Response50-75-50% load step, settling time to within 1% of Vout regulated280290310KHzDynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Response0N = Ground pin or external voltage-0.10.8VNegative Logic, ON stateON = Ground pin or external voltage2.515VControl CurrentOpen on external voltage1012mA"Positive Logic, OF stateON = Pin open or external voltage00.7VControl CurrentOPF = Ground pin or external voltage12mA"Positive Logic, OF stateON = Pin open or external voltage12mA"Positive Logic, OF stateON = Pin open or external	Reflected (back) ripple current 2	Measured at input with specified filter		15	30	mA, p-p
Vin = min., full load         87.5         89.0         %           Isolation Voltage         Input to output, continuous         2250         Val         Val           Isolation Voltage         Input to output, continuous         2250         basic         Val           Isolation Resistance         100         MQ         MQ         Isolation Capacitance         MQ           Isolation Capacitance         1600         pF         MG         MG         MG           Safety         Certified to UL-60950-1, CSA-C22.2 No 60950-1, IEC/EN60950-1, 2nd edition         Yes         Mours x 10           Calculated MTBF         PeT Telecordia SR332, Issue 1, class 3, ground fixed, Tambient = +25°C         3         Hours x 10           DYNAMIC CHARACTERISTICS         ************************************	GENERAL and SAFETY					
Isolation         Input to output, continuous         2250         Vdc           Isolation Resistance         Input to output, continuous         2250         Vdc           Isolation Resistance         100         MΩ           Isolation Capacitance         100         MΩ           Safety         Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, 2nd edition         Yes         PF           Calculated MTBF         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         3         Hours x 10           DYNAMIC CHARACTERISTICS         Free Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         30         mS           Dynamic Load Response         50-75-50% load step, settling time to within 1% of Vout         200         300         µ/sec           Dynamic Load Peak Deviation         same as above         ±250         ±300         mV           FEATURES and OPTIONS         """ suffix:         ""         ""         uffix           Negative Logic, ON state         ON = Ground pin or external voltage         -0.1         0.8         V           Negative Logic, ON state         OFF = Pin open or external voltage         1         2         mA           "P" suffix:         T         OFF = Ground pin or external voltage         0         0.7         V <td>Efficiency</td> <td>Vin = 48V, full load</td> <td>87.5</td> <td>89.0</td> <td></td> <td>%</td>	Efficiency	Vin = 48V, full load	87.5	89.0		%
Isolation Voltage         Input to output, continuous         2250         Vdc           Insulation Safety Rating         0         basic         0           Isolation Resistance         100         MO         MO           Isolation Capacitance         1600         pF           Safety         Certified to UI-60950-1, CSA-C22.2 No 60950-1, IEC/EN60950-1, 2nd edition         Yes            Safety         Certified to UI-60950-1, 2nd edition         Yes             Calculated MTBF         Per Telcordia SR332, issue 1, dass 3, ground fixed, Tambient = +25°C         3         Hours x 10           DYNAMIC CHARACTERISTICS           30         mS           Startup Time         Power on to Vout regulated         30         mS           Startup Time         Remote ON to Vout regulated         30         mS           Dynamic Load Response         50-75-50% load step, settling time to within 1% of Vout         200         300         µSec           Dynamic Load Peak Deviation         same as above         ±250         ±300         mV           FEATURES and OPTIONS                Wegative Logic, ON state         ON = Ground pin or external voltage         0.1         0.8		Vin = min., full load	87.5	89.0		%
Insulation Safety Rating       basic       MΩ         Isolation Resistance       100       MΩ         Isolation Capacitance       1600       pF         Safety       Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, 2nd edition       Yes       Image: Comparison of the compariso	Isolation					
Isolation Resistance       100       MΩ         Isolation Capacitance       100       MΩ         Isolation Capacitance       1600       pF         Safety       Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, 2nd edition       Yes       P         Calculated MTBF       Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C       3       Hours x 10         DYNAMIC CHARACTERISTICS       Fixed Switching Frequency       280       290       310       KHz         Startup Time       Power on to Vout regulated       30       mS         Dynamic Load Response       50-75-50% load step, setting time to within 1% of Vout       200       300       µSec         Dynamic Load Peak Deviation       same as above       ±250       ±300       mV         FEATURES and OPTIONS       Fearure       V       V       V         Remote On/Off Control ©       0N = Ground pin or external voltage       -0.1       0.8       V         Negative Logic, ON state       ON = Ground pin or external voltage       2.5       15       V         Control Current       Open collector/drain       1       2       mA         "P" suffix:       -       0Pri open or external voltage       0       0.7       V         C	Isolation Voltage	Input to output, continuous	2250			Vdc
Isolation CapacitanceCertified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN00950-1, 2.No.60950-1, 2.No.6	Insulation Safety Rating			basic		
Safety         Certified to UL-60950-1, CSA-C22.2 No.60950-1, IEC/EN60950-1, 2nd edition         Yes           Calculated MTBF         Per Telocridia SR332, issue 1, class 3, ground fixed, Tambient = +25°C         3         Hours x 10           DYNAMIC CHARACTERISTICS         3         Hours x 10           Exed Switching Frequency         280         290         310         KHz           Startup Time         Power on to Vout regulated         30         mS           Dynamic Load Response         50-75-50% load step, settling time to within 1% of Vout         200         300         µSec           Dynamic Load Response         50-75-50% load step, settling time to within 1% of Vout         200         300         µSec           Prest EATURES and OPTIONS         ************************************	Isolation Resistance			100		MΩ
SafetyIEC/EN60950-1, 2nd editionresCalculated MTBFPer Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C3Hours x 10DYNAMIC CHARACTERISTICSFixed Switching Frequency280290310KHzStartup TimePower on to Vout regulated30mSStartup TimeRemote ON to Vout regulated30mSDynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Peak Deviationsame as above±250±300mVFEATURES and OPTIONSRemote On/Off Control (%"N" suffix:ON = Ground pin or external voltage-0.10.8VNegative Logic, OFF stateOP = Pin open or external voltage2.515VControl CurrentOpen collector/drain12mA"P" suffix:0115VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VControl CurrentOpen collector/drain12mA"P" suffix:0115VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VControl CurrentOpen collector/drain12mA	Isolation Capacitance			1600		pF
Calculated WIBFfixed, Tambient = +25°C3Hours X toDYNAMIC CHARACTERISTICSFixed Switching Frequency280290310KHzStartup TimePower on to Vout regulated30mSStartup TimeRemote ON to Vout regulated30mSDynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Peak Deviationsame as above±250±300mVFEATURES and OPTIONS***********************************	Safety			Yes		
Fixed Switching Frequency280290310KHzStartup TimePower on to Vout regulated30mSStartup TimeRemote ON to Vout regulated30mSDynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Peak Deviationsame as above±250±300mVFEATURES and OPTIONSsame as above±250±300mVRemote On/Off Control ®"N" suffix:Negative Logic, ON stateON = Ground pin or external voltage-0.10.8VNegative Logic, OFF stateOFF = Pin open or external voltage2.515VControl Current0pen collector/drain12mA"Positive Logic, ON stateON = Pin open or external voltage1012Positive Logic, OFF stateON = Pin open or external voltage100.7VPositive Logic, OFF stateON = Pin open or external voltage100.7VPositive Logic, OFF stateON = Pin open or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VControl CurrentOpen collector/drain1	Calculated MTBF			3		Hours x 10 <sup>6</sup>
Startup TimePower on to Vout regulated30mSStartup TimeRemote ON to Vout regulated30mSDynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Peak Deviationsame as above±250±300mVFEATURES and OPTIONSRemote On/Off Control ©"N" suffix:Negative Logic, ON stateON = Ground pin or external voltage-0.10.8VNegative Logic, OFF stateOFF = Pin open or external voltage2.515VControl Current0.9 = collector/drain12mA"Positive Logic, ON stateON = Pin open or external voltage1015VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VControl CurrentOpen collector/drain12mA						
Startup TimeRemote ON to Vout regulated30mSDynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Peak Deviationsame as above±250±300mVFEATURES and OPTIONSRemote On/Off Control ® "N" suffix:Negative Logic, ON stateON = Ground pin or external voltage-0.10.8VNegative Logic, OFF stateON = Ground pin or external voltage-0.112mA"P" suffix:Positive Logic, OFF stateON = Pin open or external voltage12mA"P" suffix:Positive Logic, ON stateON = Pin open or external voltage1015VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VOpen collector/drain12mA	Fixed Switching Frequency		280	290	310	KHz
Dynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Response50-75-50% load step, settling time to within 1% of Vout200300µSecDynamic Load Peak Deviationsame as above±250±300mVFEATURES and OPTIONSRemote On/Off Control (® "N" suffix:Negative Logic, ON stateON = Ground pin or external voltage-0.10.8VNegative Logic, OFF stateON = Ground pin or external voltage2.515VControl Current0pen collector/drain12mAPositive Logic, ON stateON = Pin open or external voltage1015VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VControl CurrentOpen collector/drain12mA	Startup Time				30	mS
Dynamic Load Response1% of Vout200300µSecDynamic Load Peak Deviationsame as above±250±300mVFEATURES and OPTIONSRemote On/Off Control (5)"N" suffix:Negative Logic, ON stateON = Ground pin or external voltage-0.10.8VNegative Logic, OFF stateON = Ground pin or external voltage2.515VControl Current0.9en collector/drain12mAOpen collector/drain1015VPositive Logic, OFF stateON = Pin open or external voltage1015VPositive Logic, OFF stateON = Pin open or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VPositive Logic, OFF stateOFF = Ground pin or external voltage00.7VControl CurrentOpen collector/drain12mA	Startup Time				30	mS
FEATURES and OPTIONS         Remote On/Off Control (S         "N" suffix:       ON = Ground pin or external voltage       -0.1       0.8       V         Negative Logic, OFF state       OFF = Pin open or external voltage       2.5       15       V         Control Current       Open collector/drain       1       2       mA         "P" suffix:       ON = Pin open or external voltage       10       15       V         Positive Logic, OFF state       ON = Pin open or external voltage       10       15       V         Positive Logic, OFF state       OFF = Ground pin or external voltage       0       0.7       V         Positive Logic, OFF state       OFF = Ground pin or external voltage       0       0.7       V         Positive Logic, OFF state       OFF = Ground pin or external voltage       0       1       2       mA	Dynamic Load Response	i, o		200	300	μSec
FEATURES and OPTIONS         Remote On/Off Control (S         "N" suffix:       ON = Ground pin or external voltage       -0.1       0.8       V         Negative Logic, OFF state       OFF = Pin open or external voltage       2.5       15       V         Control Current       Open collector/drain       1       2       mA         "P" suffix:       ON = Pin open or external voltage       10       15       V         Positive Logic, OFF state       ON = Pin open or external voltage       10       15       V         Positive Logic, OFF state       OFF = Ground pin or external voltage       0       0.7       V         Positive Logic, OFF state       OFF = Ground pin or external voltage       0       0.7       V         Positive Logic, OFF state       OFF = Ground pin or external voltage       0       1       2       mA	Dynamic Load Peak Deviation	same as above		±250	±300	mV
"N" suffix:           Negative Logic, ON state         ON = Ground pin or external voltage         -0.1         0.8         V           Negative Logic, OFF state         OFF = Pin open or external voltage         2.5         15         V           Control Current         Open collector/drain         1         2         mA           "P" suffix:         ON = Pin open or external voltage         10         15         V           Positive Logic, OFF state         ON = Pin open or external voltage         0         0.7         V           Positive Logic, OFF state         OFF = Ground pin or external voltage         0         0.7         V           Control Current         Open collector/drain         1         2         mA	FEATURES and OPTIONS					
"N" suffix:           Negative Logic, ON state         ON = Ground pin or external voltage         -0.1         0.8         V           Negative Logic, OFF state         OFF = Pin open or external voltage         2.5         15         V           Control Current         Open collector/drain         1         2         mA           "P" suffix:         ON = Pin open or external voltage         10         15         V           Positive Logic, OFF state         ON = Pin open or external voltage         0         0.7         V           Positive Logic, OFF state         OFF = Ground pin or external voltage         0         0.7         V           Control Current         Open collector/drain         1         2         mA	Remote On/Off Control 5					
Negative Logic, ON state         ON = Ground pin or external voltage         -0.1         0.8         V           Negative Logic, OFF state         OFF = Pin open or external voltage         2.5         15         V           Control Current         Open collector/drain         1         2         mA           "P" suffix:         ON = Pin open or external voltage         10         15         V           Positive Logic, OFF state         ON = Pin open or external voltage         0         0.7         V           Positive Logic, OFF state         OFF = Ground pin or external voltage         0         0.7         V           Control Current         Open collector/drain         1         2         mA						
Negative Logic, OFF state         OFF = Pin open or external voltage         2.5         15         V           Control Current         Open collector/drain         1         2         mA           "P" suffix:         Positive Logic, OFF state         ON = Pin open or external voltage         10         15         V           Positive Logic, OFF state         ON = Pin open or external voltage         00         0.7         V           Positive Logic, OFF state         OFF = Ground pin or external voltage         0         0.7         V           Control Current         Open collector/drain         1         2         mA		ON = Ground pin or external voltage	-0.1		0.8	V
Control Current         Open collector/drain         1         2         mA           "P" suffix:		, , , , , , , , , , , , , , , , , , ,				V
"P" suffix:           Positive Logic, ON state         ON = Pin open or external voltage         10         15         V           Positive Logic, OFF state         OFF = Ground pin or external voltage         0         0.7         V           Control Current         Open collector/drain         1         2         mA		, v	-	1		mA
Positive Logic, ON state         ON = Pin open or external voltage         10         15         V           Positive Logic, OFF state         OFF = Ground pin or external voltage         0         0.7         V           Control Current         Open collector/drain         1         2         mA		- p		· · ·	-	
Positive Logic, OFF state         0FF = Ground pin or external voltage         0         0.7         V           Control Current         Open collector/drain         1         2         mA		ON = Pin open or external voltage	10		15	V
Control Current         Open collector/drain         1         2         mA						
			-	1		mA
	SMT Mounting	"M" suffix		· · ·		

# **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### FUNCTIONAL SPECIFICATIONS, ULS-15/2-D48 (CONT.)

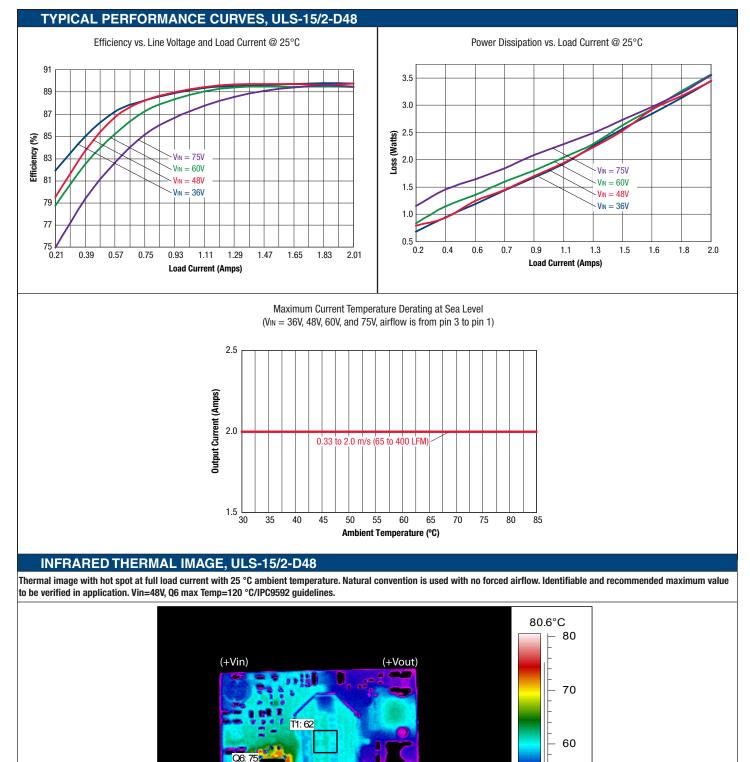
OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power	See Derating	0	30	30	W
Voltage					
Nominal Output Voltage	No trim	14.85	15.00	15.15	Vdc
Setting Accuracy	At 50% load, no trim	-1		+1	% of Vnom
Output Voltage Range	User-adjustable	-20		+10	% of Vnom.
Overvoltage Protection	Via magnetic feedback	18	19	20	Vdc
Current					
Output Current Range		0.0	2.0	2.0	А
Minimum Load			No minimum load		
Current Limit Inception	98% of Vnom., after warmup	2.45	3.0	3.45	Α
Short Circuit		-			1
Short Circuit Current	Hiccup technique, autorecovery within ±1.25% of Vout			0.6	А
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Current limiting				
Regulation 6					1
Line Regulation	Vin = min. to max., Vout = nom., lout = nom.			±0.125	% of Vout
Load Regulation	lout = min. to maxVin = 48V			±0.125	% of Vout
Ripple and Noise	5 Hz- 20 MHz BW		115	125	mV pk-pk
Temperature Coefficient	At all outputs		±0.02		% of Vout./°C
Maximum Capacitive Loading	Low ESR, resistive load only	0	2200		μF
MECHANICAL (Through Hole Models)	Conditions ① ③	-			F.
Outline Dimensions			1.30x0.90x0.36		Inches
(Please refer to outline drawing)	LxWxH		33.02x22.86x9.144		mm
Weight	LAWAII		0.58		Ounces
Toight			16.4		Grams
Through Hole Pin Diameter			0.04 & 0.062		Inches
			1.016 & 1.575		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches
ENVIRONMENTAL					μ ποποσ
Operating Ambient Temperature Range	With Derating	-40		85	0°
Operating Case Temperature Range	No derating, full power	-40		105	<u> </u>
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Thermal Protection/Shutdown	Measured in center	115	125	130	<u> </u>
Electromagnetic Interference	External filter is required	110		100	
Conducted, EN55022/CISPR22	External interior for foquilou		В		Class
Radiated, EN55022/CISPR22			B		Class
Relative humidity, non-condensing	To +85°C	10		90	%RH
Altitude	must derate -1%/1000 feet	-500		10,000	feet
/ HILMAN		-152		3048	meters
RoHS rating ④		102	RoHS-6	00-00	motoro

#### **Performance Specification Notes**

- ① Unless otherwise noted, all specifications are typical at nominal input voltage, nominal output voltage and full load. General conditions are +25° Celsius ambient temperature, near sea level altitude, natural convection airflow. All models are tested and specified with external parallel 1 µF and 10 µF multi-layer ceramic output capacitors. The external input capacitor is 22 µF ceramic. All capacitors are low-ESR types wired close to the converter. These capacitors are necessary for our test equipment and may not be needed in the user's application.
- ② Input (back) ripple current is tested and specified over 5 Hz to 20 MHz bandwidth. Input filtering is Cbus = 220 µF/100V, Cin = 33 µF/100V and Lbus = 12 µH.
- ③ All models are stable and regulate to specification under no load.
- ④ Reduction of Hazardous Substances (RoHS) compliance is to RoHS-6 (six substances restricted including lead). See specifications.
- 5 The Remote On/Off Control is referred to -Vin.
- ⑥ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme.

## **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



(-Vout)

R6:73

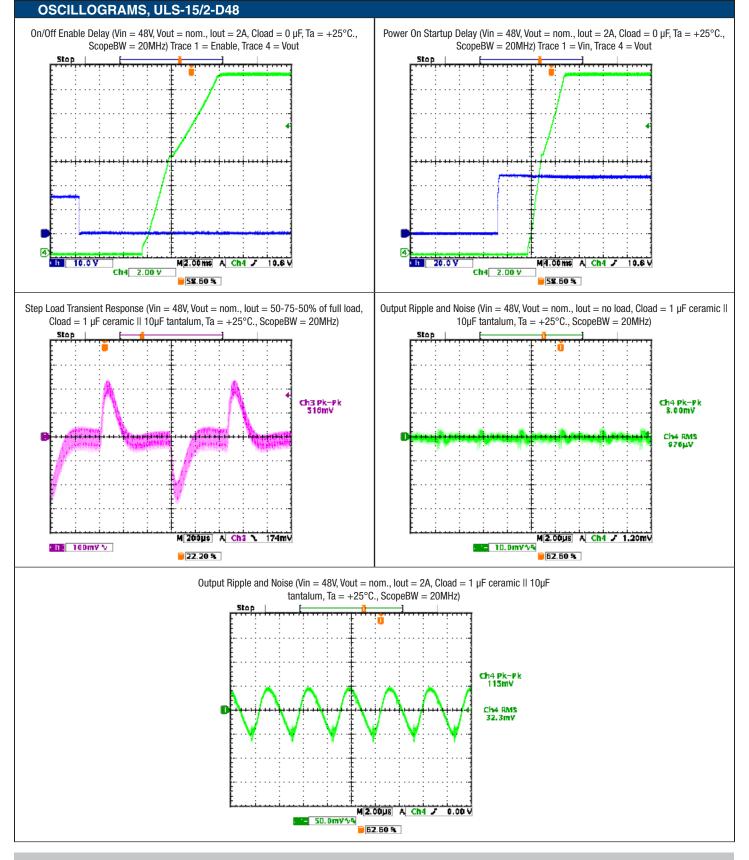
(-Vin)

50

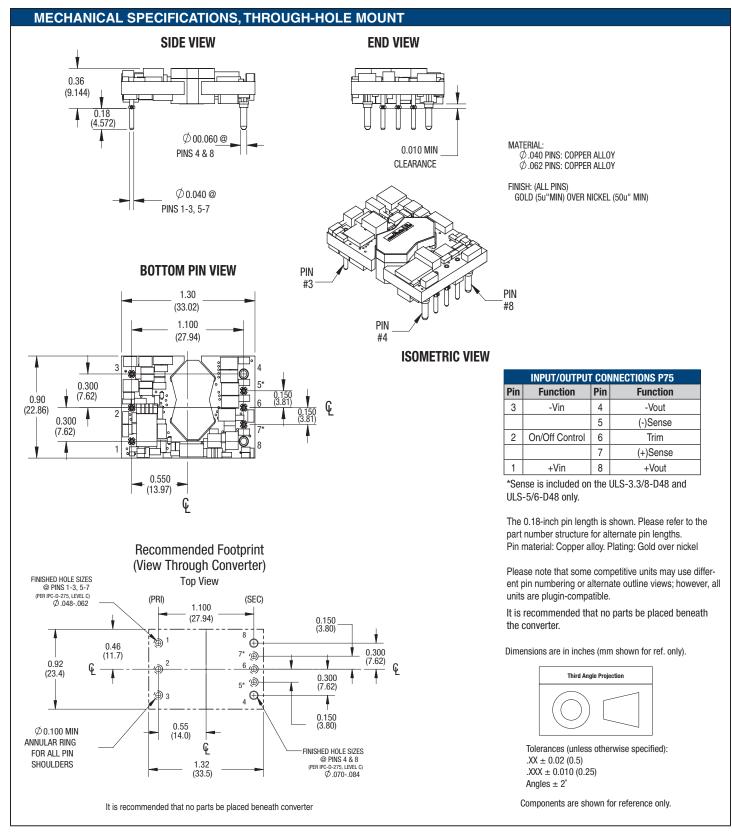
45.7°C



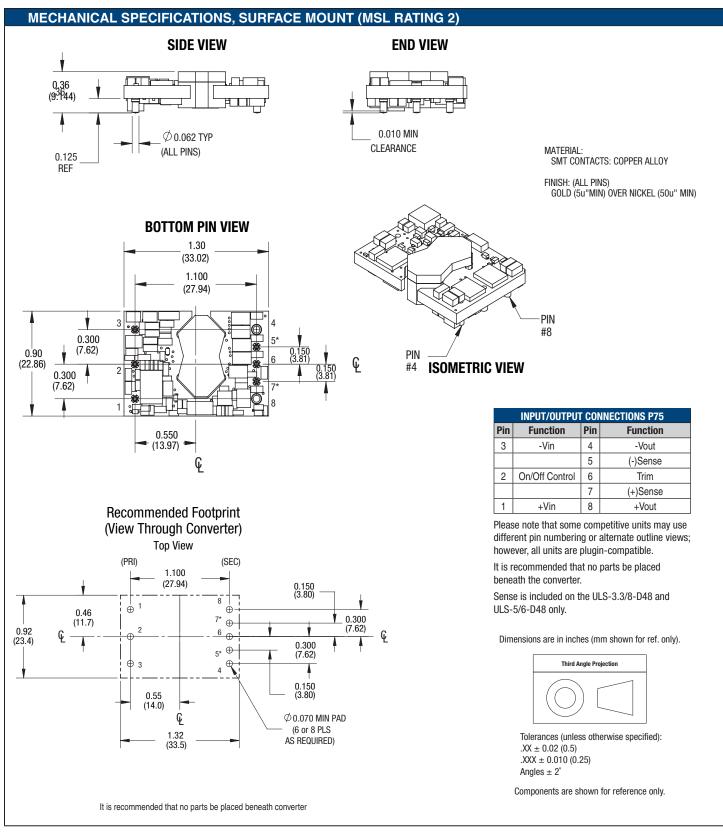
# **ULS 30-Watt Series**



# **ULS 30-Watt Series**



# **ULS 30-Watt Series**

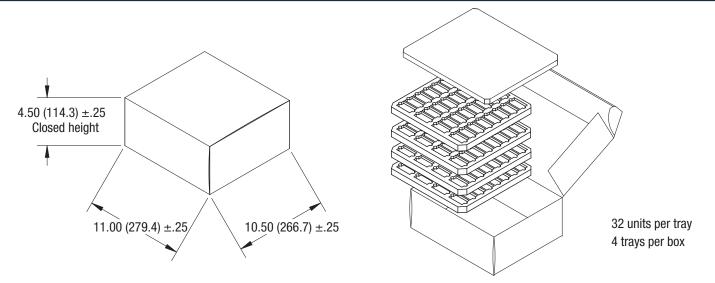




## **ULS 30-Watt Series**

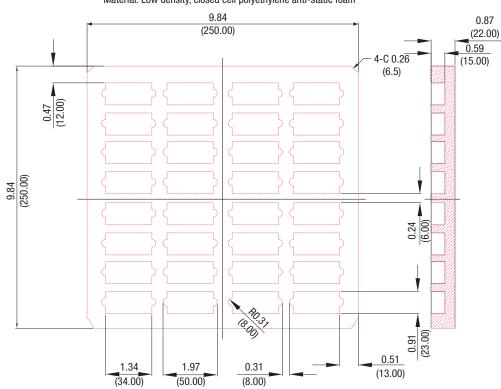
Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### SHIPPING TRAYS AND BOXES, THROUGH-HOLE MOUNT



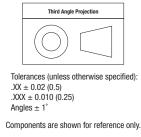
Each static dissipative polyethylene foam tray accommodates 32 converters in a 4 x 8 array.

### SHIPPING TRAY DIMENSIONS



Material: Low density, closed cell polyethylene anti-static foam

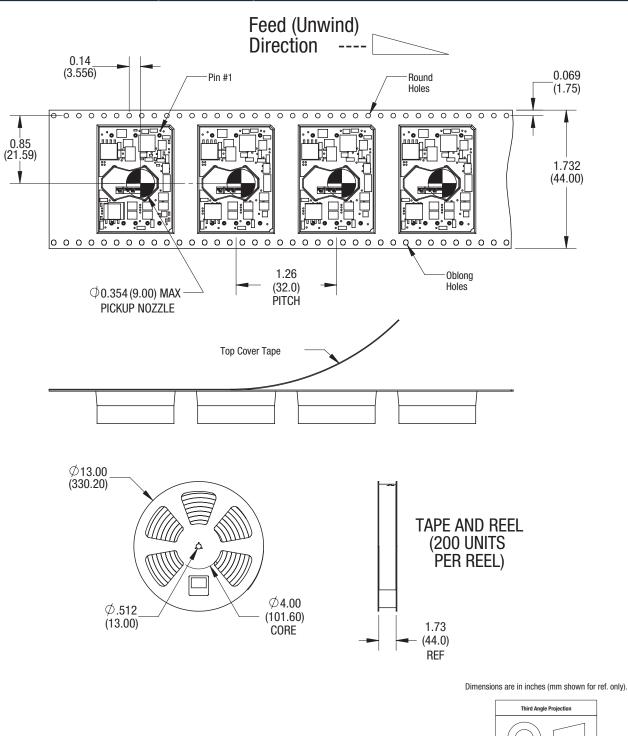
Dimensions are in inches (mm shown for ref. only).



## **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters





Components are shown for reference only.

## **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### **TECHNICAL NOTES**

### Input Fusing

Certain applications and/or safety agencies may require the installation of fuses at the inputs of power conversion components. Fuses should also be used if the possibility of sustained, non-current-limited, input-voltage polarity reversals exists. For DATEL ULS series DC/DC converters, we recommend the use of a fast blow fuse, installed in the ungrounded input supply line with a typical value about twice the maximum input current, calculated at low line with the converter's minimum efficiency.

All relevant national and international safety standards and regulations must be observed by the installer. For system safety agency approvals, the converters must be installed in compliance with the requirements of the end- use safety standard, i.e. IEC/EN/UL60950-1.

#### **Input Reverse-Polarity Protection**

If the input voltage polarity is accidentally reversed, an internal diode will become forward biased and likely draw excessive current from the power source. If this source is not current limited or the circuit appropriately fused, it could cause permanent damage to the converter.

#### Input Under-Voltage Shutdown and Start-Up Threshold

Under normal start-up conditions, devices will not begin to regulate properly until the ramping-up input voltage exceeds the Start-Up Threshold Voltage. Once operating, devices will not turn off until the input voltage drops below the Under-Voltage Shutdown limit. Subsequent re-start will not occur until the input is brought back up to the Start-Up Threshold. This built in hysteresis prevents any unstable on/off situations from occurring at a single input voltage.

#### **Start-Up Time**

The V<sub>IN</sub> to V<sub>OUT</sub> Start-Up Time is the time interval between the point at which the ramping input voltage crosses the Start-Up Threshold and the fully loaded output voltage enters and remains within its specified accuracy band. Actual measured times will vary with input source impedance, external input capacitance, and the slew rate and final value of the input voltage as it appears at the converter. The ULS Series implements a soft start circuit to limit the duty cycle of its PWM controller at power up, thereby limiting the input inrush current.

The On/Off Control to Vout start-up time assumes the converter has its nominal input voltage applied but is turned off via the On/Off Control pin. The specification defines the interval between the point at which the converter is turned on (released) and the fully loaded output voltage enters and remains within its specified accuracy band. Similar to the V<sub>IN</sub> to Vout start-up, the On/Off Control to Vout start-up time is also governed by the internal soft start circuitry and external load capacitance. The difference in start up time from V<sub>IN</sub> to Vout and from On/Off Control to Vout is therefore insignificant.

### **Input Source Impedance**

The input of ULS converters must be driven from a low ac-impedance source. The DC/DC's performance and stability can be compromised by the use of highly inductive source impedances. The input circuit shown in Figure 2 is a practical solution that can be used to minimize the effects of inductance in the input traces. For optimum performance, components should be mounted close to the DC/DC converter.

### I/O Filtering, Input Ripple Current, and Output Noise

All models in the ULS Series are tested/specified for input reflected ripple current and output noise using the specified external input/output components/ circuits and layout as shown in the following two figures. External input capacitors (C<sub>N</sub> in Figure 2) serve primarily as energy-storage elements, minimizing line voltage variations caused by transient IR drops in conductors from backplane to the DC/DC. Input caps should be selected for bulk capacitance (at appropriate frequencies), low ESR, and high rms-ripple-current ratings. The switching nature of DC/DC converters requires that dc voltage sources have low ac impedance as highly inductive source impedance can affect system stability. In Figure 2, CBUS and LBUS simulate a typical dc voltage bus. Your specific system configuration may necessitate additional considerations.

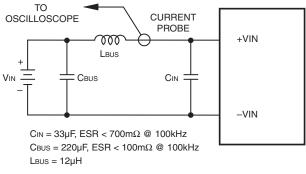


Figure 2. Measuring Input Ripple Current

In critical applications, output ripple/noise (also referred to as periodic and random deviations or PARD) may be reduced below specified limits using filtering techniques, the simplest of which is the installation of additional external output capacitors. They function as true filter elements and should be selected for bulk capacitance, low ESR and appropriate frequency response.

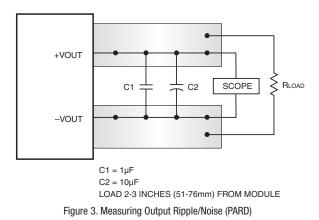
All external capacitors should have appropriate voltage ratings and be located as close to the converter as possible. Temperature variations for all relevant parameters should also be taken carefully into consideration. The most effective combination of external I/O capacitors will be a function of line voltage and source impedance, as well as particular load and layout conditions.

### **Floating Outputs**

Since these are isolated DC/DC converters, their outputs are "floating" with respect to their input. Designers will normally use the –Output as the ground/ return of the load circuit. You can however, use the +Output as ground/return to effectively reverse the output polarity.

#### **Minimum Output Loading Requirements**

ULS converters employ a synchronous-rectifier design topology and all models regulate within spec and are stable under no-load to full load conditions. Operation under no-load conditions however might slightly increase the output ripple and noise.



### Thermal Shutdown

The ULS converters are equipped with thermal-shutdown circuitry. If environmental conditions cause the temperature of the DC/DC converter to rise above the designed operating temperature, a precision temperature sensor will power down the unit. When the internal temperature decreases below the threshold of the temperature sensor, the unit will self start. See Performance/Functional Specifications.

#### **Output Over-Voltage Protection**

The ULS output voltage is monitored for an over-voltage condition using a comparator. The signal is optically coupled to the primary side and if the output voltage rises to a level which could be damaging to the load, the sensing circuitry will power down the PWM controller causing the output voltage to decrease. Following a time-out period the PWM will restart, causing the output voltage to ramp to its appropriate value. If the fault condition persists, and the output voltage again climbs to excessive levels, the over-voltage circuitry will initiate another shutdown cycle. This on/off cycling is referred to as "hiccup" mode.

#### **Current Limiting**

As soon as the output current increases to approximately 130% of its rated value, the DC/DC converter will go into a current-limiting mode. In this condition, the output voltage will decrease proportionately with increases in output current, thereby maintaining somewhat constant power dissipation. This is commonly referred to as power limiting. Current limit inception is defined as the point at which the full-power output voltage falls below the specified tolerance. See Performance/Functional Specifications. If the load current, being drawn from the converter, is significant enough, the unit will go into a short circuit condition as described below.

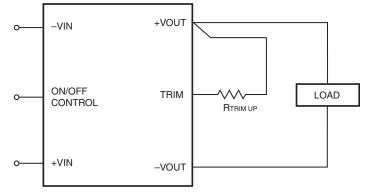


Figure 5. Trim Connections To Increase Output Voltages. If units have sense pins, Connect trim to + Sense pin.

www.murata-ps.com/support

## **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

#### **Short Circuit Condition**

When a converter is in current-limit mode, the output voltage will drop as the output current demand increases. If the output voltage drops too low, the magnetically coupled voltage used to develop primary side voltages will also drop, thereby shutting down the PWM controller. Following a time-out period, the PWM will restart causing the output voltage to begin ramping to their appropriate value. If the short-circuit condition persists, another shutdown cycle will be initiated. This on/off cycling is referred to as "hiccup" mode. The hiccup cycling reduces the average output current, thereby preventing internal temperatures from rising to excessive levels. The ULS Series is capable of enduring an indefinite short circuit output condition.

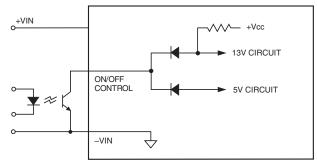
#### **On/Off Control**

The input-side, remote On/Off Control function can be ordered to operate with either logic type:

**Positive** ("P" suffix) logic models are enabled when the on/off pin is left open (or is pulled high, applying +10V to +15V with respect to -Input). Positive-logic devices are disabled when the on/off pin is pulled low (0 to 0.7V with respect to -Input).

**Negative** ("N" suffix) logic devices are off when pin is left open (or pulled high, applying +2.5V to +15V), and on when pin is pulled low (-0.1 to 0.8V) with respect to -Input as shown in Figure 4.

Dynamic control of the remote on/off function is best accomplished with a mechanical relay or an open-collector/open-drain drive circuit (optically isolated if appropriate). The drive circuit should be able to sink appropriate current (see Performance Specifications) when activated and withstand appropriate voltage when deactivated. Applying an external voltage to pin 2 when no input power is applied to the converter can cause permanent damage to the converter.





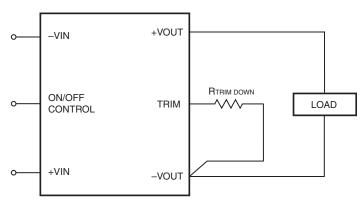


Figure 6. Trim Connections To Decrease Output Voltages. If units have sense pins, connect Trim to (-) Sense pins.

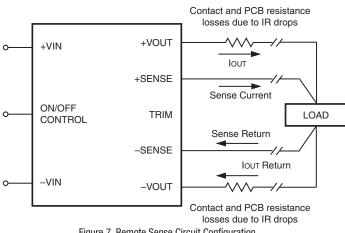
#### Remote Sense (ULS-3.3/8-D48 and ULS-5/6-D48 models only)

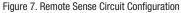
Note: The Sense and Vout lines are internally connected through low-value resistors. Nevertheless, if the sense function is not used for remote regulation the user should connect the +Sense to +Vout and -Sense to -Vout at the DC/DC converter pins. ULS series converters employ a sense feature to provide point of use regulation, thereby overcoming moderate IR drops in PCB conductors or cabling. The remote sense lines carry very little current and therefore require minimal cross-sectional-area conductors. The sense lines, which are capacitively coupled to their respective output lines, are used by the feedback control-loop to regulate the output. As such, they are not low impedance points and must be treated with care in layouts and cabling. Sense lines on a PCB should be run adjacent to dc signals, preferably ground.

 $[VOUT(+)-VOUT(-)] - [Sense(+)-Sense(-)] \le 10\% VOUT$ 

In cables and discrete wiring applications, twisted pair or other techniques should be used. Output over-voltage protection is monitored at the output voltage pin, not the Sense pin. Therefore, excessive voltage differences between Vout and Sense in conjunction with trim adjustment of the output voltage can cause the over-voltage protection circuitry to activate (see Performance Specifications for over-voltage limits). Power derating is based on maximum output current and voltage at the converter's output pins. Use of trim and sense functions can cause output voltages to increase, thereby increasing output power beyond the converter's specified rating, or cause output voltages to climb into the output over-voltage region. Therefore, the designer must ensure:

(Vout at pins) x (lout)  $\leq$  rated output power





## **ULS 30-Watt Series**

### Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

#### **Trim Equations**

Trim Down	
$R_{T_{DOWN}}(k\Omega) = \frac{511}{\Delta\%} - 10.22$	
Where $\Delta\% = \left  \left( \frac{V_{NOM} - V_{DES}}{V_{NOM}} \times 100 \right) \right $	

	irim up		
PT (kO) -	$5.11 \times \text{Vnom} \times (100 + \Delta\%)$	10.22	
$RT_{UP}(k\Omega) =$	1.225 × ∆%	Δ%	

**Note:** " $\Delta$ %" is always a positive value.

"VNOM" is the nominal, rated output voltage. "VDES" is the desired, changed output voltage.

# **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### Trimming by Using an External Voltage Source

1. The easiest way to trim the output using an external voltage source is to drive the Trim pin directly from a variable source. The following equation can be used to calculate the voltage at the Trim pin.

Vtrim = 
$$2 \times 1.24 \times \frac{V_0}{V_0} - 1.24$$

Vo is the output voltage you want; Vonominal is the nominal output voltage; Vtrim is the voltage that should appear at the trim pin.

2. If the purpose of trimming is to compensate voltage drop of power path from converter to the Load, you may separately connect the sense pin directly to the load. It's much easier than real time adjusting trim voltage.

3. CAUTION: To avoid unplanned power down cycles, do not exceed EITHER the maximum output voltage OR the maximum output power when setting the trim. If the output voltage is excessive, the OVP circuit may shut down the converter. If the maximum power is exceeded, the converter may enter current limiting. If the power is exceeded for an extended period, the converter may overheat and encounter overtemperature shut down. Be careful of external electrical noise. The Trim input is a sensitive input to the converter's feedback control loop. Excessive electrical noise may cause instability or oscillation.

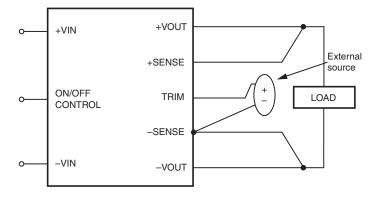


Figure 8. Trimming with an external source

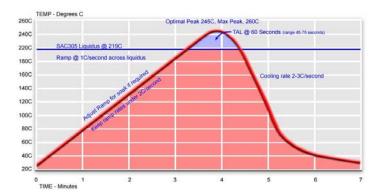
#### **Through-hole Soldering Guidelines**

Murata Power Solutions recommends the TH soldering specifications below when installing these converters. These specifications vary depending on the solder type. Exceeding these specifications may cause damage to the product. Your production environment may differ; therefore please thoroughly review these guidelines with your process engineers.

Wave Solder Operations for through-hole mounted products (THMT)					
For Sn/Ag/Cu based solders:					
Maximum Preheat Temperature	115° C.				
Maximum Pot Temperature	270° C.				
Maximum Solder Dwell Time	7 seconds				
For Sn/Pb based solders:					
Maximum Preheat Temperature	105° C.				
Maximum Pot Temperature	250° C.				
Maximum Solder Dwell Time	6 seconds				

#### **SMT Reflow Soldering Guidelines**

The surface-mount reflow solder profile shown below is suitable for SAC305 type leadfree solders. This graph should be used only as a *guideline*. Many other factors influence the success of SMT reflow soldering. Since your production environment may differ, please thoroughly review these guidelines with your process engineers.



# **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters

### **Emissions Performance**

Murata Power Solutions measures its products for radio frequency emissions against the EN 55022 and CISPR 22 standards. Passive resistance loads are employed and the output is set to the maximum voltage. If you set up your own emissions testing, make sure the output load is rated at continuous power while doing the tests.

The recommended external input and output capacitors (if required) are included. Please refer to the fundamental switching frequency. All of this information is listed in the Product Specifications. An external discrete filter is installed and the circuit diagram is shown below.

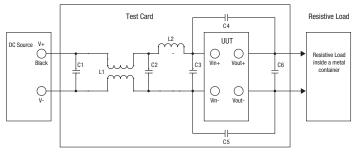


Figure 9. Conducted Emissions Test Circuit

### [1] Conducted Emissions Parts List

Reference	Part Number	Description	Vendor
L1	PE-62913	1mH, 6A	Pulse
L2	NC	4.7uH, 3.6A	Murata
C1, C2	VZ Series	Ceramic Capacitor (3.2uf) = 2.2ufd/1ufd in parallel, 100V	Panasonic
C3	VZ Series	Qty 2 - Electrolytic Capacitor 22ufd, 100V	Panasonic
C4, C5	Unknown	3.3nF, 1500V	Unknown
C6	VZ Series	Electrolytic Capacitor 33ufd, 100V	Panasonic

### [2] Conducted Emissions Test Equipment Used

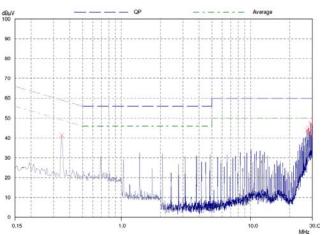
Rohde & Schwarz EMI Test Receiver (9KHz – 1000MHz) ESPC Rohde & Schwarz Software ESPC-1 Ver. 2.20 HP11947A Transient Limiter (Agilent) OHMITE 25W – Resistor combinations DC Source Programmable DC Power Supply Model 62012P-100-50

### [3] Layout Recommendations

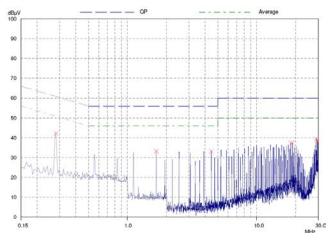
Most applications can use the filtering which is already installed inside the converter or with the addition of the recommended external capacitors. For greater emissions suppression, consider additional filter components and/or shielding. Emissions performance will depend on the user's PC board layout, the chassis shielding environment and choice of external components. Please refer to Application Note GEAN-02 for further discussion.

Since many factors affect both the amplitude and spectra of emissions, we recommend using an engineer who is experienced at emissions suppression.

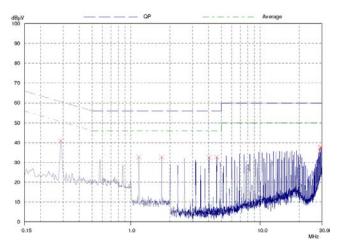
#### [4] Conducted Emissions Test Results



Graph 1. ULS-3.3/8-D48N-C conducted emissions performance, Peak Detection Mode, CISPR/EN55022, Class B, full load at 48Vin



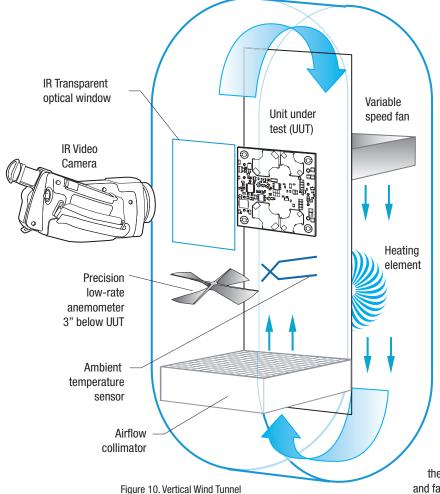
Graph 2. ULS-12/2.5-D48N-C conducted emissions performance, Peak Detection Mode, CISPR/EN55022, Class B, full load at 48Vin



Graph 3. ULS-15/2-D48P-C conducted emissions performance, Peak Detection Mode, CISPR/EN55022, Class B, full load at 48Vin

# **ULS 30-Watt Series**

Sixteenth-brick DOSA-Compatible, Isolated DC/DC Converters



### Vertical Wind Tunnel

Murata Power Solutions employs a computer controlled custom-designed closed loop vertical wind tunnel, infrared video camera system, and test instrumentation for accurate airflow and heat dissipation analysis of power products. The system includes a precision low flow-rate anemometer, variable speed fan, power supply input and load controls, temperature gauges, and adjustable heating element.

The IR camera monitors the thermal performance of the Unit Under Test (UUT) under static steady-state conditions. A special optical port is used which is transparent to infrared wavelengths.

Both through-hole and surface mount converters are soldered down to a host carrier board for realistic heat absorption and spreading. Both longitudinal and transverse airflow studies are possible by rotation of this carrier board since there are often significant differences in the heat dissipation in the two airflow directions. The combination of adjustable airflow, adjustable ambient heat, and adjustable Input/Output currents and voltages mean that a very wide range of measurement conditions can be studied.

The collimator reduces the amount of turbulence adjacent to the UUT by minimizing airflow turbulence. Such turbulence influences the effective heat transfer characteristics and gives false readings. Excess turbulence removes more heat from some surfaces and less heat from others, possibly causing uneven overheating.

Both sides of the UUT are studied since there are different thermal gradients on each side. The adjustable heating element and fan, built-in temperature gauges, and no-contact IR camera mean that power supplies are tested in real-world conditions.

Murata Power Solutions, Inc. 129 Flanders Road, Westborough, MA 01581 U.S.A. ISO 9001 and 14001 REGISTERED



This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy: Refer to: http://www.murata-ps.com/requirements/

Murata Power Solutions, Inc. makes no representation that the use of its products in the circuits described herein, or the use of other technical information contained herein, will not infringe upon existing or future patent rights. The descriptions contained herein do not imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Specifications are subject to change without notice. © 2018 Murata Power Solutions, Inc.