

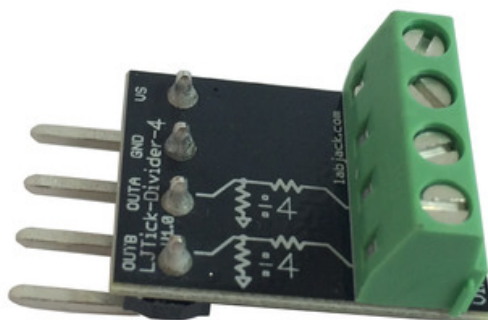
LJTick-Divider Datasheet

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[LJTick-Divider](#)

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LJTick-Divider

The LJTick-Divider (LJTD) is a signal-conditioning module designed to divide 2 single-ended channels of higher voltage analog signals down to 0-3.5 volt signals. The stock builds provide divisions of $/4$, $/5$, $/10$, and $/25$, and there is a -C custom option for user specified builds. The use of large resistors and a precision op-amp buffer provide an input impedance of about 1 M Ω . By adding or replacing resistors, many other configurations are possible.

The 4-pin design plugs into the standard AIN/AIN/GND/VS screw terminal block found on all LabJacks except the original U12. Note that the best performance on the U3 or T7 is achieved with low-voltage inputs (labeled FIO and EIO).



Figure 1: LJTICK-Divider

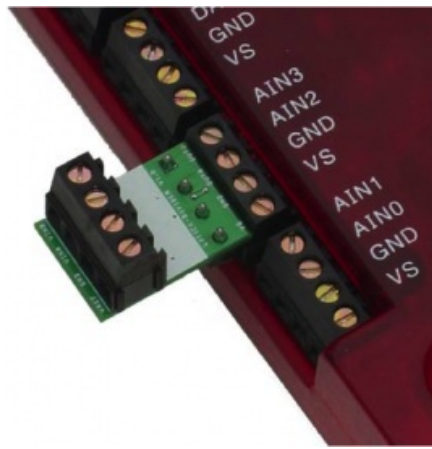


Figure 2: LJTICK-Divider With UE9

VINA/VINB: These screw terminals are for the 2 single-ended channels of input analog voltages. Each voltage is multiplied by the fractional slope to provide a lower voltage to the LabJack. Note that the outputs of the LJTD are limited to about 0-3.5 volts.

GND: Same as LabJack ground. VINA/VINB must be referred to this ground.

VREF: A 2.5 volt reference voltage output. Internally this reference is used for level shifting, but very little current is used, leaving substantial current available to the user if a very accurate 2.5 volt reference is needed.

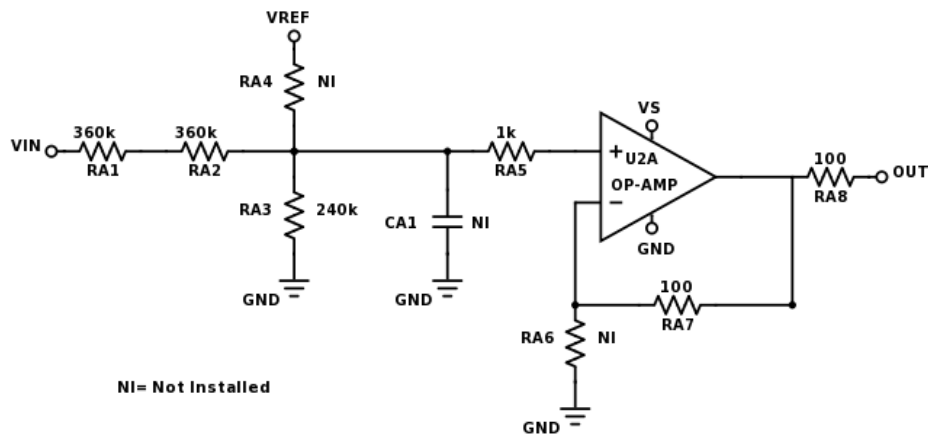


Figure 3: Schematic For Each Channel

The above figure is a schematic for one channel of the LJTD, showing the standard factory installed values for UNI10V. The input/output relationship is described by the below equations, assuming the op-amp is in the default unity gain configuration.

General Equations for Figure 3:

$$V_{out} = V_{in} \cdot R_{par} / (R_1 + R_2) + R_{par} \cdot V_{ref} / R_4$$

$$\text{Slope} = R_{par} / (R_1 + R_2)$$

$$\text{Offset} = R_{par} \cdot V_{ref} / R_4$$

$$R_{par} = R_{parallel} = 1 / \left(\frac{1}{R_1 + R_2} + \frac{1}{R_3} + \frac{1}{R_4} \right)$$

Simplified Equations for Unipolar Builds:

$$V_{out} = V_{in} \cdot R_3 / (R_1 + R_2 + R_3)$$

$$\text{Slope} = R_3 / (R_1 + R_2 + R_3)$$

The resistors R1+R2, R3, and R4, can be changed to provide other ranges as shown in the table below.

The packages for resistors R1-R4 are 0805, while all other resistors and capacitors are 0603. The tolerance of the factory installed resistors is 0.05%, so a good option available from digikey.com is the Panasonic ERA-6ARW series.

The table shows the input voltage at an output voltage of 0.0 and 2.5 volts. It also shows the input voltage for an output voltage of 3.5 volts, as the internal buffer amplifier accepts a maximum input voltage of 3.5 volts when powered by VS=5.0 volts, and thus when the amp is configured for unity gain the maximum output voltage is 3.5 volts. The Slope and Offset columns go with the formula

VIN (OUT=0): This is the input voltage that results in an output voltage of 0.0 volts. The typical minimum output voltage of the LJTD is about 0.001 volts.

VIN (OUT=2.5): This is the input voltage that results in an output voltage of 2.5 volts.

VIN (OUT=3.5): This is the input voltage that results in an output voltage of 3.5 volts. The typical maximum output voltage of the LJTD is VS-1.5 which is about 3.5 volts.

$$V_{out} = \text{Slope} \cdot V_{in} + \text{Offset}$$

Table 1. Ranges for divider circuit with different R1-R4

R1+R2	R3	R4	Slope	Offset	VIN (OUT=0)	VIN (OUT=1.0)	VIN (OUT=2.5)	VIN (OUT=3.5)	Name
[ohms]	[ohms]	[ohms]	[volts/volts]	[volts]	[volts]	[volts]	[volts]	[volts]	
720k	240k		0.25	0	0	4.0	10.0	14.0	-4
720k	180k		0.2	0	0	5.0	12.5	17.5	-5
900k	100k		0.1	0	0	10.0	25.0	35.0	-10
876k	36.5k		0.04	0	0	25.0	62.5	87.5	-25
720k	680k		0.4857	0	0	2.1	5.1	7.2	UNI5V
360k	240k		0.4	0	0	2.5	6.3	8.8	UNI6V
720k	240k		0.25	0	0	4.0	10.0	14.0	UNI10V
720k	220k		0.234	0	0	4.3	10.7	15.0	UNI11V
720k	100k		0.122	0	0	8.2	20.5	28.7	UNI21V
720k	68k		0.0863	0	0	11.6	29.0	40.6	UNI29V
720k	47k		0.0613	0	0	16.3	40.8	57.1	UNI41V
720k	33k		0.0438	0	0	22.8	57.0	79.9	UNI57V
360k		360k	0.5	1.25	-2.5	-0.5	2.5	4.5	BIP2.5V
360k	240k	180k	0.2222	1.111	-5	-0.5	6.3	10.8	BIP5V
720k	240k	180k	0.125	1.25	-10	-2.0	10.0	18.0	BIP10V
720k	68k	68k	0.0451	1.194	-26.5	-4.3	29.0	51.1	BIP25V

The labels in the Name column are used when ordering custom configurations.

U3: The LJTD is generally used with low-voltage channels on the U3-LV or U3-HV. The nominal input range of a low-voltage channel is 0-2.44 volts, so the input range provided by the LJTD is from the "VIN (OUT=0)" column to a little less than the "VIN (OUT=2.5)" column. For example, the UNI10V in this case will provide an input range of about 0 to 9.76 volts. If you set the U3 analog input to the "special" range it takes an input of about 0-3.6 volts, so the input range provided by the LJTD is from the "VIN (OUT=0)" column to the "VIN (OUT=3.5)" column. For example, the UNI10V in this case will provide an input range of about 0 to 14 volts.

U6/T7: The LJTD is used with the +/-10 or +/-1 volt range on the U6. With the +/-10 volt range the full 0-3.5 volt output of the LJTD can be measured, but only $3.5/20 = 17.5\%$ of the U6 input range is used. With the +/-1 volt range, the 0 and 1 volt output columns above apply, and 50% of the U6 input range is used.

UE9: The LJTD is used with the 0-2.5 or 0-5 volt range on the UE9. The 0 and 2.5 volt output columns above use 100% of the 0-2.5 volt UE9 input range, or the 0 and 3.5 volt columns use 70% of the 0-5 volt UE9 input range.

Attenuating Higher Voltages

High voltages can be handled by adding 1 or more external resistors in series with VIN. The extra voltage will be dropped across the external resistance such that the voltage applied to VIN is within specifications:

Simplified Equations for Unipolar Builds with External Resistor:

$$V_{out} = V_{in} \cdot R_3 / (R_1 + R_2 + R_3 + R_{ext})$$

$$\text{Slope} = R_3 / (R_1 + R_2 + R_3 + R_{ext})$$

For example, say a 10 MΩ resistor such as the [USF340-10.0M-0.01%-5PPM](#) is used for Rext with the LJTick-Divider-25. That means the slope will be $36.5k / (876k + 36.5k + 10000k) = 0.003345$, and thus a voltage of 747 volts will be divided down to 2.5 volts.

When working with a high voltage system and a USB device, consider adding a [USB isolator](#). A mistake might damage the LabJack, but hopefully the isolator will protect the host computer.

Caution: The information in this section (Attenuating Higher Voltages) is presented for convenience, is not a feature of normal LabJack operation, and you are at your own risk when working with high voltages. High voltages are dangerous and only qualified individuals should work with high voltages. A mistake could easily result in damage to the LabJack, computer, and people.

Specifications:

Parameter	Conditions	Min	Typical	Max	Units
General					
Vs, Supply Voltage (1)		2.8	5	5.5	Volts
Supply Current			1.2		mA
Operating Temperature		-40		85	°C
VREF					
Output Voltage		2.495	2.5	2.505	Volts
Initial Accuracy				±0.2	%
Maximum Output Current				24	mA
Op-Amp Buffer					
Typical Input Voltage Range		-0.1		VS - 1.5	Volts
Typical Output Voltage Range	Load ≥ 100kΩ	0.001		VS - 0.001	Volts
Input/Output					
Slope Error				±0.2	%
Offset Error				±0.2	%
Input Impedance (2)	UNI10V		960		kΩ
Input Bias current (2)	VIN = 10V		10		μA

(1) The maximum input voltage to the buffer amplifier is VS-1.5, so for proper operation with signals up to 2.5 volts, VS must be greater than 4.0 volts.

(2) The input impedance and bias current is dominated by the input resistors not the buffer amplifier. The input bias current of the internal buffer amplifier is less than ±200 pA across the voltage range, which is an important number as far as sizing

the input resistors to not create excessive offset.

Declaration of Conformity

Manufacturers Name: LabJack Corporation

Manufacturers Address: 3232 S Vance St STE 200, Lakewood, CO 80227, USA

Declares that the product

Product Name: LJTick-Divider

Model Number: LJTD

conforms to the following Product Specifications:

EMC Directive: 89/336/EEC

EN 55011 Class A

EN 61326-1: General Requirements
