Murata Power Solutions

OBSOLETE PRODUCT

DTL Series
DTL4A Model

Digitally Programmable, 10A/150V
100 Watt, Electronic Loads

Features

- 12-bit, optically isolated (500Vdc), CMOS/TTL-compatible serial input
- 0-10 Amp output in 2.44mA increments
- 10MΩ minimum output impedance
- Output voltage to 150 Volts
- Output power to 100 Watts
- ±3mA offset error; ±0.1% gain error
- 100µsec full-scale step response
- Update rates to 20kHz
- Operate in parallel for higher power
- Miniature, 2" x 2" metal package

Applications

- Static/dynamic power-supply burn-in
- Power-supply test and characterization
- Battery capacity testing
- Current-source testing
- Capacitor discharge testing
- Real-time load simulation

DATEL's new DTL4A is an optically isolated, digitally programmable, serial-input, electronic load. It is essentially a digitally controlled current source that can sink currents from 0 to 10 Amps, at loading voltages from 2.5 to 150 Volts, up to a maximum power of 100 Watts. The DTL4A is packaged in a thermally ef cient, 2" x 2" x 0.5" metal package that incorporates an aluminum baseplate with through-hole spacers for easy pcb mounting and/or external heat-sink attachment.

The DTL4A accepts a serialized, 12-bit, CMOS/TTL-compatible, digital input word easily generated by any standard digital I/O card. The DTL4A buffers and then optically isolates (500Vdc) the digital input data before storing it in a register and presenting it to an on-board, 12-bit, digital-to-analog (D/A) converter. The D/A output drives a near-ideal (10MΩ minimum output impedance), voltage-controlled current source. One LSB (least signi cant bit) of the D/A converter corresponds to a 2.4mA increment (0.024% of 10A) in load current.

The DTL4A features a max. ±3mA offset error and a max. ±0.1% gain error. It has an impressive full-scale step response time of 100µsec and can be operated dynamically at update rates up to 20kHz. Powered by a single +5V supply, the DTL4A draws a mere 150mA (maximum).

While operating in the constant-current mode up to 10 Amps (100W max. power), the output compliance voltage of the DTL4A is 2.5 to 150 Volts. Should the output/load voltage drop below the 2.5V minimum required for proper biasing, an internal monitoring circuit activates the DTL4A's output Fault line. See DATEL's DTL2A-LC for compliance voltages as low as 0.6V.

DTL4A's 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 an extremely reliable, cost-effective solution that enables you to quickly con gure impressively accurate systems.

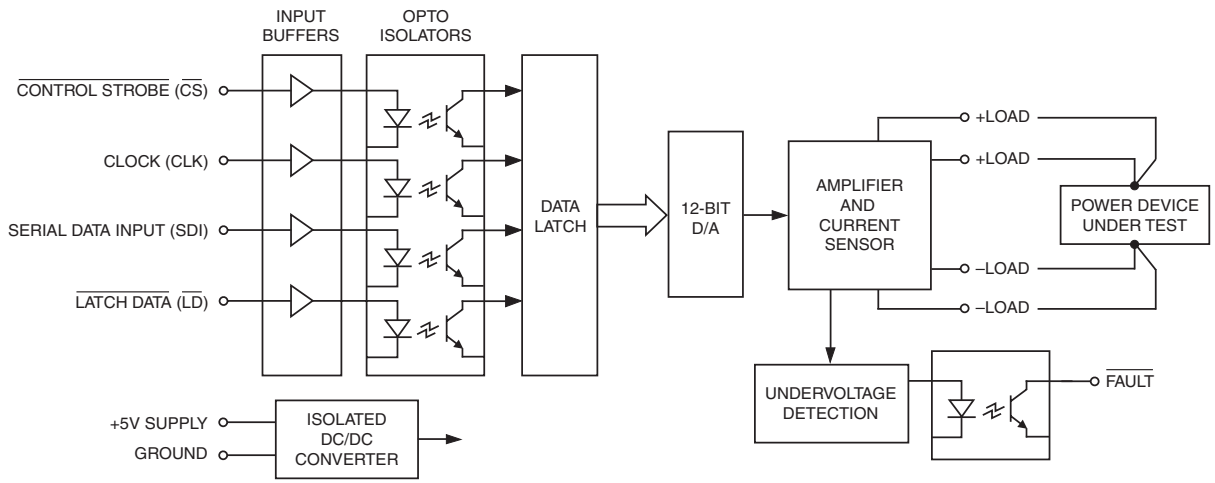


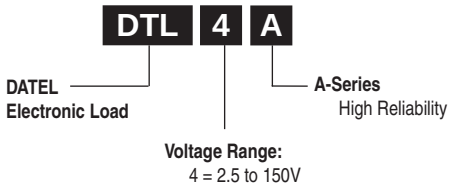
Figure 1. Simplified Schematic

Performance Specifications and Ordering Guide ①

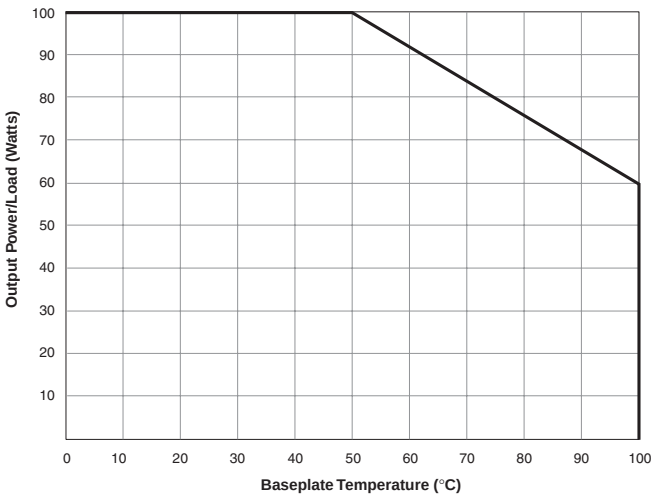
Model	Input		Output				Package (Case, Pinout)
	Resolution (Bits)	Logic Compatibility	Current (Amps)	Resolution (mA) ②	Compliance Voltage (Volts) ③	Power (Watts)	
DTL4A	12	CMOS/TTL ④	0-10	2.44	2.5-150	0-100	C24, P31

① Typical at TA = +25°C with nominal +5V supply voltage unless noted.
② The smallest increment/decrement in output current is defined by one LSB (least significant bit) of the 12-bit digital input word. One LSB is equal to full scale (FS) divided by 4096 which corresponds to 0.0244% of 10A or 2.44mA.
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 $\overline{\text{Fault}}$ Line for details.
④ See Performance/Functional Specifications for details.

PART NUMBER STRUCTURE

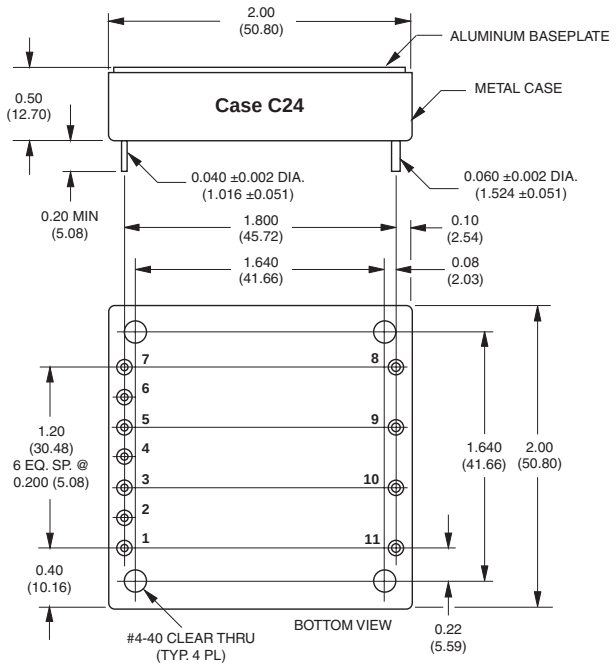


TEMPERATURE DERATIN



The horizontal axis of the above chart references the temperature of the DTL4A'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 DTL4A can reliably dissipate a continuous 10 Watts.

MECHANICAL SPECIFICATIONS



I/O Connections			
Pin	Function P31	Pin	Function P31
1	$\overline{\text{Fault}}$	7	$\overline{\text{Control Strobe}}$ ($\overline{\text{CS}}$)
2	Ground	8	–Load
3	+5 Volt Supply	9	–Load
4	$\overline{\text{Latch Data}}$ ($\overline{\text{LD}}$)	10	+Load
5	Serial Data In (SDI)	11	+Load
6	Clock (CLK)		

Contact DATEL for Heat Sink information.

Performance/Functional Specifications

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

Digital Inputs/Outputs	
Logic Compatibility (Pins 1, 4-7)	CMOS/TTL
Input Logic Levels:	
Logic "1"	+2 Volts, minimum
Logic "0"	+0.8 Volts, maximum
Input Logic Loading:	
Logic "1" (I_{IH} @ V_{IH} = 5 Volts)	20µA, maximum
Logic "0" (I_{IL} @ V_{IL} = 0 Volts)	–0.6mA, maximum
Output Logic Levels:	
Logic "1" (@ 150µA)	+3.5 Volts, minimum
Logic "0" (@ 1.6mA)	+0.4 Volts, maximum
Timing	See Timing Diagram
Output	
Current:	
Range	0-10 Amps
Resolution ①	0.024%FS (2.44mA)
Accuracy ⑥	±1%, maximum
Voltage Range ②	2.5-150 Volts
Power Range	0-100 Watts
Impedance	10MΩ, minimum
Offset Error ③	±3mA, maximum
Gain Error	±0.1%, maximum
Isolation Voltage:	
Digital Inputs/Output to ±Load	500Vdc, minimum
Any Pin to Case	500Vdc, minimum
Isolation Resistance	100MΩ, minimum
Dynamic Performance	
Output Slew Rate	±10A/µsec, minimum
Output Settling Time ④	100µsec
Digital Input Update Rate	to 20kHz
Power Requirements	
Power Supply Range (+Vcc, Pin 3)	+4.75-5.25 Volts (+5V nominal)
Power Supply Current	110mA typ., 150mA max.
Environmental	
Operating Temperature ⑤	–40 to +100°C (Case)
Storage Temperature	–40 to +125°C (Ambient)
Humidity (Non-condensing)	to 95%
Altitude Above Sea Level	10,000 feet
Physical	
Dimensions	2" x 2" x 0.5" (51 x 51 x 12.7mm)
Shielding	6-sided (Connected to pin 2)
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 The smallest increment/decrement in output current is defined by one LSB (least significant bit) of the 12-bit digital input word. One LSB is equal to full scale (FS) divided by 4096 which corresponds to 0.0244% of 10A or 2.44mA.

② 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 $\overline{\text{Fault}}$ Line for details.

③ Offset error is defined as the current sunk/sourced by the DTL4A's output, under any output voltage conditions, when the digital input word is all "0's."

④ Full scale step (10 Amps) settling to within ±2.44mA of its final value.

⑤ See Temperature Derating.

⑥ Applies over all specified ranges/combinations of load voltage/current, operating temperature, and Vcc.

Absolute Maximum Ratings	
Power Supply Voltage (+Vcc, Pin 3)	–0.5 to +5.5 Volts
Digital Input Voltage (Pins 4-7)	–0.5 to +5.5 Volts
Output Reverse-Polarity Protection	No protection
Output Overvoltage Protection	No protection
Output Undervoltage Protection	Yes (See Fault Line)
Case Temperature	+105°C
Storage Temperature (Ambient)	–40 to +125°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 DTL4A is a digitally programmable, CMOS/TTL-compatible, serial-input current sink. It's output/load current range is 0 to 10 Amps (in 2.44mA increments), 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 digital I/O coding is straight binary (see table below). A digital input of all "0's" forces a load current of 0 Amps. A digital input of all "1's" forces a load current of 9.99756 Amps.

In a typical power-supply test or burn-in application, the output pins of the device under test (DUT) are connected to the DTL4A's +Load (pins 10 and 11) and –Load (pins 8 and 9) outputs. The DTL4A's operation is controlled by its four digital input lines (Serial Data In, Clock, $\overline{\text{Latch Data}}$ and $\overline{\text{Control Strobe}}$).

Serial Input Data Word			Load Current (Amps)
MSB		**LSB**	**DTL4A**
1111	1111	1111	9.9976
1100	0000	0000	7.5000
1000	0000	0000	5.0000
0111	1111	1111	4.9976
0100	0000	0000	2.5000
0010	0000	0000	1.2500
0000	0000	0001	0.0024
0000	0000	0000	0.0000

Mapping of the Serial-Input Data to Load Current

Initialization

Preparing the DTL4A to accept new digital data is accomplished by applying logic "1's" to Control Strobe ($\overline{CS}$, pin 7), Latch Data ($\overline{LD}$, pin 4) and Clock (CLK, pin 6) with all signals present and stable for a minimum of 1µsec. During this interval, it does not matter whether or not data is present on the Serial Data In (SDI, pin 5) line.

Serial Data

Following initialization, the 12-bit digital word representing the desired output current is applied to the SDI pin. The serial data should appear starting with the most significant bit (MSB, bit 1, D11) and ending with the least significant bit (LSB, bit 12, D0). With each data bit present and stable on the SDI line, the CLK must be toggled through a low-to-high transition to register that bit. Twelve rising clock edges, at rates up to 500kHz, are required to clock all 12 digital bits into the DTL4A's input register.

Latching Data and Presenting It to the D/A

After loading the LSB, the serial data word is latched by bringing the $\overline{\text{Control Strobe}}$ (pin 7) high and then toggling the $\overline{\text{Latch Data}}$ pin (pin 4) through a high-low-high sequence. Approximately 100µsec later, the output current will settle to its final desired value.

Software: C Language

The following steps describe a typical timing sequence when using the DTL4A's 4 digital inputs and a programming language such as C. Using 4 bits of a typical 8-bit port, assign BIT_0 to the $\overline{\text{Control Strobe}}$ ($\overline{CS}$, pin 7), BIT_1 to $\overline{\text{Latch Data}}$ ($\overline{LD}$, pin 4), BIT_2 to Serial Data In (SDI, pin 5), and BIT_3 to the Clock (CLK, pin 6).

1. Initialize with $\overline{\text{Control Strobe}}$, $\overline{\text{Latch Data}}$, and Clock high:
   BIT_0 = 1, BIT_1 = 1, BIT_2 = X (don't care), BIT_3 = 1
2. Bring the $\overline{\text{Control Strobe}}$ low.
   BIT_0 = 0
3. Apply the MSB (D11) of the serial data word to Serial Data In.
   BIT_2 = 0 or 1
4. Toggle the Clock high-low-high.
   BIT_3 = 1 to 0 to 1
5. Apply D10 of the serial data word to Serial Data In.
   BIT_2 = 0 or 1
6. Toggle the Clock high-low-high.
   BIT_3 = 1 to 0 to 1
7. Repeat the process for remaining data bits D9 through D0.
8. Drive the $\overline{\text{Control Strobe}}$ high.
   BIT_0 = 1
9. Toggle the $\overline{\text{Latch Data}}$ input high-low-high.
   BIT_1 = 1 to 0 to 1.

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

For proper operation, the DTL4A's output/load voltage must always be between 2.5 and 150 Volts. The device cannot be used to directly load low-voltage, e.g. 1.8V or 2.5V, 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 DTL4A's output is at risk of becoming disabled, the $\overline{\text{Fault}}$ line activates.

The $\overline{\text{Fault}}$ line is an optically isolated, 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 (V_{OUT} < 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 DTL4A's –Load output (pins 8 and 9) and the power device under test (DUT) to "translate" the DTL4A'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 DTL4A's output be allowed to experience a polarity reversal.

If a 5V/20A 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 DTL4A always sees at least 5 Volts across its outputs.

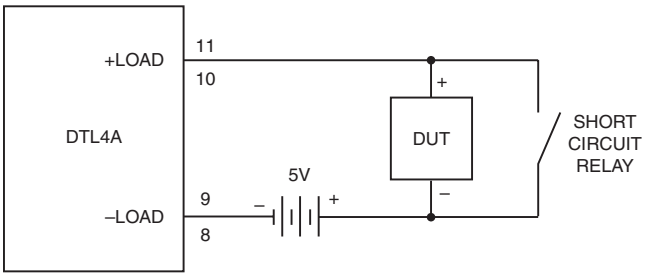
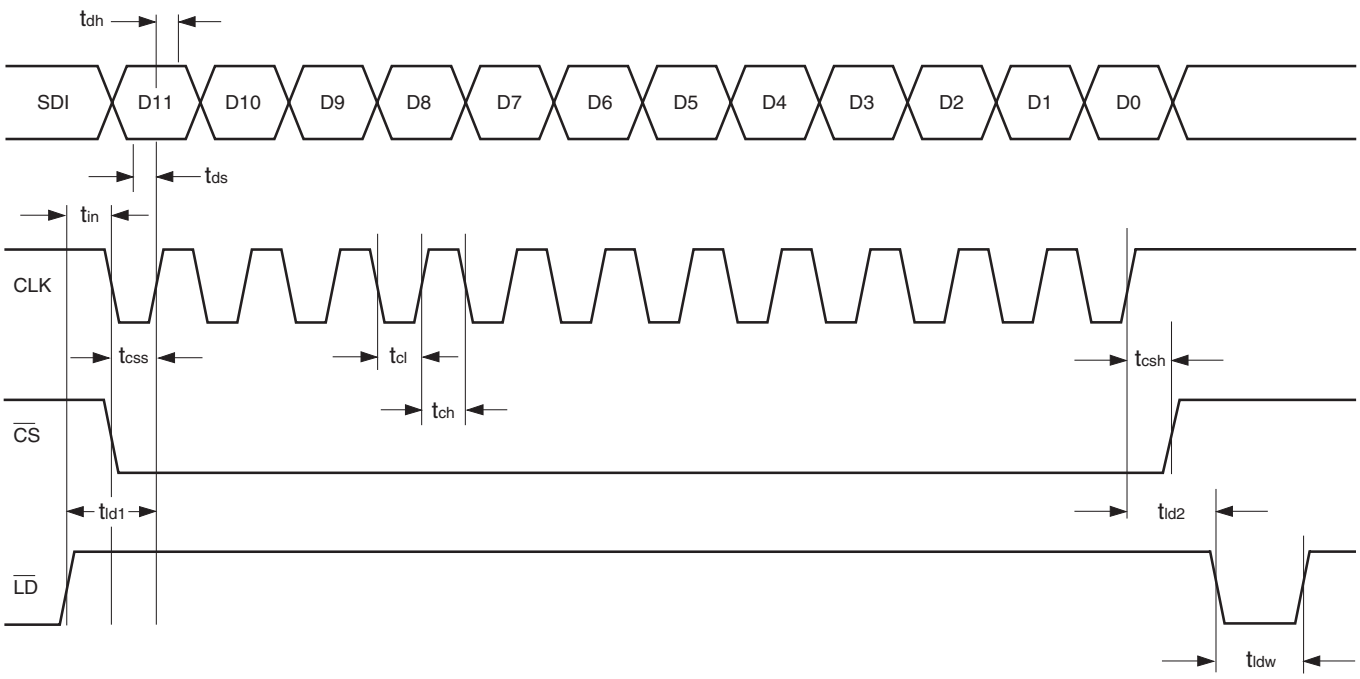


Figure 2. An "Offset Supply" Enables True Short-Circuit Testing

Thermal Considerations

The DTL4A can reliably handle 100W loads if its case 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 DTL4A applications. Please contact us for details.



Timing	Min.	Typ.	Max.	Units
CLK	–	–	200	kHz
t_{in}	1	–	–	µsec
$t_{cl} = t_{ch}$	1	–	–	µsec
t_{css}	1	–	–	µsec
t_{csh}	1	–	–	µsec
t_{ld1}	2	–	–	µsec
t_{ld2}	2	–	–	µsec
t_{ldw}	2	–	–	µsec
t_{ds}	0.5	–	–	µsec
t_{dh}	0.5	–	–	µsec

Figure 3. DTL4A Timing Diagram

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