DATEL®
INNOVATION and EXCELLENCE

A - S E R I E S

Triple Output
A-Series, TWR Models

High-Reliability, Power-Sharing 20 Watt, DC/DC Converters

Features

- **Low cost! Highly reliable!**
- **Full 20 Watts output power**
- **Power "user-allocated" among outputs**
- **Proven SMT-on-pcb construction**
- **Qual tested; HALT tested; EMC tested**
- **Output voltages: +5V/±12V or +5V/±15V**
- **Ultra-wide input voltage ranges: 9-36V or 18-75V**
- **Designed to meet UL1950 and EN60950 (basic insulation)**
- **CE mark available (75V-input models)**
- **Small packages, 2" x 2" x 0.45"**
- **Fully isolated, 1500Vdc guaranteed**
- **Guaranteed efficiencies to 82%**
- **–40 to +100°C operating temperature**
- **Modifications and customs for OEM's**

Among the three families of triple-output DC/DC converters in DATEL's new A-Series, the 20W 2" x 2" devices are distinguished by their unique "power-sharing" architecture. This feature enables devices to deliver the full 20 Watts of output power under a variety of output-loading conditions. Each unit's primary +5V output can source any current up to 3 Amps (primary power = 15W); while its auxiliary ±12/15V outputs can source currents up to ±500mA (auxiliary power = 12/15W). Devices deliver any combination of primary plus auxiliary power as long as the total output power does not exceed 20 Watts. This feature enables designers to select a single device to fulfill any number of different requirements.

As members of DATEL's new A-Series, the 20W triples exhibit both low cost and outstanding long-term reliability. Their design combines straightforward circuit topologies, the newest components, proven SMT-on-pcb construction methods, and highly repeatable automatic-assembly techniques. Their superior durability is substantiated by a rigorous in-house qualification program that includes HALT (Highly Accelerated Life Testing).

Each device has a +5V primary output and either ±12V or ±15V auxiliary outputs. "D12A" models achieve fully rated performance with inputs ranging from 9 to 36 Volts. "D48A" models operate over an input range of 18-75 Volts.

These full-featured triples have non-latching output current limiting, input overvoltage shutdown, input reverse-polarity protection, and output overvoltage clamping to protect both the power converters and their loads.

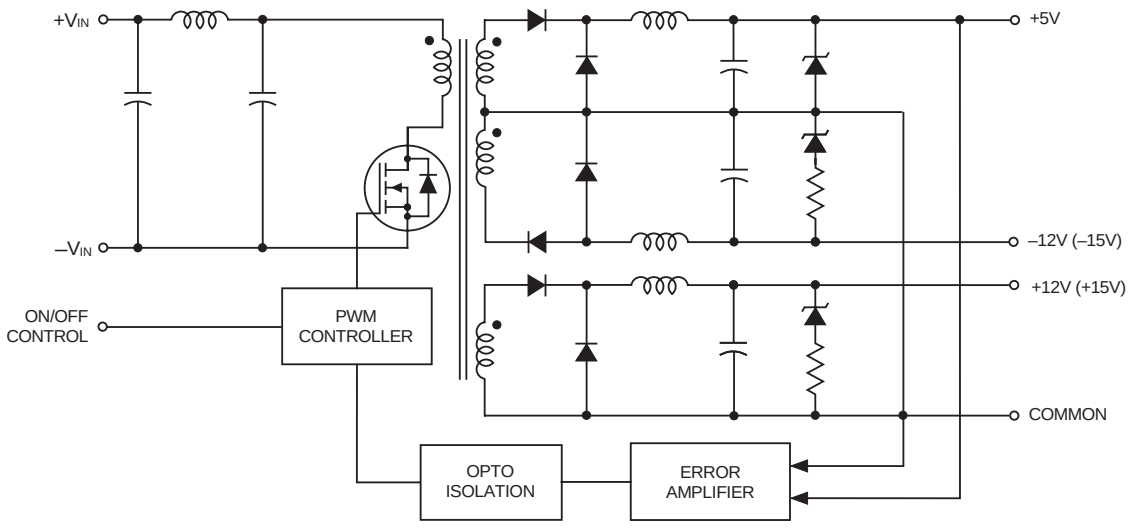


Figure 1. Simplified Schematic

Performance Specifications and Ordering Guide ①

Model	Output						Input			Efficiency		Package (Case, Pinout)
	V_{OUT} (Volts)	I_{OUT} (mA)	R/N (mVp-p) ②		Regulation (Max.)		V_{IN} Nom. (Volts)	Range (Volts)	I_{IN} ④ (mA)	Min.	Typ.	
			Typ.	Max.	Line	Load ③						
TWR-5/3000-12/500-D12A	+5	3000	50	100	±1.0%	±2.0%	24	9-36	75/1118	81%	82%	C4, P13
	±12	±500	75	125	±1.0%	±5.0%						
TWR-5/3000-12/500-D48A	+5	3000	50	100	±1.0%	±2.0%	48	18-75	40/559	82%	83%	C4, P13
	±12	±500	75	125	±1.0%	±5.0%						
TWR-5/3000-15/500-D12A	+5	3000	50	100	±1.0%	±2.0%	24	9-36	75/1118	81%	82%	C4, P13
	±15	±500	75	150	±1.0%	±5.0%						
TWR-5/3000-15/500-D48A	+5	3000	50	100	±1.0%	±2.0%	48	18-75	40/559	81%	82%	C4, P13
	±15	±500	75	150	±1.0%	±5.0%						

① Typical @ T_A = +25°C under nominal line voltage and full-load conditions unless otherwise noted. For testing and specification purposes, "full load" is defined as 2.75A on the primary +5V output and ±250/200mA on the auxiliary ±12/15V outputs. This corresponds to a total output power of 19.75W.
② Ripple/Noise (R/N) measured over a 20MHz bandwidth.
③ For the +5V output, listed spec applies over the 10% to 100% load range. For the ±12/15V outputs, listed spec applies for balanced loads over the 20% to 100% load range.
④ Nominal line voltage, no-load/full-load conditions.

PART NUMBER STRUCTURE

T WR - 5 / 3000 - 15 / 500 - D48 A

Output Configuration: **T** = Triple

Wide Range Input

Nominal Primary Output Voltage (+5 Volts)

Maximum Primary Output Current in mA

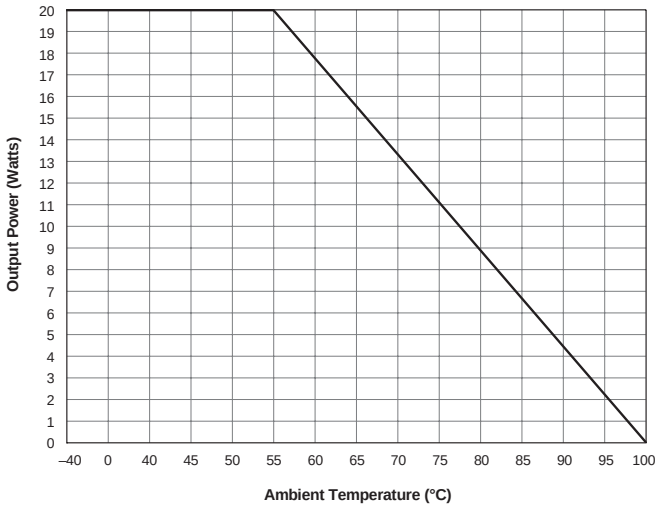
Nominal Auxiliary Output Voltages (±12 or ±15 Volts)

Maximum Auxiliary Output Currents in mA from each output

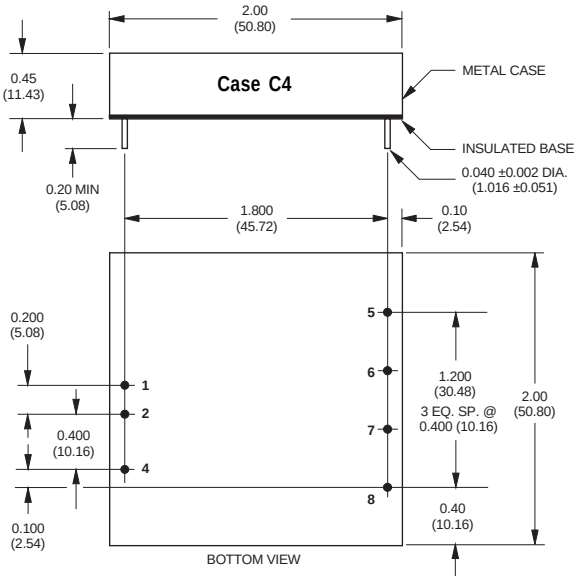
Input Voltage Range: **D12** = 9-36 Volts (24V nominal) **D48** = 18-75 Volts (48V nominal)

A-Series High Reliability

TEMPERATURE DERATING



MECHANICAL SPECIFICATIONS



I/O Connections	
Pin	Function P13
1	+Input
2	–Input
3	No Pin
4	On/Off Control
5	+12V/15V Out
6	+5V Out
7	Common
8	–12V/15V Out

Notes:

For "D12A" models, the case is connected to pin 2 ($-V_{IN}$).

For "D48A" models, the case is connected to pin 1 ($+V_{IN}$).

Performance/Functional Specifications

Typical @ T_A = +25°C under nominal line voltage and "full-load" conditions, unless noted. ①

Input	
Input Voltage Range:	
"D12A" Models	9-36 Volts (24V nominal)
"D48A" Models	18-75 Volts (48V nominal)
Input Current	See Ordering Guide
Input Filter Type ②	Pi
Overvoltage Shutdown:	
"D12A" Models	40 Volts
"D48A" Models	80 Volts
Reverse-Polarity Protection	Yes (Instantaneous, 6A maximum)
On/Off (Sync.) Control (Pin 4) ③	TTL high = off, low (or open) = on
Output	
V_{OUT} Accuracy (50% loads):	
+5V Output	±1%
±12V or ±15V Outputs	±3%
Temperature Coefficient	±0.02% per °C
Ripple/Noise (20MHz BW) ②	See Ordering Guide
Line/Load Regulation	See Ordering Guide
Efficiency	See Ordering Guide
Isolation Voltage ④	1500Vdc, minimum
Isolation Capacitance	500pF
Current Limiting	Auto-recovery
Overvoltage Protection	Zener/transorb clamps, magnetic feedback
Dynamic Characteristics	
Transient Response (50% load step)	300µsec max. to ±2% of final value
Switching Frequency	165kHz (±15kHz)
Environmental	
Operating Temperature (ambient):	
Without Derating	–40 to +55°C
With Derating	to +100°C (See Derating Curve)
Storage Temperature	–40 to +105°C
Physical	
Dimensions	2" x 2" x 0.45" (51 x 51 x 11.4mm)
Shielding	5-sided
Case Connections:	
"D12A" Models	Pin 2 ($-V_{IN}$)
"D48A" Models	Pin 1 ($+V_{IN}$)
Case Material	Corrosion resistant steel with non-conductive, epoxy-based, black enamel finish and plastic baseplate
Pin Material	Brass, solder coated
Weight	2.7 ounces (77 grams)

① These converters require 10% min. loading on their primary output and 20% min. loading on their auxiliary outputs to maintain specified regulation. Operation under no-load conditions will not damage the devices; however they may not meet all listed specifications. For testing and specification purposes, "full load" is defined as 2.75A on the primary +5V output and ±250/200mA on the auxiliary ±12/15V outputs. This corresponds to a total output power of 19.75W.

② Application-specific internal input/output filtering can be recommended or perhaps added internally upon request. Contact DATEL Applications Engineering for details.

③ Applying a voltage to the Control pin when no input power is applied to the converter can cause permanent damage to the converter.

④ Devices can be screened or modified for higher guaranteed isolation voltages. Contact DATEL Applications Engineering for details.

Absolute Maximum Ratings	
Input Voltage:	
"D12" Models	44 Volts
"D48" Models	88 Volts
Input Reverse-Polarity Protection	Current must be <6A. Brief duration only. Fusing recommended.
Output Overvoltage Protection	
+5V Output	6.8 Volts, limited duration
±12V Outputs	±15 Volts, limited duration
±15V Outputs	±18 Volts, limited duration
Output Current	Current limited. Max. currents are model dependent. Units can withstand a continuous output short on any output for 3 minutes.
Storage Temperature	–40 to +105°C
Lead Temperature (soldering, 10 sec.)	+300°C

These are stress ratings. Exposure of devices to any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied.

TECHNICAL NOTES

Filtering and Noise Reduction

All A-Series TWR 20 Watt DC/DC Converters achieve their rated ripple and noise specifications without the use of external input/output capacitors. In critical applications, input/output noise may be further reduced by installing electrolytic capacitors across the input terminals and/or low-ESR tantalum or electrolytic capacitors across the output terminals. Output capacitors should be connected between their respective output pin (pin 5, 6 or 8) and Common (pin 7). The caps should be located as close to the power converters as possible. Typical values are listed below. In many applications, using values greater than those listed will yield better results.

To Reduce Input Ripple

"D12A" Models	20µF, 50V
"D48A" Models	10µF, 100V

To Reduce Output Ripple

+5V Output	47µF, 10V, Low ESR
±12/15V Outputs	33µF, 20V, Low ESR

In critical, space-sensitive applications, DATEL may be able to tailor the internal input/output filtering of these units to meet your specific requirements. Contact our Applications Engineering Group for additional details.

Input Fusing

Certain applications and/or safety agencies may require the installation of fuses at the inputs of power conversion components. For DATEL A-Series TWR 20 Watt DC/DC Converters, you should use slow-blow type fuses with values no greater than 4A for "D12A" models and 2A for "D48A" models.

On/Off Control

The On/Off Control pin (pin 4) may be used for remote on/off operation. A TTL logic high (+2 to +5 Volts, 250µA max.) applied to pin 4 disables the converter. A TTL logic low (0 to +0.8 Volts, 70µA max.), or no connection, enables the converter. Control voltages should be referenced to pin 2 (–Input). Applying a voltage to the Control pin when no input power is applied to the converter can cause permanent damage to the converter.

Synchronization

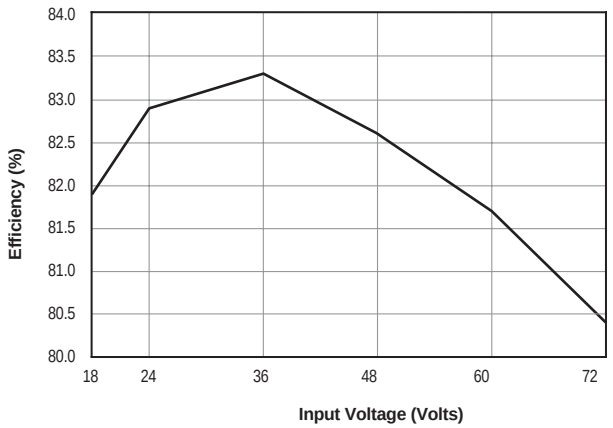
In critical applications employing multiple switching DC/DC converters, it may be desirable to intentionally synchronize the switching of selected converters (so the system noise can be reduced with notch filtering) or to purposely desynchronize the converters (to lessen the current-carrying requirements on intermediate dc buses). For multiple A-Series Converters, an external clock can be applied to pin 4 (Control) of each device. It should be a square wave with a maximum 1µsec "high" duration and an amplitude between +2V and +5V (see On/Off Control) referenced to pin 2 (–Input). The frequency of the synchronizing clock should be higher than that of any individual converter. Therefore, it should be 185kHz ±5kHz.

Typical Performance Curves (T_A = +25°C)

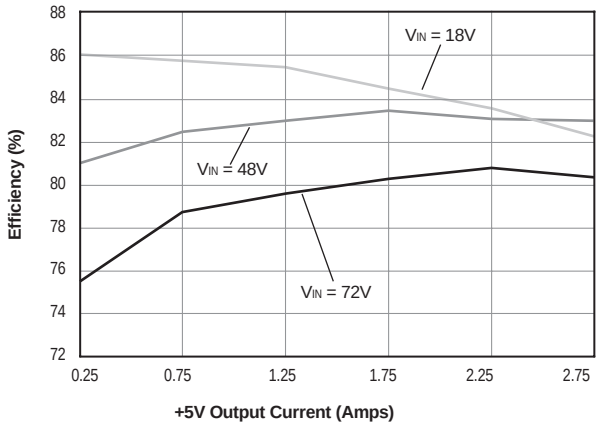
The performance curves below were derived from actual test data for a single model number (TWR-5/3000-12/250-D48). Since all devices in this series have the same circuit architecture, the performance curves are representative for all devices.

EFFICIENCY VS. INPUT VOLTAGE AND OUTPUT LOAD

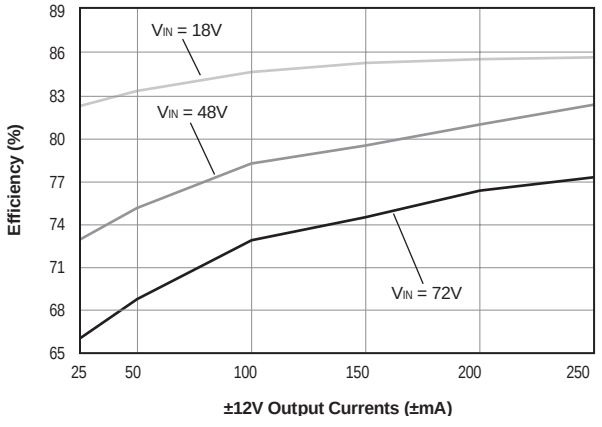
Efficiency vs. Input Voltage
(+5V output loaded @ 2.75A, ±12V outputs loaded @ ±250mA)



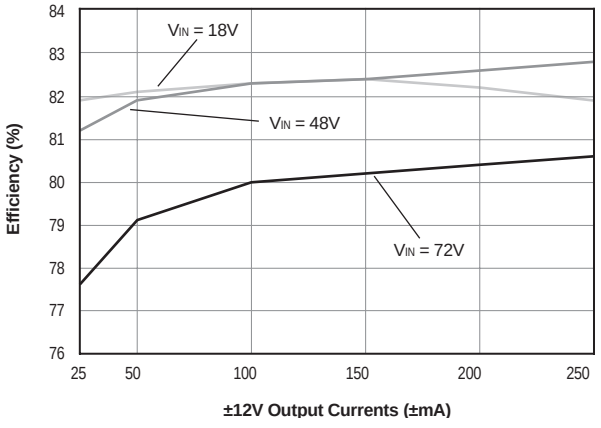
Efficiency vs. +5V Output Loading
(±12V outputs loaded @ ±250mA)



Efficiency vs. ±12V Output Loading
(+5V output loaded @ 0.55A)

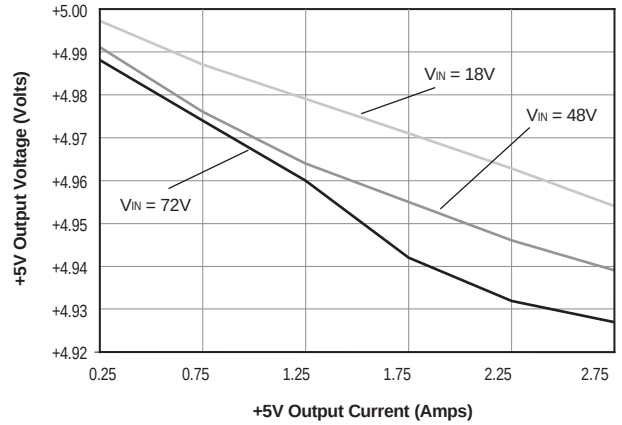


Efficiency vs. ±12V Output Loading
(+5V output loaded @ 2.75A)

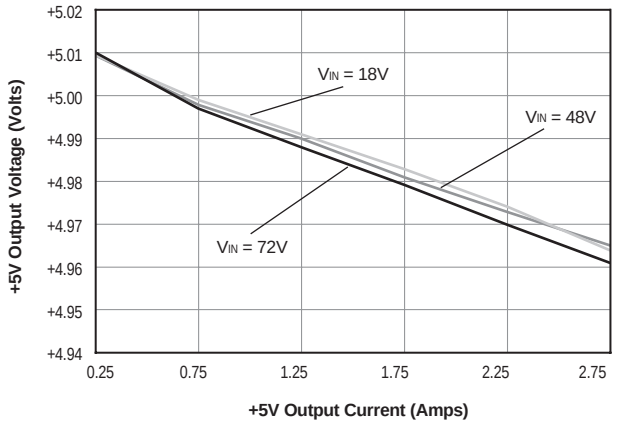


LOAD REGULATION

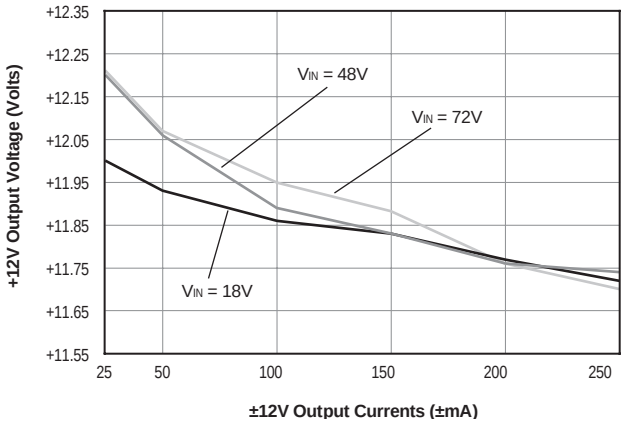
+5V Output Load Regulation
(±12V outputs loaded @ ±25mA)



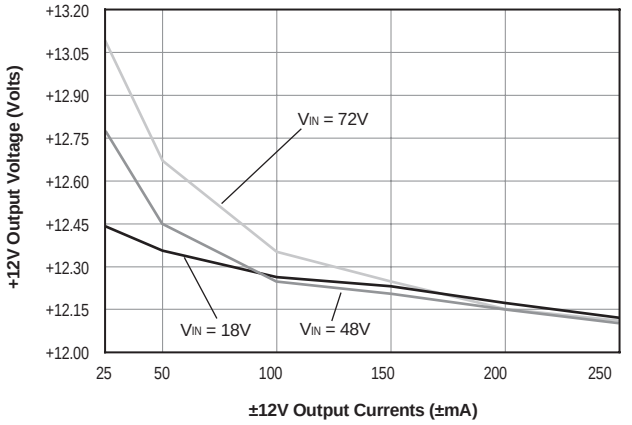
+5V Output Load Regulation
(±12V outputs loaded @ ±250mA)



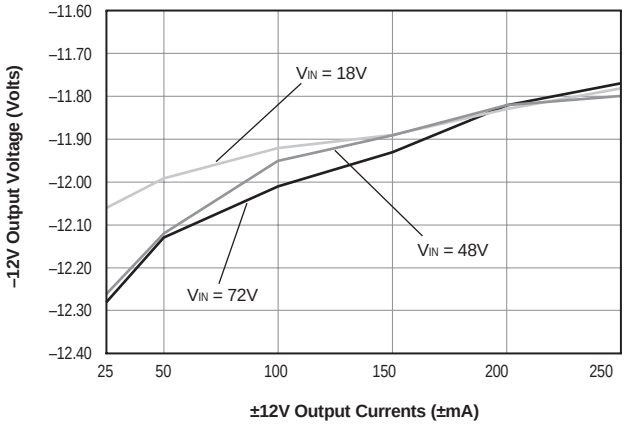
+12V Output Load Regulation
(+5V output loaded @ 0.55A)



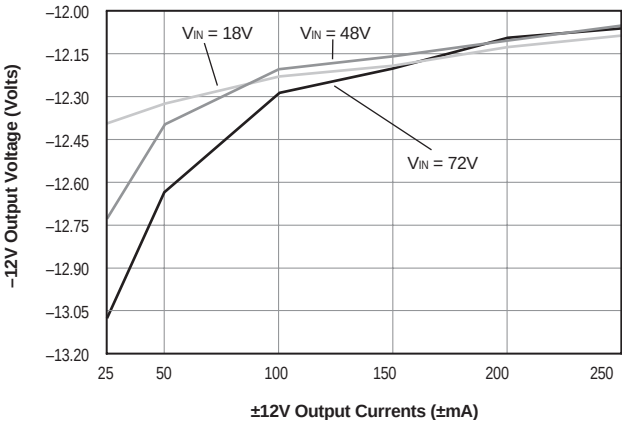
+12V Output Load Regulation
(+5V output loaded @ 2.75A)



–12V Output Load Regulation
(+5V output loaded @ 0.55A)

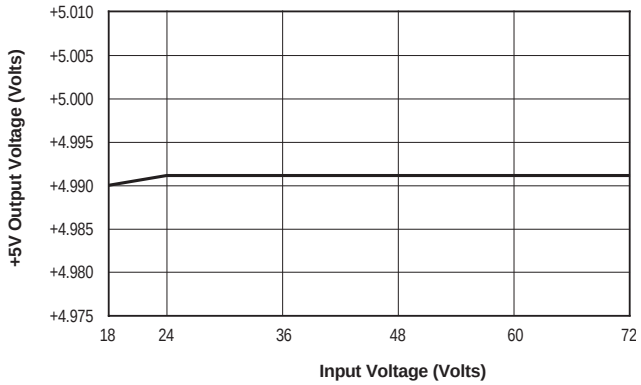


–12V Output Load Regulation
(+5V output loaded @ 2.75A)

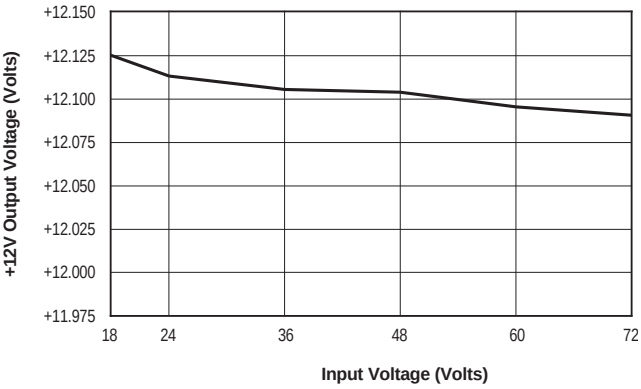


LINE REGULATION

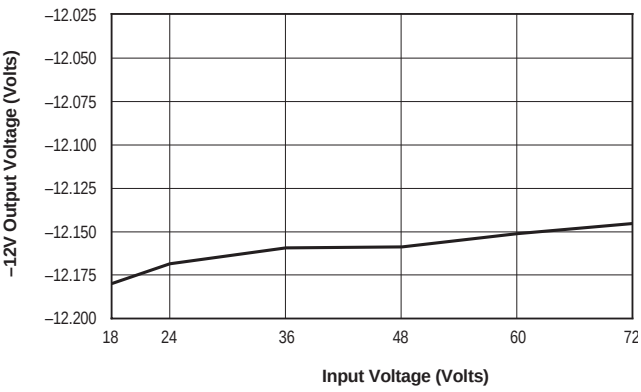
+5V Line Regulation
(+5V output loaded @ 2.75A, ±12V outputs loaded @ ±250mA)



+12V Line Regulation
(+5V output loaded @ 2.75A, ±12V outputs loaded @ ±250mA)



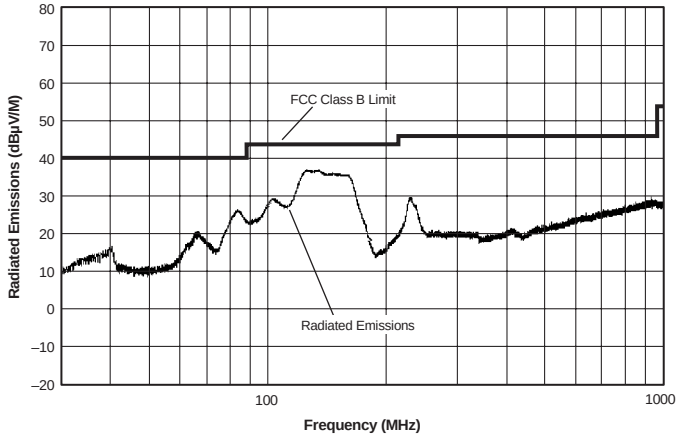
–12V Line Regulation
(+5V output loaded @ 2.75A, ±12V outputs loaded @ ±250mA)



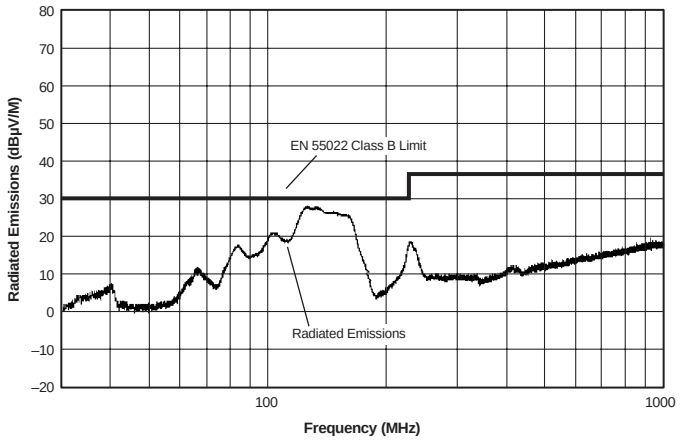
EMI RADIATED EMISSIONS

If you're designing with EMC in mind, note that all of DATEL's TWR 20 Watt A-Series DC/DC Converters have been characterized for radiated and conducted emissions in our new EMI/EMC laboratory. Testing is conducted in an EMCO 5305 GTEM test cell utilizing EMCO automated EMC test software. Radiated emissions are tested to the limits of FCC Part 15, Class B and CISPR 22 (EN 55022) Class B. Correlation to other specifications can be supplied upon request. Radiated emissions plots to FCC and CISPR 22 for model TWR-5/3000-15/500-D12A appear below. Its performance is typical of all models in the Series. Published EMC test reports are available for each model number. Contact DATEL's Applications Engineering for details.

TWR-5/3000-15/500-D12A Radiated Emissions
FCC Part 15 Class B, 3 Meters
Converter Output = +5Vdc @ 2.7A and ±15Vdc @ ±450mA



TWR-5/3000-15/500-D12A Radiated Emissions
EN 55022 Class B, 10 Meters
Converter Output = +5Vdc @ 2.7A and ±15Vdc @ ±450mA



Quality and Reliability

The A-Series are the first DC/DC Converters to emerge from DATEL's new, company-wide approach to designing and manufacturing the most reliable power converters available. The five-pronged program draws our Quality Assurance function into all aspects of new-product design, development, characterization, qualification and manufacturing.

Design for Reliability

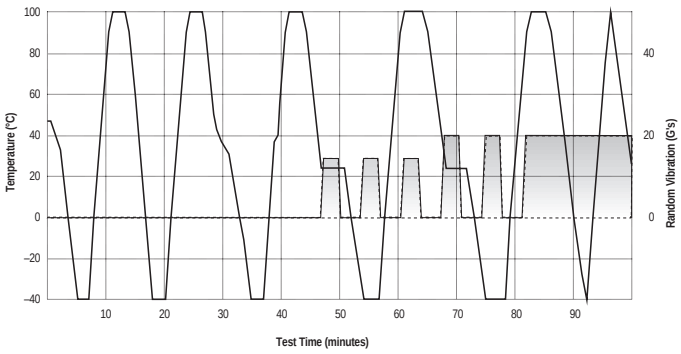
Design for Reliability is woven throughout our multi-phased, new-product-development process. Design-for-reliability practices are fully documented and begin early in the new-product development cycle with the following goals:
1. To work from an approved components/vendors list ensuring the use of reliable components and the rigorous qualification of new components.
2. To design with safety margins by adhering to a strict set of derating guidelines and performing theoretical worst-case analyses.
3. To locate potential design weaknesses early in the product-development cycle by using extensive HALT (Highly Accelerated Life Testing).
4. To prove that early design improvements are effective by employing a thorough FRACA (Failure Reporting Analysis and Corrective Action) system.

HALT Testing

The goal of the accelerated-stress techniques used by DATEL is to force device maturity, in a short period of time, by exposing devices to excessive levels of "every stimulus of potential value." We use HALT (Highly Accelerated Life Testing) repeatedly during the design and early manufacturing phases to detect potential electrical and mechanical design weaknesses that could result in possible future field failures.

During HALT, prototype and pre-production DC/DC converters are subjected to progressively higher stress levels induced by thermal cycling, rate of temperature change, vibration, power cycling, product-specific stresses (such as dc voltage variation) and combined environments. The stresses are not meant to simulate field environments but to expose any weaknesses in a product's electro/mechanical design and/or assembly processes. The goal of HALT is to make products fail so that device weaknesses can be analyzed and strengthened as appropriate. Applied stresses are continually stepped up until products eventually fail. After corrective actions and/or design changes, stresses are stepped up again and the cycle is repeated until the "fundamental limit of the technology" is determined.

Typical HALT Profile



DATEL has invested in a Qualmark OVS-1 HALT tester capable of applying voltage and temperature extremes as well as 6-axis, linear and rotational, random vibration. A typical HALT profile (shown above) consists of thermal cycling (–55 to +125°C, 30°C/minute) and simultaneous, gradually increasing, random longitudinal and rotational vibration up to 20G's with load cycling and applied-voltage extremes added as desired. Many devices in DATEL's new A-Series could not be made to fail prior to reaching either the limits of the HALT chamber or some previously known physical limit of the device. We also use the HALT chamber and its ability to rapidly cool devices to verify their "cold-start" capabilities.

Qualification

For each new product, electrical performance is verified via a comprehensive characterization process and long-term reliability is confirmed via a rigorous qualification procedure. The qual procedure includes such strenuous tests as thermal shock and 500 hour life. Qual testing is summarized below.

Qualification Testing

Qualification Test	Method/Comments
HALT	DATEL in-house procedure
High Temperature Storage	Max. rated temp., 1,000 hours
Thermal Shock	10 cycles, –55 to +125°C
Temperature/Humidity	+85°C, 85% humidity, 48 hours
Lead Integrity	DATEL in-house procedure
Life Test	+70°C, 500 hours*
Marking Permanency	DATEL in-house procedure
End Point Electrical Tests	Per product specification

* Interim electrical test at 200 hours.

In-Line Process Controls and Screening

A combination of statistical sampling and 100% inspection techniques keeps our assembly line under constant control. Parameters such as solder-paste thickness, component placement, cleanliness, etc. are statistically sampled, charted and fine tuned as necessary. Visual inspections are performed by trained operators after pick-and-place, soldering and cleaning operations. Units are 100% electrically tested prior to potting. All devices are temperature cycled, burned-in, hi-pot tested and final-electrical tested prior to external visual examination, packing and shipping.

Rapid Response to Problems

DATEL employs an outstanding corrective-action system to immediately address any detected shortcomings in either products or processes. Whenever our assembly, quality or engineering personnel spot a product/process problem, or if a product is returned with a potential defect, we immediately perform a detailed failure analysis and, if necessary, undertake corrective actions. Over time, this system has helped refine our assembly operation to yield one of the lowest product defect rates in the industry.

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ISO 9001

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