



**OBSOLETE PRODUCT**

## DTL Series DTL23A Model

Voltage-Controlled, 2 Amp  
100 Watt, Electronic Loads

### Features

- 0-10V Input/control voltage
- 0-2A output/load current
- 2.5-200V 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 DTL23A is an isolated (500Vdc), near-ideal ( $Z_{in} = Z_{out} \geq 10M\Omega$ ), analog/voltage-controlled current sink. Its 0-2.0A output/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 DTL23A supports any combination of  $I_{OUT} = 0-2.0$  Amps and  $V_{OUT} = 2.5-200$  Volts. Its thermally efficient, metal package, when properly heat sunk, can dissipate output/load power up to 100 Watts.

The easy-to-use DTL23A 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 ( $\pm 5mA$  offset error,  $\pm 1\%$  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 0.5mA change in the DTL23A's output/load current.

The DTL23A 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 DTL23A has an output compliance voltage of 2.5-200 Volts. Should the output/load voltage drop below the 2.5V required for proper biasing, an internal monitoring circuit activates the DTL23A's output Fault line. See DATEL's DTL22A-LC for compliance voltages as low as 0.6V.

The DTL23A 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.

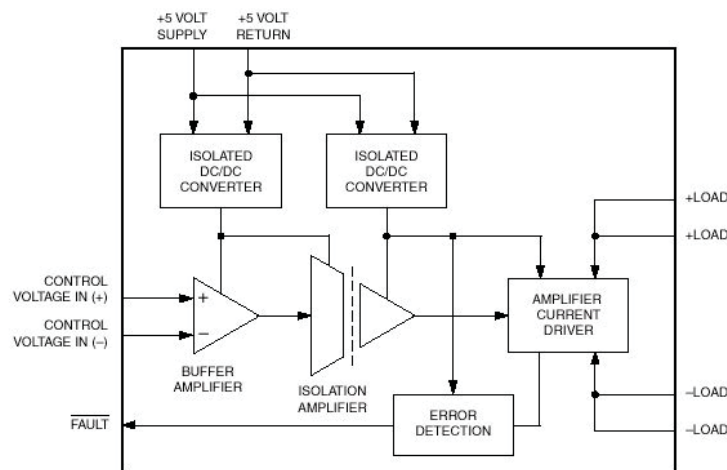
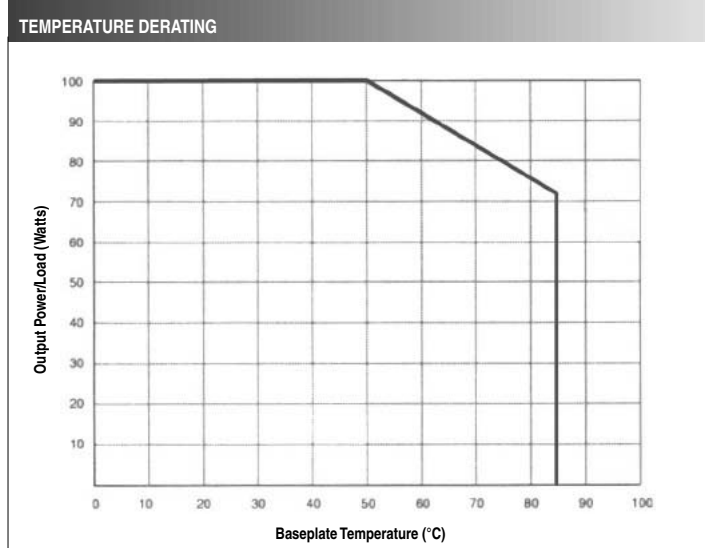
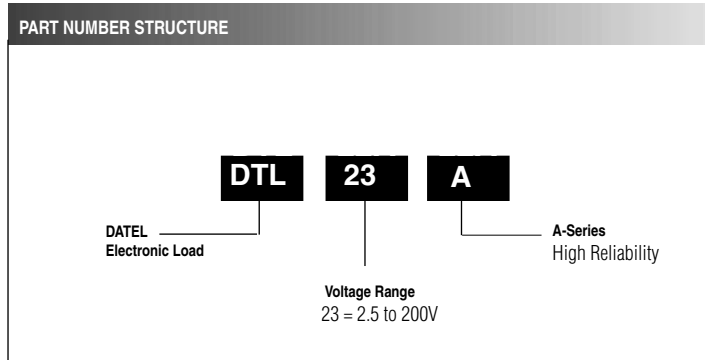


Figure 1. Simplified Schematic

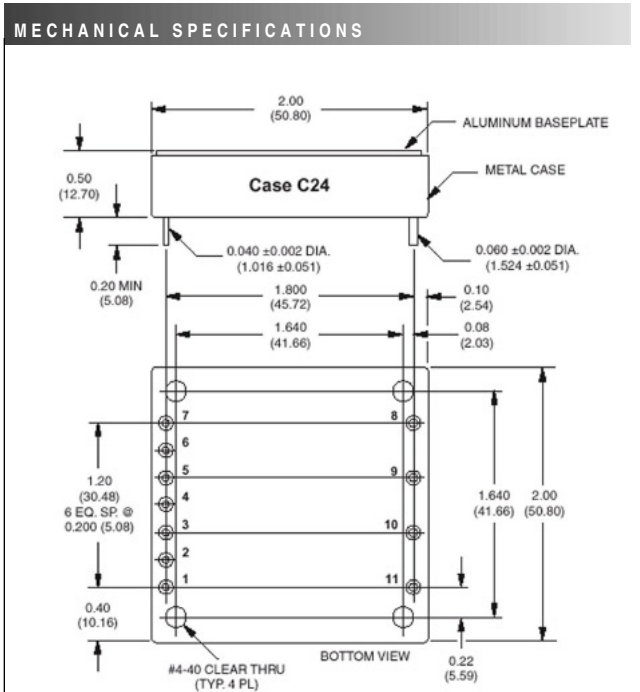
**Performance Specifications and Ordering Guide** ①

| Model  | Input                   |                     | Output         |                              |                                         |               | Package (Case, Pinout) |
|--------|-------------------------|---------------------|----------------|------------------------------|-----------------------------------------|---------------|------------------------|
|        | Control Voltage (Volts) | Impedance (Minimum) | Current (Amps) | Resolution (mA) <sup>②</sup> | Compliance Voltage (Volts) <sup>③</sup> | Power (Watts) |                        |
| DTL23A | 0 to +10V               | 10MΩ                | 0-2.0          | 0.5                          | 2.5-200                                 | 0-100         | C24, P51               |

- ① Typical at TA = +25°C with nominal +5V supply voltage, unless noted.
- ② Listed resolution (0.5mA) is for a typical application in which the DTL23A 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 (2.0 Amps), which equals approximately 0.5mA.
- 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.



The horizontal axis of the above chart references the temperature of the DTL23A'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 supplemental air flow, the DTL23A 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 @  $T_A = +25^\circ\text{C}$  with nominal +5V supply voltage, unless noted.

| Input                                  |                                                       |
|----------------------------------------|-------------------------------------------------------|
| Control Voltage                        | 0-10 Volts                                            |
| Impedance                              | 10 M $\Omega$ , minimum                               |
| Output                                 |                                                       |
| Transfer Function                      | $I_{out} \text{ (Amps)} = 0.2 V_{in} \text{ (Volts)}$ |
| <b>Current:</b>                        |                                                       |
| Range                                  | 0-2.0 Amps                                            |
| Resolution ①                           | 0.025%FS (0.5 mA)                                     |
| Offset Error ②                         | $\pm 5$ mA                                            |
| Gain Error                             | $\pm 0.25\%$ , maximum                                |
| Absolute Accuracy ③                    | $\pm 1\%$ , maximum                                   |
| <b>Voltage ④</b>                       | 2.5-200 Volts                                         |
| <b>Power ⑤</b>                         | 0-100 Watts                                           |
| <b>Isolation Voltage:</b>              |                                                       |
| Analog Input to $\pm$ Load             | 500Vdc, minimum                                       |
| +5V Power to Input or $\pm$ Load       | 500Vdc, minimum                                       |
| Any pin to case                        | 500Vdc, minimum                                       |
| <b>Isolation Resistance</b>            | 100M $\Omega$ , minimum                               |
| <b>Fault Logic Levels:</b>             |                                                       |
| Logic "1" (@ 150 $\mu$ A)              | +3.5 Volts, minimum                                   |
| Logic "0" (@ 1.6 mA)                   | +0.4 Volts, maximum                                   |
| Dynamic Performance                    |                                                       |
| <b>Output Slew Rate:</b>               | 0.4 A/ $\mu$ sec, minimum                             |
| <b>Output Settling Time ⑥</b>          | 200 $\mu$ sec                                         |
| <b>Dynamic Loading: ⑥</b>              |                                                       |
| 10mA to 2.0A                           | 5 kHz                                                 |
| 0 to 2.0A                              | 1 kHz                                                 |
| Power Requirements                     |                                                       |
| <b>Power Supply Range (+Vcc, Pin1)</b> | +4.75-5.25 Volts (+5V nominal)                        |
| <b>Power Supply Current ⑥</b>          | 110mA typ., 150mA max.                                |
| Environmental                          |                                                       |
| <b>Operating Temperature ⑦</b>         | -25 to +85 $^\circ\text{C}$                           |
| <b>Storage Temperature</b>             | -40 to +85 $^\circ\text{C}$                           |
| <b>Humidity (Non-condensing)</b>       | to 95%                                                |
| <b>Altitude Above Sea Level</b>        | 10,000 feet                                           |
| Physical                               |                                                       |
| <b>Dimensions</b>                      | 2" x 2" x 0.5" (51 x 51 x 12.7 mm)                    |
| <b>Shielding</b>                       | Six-sided                                             |
| <b>Case Material</b>                   | Tin-plated steel shell with aluminum baseplate        |
| <b>Pin Material</b>                    | Brass, solder coated                                  |
| <b>Mounting Holes</b>                  | Through-hole spacers, #4-40 clearance                 |
| <b>Weight</b>                          | 1.9 ounces (54 grams)                                 |

- ① Listed resolution (0.5mA) is for a typical application in which the DTL23A 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 (2.0 Amps), which equals approximately 0.5mA.
- ② Offset error is defined as the current sunk/sourced by the DTL23A'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  $V_{cc}$ .
- ④ For proper operation, the DTL23A'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 DTL23A 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 2.0 Amps settling to  $\pm 1\%$  ( $\pm 20$ mA) 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

|                                              |                             |
|----------------------------------------------|-----------------------------|
| <b>Power Supply Voltage (+Vcc, Pin 1)</b>    | -0.5 to +5.5 Volts          |
| <b>Control Voltage In (Pin 5)</b>            | -0.5 to +15 Volts           |
| <b>Output Reverse-Polarity Protection</b>    | No protection               |
| <b>Output Overvoltage Protection</b>         | No protection               |
| <b>Output Undervoltage Protection</b>        | Yes (See Fault Line)        |
| <b>Case Temperature</b>                      | +85 $^\circ\text{C}$        |
| <b>Storage Temperature</b>                   | -40 to +85 $^\circ\text{C}$ |
| <b>Lead Temperature (soldering, 10 sec.)</b> | +300 $^\circ\text{C}$       |

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 DTL23A is an analog programmable (0 to +10V control) current sink. Its output/load current range is 0 to 2.0 Amps over a compliance voltage range of 2.5 to 200 Volts and an output/load power range of 0 to 100 Watts. The device's transfer function is as follows:

$$I_{out} \text{ (Amps)} = 0.2 V_{in} \text{ (Volts)}$$

Examples: Control  $V_{in} = 1$  Volt,  $I_{out} = 0.2$  Amps  
Control  $V_{in} = 10$  Volts,  $I_{out} = 2.0$  Amps

In a typical power-supply test or burn-in application, the output pins of the device under test (DUT) are connected to the DTL23A's +Load (pins 10 and 11) and -Load (pins 8 and 9) outputs.

## TECHNICAL NOTES

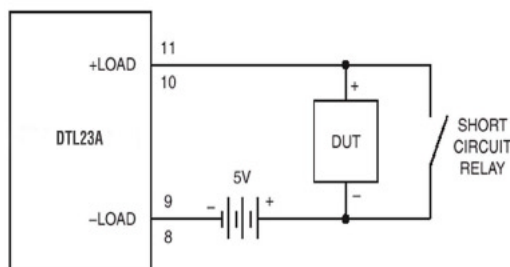
**Output Compliance Voltage and the Fault Line**

For proper operation, the DTL23A's output/load voltage must always be between 2.5 and 200 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 200V 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 DTL23A's output is at risk of becoming disabled, the Fault line activates.

The Fault line is an active-low function with an open-collector output (internal 10k $\Omega$  pull-up resistor to +5V). Under normal conditions, its output is high (logic "1"). Under fault conditions ( $V_{out} < 2.5V$ ), its output drops to a logic "0". There is no output/load-voltage monitoring circuit for voltages greater than 200V, and operation above 200V can damage the device.

An "offset supply" can be inserted between the DTL23A's -Load output (pins 8 and 9) and the power device under test (DUT) to "translate" the DTL23A's 197.5V 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 DTL23A's output be allowed to experience a polarity reversal.

If a 5V/2.0A offset supply is inserted as shown, the range of DUT voltages will be -2.5 to +195 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 DTL23A always sees at least 5 Volts across its outputs.



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

**Thermal Considerations**

The DTL23A 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. Datal's Electronic Load Applications Engineers can assist you in developing heat-sink solutions for your higher-power DTL23A applications. Please contact us for details and concerning our DTL-HS100D12 heat sink.

**Constant Resistance Application**

The DTL23A operates as a constant current electronic load in its typical configuration. A constant resistance mode of operation can be achieved as follows:

The DTL23A has a high impedance isolated analog input, that allows the analog inputs to be connected directly across the load. The DTL23A sinks 2.0 amps for a 10V full scale input or  $I = 0.2 \times V_{IN}$ . If you make  $V_{IN} = V_{LOAD}$  (the voltage across the load), then  $R = V_{LOAD}/I = V_{LOAD} / (0.2 \times V_{LOAD}) = 5$  Ohms. Consequently, the load looks like a 5 Ohm resistor.

Furthermore, if you make  $V_{IN} = k \times V_{LOAD}$  by connecting a potentiometer or resistive divider across the load, then  $R = V_{LOAD} / (0.2 \times k \times V_{LOAD}) = 5/k$  so adjusting the potentiometer will give you an adjustable power resistor e.g. at  $K = 5$ , then  $R = 1$  Ohm,  $k = 2.5$  then  $R = 2$  Ohms, etc. The only limitation that you must observe is the maximum load voltage (200V) and 100 watt power dissipation. A multiplying digital-to-analog converter, or a digital potentiometer could be utilized to make a programmable resistance.

