PRELIMINARY

DATEL®
INNOVATION and EXCELLENCE

Dual Output
Mixed Voltage, DLV Models

13 Amp, 37 Watt, DC/DC Converters
V_{OUT} Combinations of 3.3/2.5/1.8/1.5/1.2 Volts

Features

- **Two independently regulated outputs: 3.3V @ 6A; 2.5/1.8/1.5/1.2V @ 7A**
- **13A/37W total output current/power**
- **Input voltage ranges: 10-18V, 18-36V or 36-75V**
- **Standard 2" x 2" package/pinout**
- **High efficiency (to 85%)**
- **Stable no-load operation**
- **Independent V_{OUT} trim pins**
- **Remote on/off control**
- **Fully isolated (1500Vdc); I/O protected**
- **Output overvoltage protection**
- **Thermal shutdown**
- **UL60950/EN60950 certified**
- **CE marked**

DATEL's new DLV Series, dual-output, low-voltage DC/DC's provide any output combination of 3.3V (to 6 Amps) and 2.5/1.8/1.5/1.2V (to 7 Amps). Designed with two control loops for two independently regulated outputs (both using synchronous rectification), DLV's are impressively efficient (to 85%) and able to supply their full 13 Amps of output current (37W for the 3.3V/2.5V models) up to +60°C ambient with no derating (model dependent).

Housed in standard 2" x 2" x 0.5" plastic packages, DLV's offer a number of functional options (positive or negative polarity on the control pin, addition of second V_{OUT} trim pin, etc.) that make them pin compatible with, yet more powerful than, virtually all 2" x 2" duals from other leading DC/DC manufacturers.

Assembled using fully automated, SMT-on-pcb techniques, DLV's provide stable no-load operation, excellent line/load regulation (±1%), quick step response (200µsec), and low output ripple/noise (80mVp-p). All devices feature full I/O fault protection including: input overvoltage and undervoltage shutdown, output overvoltage protection, current limiting, short-circuit protection, and thermal shutdown.

All DLV models are Qual/HALT/EMI tested and certified to the operational/functional-insulation requirements of UL60950/EN60950. 48V_{IN} models (75V_{IN} max.) carry the CE mark

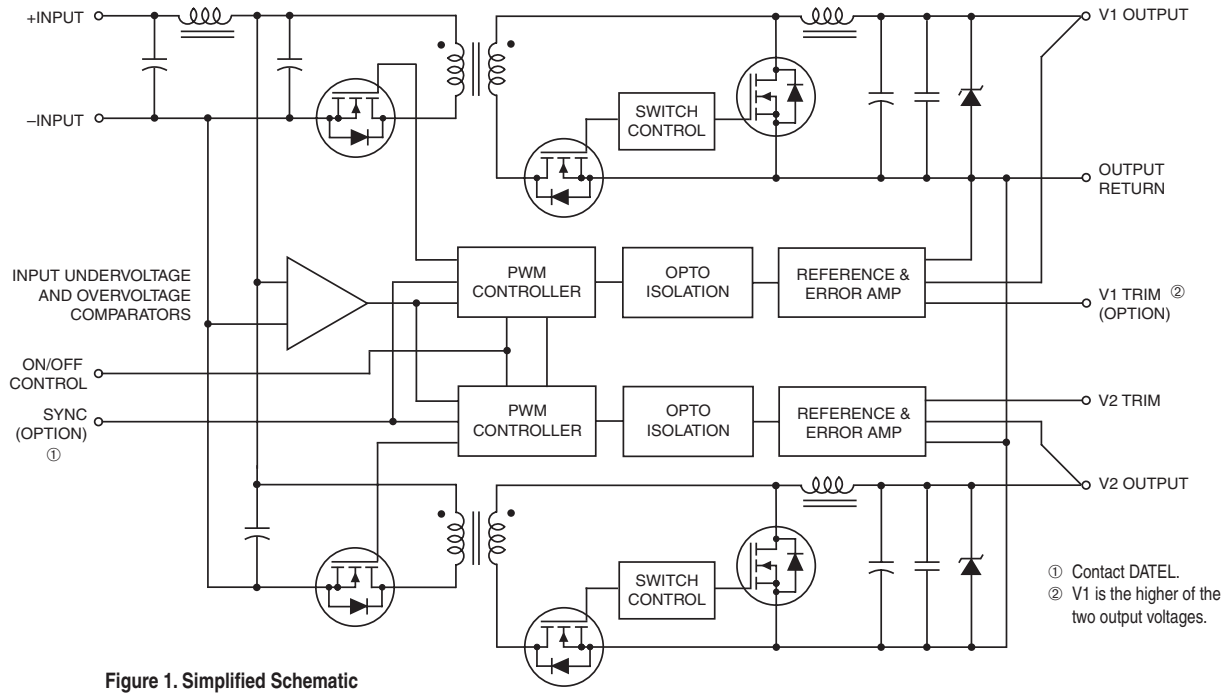

Figure 1. Simplified Schematic

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Performance Specifications and Ordering Guide ①

Model	Output						Input			Efficiency		Package (Case, Pinout)
	V_{OUT} (Volts)	I_{OUT} ② (Amps)	R/N (mVp-p) ③ Typ.	R/N (mVp-p) ③ Max.	Regulation (Max.) Line	Regulation (Max.) Load ④	V_{IN} Nom. (Volts)	Range (Volts)	I_{IN} ⑤ (mA)	Min.	Typ.	
DLV-2.5/7-1.8/7-D12	2.5	7	75	TBD	±1%	±1%	12	10-18	TBD	TBD	83%	C26, P48
	1.8	7	75	TBD	±1%	±1%						
DLV-2.5/7-1.8/7-D24	2.5	7	75	TBD	±1%	±1%	24	18-36	TBD	TBD	83%	C26, P48
	1.8	7	75	TBD	±1%	±1%						
DLV-2.5/7-1.8/7-D48	2.5	7	75	TBD	±1%	±1%	48	36-75	TBD	TBD	83%	C26, P48
	1.8	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.2/7-D12	3.3	6	75	TBD	±1%	±1%	12	10-18	TBD	TBD	83%	C26, P54
	1.2	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.2/7-D24	3.3	6	75	TBD	±1%	±1%	24	18-36	TBD	TBD	83%	C26, P54
	1.2	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.2/7-D48	3.3	6	75	TBD	±1%	±1%	48	36-75	TBD	TBD	83%	C26, P54
	1.2	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.5/7-D12	3.3	6	75	TBD	±1%	±1%	12	10-18	TBD	TBD	85%	C26, P54
	1.5	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.5/7-D24	3.3	6	75	TBD	±1%	±1%	24	18-36	TBD	TBD	85%	C26, P54
	1.5	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.5/7-D48	3.3	6	75	TBD	±1%	±1%	48	36-75	TBD	TBD	85%	C26, P54
	1.5	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.8/7-D12	3.3	6	75	TBD	±1%	±1%	12	10-18	TBD	TBD	83%	C26, P47
	1.8	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.8/7-D24	3.3	6	75	TBD	±1%	±1%	24	18-36	TBD	TBD	83%	C26, P47
	1.8	7	75	TBD	±1%	±1%						
DLV-3.3/6-1.8/7-D48	3.3	6	75	TBD	±1%	±1%	48	36-75	TBD	TBD	83%	C26, P47
	1.8	7	75	TBD	±1%	±1%						
DLV-3.3/6-2.5/7-D12	3.3	6	75	TBD	±1%	±1%	12	10-18	TBD	TBD	85%	C26, P40
	2.5	7	75	TBD	±1%	±1%						
DLV-3.3/6-2.5/7-D24	3.3	6	75	TBD	±1%	±1%	24	18-36	TBD	TBD	85%	C26, P40
	2.5	7	75	TBD	±1%	±1%						
DLV-3.3/6-2.5/7-D48	3.3	6	75	TBD	±1%	±1%	48	36-75	TBD	TBD	85%	C26, P40
	2.5	7	75	TBD	±1%	±1%						

PRELIMINARY

① Typical at T_A = +25°C under nominal line voltage and "balanced," full-power conditions: 3.3V @ 4.5A/2.5V @ 6A; 3.3V @ 5.2A/1.8V @ 7A; 3.3V @ 5.2A/1.8V @ 7A; 2.5V @ 7A/1.8V @ 7A.

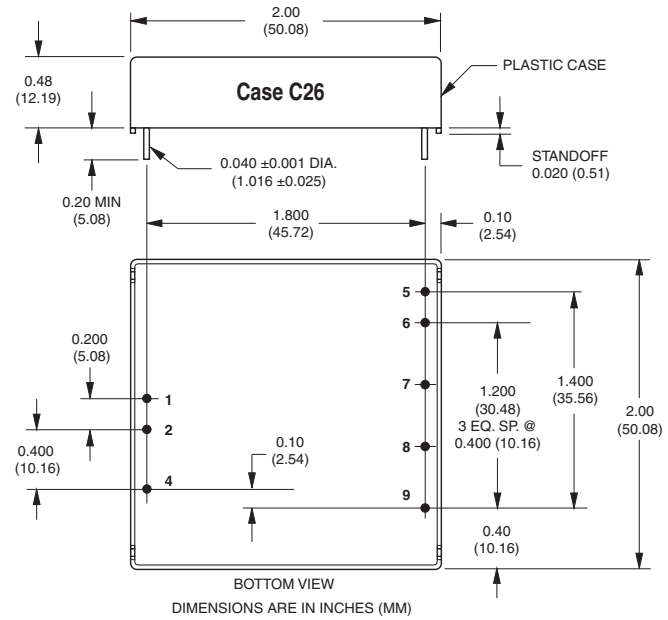
② Any combination of rated I_{OUT} current, not to exceed 35 Watts of output power. (See derating graphs.)

③ Ripple/Noise (R/N) measured over a 20MHz bandwidth. All models are specicfied with TBD ceramic capacitors.

④ Tested from no load to 100% load (other output at no load).

⑤ Nominal line voltage, no load/balanced full-power condition.

MECHANICAL SPECIFICATIONS



See page 5 for Part Number Structure and ordering details.

DLV - 3.3 / 6 - 2.5 / 7 - D48 T N

- DLV: Dual Low Voltage/ Mixed-Voltage Series
- 3.3: V_1 Nominal Output Voltage
- 6: I_1 Maximum Output Current
- 2.5: V_2 Nominal Output Voltage
- 7: I_2 Maximum Output Current
- D48: Input Voltage Range: **D12** = 10-18 Volts (12V nominal); **D24** = 18-36 Volts (24V nominal); **D48** = 36-75 Volts (48V nominal)
- T N: Add T and N suffixes as desired

I/O Connections				
Pin	Function P40	Function P47	Function P48	Function P54
1	+Input	+Input	+Input	+Input
2	–Input	–Input	–Input	–Input
3	No Pin	No Pin	No Pin	No Pin
4	On/Off Control	On/Off Control	On/Off Control	On/Off Control
5	+3.3V Trim*	+3.3V Trim*	+2.5V Trim*	+3.3V Trim*
6	+3.3V Output	+3.3V Output	+2.5V Output	+3.3V Output
7	Output Return	Output Return	Output Return	Output Return
8	+2.5V Output	+1.8V Output	+1.8V Output	+1.5V Output
9	+2.5V Trim	+1.8V Trim	+1.8V Trim	+1.5V Trim

* Optional pins

Performance/Functional Specifications

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

Input	
Input Voltage Range:	
D12 Models	10-18 Volts (12V nominal)
D24 Models	18-36 Volts (24V nominal)
D48 Models	36-75 Volts (48V nominal)
Overvoltage Shutdown:	
D12 Models	19-23 Volts (21V nominal)
D24 Models	37-42 Volts (40V nominal)
D48 Models	77-81 Volts (79V nominal)
Start-Up Threshold:	
D12 Models	9-10 Volts (9.3V nominal)
D24 Models	16.5-18 Volts (17V nominal)
D48 Models	34.5-36 Volts (35V nominal)
Undervoltage Shutdown:	
D12 Models	8.5-9.6 Volts (9.3V nominal)
D24 Models	16-17 Volts (16.5V nominal)
D48 Models	33-35 Volts (34V nominal)
Input Current:	
Normal Operating Conditions	See Ordering Guide
Standby Mode:	
Off, OV, UV, Thermal Shutdown	10mA typical
Input Reflected Ripple Current:	
Source Impedance	
D12 Models	TBD
D24 Models	TBD
D48 Models	TBD
Internal Input Filter Type	Pi (0.039µF - 2.2µH - TBD)
Reverse-Polarity Protection:	
D12 Models	TBD minute duration, 6A maximum
D24 Models	TBD minute duration, 4A maximum
D48 Models	TBD minute duration, 2A maximum
On/Off Control (Pin 4): ③ ④ ⑥	
D12, D24, D48 Models	On = open or TBD to +V_{IN},
I_{IN} = TBDµA @ TBDV	
Off = 0-0.8V, I_{IN} = TBD @ 0V	
D12N, D24N, D48N Models	On = 0-0.8V, I_{IN} = TBD @ 0V
Off = open or TBD to +5.5V	
I_{IN} = TBDµA @ TBDV	

Output	
V_{OUT} Accuracy	
2.5V/1.8V Models	1.5% / 2% maximum
3.3V/1.5V and 3.3V/1.8VModels	1% / 2% maximum
3.3V/2.5V Models	1% / 1.5% maximum
Minimum Loading Per Specification	No load
Ripple/Noise (20MHz BW)	See Ordering Guide
Line/Load Regulation	See Ordering Guide
Efficiency	See Ordering Guide/Efficiency Curves
Trim Range ⑧	±5% each output
Isolation Voltage:	
Input-to-Output	1500Vdc
Isolation Capacitance	470pF
Isolation Resistance	100MΩ
Current Limit Inception:	
2.5/1.8V Models	
2.5V @ 98%V_{OUT}, 1.8V @ TBDA	TBD Amps
1.8V @ 98%V_{OUT}, 2.5V @ TBDA	TBD Amps
3.3/1.5V Models	
3.3V @ 98.5%V_{OUT}, 1.5V @ TBDA	TBD Amps
1.5V @ 98%V_{OUT}, 3.3V @ TBDA	TBD Amps

Output (continued)	
Current Limit Inception:	
3.3/1.8V Models	
3.3V @ 98.5%V_{OUT}, 1.8V @ TBDA	TBD Amps
1.8V @ 98%V_{OUT}, 3.3V @ TBDA	TBD Amps 98.5%V_{OUT}
3.3V/2.5V Models	
3.3V @ 98.5%V_{OUT}, , 2.5V @ TBDA	TBD Amps
2.5V @ 98%V_{OUT}, 3.3V @ TBDA	TBD Amps
Short Circuit Current:	
3.3V Outputs	TBD Amps average, continuous
2.5V Outputs	TBD Amps average, continuous
1.8V Outputs	TBD Amps average, continuous
1.5V Outputs	TBD Amps average, continuous
Overvoltage Protection:	Comparator, magnetic feedback
2.5/1.8V Models	TBD/TBD
3.3/1.5V Models	TBD/TBD
3.3/1.8V Models	TBD/TBD
3.3/2.5V Models	TBD/TBD
Maximum Capacitive Loading	
2.5/1.8V Models	TBD/TBDµF
3.3/1.5V Models	TBD/TBDµF
3.3/1.8V Models	TBD/TBDµF
3.3/2.5V Models	TBD/TBDµF
Temperature Coefficient	±0.02% per °C

Dynamic Characteristics	
Dynamic Load Response:	
2.5/1.8V Models	
2.5V (50-100% step to 1.5%V_{OUT})	TBD µsec maximum
1.8V (50-100% step to 2%V_{OUT})	TBD µsec maximum
3.3/1.5V Models	
3.3V (50-100% step to 1%V_{OUT})	TBD µsec maximum
1.8V (50-100% step to 2%V_{OUT})	TBD µsec maximum
3.3/1.8V Models	
3.3V (50-100% step to 1%V_{OUT})	TBD µsec maximum
1.8V (50-100% step to 2%V_{OUT})	TBD µsec maximum
3.3V/2.5V Models	
3.3V (50-100% step to 1%V_{OUT})	TBD µsec maximum
2.5V (50-100% step to 1.5%V_{OUT})	TBD µsec maximum
Start-Up Time:	
V_{IN} to V_{OUT}	TBD
On/Off to V_{OUT}	TBD
Switching Frequency	225kHz (±TBD kHz)

Environmental	
MTBF	
D12 Models	TBD hours
D24 Models	TBD hours
D48 Models	TBD hours
Operating Temperature (Ambient):	
Without Derating:	
2.5/1.8V Models	TBD
3.3/1.8V Models	TBD
3.3V/2.5V Models	TBD
With Derating	To +100°C (See Derating Curves)
Case Temperature:	
Maximum Operational	+100°C
For Thermal Shutdown	TBD minimum, TBD maximum
Storage Temperature	–40 to +120°C

Physical	
Dimensions	2" x 2" x 0.5" (50.8 x 50.8 x 12.7mm)
Case Material	Diallyl phthalate, UL94V-0 rated
Pin Material	Brass, solder coated
Weight:	TBD
Primary to Secondary Insulation Level	Operational

① All models are specified with external TBD ceramic output capacitors.
② See Technical Notes/Graphs for details.
③ Devices may be order with opposite polarity. See Part Number Suffixes and Technical Notes for details.
④ Applying a voltage to On/Off Control (pin 4) when no input power is applied to the converter may cause permanent damage.
⑤ Output noise may be further reduced with the installation of additional external output capacitors. See Technical Notes.
⑥ On/Off control is designed to be driven with open collector or by appropriate voltage levels. Voltages must be referenced to the –Input (pin 2).
⑦ Demonstrated MTBF available on request.
⑧ Trim function for the higher of two voltages available with "T" suffix. See Part Number Suffixes and Technical Notes for details.

Absolute Maximum Ratings		
Input Voltage:		
Continuous:	D12 Models	23 Volts
	D2A Models	42 Volts
	D48 Models	81 Volts
Transient (100msec):	D12 Models	25 Volts
	D24 Models	50 Volts
	D48 Models	100 Volts
Input Reverse-Polarity Protection ②		Input Current must be limited. TBD minute duration. Fusing recommended.
D12A Models		6 Amps
D24A Models		4 Amps
D48A Models		2 Amps
Output Current ②		Current limited. Devices can withstand an indefinite output short circuit.
On/Off Control (Pin 4) Max. Voltages		
Referenced to –Input (pin 2)		
No Suffix		$+V_{IN}$
"N" Suffix		+8 Volts
Sync Control (Pin 3) Max. Voltages		
"S" Suffix		+5.7 Volts
Storage Temperature		–40 to +120°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, nor recommended.

TECHNICAL NOTES

On/Off Control

The primary-side, remote On/Off Control function (pin 4) can be specified to operate with either positive or negative polarity. Positive polarity devices (no suffix) are enabled when pin 4 is left open or pulled high (+TBDV to +TBDV with respect to –Input). Positive polarity devices are disabled when pin 4 is pulled low (0-0.8V with respect to –Input). Negative polarity devices are off when pin 4 is high/open and on when pin 2 is pulled low.

For applications where power sequencing is critical, the DLV series can be configured such that the On/Off Control pin will enable/disable only the higher of the two output voltages. Contact DATEL for more information.

Trimming Output Voltages

These DLV converters have a trim capability (pins 9 & 5) that allow users to independently adjust the output voltages ±5%. (Note: pin 5 is an option, see ordering information.) Adjustments to the output voltages 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 absolute TCR's less than 100ppm/°C to minimize sensitivity to changes in temperature.

A single resistor connected from the Trim pin 9 to +Output (pin 8), see Figure 3, will decrease the lower output voltage. A resistor connected from Trim pin 9 to Output Return (pin 7) will increase the lower output voltage. See Figure 4.

Similarly, the higher output voltage can be adjusted using a single resistor connected from the Trim (pin 5) to +Output (pin 6) or to Output Return (pin 7). See Figures 3 and 4.

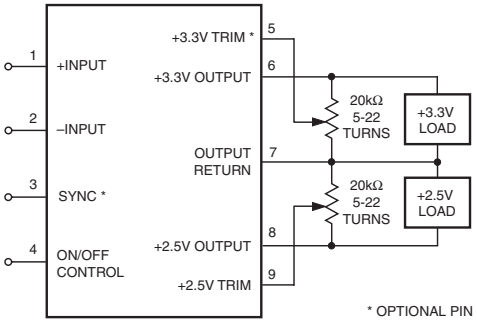


Figure 2. Trim Connections Using A Trim Pot

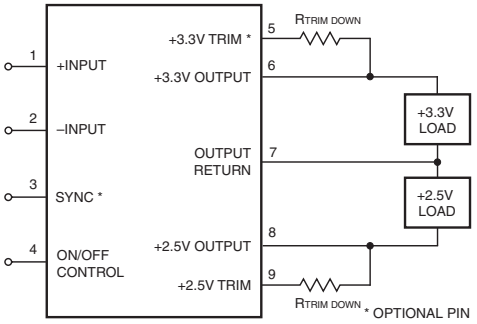


Figure 3. Trim Connections To Decrease Output Voltages Using Fixed Resistors

3.3 Volt Trim Down

$$R_{T_{DOWN}}(k\Omega) = \left[\frac{3.48(V_O - 1.577)}{3.3 - V_O}\right] - 25.5$$

2.5 Volt Trim Down

$$R_{T_{DOWN}}(k\Omega) = \left[\frac{2.41(V_O - 1.18)}{2.5 - V_O}\right] - 17.4$$

1.8 Volt Trim Down

$$R_{T_{DOWN}}(k\Omega) = \left[\frac{1.73(V_O - 0.86)}{1.8 - V_O}\right] - 14.17$$

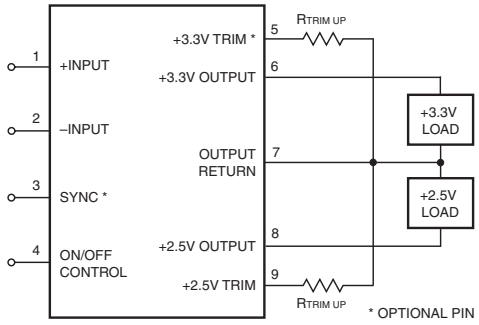


Figure 4. Trim Connections To Increase Output Voltages Using Fixed Resistors

3.3 Volt Trim Up

$$R_{T_{UP}}\ (k\Omega) = \left[\frac{5.88}{V_O - 3.3}\right] - 25.5$$

2.5 Volt Trim Up

$$R_{T_{UP}}\ (k\Omega) = \left[\frac{2.84}{V_O - 2.5}\right] - 17.4$$

1.8 Volt Trim Up

$$R_{T_{UP}}\ (k\Omega) = \left[\frac{1.49}{V_O - 1.8}\right] - 14.17$$

Note: Resistor values are in kΩ. Accuracy of adjustment is subject to tolerances of resistors and factory-adjusted output accuracy. V_O = desired output voltage.

PART NUMBER STRUCTURE

DLV - 3.3 / 6 - 2.5 / 7 - D48 T N

- **DLV** — Dual Low Voltage/ Mixed-Voltage Series
- **3.3** — V_1 Nominal Output Voltage
- **6** — I_1 Maximum Output Current
- **2.5** — V_2 Nominal Output Voltage
- **7** — I_2 Maximum Output Current
- **D48** — Input Voltage Range:
  - **D12** = 10-18 Volts (12V nominal)
  - **D24** = 18-36 Volts (24V nominal)
  - **D48** = 36-75 Volts (48V nominal)
- **T N** — Add T and N suffixes as desired

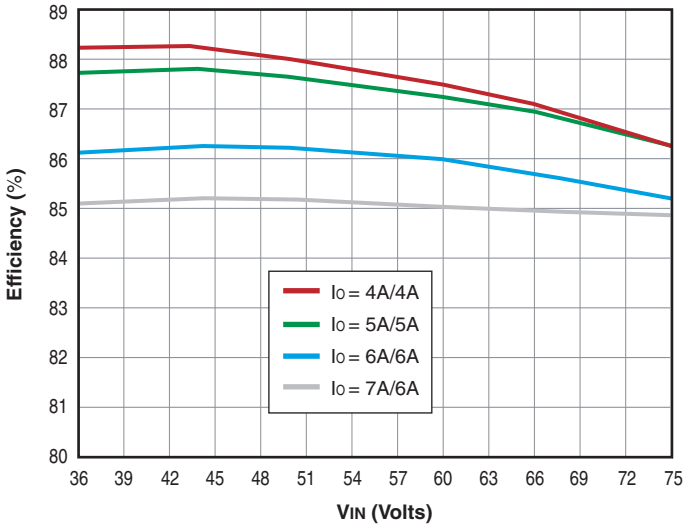
Part Number Suffixes

Standard DLV DC/DC's provide a Trim function (Pin 9) for the lower of the two output voltages. A Trim pin (Pin 5) for the higher voltage can be added by indicating a "T" suffix. An "N" suffix indicates that the On/Off Control function incorporates negative polarity logic.

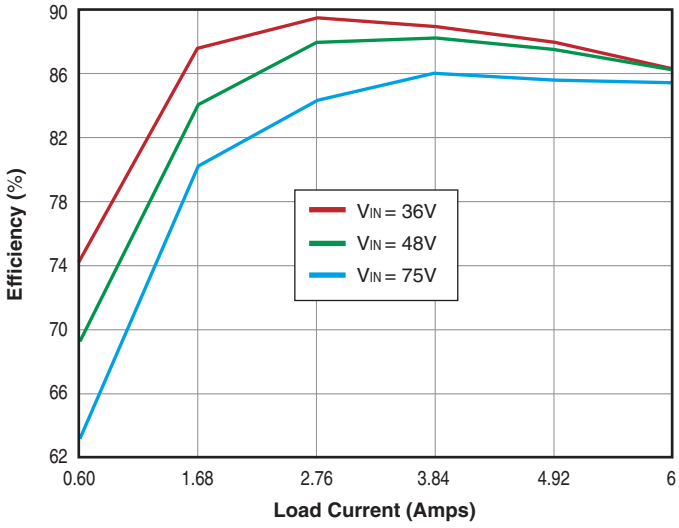
No Suffix	Pins 5 not installed, positive polarity On/Off Control
T Suffix	Pin 5 added for higher voltage Trim option
N Suffix	Negative polarity On/Off Control

TYPICAL PERFORMANCE CURVES

DLV-3.3/6-2.5/7-D48TN Efficiency vs. Load and V_{IN}

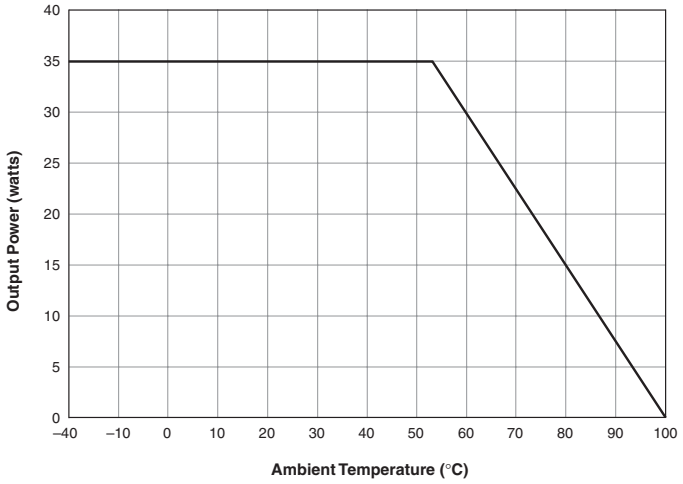


DLV-3.3/6-2.5/7-D48TN Efficiency vs. Line and Load



TEMPERATURE DERATING

DLV-3.3/6-2/5/7-D48TN Output Power vs. Ambient Temperature
(V_{IN} nominal, natural convection air flow.)



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