

# DMX-K-DRV-23

## Integrated Step Motor Driver & Basic Controller



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- 1.33 – 5<sup>th</sup> release
- 1.34 – 6<sup>th</sup> release
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**Firmware Compatibility:**

†V36

†If your module's firmware version number is less than the listed value, contact Arcus for the appropriate documentation. Arcus reserves the right to change the firmware without notice.

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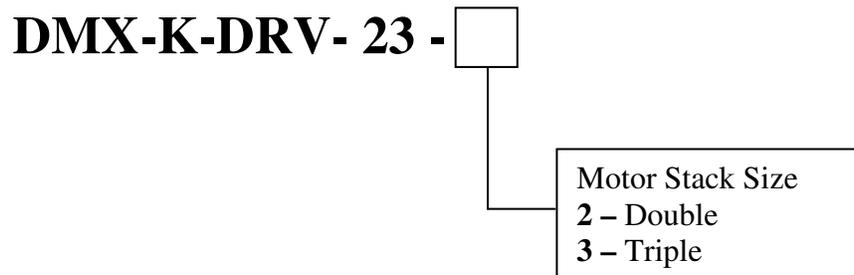
## 1. Introduction

DMX-K-DRV-23 is an integrated stepper driver and motor product. Feature highlights include: simple controller functionality, analog speed control, and an over temperature alarm output.

### 1.1. Features

- 12-24VDC voltage input
- 100mA to 2.5A peak current setting
- Full/Half/Quarter/16 microstep
- One clock (Pulse/Dir) or Two clock (CW/CCW) support
- 200K maximum pulse rate support
- 16K maximum pulse rate (controller mode)
- 34K maximum pulse rate (analog mode)
- 4 selectable motion profiles (controller mode)
- 10-bit analog input
- Opto-isolated differential Pulse/Dir (CW/CCW) inputs
- Opto-isolated driver enable input
- Opto-isolated over-temperature alarm output
  - In position output (controller mode)
- Integrated controller using DIO control
- Integrate analog speed control
- NEMA 23 motor available in various stack sizes.

### 1.2. Part Numbering Scheme



### Contacting Support

For technical support, contact: [support@arcus-technology.com](mailto:support@arcus-technology.com).

Or, contact your local distributor for technical support.

## 2. Electrical and Thermal Specifications

Parameter	Min	Max	Units
Main Power Input <sub>1</sub>	+12	+24	V
	-	2.5	A
Analog Inputs	0	+5	V
	-	25	mA
Forward Diode Current (PUL/DIR)	-	25	mA
Forward Diode Current (ENABLE)	-	45	mA
Operating Temperature <sub>2</sub>	-20	85	°C
Storage Temperature <sub>2</sub>	-55	150	°C

Table 2.0

<sub>1</sub> The supply current should match the driver current setting.

<sub>2</sub> Based on component ratings.

### 3. Dimensions

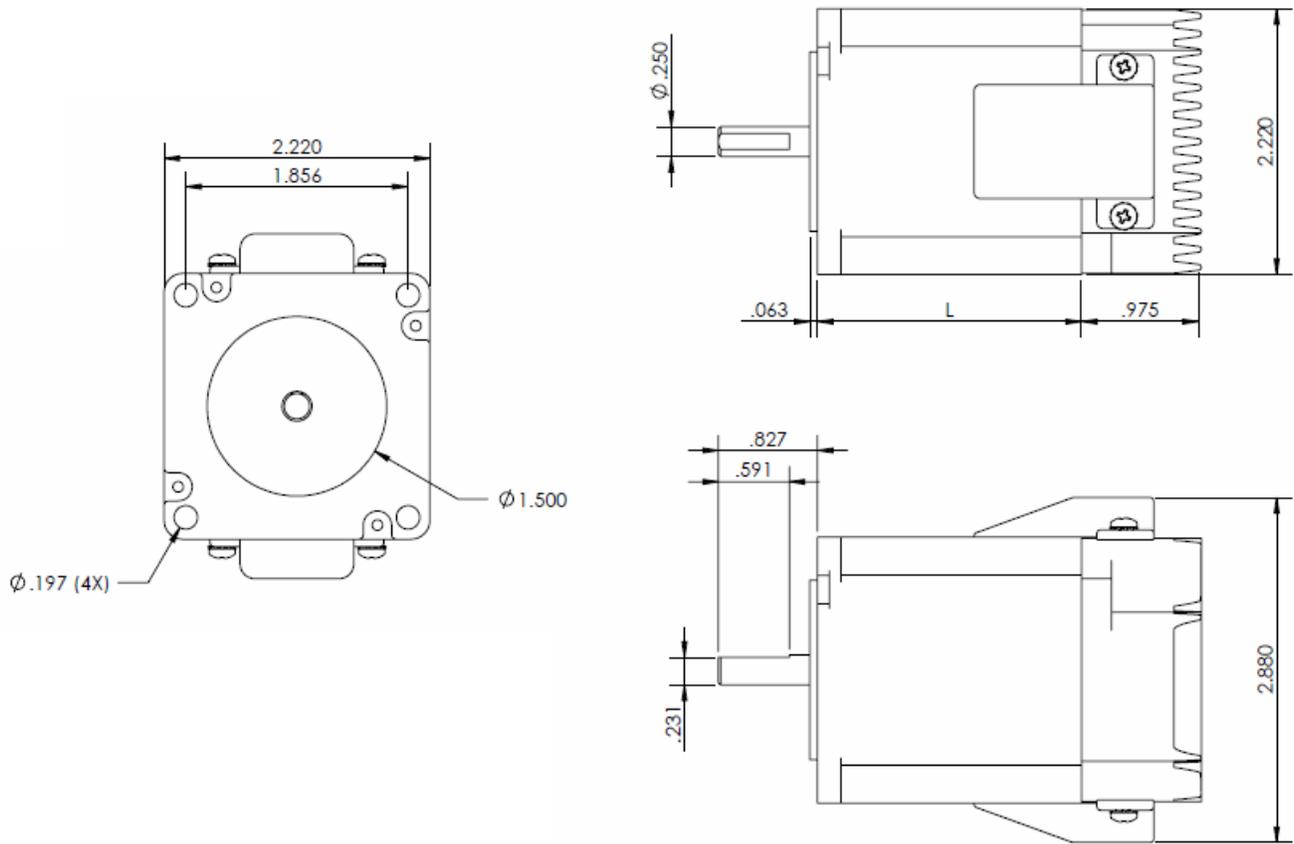


Figure 3.0

NEMA 23 Models	L (inches)
DMX-K-DRV-23-2 (double stack)	2.20
DMX-K-DRV-23-3 (triple stack)	2.99

Table 3.0

## 4. Connectivity

### 4.1. 10-Pin Connector (2mm)

DMX-K-DRV-23 comes with a single row 10 pin connector shown below.

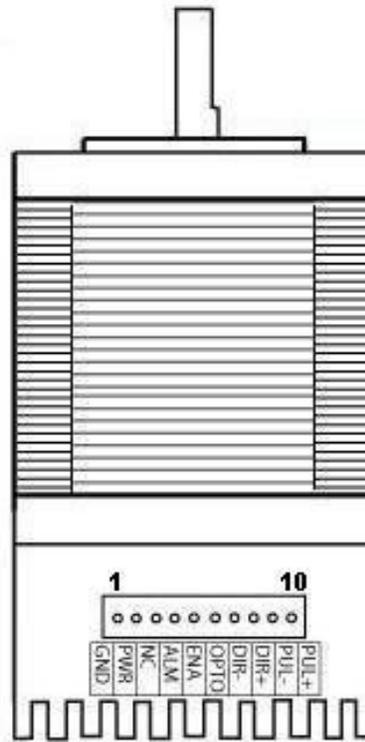


Figure 4.0

Pin #	Wire Color	In/Out	Name	Description
1	Black	I	GND	Power Input Ground
2	Red	I	V+	+12 to +24VDC Power
3	Gray	NC	NC	Reserved. Do not connect
4	White/Red	O	ALARM	Alarm output
5	Orange/White	I	ENABLE	Enable motor input
6	Orange	I	OPTO	Opto-supply for enable input
7	Blue/White	I	DIR- (CCW-)	Negative direction input / Negative counter-clockwise input
8	Blue	I	DIR+ (CCW)	Positive direction input / Positive counter-clockwise input
9	Green/White	I	PUL- (CW-)/AI	Negative pulse input / Negative clockwise input / Analog input
10	Green	I	PUL+ (CW+)	Positive pulse input / Positive clockwise input

Table 4.0

Description: Female 10 pin 2mm single row  
 Manufacturer: HIROSE  
 Part Number: DF3-10S-2C (10 pin female connector)  
 DF3-2428SC (female pin)

#### 4.2. Dipswitch for Analog/Digital Selection

DMX-K-DRV-23 can operate in digital and analog control modes. The mode is selected with the dipswitch pictured below.

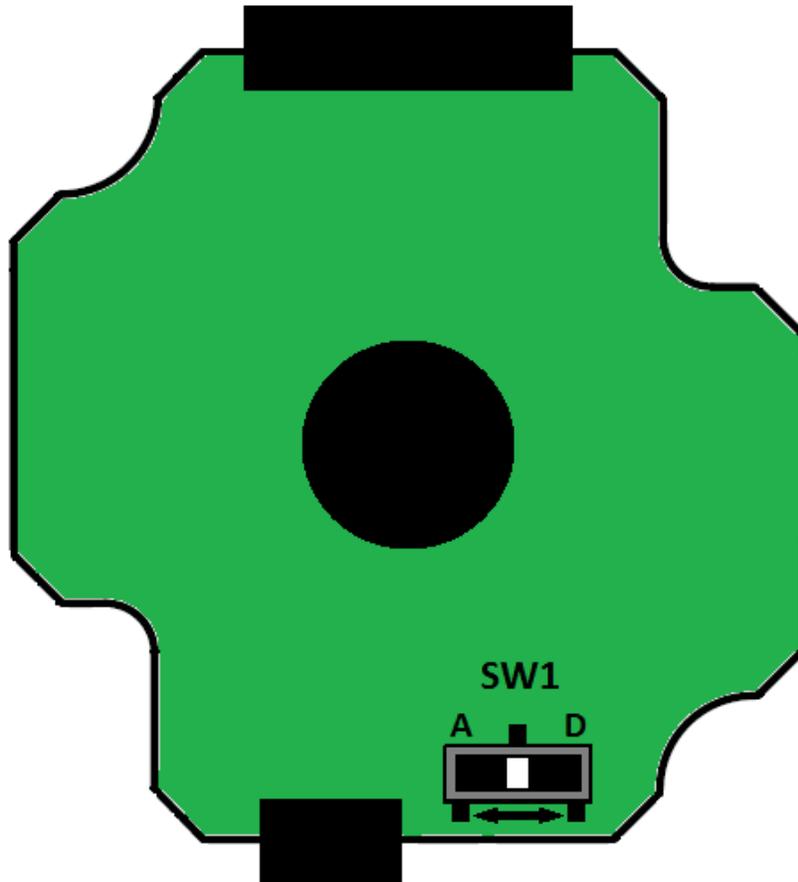


Figure 4.1

When configured to Driver or Control mode, the dipswitch should be moved to the digital (D) side.

When configured to Analog mode, the dipswitch should be moved to the analog (A) side.

### 4.3. DMX-K-DRV-23 Interface Circuit

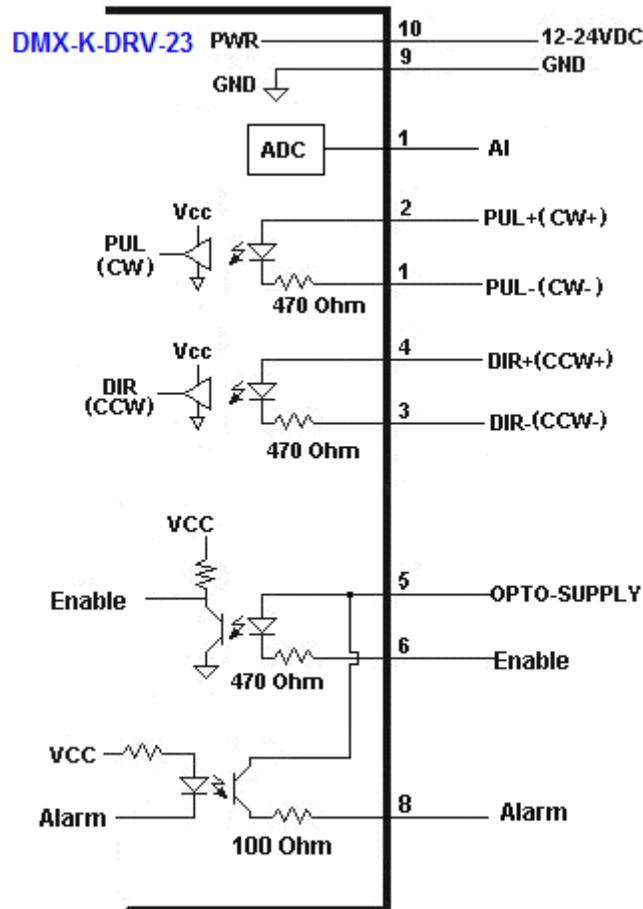


Figure 4.2

#### 4.3.1. Pulse/Dir (CW/CCW) Inputs

DMX-K-DRV-23 supports both one-clock (PULSE/DIR) and two-clock (CW/CCW) inputs.

One-clock uses the PUL signal as the pulse train input position control and the DIR signal as the direction input signal for direction control.

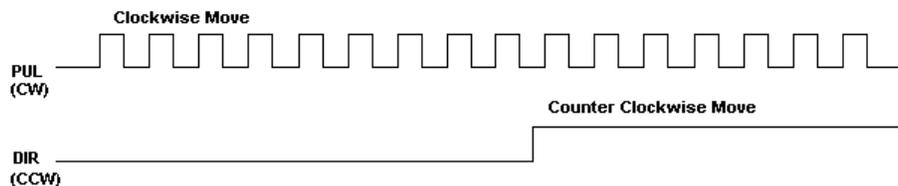


Figure 4.3

Two-clock uses CW as the clockwise pulse input and CCW as the counter clockwise pulse input for position control.

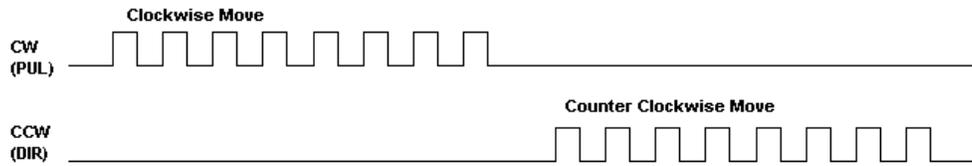


Figure 4.4

Depending on the direction polarity setting, actual direction of the rotation can be configured for the application.

Pulse/Dir (CW/CCW) inputs are opto-isolated differential inputs with a 470 Ohm resistor. Figure 4.5 shows the detailed schematic of the opto-isolated pulse and direction inputs.

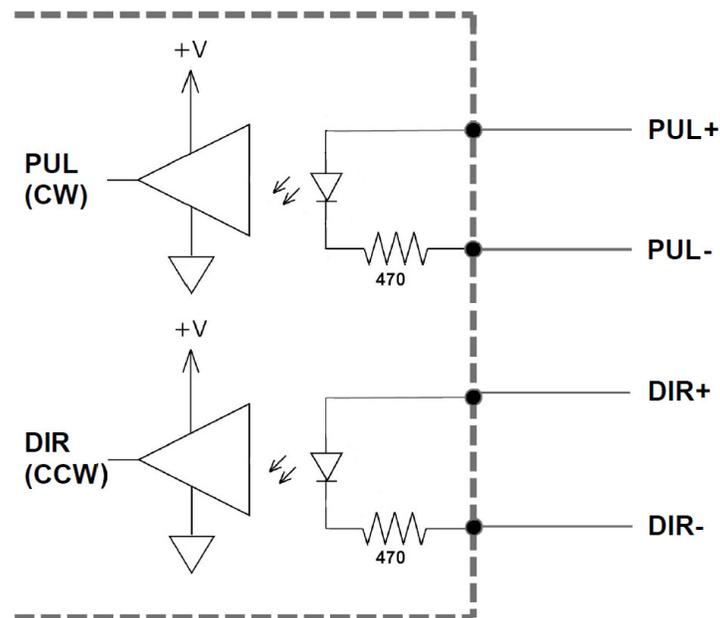


Figure 4.5

Figure 4.6 shows an example of wiring the pulse and direction inputs with a differential output.

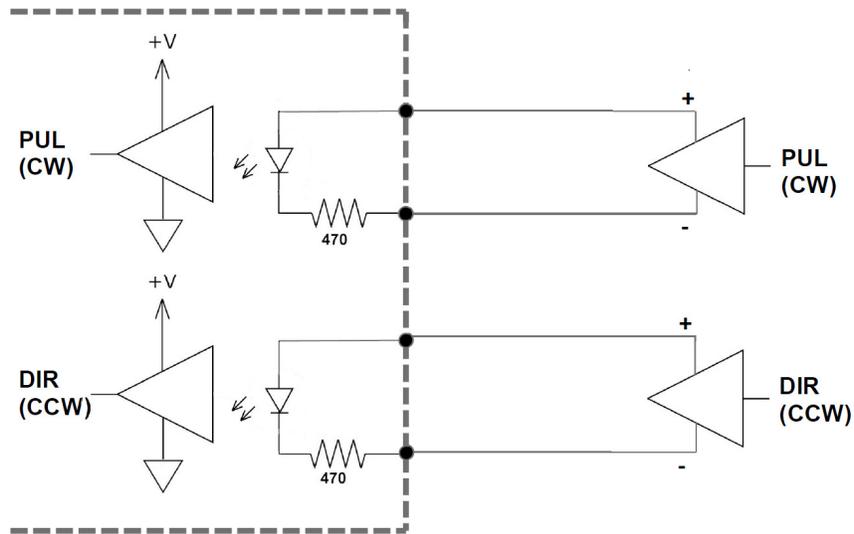


Figure 4.6

Figure 4.7 shows an example of wiring the pulse and direction inputs with an open-collector output.

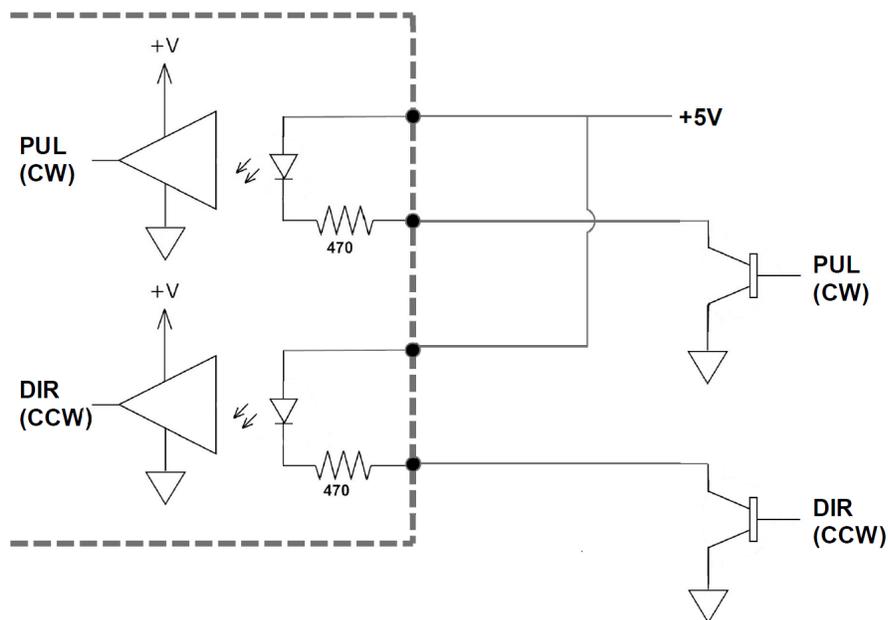


Figure 4.7

**Important Note:** The recommended voltage between the differential inputs is 5V. An additional current limiting resistor is required to support larger voltages.

### 4.3.2. Enable Input

Enable input is an opto-isolated input with a 470 Ohm resistor and diode. Figure 4.8 shows the detailed schematic of the opto-isolated enable input.

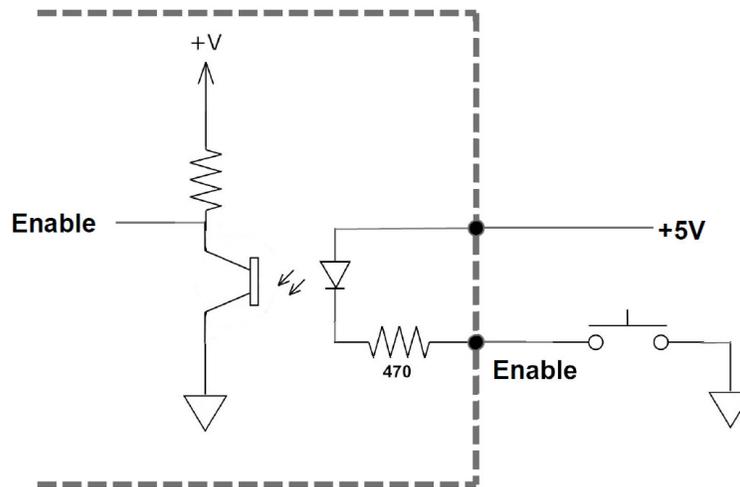


Figure 4.8

### 4.3.3. Alarm Output

Alarm output is an opto-isolated output with a 100 Ohm resistor. Figure 4.9 shows a wiring example of the opto-isolated alarm output.

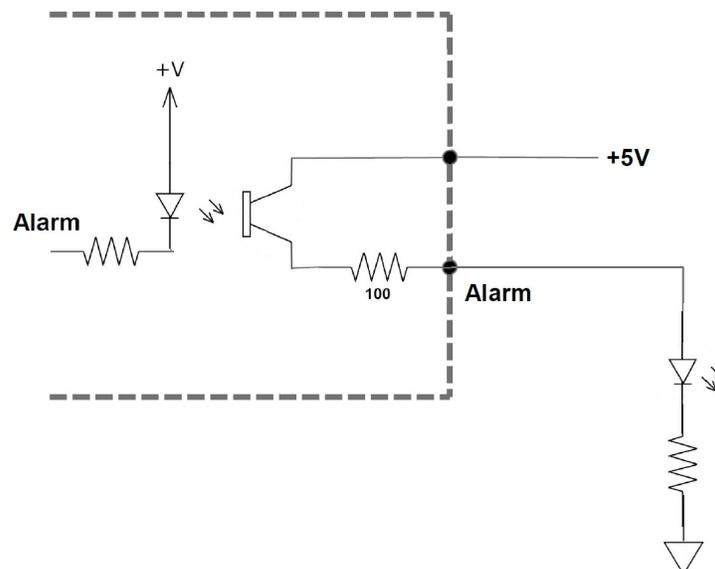


Figure 4.9

## 5. Stepper Motor Specifications

### 5.1. Operating Temperature

Electronic components used in the DMX-K-DRV-23 have a maximum ambient operating temperature of **85 C°**. DMX-K-DRV-23 electronics are potted with heat-conductive compound to the housing to evenly distribute the heat and reduce any hot spots in the driver. The housing also has integrated fins to better dissipate the heat.

DMX-K-DRV-23 should be mounted securely to a metallic bracket that can also act as a heat-sink. During operation, the step motor section typically becomes hotter than the driver section. Having the step motor mounted to a heat sink will help dissipate the heat generated by the step motor.

DMX-K-DRV-23 mounting orientation should be such that the fins are oriented vertically for better convection and heat dissipation. See Figure 5.0 below.

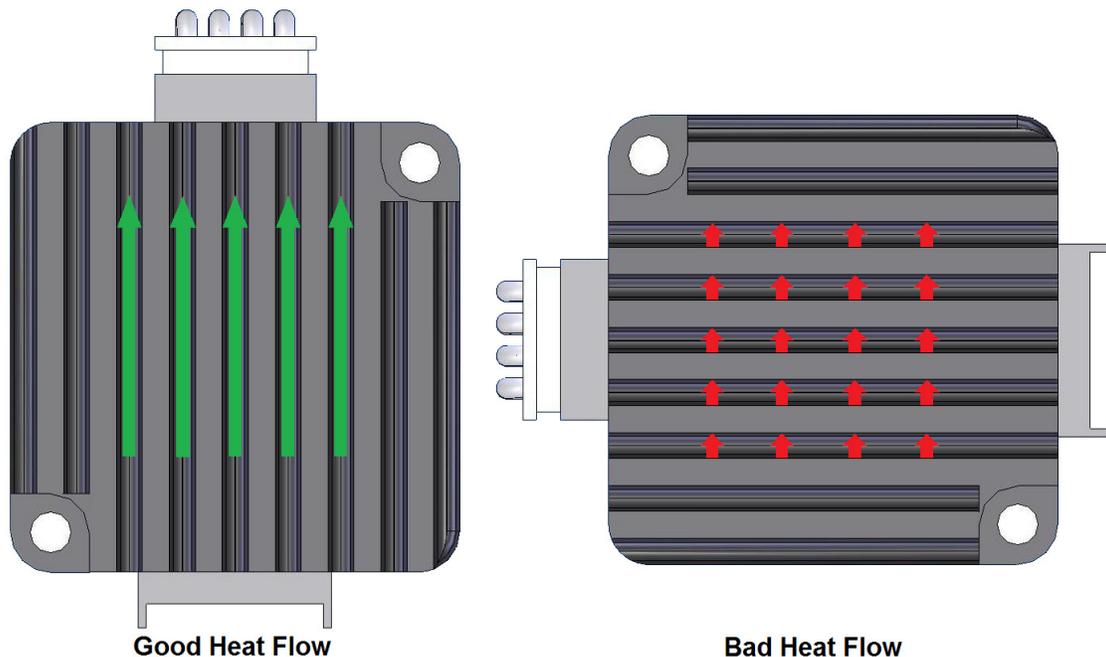


Figure 5.0

## 5.2. General Stepper Motor Specifications

The following charts show the specifications of the standard step motors used for DMX-K-DRV-23 products. All standard DMX-K-DRV-23 step motors are 1.8 degree bi-polar step motors.

Stack Size	Max Amp / Phase	Resistance / Phase	Inductance / Phase	Inertia
Double	3.9A	0.9 Ohm	2.5 mH	1.64 oz-in <sup>2</sup>
Triple	3.9A	1.13 Ohm	3.6 mH	2.62 oz-in <sup>2</sup>

Table 5.0

Stack Size	Max Axial Force	Max Radial Force
Double	15N	75N
Triple	15N	75N

Table 5.1

## 5.3. Stepper Motor Torque

The torque output of the DMX-K-DRV-23 will vary depending on the supply voltage, driver current, motor type, and target speed of the motor.

Increasing the drive current will increase the torque output, however the operating temperature will also increase. While decreasing the drive current will reduce the torque output, it will help reduce the operating temperature as well. Each application will need to adjust this setting to find the desired driver output.

Using a higher voltage to power the DMX-K-DRV-23 will allow the motor to run at faster speeds. Note that increasing the voltage will not increase the maximum holding torque of the motor.

Stepper motors in general will drop off in torque as the target speed of the motor is increased. The following torque curve shows the expected torque output based on the motor speed of the DMX-K-DRV-23.

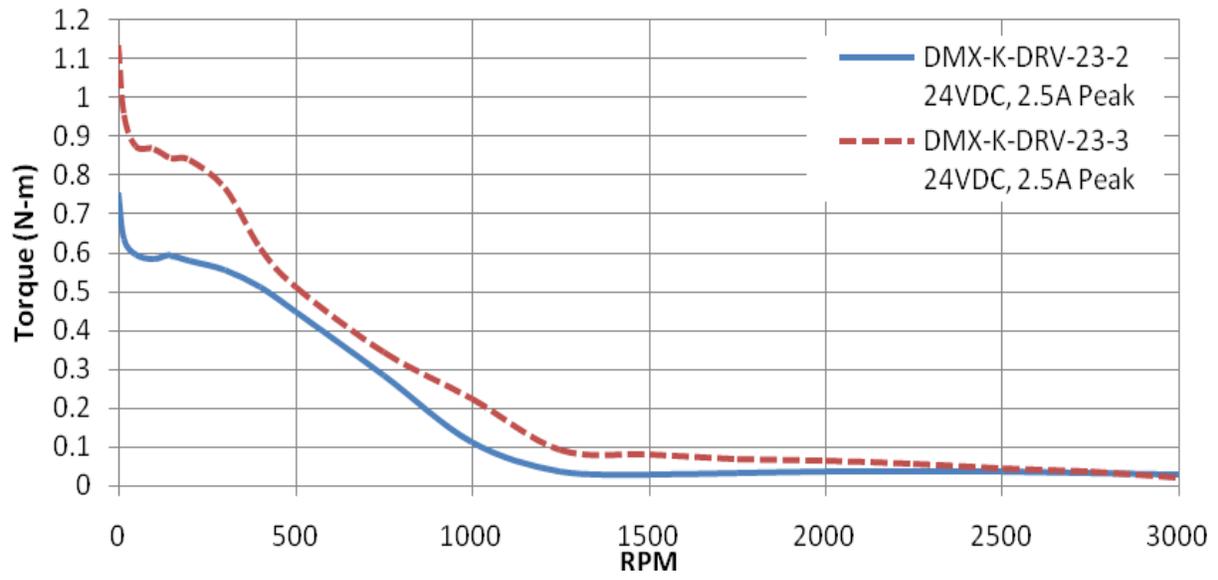


Figure 5.1

## 6. Stepper Motor Driver Specifications

### 6.1. Microstep

The standard DMX-K-DRV-23 motor is a 1.8 degree motor, which translates to 200 full steps per revolution. These steps can be divided with microstepping to increase position resolution. The available microstep settings and their corresponding resolution can be found in Table 6.0.

Microstep	Steps/Revolution
Full Step	200
Half Step	400
Quarter Step	800
1/16 Step	3200

Table 6.0

### 6.2. Current Control

DMX-K-DRV-23 has a configurable current setting from 100mA to 2.5A peak current.

Driver current is set to Run Current when the pulse input is detected and remains in run current while the pulse input is detected.

Once the pulse input has been idle for the duration defined by the Idle Time, the Idle Current will be used to hold the motor in position. The holding torque of the DMX-K-DRV-23 will be defined by the Idle Current.

### 6.3. Over Temperature Alarm

DMX-K-DRV-23 has a temperature sensor to detect over heating of the driver. Temperature sensing is done only when the driver is enabled. When the temperature goes over the over-temperature alarm value 70 C°, the Alarm Output is turned on. If the temperature goes below the 68 C°, the alarm output is turned off. If the temperature goes over 75 C°, the driver is automatically turned off and remained off until the temperature goes below 68 C°.

The automatic temperature shutdown feature can be enabled or disabled during the configuration process. Refer to Section 7 for further details.

For additional information regarding temperature precautions, refer to section 5.1.

For details on the over temperature alarm, see Figure 6.0.

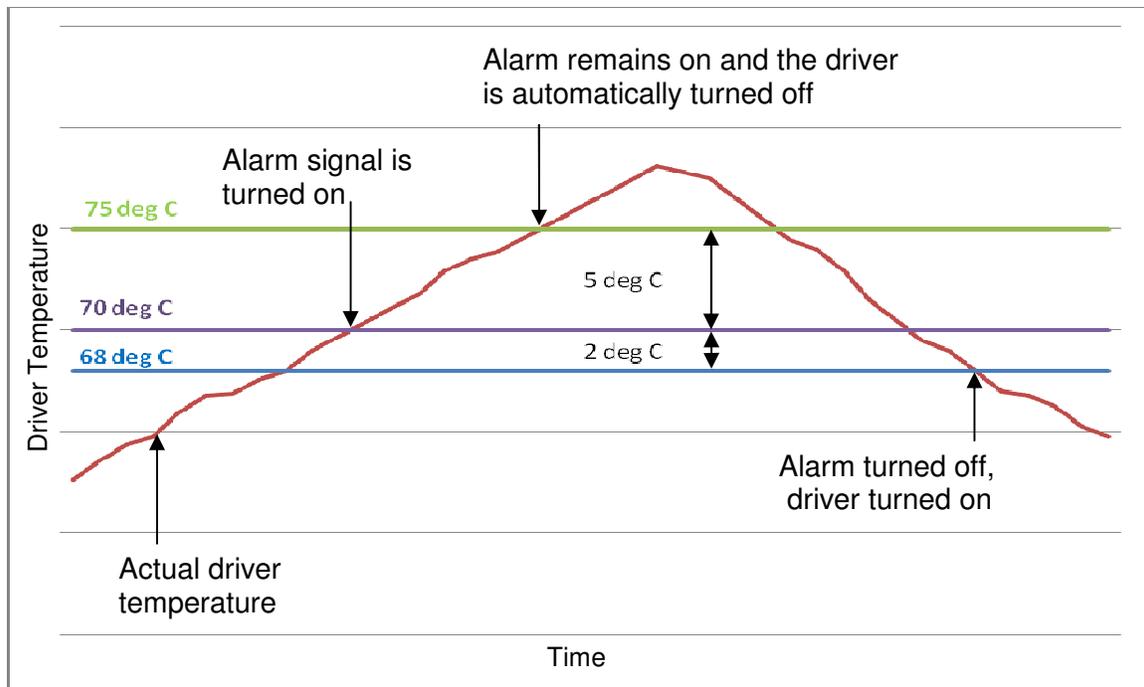


Figure 6.0

## 6.4. DIO Control

The DMX-K-DRV-23 has built-in controller capability. When configured in controller mode, the DIR, ENABLE, PUL and ALARM signals are used for DIO Control. Configuration for DIO control is detailed in Section 7. See Table 6.1 for the signal descriptions. These descriptions are only valid while the DMX-K-DRV-23 is in controller mode.

While in controller mode, the motor is always enabled. If the direction signal is toggled while the enable signal is off, the alarm signal will turn on because of its use in the Dynamic Configuration algorithm. Therefore, it is advised to toggle the enable signal before selecting a motion profile. This will prevent the alarm output from erroneously triggering.

In/Out	Name	Description
I	ENABLE	Select 2 bit motion profile (Bit 0)
I	DIR-/DIR+	Select 2 bit motion profile (Bit 1)
I	PUL-/PUL+	Trigger motion profile or abort a current move operation
O	ALARM	In-position output <sub>1</sub>

Table 6.1

1 If “Over Temp Shutdown” feature is enabled, the alarm output operates as a temperature alarm output and not an in-position output. To use as an in-position output, the “Over Temp Shutdown” feature must be disabled.

Available movement types and their corresponding parameters are shown in the table below.

Move Type	Description	Target Position	Speed(PPS)
JOG+/-	Move the motor continuously.	N/A	0-16000
ABS	Move the motor to the target position.	32 bit number	0-16000
INC	Increment the motor by the target position.	32 bit number	0-16000

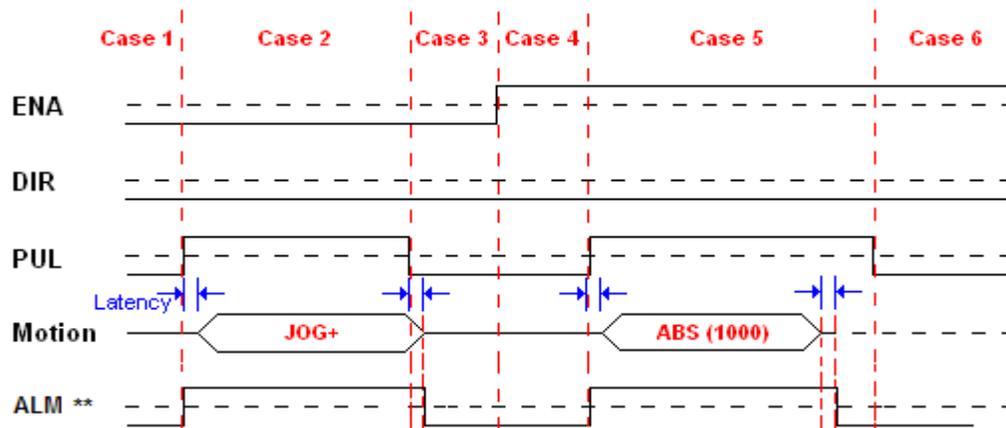
Table 6.2

### 6.4.1 Example Timing Diagram for DIO Control

Assuming that the parameters shown in Table 6.3 are stored in the DMX-K-DRV-23, the timing diagram in Figure 6.1 and Table 6.4 provide an example of DIO control use.

Motion Profile		Move Type	Target Position	Speed(PPS)
ENA	DIR			
0	0	JOG+	0	10000
0	1	JOG-	0	10000
1	0	ABS	1000	5000
1	1	INC	-1000	5000

Table 6.3



\* Latency = 500-550 us

\*\* If Over Temp Shutdown is disabled, the alarm output is used as an "In Position" output. The signal will turn on while the motor is in motion, and turn off when the motor is idle.

Figure 6.1

Case	Motion Profile		PUL	Result
	ENA	DIR		
1	0	0	0	DMX-K-DRV-23 is idle. Chosen motion profile is JOG+.
2	0	0	1	DMX-K-DRV-23 is jogging in the positive direction at a speed of 10000 pps. Motion starts on the rising edge of the PUL signal.
3	0	0	0	DMX-K-DRV-23 has stopped all motion on the falling edge of the PUL signal.
4	1	0	0	DMX-K-DRV-23 is idle. Chosen motion profile is ABS with a target position of 1000.
5	1	0	1	DMX-K-DRV-23 is moving to pulse position 1000. Note that the motor will stop once the desired position is reached, regardless of the PUL signal.
6	1	0	0	DMX-K-DRV-23 is idle.

Table 6.4

## 6.5. Analog Speed Control

The DMX-K-DRV-23 has built-in analog speed control capability. When configured in analog mode, the DIR and AI (PUL-/CW-) signals are used for analog speed control.

In analog speed control, the speed of the motor is determined by the analog input value [0 - +5VDC]. The direction of the motor is determined by the differential direction input.

After configuring the motor for analog speed control mode, the dipswitch SW1 must be moved to the analog side, designated by the “A” label. When configuring the motor back to Driver or Control mode, the dipswitch must be reverted back to the digital side, designated by the “D” label. See figure 4.1 for details.

The maximum allowable speed in analog speed control is 32K steps/second. The RPM output of the motor at this speed is dependent on the microstep setting. An analog input of 25mV or below will result in an idle state. The speed will increase linearly as the analog input voltage increases towards +5V. Figure 6.2 shows details regarding the speed of the motor in relation to the analog input voltage.

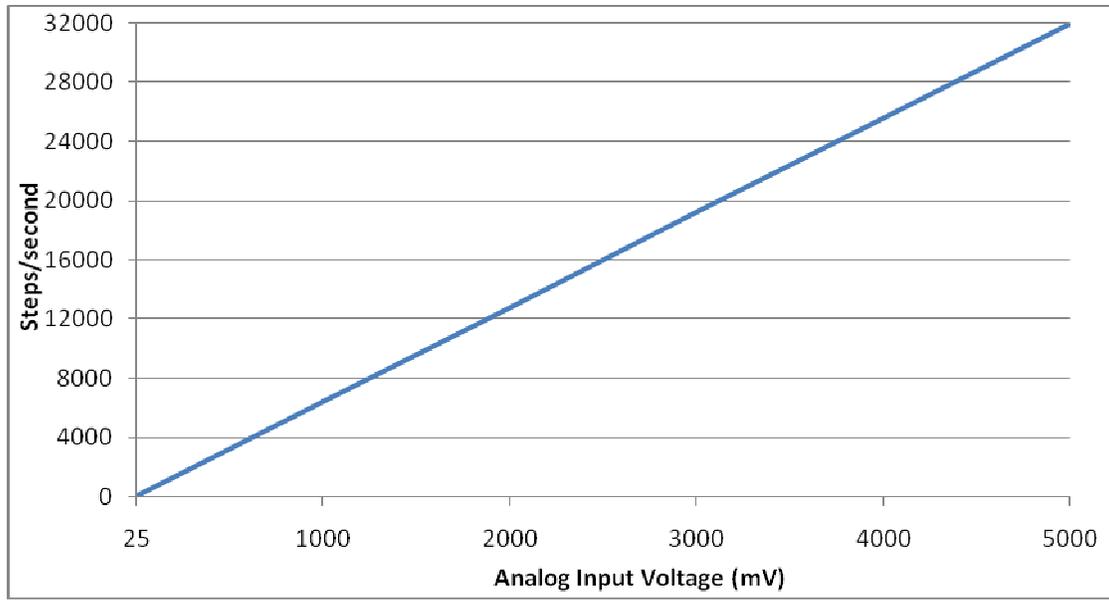


Figure 6.2

## 7. Driver Configuration

DMX-K-DRV-23 uses patented Dynamic Configuration Method to read and write the driver parameters using the control signals (Pulse, Dir, Enable, and Alarm) of the driver. Dynamic Configuration eliminates the need for jumpers, switches, resistors, potentiometers and communication port for reading and setting the driver parameters. This results in a simple and cost-effective device.

### 7.1. Configuration Cables

The DMX-CFG-USB-K23 cable is used to configure the DMX-K-DRV-23. This 10-pin cable allows communication with the software detailed in section 7.2 to set driver parameters.

### 7.2. Software

Make sure that the USB driver is installed properly before attempting to run the configuration software.

See the DMX-CFG-USB Cables manual for details on configuration. Figure 7.0 shows the configuration interface.

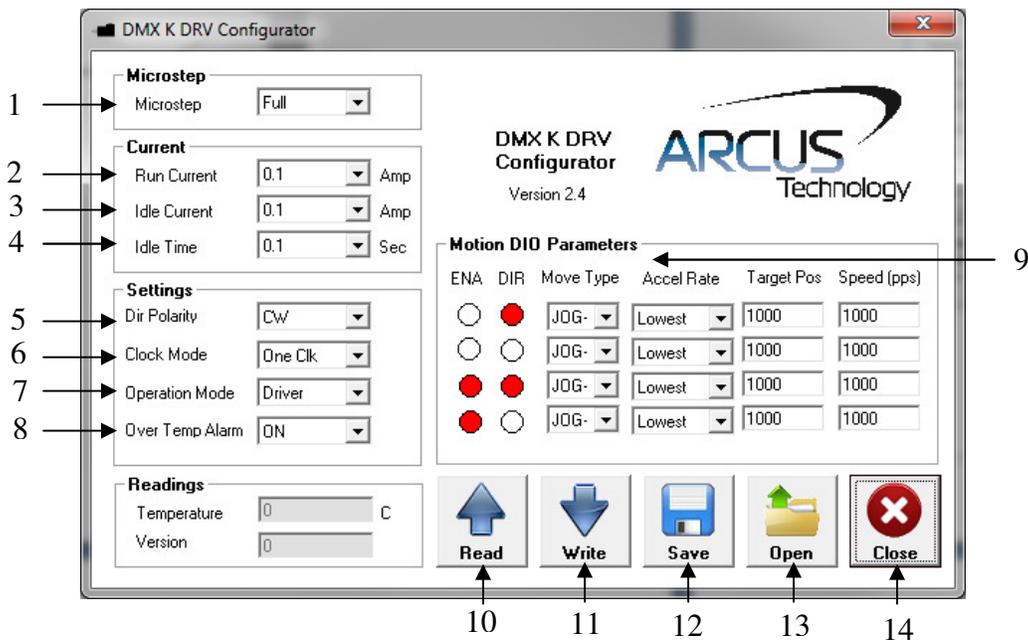


Figure 7.0

1. **Microstep Setting** - Full, Half (1/2), Quarter (1/4), Sixteen(1/16).
2. **Run Current** - 100mA to 2.5A peak current.
3. **Idle Current** - 100mA to 2.5A peak current.
4. **Idle Time** - 100 msec to 10 sec.
5. **Direction Polarity** - Toggles direction polarity.
6. **Clock mode** - One-clock or Two-clock mode.

**7. Controller or Driver mode:**

- A. Driver mode requires pulse and direction signals to move the motor.
- B. Controller mode uses the Enable and Direction inputs to specify a set of motion parameters and the Pulse input to start and stop motion.

**8. Over Temperature Shutdown** - Determines whether or not the DMX-K-DRV-23 disables when the temperature rises above a specified threshold. See Figure 6.0 for details.

**9. DIO motion parameters** - Up to four motion profiles can be set and used when the DMX-K-DRV-23 is in controller mode.

**10. Read** - Reads settings from the device and displays them.

**11. Write** - Writes the displayed settings to the device.

**12. Save** - Save driver settings to a text file.

**13. Open** - Load previously saved driver settings from a text file.

**14. Close** - Exit the configurator.

**7.3. Default Settings – Driver Mode**

$\mu$ Step	Run Current (A)	Idle Current (A)	Idle Time (ms)	Dir	Clock	Mode	Over Temp Shutdown
16	2.2	1	500	CW	One	Driver	ON

Table 7.0

**7.4. Default Settings – Control Mode**

Motion Profile		Move Type	Target Position	Speed(PPS)
ENA	DIR			
0	0	ABS	10000	10000
0	1	ABS	10000	10000
1	0	ABS	10000	10000
1	1	ABS	10000	10000

Table 7.1

## **Contact Information**

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