## FEATURES

- **Economical Position/Speed Control**
- **Accel and Decel Control**
- **Two selectable run speeds**
- **Separate (latched) Run/Stop Inputs for clutch brake applications**
- **Internal and/or External Command**
- **Operates from Single Power Supply (24 to 75 Vdc)**
- **Wide Speed Range**
- **Stable over operating temperature range (± 1%)**
- **Switch selectable Step Size and Current**
- **Patented Mid-Range Instability Electronic Damping Circuit**
- **Adjustable Idle Current Reduction**
- **External Pulse Output**
- **LED Fault Indicator**

## PRODUCT DESCRIPTION

The Pacific Scientific 6415 is an economical, high performance microstepping drive with an integral oscillator. The card is packaged with the highly popular 6410 drive and thus incorporates its many valuable features such as high resolution microstepping (200 to 51,200 steps per revolution) for smooth operation through resonance regions, mid-range instability electronic damping, single supply operation, output current adjustment, and idle current reduction.

The 6415 contains a stable, wide range voltage controlled oscillator (VCO) which provides step pulses to the driver card. There are two frequency ranges, customer selectable by a jumper. The final runspeed is controlled by the following:

- Low/High speed select Input or
- on-board multi-turn potentiometers or
- external customer potentiometer or
- customer supplied -10 Vdc to +10 Vdc analog voltage

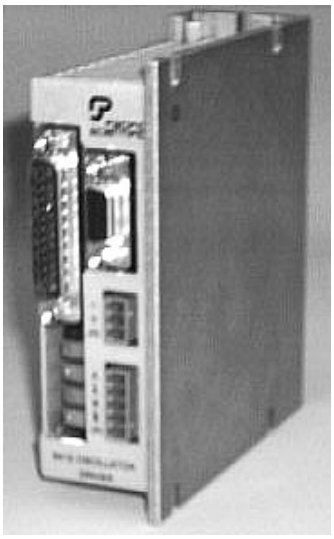
The relationship between the VCO pulse frequency and the motor shaft rpm is a function of the step size selected. Direction can be controlled by any of the following:

- Polarity of the Analog Input or
- Plug-On jumpers or
- Optically isolated discrete input

## APPLICATIONS

- **Clutch Brake Replacement**
- **Labeling Machines**
- **Packaging/Specialty Machinery**
- **Smart Conveyor Systems**
- **Semiconductor Wafer Polishing**
- **Constant Speed Applications**

**Pacific Scientific Model 6415**
**Oscillator/Microstepping Drive Module**



## SPECIFICATIONS

### 6410 Drive

Drive specifications and switch settings are unchanged. See 6410 Data Sheet.

### 6415 Oscillator

**RUN SPEED Control (Analog Input)**

| | |
|---|---|
| **Analog Input Range** | ± 10 Vdc |
| Also controllable with internal or external pots | |
| **Analog Input Impedance** | 20 KΩ (differential amp) |
| **High Frequency Range** | |
| RUN SPEED Control | 8 KHz to 500 KHz |
| LOW SPEED Control | 8 KHz to 370 KHz |
| **Low Frequency Range** | |
| RUN SPEED Control | 4 KHz to 250 KHz |
| LOW SPEED Control | 4 KHz to 180 KHz |
| **RUN SPEED/LOW SPEED Stability Over Temp. /Range** | ±1% of full scale (typical) |

**ACCEL RAMP (exponential)**

| | |
|---|---|
| **accel pot fully CW** | 0.4 sec (single time constant) |
| **accel pot fully CCW** | 0.4 msec (single time constant) |

**DECEL RAMP (linear)**

| | |
|---|---|
| **decel pot fully CW** | 1.4 sec |
| **decel pot fully CCW** | 6.0 msec |

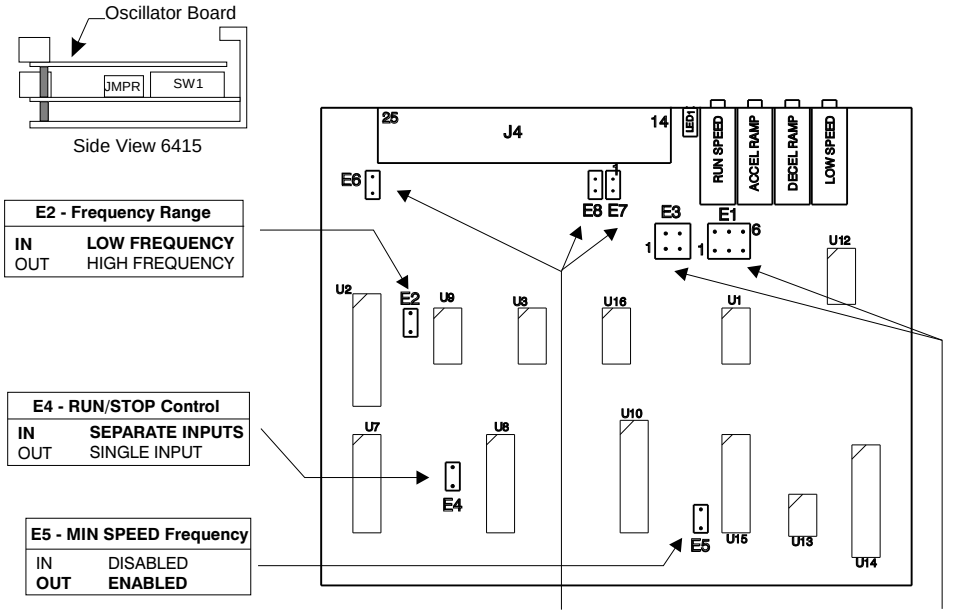
**MIN SPEED**

4 Khz Maximum (high frequency range)
2 KHz Maximum (low frequency range)
Steps below this frequency are inhibited to insure no movement at end of decel ramp. This functionality can be disabled by inserting jumper E5.

**Note:** *Motor rpm = 0.3 * Freq. (Hz)/step size. For example: If frequency = 500,000 Hz and step size = 125, rpm = 1200.*

## OSCILLATOR BOARD SETTINGS

**Note:** *Factory default settings are in* ***bold***




| E2 - Frequency Range | |
|---|---|
| **IN** | **LOW FREQUENCY** |
| OUT | HIGH FREQUENCY |

| E4 - RUN/STOP Control | |
|---|---|
| **IN** | **SEPARATE INPUTS** |
| OUT | SINGLE INPUT |

| E5 - MIN SPEED Frequency | |
|---|---|
| IN | DISABLED |
| **OUT** | **ENABLED** |

| Control Source | E6 | E7 | E8 | DIR Opto | Analog In | Rotation |
|---|---|---|---|---|---|---|
| DIR+/DIR- | OUT | OUT | OUT | Driven | -------- | CCW |
| | OUT | OUT | OUT | Not Driven | ------- | CW |
| Jumpers | IN | IN | OUT | Driven | ------- | CCW |
| | **OUT** | **OUT** | **OUT** | Not Driven | ------- | CW |
| Analog In | IN | OUT | IN | Driven | Negative | CCW |
| | IN | OUT | IN | Not Driven | Positive | CW |

| E1 | E3 - | Velocity Control Mode |
|---|---|---|
| **1-2 IN** | **1-2 IN** | Internal RUN SPEED Potentiometer |
| 3-4 IN | N/A | External Potentiometer |
| 5-6 IN | 1-2 IN | External Analog Input |
| 1-2 IN | 3-4 IN | External Analog Input scaled by internal RUN SPEED potentiometer |

## GETTING STARTED

Perform this initial power up with the motor shaft disconnected from the load. Improper wiring could result in undesired motion.

1. Connect the motor leads and power supply wires to the 6415 Oscillator Board connectors as shown on the 6410 Data Sheet.

   **Note:** *J1 on the lower board is not used.*

2. Wire the control signals for the independent RUN, STOP and DIRECTION control into connector J4 as shown in Figures 2 and 3.

3. Pull the RUN signal Low (J4-8) and the motor will ramp up to speed. Pull the STOP signal low (J4-9) and the motor decelerates to a stop. When the DIRECTION signal is pulled low (J4-10) the motor will run in the CCW direction, looking at the motor shaft. If the desired rotation for a low signal is CW, swap the connections of the motor leads on pins J3-1 and J3-2.

   **Note:** *Remove power from the drive before swapping the leads.*

4. If the motor emits a high frequency noise but the shaft is not rotating, stop the motor. Lower the RUN SPEED by turning the RUN SPEED potentiometer CCW. Increase the ACCEL RAMP by turning the ACCEL RAMP potentiometer CW.

5. After successfully establishing motion, the system can be powered down and connected to a load.

   **Note:** *A bus capacitor should be connected to the 6415 power input. The bus capacitor should be connected using a twisted pair cable no longer than three feet in length. For maximum voltage and current, a 100 volt, 5 A rms (120 Hz ripple current rating), 6000 uf capacitor is recommended.*

## I/O COMMAND AND MONITOR SIGNALS

**RUN+/RUN-, STOP+/STOP-**

**Separate Latched Inputs (E4 jumper installed - Default)**

With the E4 jumper installed, the RUN/STOP (Clutch brake) mode of the 6415 is controlled by two separate optically isolated inputs. When the RUN opto is driven momentarily, the RUN/STOP latch is placed in the RUN state and the oscillator frequency ramps to the selected speed at a rate controlled by the ACCEL potentiometer. When the STOP opto is driven momentarily, the RUN/STOP latch is placed in the STOP state and the oscillator frequency ramps to zero frequency at a rate controlled by the DECEL potentiometer.

The RUN/STOP latch is designed to be in the STOP state after applying power to the 6415 to insure that motion does not occur unintentionally.

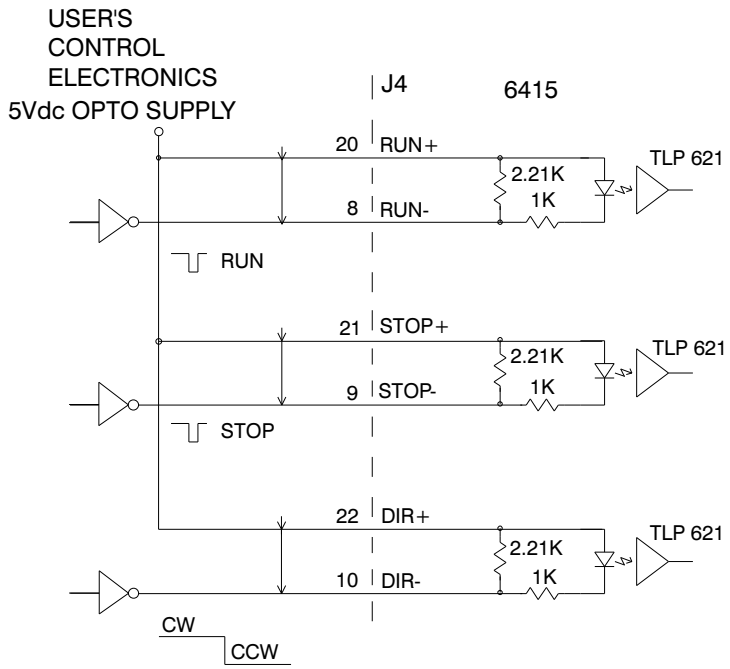



**Figure 1 - Separate RUN/STOP and DIRECTION Command Signals with User +5 Vdc Power Supply**

**Single Input (E4 jumper removed)**

If the E4 jumper is removed, the RUN/STOP mode of the drive is controlled directly from the RUN input. When the RUN opto is driven, the oscillator frequency ramps to the selected speed at a rate controlled by the ACCEL potentiometer. When the RUN opto is off, the oscillator frequency ramps to zero frequency at a rate controlled by the DECEL potentiometer.

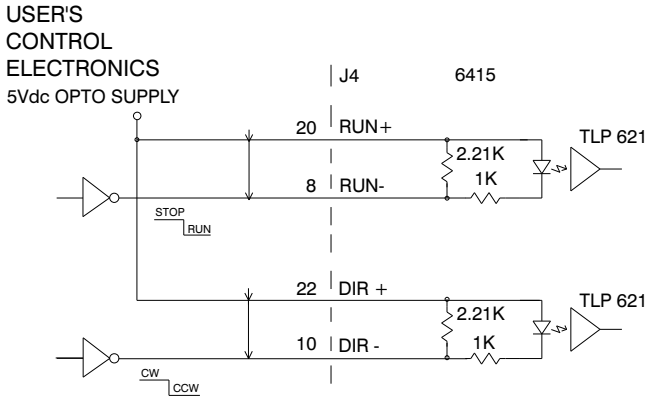



**Figure 2 - Single RUN/STOP and DIRECTION Command Signals with User +5Vdc Power Supply**

**LOW_SPD+/LOW_SPD-**

This optically isolated input selects the source of the analog speed command. With the LOW_SPD opto on (J4-7 Low), the analog speed command is derived from the LOW SPEED potentiometer.

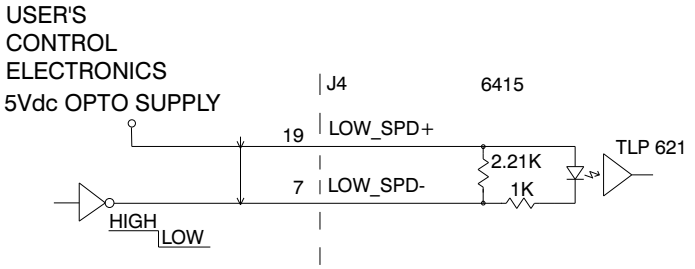



**Figure 3 - LOW_SPD Command Signal with User +5 Vdc Power Supply**

With the LOW_SPD opto off (J4-7 High), the analog speed command is derived from one of the following sources depending upon the E1 and E3 jumper configurations:

- Internal RUN SPEED potentiometer (E1 1-2 and E3 1-2 installed - Default)
- External potentiometer (E1 3-4 installed)
- External analog input (E1 5-6 and E3 1-2 installed)
- External analog input scaled (fine tuned) by internal RUN SPEED potentiometer (E1 1-2 and E3 3-4 installed)

The LOW_SPD input can changed at any time. The speed (oscillator frequency) will not change instantly, but will ramp to the newly selected speed at a rate controlled by the ACCEL or DECEL potentiometers depending upon whether the speed (magnitude) is increasing or decreasing.

Figure 6 shows the velocity wave form in a typical application where the high speed is selected when the RUN input is pulsed and latched. Near the end of the motion profile, low speed is selected to insure a short and precise stopping distance when the STOP input is pulsed.

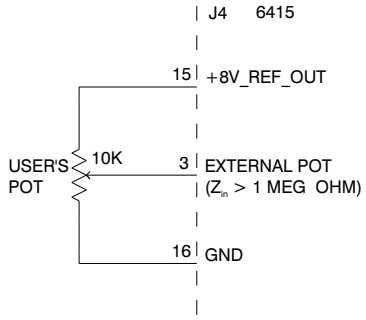



**Figure 4 - External potentiometer**

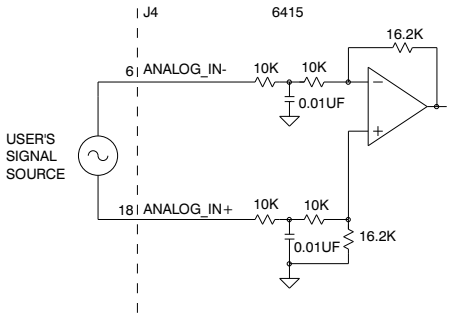



**Figure 5 - Analog Input**

## ADJUSTMENT POTENTIOMETERS

Figures 6 and 7 show the typical velocity (pulse frequency) profile in response to a separate RUN/STOP or with a single RUN/STOP and RUN/LOW commands.

Adjustments for RUN SPEED, LOW SPEED, ACCEL RAMP, and DECEL RAMP are made with 4 multi-turn potentiometers.

LOW SPEED is typically set lower than RUN SPEED to allow for accurate stopping. It can also be used as a second RUN SPEED. ACCEL RAMP is typically set to minimize time to reach RUN SPEED without allowing the motor to stall. The DECEL RAMP is linear and stable, allowing a more precise, repeatable stopping position.

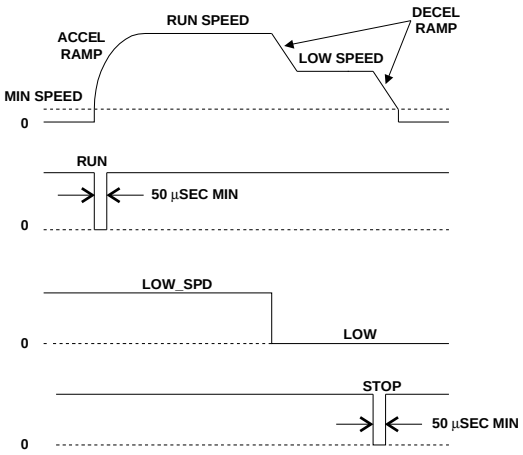



**Figure 6 - Typical Velocity Profile with Separate RUN/STOP and RUN/LOW Command Signals**

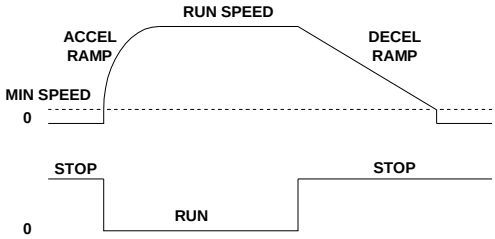



**Figure 7 - Typical Velocity Profile with a Single RUN/STOP Command Signal**

**DIR+/DIR-**

This optically isolated input controls the direction of motor rotation when the E6, E7 and E8 jumpers are removed. Motor rotation is CCW if the opto is driven and CW otherwise. The direction of motor rotation can also be controlled by the analog input or plug on jumpers as shown.

| Control Source | Jumper E6 | Jumper E7 | Jumper E8 | DIR Opto | Analog In | Rotation |
|---|---|---|---|---|---|---|
| DIR+/DIR- | Out | Out | Out | Driven | _____ | CCW |
| | Out | Out | Out | Not Driven | _____ | CW |
| Jumpers | In | In | Out | Driven | _____ | CCW |
| | Out | Out | Out | Not Driven | _____ | CW |
| Analog In | In | Out | In | Driven | Negative | CCW |
| | In | Out | In | Not Driven | Positive | CW |

**Enable**

Enable input has the same functionality as the 6410 (Refer to 6410 Data Sheet). As in the 6410, the default is the drive is enabled unless the Enable opto is driven. However, this functionality can be reversed so that the opto must be driven to enable the drive.

**Enabled LED**

LED is lit when drive is enabled. A fault is indicated if the drive is commanded enabled but the LED is not lit.

**External Step Pulse**

The step pulse output from the VCO is available on J4-12, J4-13, J4-24, and J4-25. This can be connected to up to four additional 6410 drives.

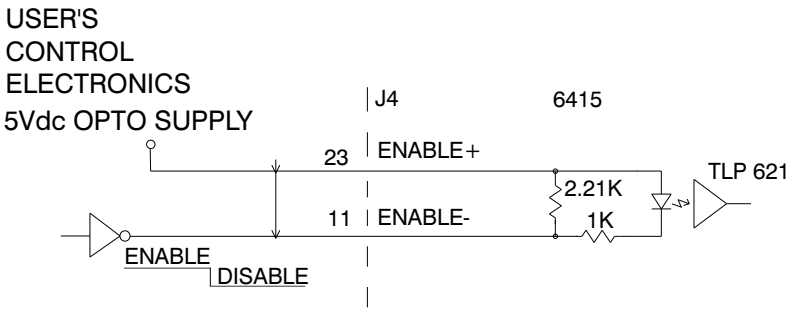



**Figure 8 - Enable Input**

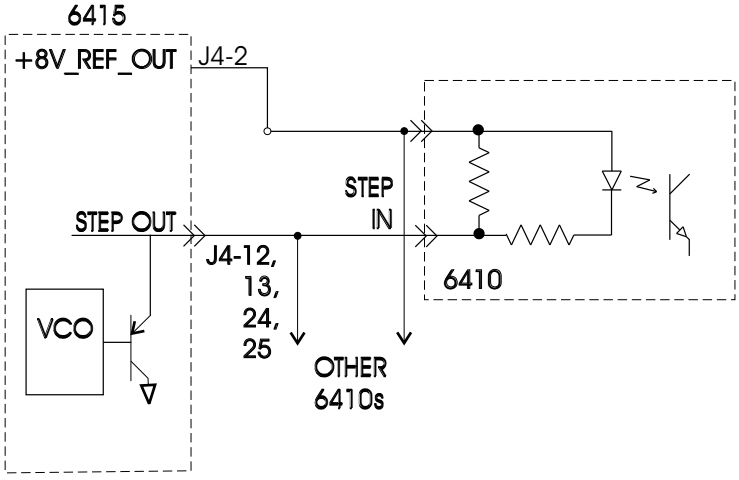



**Figure 9 - External Step Pulse**

## CONNECTION DIAGRAM

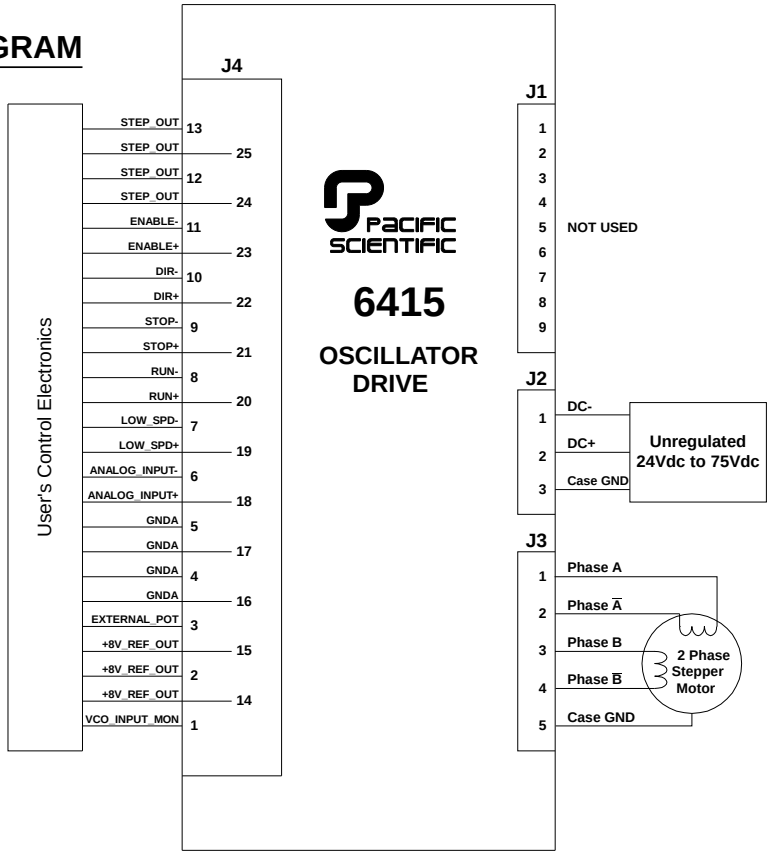



**Figure 10 - 6415 Connection Diagram**

## MOUNTING DIMENSIONS

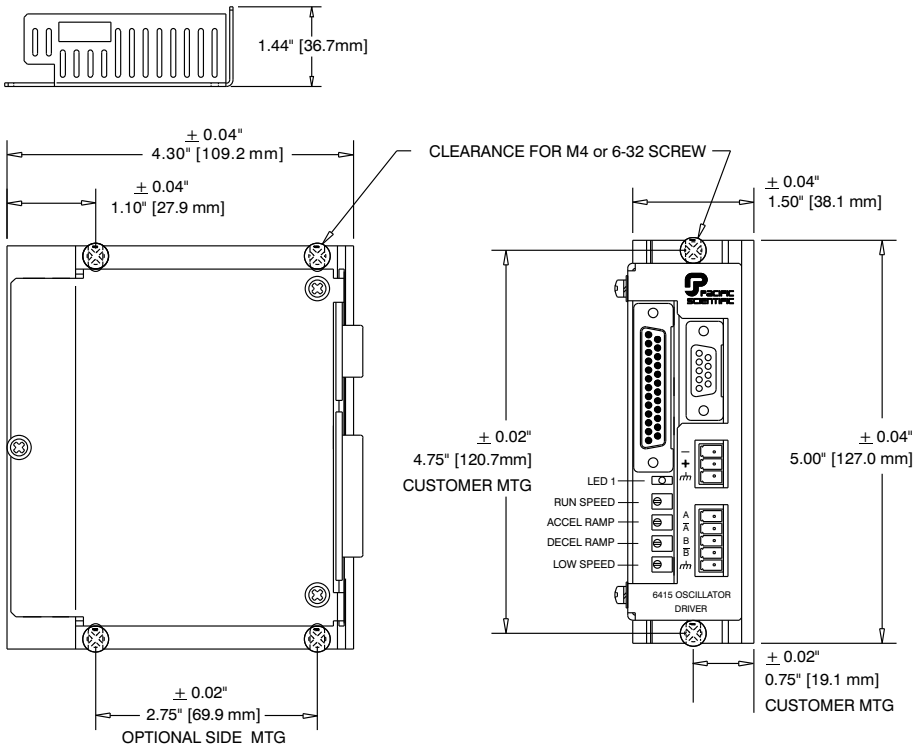



**Figure 11 - 6415 Mounting Dimensions**