Preliminary

DTL24A
ANALOG CONTROLLED
ELECTRONIC LOAD

▲

MADE IN USA

DTL Series
DTL24A Model

Voltage-Controlled, 10 Amp
100 Watt, Electronic Loads

Features

- 0-10V Input/control voltage
- 0-10A output/load current
- 2.5-150V output compliance voltage
- 0-100W output/load power
- 10MΩ output impedance
- 500Vdc Isolation
- ±1% accuracy under all conditions
- 200µsec full-scale step response
- 2" x 2", shielded metal package
- Operate in parallel for higher power

Applications

- Power-supply test and characterization
- Static/dynamic power-supply burn-in
- Power-resistor substitution
- Real-time load simulation
- Capacitor discharge testing

The DTL24A is an isolated (500Vdc), near-ideal (Zin = Z_{OUT} >= 10MΩ), analog/voltage-controlled current sink. It's 0-10A ouput/load current is straightforwardly "programmed" by applying a 0-10V input. The control signal can be generated by circuits as simple as the wiper of a trimpot or as sophisticated as programmable logic controllers (PLC's) or analog-output computer I/O boards (D/A boards). The DTL24A supports any combination of I_{OUT} = 0-10 Amps and V_{OUT} = 2.5-150 Volts. Its thermally efficient, metal package, when properly heat sunk, can dissipate output/load power up to 100 Watts.

The easy-to-use DTL24A is an excellent building block for low-cost, fully flexible, power-supply (AC/DC or DC/DC) or power-component (MOSFET's, diodes, etc.) test and burn-in applications. It is accurate (±5mA offset error, ±1% overall accuracy), fast (200µsec full-scale step response), and capable of impressive resolution. If it is controlled with a 12-bit, 0-10V D/A converter, for example, one LSB (least significant bit) of the D/A corresponds to a 2.5mA change in the DTL24A's output/load current.

The DTL24A is packaged in a small (2" x 2" x 0.5"), thermally efficient metal package incorporating an aluminum baseplate with through-hole mounting inserts. It is powered by a single +5V supply and draws a mere 150mA.

The DTL24A has an output compliance voltage of 2.5-150 Volts. Should the output/load voltage drop below the 2.5V required for proper biasing, an internal monitoring circuit activates the DTL24A's output Fault line. See DATEL's DTL22A-LC for compliance voltages as low as 0.6V.

The DTL24A and other electronic loads, controller boards, and software from DATEL are outstanding building-block components for power-supply burn-in and test systems. They are extremely reliable, cost-effective solutions that enable you to quickly configure impressively accurate systems.
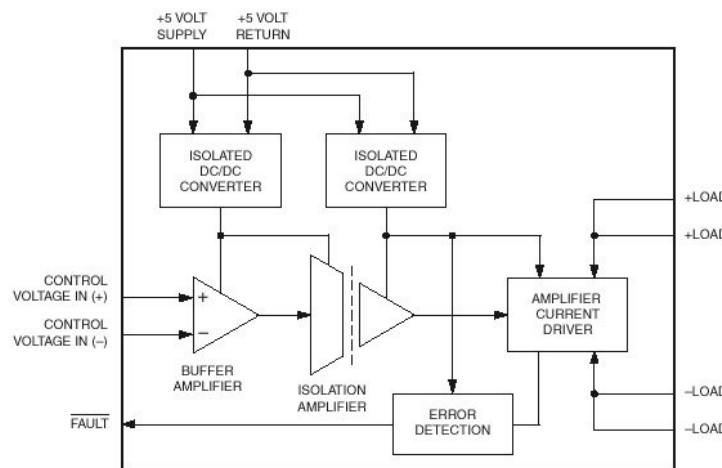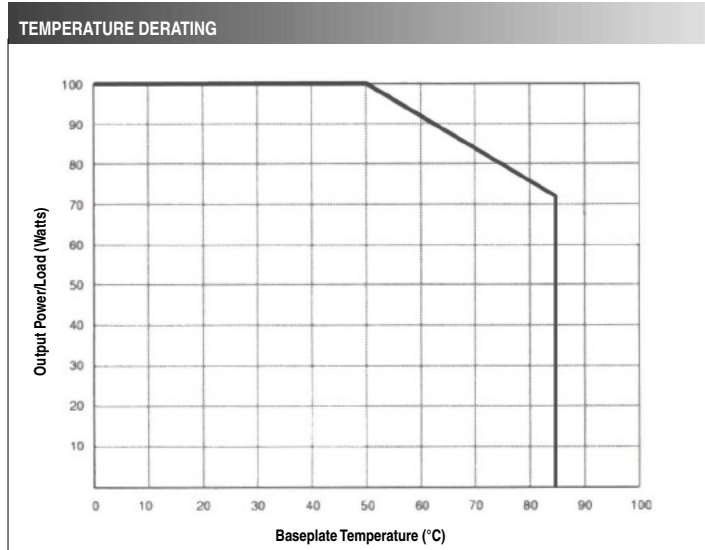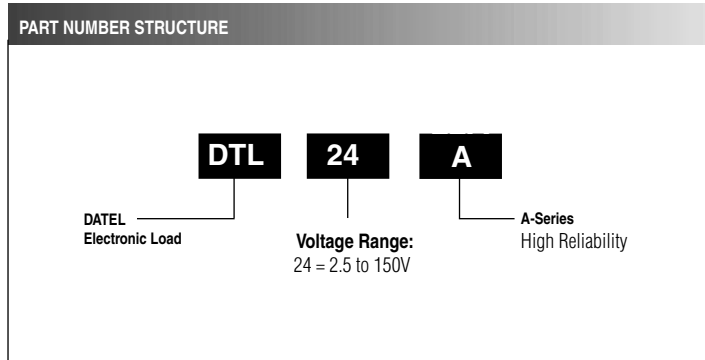

Figure 1. Simplified Schematic

Performance Specifications and Ordering Guide [1]

	Input		Output				
Model	**Control Voltage (Volts)**	**Impedance (Minimum)**	**Current (Amps)**	**Resolution (mA)[2]**	**Compliance Voltage (Volts)[3]**	**Power (Watts)**	**Package (Case, Pinout)**
DTL24A	0 to +10V	10MΩ	0-10	2.5	2.5-150	0-100	C24, P51

[1] Typical at T_A = +25°C with nominal +5V supply voltage, unless noted.

[2] Listed resolution (2.5mA) is for a typical application in which the DTL24A is controlled by a voltage generated by a 12-bit D/A converter with a 0-10V output range. One LSB (least significant bit) of the D/A corresponds to 0.0244% (1/4096) of full scale (10 Amps), which equals approximately 2.5mA.

[3] For proper operation, the unit's output/load voltage must remain within this range. Voltages greater than the listed maximum can damage the device. Voltages less than the minimum provide insufficient bias for the output stage and will result in unpredictable or no operation. See Output Compliance Voltage and the Fault Line for details.

PART NUMBER STRUCTURE

DTL **24** **A**

DATEL
Electronic Load

Voltage Range:
24 = 2.5 to 150V

A-Series
High Reliability

MECHANICAL SPECIFICATIONS

TEMPERATURE DERATING

The horizontal axis of the above chart references the temperature of the DTL24A's aluminum baseplate. The device can continually dissipate up to 100 Watts if the baseplate is maintained at or below +50°C. At +25°C ambient temperature, with no heat sink or supplemenatal air flow, the DTL24A can reliably dissipate a continuous 10 Watts.
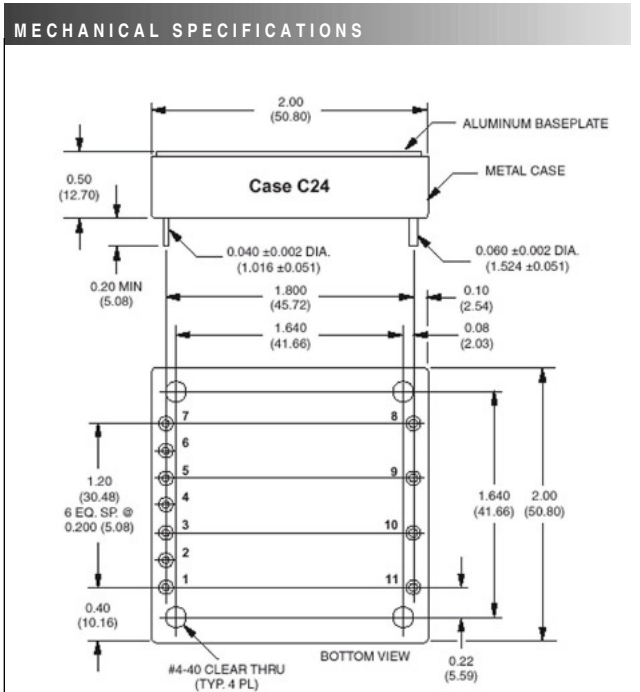
I/O Connections			
Pin	**Function P51**	**Pin**	**Function P51**
1	+5 Volt Supply	7	Control Voltage In (-)
2	+5 Volt Return	8	-Load
3	Fault	9	-Load
4	No Pin	10	+Load
5	Control Voltage In (+)	11	+Load
6	No Pin		

Contact DATEL for Heat Sink information.

Performance/Functional Specifications

Typical @ T_A = +25°C with nominal +5V supply voltage, unless noted.

Input	
Control Voltage	0-10 Volts
Impedance	10 MΩ, minimum
Output	
Transfer Function	I_{OUT} (Amps) = 1 x V_{IN} (Volts)
Current:	
Range	0-10 Amps
Resolution ①	0.025%FS (2.5 mA)
Offset Error ②	±5 mA
Gain Error	±0.25%, maximum
Absolute Accuracy ③	±1%, maximum
Voltage ④	2.5-150 Volts
Power ⑤	0-100 Watts
Isolation Voltage:	
Analog Input to ± Load	500Vdc, minimum
+5V Power to Input or ± Load	500Vdc, minimum
Any pin to case	500Vdc, minimum
Isolation Resistance	100MΩ, minimum
Fault Logic Levels:	
Logic "1" (@150µA)	+3.5 Volts, minimum
Logic "0" (@1.6 mA)	+0.4 Volts, maximum
Dynamic Performance	
Output Slew Rate:	0.4 A/µsec, minimum
Output Settling Time ⑥	200 µsec
Dynamic Loading: ⑥	
10mA to 10A	5 kHz
0 to 10A	1 kHz
Power Requirements	
Power Supply Range (+Vcc, Pin1)	+4.75-5.25 Volts (+5V nominal)
Power Supply Current ⑥	110mA typ., 150mA max.
Environmental	
Operating Temperature ⑦	-25 to +85°C
Storage Temperature	-40 to +85°C
Humidity (Non-condensing)	to 95%
Altitude Above Sea Level	10,000 feet
Physical	
Dimensions	2" x 2" x 0.5" (51 x 51 x 12.7 mm)
Shielding	Six-sided
Case Material	Tin-plated steel shell with aluminum baseplate
Pin Material	Brass, solder coated
Mounting Holes	Through-hole spacers, #4-40 clearance
Weight	1.9 ounces (54 grams)

① Listed resolution (2.5mA) is for a typical application in which the DTL24A is controlled by a voltage generated by a 12-bit D/A converter with a 0-10V output range. One LSB (least significant bit) of the D/A corresponds to 0.0244% (1/4096) of full scale (10 Amps), which equals approximately 2.5mA.

② Offset error is defined as the current sunk/sourced by the DTL24A's output, under any output-voltage conditions, when the applied control voltage is 0 Volts.

③ Applies over all ranges/combinations of specified output current, load voltage, output power, operating temperature and Vcc.

④ For proper operation, the DTL24A's output voltage must remain within the range listed. Voltages greater than the listed maximum can damage the device. Voltages less than the listed minimum provide insufficient bias for the output stage and will result in unpredictable or no operation. See Output Compliance Voltage and Fault Line for details.

⑤ The DTL24A can achieve its maximum output/load power only when its baseplate temperature is properly maintained. See Temperature Derating.

⑥ Specified for the full-scale step from 10mA to 10 Amps settling to ±1% (±100mA) of final value. A minimal loading of 10mA is recommended to achieve the fastest dynamic response.

⑦ Baseplate temperature. See Note 5 and Temperature Derating.

Absolute Maximum Ratings	
Power Supply Voltage (+Vcc, Pin 1)	-0.5 to +5.5 Volts
Control Voltage In (Pin 5)	-0.5 to +15 Volts
Output Reverse-Polarity Protection	No protection
Output Overvoltage Protection	No protection
Output Undervoltage Protection	Yes (See Fault Line)
Case Temperature	+85°C
Storage Temperature	−40 to +85°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

Overview

The DTL24A is an analog programmable (0 to +10V control) current sink. Its output/load current range is 0 to 10 Amps over a compliance voltage range of 2.5 to 150 Volts and an output/load power range of 0 to 100 Watts. The device's transfer function is as follows:

$$I_{out} \text{ (Amps)} = 1 \times V_{IN} \text{ (Volts)}$$

Examples: Control V_{IN} = 1 Volt, I_{OUT} = 1 Amps
Control V_{IN} = 10 Volts, I_{OUT} = 10 Amps

In a typical power-supply test or burn-in application, the output pins of the device under test (DUT) are connected to the DTL24A's +Load (pins 10 and 11) and -Load (pins 8 and 9) outputs.

TECHNICAL NOTES

Output Compliance Voltage and the $\overline{\text{Fault}}$ Line

For proper operation, the DTL24A's output/load voltage must always be between 2.5 and 150 Volts. The device cannot be used to directly load extremely low voltage (such as 1.5V or 1.8V) power components or to simulate a true short circuit (0 Volts). Voltages greater than 150V can damage the device. Voltages < 2.5V will result in insufficient biasing of the output current source and consequently unpredictable or no operation. Accordingly, we have installed an internal output/load-voltage monitoring circuit. If the output//load voltage drops below 2.5V and the DTL24A's output is at risk of becoming disabled, the $\overline{\text{Fault}}$ line activates.

The $\overline{\text{Fault}}$ line is an active-low function with an open-collector output (internal 10kΩ pull-up resistor to +5V). Under normal conditions, its output is high (logic "1"). Under fault conditions (Vout < 2.5V), its output drops to a logic "0". There is no output/load-voltage monitoring circuit for voltages greater than 150V, and operation above 150V can damage the device.

An "offset supply" can be inserted between the DTL24A's -Load output (pins 8 and 9) and the power device under test (DUT) to "translate" the DTL24A's 147.5V output/load voltage range. The offset supply must have adequate current capabilities and be connected with the polarities indicated in Figure 2 below. Under no circumstances should the voltage across the DTL24A's output be allowed to experience a polarity reversal.

If a 5V/10A offset supply is inserted as shown, the range of DUT voltages will be -2.5 to +145 Volts. Such a configuration can be used for true short-circuit testing. A mechanical relay can be used to short the outputs of the DUT while the offset supply ensures the DTL24A always sees at least 5 Volts across its outputs.
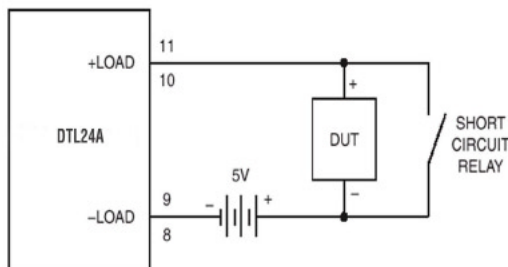
Thermal Considerations

The DTL24A can reliably handle 100W loads if its aluminum baseplate temperature is maintained at or below +50°C. With no heat sinking or auxiliary cooling, the device can only handle loads up to 10 Watts. Please refer to the Temperature Derating Curve for additional information. Datel's Electronic Load Applications Engineers can assist you in developing heat-sink solutions for your higher-power DTL24A applications. Please contact us for details and concerning our DTL-HS100D12 heat sink.

Constant Resistance Application

The DTL24A operates as a constant current electronic load in its typical configuration. A constant resistance mode of operation can be achieved as follows:

The DTL24A has a high impedance isolated analog input, that allows the analog inputs to be connected directly across the load. The DTL24A sinks 10 amps for a 10V full scale input or $I = 1 \times V_{IN}$. If you make $V_{IN} = V_{LOAD}$ (the voltage across the load), then $R = V_{LOAD}/I = V_{LOAD} / (1 \times V_{LOAD}) = 1.0$ Ohms. Consequently, the load looks like a 1.0 Ohm resistor.

Furthermore, if you make $V_{IN} = k \times V_{LOAD}$ by connecting a potentiometer or resistive divider across the load, then $R = V_{LOAD} / (1 \times k \times V_{LOAD}) = 1/k$ so adjusting the potentiometer will give you an adjustable power resistor e.g. at K = 1, then R = 1 Ohm, k = 0.5 then R = 2 Ohms, etc. The only limitation that you must observe is the maximum load voltage (150V) and 100 watt power dissipation. A multiplying digital-to-analog converter, or a digital potentiometer could be utilized to make a programmable resistance.

**Figure 2. An "offset Supply" Enables
True Short-Circuit Testing**