

## **ULT Series**

### Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range



#### **FEATURES**

- 2:1 Input Voltage Range (36V 75V, 48 Volts, nominal)
- Up to 30W output power @ 36 48 75Vin
- 89% efficiency (typical, 5Vout)
- Through-hole and optional SMT package
- Miniature 1/32 brick open frame package
- Positive & Negative Logic On/Off control option
- Over-current & Over-temperature protection
- Low output ripple and noise
- Strong thermal derating characteristics
- Operational Temperature Range –40°C to +85°C
- 1500V I/O isolation
- Tight line/load regulation
- Certified to UL/IEC 60950-1, CAN/CSA C22.2 No. 60950-1, safety approvals, 2nd Edition

#### **PRODUCT OVERVIEW**

The ULT Series isolated DC/DC converter represents the next generation converters in a 1/32 brick package. This converter is the "industry-standard" 1/32 brick form factor (0.92" x 0.75" x 0.35"). The product fully complies with RoHS-6 directive.

The thirty-second brick is offered as an open frame module; mounting options include throughhole or surface mount (SMT) pinouts. Typical applications include Optical Networking Equipment, Wireless Base Station applications, Microwave Radio communications, and Telecom and Data Equipment applications. Modules will supply an output power of up to 30 watts over the input range of 36-75V. The ULT Series also provides a cost effective approach to highly efficient systems requiring 12V, 5V, and 3.3V voltages, eliminating the requirement for a "Bus Converter" and multiple PoL converters. The ULT family provides basic insulation with 1500Vdc isolation meeting the requirements of UL/IEC 60950. The ULT series modules are DOSA compatible industry standard 1/32 brick.



Figure 1. Connection Diagram

Typical topology is shown. Murata Power Solutions recommends an external fuse.





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PERFORMANCE SP	ECIFICA	TIONS SUM	MARY AN	ID ORDERI	NG GUIDE	0								
				Outpu	t					Input		Effic	iency	Package
Root Model ①	Vout	Іоит	Power	R/N (mV	pk-pk) ②	Regulation	n (max.) <sup>③</sup>	VIN Nom.	Range	lin, no load	lın, full	LIIIC	iency	rackaye
	(V)	(A, max.)	(W)	Тур.	Max.	Line	Load	(V)	(V)	(mA)	load (A)	Min.	Тур.	Case (inches)
ULT-3.3/7.5-D48	3.3	7.5	24.75	45	50	±0.15%	±0.2%	48	36-75	20	0.6	84%	85.5%	0.92 x 0.75 x 0.35
ULT-5/5-D48	5	5	25	50	75	±0.1%	±0.125%	48	36-75	20	0.59	87%	89%	0.92 x 0.75 x 0.35
ULT-12/2.5-D48	12	2.5	30	70	100	±0.075%	±0.125%	48	36-75	20	0.68	90%	92%	0.92 x 0.75 x 0.35

<sup>①</sup> Please refer to the Part Number Structure when ordering.

<sup>②</sup> All specifications are typical at nominal line voltage and full load, +25°C unless otherwise noted. See detailed specifications. External input capacitors are  $33\mu$ F electrolytic and three 1 $\mu$ F ceramic. Output ripple is measured with 400 $\mu$ F capacitance across output pins for the 3.3Vout and 5Vout model. The 12Vout model

is measured with 188 $\mu\text{F}$ . Output 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.

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#### FUNCTIONAL SPECIFICATIONS (ULT-3.3/7.5-D48-C)

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous	Full temperature range	36		80	Vdc
	Operating or non-operating, 100 mS max.			100	Vda
Input Voltage, Transient ᠖	duration			100	Vdc
Isolation Voltage	Input to output tested			1500	Vdc
Input Reverse Polarity	None, install external fuse		none		Vdc
On/Off Remote Control	Power on or off, referred to -Vin			15	Vdc
Output Power				25	W
Output Current	Current-limited, no damage, short-circuit protected			7.5	A
Storage Temperature Range	Vin = Zero (no power)	-40		125	°C
	of devices to greater than any of these conditions m	ay adversely affect lon	g-term reliability. Proper ope	eration under conditions	s other than those
listed in the Performance/Functional Specification					
INPUT	Conditions ① ③				
Operating voltage range		36	48	75	Vdc
Recommended External Fuse <sup>(3)</sup>	Fast blow		2		A
Start-up threshold	Rising input voltage	32.5	33.3	34.5	Vdc
Undervoltage lockout (@ ½ load)	Falling input voltage	30.75	31.75	32.75	Vdc
Turn-On/Turn-Off Hysteresis		1.22	1.3	1.32	Vdc
Overvoltage shutdown	Rising input voltage		N/A		Vdc
Reverse Polarity Protection	None, install external fuse		None		Vdc
Internal Filter Type			Capacitive		
Input current					
Full Load Current Conditions	Vin = nominal		0.6	0.62	Α
Low Line Input Currrent	Vin = minimum		0.8	0.83	Α
Inrush Transient	Vin = 48V		0.05		A2-Sec.
Short Circuit input current			0.04	0.1	mA
No Load input current	lout = minimum, unit=0N		20	40	mA
Shut-Down Mode input current (Off, UV, OT)			6	10	mA
Reflected (back) ripple current 2	Measured at input with specified filter		30		mA, pk-pk
GENERAL and SAFETY					
Efficiency	Vin=48V	84	85.5		%
	Vin=36V	83.5	85.5		%
Isolation					
Isolation Voltage, Input to Output			1500		Vdc
Insulation Safety Rating		4.0	basic		
Isolation Resistance		10	(700		ΜΩ
Isolation Capacitance			1700		pF
Safety	UL-60950-1, CSA-C22.2 No.60950-1,		Yes		
(certified to the following requirements)	IEC/60950-1, 2nd edition Per Telcordia SR332, issue 1, class 3, ground				
Calculated MTBF ④	fixed, Tambient=+25°C		TBD		Hours x 10 <sup>3</sup>
DYNAMIC CHARACTERISTICS					
Fixed Switching Frequency		250	287	320	KHz
		200	201		mS
Startup Time	Power On, to Vout regulation hand 100%			50	
Startup Time Startup Time	Power On, to Vout regulation band, 100% Remote ON to Vout Regulated			<u> </u>	
Startup Time	Remote ON to Vout Regulated		75	50	mS
Startup Time Dynamic Load Response	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout		75 +100		mS µSec
Startup Time Dynamic Load Response Dynamic Load Peak Deviation	Remote ON to Vout Regulated			50	mS
Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout			50	mS µSec
Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control ®	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout			50	mS µSec
Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout same as above	-0.7		50 150	mS µSec mV
Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © "N" suffix Negative Logic, ON state	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout same as above ON = pin grounded or external voltage	-0.7		50 150 1.0	mS µSec mV Vdc
Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (6) "N" suffix Negative Logic, ON state Negative Logic, OFF state	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout same as above ON = pin grounded or external voltage OFF = pin open or external voltage	-0.7 10	±100	50 150	mS µSec mV Vdc Vdc
Startup Time 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	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout same as above ON = pin grounded or external voltage			50 150 1.0	mS µSec mV Vdc
Startup Time 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	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout same as above ON = pin grounded or external voltage OFF = pin open or external voltage open collector/drain	10	±100	50 150 1.0 15	mS µSec mV Vdc Vdc mA
Startup Time 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	Remote ON to Vout Regulated 50-75-50% load step to 1% of Vout same as above ON = pin grounded or external voltage OFF = pin open or external voltage		±100	50 150 1.0	mS µSec mV Vdc Vdc

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#### FUNCTIONAL SPECIFICATIONS (ULT-3.3/7.5-D48-C, CONT.)

OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power		0	24.75	25	W
Voltage					
Nominal Output Voltage		3.2505	3.3	3.35	Vdc
Setting Accuracy	At 50% load	-1.5		1.5	Vdc
Output Trim Range ®	User selectable (see trim formulas)	-20		10	% of Vout
Overvoltage Protection		3.9		4.6	Vdc
Current			1		
Output Current Range		0	7.5	7.5	A
Minimum Load	no minimal load required				
Current Limit Inception (9)	98% of Vnom., after warmup	8.8	10.8	12.5	A
Short Circuit	· · · · ·				-
Short Circuit Current	Hiccup technique, autorecovery within ±1.25% of Vout			0.3	А
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting		Non-latching		
Regulation ⑦					
Line Regulation	Vin=min. to max., Vout=nom., full load			±0.15	% of Vout
Load Regulation	lout=min. to max., Vin=nom.			±0.2	% of Vout
Ripple and Noise <sup>(12)</sup>	Tested with eight 47µF ceramic caps in parallel		45	50	mV pk-pk
Temperature Coefficient	At all outputs		0.02		% of Vout./°C
Maximum Capacitive Loading	Low ESR	400		5,000	μF
Remote Sense Compliance	Vsense = Vout - Vload, sense connected at load			10	% of Vout
MECHANICAL (Through Hole Models)	Conditions ① ③	Minimum	Typical/Nominal	Maximum	Units
Outline Dimensions			0.92 x 0.75 x 0.35		Inches
(Please refer to outline drawing)	LxWxH		23.4x19.05x8.89		mm
Weight			0.32		Ounces
			9.07		Grams
Through Hole Pin Diameter			.04 & .062		Inches
			1.02 & 1.57		mm
Through Hole Pin Material			Brass		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		3-5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range 🔞	See derating curves	-40		85	0°
Storage Temperature	Vin = Zero (no power)	-55		125	0°
Thermal Protection/Shutdown		120	130	140	0°
Electromagnetic Interference	External filter is required				
Conducted, EN55022/CISPR22				В	Class
RoHS rating			RoHS-6		

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#### **Performance Specification Notes**

① All specifications are typical unless noted. Ambient temperature =  $+25^{\circ}$ Celsius, V<sub>IN</sub> is nominal, output current is maximum rated nominal. External output capacitance consists of 400µF capacitors across output pins; one 33µF low ESR, and three 1µF external input capacitors. All caps are low ESR.

Testing must be kept short enough that the converter does not appreciably heat up during testing. For extended testing, use plenty of airflow. See derating curves for temperature performance. All models are stable and regulate within spec without external cacacitance.

- ② Input Ripple Current is tested and specified over a 5-20 MHz bandwidth and uses a special set of external filters only for the Ripple Current specifications. Input filtering is C<sub>IN</sub> = 33 µF, C<sub>BUS</sub> = 220 µF, L<sub>BUS</sub> = 12 µH. Use capacitor rated voltages which are twice the maximum expected voltage. Capacitors must accept high speed AC switching currents.
- ③ Note that Maximum Current Derating Curves indicate an average current at nominal input voltage. At higher temperatures and/or lower airflow, the converter will tolerate brief full current outputs if the average RMS current over time does not exceed the Derating curve. All Derating curves are presented at sea level altitude. Be aware of reduced power dissipation with increasing density altitude.
- ④ Mean Time Before Failure (MTBF) is calculated using the Telcordia (Belcore) SR-332 Method 1, Case 3, Issue 1, ground fixed conditions. Operating temperature = +25°C, full output load, natural air convection.
- ⑤ The output may be shorted to ground indefinitely with no damage. The Output Short Circuit Current shown in the specifications is an average consisting of very short bursts of full rated current to test whether the output circuit can be repowered.
- 6 The On/Off pin allows the converter to be turned on or off by an external device such as a switch, a transistor, a logic gate, or an optical isolator. If the "logic pin" is left floating the measured voltage will be outside the limit's in the data sheet. Those numbers define the levels needed for the "control function" to take place and do not represent the voltage that may be present on the logic pin.

- Regulation specifications describe the deviation as the input line voltage or output load current is varied from a nominal midpoint value to either extreme (50% load).
- ⑧ Do not exceed maximum power ratings, sense limits or output overvoltage when adjusting output trim values.
- ③ Output overload protection is non-latching. When the output overload is removed, the output will automatically recover.
- In All models are fully operational and meet published specifications, including "cold start" at -40°C.
- ① The converter will shut off if the input falls below the undervoltage threshold. It will not restart until the input exceeds the Input Start Up Voltage.
- Output noise may be further reduced by installing an external filter. See the Application Notes. Use only as much output filtering as needed <u>and no</u> <u>more</u>. Larger caps (especially low-ESR ceramic types) may slow transient response or degrade dynamic performance. Thoroughly test your application with all components installed.
- If reverse polarity is accidentally applied to the input, always connect an external fast blow input fuse in series with the +ViN input.
- Although extremely unlikely, failure of the internal components of this product may expose external application circuits to dangerous voltages, currents, temperatures or power levels. Please thoroughly verify all applications before committing them to service. Be sure to include appropriately rated FUSES (see specifications and Application Notes) to reduce the risk of failure.
- (9) Special care should be exercised so that Input Voltage Transient does not exceed specified Max 100V/100ms. At normal input a large transient spike can be generated as a result of distribution inductance and high inrush current charging input cap on converter. This can be eliminated with 33µF electrolytic capacitor mounted close to Converter input. The series resistance (500m $\Omega$  < ESR < 700m $\Omega$ ) is essential in this solution.

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#### FUNCTIONAL SPECIFICATIONS (ULT-5/5-D48-C)

ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
nput Voltage, Continuous	Full temperature range	36		80	Vdc
nput Voltage, Transient 🕫	Operating or non-operating, 100 mS max. duration			100	Vdc
solation Voltage	Input to output tested			1500	Vdc
nput Reverse Polarity	None, install external fuse		none		Vdc
Dn/Off Remote Control	Power on or off, referred to -Vin	0		15	Vdc
Dutput Power		0		25.25	W
Dutput Current	Current-limited, no damage, short-circuit protected	0		5	Α
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
	of devices to greater than any of these conditions m	av adverselv affect long	-term reliability. Proper ope	eration under conditions	s other than tho
isted in the Performance/Functional Specification		.,	, , ,		
INPUT	Conditions ① ③				
Dperating voltage range		36	48	75	Vdc
Recommended External Fuse	Fast blow		2		A
Start-up threshold <sup>(2)</sup>	Rising input voltage	32	33.25	34.25	Vdc
•		-			_
Jndervoltage lockout (@ ½ load) (1)	Falling input voltage	30.8	32.5	34	Vdc
Furn-On/Turn-Off Hysteresis	Dising input with an	1.03	1.31	1.61	Vdc
Overvoltage shutdown	Rising input voltage		N/A		Vdc
Reverse Polarity Protection	None, install external fuse		N/A		Vdc
nternal Filter Type			Capacitive		
nput current			0 ==	0.7	
Full Load Conditions	Vin = nominal		0.59	0.6	A
Low Line	Vin = minimum		0.79	0.81	A
Inrush Transient			0.05		A2-Sec.
Short Circuit input current			50	100	mA
No Load input current	lout = minimum, unit=ON		20	40	mA
Shut-Down Mode input current (Off, UV, OT)			1	3	mA
Reflected (back) ripple current ②	Measured at input with specified filter		15	30	mA, pk-pl
GENERAL and SAFETY					
Efficiency	Vin=48V	87	89		%
Linciency	Vin=36V	87	88.5		%
solation					
Isolation Voltage, Input to Output			1500		Vdc
Isolation Voltage					Vdc
Insulation Safety Rating			basic		
Isolation Resistance		10			ΜΩ
Isolation Capacitance			1650		pF
•	UL-60950-1, CSA-C22.2 No.60950-1,		Vc-		
Safety			Yes		
,	IEC/60950-1, 2nd edition				
-	IEC/60950-1, 2nd edition Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C		7.3		Hours x 10
-	Per Telcordia SR332, issue 1, class 3, ground				Hours x 10
Calculated MTBF DYNAMIC CHARACTERISTICS	Per Telcordia SR332, issue 1, class 3, ground	225		285	Hours x 10
Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency	Per Telcordia SR332, issue 1, class 3, ground	225	7.3	<u>285</u> 10	
Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C	225	7.3		KHz
Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100%	225	7.3 255 5	10	KHz mS
Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated	225	7.3 255 5 5	10 10	KHz mS mS
Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band	225	7.3 255 5 5 75	10 10	KHz mS mS µSec
Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band	225	7.3 255 5 5 75	10 10	KHz mS mS µSec
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 ©	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band	225	7.3 255 5 5 75	10 10	KHz mS mS µSec
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 'N" suffix	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above		7.3 255 5 5 75	10 10 150	KHz mS mS µSec mV
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 © 'N" suffix Negative Logic, ON state	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage	-0.7	7.3 255 5 5 75	10 10 150 1.2	KHz mS mS µSec mV
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 'N" suffix Negative Logic, ON state Negative Logic, OFF state	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage OFF = pin open or external voltage		7.3 255 5 5 5 75 ±150	10 10 150	KHz mS mS µSec mV Vdc
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 © 'N" suffix Negative Logic, ON state Negative Logic, OFF state Control Current	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage	-0.7	7.3 255 5 5 75	10 10 150 1.2	KHz mS mS µSec mV
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 (6) 'N" suffix Negative Logic, ON state Negative Logic, OFF state Control Current 'P" suffix	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage OFF = pin open or external voltage open collector/drain	-0.7 10	7.3 255 5 5 5 75 ±150	10 10 150 1.2 1.5	KHz mS mS µSec mV
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 © "N" suffix Negative Logic, ON state Control Current "P" suffix Positive Logic, ON state	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage OFF = pin open or external voltage open collector/drain ON = pin open or external voltage	-0.7 10 10	7.3 255 5 5 5 75 ±150	10 10 150 1.2 15 15	KHz mS mS µSec mV Vdc Vdc Vdc Vdc
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 © "N" suffix Negative Logic, OF state Control Current "P" suffix Positive Logic, ON state Positive Logic, ON state Positive Logic, OFF state Control Current	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage OFF = pin open or external voltage open collector/drain ON = pin open or external voltage OFF = ground pin or external voltage	-0.7 10	7.3 255 5 5 75 ±150 1	10 10 150 1.2 1.5	mS mS μSec mV Vdc Vdc Vdc mA
Calculated MTBF DYNAMIC CHARACTERISTICS Fixed Switching Frequency Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control (6) "N" suffix Negative Logic, ON state Negative Logic, OFF state Control Current "P" suffix Positive Logic, ON state	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C Power On, to Vout regulation band, 100% Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage OFF = pin open or external voltage open collector/drain ON = pin open or external voltage	-0.7 10 10	7.3 255 5 5 5 75 ±150	10 10 150 1.2 15 15	М 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

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#### FUNCTIONAL SPECIFICATIONS (ULT-5/5-D48-C, CONT.)

OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power		0	25	25.25	W
Voltage	1		1		1
Nominal Output Voltage		4.925	5	5.075	Vdc
Setting Accuracy	At 50% load	-1.5		1.5	% of Vo nom
Output Trim Range ®	User selectable (see trim formulas)	-20		10	% of Vout
Overvoltage Protection		6	6.6	7.2	Vdc
Current	1		-		-
Output Current Range		0	5	5	A
Minimum Load					
Current Limit Inception (9)	98% of Vnom., after warmup	5.5	7	8.4	A
Short Circuit					
Short Circuit Current	Hiccup technique, autorecovery within ±1.25% of Vout			0.3	А
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting		Non-latching		
Regulation ⑦					
Line Regulation	Vin=min. to max., Vout=nom., full load			±0.1	% of Vout
Load Regulation	lout=min. to max., Vin=nom.			±0.125	% of Vout
Ripple and Noise <sup>(2)</sup>	Tested with eight 47µF ceramic caps in parallel		50	75	mV pk-pk
Temperature Coefficient	At all outputs		0.02		% of Vout./°C
Maximum Capacitive Loading	Low ESR	400		5,000	μF
Remote Sense Compliance	Vsense = Vout - Vload, sense connected at load			10	% of Vout
MECHANICAL (Through Hole Models)	Conditions (1) (3)	Minimum	Typical/Nominal	Maximum	Units
Outline Dimensions			0.92 x 0.75 x 0.35		Inches
(Please refer to outline drawing)	LxWxH		23.4x19.05x8.89		mm
Weight			0.32		Ounces
			9.07		Grams
Through Hole Pin Diameter			.04 & .062		Inches
			1.02 & 1.57		mm
Through Hole Pin Material			Brass		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		3-5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range 🔞	No Derating, full power, Natural convection, Vertical mount. See derating curves.	-40		85	°C
Storage Temperature	Vin = Zero (no power)	-55		125	0°
Thermal Protection/Shutdown		120	130	140	°C
Electromagnetic Interference	External filter is required				
Conducted, EN55022/CISPR22				В	Class
RoHS rating			RoHS-6		

# **ULT Series**

### Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range

#### **Performance Specification Notes**

① All specifications are typical unless noted. Ambient temperature =  $+25^{\circ}$ Celsius, V<sub>IN</sub> is nominal, output current is maximum rated nominal. External output capacitance consists of 400µF capacitors across output pins; one 33µF low ESR, and three 1µF external input capacitors. All caps are low ESR.

Testing must be kept short enough that the converter does not appreciably heat up during testing. For extended testing, use plenty of airflow. See derating curves for temperature performance. All models are stable and regulate within spec without external cacacitance.

- ② Input Ripple Current is tested and specified over a 5-20 MHz bandwidth and uses a special set of external filters only for the Ripple Current specifications. Input filtering is C<sub>IN</sub> = 33 µF, C<sub>BUS</sub> = 220 µF, L<sub>BUS</sub> = 12 µH. Use capacitor rated voltages which are twice the maximum expected voltage. Capacitors must accept high speed AC switching currents.
- ③ Note that Maximum Current Derating Curves indicate an average current at nominal input voltage. At higher temperatures and/or lower airflow, the converter will tolerate brief full current outputs if the average RMS current over time does not exceed the Derating curve. All Derating curves are presented at sea level altitude. Be aware of reduced power dissipation with increasing density altitude.
- ④ Mean Time Before Failure (MTBF) is calculated using the Telcordia (Belcore) SR-332 Method 1, Case 3, Issue 1, ground fixed conditions. Operating temperature = +25°C, full output load, natural air convection.
- ⑤ The output may be shorted to ground indefinitely with no damage. The Output Short Circuit Current shown in the specifications is an average consisting of very short bursts of full rated current to test whether the output circuit can be repowered.
- ⑥ The On/Off pin allows the converter to be turned on or off by an external device such as a switch, a transistor, a logic gate, or an optical isolator. If the "logic pin" is left floating the measured voltage will be outside the limit's in the data sheet. Those numbers define the levels needed for the "control function" to take place and do not represent the voltage that may be present on the logic pin.

- Regulation specifications describe the deviation as the input line voltage or output load current is varied from a nominal midpoint value to either extreme (50% load).
- ⑧ Do not exceed maximum power ratings, sense limits or output overvoltage when adjusting output trim values.
- ③ Output overload protection is non-latching. When the output overload is removed, the output will automatically recover.
- In All models are fully operational and meet published specifications, including "cold start" at -40°C.
- ① The converter will shut off if the input falls below the undervoltage threshold. It will not restart until the input exceeds the Input Start Up Voltage.
- Output noise may be further reduced by installing an external filter. See the Application Notes. Use only as much output filtering as needed <u>and no</u> <u>more</u>. Larger caps (especially low-ESR ceramic types) may slow transient response or degrade dynamic performance. Thoroughly test your application with all components installed.
- If reverse polarity is accidentally applied to the input, always connect an external fast blow input fuse in series with the +ViN input.
- Although extremely unlikely, failure of the internal components of this product may expose external application circuits to dangerous voltages, currents, temperatures or power levels. Please thoroughly verify all applications before committing them to service. Be sure to include appropriately rated FUSES (see specifications and Application Notes) to reduce the risk of failure.
- Special care should be exercised so that Input Voltage Transient does not exceed specified Max 100V/100ms. At normal input a large transient spike can be generated as a result of distribution inductance and high inrush current charging input cap on converter. This can be eliminated with 33µF electrolytic capacitor mounted close to Converter input. The series resistance (500mΩ < ESR < 700mΩ) is essential in this solution.</p>

# **ULT Series**



# **ULT Series**



www.murata-ps.com/support

# **ULT Series**

### Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range

### FUNCTIONAL SPECIFICATIONS (ULT-12/2.5-D48-C)

Operating or non-operating, 100 mS mac. duration         100         Vdc           solution Voltage         Imput to oxight lessed         1500         Vdc           put Reverse Polarly         None, instal external face         none         Vdc           multiput Power         0         30.3         W           output Current         Corrent-limited, no danage, atort cicical protected         0         2.5         A.           Storage Temperature Range         Win - Zaro (inp power)         -40         125         "C           Storage Temperature Range         Win - Zaro (inp power)         -40         125         "C           Storage Temperature Range         Win - Zaro (inp power)         -40         125         "C           Storage Temperature Range         Win - Zaro (inp power)         -40         125         "C           Storage Temperature Range         Storage Temperature Range         2         A         A           Note         Revert Board My Power         2         33         34         Vdc           Storage Temperature Range Moor         Bising input voltage         30.75         31.8         33         Vdc           Storage Temperature Range Moor         Bising input voltage         30.70         A         A         A	ABSOLUTE MAXIMUM RATINGS	Conditions ①	Minimum	Typical/Nominal	Maximum	Units		
Part Votage         Initial         Initia         Initial <thinitial< th=""></thinitial<>	Input Voltage, Continuous	Full temperature range	36		80	Vdc		
None, install external tase         none         VMC           Nord Hennek Control         Power or off, referred to 'n         0         30.3         WL           Nord Hennek Control         Over or off, referred to 'n         0         30.3         WL           Nature Control         Current         0         30.3         WL           Storage Emperature Range         Vm = Zcro (no power)         -40         125         ~5           Storage Emperature Range         Vm = Zcro (no power)         -40         125         ~5           Storage Emperature Range         OmtHitons 10.9         -6         2.5         A           Storage Emperature Range         OmtHitons 10.9         -6         2.5         A           Storage Emperature Range         Control filling for voltage         36         48         75         VC           Beammended External Fuse         Fast blow         2         A         A         Ver         A         A         Ver         A         A	nput Voltage, Transient 🐵				100	Vdc		
Dir/Off Benetic ControlPower on <i>e</i> off, referred to -Vin015.VMCDir/Dur Proter030.3WDurbut CurrentCurrent-limited, no denage, stort-circuit protected02.5.A.Storage Temperature RangeVin = 220 (in proven)-40125~CStorage Temperature RangeVin = 220 (in proven)-40125~CStorage Temperature RangeConditions may adversally affect long-term reliability. Proper operation under conditions other than thill in on timble or incommendad.IVP1TConditions 0.02.23334VdCStorage Temperature RangeStorage Temperature Range2.23334VdCStorage Temperature Range RangeStorage Temperature Range RangeN/AVdCVdCStorage Temperature Range Ra	solation Voltage	Input to output tested			1500	Vdc		
Uniput Prover         0         30.3         W           Upput Current         Current-Imited, no damage, short-carupt potected         0         2.5         A           Storage Emperature Range         Vin = zero (no power)         -40         125         °C           Storage Emperature Range         Vin = zero (no power)         -40         125         °C           Storage Emperature Range         Correction Range developed storage to greater than any of these conditions may advessely affect long-term reliability. Proper operation under conditions of the the the tested in the Partormance/Functional Specifications Table is not implied or recommended.         Vin Expect Storage Storag	nput Reverse Polarity	None, install external fuse		none		Vdc		
Dubut Current         Current-limiting, no sampa, short-cicul protected         0         2.5         A           Storage Temperature Range         Win = Zeo (no power)         -40         125         °°C           Storage Temperature Range         Non = Zeo (no power)         -40         125         °°C           Start et al in the Portmane Specifications Table is on limited or commended.         NPUT         Pontfiltens, 0:30         Post et al.         2         A           Becommended External Fase         Fast blow         36         48         75         V/dc           Becommended External Fase         Fast blow         31.3         33.4         V/dc         V/dc           An indervotage fockout (@ ½ load) ©         Falling input votage         30.75         31.8         33         V/dc           New votage shutdown         Rising input votage         1.3         1.31         1.2         V/dc           Instart First Pype         Capacitive         Capacitive         V/dc         No         A           Instart First Pype         0.05         0.1         mA         A         SA           Induct Current Conditions         Vin = nominal         0.68         0.70         A           Intrast Transtart         Vin = 48/W         0.05	Dn/Off Remote Control	Power on or off, referred to -Vin	0		15	Vdc		
Sharby Emergenture Range         Vin = Zer (nc power)         -4.0         128         **C           Sharby Emergenture Range were set less and provide or recommended. Surpart Range and presente man and versely affect long-term reliability. Proper operation under conditions were the num to the conditions may adversely affect long-term reliability. Proper operation under conditions were the and provide and the conditions may adversely affect long-term reliability. Proper operation under conditions were the and provide and the conditions of the condite conditions of the conditions of the condite conditions	Output Power		0		30.3	W		
bisolule 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 isset in the Profession Stable is not implied or accommended. INPUT Portal of Volage range Part Portal Porta Portal Portal Portal Portal Portal Portal Portal	Dutput Current	Current-limited, no damage, short-circuit protected	0		2.5	A		
NPUT     Conditions Table is not implied or recommended.       INPUT     Conditions Table is not implied or recommended.       Deparating voltage range     Conditions Table is not implied or recommended.       Start-up threshold ③     Rising input voltage     38.     48.       Start-up threshold ④     Pailing input voltage     30.75     31.8     33.3     34.       Viewordtage shutdown     Rising input voltage     N/A     Viewordtage shutdown       Umm-Off Hystersis     Viewordtage shutdown     A maining       Up of Current Conditions     Vin = nominal     0.058     A A       Full Load Current Conditions     Vin = nominal     0.058     A A       Inrush Thansient     Vin = 48V.     0.055     A A       Startow Wine Input Current     Vin = nimum, unit=ON     0.055     A A       Startow Tinge Loared A and SAFETY     OD <th <="" colspan="2" td=""><td>Storage Temperature Range</td><td>Vin = Zero (no power)</td><td>-40</td><td></td><td>125</td><td>°C</td></th>	<td>Storage Temperature Range</td> <td>Vin = Zero (no power)</td> <td>-40</td> <td></td> <td>125</td> <td>°C</td>		Storage Temperature Range	Vin = Zero (no power)	-40		125	°C
NPUT     Conditions Table is not implied or recommended.       INPUT     Conditions Table is not implied or recommended.       Deparating voltage range     Conditions Table is not implied or recommended.       Start-up threshold ③     Rising input voltage     38.     48.       Start-up threshold ④     Pailing input voltage     30.75     31.8     33.3     34.       Viewordtage shutdown     Rising input voltage     N/A     Viewordtage shutdown       Umm-Off Hystersis     Viewordtage shutdown     A maining       Up of Current Conditions     Vin = nominal     0.058     A A       Full Load Current Conditions     Vin = nominal     0.058     A A       Inrush Thansient     Vin = 48V.     0.055     A A       Startow Wine Input Current     Vin = nimum, unit=ON     0.055     A A       Startow Tinge Loared A and SAFETY     OD <th <="" colspan="2" td=""><td></td><td>of devices to greater than any of these conditions ma</td><td>ay adversely affect lon</td><td>g-term reliability. Proper ope</td><td>eration under condition</td><td>s other than thos</td></th>	<td></td> <td>of devices to greater than any of these conditions ma</td> <td>ay adversely affect lon</td> <td>g-term reliability. Proper ope</td> <td>eration under condition</td> <td>s other than thos</td>			of devices to greater than any of these conditions ma	ay adversely affect lon	g-term reliability. Proper ope	eration under condition	s other than thos
Operating voltage range         Description         38         48         75         VVic leasommende External Fuses         Past blow         2         A           Becommende External Fuses         Rising input voltage         32         33         34         VVic           Becommende External Fuses         Rising input voltage         30.75         31.8         33         VVic           Providage Studiown         Rising input voltage         30.75         31.8         33         VVic           Verorlage Studiodwn         Rising input voltage         NA         VVic         VVic           Verorlage Studiodwn         Rising input voltage         NA         VVic         VVic           Put Load Current Conditions         None, install external fuse         None         VVic         Vic           Ful Load Current Conditions         Vin = minimum         0.82         0.95         A           Insub Transitent         Vin = 48V.         0.05         .0.1         mA           No Load input Current         Vin = 48V.         0.05         .0.1         mA           Studiown Mode Input Current (Off, UV, OT)         Measured at input with specified filter         30         mA/p.kpl           External Vin = 48V.         90         92         %								
Becommende External Fuse         Fast blow         net         2         A           Raining input voltage         32         33         34         Vide           Indervoltage tockout (@ ½ load) ③         Falling input voltage         30.75         31.8         33         Vide           Vervoltage shutform         Rising input voltage         30.75         31.8         33         Vide           Vervoltage shutform         Rising input voltage         1.3         1.31         1.32         Vide           vervoltage shutform         None         Rising input voltage         None         Vide         Vide           runnor furrer Mitystressis         None         Rising input voltage         Rising input voltage         Vide         Vide           rput current         None         Rising input voltage         Rising input voltage         Rising input voltage         Vide         Vide           rput current         Vin = notninal         0.68         0.70         A         A         A           Low Une Input Current         Vin = notninal         0.05         0.1         mA         A           Not count mode Input Current         Vin = notninal         0.05         0.1         mA         A           Shot Growin Mode Input Curr	INPUT	Conditions ① ③						
Becommende External Fuse         Fast blow         net         2         A           Raining input voltage         32         33         34         Vide           Indervoltage tockout (@ ½ load) ③         Falling input voltage         30.75         31.8         33         Vide           Vervoltage shutform         Rising input voltage         30.75         31.8         33         Vide           Vervoltage shutform         Rising input voltage         1.3         1.31         1.32         Vide           vervoltage shutform         None         Rising input voltage         None         Vide         Vide           runnor furrer Mitystressis         None         Rising input voltage         Rising input voltage         Vide         Vide           rput current         None         Rising input voltage         Rising input voltage         Rising input voltage         Vide         Vide           rput current         Vin = notninal         0.68         0.70         A         A         A           Low Une Input Current         Vin = notninal         0.05         0.1         mA         A           Not count mode Input Current         Vin = notninal         0.05         0.1         mA         A           Shot Growin Mode Input Curr	Operating voltage range		36	48	75	Vdc		
Start-up threshold ③         Rising input voltage         32         33         34         Vdc           Inder-ordage lockout (@ ½ lod) ⑥         Failing input voltage         30,75         31.8         33         Vdc           Vervoltage shuttown         Rising input voltage         1.3         1.31         1.32         Vdc           Vervoltage shuttown         None, install external fuse         None         Vdc         Vdc           Vervoltage shuttown         None, install external fuse         None         Vdc         Vdc           Put Lacd Current Conditions         Vm = nominal         0.68         0.70         A           Low line Input Current         Vm = nominal         0.05         0.1         mA           No Load Input Current         Vm = nominal         0.05         0.1         mA           No Load Input Current         Vm = nominal         0.05         0.1         mA           ShotGrown Mode Input Current (Off, UV, 07)         Measured at input with specified filter         30         mA A, pk-pl           Externet (Off, UV, 07)         Measured at input with specified filter         30         mA         pk-pl           Externet (Off, UV, 07)         Measured at input with specified filter         30         mA         pk-pl		Fast blow						
Intervoltage tockout (@ ½ food) ◎         Falling input voltage         30.75         31.8         33         Vdc           Networklage shutdown         Rising input voltage         1.3         1.31         1.32         Vdc           Networklage shutdown         None, install external fuse         1.3         1.31         1.32         Vdc           Network Planty Protection         None, install external fuse         1.3         1.31         1.32         Vdc           Inrush Transient         Vin = nominal         0.68         0.70         A           Low Line Input Current         Vin = nominal         0.68         0.70         A           Shot Gircuit Input Current         Vin = nominal         0.68         0.70         A           Shot Gircuit Input Current         Vin = 48V.         0.05         0.1         mA           Shot Gircuit Input Current (Øf, UV, OT)         Ind = minimum, unit=0N         20         40         mA           Shot Gircuit Input Current (Øf, UV, OT)         Measured at input with specified filter         30         mA, pb-pi           GENERAL and SFETY         Vin=48V         90         92         %           Station Chapetiance         1500         Incolo         MC           Isolation Statey Rating         <			32	33				
Derivolage shutdown         Rising input voltage         NA         Vdc         Vdc           um-On/Tur-Off Hysteresis         1.3         1.31         1.32         Vdc           verser Polarity Protection         None, install external fuse         1.0         1.3         1.31         1.32         Vdc           verser Polarity Protection         None, install external fuse         1.0         Capacitive         Vdc           Full Laad Current Conditions         Vin = nominal         0.68         0.70         A           Low line Input Durrent         Vin = nimimum         0.92         0.95         A           Low line Input Durrent         Vin = 48V.         0.05         0.11         mA           No Load Input Current (0f, UV, 07)         Iout = minimum, unt=0N         20         40         mA           Shutdown Mode Input Current (0f, UV, 07)         Measured at input with specified filter         30         mA, pk-pl           GELEFAL and SAFETY         Vin=48V         90         92         %           Isolation         Vin=48V         90         92         %           Isolation Resistance         Ioutyut Insulation Safety Rating         Iousian         Vdc           Isolation Resistance         Ioutyut Insulation Safety Rating         Io			-		-	_		
January Data         January January Data         January January January Data         Vice           None, Install external fuse         None, Install external fuse         None         Vice           network Filter Type         Capacitive         Vice         Vice           network Filter Type         Capacitive         Vine         Vin		÷ ; •	30.75		33			
None         None, install external fuse         None         Vdc           Internal Filter Type         Capacitive         Capacitive         Image: Capaciti		HISING INPUT VOITAGE	1.0		1.00			
nternal Filter Type   Capacitive   Capacitive   nput current		None install sub-markfure	١.১		1.32			
put current         Nin = nominal         0.68         0.70         A           Full Lasd Current Conditions         Vin = nominal         0.92         0.95         A           Low Line Input Current         Vin = 48V.         0.05         0.11         mA           Short Gircuit Input Current.         0.05         0.1         mA           No Laad Input Current         Iout = minimum, unit=ON         20         40         mA           No Laad Input Current (UT, UV, OT)         1         3         mA           Reletede (back) ripple current (WI, UV, OT)         1         3         mA           Reletede (back) ripple current (WI, UV, OT)         1         3         mA           GENERAL and SAFETY         Vin=48V         90         92         %           Gistation         Vin=36V         89         91         %         %           Isolation Voltage, Input to Output         1500         V/dc         MO         %           Isolation Resistance         100         MO         MO         %           Isolation Capacitance         100         MO         MO         %           Starbut Time         Poer Folcordia RSR23, Issue 1, Class 3, ground fixed, Tambient=+25°C         TBD         Hours x 10		None, install external tuse				Vac		
Full Lad Current Conditions         Vin = ominial         0.68         0.70         A           Low Line Input Current         Vin = minimum         0.92         0.95         A           Inrush Transitent         Vin = 48V.         0.05         A2-Sec.           Shot Circuit Input Current.         0.01         mA           No Load Input Current.         0.05         0.1         mA           Shutdown Mode Input Current (Off, UV, OT)         1         3         mA           Attered (back) ripple current (2)         Measured at input with specified filter         30         mA, Pk-pi           GENERAL and SAFETY         Vin=48V         90         92         %           Solation         Vin=48V         90         92         %           Isolation Resistance         1500         Vin         Wdc           Isolation Resistance         1600         MC         MC           Isolation Resistance         100%         MC         MC           Isolation Resistance         100         MC				Lapacitive				
Low Line Input Current         Vin = minimum         0.92         0.95         A           Inrush Transient         Vin = 48V.         0.05         0.1         M2-Sec.           Short Circuit Input Current.         0.05         0.1         mA           No Load Input Current (M1, UV, OT)         1         3         mA           Shuddown Mode Input Current (M1, UV, OT)         1         3         mA           Kellected (back) ripple current (W1, UV, OT)         1         3         mA           Kellected (back) ripple current (W1, UV, OT)         Win=48V         90         92         %           Generation         30         mA/pk-pi         90         92         %           Generation         1500         Measured at input with specified filter         30         Vdc           Insulation Safety Rating         1500         Mo         Vdc         Mo           Isolation Capacitance         100         MO         MO         Safety         Mc           Isolation Capacitance         Per Telecordia SR323; issue 1, class 3; ground fixed, Tambient=+25°C         TBD         Hours x 10           VYAMMIC CHARACITERISTICS         Safety Time         Power On, to Vout regulation band, 100% messive load         6         30         mS		Was as the		0.00	0.70			
Inrush Transient         Vin = 48V.         0.05         A2-Sec.           Short Circuit Input Current.         Iout = minimum, unit=0N         20         40         mA           No Load Input Current (0ff, UV, 0T)         Iout = minimum, unit=0N         20         40         mA           Shutdown Mode Input Current (0ff, UV, 0T)         Measured at input with specified filter         30         mA, pk-pl           GENETRAL and SAFETY         Measured at input with specified filter         30         mA, pk-pl           GENETRAL and SAFETY         Vin=48V         90         92         %           Solation         Vin=56V         89         91         %           Isolation Notage, Input to Output         1500         Vin=56V         %           Isolation Capacitance         100         MΩ         MΩ           Isolation Resistance         100         MΩ         MΩ								
Short Circuit Input Current.         0.05         0.1         mA           No Load Input Current         Iout = minimum, unit=0N         20         40         mA           Shutdown Mode linput Current (Off, UV, OT)         1         3         mA, pk-pl           GENERAL and SAFETY         Measured at input with specified filter         30         mA, pk-pl           GENERAL and SAFETY         Vin=48V         90         92         %           Generation         Vin=36V         89         91         %           Isolation Voltage, Input to Output         1500         Vin=36V         %           Insulation Safety Rating         basic         Measured at input with specified filter         Vin=48V         90         92         %           Insulation Safety Rating         1500         Measured         %         Solation         Vin=36V         %           Isolation Resistance         100         MO(0         MO(0)         Measured at input kinsts, spread at input k					0.95			
No Load Input Current     lout = minimum, unit=0N     20     40     mA       Shutdown Mode Input Current (Off, UV, OT)     Measured at input with specified filter     1     3     mA       Shutdown Mode Input Current (Off, UV, OT)     Measured at input with specified filter     30     mA, pk-pi       GENERAL and SAFETY     Vin=48V     90     92     %       officiency     Vin=48V     90     92     %       solation     Insulation Safety Rating     %     %       Isolation Resistance     100     MC     MC       Isolation Resistance     100     MC     MC       Isolation Resistance     100     MC     MC       Safety     UL-60950-1, CSA-C22.2 No.60950-1, IEC/60960-1, and edition     Yes     Mc       Safety     UL-60950-1, CSA-C22.2 No.60950-1, IEC/60960-1, CSA-C22.2 No.60950-1, IEC/60960-1, and edition     Mc     Mc       Safety     Der Telocrofia BR32, Issue 1, class 3, ground fixed, Tambient=+25°C     TBD     Hours x 10       Dynamic Load Response     50-75-60% load		Vin = 48V.						
Shutdown Mode Input Current (Off, UV, OT)         1         3         mA           Ieffected (back) ripple current @         Measured at input with specified filter         30         mA, pk-pl           GENERAL and SAFETY         30         MA, pk-pl           Generation Safety Rating         90         92         %           solation         88         91         %           Insulation Safety Rating         1500         Vic         %           Isolation Voitage, Input to Output         100         MAO         MAO           Isolation Safety Rating         100         MAO         MAO           Isolation Capacitance         1100         MAO         MAO           Isolation Fiestance         1000         MAO         MAO           CVMAMIC CHARACTERISTICS         Yes         Wesset         Wesset           Startup Time         Power On, to Vout regulation band, 100% resistive load         6         30         mS           Startup Time         Remote ON to Vout Regulated         12         30         mS           Vynamic Load Response         50-75-50% load step to 1% error band         100         150         µSec           Vynamic Load Response         50-75-50% load step to 1% error band         100         150	•							
Instruction       Measured at input with specified filter       30       mA, pk-pl         GENERAL and SAFETY       Vin=48V       90       92       %         ifficiency       Vin=48V       90       92       %         solation       Vin=36V       89       91       %         solation Outage, Input to Output       1500       Vin=36V       89       91       %         Isolation Notage, Input to Output       1500       basic       Vin=36V       %         Isolation Outage, Input to Output       100       MO       MO       MO         Isolation Resistance       100       MO       MO </td <td></td> <td>lout = minimum, unit=0N</td> <td></td> <td></td> <td></td> <td></td>		lout = minimum, unit=0N						
GENERAL and SAFETY         Vin=48V         90         92         %           Efficiency         Vin=36V         89         91         %           solation         1solation Safety Rating         1500         Vdc           Isolation Safety Rating         1500         Vdc           Isolation Capacitance         100         MΩ           Isolation Capacitance         100         MΩ           Safety         UL-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, 2nd edition         Yes           Safety         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C         TBD         Hours x 10           DVNAMIC CHARACTERISTICS         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C         TBD         Hours x 10           Startup Time         Power On, to Vout regulation band, 100% resistive load         6         30         mS           Startup Time         Remote ON to Vout Regulated         12         30         mS           Vynamic Load Peak Deviation same as above         ±150         ±250         mV           FEATURES and OPTIONS         Semete On/Off Control ®         15         Vdc           N* suffix         ON = pin open or external voltage         10         15         Vdc           Negative Logic, OFF state	• • • • • •				3			
Vin=48V         90         92         %           Vin=36V         89         91         %           solation          89         91         %           solation Voltage, Input to Output          1500         Vdc         %           Insulation Safety Rating          1500         Vdc         Vdc           Isolation Resistance          100         MQ         isolation Capacitance          MQ           Safety         UL-60950-1, CSA-C22.2 No.60950-1, and edition         Yes          Feer Eleccreation (EcGe050-1, 2nd edition (EcGe050-1, 2nd edition fixed, Tambient=+25°C         Yes         Hours x 10           DVNAMIC CHARACTERISTICS         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C         TBD         Hours x 10           DVNAMIC CHARACTERISTICS         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C         TBD         Hours x 10           Startup Time         Power On, to Vout regulation band, 100% (resistive load         6         30         mS           Startup Time         Remote ON to Vout Regulated         12         30         mS           Dynamic Load Response         50-75-50% load step to 1% error band         100         150         µSec           Time GOVICO	Reflected (back) ripple current ②	Measured at input with specified filter		30		mA, pk-pk		
Interface         Vin=36V         89         91         %           solation	GENERAL and SAFETY							
Vin=stov         89         91         %           solation         isolation Voltage, Input to Output         1500         Vdc           Insulation Safety Rating         1500         basic         Vdc           Isolation Resistance         100         MΩ         1600         PF           Isolation Capacitance         100         MΩ         1600         PF           Safety         UL-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, 2nd edition         Yes          Mours x10           Safety         UL-60950-1, 2nd edition         Yes          Hours x10           CharacterRISTICS         Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C         TBD         Hours x10           DYNAMIC CHARACTERISTICS         Yes          Hours x10           cds witching Frequency         Power On, to Vout regulation band, 100% resistue load         6         30         mS           startup Time         Remote ON to Vout Regulated         12         30         mS           startup Time         Remote ON to Vout Regulated         100         150         µSec           Tynamic Load Response         50-75-50% load step to 1% error band         100         150         µSec           The Safet Load Response         50-75	Efficiency							
Isolation Voltage, Input to Output       1500       Vdc         Insulation Safety Rating       0       basic       0         Isolation Resistance       100       MΩ         Isolation Capacitance       1000       MΩ         Safety       UL-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, and edition       Yes       PF         Safety       UL-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, and edition       Yes       Hours x 10         Control CHARACTERISTICS       TBD       Hours x 10         DYNAMIC CHARACTERISTICS       70       300       330       KHz         Startup Time       Power On, to Vout regulation band, 100% resistive load       6       30       mS         Startup Time       Remote ON to Vout Regulated       12       30       mS         Oynamic Load Response       50-75-50% load step to 1% error band       100       150       µSec         Oynamic Load Peak Deviation       same as above       ±150       ±250       mV         FEATURES and OPTIONS       Vdc       Ns uffix       N       N         Negative Logic, OFF state       OFF = pin open or external voltage       10       15       Vdc         Control Current       open collector/drain       1       mA       MA	-	Vin=36V	89	91		%		
Insulation Safety RatingbasicMIsolation Resistance100MΩIsolation Capacitance1600 $PF$ SafetyUL-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, 2nd editionYesCalculated MTBF ③Per Telocridia SR332, issue 1, class 3, ground fixed, Tambient=+25°CTBDHours x 10DYNAMIC CHARACTERISTICSFrequency0270300330KHzStartup TimePower On, to Vout regulation band, 100% resistive load630mSStartup TimeStartup TimeRemote ON to Vout Regulated1230mSysecOynamic Load Response50-75-50% load step to 1% error band1000150ySecOynamic Load Peak Deviation same as above $\pm 150$ $\pm 250$ mVFEATURES and OPTIONSVersitive Logic, ON stateON = pin grounded or external voltage-0.70.9VdcVdc Negative Logic, OFF stateON = pin open or external voltage1015VdcPositive Logic, OFF stateON = pin open or external voltage1015VdcPositive Logic, OFF stateON = pin open or external voltage1015VPositive Logic, OFF stateOFF = ground pin or external voltage1015VPositive Logic, OFF stateOFF = ground pin or external voltage1015VPositive Logic, OFF stateOFF = ground pin or external voltage0.70.9V <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
Isolation Resistance       100       MΩ         Isolation Capacitance       0L-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, 2nd edition       Yes       Per         Calculated MTBF ®       Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C       TBD       Hours x 10         DYNAMIC CHARACTERISTICS       TBD       Hours x 10         iced Switching Frequency       270       300       330       KHz         Startup Time       Power On, to Vout regulation band, 100% resistive load       6       30       mS         Startup Time       Remote ON to Vout Regulated       12       30       mS         Oynamic Load Response       50-75-50% load step to 1% error band       100       150       µSec         Oynamic Load Peak Deviation       same as above       ±150       ±250       mV         FEATURES and OPTIONS       ************************************	Isolation Voltage, Input to Output		1500			Vdc		
Isolation Capacitance       1600       pF         Safety       UL-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, 2nd edition       Yes          Calculated MTBF (*)       Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C       TBD       Hours x 10         DYNAMIC CHARACTERISTICS       ************************************	Insulation Safety Rating			basic				
Safety     UL-60950-1, CSA-C22.2 No.60950-1, IEC/60950-1, 2nd edition     Yes       Calculated MTBF (a)     Per Teloordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C     TBD     Hours x 10       DYNAMIC CHARACTERISTICS     TBD     Hours x 10       Fixed Switching Frequency     270     300     330     KHz       Startup Time     Power On, to Vout regulation band, 100% resistive load     6     30     mS       Startup Time     Remote ON to Vout Regulated     12     30     mS       Dynamic Load Response     50-75-50% load step to 1% error band     100     150     µSec       Dynamic Load Peak Deviation     same as above     ±150     ±250     mV       FEATURES and OPTIONS     Features     0N = pin grounded or external voltage     10     15     Vdc       Negative Logic, OFF state     OFF = pin open or external voltage     10     15     Vdc       Control Current     open collector/drain     1     mA       P <sup>m</sup> suffix     Postive Logic, OFF state     ON = pin open or external voltage     10     15     V       Positive Logic, OFF state     ON = pin open or external voltage     10     15     V	Isolation Resistance							
sarety       IEC/60950-1, 2nd edition       Yes         Calculated MTBF (a)       Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient=+25°C       TBD       Hours x 10         DYNAMIC CHARACTERISTICS       TBD       KHz         Startup Time       Power On, to Vout regulation band, 100% resistive load       6       30       mS         Startup Time       Remote ON to Vout Regulated       12       30       mS         Oynamic Load Response       50-75-50% load step to 1% error band       100       150       µSec         Oynamic Load Response       50-75-50% load step to 1% error band       100       150       µSec         Oynamic Load Response       50-75-50% load step to 1% error band       100       150       µSec         Oynamic Load Response       50-75-50% load step to 1% error band       100       150       µSec         Wr EFATURES and OPTIONS       #EATURES and OPTIONS       #150       ±250       mV         Wr suffix       ON = pin grounded or external voltage       -0.7       0.9       Vdc         Negative Logic, OFF state       OFF = pin open or external voltage       10       15       Vdc         Control Current       0pen collector/drain       1       mA       Positive Logic, OFF state       0FF = ground pin or external voltage	Isolation Capacitance			1600		pF		
Interview         Interview <thinterview< th="">         Interview         <thinterview< th="">         Interview         <thinterview< th=""> <thinterview< th=""> <thint< td=""><td>Safaty</td><td></td><td></td><td>Vac</td><td></td><td></td></thint<></thinterview<></thinterview<></thinterview<></thinterview<>	Safaty			Vac				
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Power On, to Vout regulation band, 100% resistive load         6         30         mS           Startup Time         Remote ON to Vout Regulated         12         30         mS           Dynamic Load Response         50-75-50% load step to 1% error band         100         150         µSec           Dynamic Load Response         50-75-50% load step to 1% error band         100         150         µSec           Dynamic Load Peak Deviation         same as above         ±150         ±250         mV           FEATURES and OPTIONS         same as above         ±150         ±250         mV           Remote On/Off Control ©         "N" suffix  <	DYNAMIC CHARACTERISTICS							
Power On, to Vout regulation band, 100% resistive load         6         30         mS           Startup Time         Remote ON to Vout Regulated         12         30         mS           Startup Time         Remote ON to Vout Regulated         12         30         mS           Dynamic Load Response         50-75-50% load step to 1% error band         100         150         µSec           Dynamic Load Peak Deviation         same as above         ±150         ±250         mV           FEATURES and OPTIONS         FEATURES and OPTIONS         ####################################	Fixed Switching Frequency		270	300	330	KHz		
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Dynamic Load Response         50-75-50% load step to 1% error band         100         150         µSec           Dynamic Load Peak Deviation         same as above         ±150         ±250         mV           FEATURES and OPTIONS           Remote On/Off Control ®           'N" suffix           Negative Logic, ON state         ON = pin grounded or external voltage         -0.7         0.9         Vdc           Negative Logic, OFF state         OFF = pin open or external voltage         10         15         Vdc           Open collector/drain         1         mA           'P" suffix           Positive Logic, ON state         ON = pin open or external voltage         10         15         Vdc           Positive Logic, ON state         ON = pin open or external voltage         10         15         V           Positive Logic, ON state         ON = pin open or external voltage         10         15         V           Positive Logic, OFF state         OFF = ground pin or external voltage         -0.7         0.9         V		100% resistive load				1		
Dynamic Load Peak Deviation         same as above         ±150         ±250         mV           FEATURES and OPTIONS           Remote On/Off Control ©           'N" suffix           Negative Logic, ON state         ON = pin grounded or external voltage         -0.7         0.9         Vdc           Negative Logic, OFF state         OFF = pin open or external voltage         10         15         Vdc           Control Current         open collector/drain         1         mA           'P" suffix           Positive Logic, ON state         ON = pin open or external voltage         10         15         V           Positive Logic, OFF state         ON = pin open or external voltage         10         15         V	•			12	30	mS		
FEATURES and OPTIONS         Remote On/Off Control (6)         'N" suffix         Negative Logic, ON state       ON = pin grounded or external voltage       -0.7       0.9       Vdc         Negative Logic, OFF state       OFF = pin open or external voltage       10       15       Vdc         Control Current       open collector/drain       1       mA         'P" suffix	Startup Time	Remote ON to Vout Regulated						
Remote On/Off Control ©         'N" suffix       Negative Logic, ON state       ON = pin grounded or external voltage       -0.7       0.9       Vdc         Negative Logic, OFF state       OFF = pin open or external voltage       10       15       Vdc         Control Current       open collector/drain       1       mA         '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       -0.7       0.9       V	Startup Time Dynamic Load Response	Remote ON to Vout Regulated 50-75-50% load step to 1% error band		100	150	µSec		
N" suffix           Negative Logic, ON state         ON = pin grounded or external voltage         -0.7         0.9         Vdc           Negative Logic, OFF state         OFF = pin open or external voltage         10         15         Vdc           Control Current         open collector/drain         1         mA           'P" suffix         ON = pin open or external voltage         10         15         V           Positive Logic, ON state         ON = pin open or external voltage         10         15         V           Positive Logic, OFF state         OFF = ground pin or external voltage         -0.7         0.9         V	Startup Time Dynamic Load Response Dynamic Load Peak Deviation	Remote ON to Vout Regulated 50-75-50% load step to 1% error band		100	150	µSec		
Negative Logic, ON state         ON = pin grounded or external voltage         -0.7         0.9         Vdc           Negative Logic, OFF state         OFF = pin open or external voltage         10         15         Vdc           Control Current         open collector/drain         1         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         10         15         V	Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS	Remote ON to Vout Regulated 50-75-50% load step to 1% error band		100	150	µSec		
Negative Logic, OFF state         OFF = pin open or external voltage         10         15         Vdc           Control Current         open collector/drain         1         mA           'P" suffix         ON = pin open or external voltage         10         15         Vdc           Positive Logic, ON state         ON = pin open or external voltage         10         15         V           Positive Logic, OFF state         OFF = ground pin or external voltage         -0.7         0.9         V	Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control ©	Remote ON to Vout Regulated 50-75-50% load step to 1% error band		100	150	µSec		
Control Current         open collector/drain         1         mA           'P" suffix         Positive Logic, ON state         0N = pin open or external voltage         10         15         V           Positive Logic, OFF state         OFF = ground pin or external voltage         -0.7         0.9         V	Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © 'N" suffix	Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above	07	100	150 ±250	μSec mV		
'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         -0.7         0.9         V	Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © 'N" suffix Negative Logic, ON state	Remote ON to Vout Regulated 50-75-50% load step to 1% error band same as above ON = pin grounded or external voltage		100	150 ±250	μSec mV Vdc		
Positive Logic, ON state         ON = pin open or external voltage         10         15         V           Positive Logic, OFF state         OFF = ground pin or external voltage         -0.7         0.9         V	Startup Time Dynamic Load Response Dynamic Load Peak Deviation FEATURES and OPTIONS Remote On/Off Control © 'N" suffix Negative Logic, ON state Negative Logic, OFF state	Remote ON to Vout Regulated         50-75-50% load step to 1% error band         same as above         ON = pin grounded or external voltage         OFF = pin open or external voltage		100 ±150	150 ±250	μSec mV Vdc Vdc		
Positive Logic, OFF state         OFF = ground pin or external voltage         -0.7         0.9         V	Startup Time 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	Remote ON to Vout Regulated         50-75-50% load step to 1% error band         same as above         ON = pin grounded or external voltage         OFF = pin open or external voltage		100 ±150	150 ±250	μSec mV Vdc Vdc		
	Startup Time 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	Remote ON to Vout Regulated         50-75-50% load step to 1% error band         same as above         ON = pin grounded or external voltage         OFF = pin open or external voltage         open collector/drain	10	100 ±150	150 ±250 0.9 15	μSec mV Vdc Vdc mA		
Control Current         open collector/drain         1         mA	Startup Time 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	Remote ON to Vout Regulated         50-75-50% load step to 1% error band         same as above         ON = pin grounded or external voltage         OFF = pin open or external voltage         open collector/drain         ON = pin open or external voltage	10	100 ±150	150 ±250 0.9 15 15	μSec mV Vdc Vdc MA		
	Startup Time 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	Remote ON to Vout Regulated         50-75-50% load step to 1% error band         same as above         ON = pin grounded or external voltage         OFF = pin open or external voltage         open collector/drain         ON = pin open or external voltage	10	100 ±150	150 ±250 0.9 15 15	μSec mV Vdc Vdc MA		

# **ULT Series**

### Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range

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

OUTPUT	Conditions ①	Minimum	Typical/Nominal	Maximum	Units
Total Output Power		0	30	30.3	W
Voltage	1		-		
Nominal Output Voltage		11.88	12	12.12	Vdc
Setting Accuracy	At 50% load	-1		1	% of Vo nom
Output Trim Range ®	User selectable (see trim formulas)	-20		10	% of Vout
Overvoltage Protection		13.3	15	18	Vdc
Current	1				
Output Current Range		0	2.5	2.5	A
Minimum Load	no minimal load required				
Current Limit Inception (9)	98% of Vnom., after warmup	2.65	3.55	4.3	A
Short Circuit			- I		
Short Circuit Current	Hiccup technique, autorecovery within ±1.25% of Vout		0.4		А
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Hiccup current limiting		Non-latching		
Regulation ⑦					
Line Regulation	Vin=min. to max., Vout=nom., full load			±0.075	% of Vout
Load Regulation	lout=min. to max., Vin=nom.			±0.125	% of Vout
Ripple and Noise <sup>(1)</sup>	Tested with 4x47uF output caps.		70	100	mV pk-pk
Temperature Coefficient	At all outputs		0.02		% of Vout./°C
Maximum Capacitive Loading	Full resistive load, low ESR	200		2,200	μF
Remote Sense Compliance	Vsense = Vout - Vload, sense connected at load			10	% of Vout
MECHANICAL (Through Hole Models)	Conditions ① ③	Minimum	Typical/Nominal	Maximum	Units
Outline Dimensions			0.92 x 0.75 x 0.35		Inches
(Please refer to outline drawing)	LxWxH		23.4x19.05x8.89		mm
Weight			0.32		Ounces
			9.07		Grams
Through Hole Pin Diameter			.04 & .062		Inches
			1.02 & 1.57		mm
Through Hole Pin Material			Brass		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		3-5		µ-inches
ENVIRONMENTAL		40		05	00
Operating Ambient Temperature Range (1)	See derating curves	-40		85	<u> </u>
Storage Temperature	Vin = Zero (no power)	-55	100	125	0° 0°
Thermal Protection/Shutdown	External filter is required	120	130	140	<u>َ</u> نَ
Electromagnetic Interference	External filter is required			D	Class
Conducted, EN55022/CISPR22			DollC C	В	Class
RoHS rating			RoHS-6		

# **ULT Series**

### Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range

#### **Performance Specification Notes**

① All specifications are typical unless noted. Ambient temperature =  $+25^{\circ}$ Celsius, V<sub>IN</sub> is nominal, output current is maximum rated nominal. External output capacitance consists of 400µF capacitors across output pins; one 33µF low ESR, and three 1µF external input capacitors. All caps are low ESR.

Testing must be kept short enough that the converter does not appreciably heat up during testing. For extended testing, use plenty of airflow. See derating curves for temperature performance. All models are stable and regulate within spec without external cacacitance.

- ② Input Ripple Current is tested and specified over a 5-20 MHz bandwidth and uses a special set of external filters only for the Ripple Current specifications. Input filtering is C<sub>IN</sub> = 33 µF, C<sub>BUS</sub> = 220 µF, L<sub>BUS</sub> = 12 µH. Use capacitor rated voltages which are twice the maximum expected voltage. Capacitors must accept high speed AC switching currents.
- ③ Note that Maximum Current Derating Curves indicate an average current at nominal input voltage. At higher temperatures and/or lower airflow, the converter will tolerate brief full current outputs if the average RMS current over time does not exceed the Derating curve. All Derating curves are presented at sea level altitude. Be aware of reduced power dissipation with increasing density altitude.
- ④ Mean Time Before Failure (MTBF) is calculated using the Telcordia (Belcore) SR-332 Method 1, Case 3, Issue 1, ground fixed conditions. Operating temperature = +25°C, full output load, natural air convection.
- ⑤ The output may be shorted to ground indefinitely with no damage. The Output Short Circuit Current shown in the specifications is an average consisting of very short bursts of full rated current to test whether the output circuit can be repowered.
- ⑥ The On/Off pin allows the converter to be turned on or off by an external device such as a switch, a transistor, a logic gate, or an optical isolator. If the "logic pin" is left floating the measured voltage will be outside the limit's in the data sheet. Those numbers define the levels needed for the "control function" to take place and do not represent the voltage that may be present on the logic pin.

- Regulation specifications describe the deviation as the input line voltage or output load current is varied from a nominal midpoint value to either extreme (50% load).
- ⑧ Do not exceed maximum power ratings, sense limits or output overvoltage when adjusting output trim values.
- ③ Output overload protection is non-latching. When the output overload is removed, the output will automatically recover.
- In All models are fully operational and meet published specifications, including "cold start" at -40°C.
- ① The converter will shut off if the input falls below the undervoltage threshold. It will not restart until the input exceeds the Input Start Up Voltage.
- Output noise may be further reduced by installing an external filter. See the Application Notes. Use only as much output filtering as needed <u>and no</u> <u>more</u>. Larger caps (especially low-ESR ceramic types) may slow transient response or degrade dynamic performance. Thoroughly test your application with all components installed.
- If reverse polarity is accidentally applied to the input, always connect an external fast blow input fuse in series with the +ViN input.
- Although extremely unlikely, failure of the internal components of this product may expose external application circuits to dangerous voltages, currents, temperatures or power levels. Please thoroughly verify all applications before committing them to service. Be sure to include appropriately rated FUSES (see specifications and Application Notes) to reduce the risk of failure.
- (9) Special care should be exercised so that Input Voltage Transient does not exceed specified Max 100V/100ms. At normal input a large transient spike can be generated as a result of distribution inductance and high inrush current charging input cap on converter. This can be eliminated with 33µF electrolytic capacitor mounted close to Converter input. The series resistance (500m $\Omega$  < ESR < 700m $\Omega$ ) is essential in this solution.

# **ULT Series**

### Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range



www.murata-ps.com/support

## **ULT Series**

### Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range



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## **ULT Series**





## **ULT Series**



## **ULT Series**





## **ULT Series**

Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range

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



49 UNITS PER TRAY 2 TRAYS PER CARTON

MPQ=98 UNITS

## **ULT Series**

Thirty-Second-Brick Isolated DC/DC Converters with 2:1 Wide Input Range



Tolerances (unless otherwise specified): .XX  $\pm$  0.02 (0.5) .XXX  $\pm$  0.010 (0.25) Angles  $\pm$  1°

Components are shown for reference only.

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#### **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 Murata Power Solutions' ULT 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.

#### **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 ULT 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 ULT 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 ULT 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 (CIN 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**

ULT 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.

Model	Tested with	Maximum Capacitance Loading
ULT-3.3/7.5-D48	Four 100µF output capacitors & Three 1µF and 33µF (low ESR) external input capacitors	5000µF
ULT-5/5-D48	Four 100µF output capacitors & Three 1µF and 33µF (low ESR) external input capacitors	5000µF
ULT-12/2.5-D48	Four $47\mu$ F output capacitors & three $1\mu$ F and $33\mu$ F (low ESR) external input capacitors.	2200µF

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LOAD 2-3 INCHES (51-76mm) FROM MODULE \*The ULT-12/2.5-D48 model is tested with 47µF output caps Figure 3. Measuring Output Ripple/Noise (PARD)

#### **Thermal Shutdown**

The ULT 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 inside the PWM (see U1 in figure 4) 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.



Figure 4. Thermal Shutdown

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

The ULT 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.

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#### **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 ULT Series is capable of enduring an indefinite short circuit output condition.

#### **Remote Sense**

**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  $+V_{OUT}$  and -Sense to  $-V_{OUT}$  at the DC/DC converter pins. ULT 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 Vour 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



Figure 5. Remote Sense Circuit Configuration

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#### **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 (-0.7 to 0.9V with respect to –Input).

**Negative** ("N" suffix) logic devices are off when pin is left open (or pulled high, applying +10V to +15V), and on when pin is pulled low (-0.7 to +0.9V) with respect to -Input.

NOTE: Please refer to the Functional Specs for each specific ULT model.

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.

#### **OUTPUT VOLTAGE ADJUSTMENT**

#### **Trim Equations**

Adjustable output voltage pin. If the Trim pin is left open circuit the output voltage is set to Vo nom. Adjustment by means of the external resistor must be possible to achieve an output voltage of Vo nom. +10% or -20%.

Connecting an external resistor between the TRIM pin and the –Sense pin decreases the output voltage set point. The following equation determines the required external resistor value to obtain a percentage output voltage change of  $\Delta$ %:

Rtrim-down =  $[(511/\Delta\%) - 10.22]$  K $\Omega$ 

Where:

 $\Delta\% = [(Vo set - Vdesired) / Vo set] \times 100$ 

Connecting an external resistor between the TRIM pin and the +Sense pin increases the output voltage set point. The following equation determines the required external resistor value to obtain a percentage output voltage change of  $\Delta$ %:

Rtrim-up =  $[5.11 \text{ x Vo set x } (100 + \Delta\%) / (1.225 \text{ x } \Delta\%) - (511 / \Delta\%) - 10.22]$  KΩ

Where:

 $\Delta\% = [(Vdesired - Vo set) / Vo set] \times 100$ 

To maintain set point accuracy, the trim resistor tolerance should be at least  $\pm \ 1.0\%$ 



Figure 6. Driving the Negative Logic On/Off Control Pin (simplified circuit)



Figure 7. Trim Connections To Increase Output Voltages

Connect sense to its respective Vout pin if sense is not used with a remote load.



Figure 8. Trim Connections To Decrease Output Voltages

### **IR Transparent** optical window Variable Unit under speed fan test (UUT) IR Video Camera Heating element Precision low-rate anemometer 3" below UUT Ambient temperature sensor Airflow collimator

Figure 9. Vertical Wind Tunnel

#### **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				

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#### **Vertical Wind Tunnel**

Murata Power Solutions employs a computer controlled customdesigned 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 10"  $\times$  10" 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.

#### **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.



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/