DATEL®
INNOVATION and EXCELLENCE

Single Output
UEP Models

High-Density, 2" x 1"
1-4.5 Amp, 11-18 Watt DC/DC's

Features

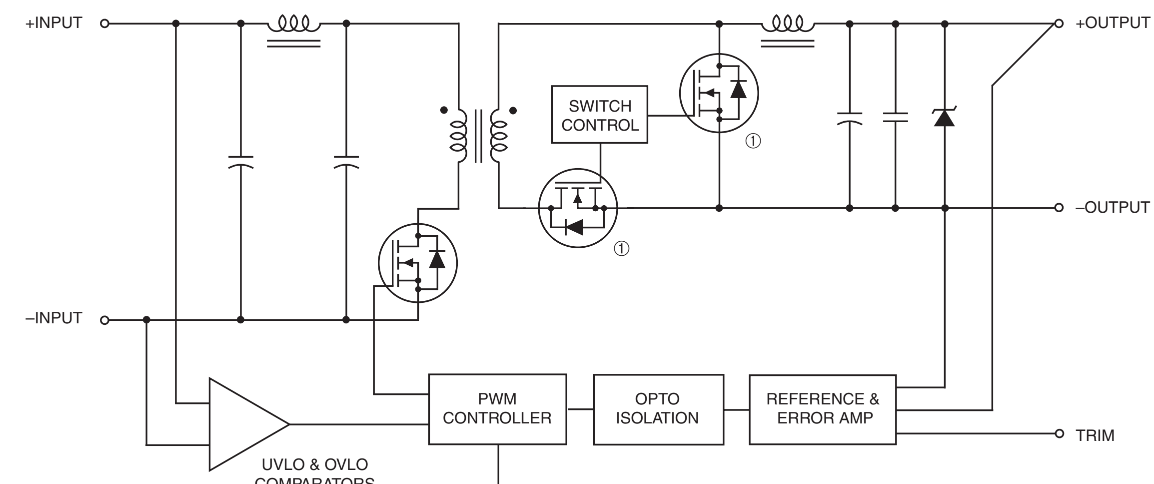
- **Models Include**
  3.3V @ 4.5A
  5V @ 3.5A
  12V @ 1.2A
  15V @ 1A
- **Choice of 3 input ranges:**
  10-18V, 18-36V, 36-75V
- **Guaranteed efficiencies to 86%**
- **11-18 Watts in 1" x 2" package**
- **340kHz synchronous-rectifier topologies**
- **–40 to +60/70°C ambient w/o derating**
- **Fully isolated (1500Vdc); I/O protected**
- **Trim and On/Off Control**
- **UL60950/EN60950 certified**
- **CE mark (75V$_{IN}$ models)**

The UEP 11-18Watt series DC/DC converter is an alternative pinout for DATEL's flagship A-Series. An external pinout configuration affords the design layout to be oriented for optimal thermal performance thereby increasing available output power as much as 20%. Available in a 1" x 2" package, these converters can deliver up to 18 Watts at the same ambient temperatures as their 15 Watt counterparts.

By combining a high-frequency (340kHz), high-efficiency (to 88%), synchronous-rectifier topology with the newest components and time-tested, fully automated, SMT-on-pcb construction, these UEP Models are able to bring you 11-18W in the standard 2" x 1" package from which most competitors can only get 5-10W. All UEP's deliver their full output power over ambient temperature ranges from –40°C to as high as +70°C (model and input voltage dependent) without heat sinks or supplemental forced-air cooling. Devices derate to +100°C.

Output voltages are 3.3, 5, 12 or 15 Volts. Input voltage ranges are 10-18V ("D12" models), 18-36V ("D24" models) or 36-75V ("D48") models. All models feature input pi filters, input undervoltage and overvoltage lockout, input reverse-polarity protection, output overvoltage protection, output current limiting, and continuous short-circuit protection. Standard features also include On/Off Control and output-trim. All models are certified to IEC950, UL60950 and EN60950 safety requirements for OPERATIONAL insulation. "D48" models (36-75V inputs) are CE marked.

UEP 11-18W DC/DC's are packaged in low-cost, light-weight, diallyl phthalate (UL94V-0 rated) plastic packages with standoffs. EMC compliance is achieved via a low-noise design rather than through expensive metal shielding.



① 1.5, 1.8, 2.5, 3.3V and 5V-output models use the synchronous-rectifier configuration shown above. 12V and 15V-output models employ a standard, diode-rectification architecture.

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)			
			Typ.	Max.	Line	Load ③				Min.	Typ.	
UEP-3.3/4500-D12	3.3	4500	85	100	±0.2%	±0.5%	12	10-18	80/1490	84.5%	83.5%	C15, P21
UEP-3.3/4500-D24	3.3	4500	85	100	±0.2%	±0.5%	24	18-36	50/730	87.5%	85.5%	C15, P21
UEP-3.3/4500-D48	3.3	4500	85	100	±0.2%	±0.5%	48	36-75	35/360	87.5%	85.5%	C15, P21
UEP-5/3500-D12	5	3500	85	100	±0.2%	±0.5%	12	10-18	120/1760	86%	84%	C15, P21
UEP-5/3500-D24	5	3500	85	100	±0.2%	±0.5%	24	18-36	65/850	88%	86%	C15, P21
UEP-5/3500-D48	5	3500	85	100	±0.2%	±0.5%	48	36-75	40/430	88%	86%	C15, P21
UEP-12/1400-D12	12	1400	85	100	±0.2%	±0.5%	12	10-18	60/1650	85%	82.5%	C15, P21
UEP-12/1400-D24	12	1400	85	100	±0.2%	±0.5%	24	18-36	45/800	87%	85%	C15, P21
UEP-12/1400-D48	12	1400	85	100	±0.2%	±0.5%	48	36-75	20/400	87%	85%	C15, P21
UEP-15/1200-D12	15	1200	85	100	±0.2%	±0.5%	12	10-18	60/1760	85%	82.%	C15, P21
UEP-15/1200-D24	15	1200	85	100	±0.2%	±0.5%	24	18-36	45/860	87%	85%	C15, P21
UEP-15/1200-D48	15	1200	85	100	±0.2%	±0.5%	48	36-75	30/430	87%	85%	C15, P21

① Typical at T_A = +25°C under nominal line voltage and full-load conditions, unless otherwise noted.
② Ripple/Noise (R/N) is tested/speciifed over a 20MHz bandwidth. All models are specified with no external input/output capacitors.
③ Load regulation is specified over 10%-100% load conditions.
④ Nominal line voltage, no-load/full-load conditions.

PART NUMBER STRUCTURE

U EP - 3.3 / 4500 - D48 N

Output Configuration:
U = Unipolar

Wide Range Input

Nominal Output Voltage:
3.3, 5, 12 or 15 Volts

Maximum Output Current
in mA

N Suffix
Available for 12V_{OUT} and 15V_{OUT} Models

Input Voltage Range:
D12 = 10-18 Volts (12V nominal)
D24 = 18-36 Volts (24V nominal)
D48 = 36-75 Volts (48V nominal)

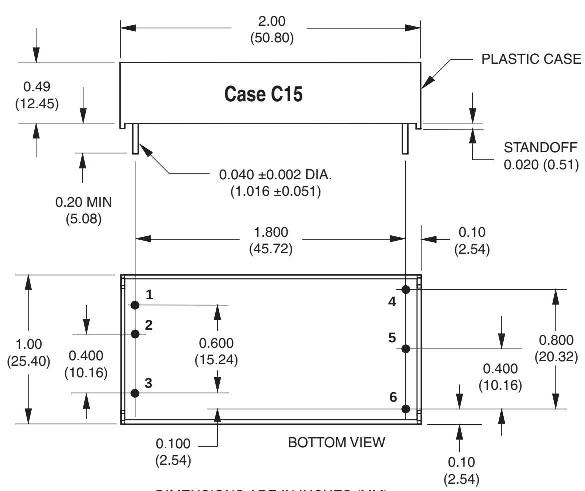
Optional Functions

UEP converters are designed such that the 12 and 15V_{OUT} models can be configures for either positive logic on/off control (no suffix) or negative logic ("N" suffix). 3.3 and 5V_{OUT} models are available with positive logic only (no suffix).

No Suffix On/Off Control function (positive polarity) on pin 3

N On/Off Control function (negative polarity) on pin 3. (12V and 15V models only.

MECHANICAL SPECIFICATIONS



DIMENSIONS ARE IN INCHES (MM)

I/O Connections	
Pin	Function P21
1	+Input
2	Input Return
3	On/Off Control
4	+Output
5	Output Return
6	Trim

Performance/Functional Specifications

Typical @ T_A = +25°C under nominal line voltage and full-load conditions, unless noted. ①②

Input	
Input Voltage Range:	
D12A Models	10-18 Volts (12V nominal)
D24A Models	18-36 Volts (24V nominal)
D48A Models	36-75 Volts (48V nominal)
Overvoltage Shutdown:	
D12A Models	18.5-21 Volts (20V typical)
D24A Models	37-40 Volts (38V typical)
D48A Models	77-81 Volts (78.5V typical)
Start-Up Threshold: ③	
D12A Models	9.3-9.8 Volts (9.6V typical)
D24A Models	16.5-18 Volts (17V typical)
D48A Models	34-36 Volts (35V typical)
Undervoltage Shutdown: ③	
D12A Models	7-8.5 Volts (8V typical)
D24A Models	15.5-17.5 Volts (16.5V typical)
D48A Models	32.5-35.5 Volts (34.5V typical)
Input Current:	
Normal Operating Conditions	See Ordering Guide
Standby Mode (Off, OV, UV)	5mA
Input Filter Type	Pi
Reverse-Polarity Protection	Brief duration, 10A maximum
On/Off Control (Optional, Pin 3): ④	
D12, D24, & D48 Models	On = open or 13V - +V_{IN}, I_{IN} = 50µA max.
	Off = 0-0.8V, I_{IN} = 1mA max.
D12N, D24N, & D48N Models	On = 0-0.5V, I_{IN} = 50µA max.
	Off = open or 2.4-10V, I_{IN} = 3.7mA max.

Output	
V_{OUT} Accuracy (50% load):	±1.5%, maximum
Minimum Loading: ②	
3.3V/5V Outputs	No load
12V/15V Outputs	25mA
Ripple/Noise (20MHz BW) ① ⑤	See Ordering Guide
Line/Load Regulation	See Ordering Guide
Efficiency	See Ordering Guide
Isolation Voltage:	
Input-to-Output	1500Vdc minimum
Isolation Capacitance	470pF
Isolation Resistance	100MΩ
Current Limit Inception:	
3.3V Models	5.5-7 Amps
5V Models	5.5-6 Amps
12V Models	1.9-2.7 Amps
15V Models	1.5-2.1 Amps
Short Circuit: ③	Hiccup, indefinite
Average Current	3 Amps maximum
V_{OUT} Trim Range	±5%
Overvoltage Protection	Zener/transorb clamp, magnetic feedback
Temperature Coefficient	±0.04% per °C.

Dynamic Characteristics	
Transient Response (50-100% load)	200µsec max. to ±1.5% of final value
Start-Up Time: ③	
V_{IN} to V_{OUT}	50msec
On/Off to V_{OUT}	30msec
Switching Frequency	340kHz (±40kHz)

Environmental	
Operating Temperature (Ambient):	
Without Derating ⑥	–40 to +60/70°C
With Derating	to +100°C (See Derating Curves)
Case Temperature:	
Maximum Allowable	+100°C
Storage Temperature	–40 to +105°C

Physical	
Dimensions	2" x 1" x 0.49" (51 x 25 x 12.45mm)
Shielding	None
Case Material	Diallyl phthalate, meets EN60950 flamability requirements
Pin Material	Brass, solder coated
Weight	1.4 ounces (39.7 grams)

① All models are specified with no external input/output capacitors.
② See Minimum Output Loading Requirements under Technical Notes.
③ See Technical Notes for details.
④ The On/Off Control is designed to be driven with open-collector logic or the application of appropriate voltages (referenced to –Input (Pin 2)). Applying a voltage to the On/Off Control pin when no input voltage is applied to the converter may cause permanent damage. See Technical Notes.
⑤ Output noise may be further reduced with the addition of external output capacitors. See Technical Notes.
⑥ Operating temperature range without derating is model and input-voltage dependent. See Temperature Derating.

Absolute Maximum Ratings	
Input Voltage:	
Continuous:	
D12 Models	22 Volts
D24 Models	44 Volts
D48 Models	88 Volts
Transient (100msec):	
D12 Models	50 Volts
D24 Models	50 Volts
D48 Models	100 Volts
Input Reverse-Polarity Protection	Current must be <10 Amps. Brief duration only. Fusing recommended.
Output Overvoltage Protection:	
3.3V Outputs	4.5 Volts, unlimited duration
5V/12V/15V Outputs	6.8/15/18 Volts, unlimited duration
Output Current	Hiccup. Devices can withstand sustained output short circuits without damage.
Case Temperature	+100°C
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

Floating Outputs

Since these are isolated DC/DC converters, their outputs are "floating." Designers will usually use the –Output (pin 5) as the ground/return of the load circuit. You can, however, use the +Output (pin 4) as ground/return to effectively reverse the output polarity.

Minimum Output Loading Requirements

3.3 and 5V models employ a synchronous-rectifier design topology. All models regulate within spec and are stable under no-load conditions. 12/15V models employ a traditional forward, diode-rectification architecture and require 25mA loading to achieve their listed regulation specs. Operation under 25mA load conditions will not damage the 12/15V devices; however they may not meet all listed specifications.

Filtering and Noise Reduction

All UEP Series DC/DC Converters achieve their rated ripple and noise specifications with no external input/output capacitors. In critical applications, input/output noise may be further reduced by installing external I/O caps. Input capacitors should be selected for bulk capacitance, low ESR and high rms-ripple-current ratings. Output capacitors should be selected for low ESR and appropriate frequency response. All caps should have appropriate voltage ratings and be mounted as close to the converters as possible.

The most effective combination of external I/O capacitors will be a function of your particular load and layout conditions. Our Applications Engineers recommend potential solutions and can discuss the possibility of our modifying a given device's internal filtering 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. Fuses should also be used if the possibility of sustained, non-current-limited, input-voltage polarity reversals exists. For DATEL UER 11-18 Watt DC/DC Converters, you should use slow-blow type fuses with values no greater than the following.

V_{IN} Range	Fuse Value
D12 Models	3 Amps
D24 Models	2 Amps
D48 Models	1 Amp

Trimming Output Voltages

These converters have a trim capability (pin 6) that allows users to adjust the output voltage ±5%. Adjustments to the output voltage can be accomplished via a trim pot, Figure 2, or a single fixed resistor as shown in Figures 3 and 4. A single fixed resistor can increase or decrease the output voltage depending on its connection. Fixed resistors should have an absolute TCR less than 100ppm/°C to minimize sensitivity to changes in temperature.

A single resistor connected from the Trim (pin 6) to the +Output (pin 4), see Figure 3, will decrease the output voltage. A resistor connected from the Trim (pin 6) to –Output (pin 5) will increase the output voltage.

Trim adjustment greater than 5% can have an adverse effect on the converter's performance and is not recommended.

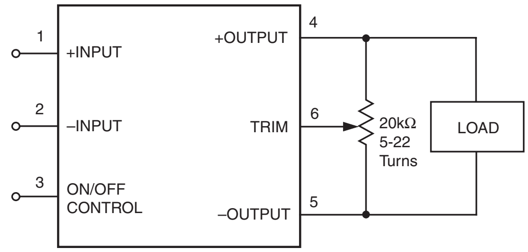


Figure 2. Trim Connections Using A Trim Pot

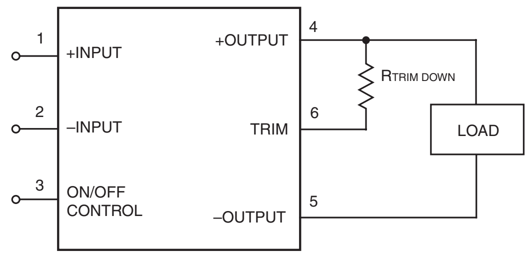


Figure 3. Trim Connections To Decrease Output Voltage Using Fixed Resistors

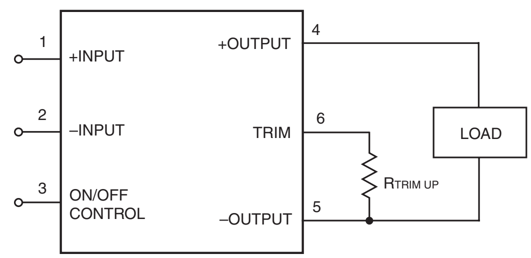


Figure 4. Trim Connections To Increase Output Voltage Using Fixed Resistors

Model	Trim Equation
UEP-3.3/4500-D12 **UEP-3.3/4500-D24** **UEP-3.3/4500-D48**	$R_{T_{DOWN}}(k\Omega) = \frac{2.49(V_O - 1.27)}{3.3 - V_O} - 16.9$
	$R_{T_{UP}}(k\Omega) = \frac{3.16}{V_O - 3.3} - 16.9$
UEP-5/3500-D12 **UEP-5/3500-D24** **UEP-5/3500-D48**	$R_{T_{DOWN}}(k\Omega) = \frac{2.49(V_O - 2.527)}{5 - V_O} - 15$
	$R_{T_{UP}}(k\Omega) = \frac{6.292}{V_O - 5} - 15$
UEP-12/1400-D12 **UEP-12/1400-D24** **UEP-12/1400-D48**	$R_{T_{DOWN}}(k\Omega) = \frac{6.34(V_O - 5.714)}{12 - V_O} - 49.9$
	$R_{T_{UP}}(k\Omega) = \frac{36.23}{V_O - 12} - 49.9$
UEP-15/1200-D12 **UEP-15/1200-D24** **UEP-15/1200-D48**	$R_{T_{DOWN}}(k\Omega) = \frac{7.87(V_O - 7.136)}{15 - V_O} - 63.4$
	$R_{T_{UP}}(k\Omega) = \frac{56.16}{V_O - 15} - 63.4$

Accuracy of adjustment is subject to tolerances or resistor values and factory-adjusted output accuracy. V_O = desired output voltage.

Start-Up Threshold and Undervoltage Shutdown

Under normal start-up conditions, UEP DC/DC Converters will not begin to regulate properly until the ramping input voltage exceeds the Start-Up Threshold. Once operating, devices will turn off when the applied voltage drops below the Undervoltage Shutdown point. Devices will remain off as long as the undervoltage condition continues. Units will automatically re-start when the applied voltage is brought back above the Start-Up Threshold. The hysteresis built into this function avoids an indeterminate on/off condition at a single input voltage. See Performance/Functional Specifications table for actual limits.

On/Off Control

The input-side, remote On/Off Control function (pin 4) can be ordered to operate with either polarity (12 and 15 Volt models only). Positive-polarity devices (standard, no part-number suffix) are enabled when pin 3 is left open or is pulled high (+13V to V_{IN} applied with respect to –Input, pin 2, (see Figure 2). Positive-polarity devices are disabled when pin 5 is pulled low (0-0.8V with respect to –Input). Negative-polarity devices are off when pin 3 is open or pulled high (+2.4V to +10V), and on when pin 3 is pulled low (0-0.5V). See Figure 3.

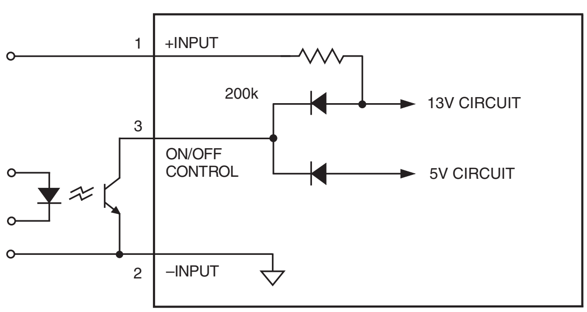


Figure 2. Driving the Positive Polarity On/Off Control Pin

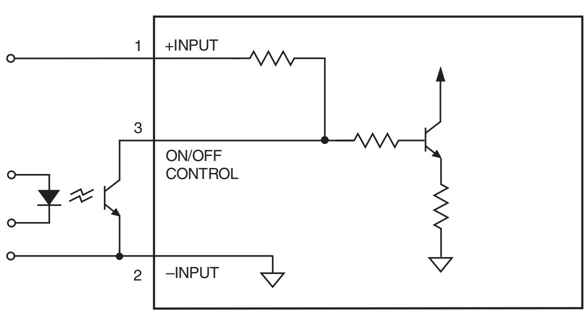


Figure 3. Driving the Negative Polarity On/Off Control Pin

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 Specs) when activated and withstand appropriate voltage when deactivated.

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

Sync Function (Optional)

Contact DATEL for further information.

Start-Up Time

The V_{IN} to V_{OUT} start-up time is the interval of time where the input voltage crosses the turn-on threshold point, 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/output capacitance, and load. The UHE Series implements a soft start circuit that limits the duty cycle of the PWM controller at power up, thereby limiting the Input Inrush current.

The On/Off Control to V_{OUT} 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 time at which the converter is turned on and the fully loaded output voltage enters and remains within its specified accuracy band. Similar to the V_{IN} to V_{OUT} start-up, the On/Off Control to V_{OUT} start-up time is also governed by the internal soft start circuitry and external load capacitance.

Input Overvoltage/Undervoltage Shutdown and Start-Up Threshold

Under normal start-up conditions, devices will not begin to regulate until the ramping-up input voltage exceeds the Start-Up Threshold Voltage (35V for "D48" models). Once operating, devices will not turn off until the input voltage drops below the Undervoltage Shutdown limit (34V for "D48" models). 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.

Input voltages exceeding the input overvoltage shutdown specification listed in the Performance/Functional Specifications will cause the device to shutdown. A built-in hysteresis of 0.6 to 1.6 Volts for all models will not allow the converter to restart until the input voltage is sufficiently reduced.

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 the source is not current limited (<10A) nor the circuit appropriately fused, it could cause permanent damage to the converter.

Current Limiting

When output increases to 120% to 190% of the rated output current, 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 a somewhat constant power dissipation. This is commonly referred to as power limiting. Current limit inception is defined as the point where 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. See "Short Circuit Condition."

Short Circuit Condition

When a converter is in current limit mode the output voltages 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 its 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 UEP is capable of enduring an indefinite short circuit output condition.

Thermal Shutdown

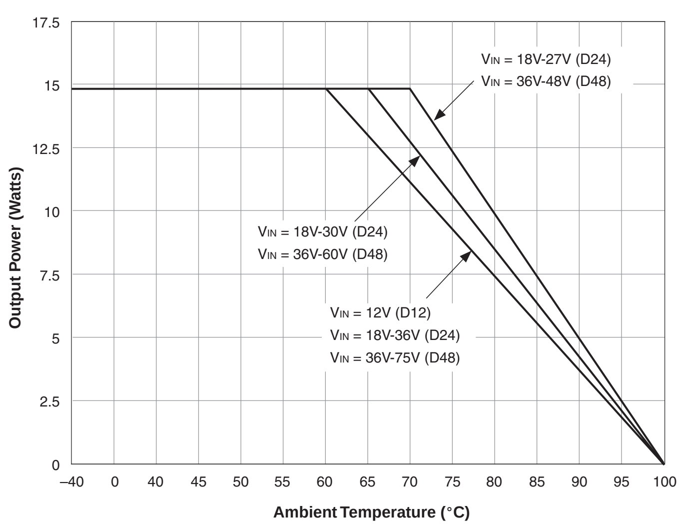
These UEP converters are equipped with Thermal Shutdown Circuitry. If environmental conditions cause the internal temperature of the DC/DC converter rises above the designed operating temperature, a precision temperature sensor will power down the unit. When the internal temperature decreases below the threshold of the temperature sensor the unit will self start. See Performance/Functional Specifications.

Output Overvoltage Protection

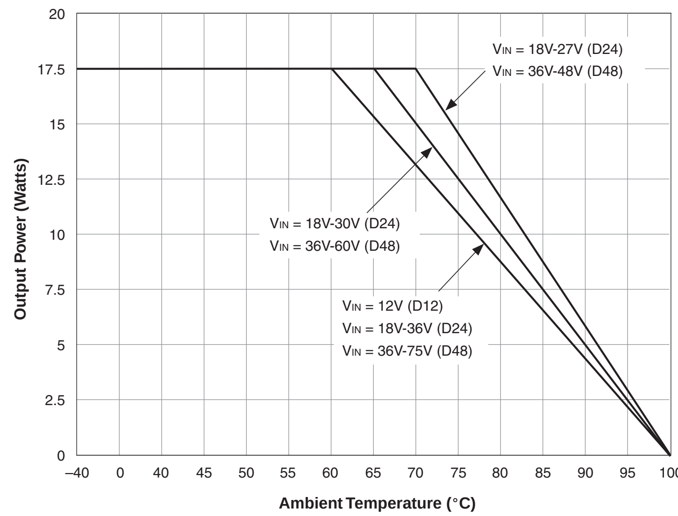
UEP output voltages are monitored for an overvoltage condition via a comparator which is optically coupled to the primary side. If the output voltage should rise to a level which could be damaging to the load circuitry, the sensing circuitry will power down the PWM controller causing the output voltages to decrease. Following a time-out period the PWM will restart, causing the output voltages to ramp to their appropriate values. If the fault condition persists, and the output voltages again climb to excessive levels, the overvoltage circuitry will initiate another shutdown cycle. This on/off cycling is referred to as "hiccup" mode.

TEMPERATURE DERATING

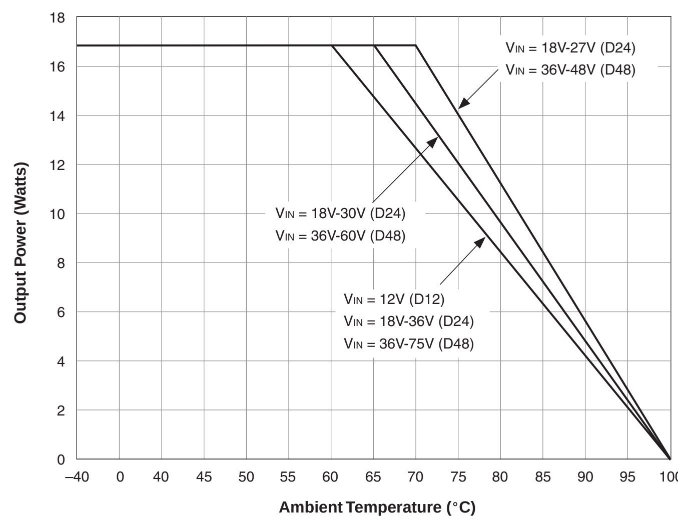
Temperature Derating Curves for 3.3V Output Models



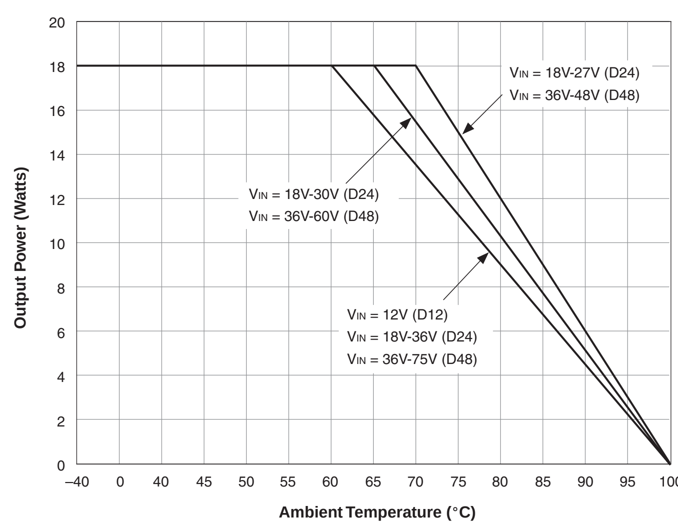
Temperature Derating Curves for 5V Output Models



Temperature Derating Curves for 12V Output Models

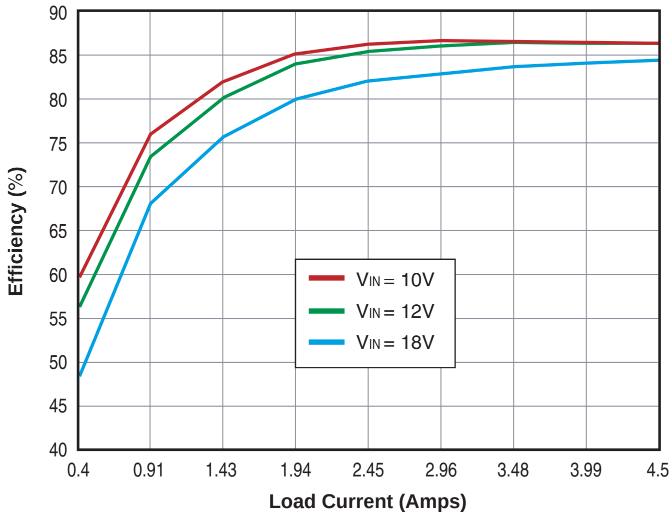


Temperature Derating Curves for 15V Output Models

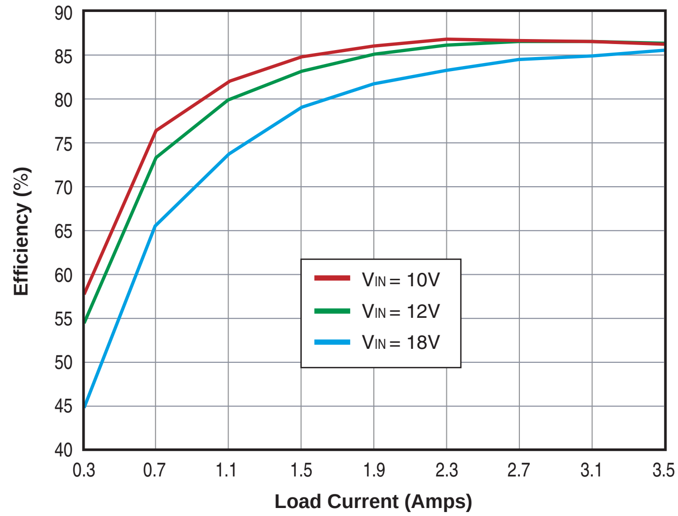


EFFICIENCY VS. LINE AND LOAD

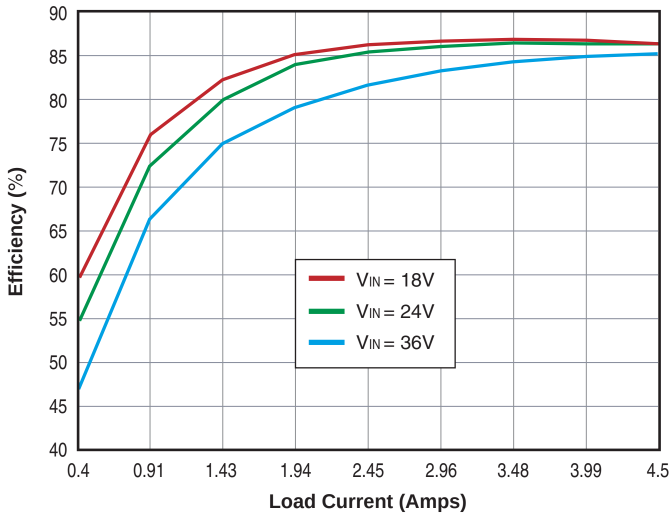
UEP-3.3/4500-D12 Efficiency vs. Line Voltage and Load Current



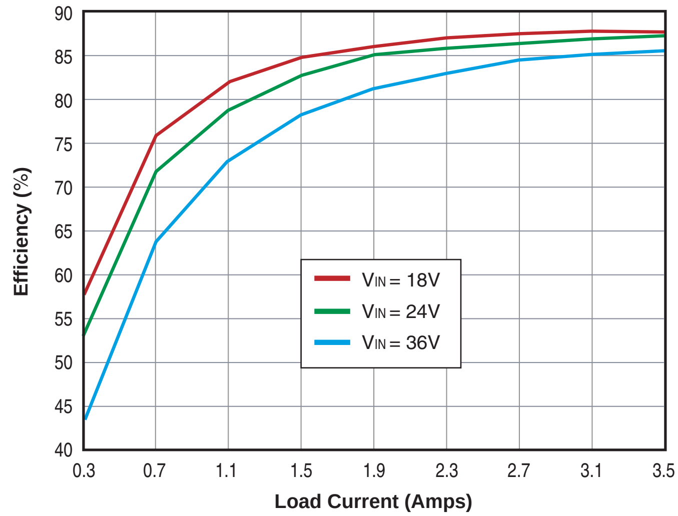
UEP-5/3500-D12 Efficiency vs. Line Voltage and Load Current



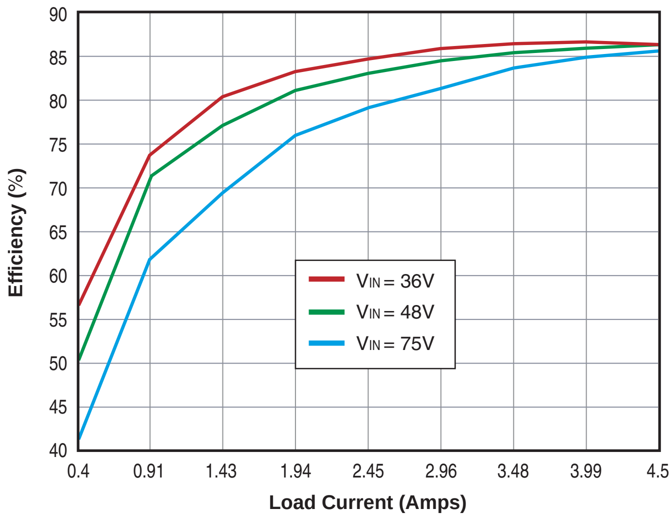
UEP-3.3/4500-D24 Efficiency vs. Line Voltage and Load Current



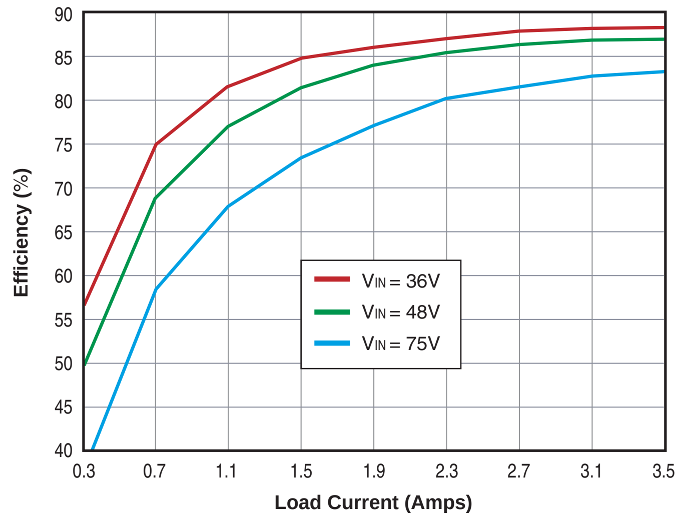
UEP-5/3500-D24 Efficiency vs. Line Voltage and Load Current



UEP-3.3/4500-D48 Efficiency vs. Line Voltage and Load Current

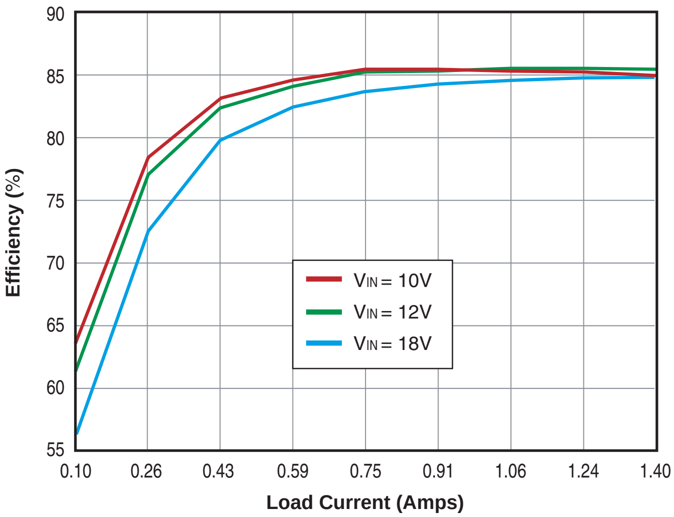


UEP-5/3500-D48 Efficiency vs. Line Voltage and Load Current

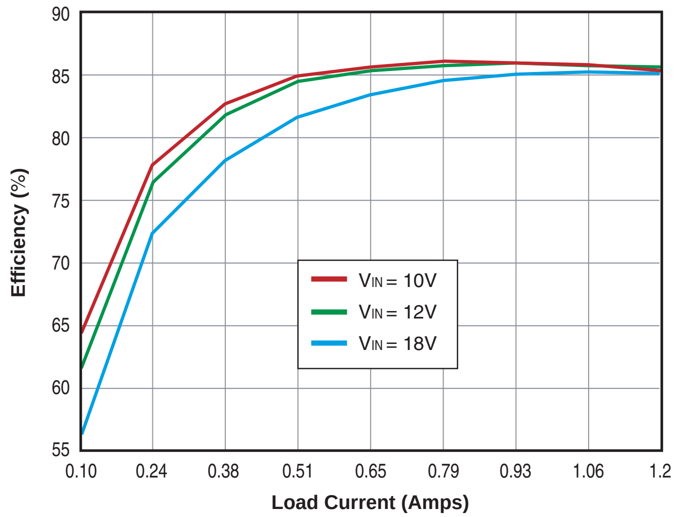


EFFICIENCY VS. LINE AND LOAD

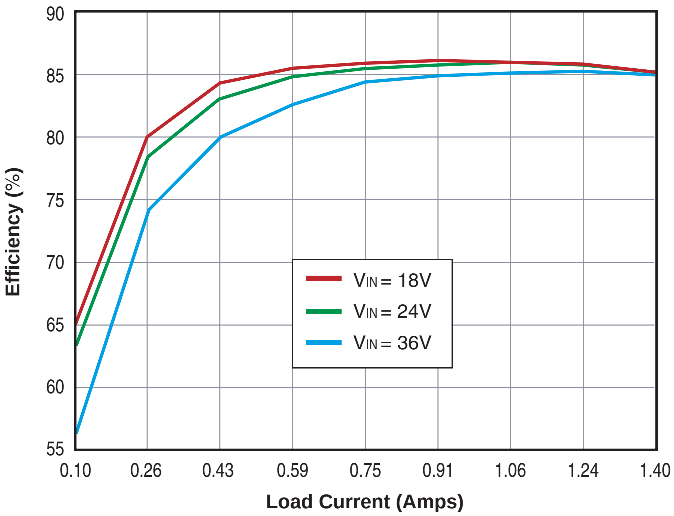
UEP-12/1400-D12 Efficiency vs. Line Voltage and Load Current



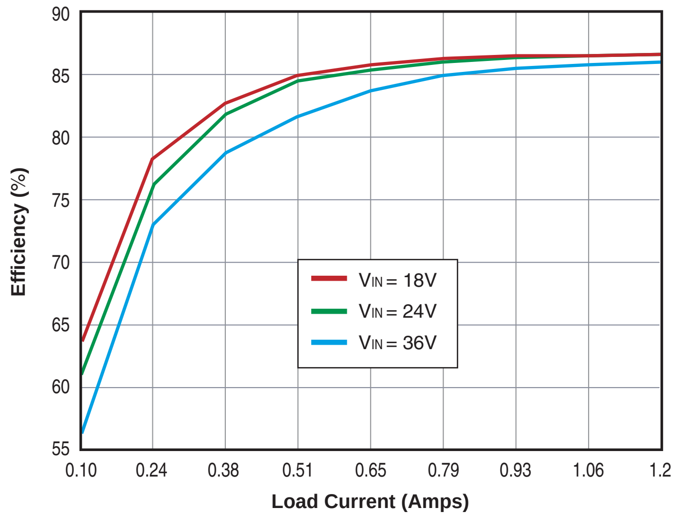
UEP-15/1200-D12 Efficiency vs. Line Voltage and Load Current



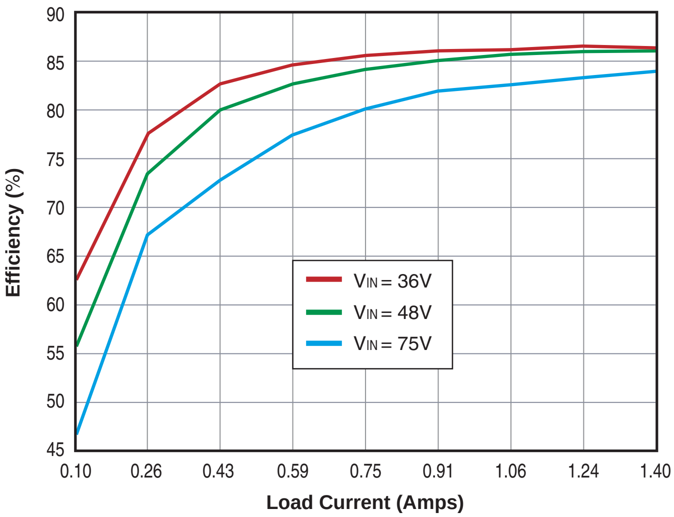
UEP-12/1400-D24 Efficiency vs. Line Voltage and Load Current



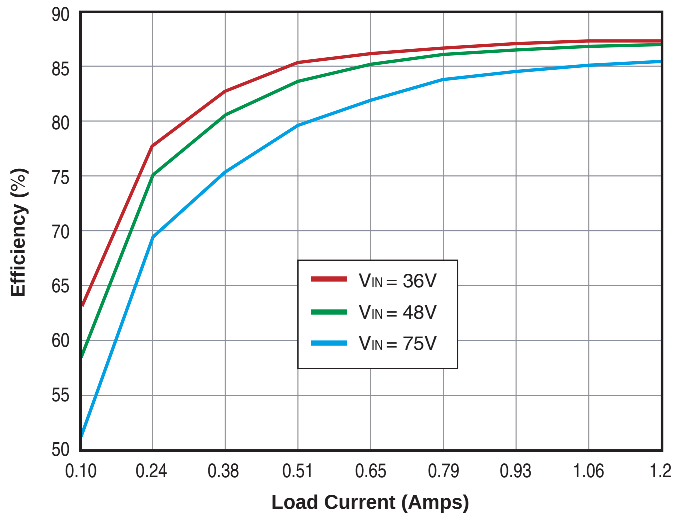
UEP-15/1200-D24 Efficiency vs. Line Voltage and Load Current



UEP-12/1400-D48 Efficiency vs. Line Voltage and Load Current

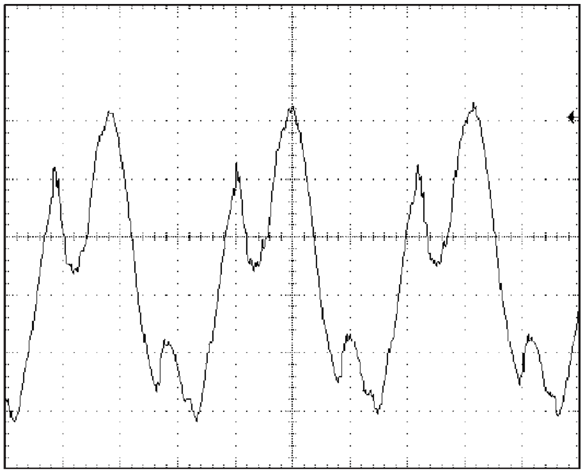


UEP-15/1200-D48 Efficiency vs. Line Voltage and Load Current



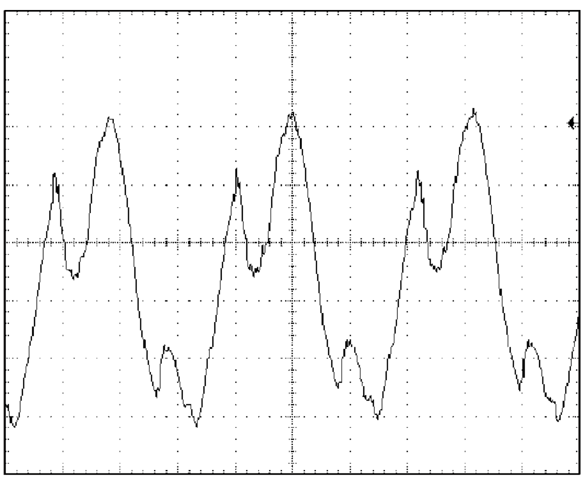
Typical Performance Curves

Output Ripple and Noise (PARD)
(V_{IN} = nominal, 3.3V @ 4.5A, no external capacitors.)



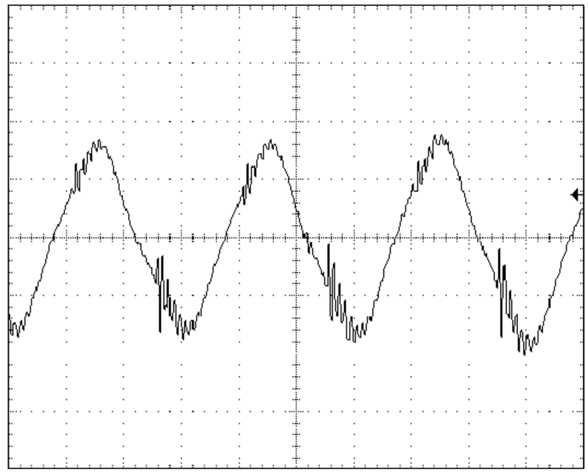
20mV/div, 20MHz BW

Output Ripple and Noise (PARD)
(V_{IN} = nominal, 5V @ 3.5A, no external capacitors.)

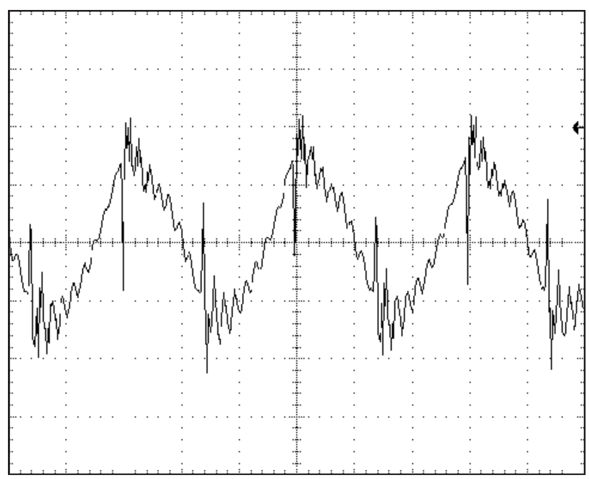


20mV/div, 20MHz BW

Output Ripple and Noise (PARD)
(V_{IN} = nominal, 12V @ 1.4A, no external capacitors.)



Output Ripple and Noise (PARD)
(V_{IN} = nominal, 15V @ 1.2A, no external capacitors.)



20mV/div, 20MHz BW

DATEL®
INNOVATION and EXCELLENCE

ISO-9001 REGISTERED

DS-0502 9/01

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1151
Tel: (508) 339-3000 (800) 233-2765 Fax: (508) 339-6356
Internet: www.datel.com Email: sales@datel.com
Data Sheet Fax Back: (508) 261-2857

DATEL (UK) LTD. Tadley, England Tel: (01256)-880444
DATEL S.A.R.L. Montigny Le Bretonneux, France Tel: 01-34-60-01-01
DATEL GmbH München, Germany Tel: 89-544334-0
DATEL KK Tokyo, Japan Tel: 3-3779-1031, Osaka Tel: 6-6354-2025