User's Manual

Version 3.4.4

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TMAC

Contents

Chapter 1: TMAC System Overview

Introduction to TMAC

The TMAC system services the expanding industry of multi-function machines that run multiple processes simultaneously. Machines like Swiss-type lathes and mill turn lathes often have several tools cutting simultaneously on different features of a part. The tools on these multi-path machines need to be monitored and possibly adaptively controlled at the same time. TMAC can monitor several tools simultaneously, while controlling feedrate and providing alarm status indications for each tool.

TMAC runs on a Linux operating system, which provides real time control as well as virtually unlimited expansion capability. It allows for developing newer, faster, and more complex applications as machines change and user requirements become more sophisticated.

See Also:

"Primary TMAC Features" Page 2

"TMAC System Components" Page 4

Modes of Operation

TMAC offers the following modes of operation:

- **Cutting Mode**: Monitor power, vibration, strain, coolant flow, coolant pressure, spindle speed, and various other important machine factors. Multiple channels can be monitored simultaneously while monitored channels are tested against user-programmed limits to alert the operator of machining anomalies.
- **Bearing Health Mode**: TMAC can perform a bearing analysis on machine bearings to aid in diagnosing bearing conditions.
- **Millivolt Mode**: TMAC allows passing limits through commands without utilizing the job structure

See Also:

"Cutting Mode" Page 26

"Bearing Health Mode" Page 28

"Millivolt Mode" Page 30

CNC/TMAC Interface

TMAC can receive commands from the CNC through an RS232, parallel input/output, file-drop, or Ethernet connection (if available).

Each type of interface provides direct communication between CNC macro routines, part programs, and TMAC. The programmed limits, along with their associated alarms, may be interfaced to the CNC in a variety of ways depending on system requirements.

Primary TMAC Features

TMAC has a wealth of powerful features available.

Learning Operations

In order to establish a monitoring baseline, TMAC captures each sensor's value as a machining operation is performed. TMAC then stores the associated value as the nominal for the designated tool in that operation.

This operation is referred to as “learning” a tool, where each new tool and/or monitoring operation must be learned separately. Once TMAC learns the tools and/or monitoring operations, limits can be programmed that trigger a CNC alarm.

This feature can also be used to automatically create jobs and operations.

See Also:

"Learn Mode" Page 118

Time Increment Editor

The Time Increment Editor allows the user to create time increments for each phase of an operation.

Each time increment allows different limits to be programmed for each phase of an operation. The program can then start the monitoring process for the operation and use specific job parameters.

See Also:

"Time Increments" Page 130

Data Viewer

The Data Viewer is a diagnostics tool for analyzing historical data (recordings). The Data Viewer has a wealth of features that allow exploration of recordings from completed operations. While displaying data for an operation, the viewer allows the following:

- Mark a point of interest on the recording
- View any events that occurred during the operation, such as alarms, start and stop events, and time increments.
- Calculate the difference between two data points of the recording.
- Observe data at specific moments in during the operation.
- View bearing health results
- Overlay recordings for easy comparison of operations

See Also:

"Data Viewer" Page 184

Monitor Multiple Channels

TMAC can accept commands for multi-channel starts, allowing monitoring of multiple sensors simultaneously.

See Also:

"Issuing RS232 Commands for Multichannel Starts" Page 209

"Issuing Variable Commands for Multichannel Starts" Page 215

"Views" Page 37

Chapter 2: TMAC System Components

Overview

The TMAC system includes the following physical components:

- **TMAC Control Unit**: A Linux-based computer that stores and processes machine data.
- **TMAC HMI**: A browser-based interface that provides visual representation of the monitored channels.
- **Input Devices**: TMAC can communicate directly with various sensors and other hardware.
- **CNCs**: TMAC can be integrated with wide variety of controls.

See Also:

"TMAC Control Unit" Page 5

"TMAC HMI" Page 5

TMAC Control Unit

The TMAC Control Unit (TCU) is Linux-based and can handle multiple processes and functions simultaneously. The TMAC system communicates with multiple input devices through a variety of connection protocols based on the system configuration. TMAC can interpret analog and digital data. The TMAC processes running on the TCU may be referred to as "the data side" in legacy documentation.

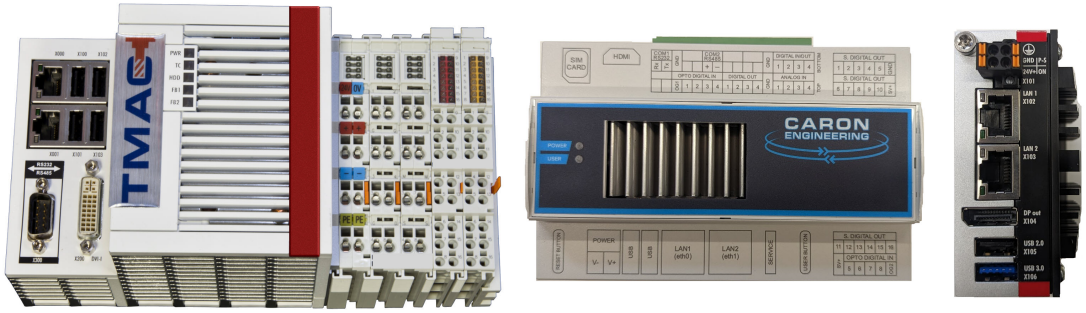

Figure 2-1: TMAC Control Unit (3 Options)

TMAC HMI

The HMI (Human Machine Interface) is a browser-based interface that provides a visual representation of the monitored channels. Using the HMI the user can review data, create or edit jobs, adjust system settings and view live operations.

The browser-based infrastructure of the HMI provides the flexibility of viewing the HMI on any networked device with the following browsers:

- Google Chrome
- Apple Safari
- TMAC Explorer (A CEI provided front end application)

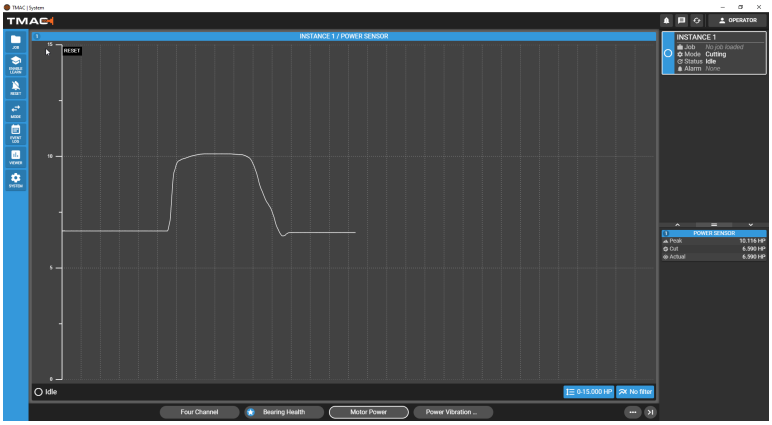

Figure 2-2: TMAC HMI

Note: For full functionality CEI recommends using the TMAC Explorer for viewing the HMI.

Input Sensors

TMAC can process inputs from multiple sensors. The following are some of the sensors that can provide input to TMAC.

- CEI analog sensors
- USB sensors
- Generic analog sensors
- Ethernet Sensors

TMAC's flexibility enables it to handle other inputs as well. Several sensors are available for various machining processes, allowing measurement and monitoring of:

- Motor power (HP, kW or mV)
- Strain
- Vibration or acceleration (g)
- Coolant flow (GPM/LPM)
- Coolant pressure (PSI/BAR)
- Spindle speed (RPM)

All sensor data is processed by the TCU.

Power Transducer

The power transducer is a Hall effect sensor that outputs a 0-10V signal relative to horsepower (HP). The transducer offers scalable adjustments for a range of 2-90 HP in 0.1 HP increments. A 4-125 HP option is also available.

Figure 2-3: Power Transducer

Millivolt Input

Millivolt monitoring uses a power sensor 0 to 10000mV signal value without converting voltage data to power. Specifications using the millivolt scale establish a correlation between spindle torque and transducer output. This process yields fixed limit alarm settings in millivolts.

High Precision Power Sensor

The High Precision Power Sensor offers high speed power measurements. The sensor outputs a 24 bit digital signal via an Ethernet connection, and it has a DIN rail mounted enclosure.

Figure 2-4: High Precision Power Sensor

Note: This sensor is a legacy product.

PT800

The PT800 3-phase power transducer offers high speed power measurements. The sensor outputs a 24 bit digital signal via an Ethernet connection, and it has a DIN rail mounted enclosure. The PT800 uses a Hall effect sensor with external current transformers.

Figure 2-5: PT800 Power Sensor

Note: Single Phase PT800s are available upon request.

Coax Vibration Sensor - [CEI-VIB-WMR]

The vibration sensor is an advanced sensor platform that has been designed to measure a wide range of motion amplitude and frequency. It is housed in an anodized aluminum case. The connector is IP67 rated for wet environments and the electronics are fully encapsulated. Vibration sensors are useful in the following machining operations:

- Spindle bearing monitoring
- Turning applications
- Grinding applications
- Bar feeder applications

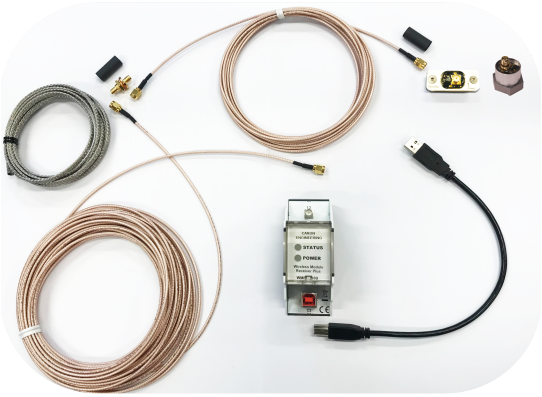

Figure 2-6: Coax Vibration Sensor- Full kit w/Alternative Magnet Base

Coax Strain Sensor - [CEI-STR-WMR]

The strain sensor is designed to sense the strain (material deflection) by embedding the sensor into the monitored component. The strain gauge type may vary by application, and must be installed by Caron Engineering. Strain sensors contain a 24 bit ADC. The connector is IP67 rated for wet environments and the electronics are fully encapsulated.

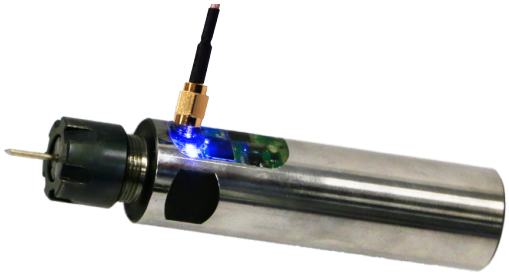

Figure 2-7: Mounted Strain Sensor

Coolant Sensors

TMAC can monitor coolant flow and/or pressure. There are two types of coolant sensors that can be integrated with TMAC.

A coolant sensor makes precise measurements of actual flow and/or pressure through the coolant system. The sensor allows the system to be configured to monitor the diverse coolant flows and/or pressures occurring in coolant systems.

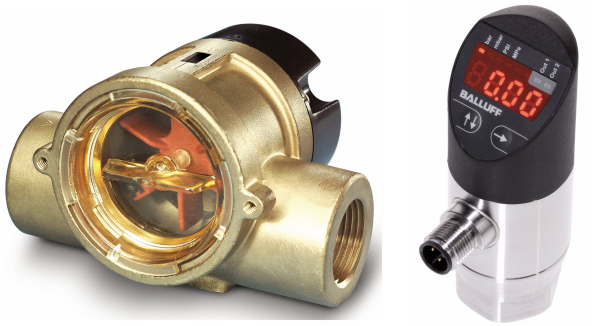

Figure 2-8: Coolant Flow (Left) and Coolant Pressure (Right) Sensors

Each coolant sensor sends signals to the TCU which processes the data for integration into the TMAC system.

Note: A wide variety of application dependent sensors are available. Contact CEI for more information on Coolant flow and pressure sensors.

Spindle Speed Sensor

The spindle speed sensor measures RPM of the spindle.

The spindle speed sensor sends signals to the TCU which processes the data for integration.

Generic Analog Sensor

TMAC is capable of taking in data from a generic analog signal. These generic analog sensors are configured during system integration. Analog signals can be converted to a wide variety of ranges and unit types by creating a proportional relationship between the signal and the specified range of output values.

CNC Interfaces

TMAC can communicate directly with various CNCs using RS232, digital I/O and Ethernet connections.

Chapter 3: TMAC Explorer

Overview:

The TMAC Explorer is a Windows application that renders the TMAC HMI for any TMAC system. Additionally, the TMAC Explorer provides an easy interface for managing TMACs on a network. The following capabilities are available for the TMAC Explorer:

- Connect to a TMAC 3.0 system
- Display all TMACs connected to an associated network
- Manually add a TMAC by entering an IP address for the TMAC system
- Designate TMACs as favorites for quick access
- Enable Auto-connect for one TMAC in the favorite list. Auto-connect automatically connects to the associated TMAC when the TMAC Explorer is launched
- Access additional TMAC related apps and settings in the TMAC Utility Bar

Figure 3-1: TMAC Explorer - Network List

Note: Closing the TMAC Explorer window using the window's form control button ("X") does not close the software. The Explorer still runs from the task bar. To fully close the explorer software, right-click the in the task tray.

Managing Systems with the TMAC Explorer

The TMAC Explorer allows for easy management of TMAC systems on a network. The displayed TMAC list can be filtered using the buttons above the list. The filter buttons have the following affects on the TMAC list:

- **Recent**: Displays the TMACs that have recently been connected to by the device running the TMAC Explorer
- **Favorites**: Displays all TMACs that have been marked as a favorite
- **Network**: Displays all TMACs that are connected to the same network as the device that the TMAC Explorer is installed to.

If a TMAC is not displayed in the list of networked TMACs, the TMAC can be added manually by pressing ··· button and selecting **Manual Connect**. See "Manually Connecting to a TMAC" Page 14 for more information.

Interpreting TMAC Cards in the TMAC List

Additional information can be discerned from looking closer at the TMAC "Cards" in the TMAC lists. Each TMAC Card contains the following information:

- **Machine Name** (1) - Displays the Machine name assigned to the TMAC in the system configuration
- **IP address** (2) - Displays the IP address of the associated TMAC Control Unit
- **Instance Names** (3) - Displays the names for all instances for the associated TMAC
- **Version Number** (4) - Displays the version of TMAC on the TMAC Control Unit. This can differ from the version of the explorer that is installed.

  Note: If the Explorer is a more recent version than the TCU being connected to, a system notification alerts the user that an update is available.

- **Context Menu** ··· (5) - Use the context menu to connect to the associated TMAC, or to add the TMAC to the favorites list.

Figure 3-2: TMAC Card

Marking a TMAC as a Favorite

Use the following steps to mark a TMAC as a favorite:

1. Click the **Network** filter button to display the networked TMACs visible to the TMAC Explorer
2. If the TMAC does not appear in the list, add it manually using the steps documented "Manually Adding a TMAC to the TMAC Favorites List" Page 13

   Note: When a TMAC is added manually, it is automatically flagged as a favorite.

3. Locate the desired TMAC from the networked TMAC list and press the associated ··· button

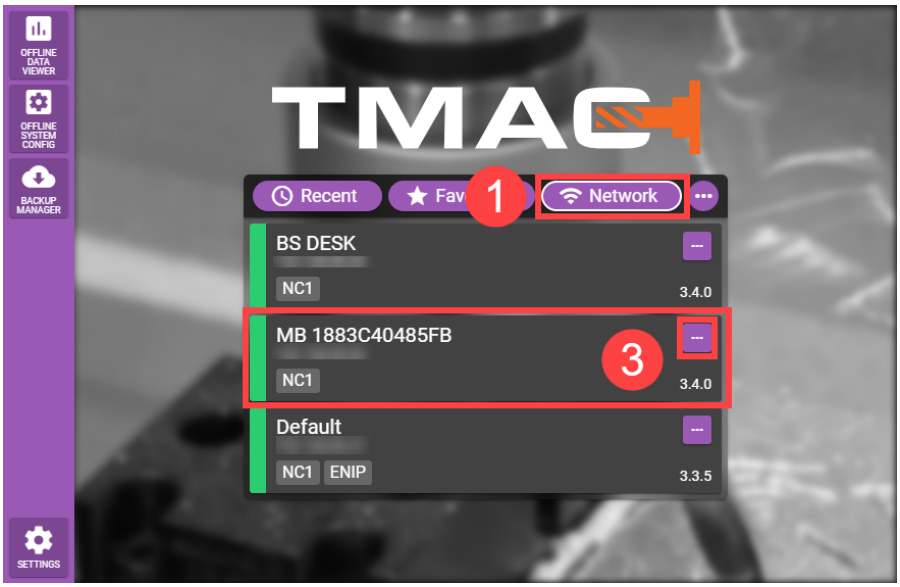

Figure 3-3: Setting Default TMAC

4. Select **Add to Favorites**. The TMAC card for the favorited TMAC will now appear in the favorites list and is marked with a ★

Manually Adding a TMAC to the TMAC Favorites List

To manually add a TMAC, perform the following steps:

1. Press **Favorites** filter button
2. Press the ··· button above the list of TMACs

Figure 3-4: Manually Adding a TMAC to the List

3. Select **Manual Add** + from the menu

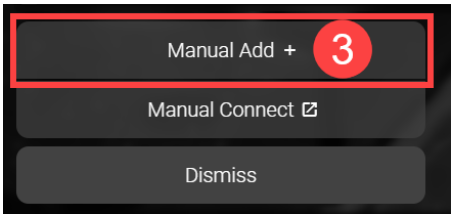

Figure 3-5: Manually Adding a TMAC to the List

4. Enter the IP Address of the TCU to add to the TMAC list and press ✓

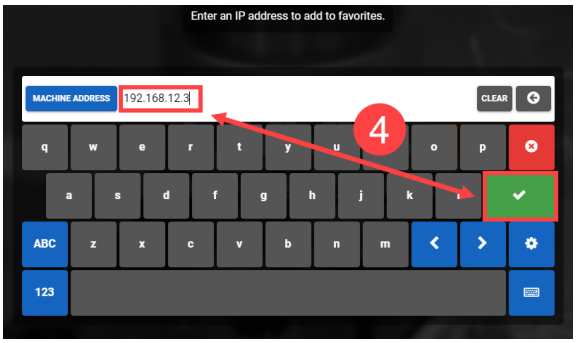

Figure 3-6: Manually adding a TMAC to the Machine List

Note: The TMAC must be connected to the network to be added manually. Additionally, if the TMAC is not configured, the displayed TMAC Card is grey. The TMAC must be configured for the explorer to be able to connect to the associated TCU.

Manually Connecting to a TMAC

To manually connect to a TMAC that is not in the TMAC list, perform the following steps:

1. Press the ••• button above the list of TMACs

Figure 3-7: Manually Adding a TMAC to the List

2. Select **Manual Add +** from the menu

Figure 3-8: Manually Adding a TMAC to the List

3. Enter the IP Address of the TCU to add to the TMAC list and press ✓

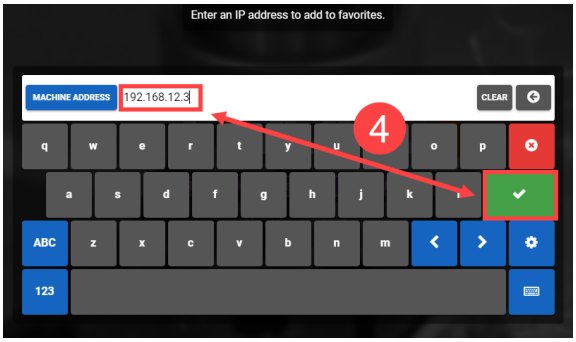

Figure 3-9: Manually adding a TMAC to the Machine List

If a connection is established, the associated TMAC HMI is rendered in the Explorer.

Disconnecting from a TMAC

While connected to a TMAC using the TMAC Explorer, the utility bar and Explorer settings can not be accessed. Use the following steps to disconnect from TMAC:

1. Click the Disconnect button on the TMAC Tool Bar

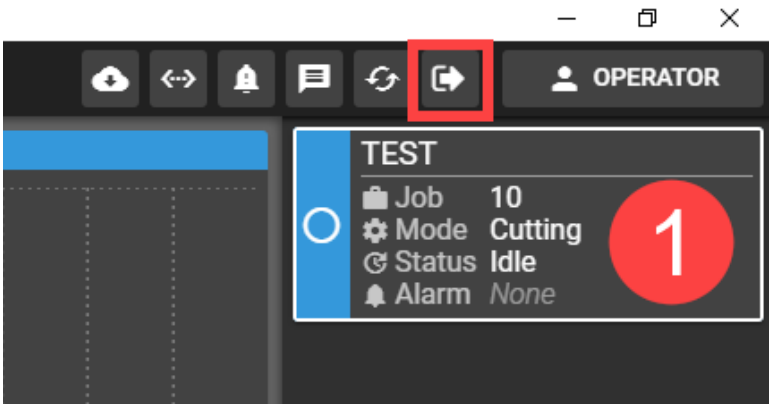

Figure 3-10: Disconnecting from a TMAC Step 1

2. Select Disconnect

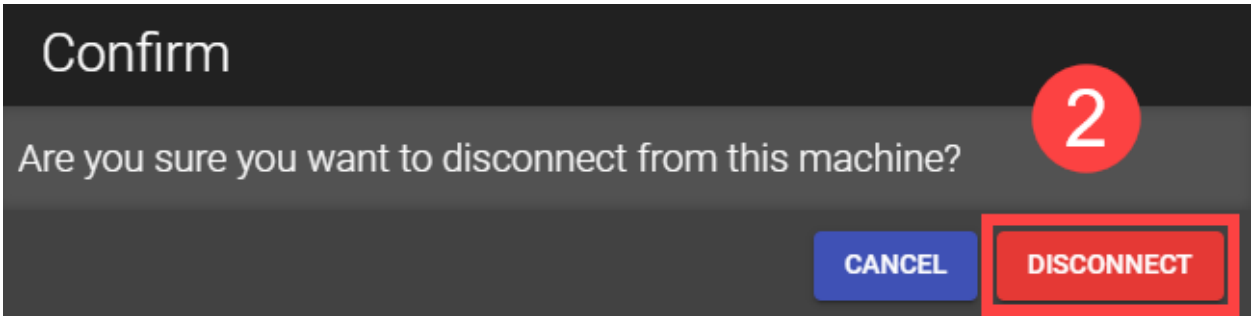

Figure 3-11: Disconnecting from a TMAC Step 2

See Also

"TMAC HMI Action Bar" Page 33

"System Menu" Page 46

TMAC Utility Bar

The TMAC Explorer offers access to additional TMAC related utilities and settings through the TMAC Explorer Utility bar. The Utility bar currently offers the following:

- **Offline Data Viewer**: Offers the full functionality of the TMAC data viewer to view exported recordings. This does not require an active connection to a TMAC system.
- **Offline System Configuration**: Offers the ability to create, view and edit a TMAC system configuration file without an active connection to a TMAC system. System Configuration files should only be created/edited by system integrators and supervisors.
- **Backup Manager**: Offers the ability to configure and manage Auto-backup settings
- **Settings**: Provides access to general display settings, device information, and machine information.

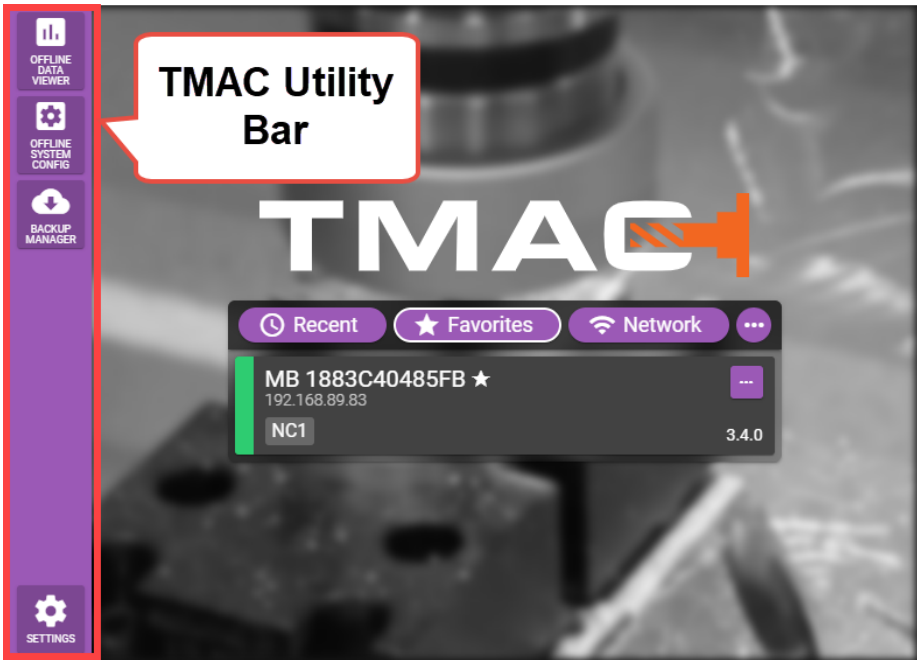

Figure 3-12: TMAC Explorer Utility Bar

Offline Data Viewer

The Offline Data Viewer provides an interface to view exported recordings. This allows TMAC recording data to be accessed and viewed on any device that the TMAC Explorer is installed on without an active TMAC connection. Additionally, recording data from multiple TMAC systems can be viewed at once allowing for easy comparisons of multiple systems that monitor the same machining process. The Offline Data Viewer currently allows the user to view **Cutting Mode** and **Millivolt Mode** recordings. Please refer to **Chapter 13: Data Viewer** for Data Viewer functionality.

See Also:

"Data Viewer" Page 184

"Exporting Recordings" Page 200

Opening Recordings with the Offline Data Viewer

Use the following steps to launch the Offline Data Viewer and view an exported TMAC recording:

Note: This procedure documents launching the Offline Data Viewer from the TMAC Explorer. When installing the TMAC explorer, there is an option to add shortcuts on the desktop and start menu for each TMAC utility available in the Utility bar. If this option was enabled at installation, the utilities may be launched directly using the provided shortcuts.

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1. Press the **Offline Data Viewer** button on the TMAC Utility bar

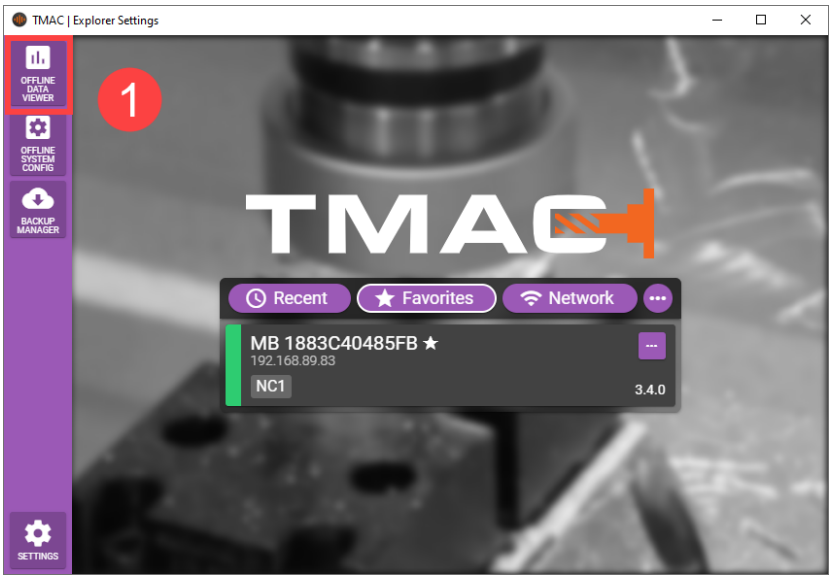

Figure 3-13: Opening the Offline Data Viewer Step 1

2. Select the Mode of Operation

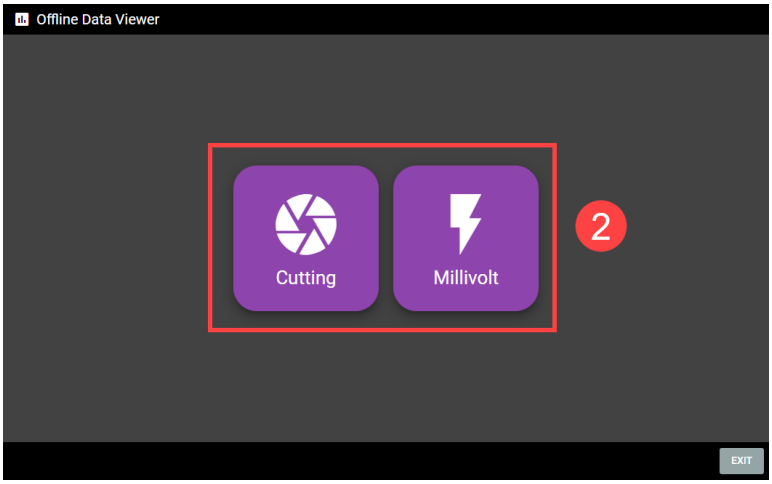

Figure 3-14: Selecting Mode of Operation

3. Navigate to and select the exported TMAC recording file
4. Press **Open**

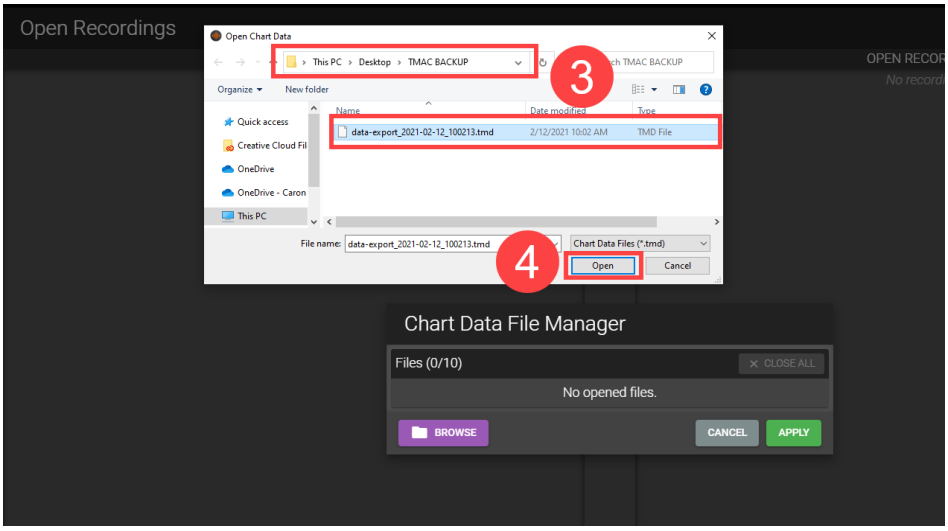

Figure 3-15: Selecting Recording Files

Note: Up to 10 recording files can be opened in the Data Viewer. Use the **BROWSE** button to add additional recording files, if necessary. Each recording file may include multiple TMAC recordings.

5. Once all desired recording files have been selected, press **APPLY**

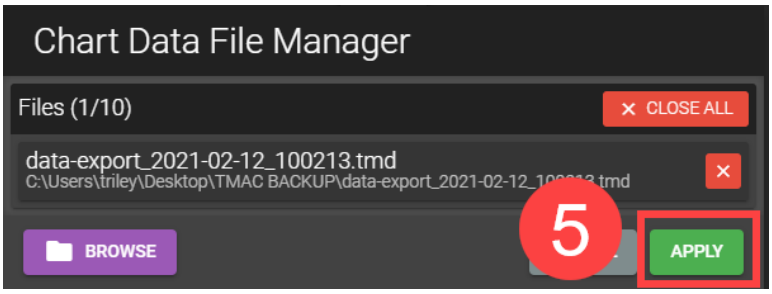

Figure 3-16: Selecting Mode of Operation

Once recordings are opened, the Offline Data Viewer funtions as normal. For descriptions of Data Viewer functionality, refer to "Data Viewer" Page 184.

Offline System Configuration

The offline system configuration utility provides a software interface to create, edit and view TMAC configurations. This should only be used by system integrators or as directed by CEI support. System configuration is documented in the *System Integrator's Manual.*

Auto-Backup Manager

The Auto-Backup Manager provides an interface to manage TMAC automated system backups. Each machine (TCU) can be configured to auto-backup to only one device at a time, but mutilple machines (TCUs) may be configured to auto-backup to the same device (In this context, "device" is referring to the PC or device where the TMAC Explorer application is installed).

Automated system backups include all information, data, and settings that a manual backup provides. Once the Auto- backup settings are configured, the backup device periodically compares the current the machine data, information, and settings to the most recent backup files. If any changes have occurred, the auto-backup manager updates the machine's backup files and appends the changes to the Auto-backup Manager's activity log.

Note: TMAC's auto-backup feature can only backup data while the TMAC Exlorer app is running. If the Explorer app is closed using the window's form control button ("x"), the Explorer app does not stop running. Instead the Explorer window is closed and the app runs from the task tray. The Explorer app icon can be right-clicked to access Explorer Utility apps, favorite machines, and to fully close the application.

Auto-Backup Manager Interface

When the Auto-Backup manager is launched from the TMAC Explorer Utility bar, the application opens in a separate window. Each machine that is marked as a favorite for the current device is displayed in the list on the left. The list consists of managed and available machines. A managed machine is a TCU that is already registed to a device that is managing that system's auto-backups. Selecting overview from the machine list provides information about the current device, backup manager version information, an activity log and access to the backup file path for the device. (See Figure below)

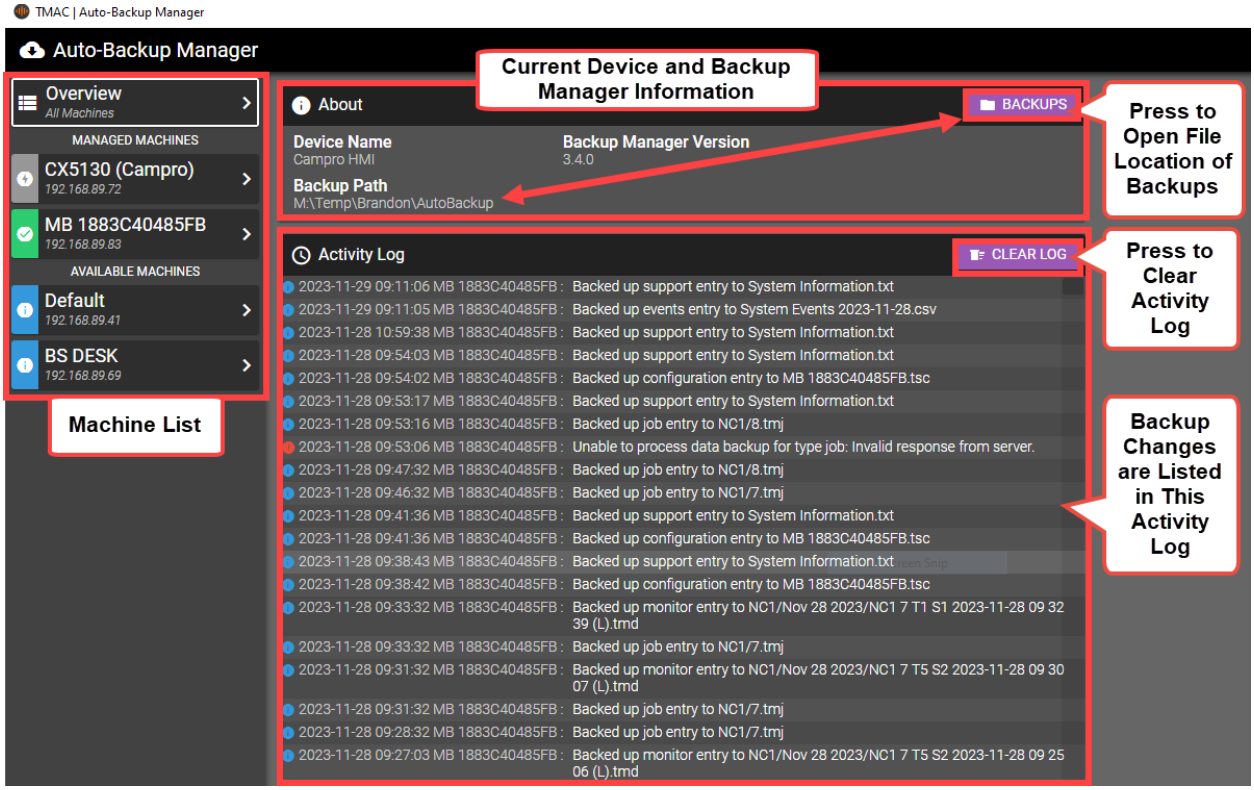

Figure 3-17: Auto-backup Manager - Machine Overview

Selecting a machine from the list of available machines provides information related to the machine including machine name, the TCU's Ip address, and version of TMAC installed on the TCU. Additionally, pressing the **Enable** button opens the machine's Auto-backup settings in a separate window of the TMAC Explorer. Auto-backup settings are located in TMAC's data management settings and are documented in Chapter 6's "Auto-Backup" Page 61

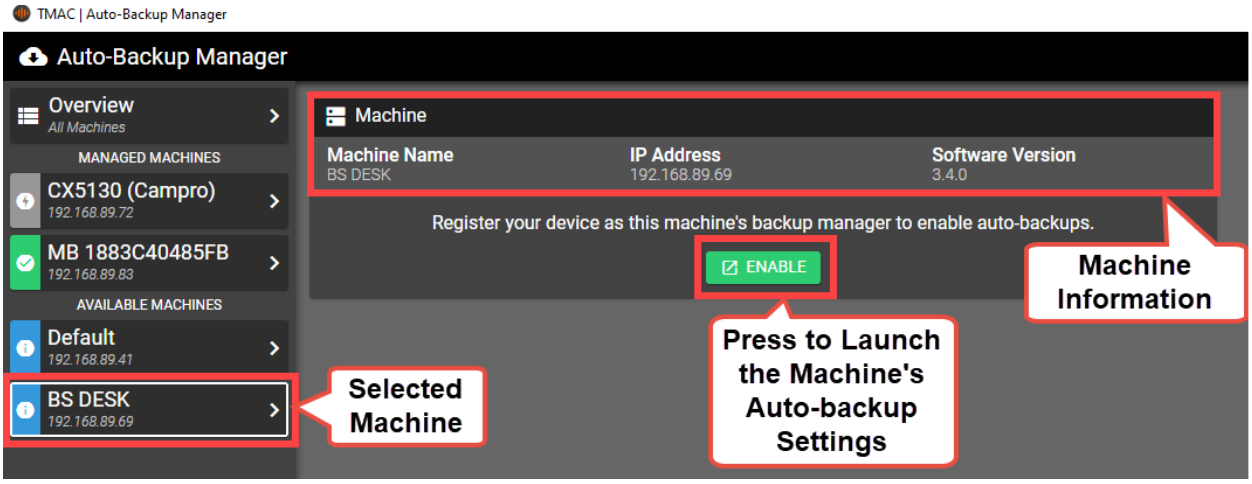

Figure 3-18: Auto Backup Manager - Available Device

Managed Machines

The machines in the "Managed Machines" list are TMACs that are already registered to the current device for auto-backup management. When one of the managed machines is selected from the list, the machine name, the TCU's Ip address, and the version of TMAC installed on the TCU are displayed. Additionally, a machine specific activity log is displayed. Pressing the **Settings** button launches the machine's Auto-backup settings in a separate window of the TMAC Explorer. See "Auto-Backup" Page 61 for more information.

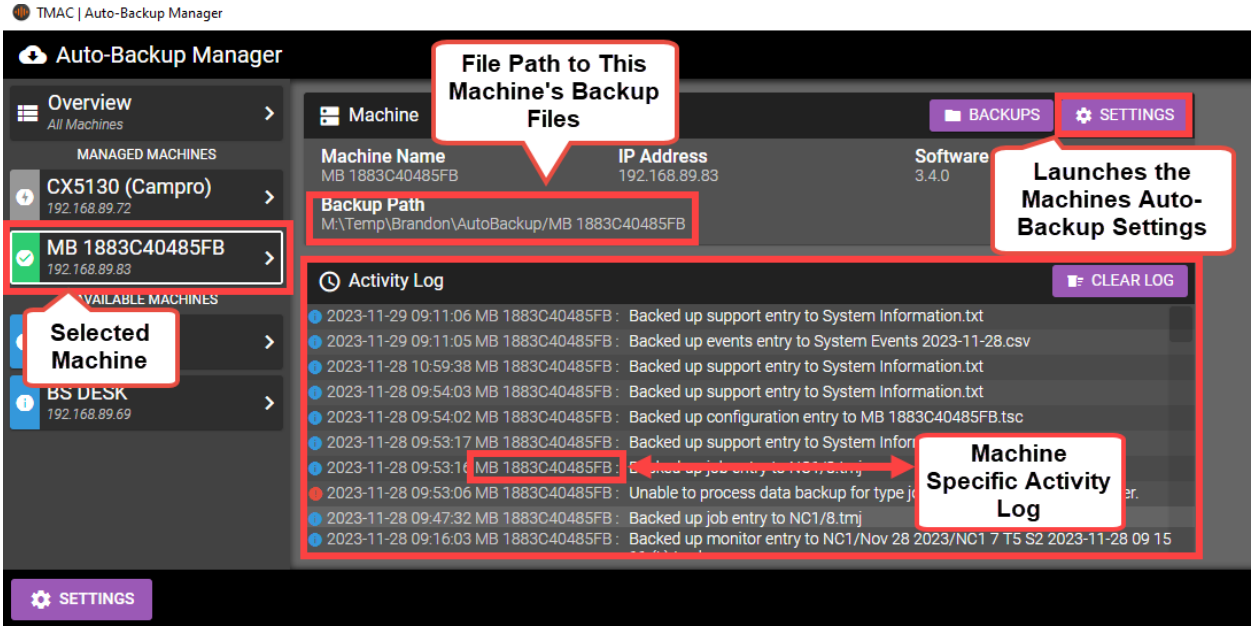

Figure 3-19: Auto Backup Manager - Managed Device

Open the Backup File Location

Use the following steps to open the backup file location from Auto-backup Manager:

1. Select a machine from the "Managed Machines" list
2. Press the **Backups** button

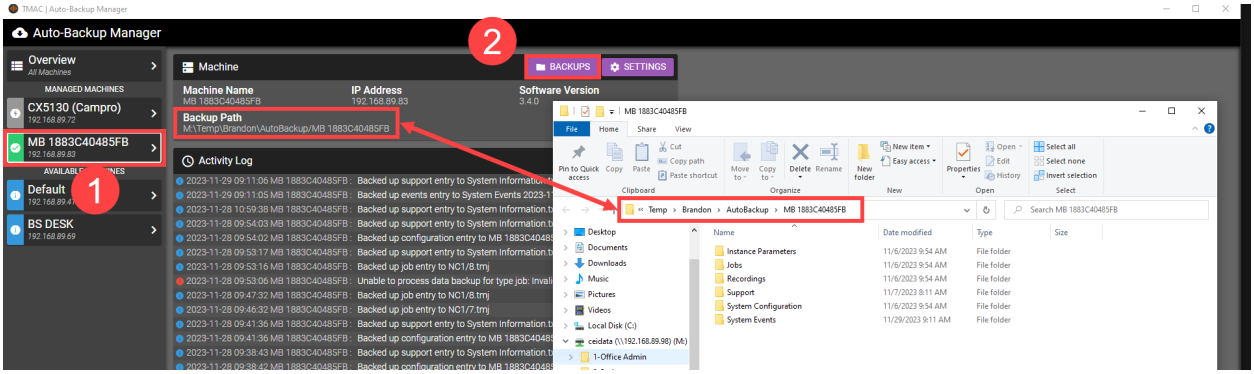

Figure 3-20: Opening the Backup File Path

Setting the Backup File Path

Use the following steps to change the file path for all backups that the current device is managing:

1. Press the **Settings** button
2. Press **Browse**

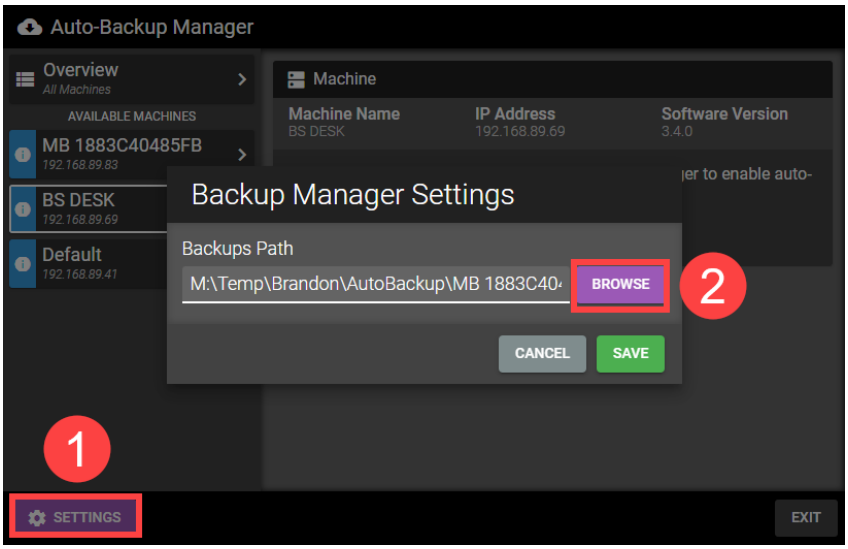

Figure 3-21: Opening the Backup File Path

3. Navigate to the desired file directory and press **Select Folder**

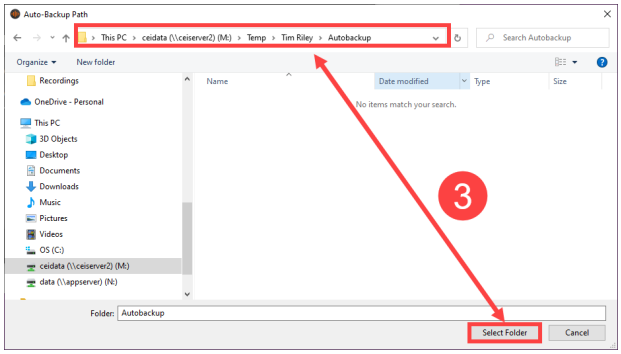

Figure 3-22: Opening the Backup File Path

4. Press Save

Explorer Settings

The Settings button on TMAC Utility bar opens general settings related to the TMAC Explorer app. The settings menu has the following two tabs:

- **General**: The general tab provides device details and display options
- **Machines**: Provides a list of favorite and registed machines for the device

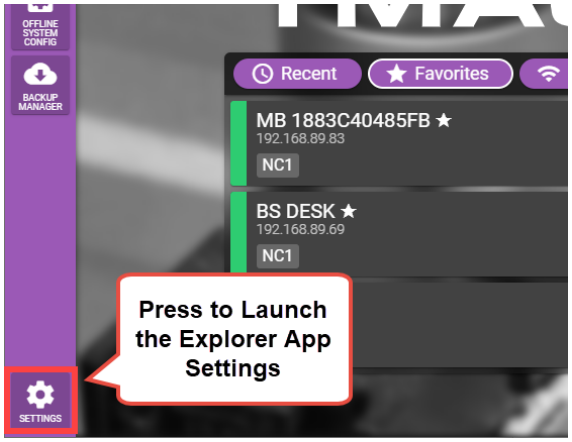

Figure 3-23: TMAC Explorer Settings

Note: Display settings set in the Explorer settings are associated with the device and will override the same settings on the machine side. For example if low performance mode is **not** enabled in the Display Options ("Low Performance Mode" Page 51) and it **is** enabled in the Explorer settings, the device will render the machine's HMI in low performance mode upon connection.

Explorer Settings - General Tab

The general tab provides access to the following settings:

- **Device Details**: Customize details related to the current device
  - **Device Name**: A name for the current device as its is displayed in TMAC
  - **Description**: An optional description field to provide additional details pertinent to the current device
- **Display Options**: Set TMAC display options from the "General Tab" Page 51

- **Low Performance Mode**: Enable Low performance mode when the device connects to a machine. Setting Low Performance mode here overrides the setting on the machine (TCU). See "Low Performance Mode" Page 51
- **Remote File System Mode**: Enable Remote File System mode when the device connects to a machine. Setting **RemoteFile System Mode** here overrides the setting on the machine (TCU). See "Remote File System Mode" Page 52
- **Single Window Mode**: Enable Single Window mode when the device connects to a machine. Setting Single Window mode here overrides the setting on the machine (TCU). See "Single Window Mode" Page 51

- **Other Settings - Sidebar Color**: Set the color of the TMAC Utility Bar

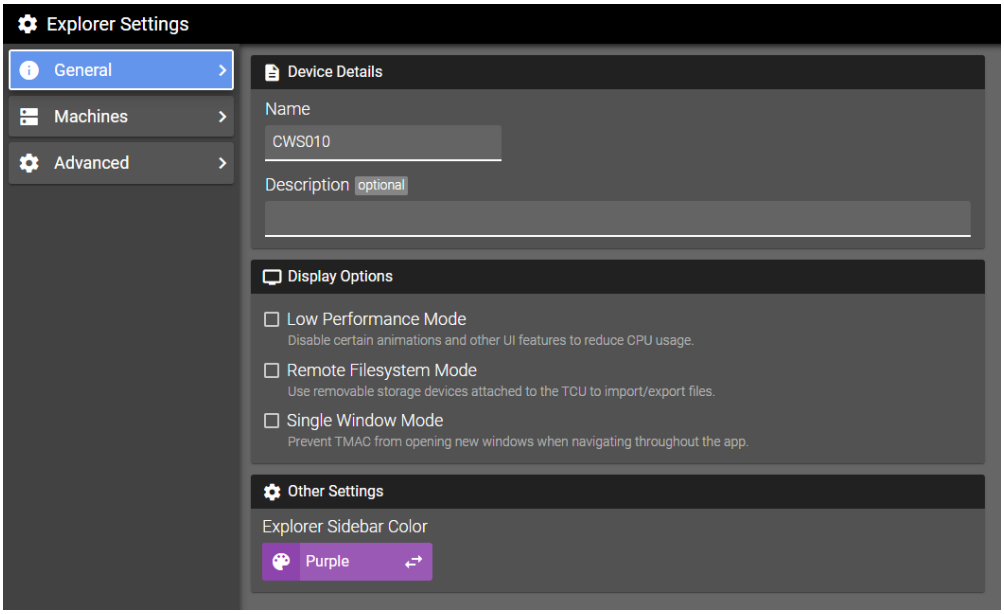

Figure 3-24: Explorer Settings - General Tab

Explorer Settings - Machines Tab

The Machines tab provides lists of the current device's favorited and registered machines. The favorites list displayed in the Explorer can be modified by reordering or removing machines from this menu (See the figure below). The Registered Machine list displays all machines that the current device is managing.

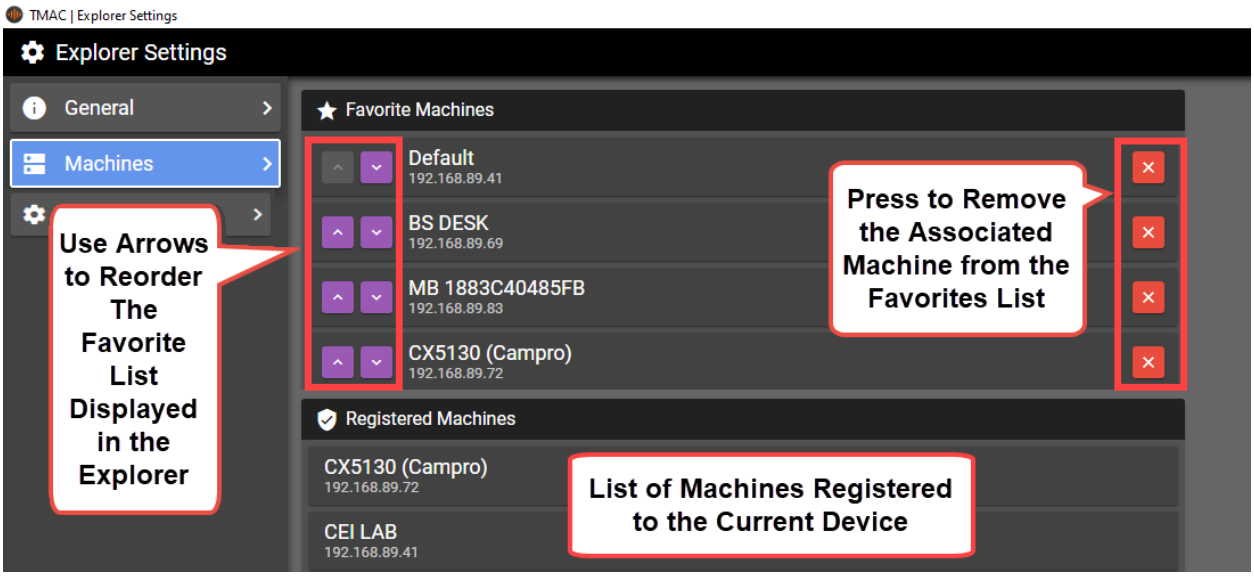

Figure 3-25: Explorer Settings - Machines Tab

Explorer Settings - Advanced Tab

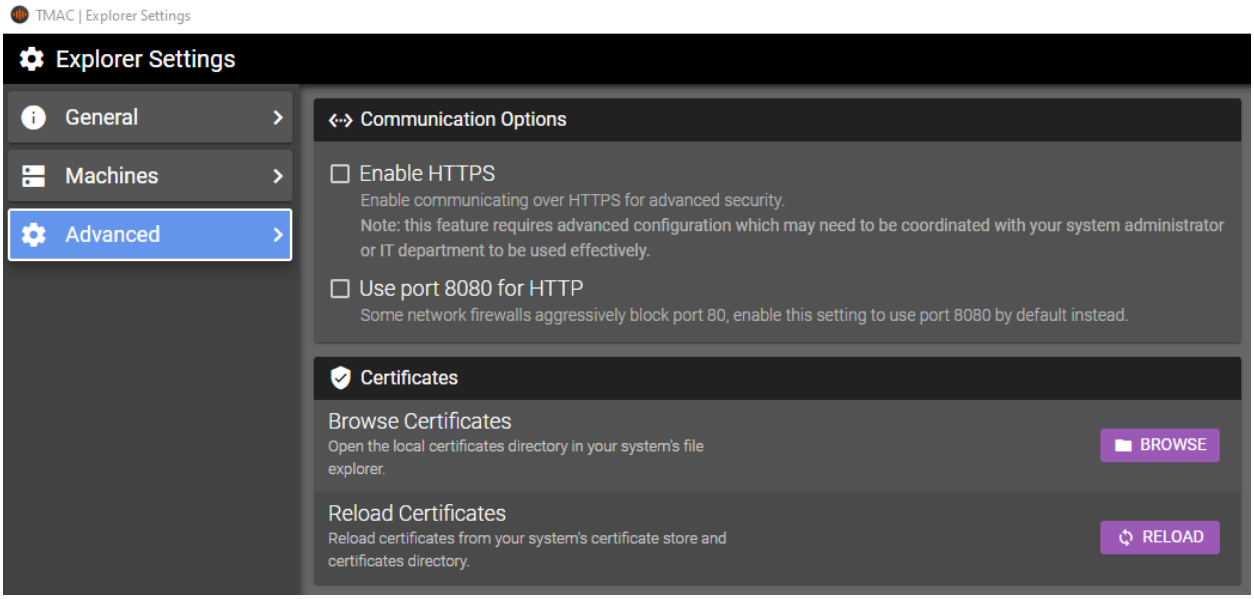

Figure 3-26: Explorer Settings - Advanced Tab

Chapter 4: Modes of Operation

TMAC offers several modes of operation. Each mode of operation changes how TMAC processes, stores and displays data. The following modes of operation are available:

- **Cutting Mode**: Monitor power, vibration, strain, coolant flow, coolant pressure, spindle speed, and various other important machine factors. Multiple channels can be monitored simultaneously while monitored channels are tested against user-programmed limits to alert the operator of machining anomalies.
- **Bearing Health Mode**: TMAC can perform a bearing analysis on machine bearings to aid in diagnosing bearing conditions.
- **Millivolt Mode**: TMAC allows passing limits through commands without utilizing the job structure

See Also:

"Cutting Mode" Page 26

"Bearing Health Mode" Page 28

"Millivolt Mode" Page 30

Cutting Mode

TMAC learns the operation and all limits are programmed as a percentage of the learned value. On subsequent runs of a learned operation, each limit is compared to the learned value. If any of the programmed limits are reached, an alarm condition is triggered. In addition, TMAC can trigger a machine response to the alarm.

TMAC can monitor multiple channels with various hardware, but the basic premise of monitoring is the same, no matter what is being monitored.

Note: Some aspects of Cutting Mode require more extensive documentation and are allotted individual chapters throughout the document.

See Also:

"Learn Mode" Page 118

"Adaptive Control" Page 121

"Time Increments" Page 130

"Limits and Delays" Page 142

Channel Classes

TMAC is capable of monitoring operations with a wide variety of sensors. These sensors are typically referred to as Channels in TMAC. The following Channel Classes are available in TMAC:

- **Primary**: The primary channel class includes power, strain, and vibration. Primary channels have full access to TMAC features and capabilities in the Job Editor.
- **Coolant**: The coolant channel class includes all coolant flow and pressure sensors.
- **Spindle**: The spindle channel class includes all spindle speed sensors
- **Passive Channels**: Passive channel classes are used to gather additional machine data while monitoring. Passive channel data is viewable on the details tab of the Data Viewer and in the Channels tab of the System Menu Diagnostics.

See Also:

"Power Monitoring" Page 27

"Vibration Monitoring" Page 27

"Strain Monitoring" Page 27

"Coolant Monitoring" Page 27

Power Monitoring

Measuring true motor power is one of the most accurate and cost-effective ways to determine tool wear or breakage. In addition, sensing true power can help determine the integrity of the motor. The power used by a operation is a more accurate indicator of tool condition than, for example, measuring spindle or axis motor current or voltage.

TMAC isolates the power used by the tool by measuring the motor power at idle and subtracting it from the power used during the operation. As a tool wears, it requires more power to cut a part. By measuring true motor power for a spindle or feed axis, TMAC can determine when a tool is worn or broken. TMAC compares measurements of motor power to programmed limits, commanding the control to take corrective action before tools or parts are destroyed.

Vibration Monitoring

Vibration monitoring operates on the principle that as a tool wears, vibration magnitude increases. TMAC can monitor the magnitude of vibration during a cut using vibration sensor data measured in units of g (gravitational constant).

TMAC vibration monitoring is particularly useful, but not limited to, the following:

- In an operation where a static tool is making light cuts and the power is too small to be detectable by TMAC
- A constant surface operation, such as a turning operation, where the power is constantly increasing to the maximum. This tends to mask wear or breakage of cutting tools
- Pinch Turning

Strain Monitoring

Strain monitoring is used for applications requiring force measurement. When a tool is in contact with a part, the tool may flex or bend depending on the material being cut. This flexing is measured as strain by a strain gauge sensor. Strain Gauge monitoring operates on the principle that as a tool wears, the strain on the tool increases.

Coolant Monitoring

TMAC can monitor the flow and/or pressure of coolant with a variety of sensors. While monitoring coolant pressure and/or flow, an alarm is triggered when a programmed limit is reached. Refer to the System Integrators manual for information pertaining to the hardware used in Coolant monitoring.

Spindle Speed Monitoring

TMAC measures the spindle speed and warns of deviations from a programmed set point. A system integrator can configure TMAC for up to three different gear ranges with different spindle speed parameters.

Bearing Health Mode

TMAC can utilize a vibration sensor attached to a machine bearing housing to perform an acceleration and velocity analysis on the vibration signal. The analysis diagnoses bearing health and other bearing issues.

Performing a Bearing Health Analysis

A bearing health analysis can be started from the HMI or by sending a command through the CNC. See "Commands" Page 208 for more information.

A bearing health analysis should be performed when the machine is running at max RPM and is not engaged in cutting. Bearing health analysis also requires a balanced tool in the spindle. CEI recommends using a hydraulic clamp or shrink fit tool.

To start a bearing health analysis from the HMI, perform the following steps:

1. Click the **MODE** button on the TMAC Action Bar
2. Select Bearing Health from the menu

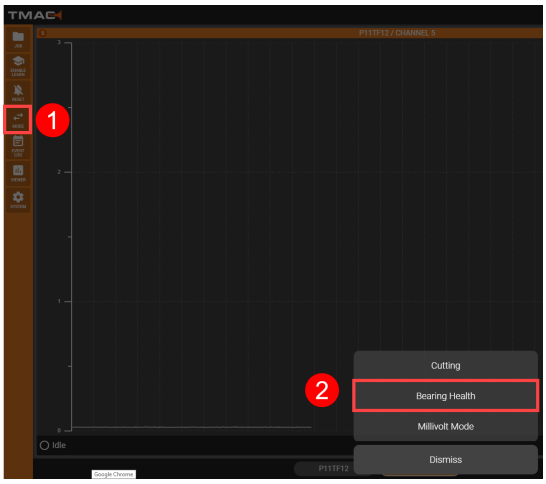

Figure 4-1: Select Bearing Health Mode

3. Prepare the machine for a bearing health analysis
4. Ensure that the current view displays the desired vibration channel by selecting it at the bottom of the HMI.
5. Click the **START** button on the bottom-right of the live graph.

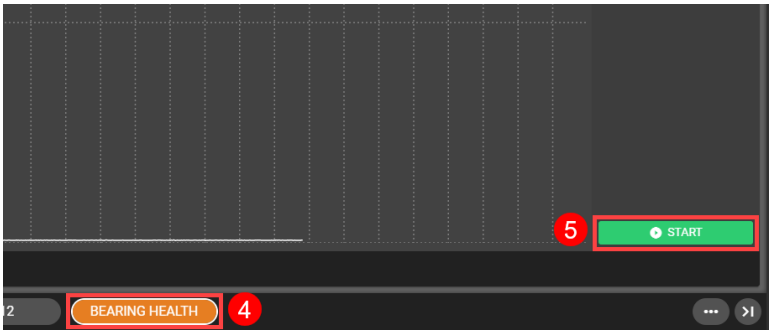

Figure 4-2: Start Bearing Health Analysis

Once started, TMAC begins recording vibration signal data to be analyzed. A progress wheel in the center of the live graph displays the progress of the bearing health analysis.

Reviewing Bearing

Once a bearing health analysis is complete, the TMAC HMI displays the results of the analysis. See Figure 4-4

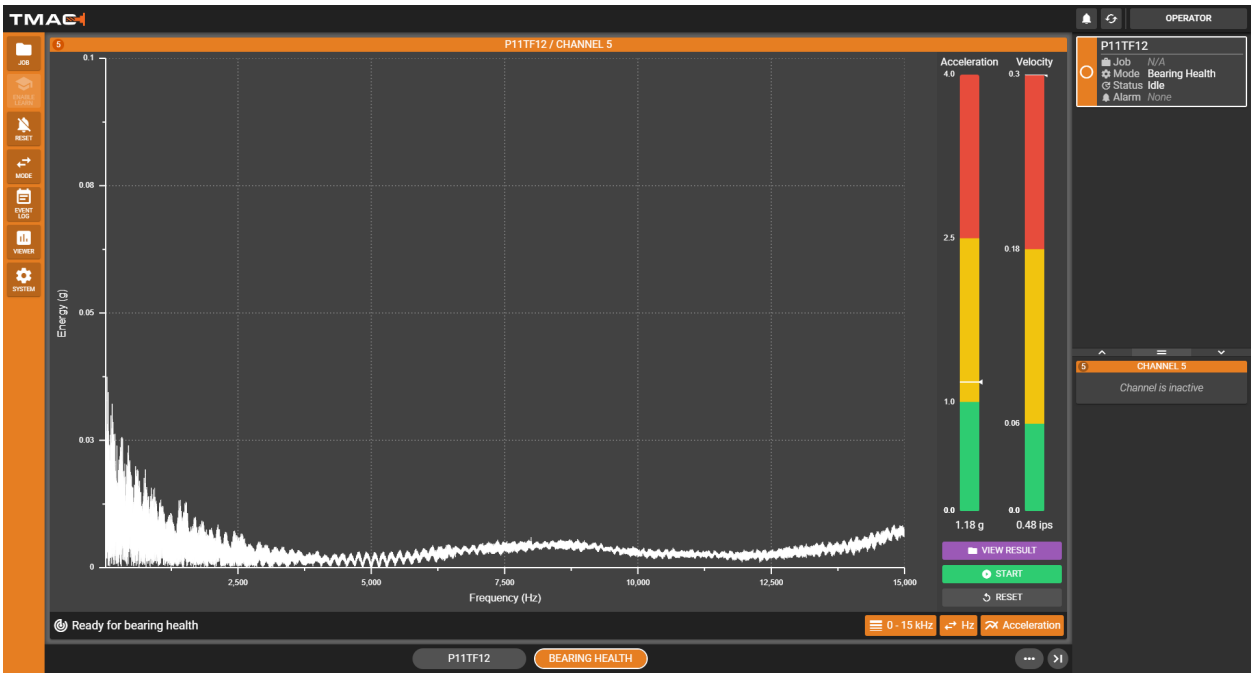

Figure 4-3: Bearing Health Results

A full bearing health analysis consists of acceleration analysis and velocity analysis. The acceleration analysis is displayed graphically over a range of frequencies, by default. In addition to the graphical representation, two bars for the velocity and acceleration analysis display whether the bearing is in good health or needs further diagnosis. Each bar has a range of RMS (root-mean-squared) values that aid in determining the bearing health. Refer to table 4-1 for a description of what each color section of the bar represents and the course of action to take.

Bearing Health Analysis Status Bar Colors	
Color	**Description**
Green	Excellent or good condition; no action needed
Yellow	Needs attention
Red	Needs Immediate Attention

Table 4-1: Bearing Health Analysis Status Bar Colors

Millivolt Mode

TMAC allows passing of limits through commands without utilizing the job structure. In Millivolt mode, TMAC displays analog output data in mV. Millivolt monitoring operates on the principal that as a tool deteriorates, the millivolt level increases. Certain machining specifications may require the power displays and alarm settings to be in millivolts. A millivolt scale reveals the actual analog output signal. The millivolt scale is only supported for specific operations. Certain features are unavailable for millivolt operations. In Millivolt mode, the job structure is not used. All parameters for an operation are passed in commands from the CNC

Note: Millivolt mode utilizes a fixed power scale from 0 to 10000 mV.

Limit Alarms and Delays in Millivolt Operation

Machining specifications calling for a Millivolt display format may refer to the limit alarms as a "*yellow limit*" and a “*red limit*”. The "*yellow limit*" and “*red limit*” correlate to wear and extreme limits, respectively.

There is always a one second delay in issuing a yellow or red limit alarm. The yellow limit or red limit must be exceeded for one second before an alarm is issued in all cases.

Chapter 5: TMAC HMI Functionality

The TMAC HMI (Human-Machine Interface) is a browser-based interface that grants access to TMAC functionality (e.g. creation of jobs, diagnostic analysis, etc...). The TMAC HMI provides an instant visual representation of machine data. The HMI is supported on the following platforms:

- Google Chrome
- Apple Safari
- TMAC Explorer

See Also:

"Views" Page 37

"Profiles" Page 43

TMAC HMI: Features and Components

The TMAC HMI is a browser-based graphical user interface and is supported across a variety of devices. The HMI responds to either a touch-screen monitor or a keyboard and mouse. The TMAC HMI has several functions:

- Graphically and numerically displays data from interfaced sensors and instances
- Launch TMAC features such as the Job Editor, Data Viewer, Event Log, System Menu, and View Editor
- Launch the View Editor
- Toggle between Operation Modes
- Reset the system, clearing any alarms

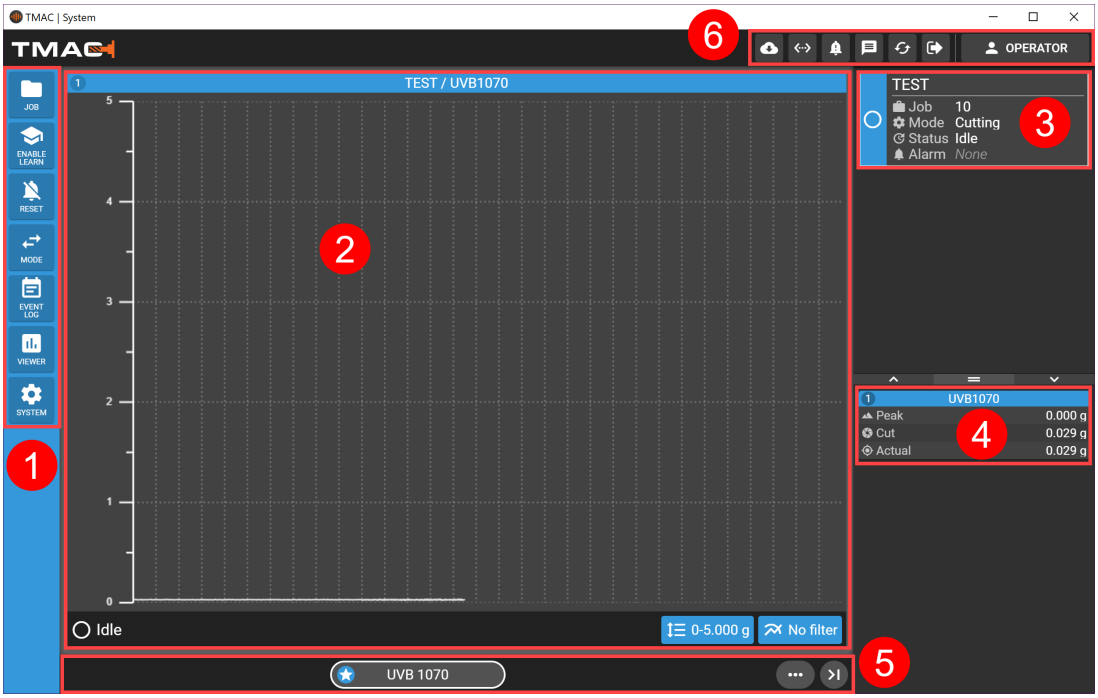

Figure 5-1: HMI Components

The HMI has the following components on the default screen:

- TMAC Action Bar (1)
- Live Graph(s) (2)
- System Overview (3)
- Channel Summary (4)
- View Selection Bar (5)
- TMAC Toolbar (6)

See Also:

"Data Viewer" Page 184

"Event Log" Page 170

"Jobs" Page 71

TMAC HMI Action Bar

The TMAC HMI Action Bar is a vertical menu located on the left side of the interface. The Action Bar functionality is displayed in the Table 5-1 below.

TMAC HMI Action Bar Functionality	
Button	**Functionality**
	Launches the Job Operations Window
	Switches the system between Monitor and Learn mode
	Resets the system clearing any alarms. Do not use the reset button while monitoring, or TMAC will not continue to monitor the operation.
	Switches the Operation Mode
	Launches the Event Log in a new tab of the browser
	Launches the Data Viewer for review of data stored from operations
	Launches a System settings menu for system configuration

Table 5-1: TMAC HMI Action Bar Functionality

Some Action Bar buttons are discussed more in depth in the individual sections of the manual.

Note: The buttons on the TMAC Action Bar are tied to TMAC instances. Clicking a button on the TMAC Action Bar performs the action described in Table 5-1 as it pertains to the instance selected in the System Summary. For example, clicking the Reset button resets the alarm states for the selected instance."System and Channel Summary" Page 36

See Also:

"Jobs" Page 71

"Learn Mode" Page 118

"Event Log" Page 170

"Data Viewer" Page 184

"The System Button" Page 45

TMAC HMI Graph Colors

On the live graph of the HMI, the graph background color is representative of the system state that is currently active in TMAC. These color backgrounds apply to Cutting Mode operations only. The various system states and their associated colors are displayed in Table 5-2.

TMAC System State Background Color	
System State	**Color**
Monitor	Black
Learn	Green
Disabled	Gray
Monitor Hold	Gray
Start Delay	Purple

Table 5-2: System State Colors

Displaying Limits, Alarms and Events

The HMI graph displays limits, learned value, idle value, and various events on the live graph during cutting mode operations. Limits appear on the graph as dotted horizontal lines. The lines are color coded to indicate the limit type. Learned and idle values are also represented by horizontal dotted lines.

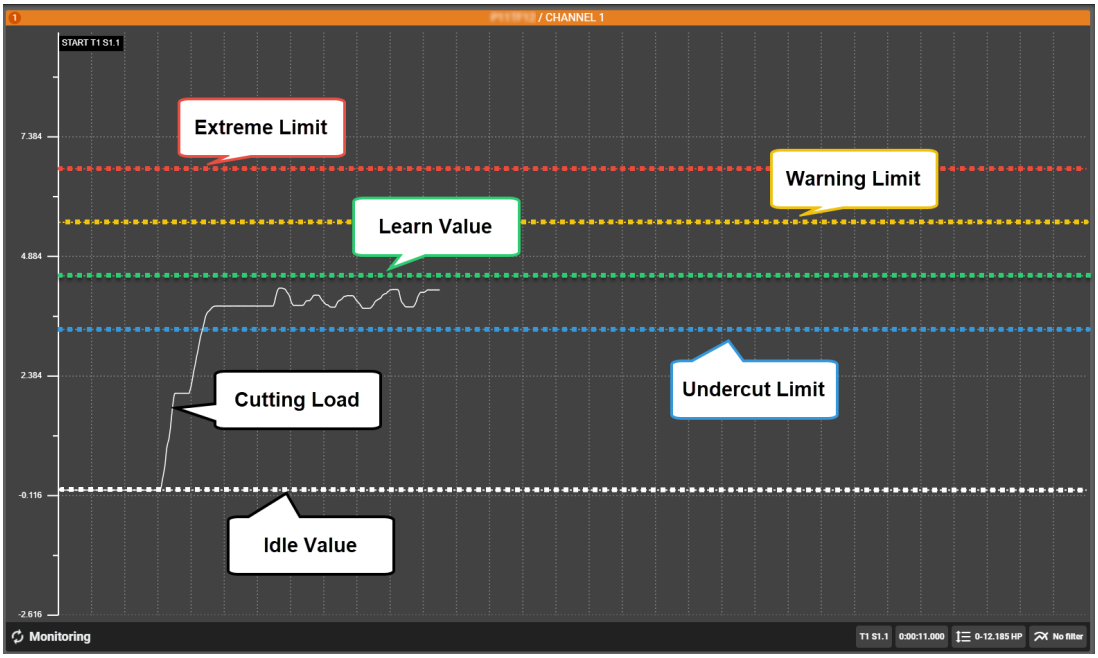

Figure 5-2: Standard Limit Example

Work limits are represented differently than standard limits on the HMI. As a operation progresses, work is accumulated. Work limits are represented on the right side of the live graph by circular progress bars. As work accumulates, the progress bars fill one at a time until the cut is finished. The undercut bar fills first, followed by learned and wear progress bars. In addition to progress bars, the area on the live graph between the idle capture and signal value is filled with a color representing the work values (blue for undercut work, green for learned work, and yellow for wear).

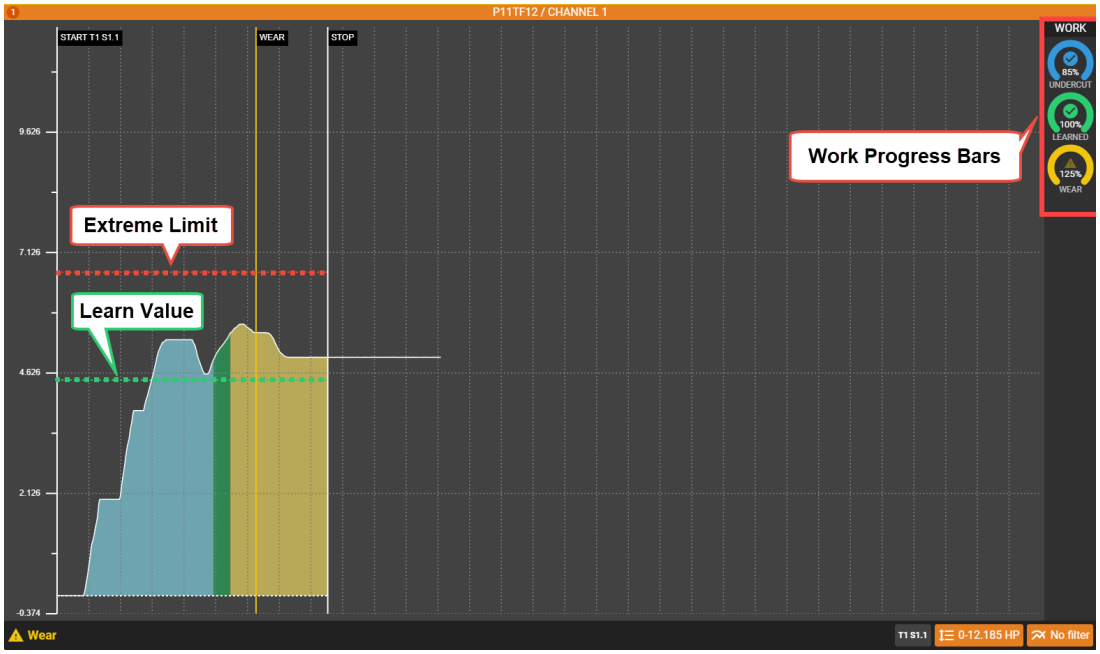

Figure 5-3: Work Limit Example

Events (such as alarms, resets, Monitor starts and Monitor stops) appear as vertical lines. Event lines are labeled on the graph.

Table 5-3 describes for how certain limits, alarms, and events are displayed on the HMI.

Description of HMI Limits, Alarms and Values		
Limit or Value	**Line type**	**Color**
Extreme Limit	Horizontal Dotted	Red
Wear Limit	Horizontal Dotted	Yellow
Undercut	Horizontal Dotted	Blue
Learned	Horizontal Dotted	Green
Idle	Horizontal Dotted	White
Extreme Alarm	Vertical Solid	Red
Wear Alarm	Vertical Solid	Yellow
Undercut Alarm	Vertical Solid	Red
Monitor Start	Vertical Solid	White
Monitor Stop	Vertical Solid	White
Custom Event	Vertical Solid	User Configured

Table 5-3: System State Colors

Table 5-3 does not display a list of all limits, events or alarm types.

System and Channel Summary

The fields on the right side of the screen display system and channel information. The top half of the fields (System Summary) are dedicated to the TMAC instances in the System. For each instance the following information is displayed:

- Machine Name
- Active Job Name
- Current Operation Mode
- Current System State
- Alarm Status

The bottom half of the fields (Channel Summary) is dedicated to configured channels in the system. For each channel, the following data is displayed:

- Signal Value
- Actual Value
- Peak Value

Figure 5-4: System Overview (left) and Channel Summary (right) Example

Note: Specific channel classes may provide more or less information than what is documented.

Manipulating the Channel and System Summaries

The system and channel summary fields can be adjusted using the action bar found in the middle of the summary fields. Both the channel and system summary fields can be scrolled through using a mouse wheel or finger swipe. The action bar functionality is described in the Table 5-4.

Indicator Action Bar Functionality	
Action Bar Button	**Function**
	Clicking his button from the default position will hide the process indicator fields Clicking this button from the bottom position will return the action bar to default the position
	clicking and dragging this button adjusts the vertical position of the indicator action bar
	Clicking his button from the default position will hide the Channel indicator fields Clicking this button from the top position will return the action bar to default the position
	Clicking this button minimizes the sidebar that displays the Channel Summary and system overview.

Table 5-4: Indicator Action Bar Functionality

Views

The largest portion of the HMI is dedicated to the display of sensor channels in a graphical user interface. Up to four channels can be viewed at the same time, but this requires the creation of views. If no views have been previously created, the graph portion of the HMI offers the following two options:

- **Create View**: Launches the view editor
- **Create Default Views**: Automatically creates a view for each channel available to the TMAC instance

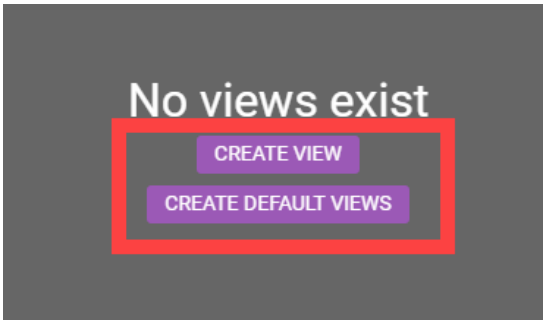

Figure 5-5: No Views Created

All existing views are located on the bottom portion of the HMI. Each existing view is represented by a button that, when clicked, switches the graphical interface to the selected view. Clicking the "..." button opens a menu that displays the following:

- **Current View**: Name of the current view displayed at the top of the menu
- **Create New View**: Launches the View Editor for the creation of a new view
- **Edit Current View**: Launches the View Editor to edit the selected view
- **Delete Current View**: Deletes the selected view
- **Delete All Views**: Deletes all views that have been created

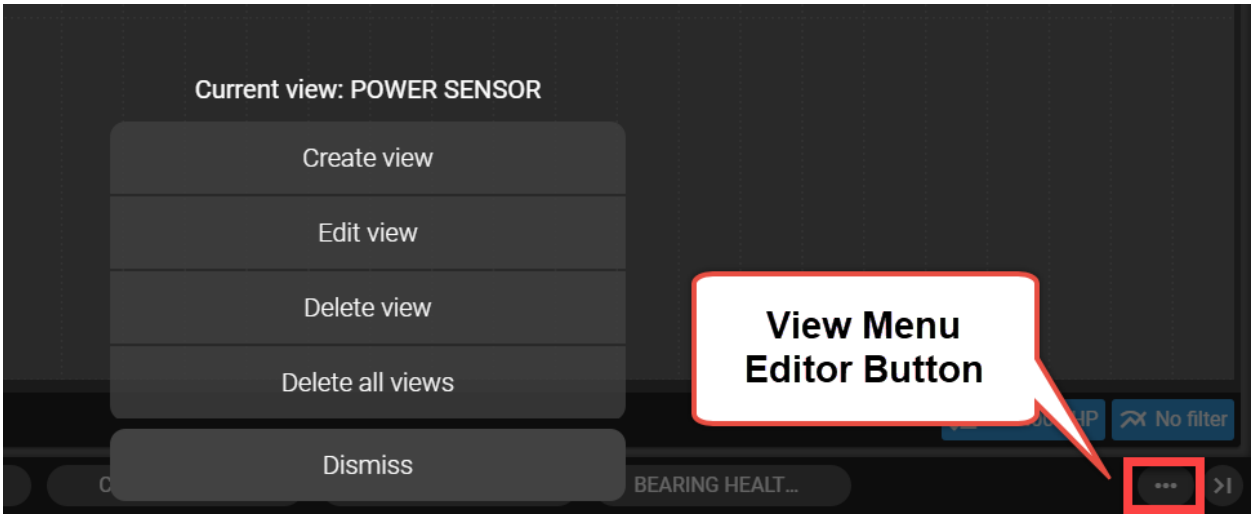

Figure 5-6: View Editor Menu Button

Note: If a larger number of views are created, the list of views becomes scrollable.

Using the View Editor

The View Editor allows the user to select a visual representation of up to six channels in the TMAC system. When creating a new view, the default layout is one channel (See Figure 5-6). For descriptions of full toolbar functionality refer to Table 5-5.

View Editor Toolbar Functionality	
Button	**Description**
	Renames the View
	Set View as default. See "Setting a Default View" Page 40 for more information.
	Select a pre-configured View layout; Options can be filtered by number of panels
	Clears all changes made and reverts the view to the default configuration

Table 5-5: View Editor Toolbar

Once the desired layout of channel fields has been selected, the channel for each field can be selected by clicking the **SELECT CHANNEL** button in each field. Once the view is complete, click the **SAVE AND EXIT** button to make the view available in the HMI.

Example: Creating a Three Channel View

The following steps display how a user could create a three channel view to display vibration, spindle speed and coolant flow:

1. Press the ··· button to open the View Menu
2. Select Create View

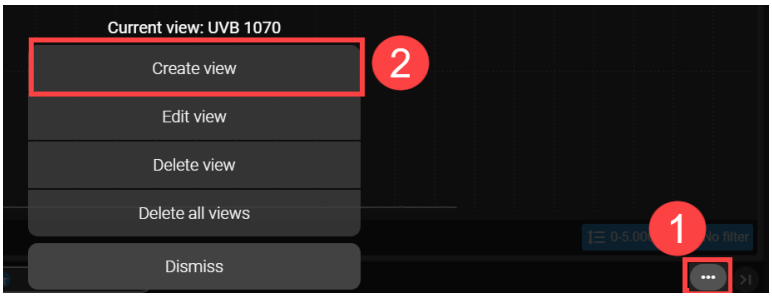

Figure 5-7: Example - Creating a View Steps 1-2

3. Enter a name for the view and press the **CREATE** button

Figure 5-8: Example - Creating a View Step 3

4. Press the **EDIT LAYOUT** button to select a pre-configured layout
5. Select the **3 Panels** button to filter the layouts
6. Choose the desired layout and press **SELECT**

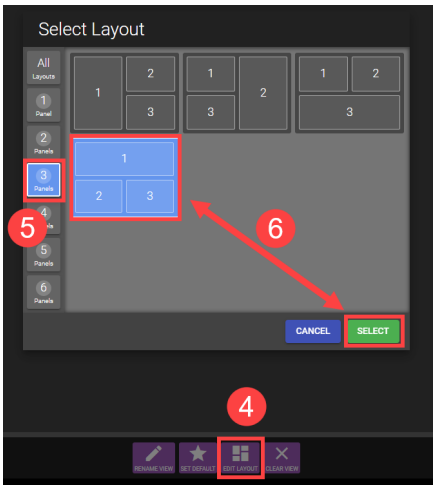

Figure 5-9: Example - Creating a View Steps 4-6

7. Click the **SELECT CHANNEL** button in one of the fields
8. Select the channel to be displayed by clicking the corresponding TMAC instance and channel from the provided list and press the SELECT button

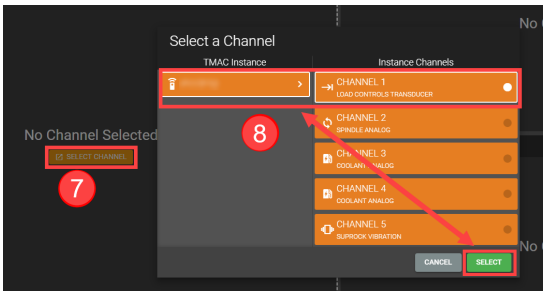

Figure 5-10: Example - Creating a View Steps 7-8

9. Repeat steps 7 and 8 for each remaining view field until all desired channels are displayed.
10. When the view is configured, click the Save and Exit button

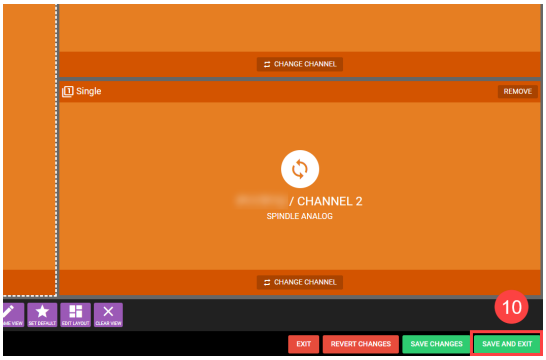

Figure 5-11: Example - Creating a View Step 10

Setting a Default View

The View Editor allows a single view to be set as a default per instance. Setting a view as default does the following:

- Default views are labeled with a star icon (See figure below). The background of the star label is the same color as the associated instance color. See "General Tab" Page 66
- Clicking on an instance listed in the System Summary instantly renders the default view for that instance in the HMI.

Figure 5-12: Default View Icon (Outlined in Red)

To set a view as default, open the view in the View Editor and perform the following steps:

1. Click the **SET AS DEFAULT VIEW** button
2. Select an instance from the list to associate with the View
3. Click **SAVE AND EXIT**.

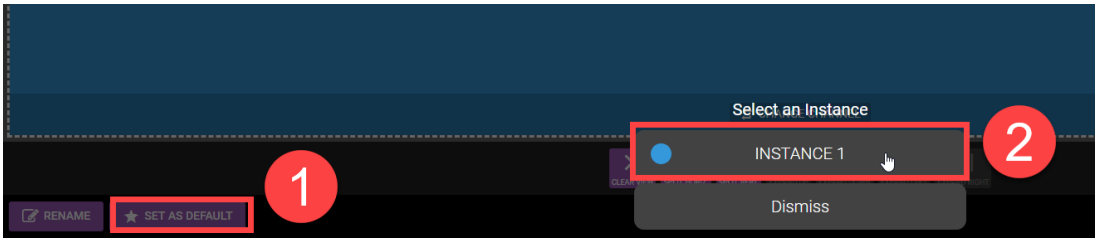

Figure 5-13: Default View

TMAC Toolbar

The buttons of the TMAC Toolbar provide the following functionality:

- **Active Downloads (Cloud button)**: View active downloads in the TMAC Explorer
- **Communications**: View communication status of CNCs, Serial Ports, and Ethercat Devices. Addionally the system diagnostics window can be launched from the drop-down
- **Alarm Message list (Bell button)**: View system alarms messages and definitions
- **Notifications (Message Box)** : View system notifications. Pressing the settings button in the drop-down opens the notification settings in the System Information menu
- **Refresh button**: Refreshes the TMAC Explorer and HMI
- **Disconnect button (Arrow)**: Disconnects from the TMAC system and returns to the machine list in the TMAC Explorer (Explorer only)
- **Profile Sign-in**: Sign in or switch profiles

Figure 5-14: TMAC Toolbar

See Also:

"Alarm Messages" Page 41

"Profiles" Page 43

"Disconnecting from a TMAC" Page 14

Alarm Messages

When TMAC enters an alarm state, the HMI alerts the user with an alarm message. Alarm messages are accessible by clicking the **Bell** button on the TMAC toolbar. All active system alarms are listed and provide the following information:

- **Instance Name**: Name of the TMAC instance associated with the alarm.
- **Alarm Name**: Name of the triggered alarm
- **Alarm Description**: Brief description of why the alarm was triggered.

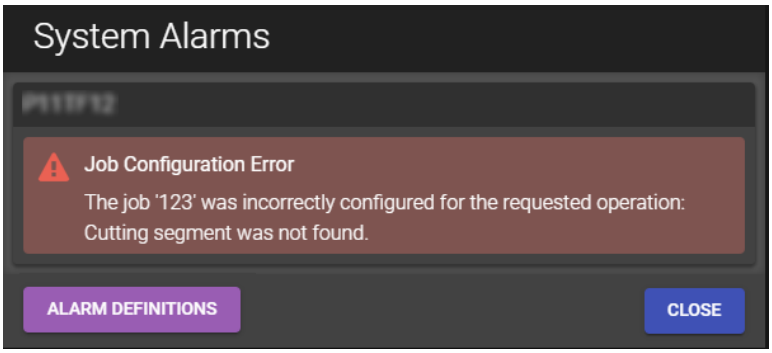

Figure 5-15: Sample Alarm Message

Additionally, pressing the **ALARM DEFINTIONS** button opens a menu that lists all system alarms that TMAC can produce. Each menu item is expandable to display descriptions and corrective actions (if any) for each alarm.

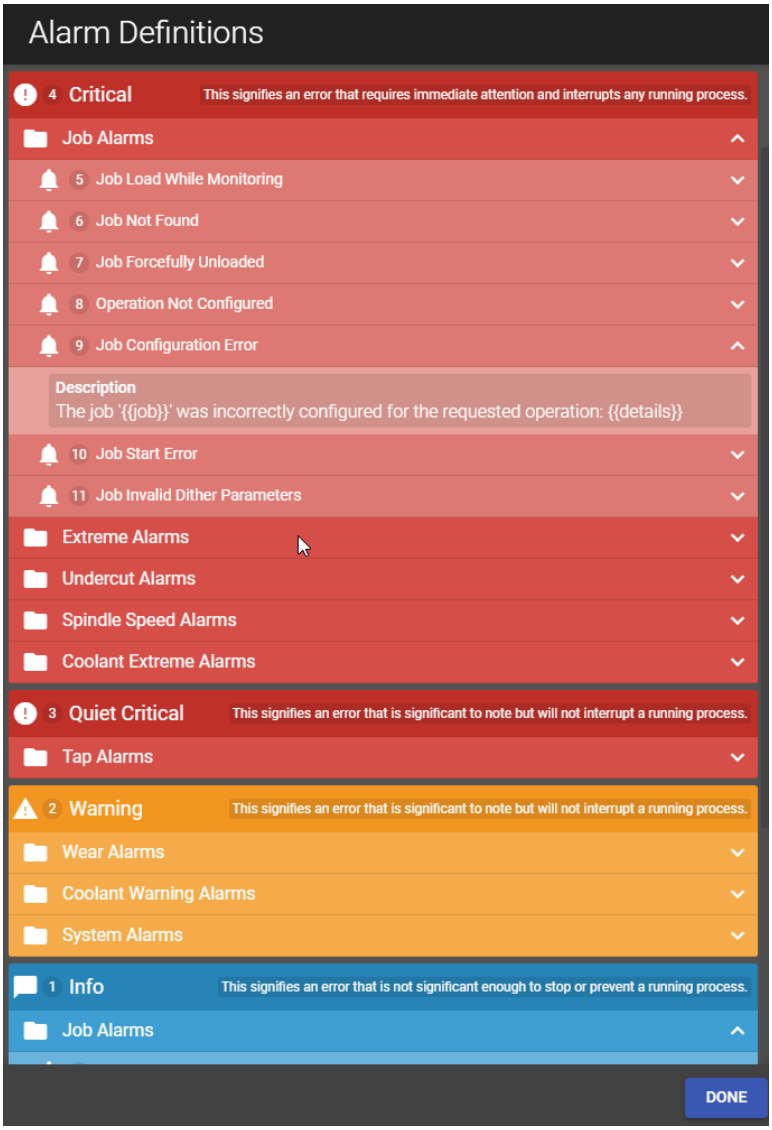

Figure 5-16: Alarm Definitions

Note: The alarm codes listed in the Alarm Definitions menu are also listed in the alarm tables in Chapter 15 "Alarms and Error Messages" Page A-1

Profiles

TMAC is capable of providing password protected user profiles that restrict access to certain features, functions and settings. By default, TMAC has the following user profiles:

- **Operator**: Access to basic HMI functionality with restrictions to features and system settings
- **Supervisor**: Wider access to features and settings
- **Integrator**: Full access to features, settings and diagnostics. This level is used by TMAC system installers.

In addition to the default profiles, TMAC provides the ability to create customized profiles. Customized profiles allow specific functions and features to be restricted on an individual basis.

Changing Profiles

The active profile is displayed in the TMAC Toolbar. To change profiles, do the following:

1. Click the Profile button on the HMI
2. Select the desired profile from the list
3. If applicable, enter a password in the field
4. Press **Sign In**

Note: Step two is bypassed when changing from the Operator profile to another profile. When changing profiles from any profile other than Operator, the user can also select **Sign Out** at step 2. Selecting **Sign Out**, changes the active profile to the Operator profile.

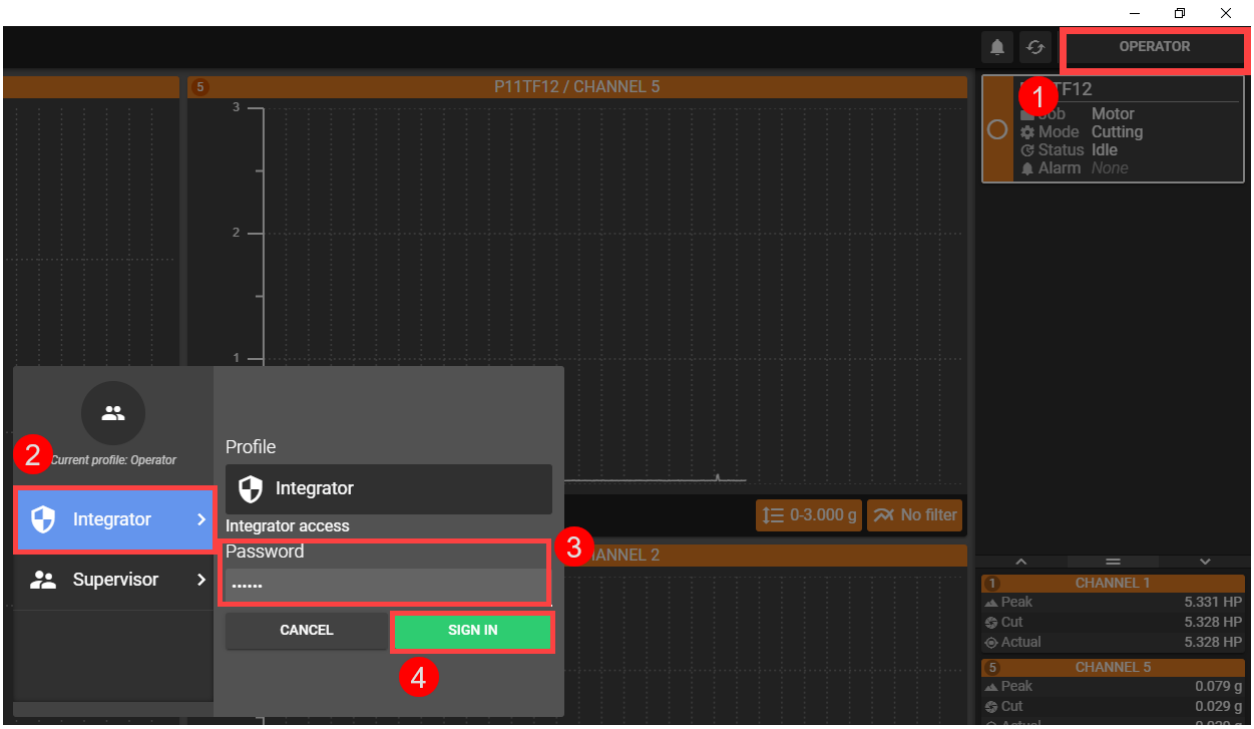

Figure 5-17: Main User Interface

Resetting a Password

If a password is forgotten, contact CEI to request a temporary password reset code. Locate the TMAC serial number in the General tab of the System information window. The TCU hardware should also be labeled with the TMAC serial number. Once system information has been confirmed, CEI will respond with a password reset code.

Applying the Reset Code

Use the following steps to apply the password reset code:

1. Click the Reset Password link

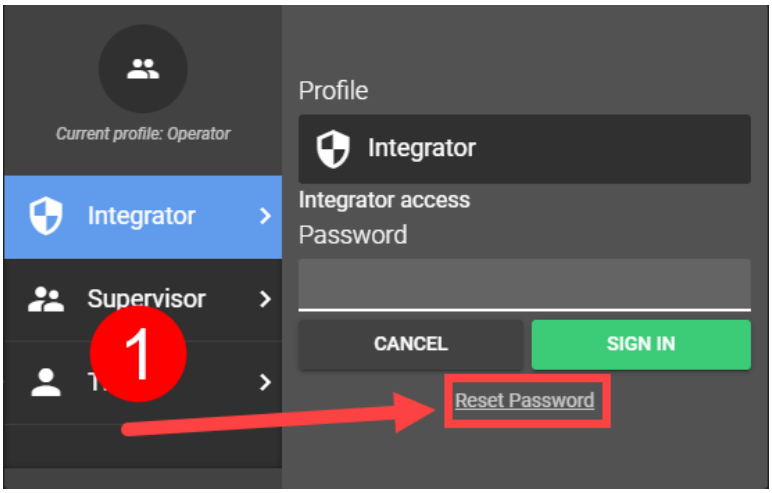

Figure 5-18: Password Reset Step 1

2. Enter the reset code sent by CEI
3. Enter the new password in the fields
4. Click **SUBMIT**

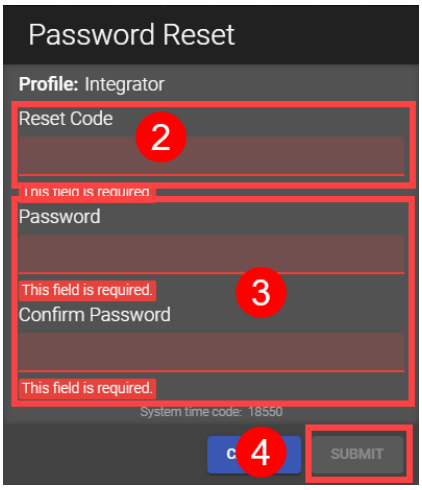

Figure 5-19: Password Reset Steps 2-4

Chapter 6: The System Button

Overview

The **SYSTEM** button provides access to the joint system and configuration menu. The system menu provides system tools and information for diagnostic purposes. The configuration menu contains system and instance parameters that affect the overall functionality of TMAC. The availability of certain features and functions may vary based on permissions available to the active profile.

See Also:

"Instance Parameters" Page 65

"System Menu" Page 46

"System Menu: Configuration Sub-Menu" Page 65

System Menu

The System Menu contains the following buttons:

- **Enable/Disable Part Re-cut** : Enables part re-cut, ignoring undercut limits until Part Re-cut is disabled.
- **Monitor Enable/Disable**: Disables all monitoring for the system
- **View System Log**: Launches the TMAC Log Viewer
- **System Information**: Launches a menu that displays various system information
- **Data Management**: Opens settings related to data management, including disk usage, backup settings and data purge settings
- **Diagnostics**: Launches a menu of tools and information for testing and diagnostic purposes

See Also:

"Diagnostics" Page 64

"System Information" Page 50

Part Re-Cut

The Part Re-cut feature disables the undercut alarm for a job or operation. When a part needs to be re-cut, the signal value does not exceed the normal levels for the operation. The undercut limit requires the signal value to exceed a certain threshold. It is likely during a part re-cut that a false undercut alarm will be generated by not satisfying the expected threshold. It is then advisable to disable the undercut alarm by turning on part re-cut mode.

Note: If Part Re-cut is enabled, signature limit types are ignored during a cutting operation.

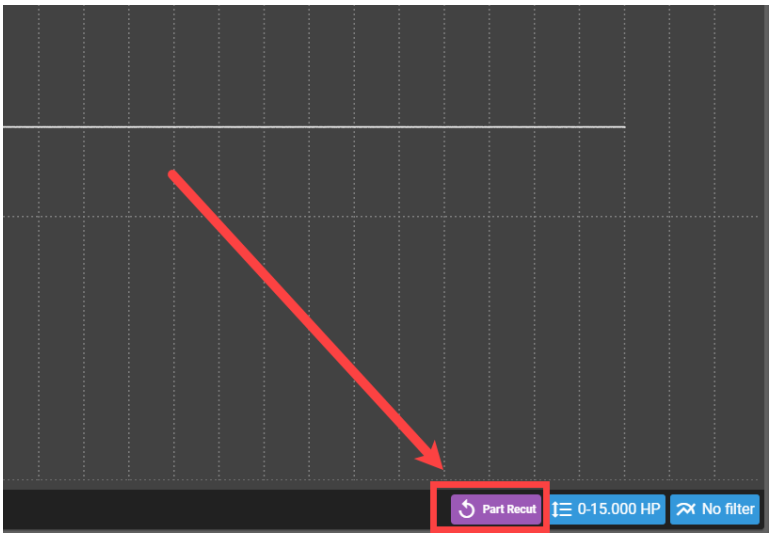

Figure 6-1: Part Re-cut enabled (Purple Widget)

Enable Part Re-cut

To enable part re-cut use the following steps:

1. Select the desired TMAC Instance from the System Summary
2. Click the **SYSTEM** button on the TMAC Action Bar
3. Click the **ENABLE PART RE-CUT** button

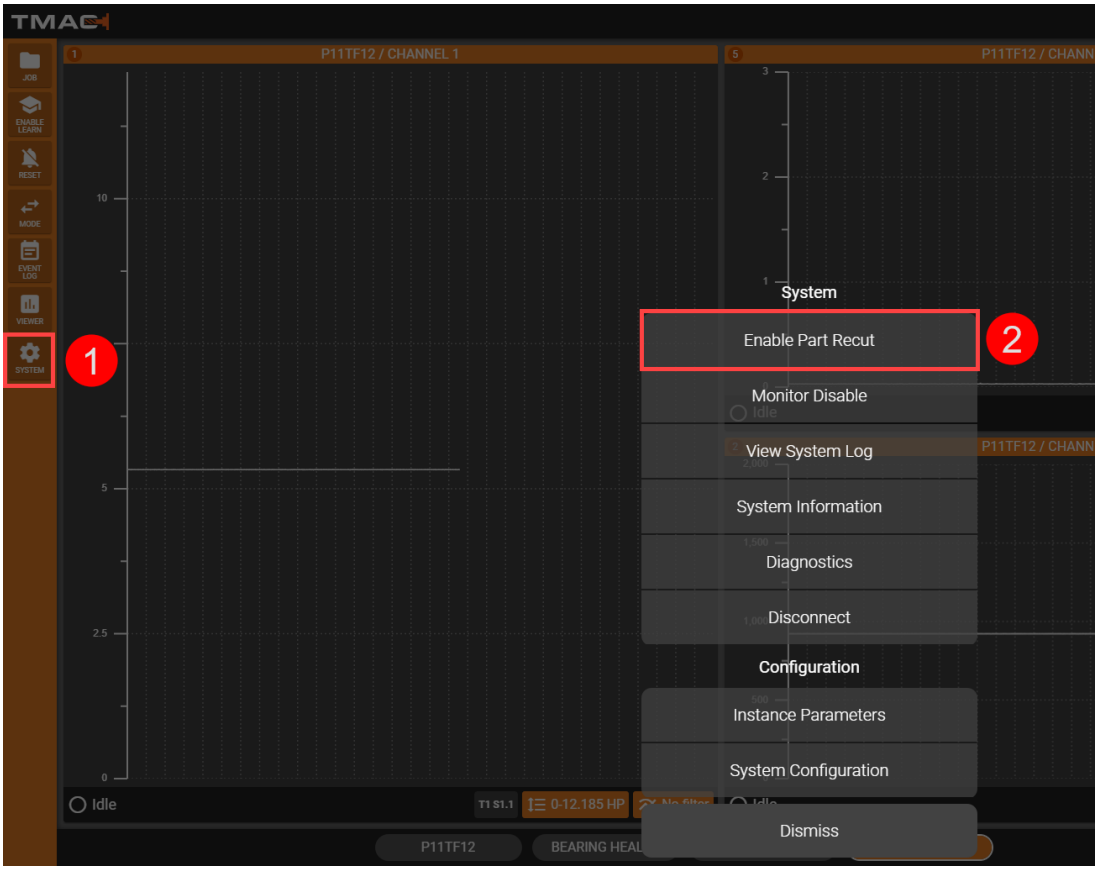

Figure 6-2: Part Re-cut

To disable Part Re-cut follow the steps above and click the Enable/Disable Part Re-cut button. Part Re-cut can also be disabled by clicking the **RESET** button or by sending a command from the control.

Monitor Disable

The Monitor Disable feature disables all monitoring for the selected TMAC Instance. When monitoring is disabled, the system does not perform any monitoring functions. The live graphs for all channels are light gray while in the disabled state.

Note: When TMAC is disabled, monitored operations are unprotected.

Setting Monitor Disable

To disable monitoring use the following steps:

1. Select the desired TMAC Instance from the System Summary
2. click the **SYSTEM** button on the TMAC Action Bar
3. click Monitor Disable
4. click **TURN ON**

This TMAC process remains disabled until monitoring is turned on with the Monitor DISABLE/ENABLE button or a command through the CNC.

Note: The Monitor Disable state persists through cycling power on the machine.

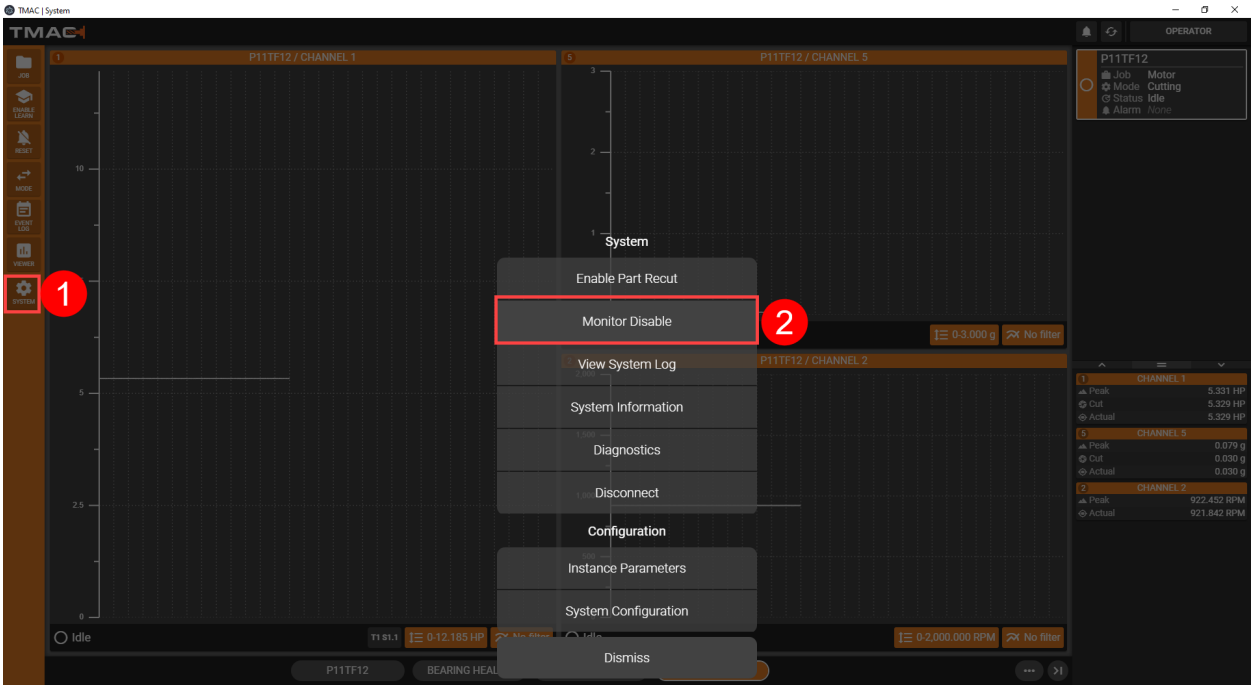

Figure 6-3: Monitor Disable

Log Viewer

The TMAC Log Viewer displays a list of system events for diagnostic purposes. A log is created for each day the TMAC system is used for any purpose. This feature is primarily used by system integrators and supervisors for product support and diagnostics. An example of the log viewer is displayed in Figure 6-4.

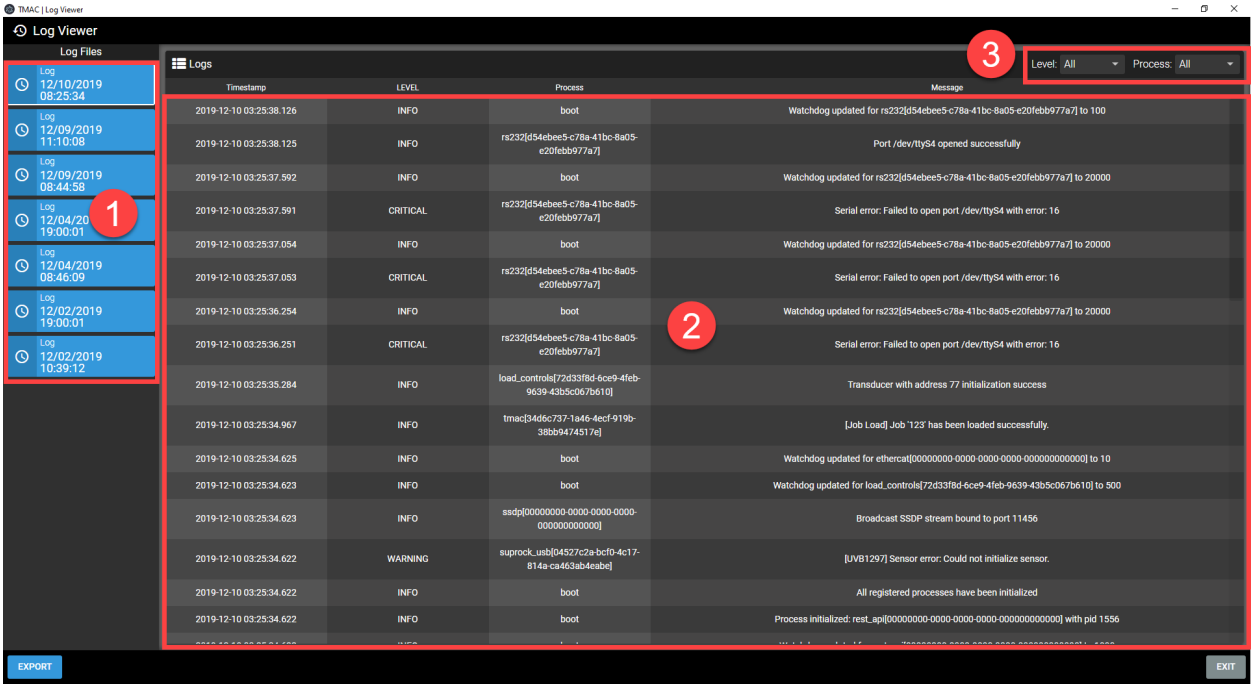

Figure 6-4: Log Viewer

The Log viewer is split into the following three sections:

1. **List of Log Files**: List of logs for each day the system was used
2. **Output**: List of events for the selected log. Each event displays a time stamp, level, process and a descriptive message.
3. **Filter Options**: Use the drop-downs to select filters by level (All, Error, Critical, Warning, Notice, and Info) and process (All, Boot, EtherCAT, RS232, Rest API, Webserver, SSDP1, Websocket, Suprock_USB, tmac1, tmac1/commands, etc...)

System Information

Clicking the **System Information** button in the System Menu opens a menu containing general information about TMAC. The System Information window has the following tabs:

- General
- Profiles
- Notifications
- Devices
- Documents
- Support
- System Update

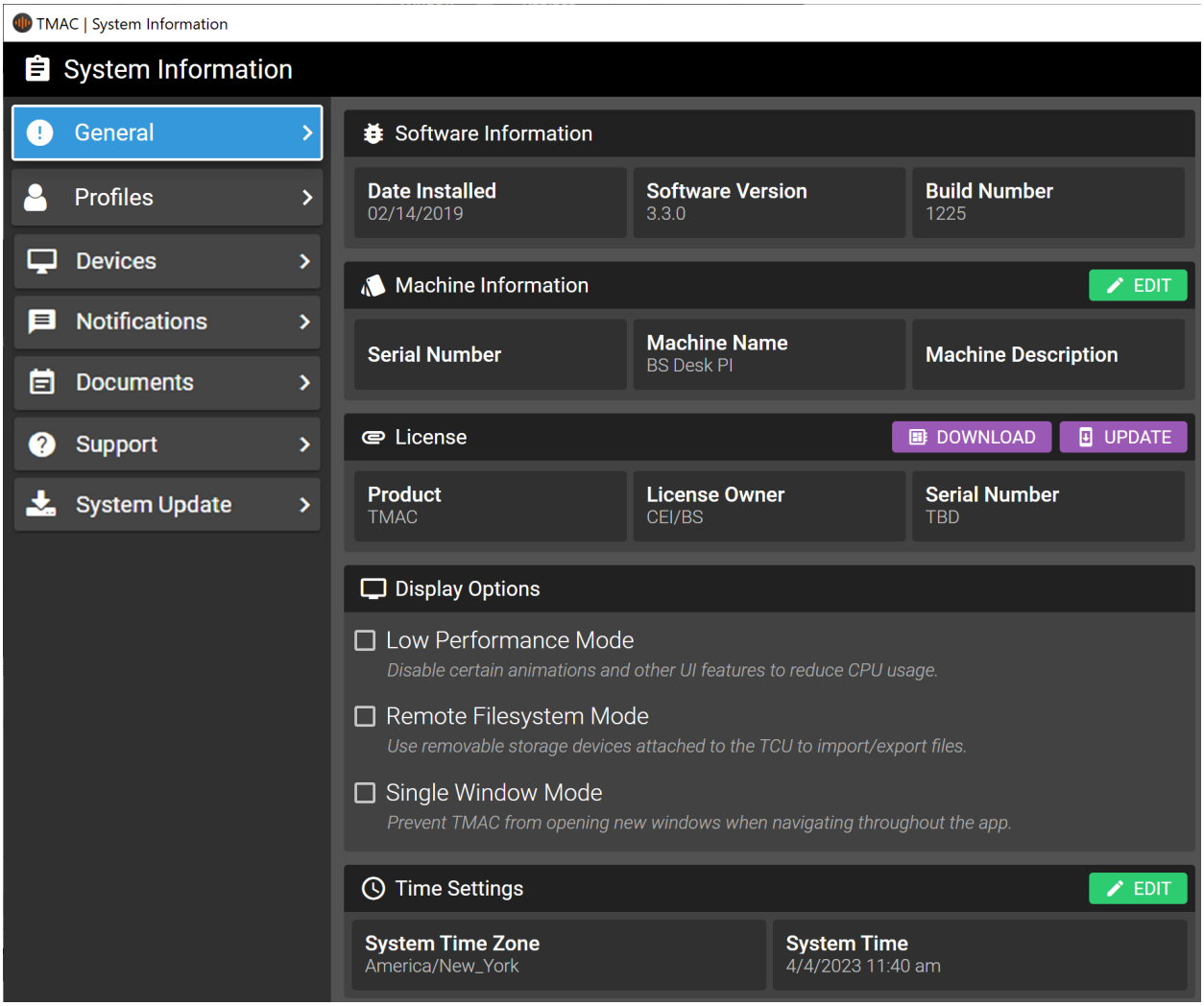

Figure 6-5: System Information General Tab

General Tab

The General tab displays the following information.

- Software information
  - Date Installed
  - Software Version
  - Build Number
- Machine Information
  - Serial Number
  - Machine Name
  - Machine Description

  Note: Pressing the **EDIT** button allows the information displayed here to be changed. Additionally, the state of the auto-backup feature for the system is displayed (Enabled = true, Disabled = false)
- License
  - Product
  - License Owner
  - Serial Number
  - Download - download a copy of the system's license
  - Update - update the system license
- Display Options
  - Low Performance Mode - "Low Performance Mode" Page 51
  - Remote Filesystem Mode - "Remote File System Mode" Page 52
  - Single Window Mode - "Single Window Mode" Page 51
- Time Settings
  - System Time Zone
  - System Time

Low Performance Mode

Some TMAC features and functions require a significant amount of CPU and GPU resources. Low Performance mode allows TMAC to operate more efficiently on low end PC hardware by limiting some resource intensive features of the user interface. When Low Performance mode is enabled, the following user interface changes occur:

- Reduction of the use of animations (moving icons, flashing alarms, etc...)
- Area under the curve data is displayed in similar manner to legacy software. (No shading under the curve, signal line changes color to display work in place of shading.)

Note: The TCU will still function normally in low performance mode. Only the HMI is impacted.

Single Window Mode

By default, TMAC opens a new window when opening the Event Log and Data Viewer. Enabling **Single Window Mode** prevents TMAC from opening new windows for the Event Log and Data Viewer.

Remote File System Mode

When enabled, TMAC may still access the file system for importing and exporting data to an external USB drive while in Single Window Mode

Editing Time Settings

Due to how the TMAC system is assembled and prepared prior to on site installation, there may be a discrepancy between the time setting on the TCU and the actual time settings on site. This can cause TMAC to store the incorrect time of system events in recording, system and event log data. It is recommended to update the time settings to remedy this discrepancy using the following steps:

1. Press the **EDIT** button

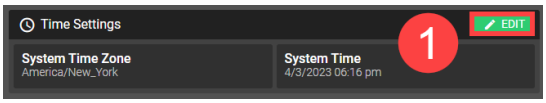

Figure 6-6: Editing Time Settings Step 1

2. Press the check-boxes for Time Zone, Time, and Date
3. Press the **AUTO-DETECT** buttons for Time Zone, Time and Date. This automatically populates the fields based on the time settings of the PC being used to connect to TMAC.

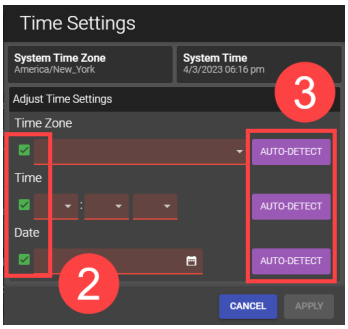

Figure 6-7: Editing Time Settings Steps 2-3

4. Press **APPLY**.

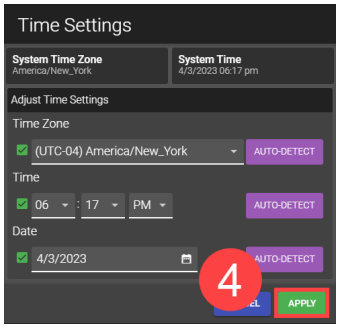

Figure 6-8: Editing Time Settings Step 4

Note: The Time setting may also be set manually, in place of using the auto-detect feature.

5. After pressing **APPLY**, the changes are still pending. Press the **SAVE CHANGES** button to confirm the changes

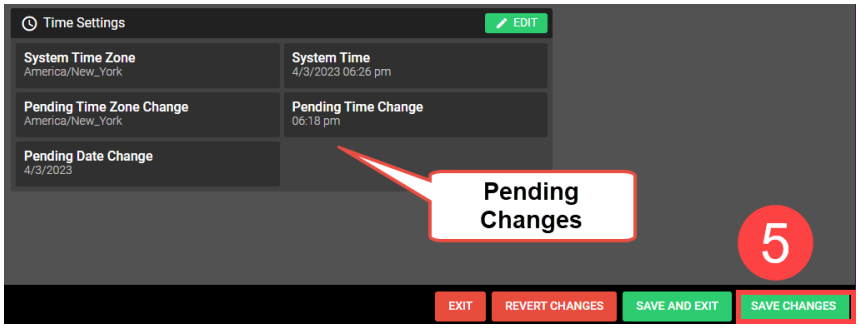

Figure 6-9: Editing Time Settings Step 5

Profiles Tab

The Profiles tab allows the following:

- View, create, delete, and edit user profiles
- Add Application Integrations allowing external applications to access TMAC data and settings

Access to this menu is dependent on the permissions of the active profile.

Profiles

Each profile has associated permissions that either restrict or expand access to features and settings in TMAC. These permissions can be changed for both user-created profiles and TMAC's default profiles.

To add a profile use the following steps:

1. Click the +**NEW** button
2. Enter a name and password for the profile. An optional description field is provided
3. Set any desired system permissions by clicking the associated check-boxes.
4. Click **SAVE**

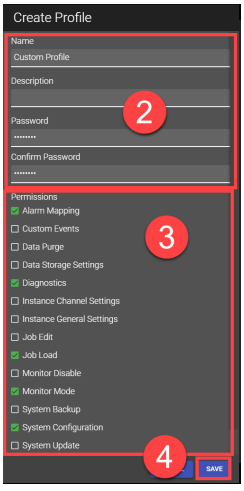

Figure 6-10: Creating a Profile

Once a profile is created, it can be deleted by clicking the **DELETE** button to the right of the associated profile.

Editing Profiles

If the active profile has permissions to edit profiles, all profiles can be edited to change the following:

- Name (user-created profiles only)
- Description (user-created profiles only)
- Password
- Permissions

To edit a profile, click the **EDIT** button and make any desired changes. Refer to Appendix A "Reference Tables" Page B-1 for a table listing available permissions for profiles.

Application Integrations

The TMAC Rest API allows 3rd party applications to access certain data and settings from the TMAC system. In order to establish access to TMAC through the Rest API, an application profile must be added. To add an application profile use the following steps:

To add a profile use the following steps:

1. Click the +**NEW** button
2. Enter a name for the 3rd party application
3. Set any desired permissions by clicking the associated check-boxes.
4. Click **SAVE**

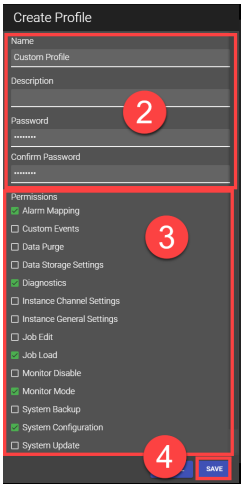

Figure 6-11: Creating a Profile

Once an application profile is created, it can be deleted by clicking the **DELETE** button to the right of the associated profile. Refer to Appendix B "Reference Tables" Page B-1 for a table listing available permissions for application profiles.

Devices Tab

The Device tab provides details associated with the device that the TMAC Explorer is installed on. Additionally, a list of devices that are currently registered with the connected TMAC (TCU) is provided. Device registration is associated with the Auto-Backup feature. A device must be registered with a TCU for the TCU to be configured for Auto-backup. Pressing the **EDIT** button allows the **Device Name** and **Device Description** to be changed. Multiple devices may be registered with the same TCU.

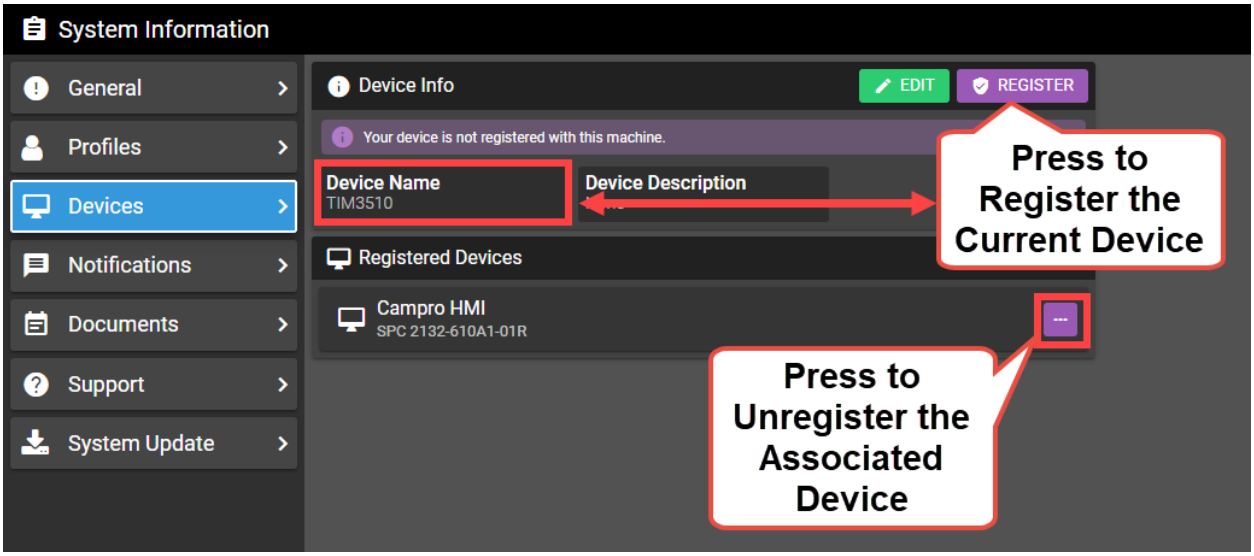

Figure 6-12: System Information Device Tab

See Also:

"Auto-Backup Manager" Page 18

"TMAC Explorer" Page 10

Notification Tab

In the Notifications tab, users may enable and disable system notifications. System notifications appear under the Notifications button on the TMAC Toolbar, see "TMAC Toolbar" Page 41 for more information. The following notifications can be enabled or disabled:

- **System Update**: Notifies if an update becomes available
- **License Status**: Notifies if license is invalid
- **Data Purge**: Notifies of data purge progression and completion
- **System Backup**: Notifies of system backup progression and completion
- **Storage Levels**: Notifies if storage usage levels cross preset threshold or become full
- **Miscellaneous**: Notifications that don't fit into one of the above categories

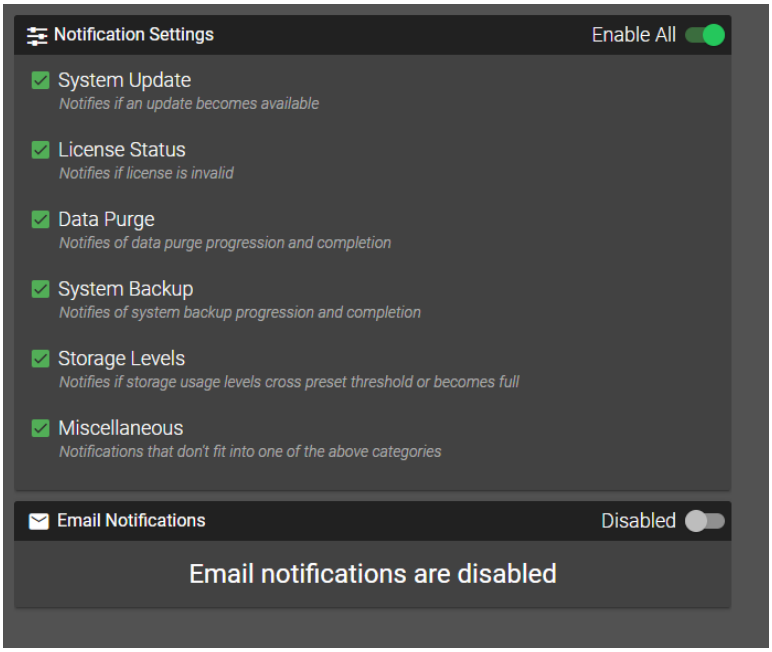

Figure 6-13: Notifications Tab

Email Notifications

TMAC is capable of sending system notifications via email. This requires network access from the TCU to the outgoing mail server. To enable email notfications, the TCU must have either:

- external internet access or,
- access to a local-network SMTP server

Network administrators should determine the best solution for email notification setup. Establishing an internet connection on the TCU requires changes to the system configuration and should be completed by a system integrator or network administrator.

See Also:

"Email Notifications" Page 68

Setting up the Outgoing Mail Server

The following fields need to be set to allow TMAC to send email notifications:

- **Protocol**: This is the protocol used to communicate with the email provider. Options are:
  - **SMTP**: This protocol is considered less secure.
  - **SMTPS**: Many email providers require SMTPS for it's increased security
- **Server Name**: The URL or IP address of the email provider's outgoing mail server. Example - *smtp.gmail.com*
- **Port Number**: The remote port used for communication with the email provider's mail server. Examples - *25, 465 or 587*
- **Username**: The username used to authenticate outgoing messages. Many email providers require a full email address in this field. Example - *<username>@gmail.com*
- **Password**: The password used to authenticate outgoing messages. Many providers require configuring secure "app passwords" to use in this field in place of an actual account password

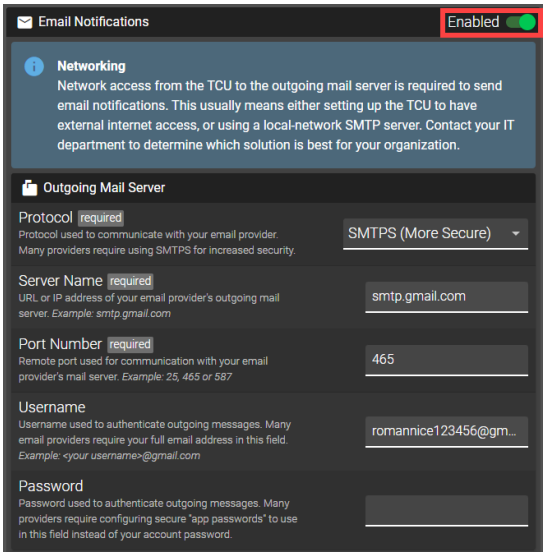

Figure 6-14: Outgoing Mail Server Settings

SMTP and SMTPS settings vary per email provider and are publicly available information.

Message Options

The following message options must be set for email notifications:

- **From**: The email address that notifications will be sent from
- **To**: The email address that is to receive notifications
- **Cc**: Any additional emails that need to receive notifications; Multiple emails must be separated by a comma
- **Reduced Message Size**: Send a smaller notification message. Useful for notifications sent to SMS recipients

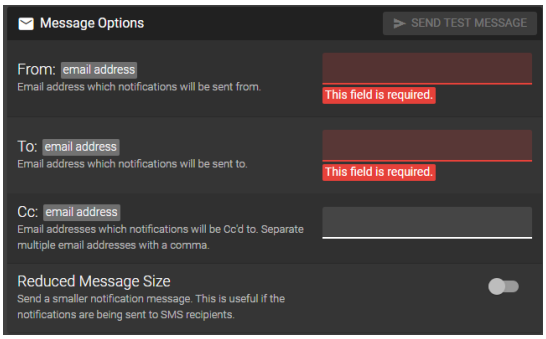

Figure 6-15: Outgoing Mail Server Settings

Note: The **SEND TEST MESSAGE** button will send an alarm notification message to the email addresses or phone number configured in the message options. This feature tests that email notifications are operating as intended.

Documents Tab

In the Documents tab, users may view the following information:

- **Release Notes**: Select the version from the drop-down menu to view that version's release notes. Release notes contain new features and bug fixes that were applied for the version.
- **EULA**: Read the Caron Engineering End User License Agreement

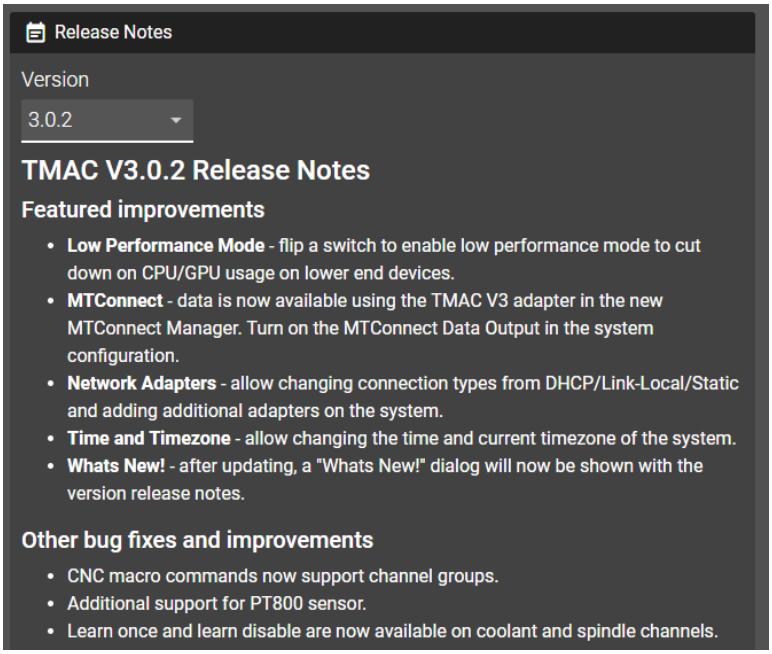

Figure 6-16: Documents Tab

Support Tab

The Support tab displays a custom support message that generally provides support contact information. This message is set in the system configuration by the system installer. Additionally, TMAC provides a support package utility that bundles specific system information useful for support troubleshooting. To download a full support package, click the **DOWNLOAD SUPPORT PACKAGE** button and choose a file location to save to. Support packages are saved as a .zip file and should be saved on the PC that is being used to view the HMI.

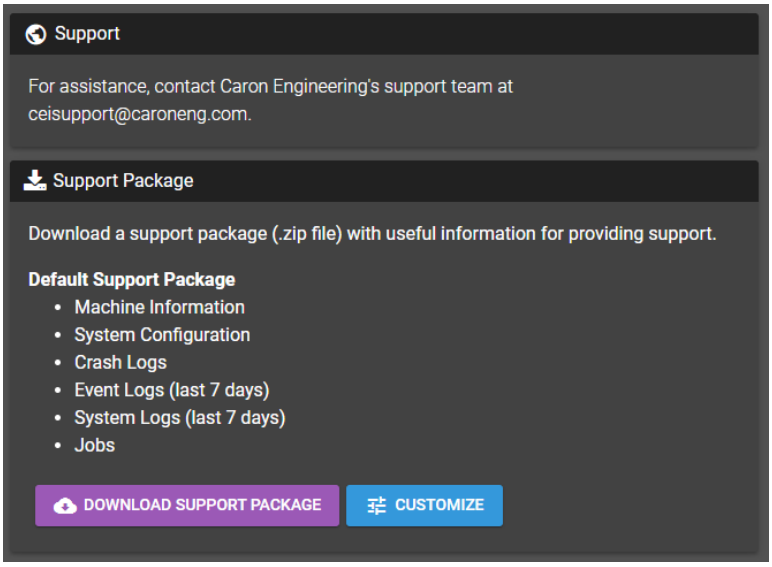

Figure 6-17: Support Tab

Custom Support Package

Pressing the **CUSTOMIZE** button allows the user to exlude certain information from the support package, or limit the number of days of data to include. Machine information, system configuration, and crash logs are always included, but the user may exclude the event log, system log, and jobs. If a time range is selected, TMAC will limit the data included number of days selected (Past 1 day to past week).

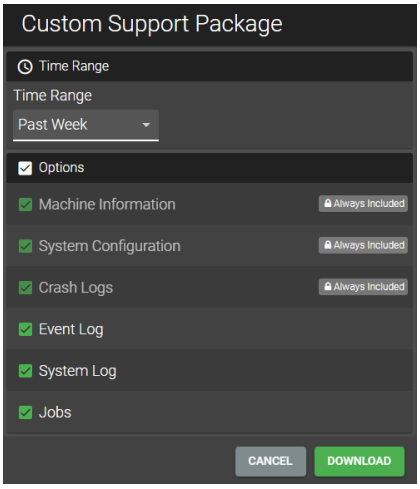

Figure 6-18: Custom Support Package Options

System Update Tab

The System Update tab displays the following:

- Current version number
- Latest version number
- Date the system was last updated

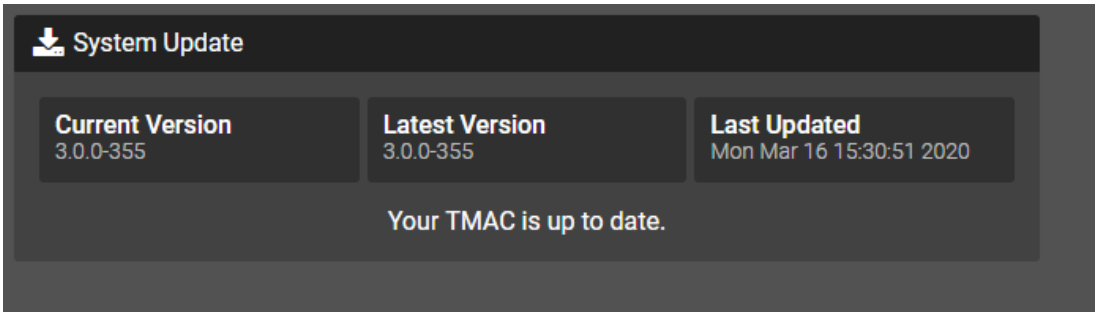

Figure 6-19: System Update Tab

If the system is not up to date, an update button is available. To update the system, simply click the **UPDATE SYSTEM** button.

Note: This UPDATE SYSTEM button is only available when using the TMAC Explorer.

Data Management

Clicking the **Data Management** button in the System Menu opens a menu containing settings pertaining to data usage, data purging and system backups. The Data Management window has the following tabs:

- **Data Usage**: A summary of storage statistics for the TMAC system.
- **Auto- Backup**: Manage Auto-backup settings
- **Manual Backup**: A utility to create a manual backup of part or all of the TMAC system; See "Manual Backup" Page 62
- **Data Purge**: A utility to purge system data; See "Purging System Data" Page 63

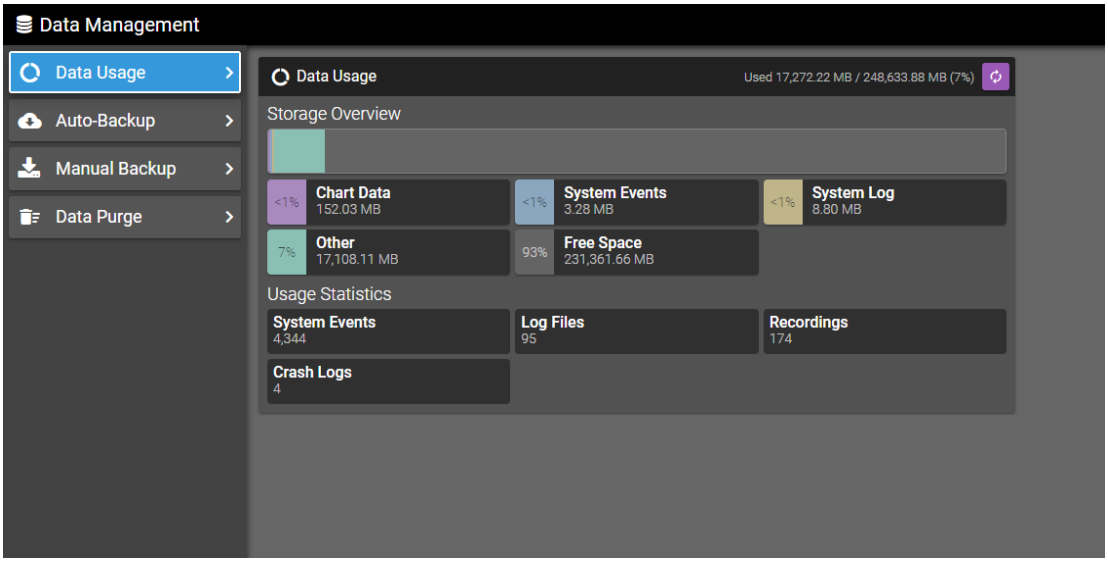

Figure 6-20: System Menu - Data Management

Data Usage

The Data Usage tab displays a summary of storage statistics for the TMAC system. The following information can be viewed:

a. Total space available and total space used in MB

b. Percentage of space used by chart data, system events, system logs, and free space

c. The number of system events, log files, crash logs and recordings stored by the system

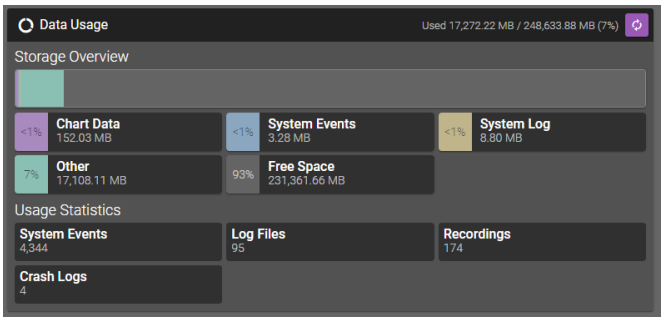

Figure 6-21: System Menu - Data Management

Auto-Backup

The Auto-Backup tab provides an overview of the Auto-Backup settings for the TMAC system. The following information is available:

- **Auto-Backups**: Displays whether whether or not the auto backups are enabled and configured for the TMAC system
- **Auto-Backup Manager**: Displays the name of the device registered for auto-backup management of the TMAC system

Note: If connected to the TCU using the device registered for auto-backups, additional backup settings are available. Additionally, a green verification message is displayed if the current device is registed as the auto-backup manager. See the figure below.

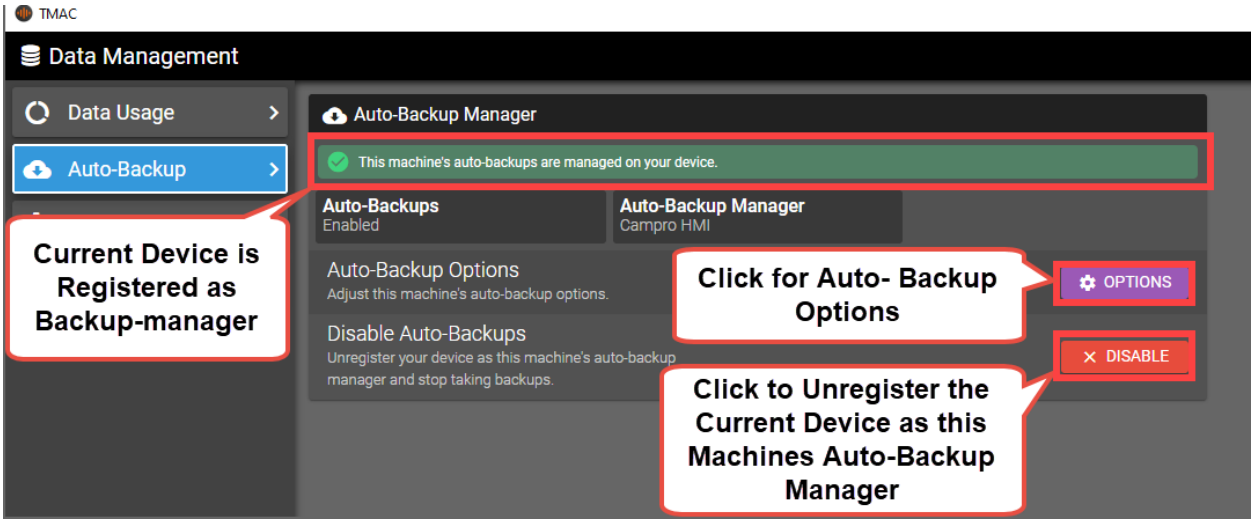

Figure 6-22: Data Management- Auto Backup Tab

Auto-Backup Options

When the Options button is pressed, the following Auto-backup options are displayed:

- **Backup Recordings**: When checked, recording data for the system is included in the auto-backups
- **Back-up System Events**: When checked, recording data for the system is included in the auto-backups

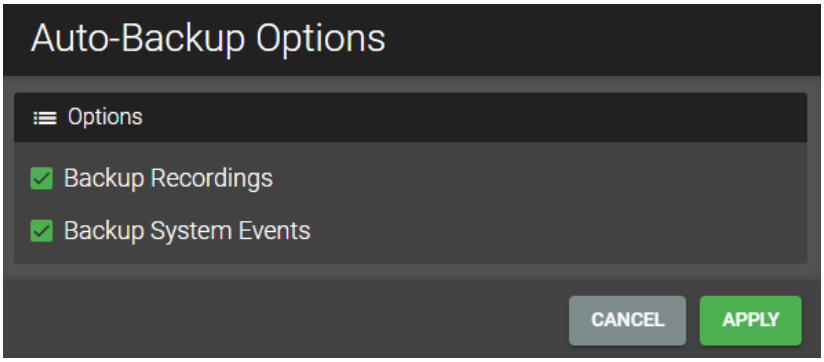

Figure 6-23: Data Managment - Auto-Backup Options

Manual Backup

The Manual Backup tab provides a simple interface to create a backup file of data stored on the database. The data backup tool can backup specific data types, data from a certain time frame, or all system data. Backup data must be directed to a external storage device connected to the TCU (USB drive, external hard drive, etc...). The data backup tool provides a list of eligible storage devices. When creating a manual backup, the following options determine the content of the backup file:

- **Full Backup**: Toggling on this button sets the backup tool to store all system events, logs, and recordings to the backup regardless of time frame.
- **Machine Recordings**: Mark this check box to add all local recordings to the backup file
- **Imported Recordings**: Mark this check box to add all imported recordings to the backup file
- **System Events**: Mark this check box to add system events to the backup file
- **System Logs**: Mark this check box to add system logs to the backup file
- **Backup Time Frame**: This setting restricts the data backup to data that occurred since a date set by the user. When a backup is performed and a time frame is picked, TMAC backs up all data of the selected types (system events, logs, recordings etc...) excluding data that was stored prior to the selected date. For example, selecting past week for a backup excludes all data older than one week from the backup.

To perform a backup, select the storage device and data to include, then click the backup button.

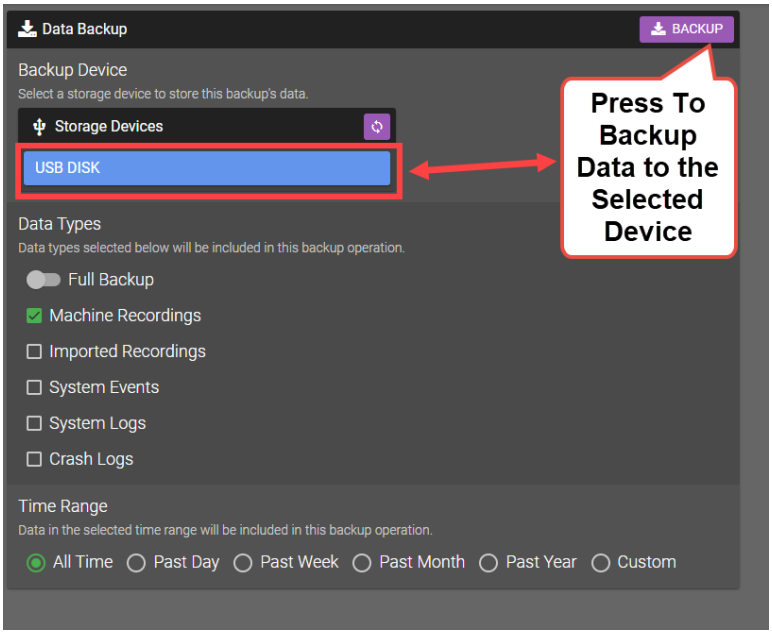

Figure 6-24: Data Backup Tool

Purging System Data

TMAC is capable of storing large amounts of data over time. Data Purge provides a fast and simple way to remove unwanted data stored on the database. The data purge tool can remove specific data types, data from a certain time frame, or all system data. When performing a data purge, the following options determine what data is purged:

- **Full Purge**: Toggling this button sets the purge tool to remove all system events, logs, and recordings regardless of the time frame.
- **Machine Recordings**: Mark this check box to set the purge tool to remove all recordings local to the TMAC System

  Note: The most recent learned recording for each cutting operation is retained during a data purge that purges machine recordings.
- **Imported Recordings**: Mark this check box to set the purge tool to remove all recordings that have been imported in the Data Viewer
- **System Events**: Mark this check box to set the purge tool to remove all system events
- **System Logs**: Mark this check box to set the purge tool to remove all system logs
- **Crash Logs**: Mark this check box to set the purge tool to remove all Crash logs
- **Preserve Data**: This setting prevents the purge from removing data that occurred since a date set by the user. When a purge is performed and a time frame is picked, TMAC removes all data of the selected types (system events, logs, recordings etc...) excluding data that was stored since the selected date. Data is also kept for the date chosen.
- **Advanced - Only Purge Backed-up Data**: When enabled, TMAC prevents data that has not been backed-up from being purged during a purge operation
- **Reclaim Space**: A certain amount of disk space is allocated for the database. When data is purged from the database, the data is removed, but the amount of space reserved for the database does not change. Marking

this check-box allows TMAC to rewrite the database and free some of the space allocated to the database.

Note: This process can take some time and TMAC can not be used while reclaiming space. The reclaim space feature is typically used for maintenance and should be used as a last resort.

To perform a data purge, select the desired purge options and click the purge button.

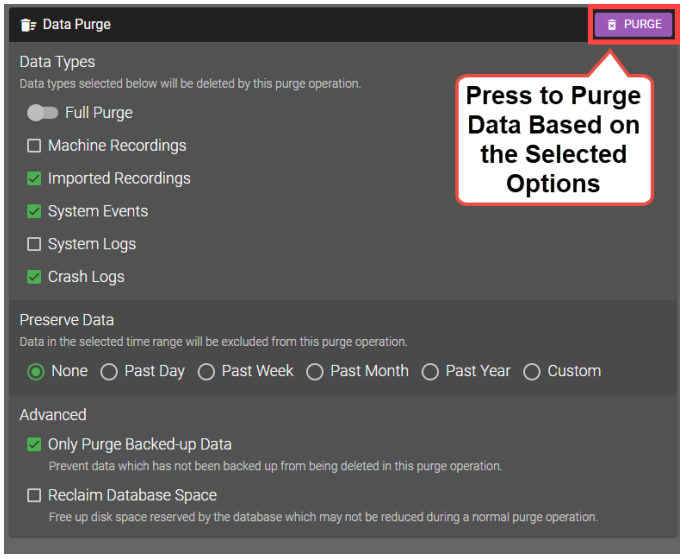

Figure 6-25: Data Purge Tool

Diagnostics

The diagnostics window provides system information primarily used for support and testing of the system. In general, the features and information available only need to be accessed by system integrators and supervisors. The following information is available:

- **Channels**: View channel data including Min Scale, Max Scale, and current value for each channel. Channels are organized by type (primary, spindle, coolant and passive channels).
- **Inputs/Outputs**: View and test system inputs and outputs. Outputs can be turned on and off from the TMAC Explorer for testing.
- **Communications**: Displays the communication (connected or disconnected) status of all CNC, serial port, and ethercat devices
- **Processes**: View and restart any TMAC process. CPU and memory use are displayed for each process

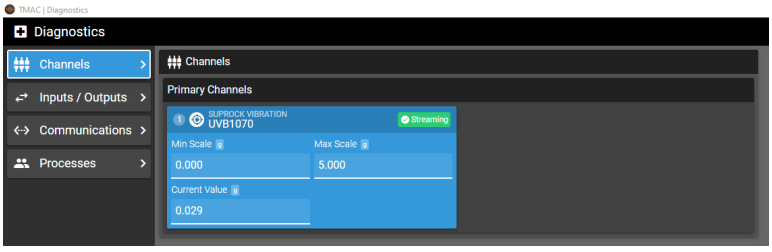

Figure 6-26: Diagnostics Window

System Menu: Configuration Sub-Menu

The Configuration Menu contains the following buttons:

- **Instance Parameters**: A menu of settings specific to each instance of the TMAC System
- **System Configuration**: This section is used to configure the TMAC system and should only be accessed by system integrators. Refer to the *TMAC System Integrator's Manual* for more information.

Instance Parameters

Instance parameters apply to specific instances in the TMAC system. A TMAC system may include several instances depending on the machine and CNC that TMAC is integrated with. This settings menu has the following tabs:

- General
- Channels
- Alarms
- Data Storage
- Custom Events

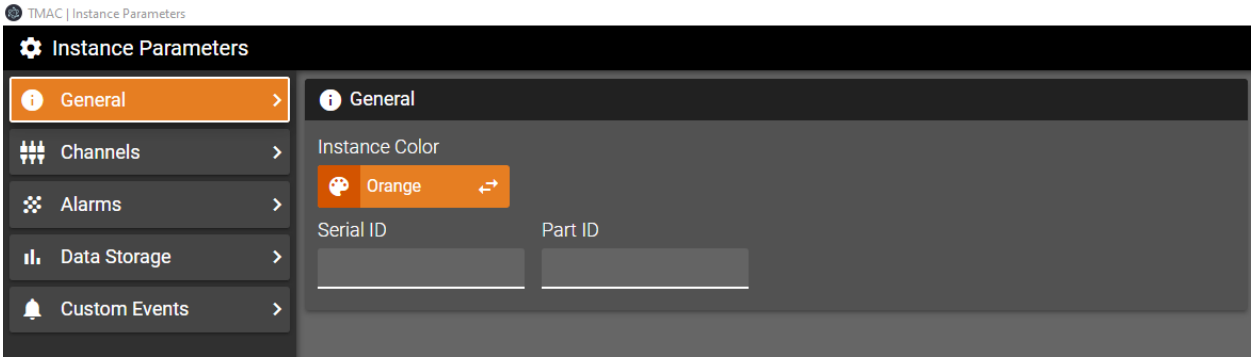

Figure 6-27: Instance Parameters

See Also:

"General Tab" Page 66

"Channels Tab" Page 66

"Alarms Tab" Page 68

"Data Storage Tab" Page 69

General Tab

The settings on the General tab allow labels to be set to differentiate between instances. The following settings can be changed or set:

- **Instance Color**: Select an accent color for the user interface specific to the instance. This also changes the color of elements in the HMI throughout the software to help differentiate between instances.
- **Serial ID**: Set a serial identifier to the Event log and recordings associated with the instance
- **Part ID**: Set a part identifier to the Event log and recordings associated with the instance

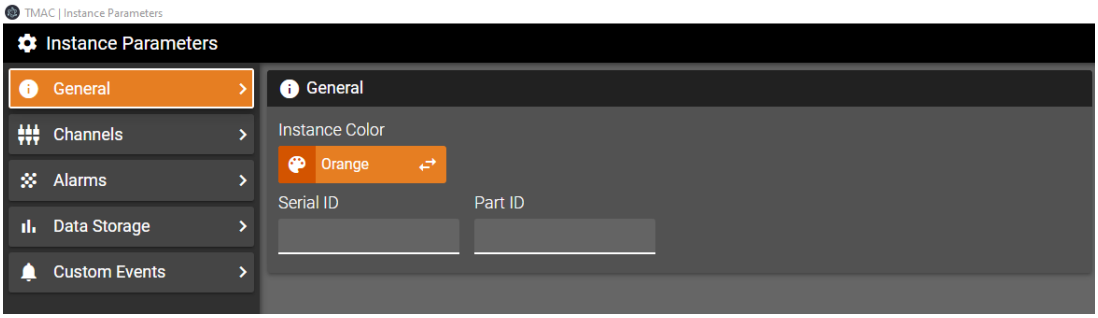

Figure 6-28: Instance Parameters - General Tab

Channels Tab

The Channels tab displays a list of channels and channel information. Channels are organized by channel class (Primary, Spindle, Coolant, and Passive). The following channel information is displayed for each channel:

- **Channel Name**: This parameter is set in the configuration and can not be changed here.
- **Min Scale Range**: This parameter is set in the configuration and can not be changed here.
- **Max Scale Range**:This parameter is set in the configuration and can not be changed here.
- **Learn Scale**: The scale used by TMAC during a learn operation. This parameter must be set for each primary channel in each TMAC instance

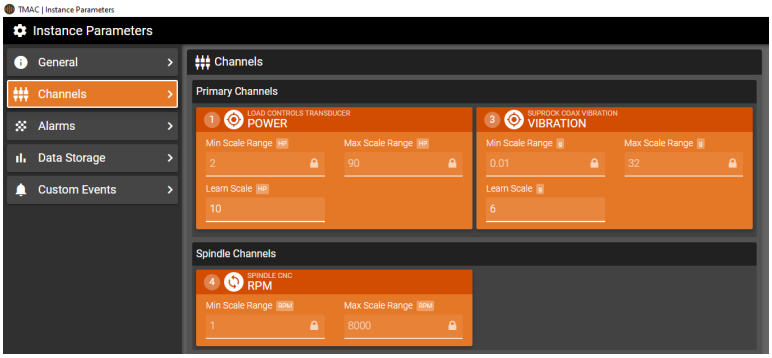

Figure 6-29: Channels Tab

Note: If any passive channels are configured, TMAC automatically collects passive channel data with a start monitor. This feature is on by default, but can be turned off by toggling the **Auto start passive channels** switch on the passive channels panel.

Channel Groups

In addition to viewing channel data, the channels tab allows for the creation of channel groups. A channel group is a collection of user specified channels. Issuing a command to a channel group issues the command to all channels in the group. Channel groups availability is dependent on the permissions of the active profile.

Example: If a channel group consists of three channels, a single start command can be issued for the channel group and TMAC will issue start commands to all three channels simultaneously.

Use the following steps to create a channel group:

1. Click **ADD GROUP**
2. Enter Channel Group information
    a. Group Name:
    b. Group ID:
    c. Group Description:
3. Click **ADD CHANNEL**
4. Select channels for the group
5. Click Add

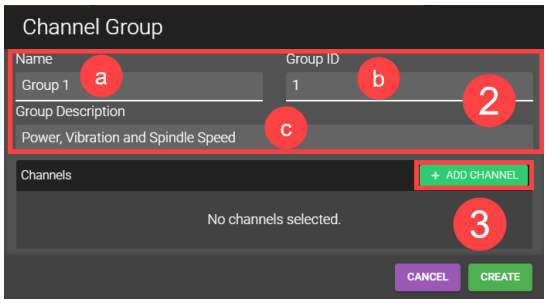

Figure 6-30: Add Channel Group Steps 2-3

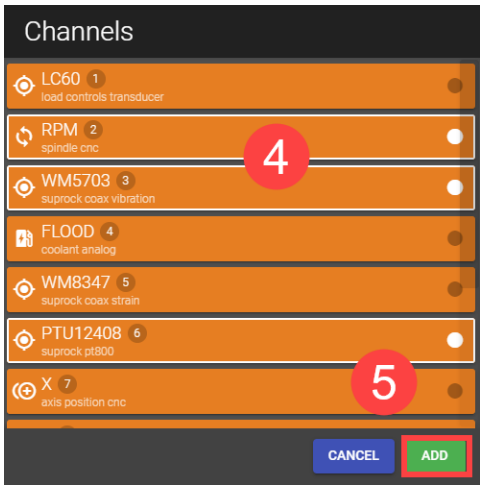

Figure 6-31: Add Channel Group Steps 4-5

Channels can be added and removed from the channel group at any time.

Figure 6-32: Channel Group

Alarms Tab

The alarms tab allows TMAC alarms to be mapped to specific alarm bits. Alarm bits are generally mapped during system integration. Enabling the Ignore Passive Channel Alarms check-box prevents passive channels from triggering alarm conditions.

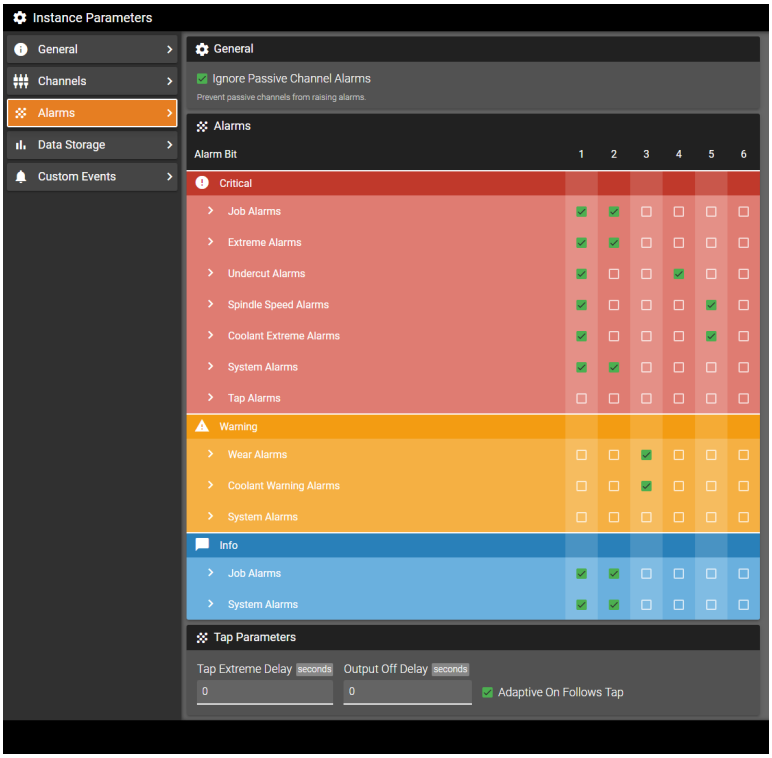

Figure 6-33: Alarms Tab

In addition to the ability to map alarm bits, the following Tap parameters are programmable:

- **Tap Extreme Delay**
- **Output Off Delay**
- **Adaptive ON Follows Tap**

These settings and their impact on tap operations are described in Features section of **Chapter 7: Jobs**

Email Notifications

When a system is configured to send email notifications, TMAC emails a preconfigured alarm message each time an alarm occurs. The alarm message email notifications can be disabled by alarm category per instance. For example, an instance could be set up to only send email notifications for critical alarms.

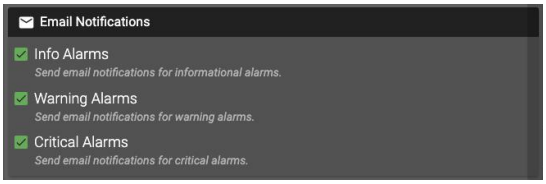

Figure 6-34: Instance Parameters - Email Notifications

Data Storage Tab

The Data Storage tab allows storage limits to be set for Data Viewer recordings and system events. The following data storage parameters are available for recordings:

- **Save Alarm Files Only**: If checked, TMAC only saves recordings for operations that contain alarm events
- **Limit Recording Count**: Users can limit the amount of recordings saved
  - **# of Recordings**: TMAC keeps a number of recordings based on user input. Once the user inputted number of recordings is reached, any new recording deletes the oldest recording.
  - **# of Days**: TMAC deletes all recordings older than the number of days set
- **Extra Recording Time**: If configured, TMAC adds additional channel data to Data Viewer recordings
  - **Before Start**: TMAC records streaming data prior to a start command for an operation. Range is 0 - 5 seconds
  - **After Stop**: TMAC continues to record data after a stop command for the amount of time specified. Range is 0 - 5 seconds
  - **After Extreme**: After an extreme alarm is triggered, TMAC continues to record data for the time specified. Range is 0-5 seconds

Note: The Always Streaming feature must be enabled in the system configuration for each sensor to utilize the extra recording time feature.

The following data storage parameters are available for system events:

- **Enable System Events**: If checked, TMAC saves system events for viewing in the Event Log
- **Limit Event Count**: Users can limit the number of events saved by TMAC
  - **# of Events**: TMAC keeps a number of system events based on user input. Once the number of events is reached, any new event deletes the oldest event.
  - **# of Days**: TMAC deletes all events older than the number of days set

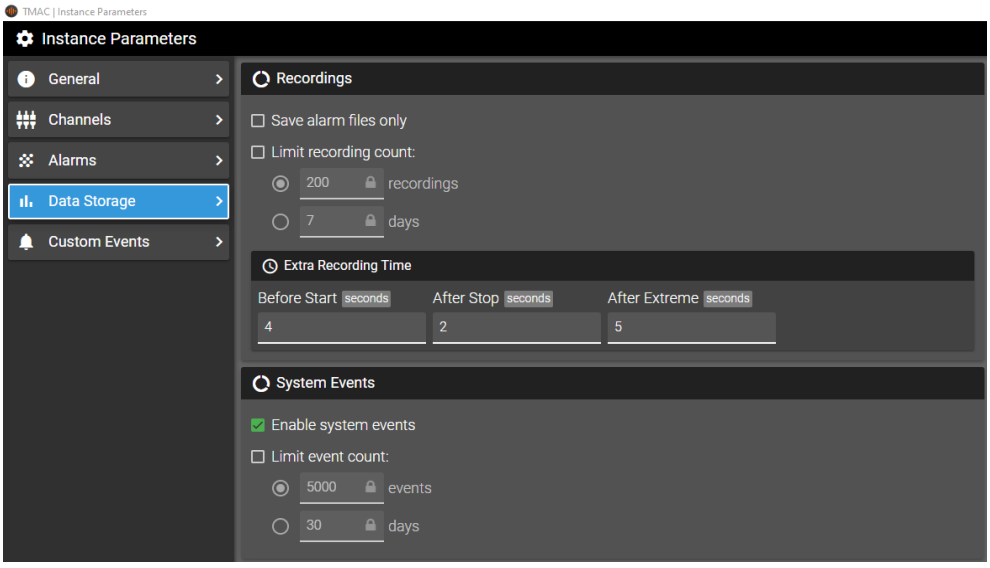

Figure 6-35: Data Storage Tab

Custom Events Tab

A Custom event is a user created event. Custom events allow the user to mark events in the Event Log or chart data. Additionally, machine and system data can be passed with the custom event, allowing additional data to be stored and reviewed in the Data Viewer and Event log.

For example, a custom event could be created to pass the spindle speed of the machine at a certain point in a part program. To do this, the user would create the custom event and add a call in the part program at the desired time. After the part program is executed, the custom event is stored with the associated chart data. The custom event appears on the recording as a vertical line. The event on the recording is labeled with the name and color assigned to the custom event at creation.

Adding a Custom Event

Use the following steps to create a custom event:

1. Click the **ADD EVENT** button
2. Enter Event Information:
    a. **Event Type**: System or Channel. The event type determines where the custom event is viewable. System events appear in the event log and channel events appear in chart data recordings for associated operations.
    b. **Event ID**: This is a unique identifier for the event. It is used to add the event to the system event log or chart data based on the custom event type.
    c. **Event Name**: Set an event name to easily identify the event in the Event Log or Data Viewer
    d. **Description**: Provides a brief description of the purpose of the custom event.
    e. **Event Color**: Customize the color of the event as it appears in the Event log or Data Viewer. Setting a color helps distinguish between custom events and other standard system events that occur.
3. Click **APPLY**

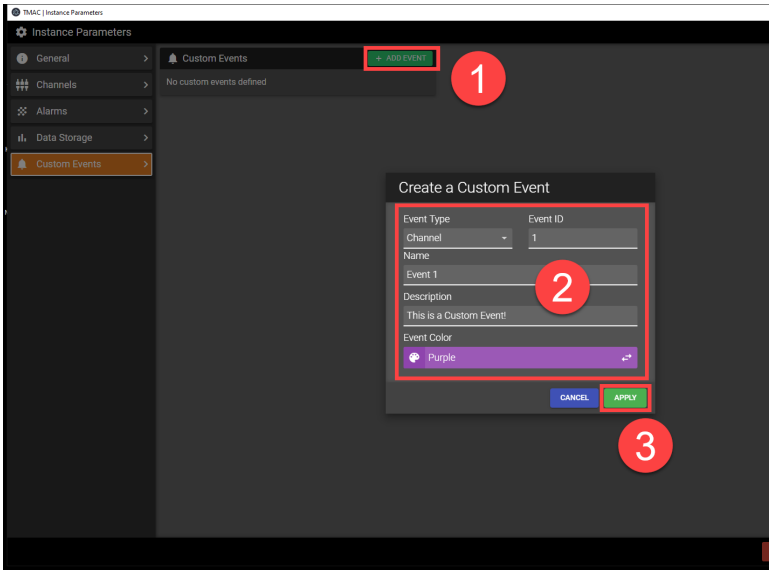

Figure 6-36: Creating a Custom Event

Chapter 7: Jobs

Overview:

TMAC uses a jobs-based system to store monitoring information. A job contains all parameters that TMAC needs to monitor tools for any operation in a machining task. A valid operation must include a tool, section, and channel (s). A job must contain at least one operation. For each operation in a job, limits and parameters must be specified.

Each job is stored in the database. An unlimited number of jobs can be created. Tool numbers from 1-99999999 and section numbers from 1-99 can be specified for each operation. Once a job is created, it can be loaded at any time using the Job Operations Menu or by external command. The job-based structure is utilized specifically for Cutting Mode operations.

Note: Calls for the job and operations can be included in the part program. While in Learn mode, TMAC can utilize these calls to automatically create the job and populate it with the called operations. See "Creating Cutting Operations Automatically Using Learn Mode".

See Also:

"Creating Jobs Automatically Using Learn Mode" Page 119

"Millivolt Mode" Page 30

Job Operations Menu

The Job Operations Menu is where the process of creating a job begins. To access the Job Operations window, click the Job button on the TMAC Action Bar and the following options are displayed:

- **Edit Active Job**: Launch the Job Editor to make changes to the active job
- **Edit Job**: Launch the Job Editor to make changes to a job
- **Load Job**: Manually change the active job
- **Create Job**: Launch the Job Editor to create a new job
- **Duplicate Job**: Create a copy of an existing job saved under a different name
- **Delete Job**: Delete a job
- **Import Job**: Import a TMAC 3.0 job, or import a legacy job file for use in TMAC 3.0
- **Export Job**: Exports a TMAC 3.0 Job for importing to other systems
- **Edit Tool and Section Details**: Opens an interface where Tool and Section names and descriptions can be added or changed for all jobs on the system.
- **Dismiss**: Close the Job Operation window

Figure 7-1: Job Operations Window

Edit Active Job

Use the following steps to launch the Job Editor:

1. Click the **JOB** button on the TMAC Action Bar
2. Select Edit Active Job

Changes can now be made to the active job using the Job Editor

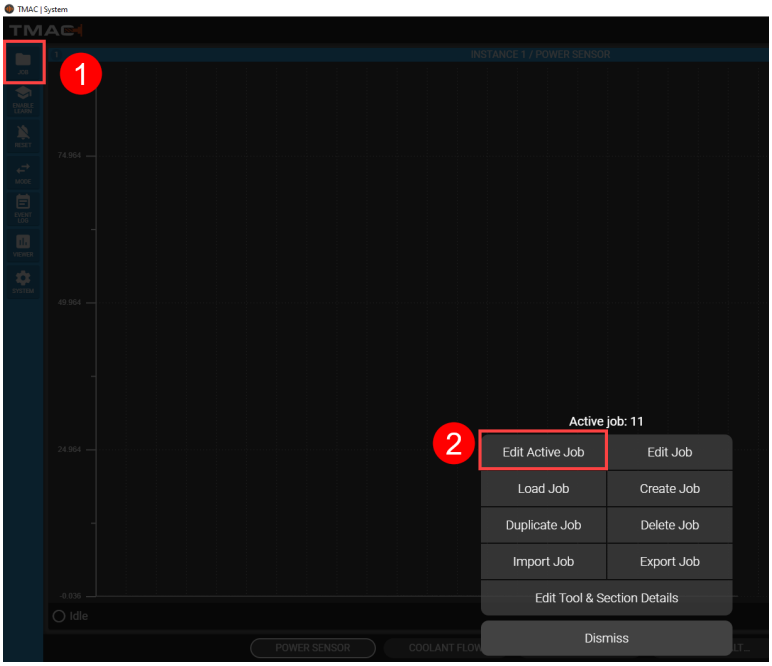

Figure 7-2: Edit Active Job Steps 1-2

Edit Job

Use the following steps to launch the Job Editor:

1. Click the **JOB** button on the TMAC Action Bar
2. Select Edit Job

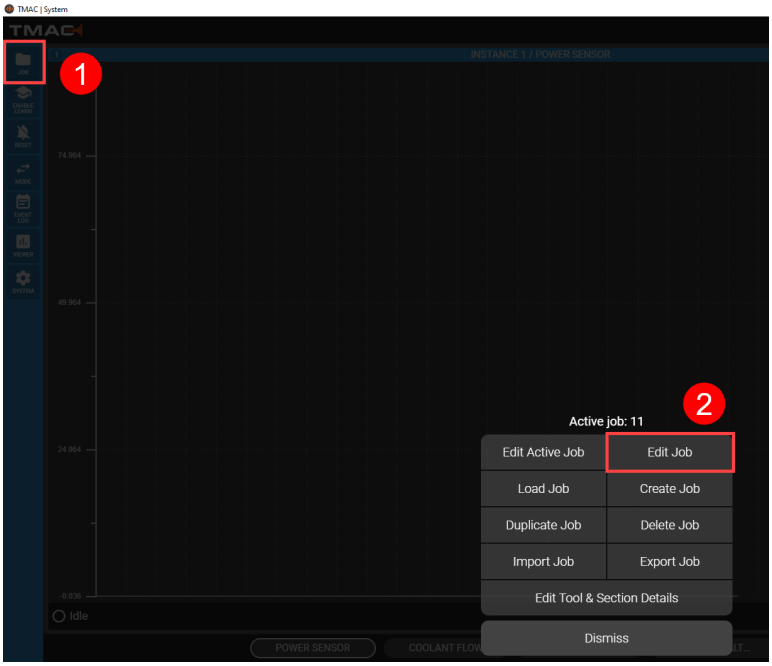

Figure 7-3: Edit Job Steps 1-2

3. Select a job from the list
4. Click **SELECT**

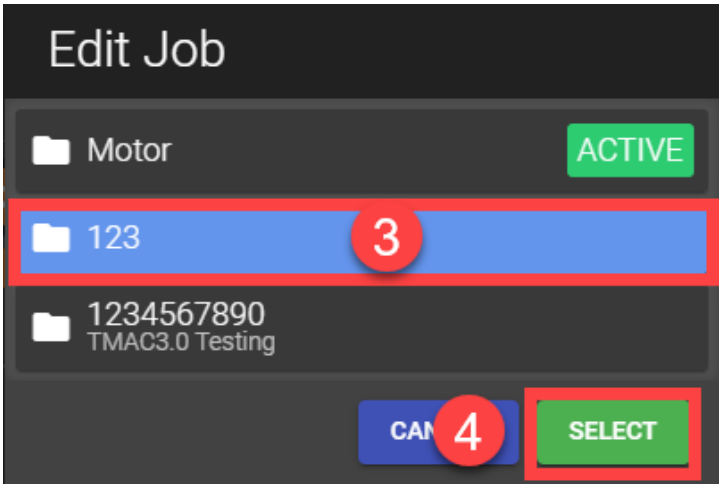

Figure 7-4: Edit Job 3-4

Load Job

Use the following steps to load a Job:

1. Click the **JOB** button on the TMAC Action Bar
2. Select Load Job

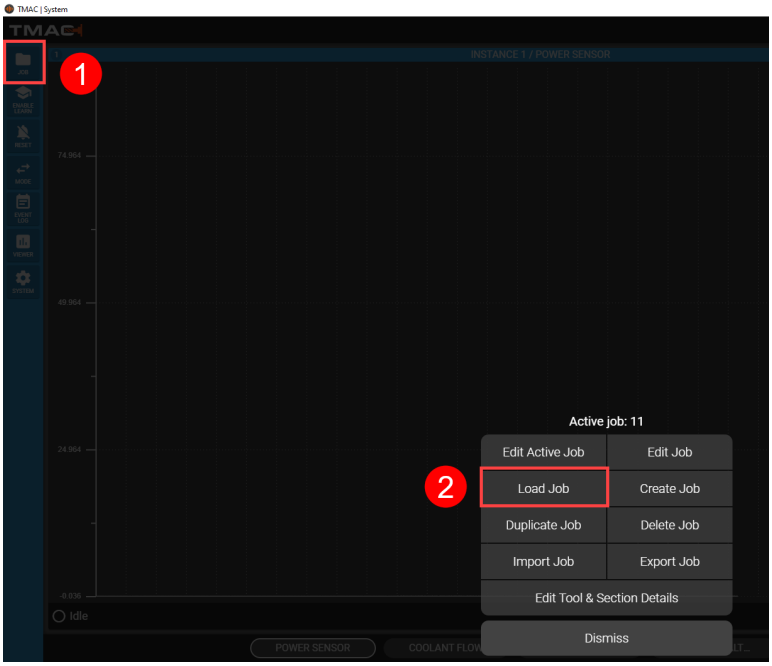

Figure 7-5: Load Job Steps 1-2

3. Select a job from the list to load as the active job
4. Click **SELECT**

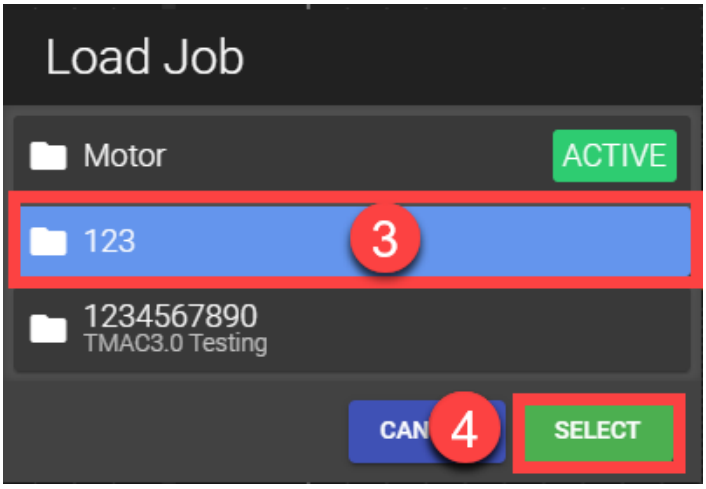

Figure 7-6: Load Job Steps 3-4

Create Job

Use to following steps to create a new job:

1. Click the **JOB** button on the TMAC Action Bar
2. Select Create Job

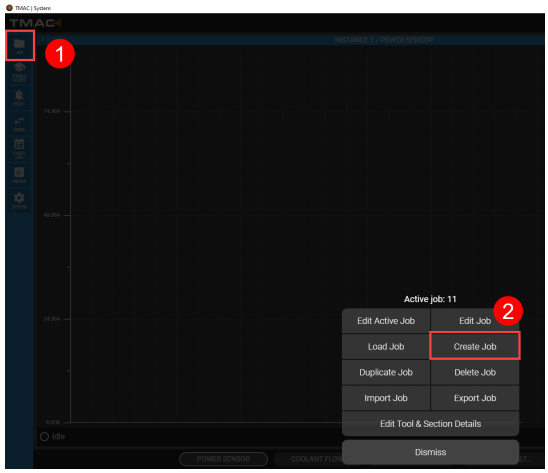

Figure 7-7: Create Job Steps 1-2

3. Enter a Name and Description for the Job
4. Mark any desired options from the following:
    a. **Open in job editor**: After **CREATE** is clicked, the new job opens in the Job editor for editing
    b. **Load job immediately**: After **CREATE** is clicked, the new job is loaded as the active job
5. Click **CREATE**

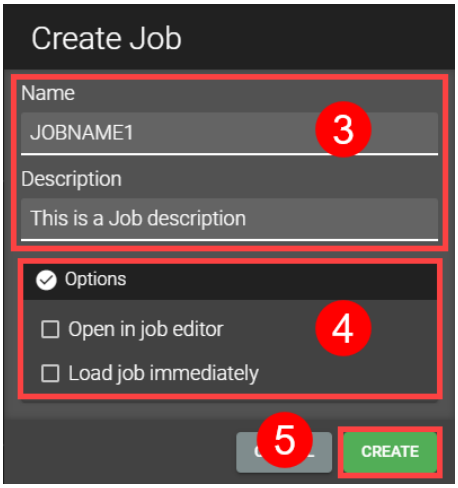

Figure 7-8: Create Job Steps 3-5

Duplicate Job

Use the following steps to save a duplicate of a job under a new name:

1. Click the **JOB** button on the TMAC Action Bar
2. Select Duplicate Job

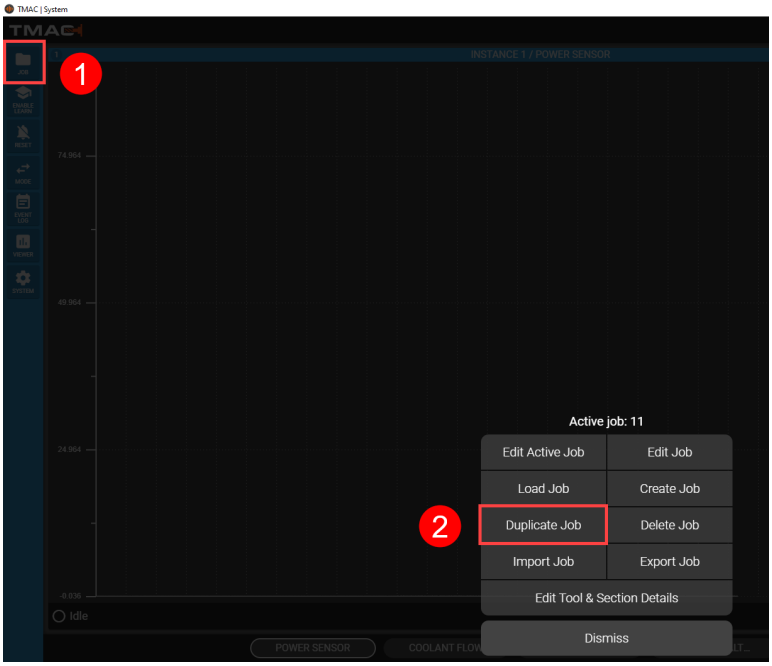

Figure 7-9: Duplicate Job Steps 1-2

3. Choose a job to duplicate from the list
4. Click **SELECT**

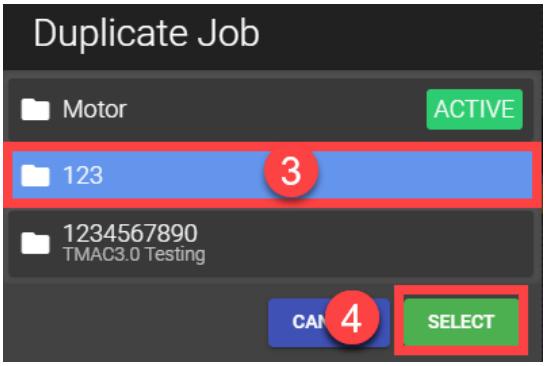

Figure 7-10: Duplicate Job Steps 3-4

5. Enter a Name and Description for the Job

6. Mark any desired options from the following:
    a. **Open in job editor**: After **Duplicate** is clicked, the new job opens in the Job editor for editing
    b. **Load job immediately**: After **Duplicate** is clicked, the new job is loaded as the active job
7. Click **Duplicate**

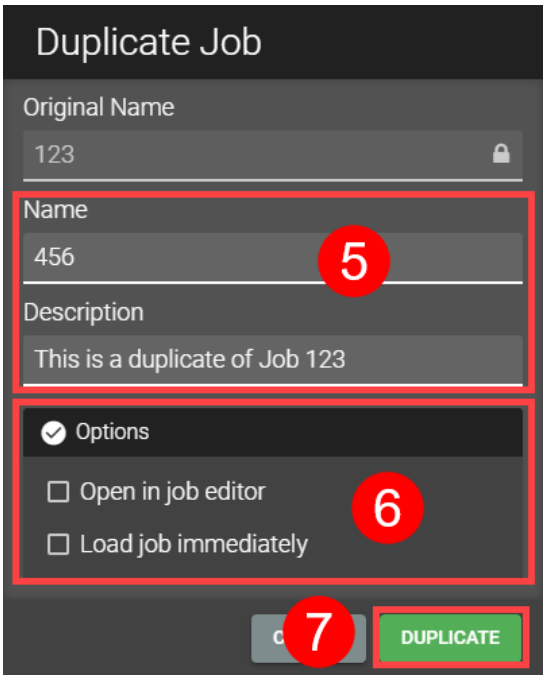

Figure 7-11: Duplicate Job Steps 5-7

Delete Job

Use the following steps to delete a job:

1. Click the **JOB** button on the TMAC Action Bar
2. Select Delete Job

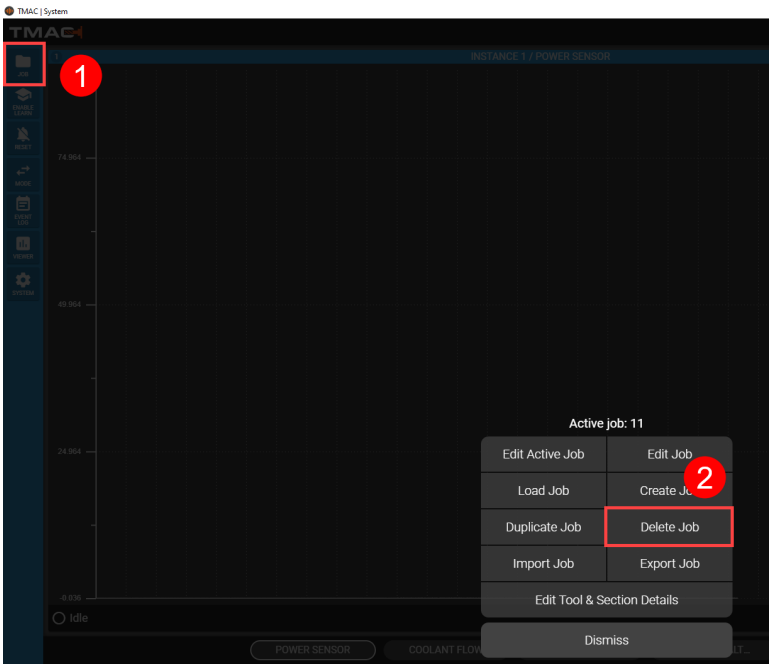

Figure 7-12: Delete Job Steps 1-2

3. Select a job from the list
4. Click **SELECT**

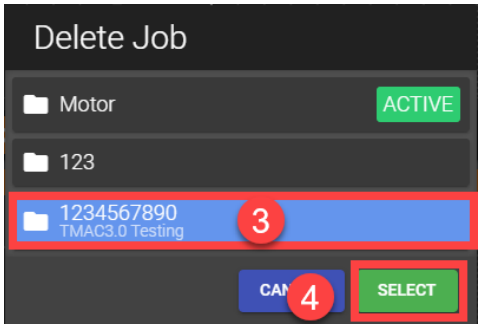

Figure 7-13: Delete a Job Steps 3-4

Importing A TMAC 3.0 Job

Importing a TMAC 3.0 job file (.tmj) adds a new job to the TMAC system. This job contains all data and parameters from the associated job. Use the following steps to import a TMAC 3.0 job:

1. Click the **JOB** button on the TMAC Action Bar
2. Click Import job

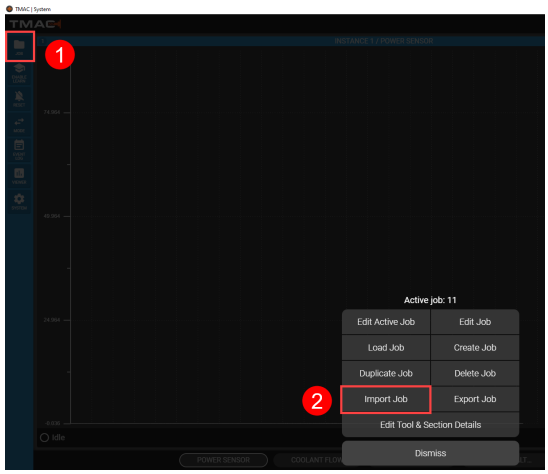

Figure 7-14: Import TMAC 3.0 Job Steps 1-2

3. Click the **SELECT FILE** button
4. Select a .tmj file to import
5. Ensure the instance listed is the instance associated with the selected job file. If the displayed instance is incorrect, select a new one by clicking the instance button. Click **NEXT**

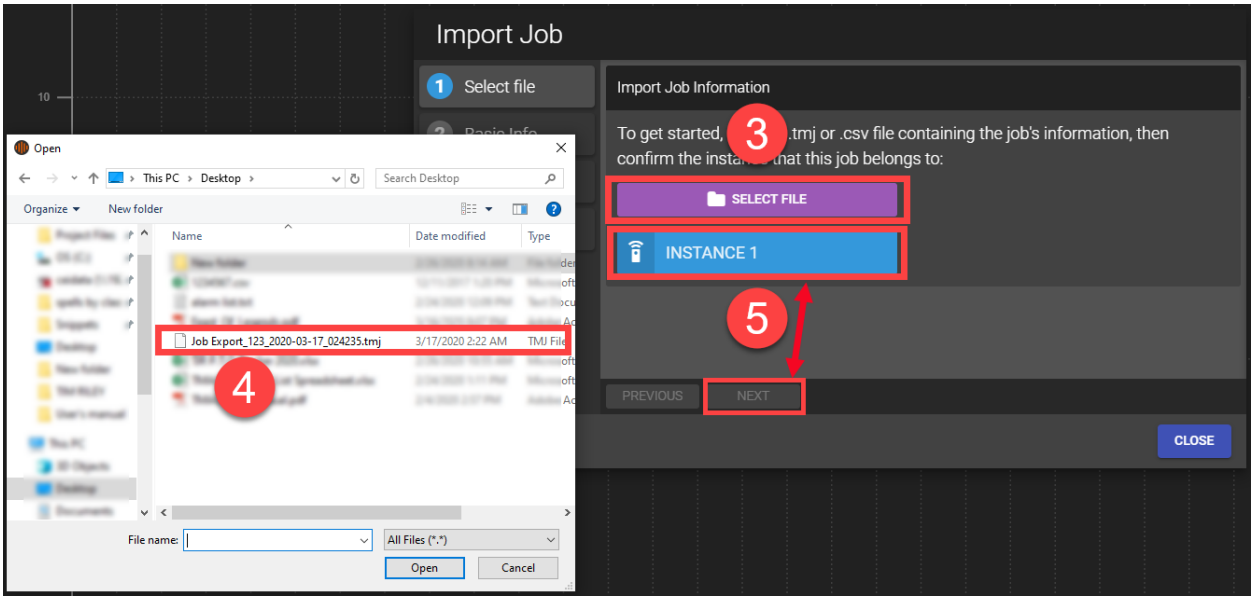

Figure 7-15: Import TMAC 3.0 Job Steps 3-5

6. Enter a name and description for the imported job, then click next

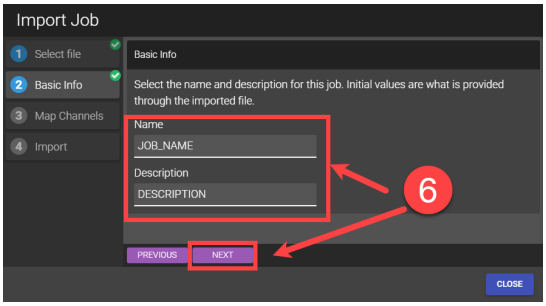

Figure 7-16: Import TMAC 3.0 Job Steps 6

7. Each channel in the imported file needs to be mapped to a channel that exists in the selected TMAC instance. The channels listed on the left represent the channels stored in the imported job. Check each channel to ensure that it is mapped correctly. If any channel is mapped incorrectly, click the Channel button on the right to select the correct channel.
8. Click Next

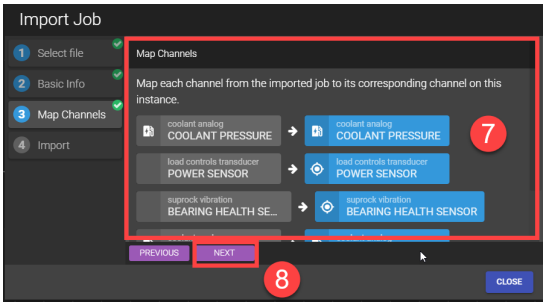

Figure 7-17: Import TMAC 3.0 Job Steps 7-8

9. Review the displayed import summary for accuracy and click **IMPORT** to import the job.

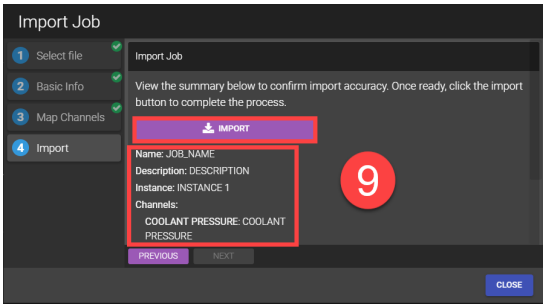

Figure 7-18: Import TMAC 3.0 Job Step 9

Importing Legacy Jobs

Legacy job files from TMAC MP version 2.0+ can be imported for use in TMAC 3.0. Importing a legacy job requires a more involved process than importing a TMAC 3.0 job. Users should be familiar with both systems and the job to be imported before beginning the process.

Use the following steps to import a legacy job:

1. Click the **JOB** button on the TMAC Action Bar
2. Click Import job

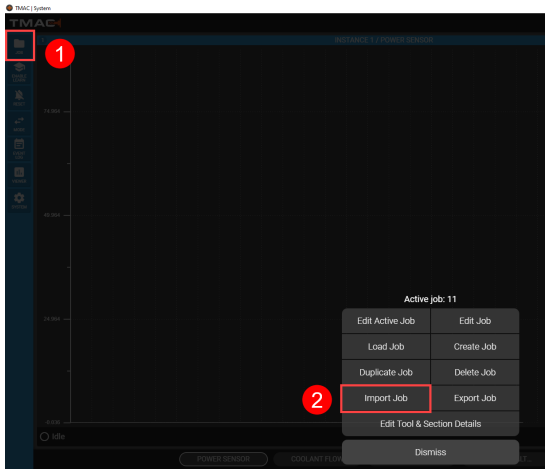

Figure 7-19: Import Legacy Job Steps 1-2

3. Click the **SELECT FILE** button
4. Select a .csv legacy job file to import
5. Ensure the instance listed is the instance associated with the selected job file. If the displayed instance is incorrect, select a new one by clicking the instance button. click **NEXT**

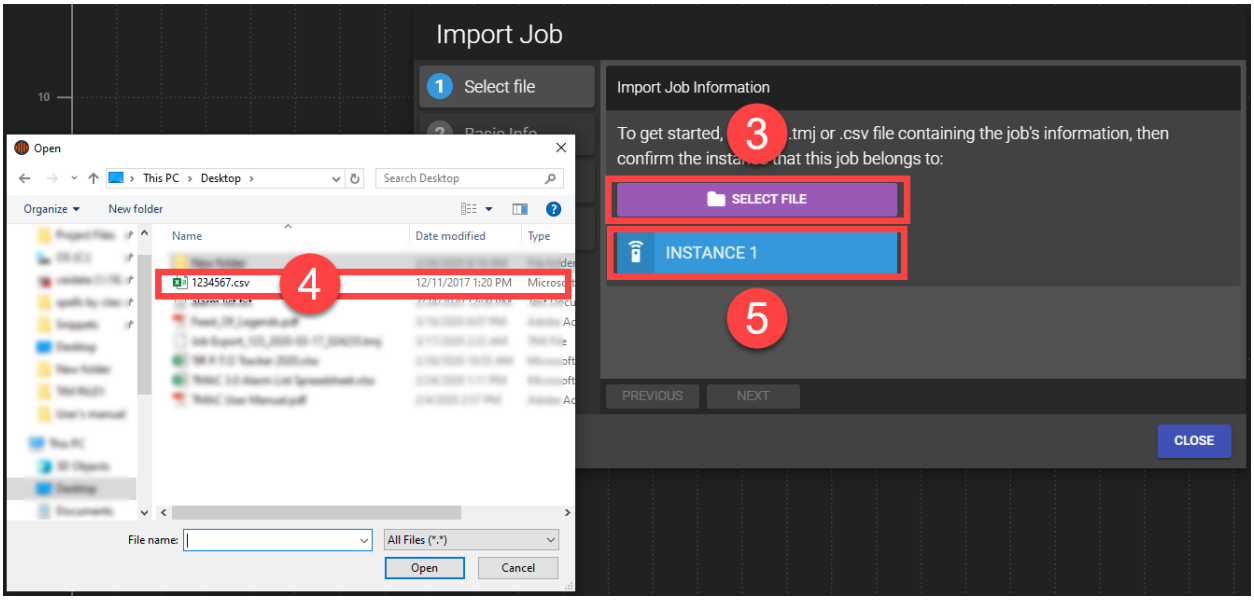

Figure 7-20: Import Legacy Job Steps 3-5

6. TMAC automatically adds the job name from the legacy file. If desired, change the job name and add a description for the job.

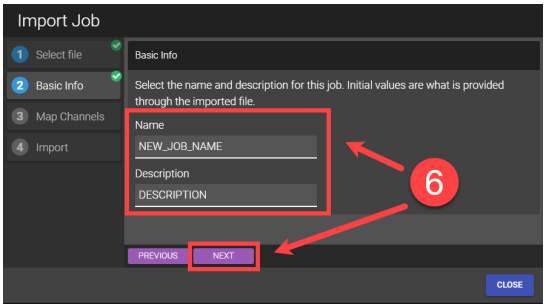

Figure 7-21: Import Legacy Job Step 6

7. Each channel in the imported file needs to be mapped to a channel that exists in the selected TMAC instance. In TMAC MP, channels have dedicated channel numbers and were not named. Assign a TMAC 3.0 channel to each legacy channel number by clicking the associated **SELECT ITEM** button. Ensure each channel is correctly mapped before continuing.
8. Click **NEXT**

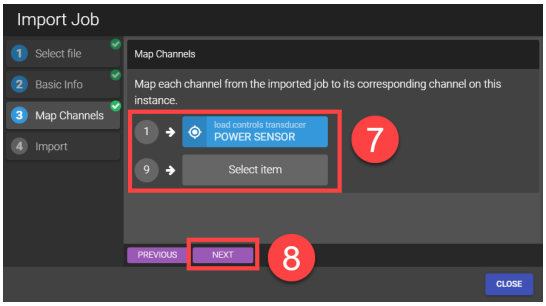

Figure 7-22: Import Legacy Job Steps 7-8

9. Review the displayed import summary for accuracy and click **IMPORT** to import the job.

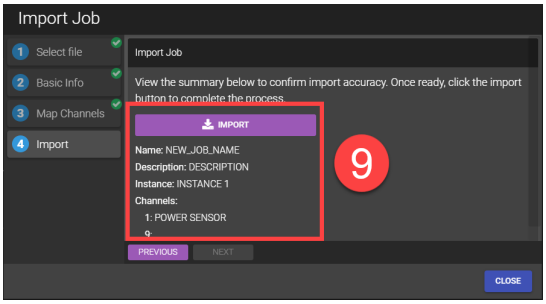

Figure 7-23: Import Legacy Job Step 9

Note: The Learn Once feature is automatically set for each operation in the imported job. Additionally any fixed scale values set in the legacy job do not carry over to the TMAC 3.0 job.

Export a Job

TMAC is able to export jobs to a text file. This allows for the exported job file to be imported into a separate TMAC 3.0 system. When a TMAC 3.0 job is exported, all job data and parameters are stored in the exported file.

Use the following steps to export a TMAC 3.0 job:

1. Click the **JOB** button on the TMAC Action Bar
2. Click Export job

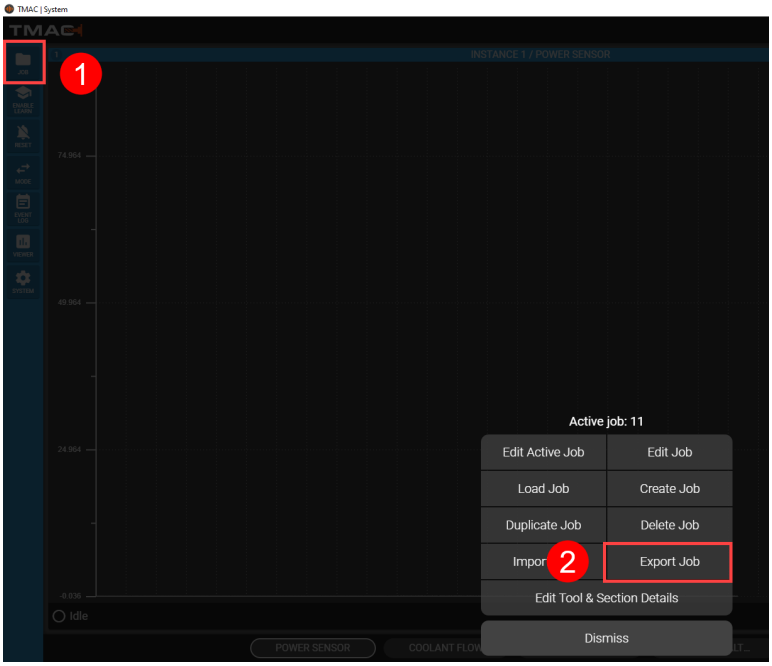

Figure 7-24: Export a Job Steps 1-2

3. Select a job from the list to export

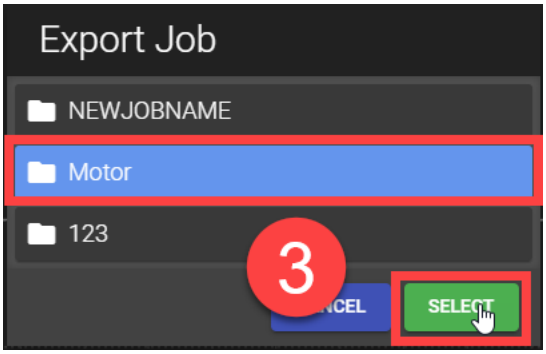

Figure 7-25: Export a Job Step 3

4. Navigate to the desired directory and click save

Edit Tool & Section Details

The Job Operations menu provides an interface where Tool and Section details can be added or changed for all jobs on the system. The following details may be added or changed:

- **Name**: Add a name to any Tool that exists in the TMAC system. The tool will still have an assigned tool number
- **Description**: Add a description to any Tool or section that exists in the TMAC system

Use the following steps to edit Tool and Section details:

1. Click the **JOB** button on the TMAC Action Bar
2. Select Edit Tool and Section Details

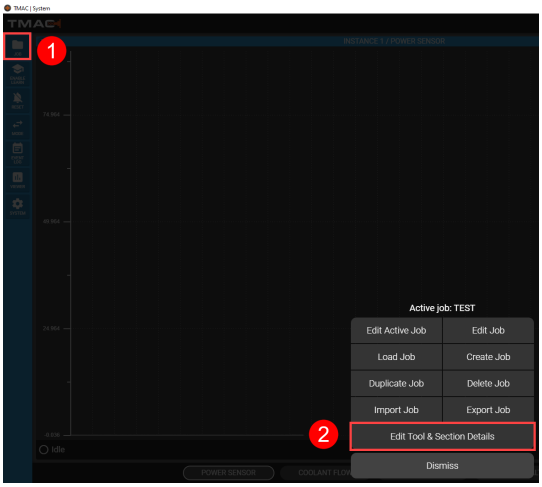

Figure 7-26: Edit Tool and Section Details Steps 1-2

3. Select a Job from the job list. The active job is marked with a green dot. All tools that exist in the job are displayed

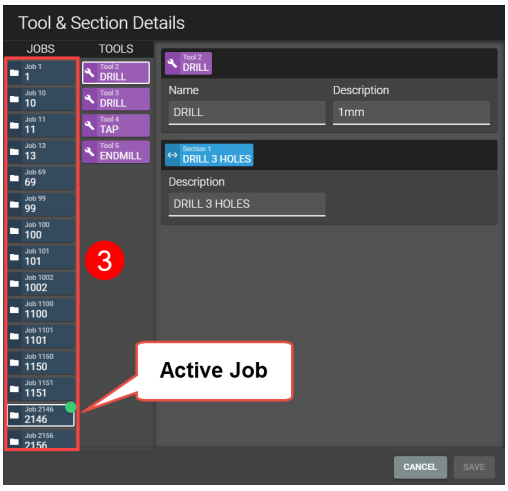

Figure 7-27: Edit Tool and Section Details Step 3

4. Select a tool from the list. All sections associated with the tool are displayed

a. Enter a name and description for the selected tool

b. Enter descriptions for each section associated with the selected tool

5. Repeat steps 3 and 4 until all desired changes are made
6. Press **SAVE**

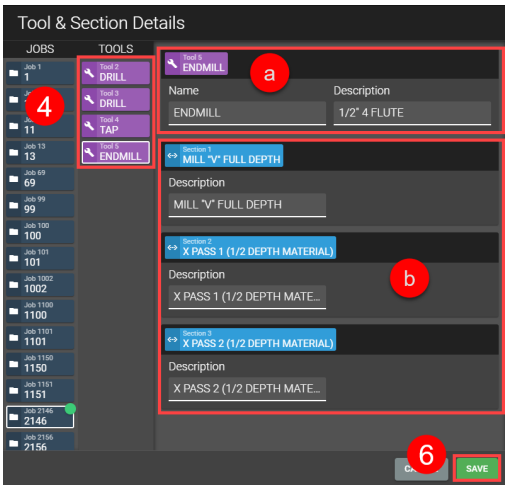

Figure 7-28: Edit Tool and Section Details Step 4-6

Note: The Tool and Section details are also able to be edited in the job editor.

Using the Job Editor

The Job editor is split into two major sections. The channels and operations are on the left side (1) and the programmable features, limits and delays are in the body of the Editor (2). Selecting a tool from the list changes the listed operations to those associated with the tool. The Job Editor allows the following actions to be performed:

- Add or delete operations
- Cycle through and search for operations
- Launch the Time Increment Editor or Data Viewer
- Edit Operation Details and implement Global settings over multiple operations
- Set Tool and Section details, features, limits, delays and channel scales

Refer to Table 7-1 to see which features are available per channel class.

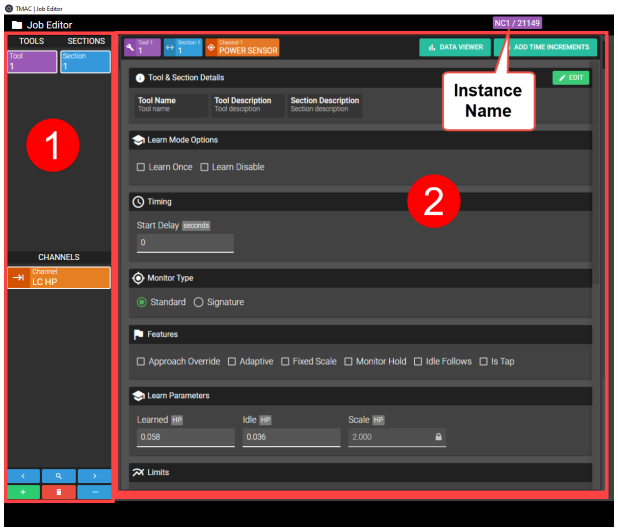

Figure 7-29: Example Job Editor

Note: A recording for the selected operation must exist for TMAC to launch the Time Increment Editor from the Job Editor.

TMAC Features for Channel Classes			
Feature	**Primary**	**Spindle**	**Coolant**
Learn Once	x		x
Learn Disable	x		x
Approach Override	x		
Adaptive	x		
Dither	x		
Fixed Scale	x		
Monitor Hold	x	x	x
Monitor Type: Signature or Standard	x		
Idle Follows	x		
Idle Reset	x		
Filter	x		x
Start Delay	x	x	x
Time Increments	x		

Table 7-1: TMAC Features Per Channel Classes

Selecting Channels for an Operation

The available channels are displayed on the left side of the Job Editor. To add a channel to the job use the following steps:

1. Click the "+" button on the Job Editor Toolbar
2. Click Select Channels

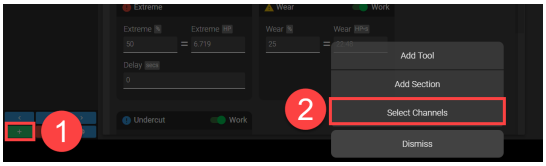

Figure 7-30: Selecting Channels for an Operation Steps 1-2

3. Click the Channels field

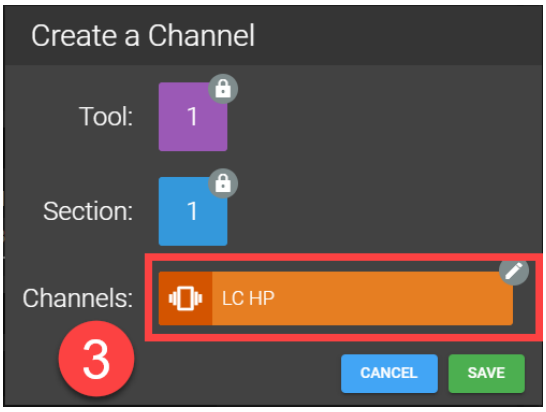

Figure 7-31: Selecting Channels for an Operation Step 3

4. Select the desired channels to add to the operation
5. Click **SAVE** to close the Select Channels window

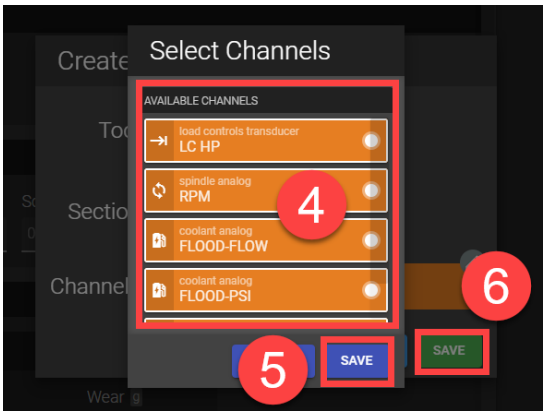

Figure 7-32: Selecting Channels for an Operation Steps 4-6

6. Click **SAVE** to close the Create a Channel window

Manually Adding an Operation

The available operations are listed on the left side of the Job Editor. To add an operation to the job, use the following steps:

1. Click the "+" button on the Job Editor Toolbar
2. Select one of the following:
    a. Add Tool: Adds a new tool and section
    b. Add Section: Adds a section to the tool selected on the left side of the Job Editor. If selecting Add Section proceed to Step 5

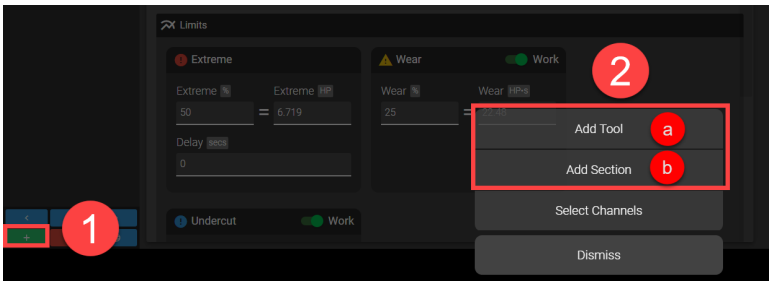

Figure 7-33: Standard Limit Example

3. Click the Tool field

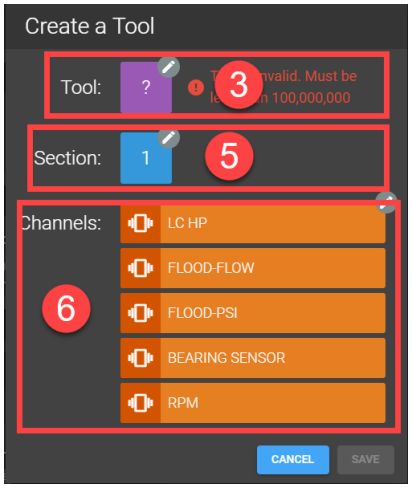

Figure 7-34: Standard Limit Example

4. Enter the desired tool number. By default, the section added with the tool is Section 1. This can be changed by clicking the section field.
5. Enter the desired section number.
6. Ensure that the channels to be associated with the new tool are listed in the Channels field
    a. If all associated channels are listed, proceed to step 7
    b. If the Channels list is incorrect, click the channel field and select the appropriate channels
7. Once the preferred channel and section are selected, click **SAVE**.

Navigating Operations

Jobs can potentially contain many operations, which can make finding a specific operation in the job editor more difficult. The job editor offers navigation tools to aid in finding specific operations in a job. Refer to the following table for description of the navigation tools.

Job Editor Navigation Tools	
Navigation Button	**Function**
	Cycles to the previous operation.
	Search for a specific operation by entering a specific tool and section number
	Cycles to the next operation

Table 7-2: Indicator Action Bar Functionality

Searching for an Operation

Use the following steps to search for a specific operation:

1. Click the  button in the Job Editor
2. Enter the tool and section numbers of the operation
3. Click **GO**

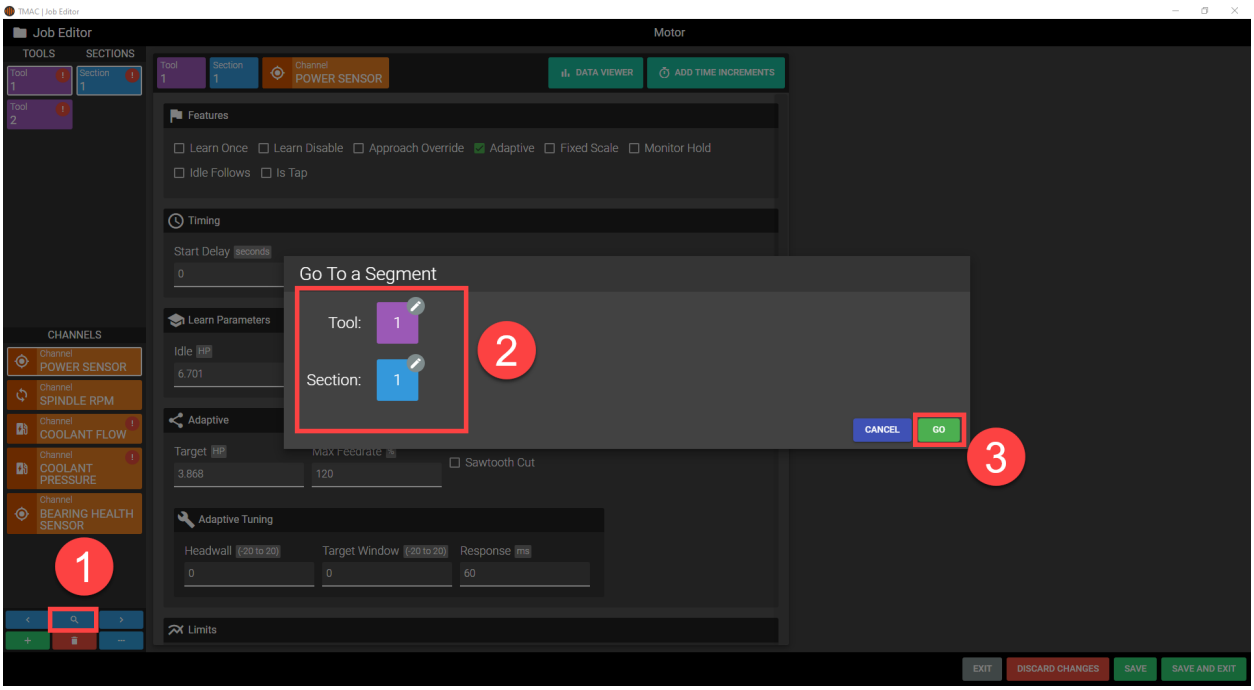

Figure 7-35: Searching for an Operation

Launching the Data Viewer From the Job Editor

The **Data Viewer** button in the job editor launches the **Data Viewer** in a separate window. The most recent recording of the selected operation is automatically opened, if one exists. Additionally, recording filters are automatically applied based on the selected operation in the job editor. These filters apply when the **Next** and **Previous** buttons are used to cycle through recordings in the Data Viewer. For a full description of the Data Viewer's functionality, refer to "Data Viewer" Page 184.

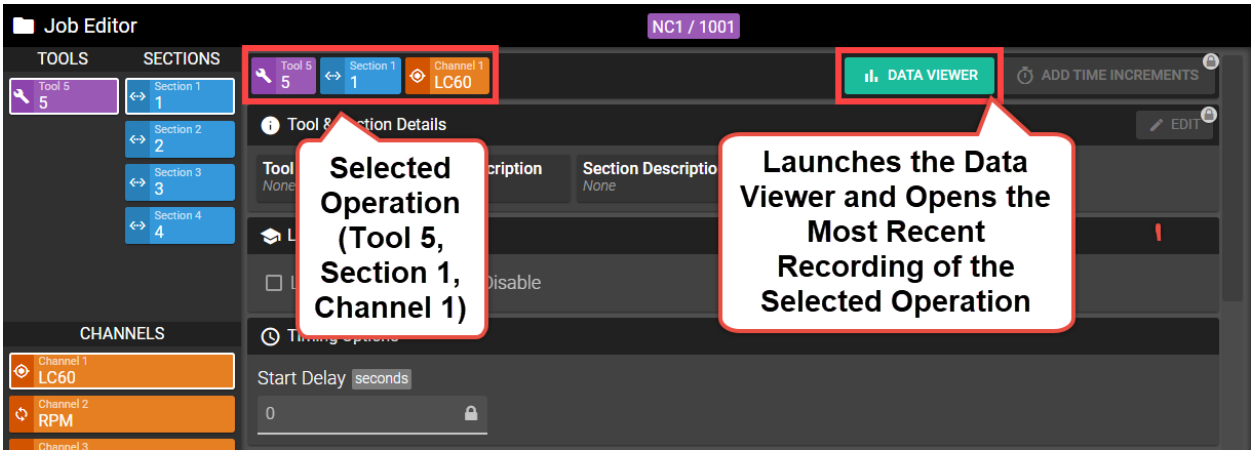

Figure 7-36: Job Editor - Data Viewer Button

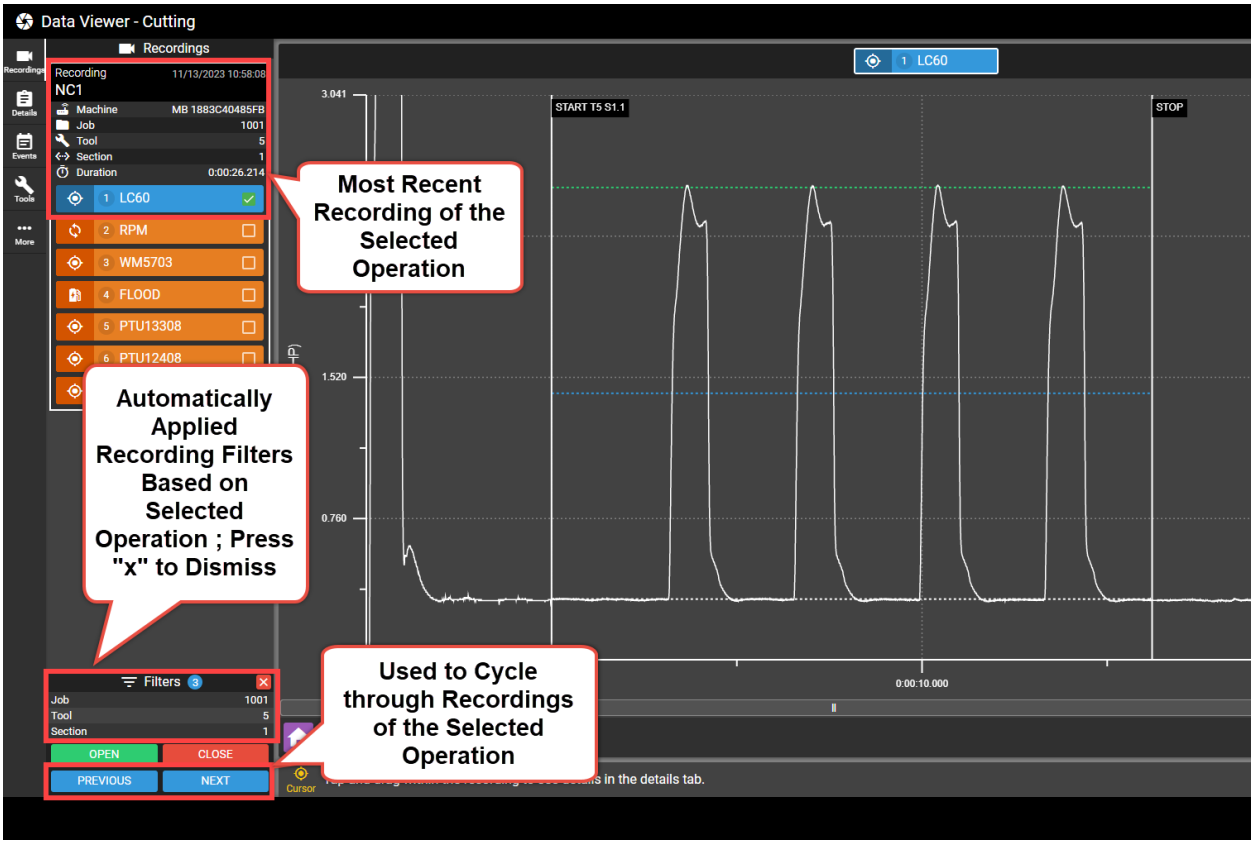

Figure 7-37: Data Viewer Recording of Selected Operation When Launched from the Job Editor

Launching the Time Increment Editor From the Job Editor

The **Add Time Increment** button in the job editor launches the **Time Increment editor**. The most recent recording of the selected operation is automatically opened, if one exists. Additionally, recording filters are automatically applied based on the selected operation in the job editor. For a full description of the Data Viewer's functionality, refer to "Time Increments" Page 130.

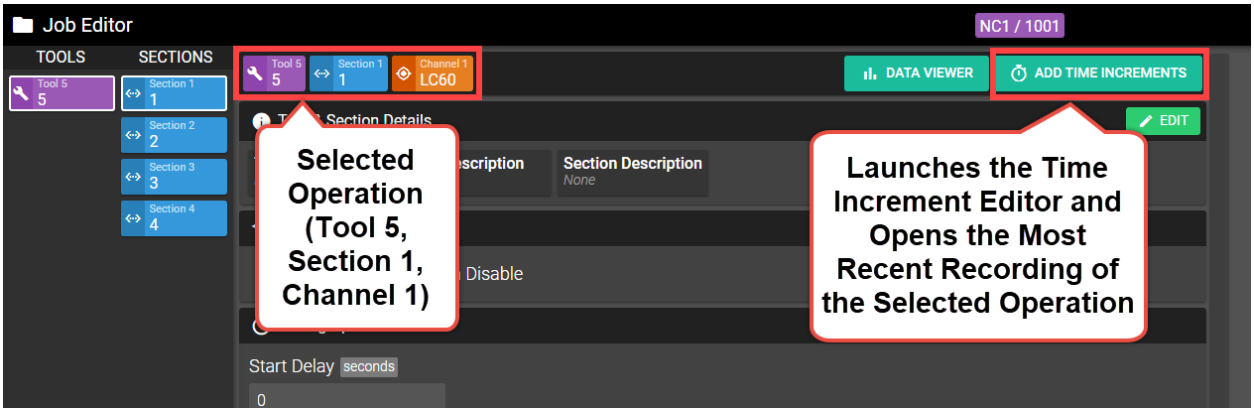

Figure 7-38: Job Editor - Add Time Increment Button

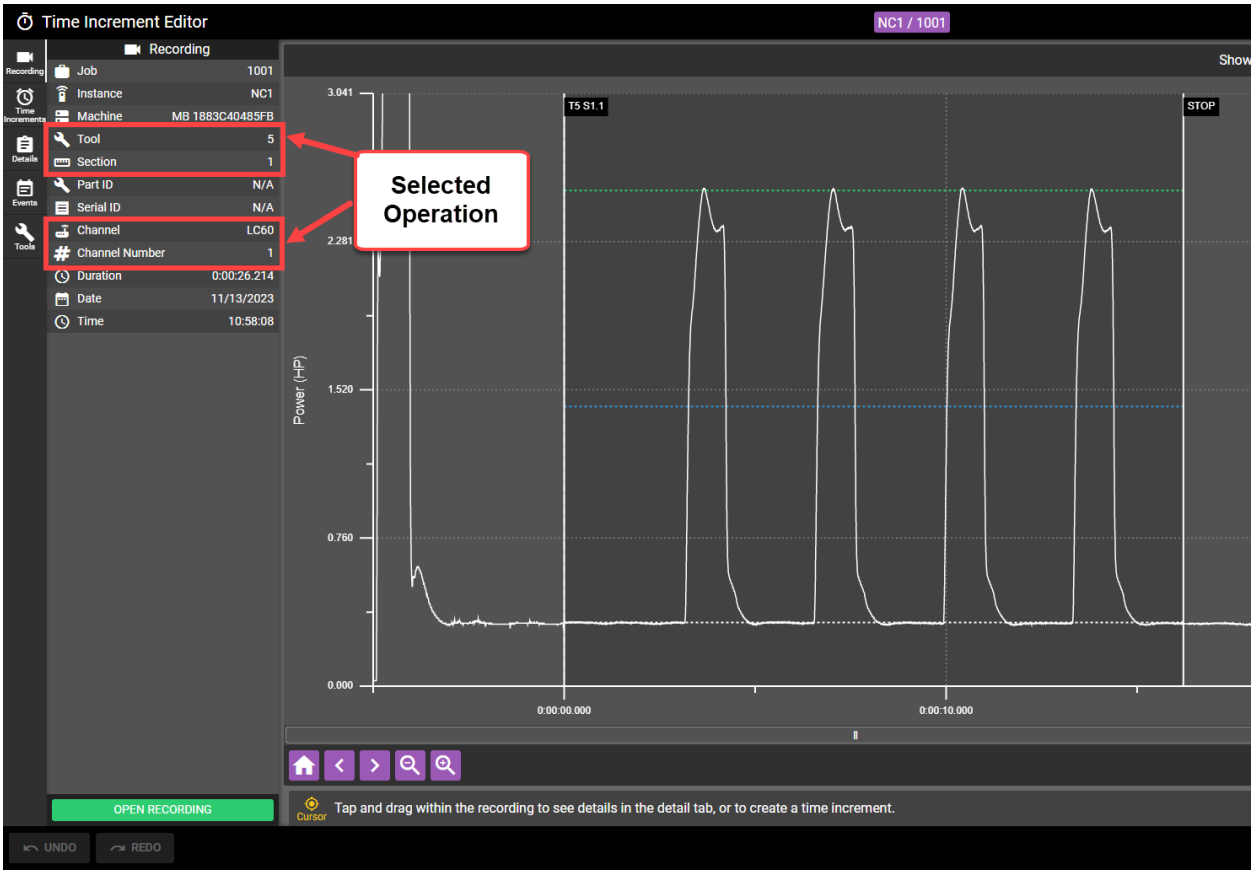

Figure 7-39: Time Increment Editor - Recording of Selected Operation When Launched from the Job Editor

Job Options Menu

Pressing the ··· button opens a menu with additional job options. This menu allows the following options:

- **Edit Details**: Change the job name and description
- **Global Edits**: Set features and limits for multiple operations in the job at once
- **Duplicate**: Create a copy of a tool or section as a new tool or section number.
- **Reassign**: Reassign The a tool or section number from the selected operation
- **Show Tool Names**: Displays the tool names in place of tool numbers in the tool list

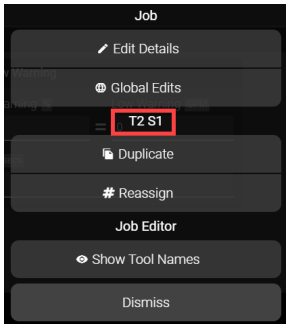

Figure 7-40: Job Options Menu

Note: The Duplicate and Reassign option in the Job Options menu are dependent on the operation selected prior to pressing the ··· button. The selected operation is displayed above these option in the Job Options menu (See red outline in Figure 7-36).

Edit Details

Selecting **Edit Details** from the Job Options menu allow the job name and description to be changed.

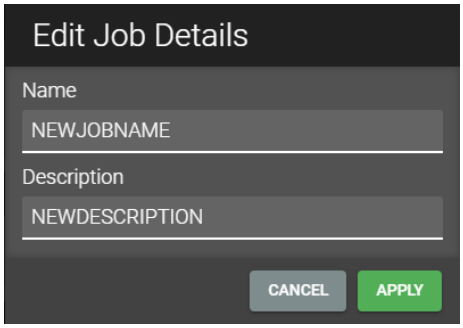

Figure 7-41: Edit Job Details

Note: Changing the job name and description does not update existing recordings, events, and logs. Any existing recordings, events, and logs will refer to the previous job name.

Global Edits

In some jobs, multiple operations could require the same features or parameters to be changed. The Job editor provides a global edits tool that can apply the same changes across multiple operations at once. Any feature or parameter set in the Job Editor can be changed using global edits. Access the global edits feature by clicking the button in the Job Editor.

Selecting Operations for Global Edits

When the button is clicked, TMAC prompts the user to select which operations to apply global edits to. The available operations are listed on the left side of the window and the following buttons may be used to manipulate the lists:

- **SELECT ALL**: Selects all operation in the associated list.
- **DESELECT ALL**: Deselects all operations in the associated list
- **ADD**: Moves the selected operations from the **Excluded Operations** list to the **Operations to Edit** list
- **REMOVE**: Moves any operations selected in the **Operations to Edit** list to the **Excluded Operations** list
- **ADD ALL**: Moves all operations from the **Excluded Operations** list to the **Operations to Edit** list, regardless of selection.
- **REMOVE ALL**: Moves all operations from the **Operations to Edit** list to the **Excluded Operations** list, regardless of selection.

Use the following steps to select operations for global edits:

1. Mark each operation individually by clicking the associated check-boxes, or using the operation buttons described above
2. Click the **ADD** button
3. Click **CONFIRM**

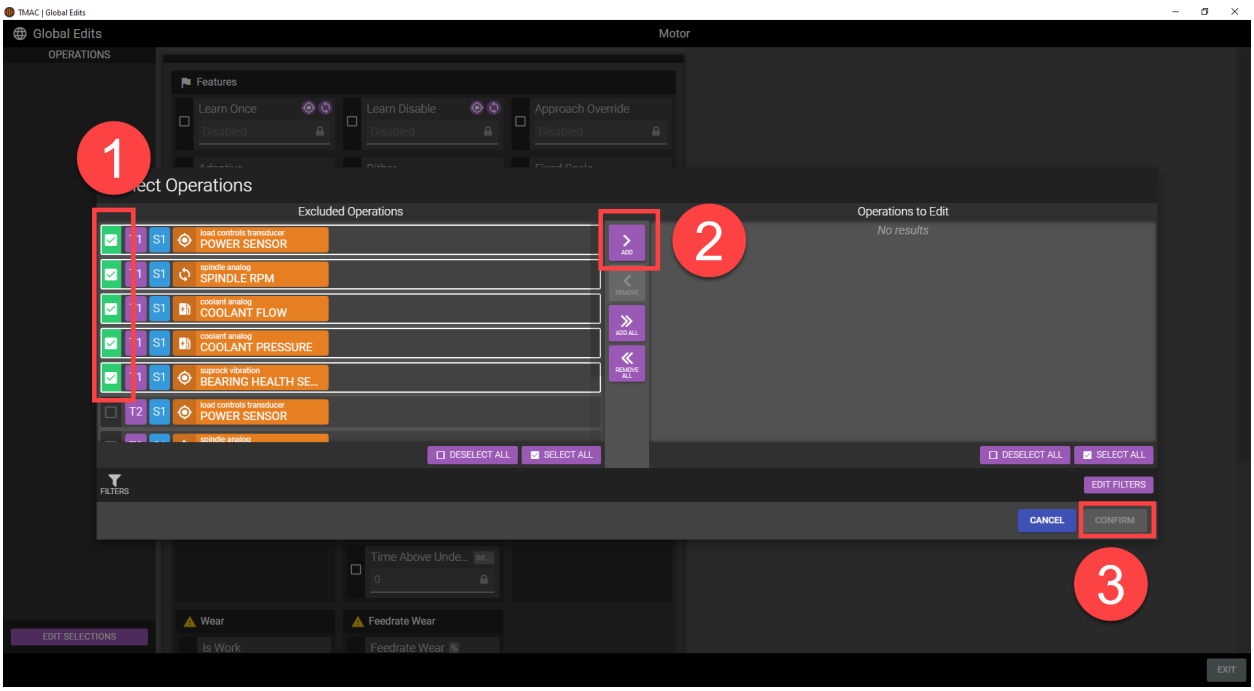

Figure 7-42: Selecting Operations for Global Edits

Filtering Operations for Global Edits

The list of operations in the Select Operations window can be filtered by clicking the **EDIT FILTERS** button. The following filters are available:

- **Tool**: Filters the list of operations to display only operations containing the specified tool number
- **Section**: Filters the list of operations to display only operations containing the specified section number
- **Channel Class**: Filters the list of operations to display only operations containing the specified channel class (primary, coolant, spindle)
- **Channel Type**: Filters the list of operations to display only operations containing the specified channel type (power, vibration, strain, etc...)
- **Channel Name**: Filters the list of operations to display only operations containing the specified channel name

Click **SAVE** to apply the filters.

Applying Global Edits

Once operations have been specified, individual parameters and features can be selected. The operations for which global edits are to be applied to are listed on the left hand side of the screen (1). This list can be edited by clicking the **EDIT SELECTIONS** button (2). The job name is displayed at the top of the screen (3) and indvidual parameters populate the right side(4). Additionally, the parameters can be filtered by channel class (primary, spindle and coolant) using the channel class buttons at the top of the screen (5). Certain features in the Job Editor may not be setable using Global Edits.

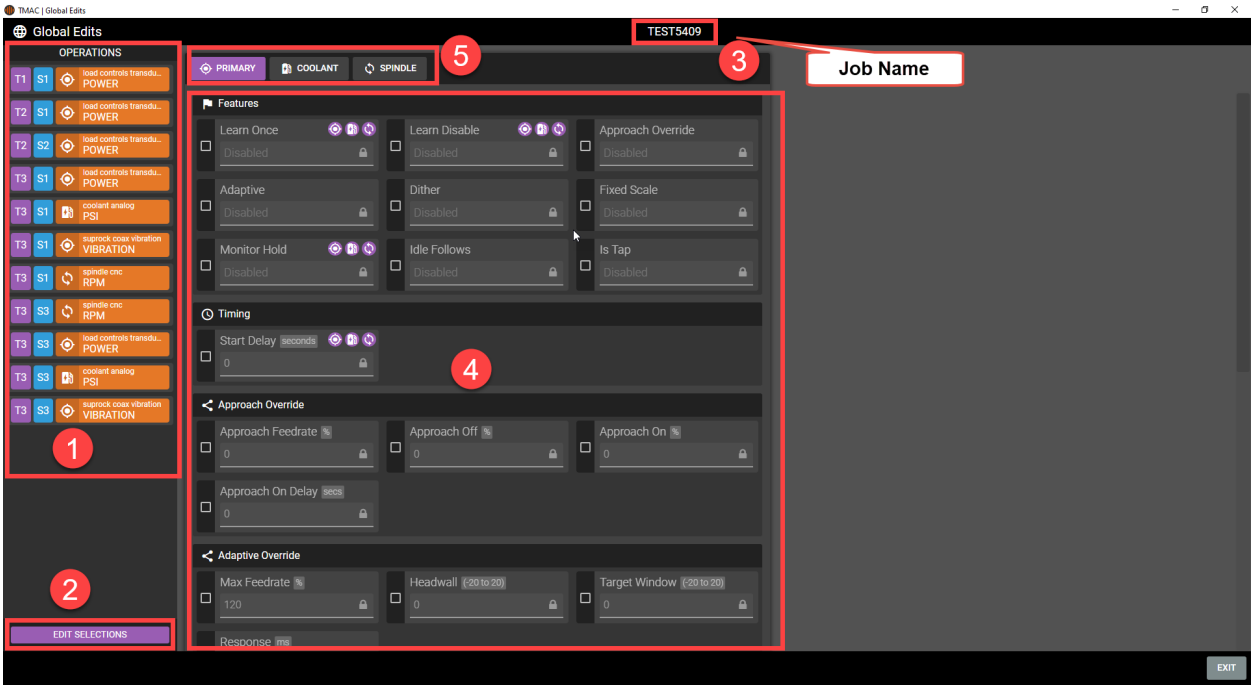

Figure 7-43: Applying Global Edits

To set parameters using global edits, use the following steps:

1. Mark a parameter or feature to set by clicking the associated check-box
2. Enter the desired value for the parameter or feature

a. If the parameter or feature requires a numeric value, enter it in the field

b. If the feature normally requires flagging a check-box or switch in the Job Editor, select Enabled or Disabled from the dropdown.

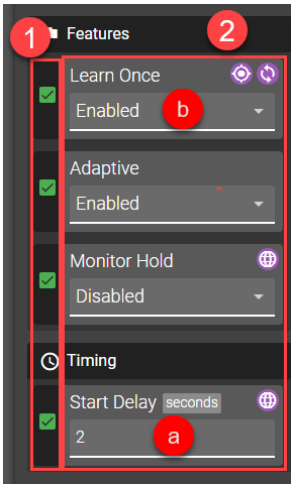

Figure 7-44: Applying Global Edits Steps

3. Repeat steps 1 and 2 for each feature and parameter to be set globally.
4. Click **SAVE AND EXIT**
5. Review all changes in the provided summary and click **CONFIRM** to send the changes to the Job Editor.

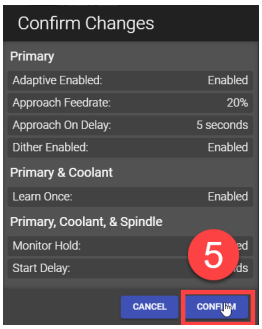

Figure 7-45: Confirm Changes

6. Press Save in the Job Editor to save the applied global edits.

Note: Certain features on the global edits screen are marked with purple icons. These icons represent a channel class. The icons match the symbols seen on the channel class buttons at the top of the screen. If a feature marked with these icons is applied using global edits, the feature is applied to channels with that class type.

Duplicating Operations

Selecting **Duplicate** from the Job Options menu allows the user to duplicate the tool or a section from the selected operation. Duplicating a tool creates a new tool and duplicates all sections associated with the selected tool. Every parameter, feature and limit from the old operations are copied to the new operations with new tool and section numbers. Duplicating a section creates a new section associated with any tool and copies all parameters, features and limits from the selected section to the new section.

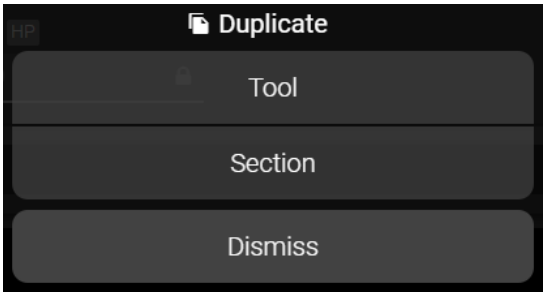

Figure 7-46: Duplicate Menu

Note: Duplicated operations can not access the chart data used to create time increments from the old operation. For example if Tool 2 Section 1 was duplicated from Tool 1 Section 1, the time increment editor can not be opened for Tool 2 Section 1 as there is no chart data available for the new tool. If a tool already has time increments when it is duplicated, the time increments will be duplicated as well.

Duplicating a Tool

Use the following steps as a guide for duplicating a tool:

1. Select the desired tool from the list
2. Ensure all desired features and parameters are set for the operation.

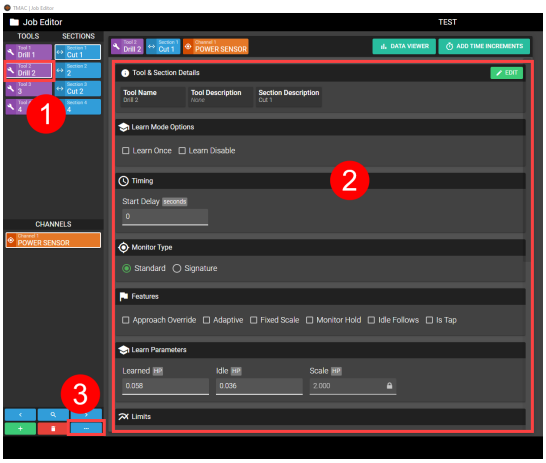

Figure 7-47: Duplicating a Tool Steps 1-3

3. Press the ··· button and select **Duplicate**
4. Select Tool

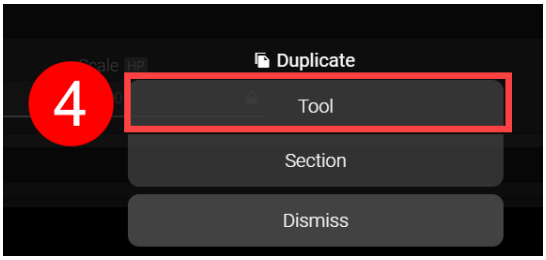

Figure 7-48: Duplicating a Tool Step 4

5. Enter a tool number for the new tool
6. If the tool name and descriptions need to be included in the duplication, mark the **Duplicate Details** check-box
7. Click **DUPLICATE**

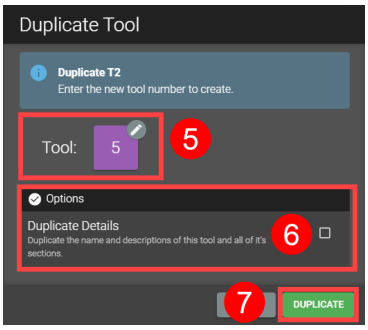

Figure 7-49: Duplicating a Tool Steps 5-7

Duplicating a Section

Use the following steps as a guide for duplicating a Section:

1. Select the desired tool and section from the list
2. Ensure all desired features and parameters are set for the operation.

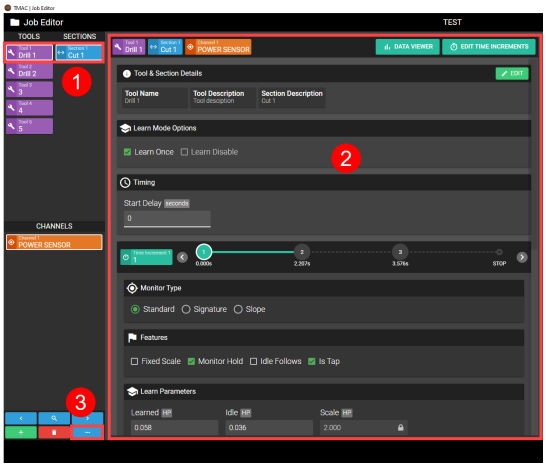

Figure 7-50: Duplicating a Section Steps 1-3

3. Press the ··· button and select **Duplicate**
4. Select Section

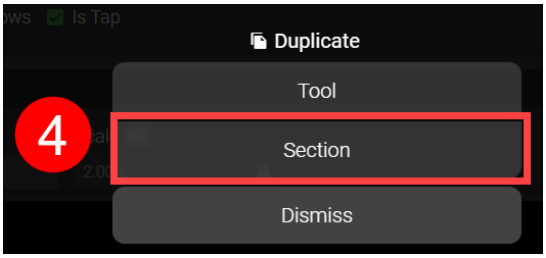

Figure 7-51: Duplicating a Section Step 4

5. Enter a tool number to associate with the new section. The tool number can be an existing tool or a new tool
6. Enter a new section number
7. If the section description needs to be included in the duplication, mark the **Duplicate Details** check-box
8. Click **DUPLICATE**

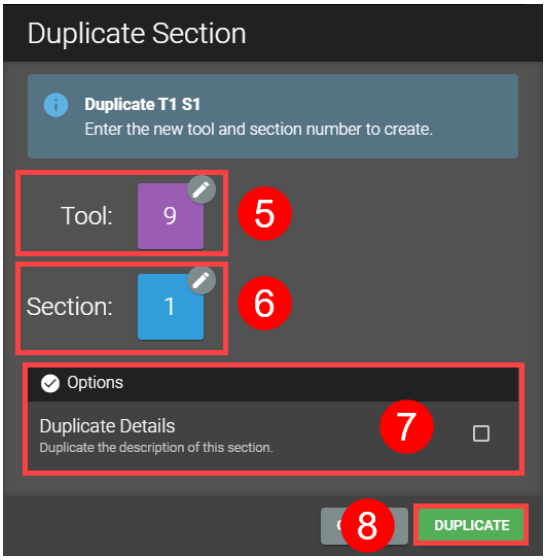

Figure 7-52: Duplicating a Tool Steps 5-8

Reassigning Operations

Selecting **Reassing** from the Job Options menu allows the user to reassign the tool or a section from the selected operation. Reassigning a tool changes the tool number and associates all of its sections with the new number. Reassigning a section changes the section number associates the new section number with any tool number.

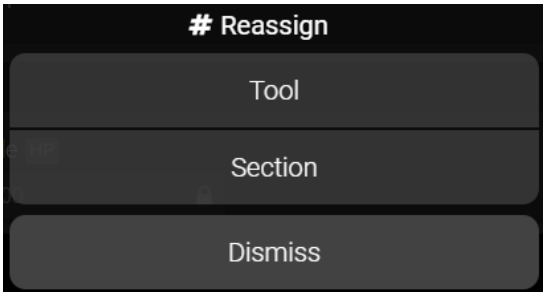

Figure 7-53: Reassign Menu

Note: Reassigned operations can not access the chart data used to create time increments from the old operation. For example if Tool 2 Section 1 was reassigned to Tool 1 Section 1, the time increment editor can not be opened for Tool 2 Section 1 as there is no chart data available for the new Operation.

Reassigning a Tool

Use the following steps as a guide for reassigning a tool:

1. Select the desired tool from the list

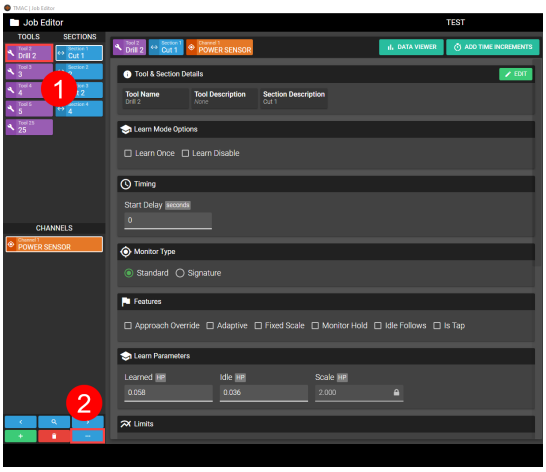

Figure 7-54: Reassigning a Tool Steps 1-2

2. Press the --- button and select **Reassign**
3. Select Tool

Figure 7-55: Reassigning a Tool Step 3

4. Enter a new tool number for the selected tool
5. Mark the **Reassign Details** check-box to include the name and description details for the tool and all of its sections
6. Click **Reassign**

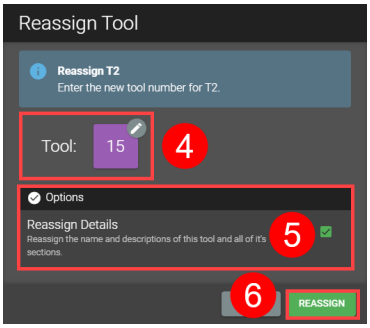

Figure 7-56: Reassigning a Tool Steps 4-6

Reassigning a Section

Use the following steps as a guide for reassigning a Section:

1. Select the desired tool and section from the list

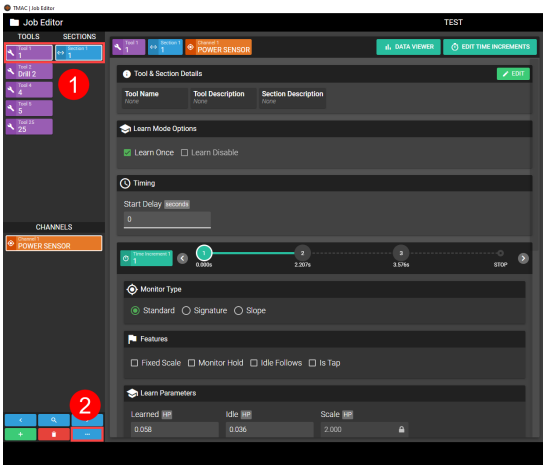

Figure 7-57: Reassigning a Section Steps 1-2

2. Press the ··· button and select **Reassign**
3. Select Section

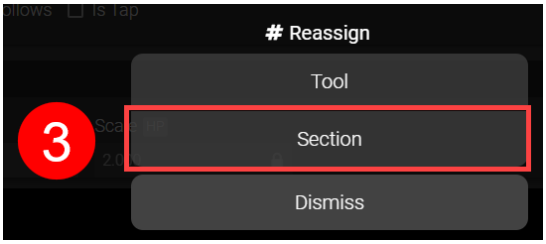

Figure 7-58: Reassigning Section Step 3

4. Enter a tool number to associate with the new section. The tool number can be an existing tool or a new tool
5. Enter a new section number
6. Mark the **Reassign Details** check-box to include the description of the section
7. Click **REASSIGN**

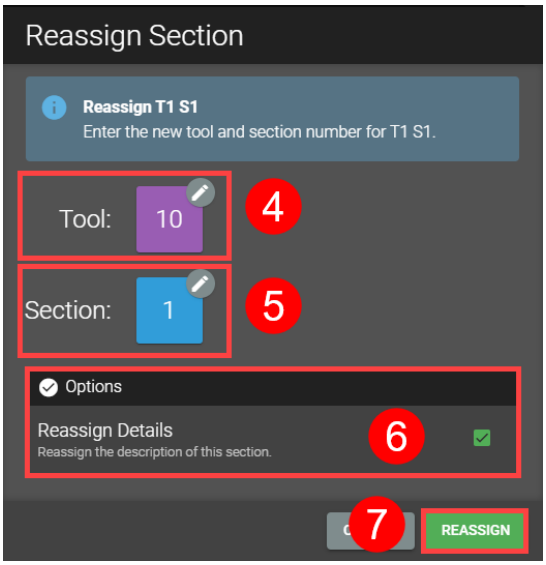

Figure 7-59: Reassigning a Section Steps 4-7

Show Tool Names

Selecting Show Tool Names from the job options menu displays tool names and section descriptions in the tool list. Figure 7-42 shows a comparison of how tool names and section descriptions are displayed when Show Tool Names is enabled.

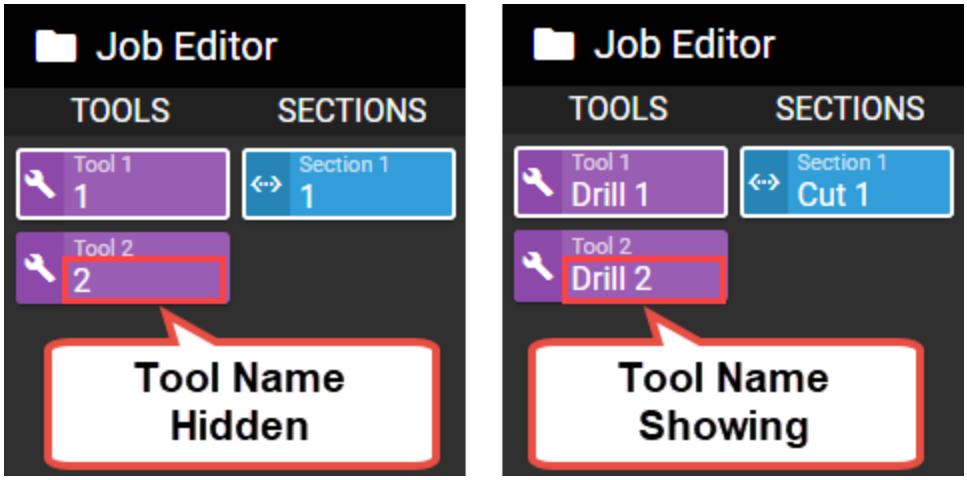

Figure 7-60: Show/hide Tool Name Comparison

Edit Tool and Section Details

Use the following steps to edit Tool and Section details from job editor:

1. Select an operation from the tool list
2. Press the **EDIT** button in the Tool & Section Details section of the Job Editor

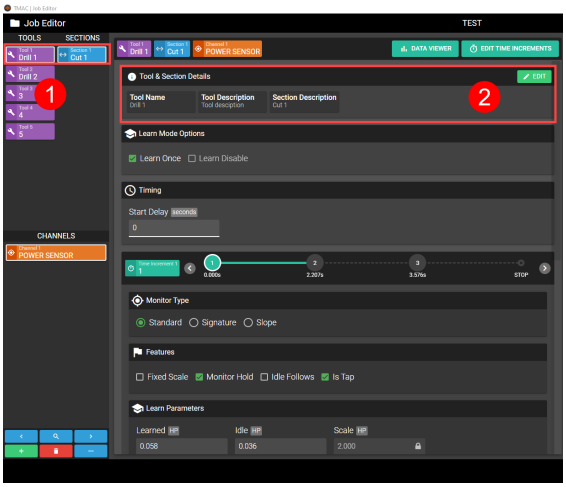

Figure 7-61: Job Editor Tool and Section Details Steps 1-2

3. Select a tool from the list. All sections associated with the tool are displayed
    a. Enter a name and description for the selected tool
    b. Enter descriptions for each section associated with the selected tool
4. Repeat steps 3 and 4 until all desired changes are made
5. Press **APPLY**

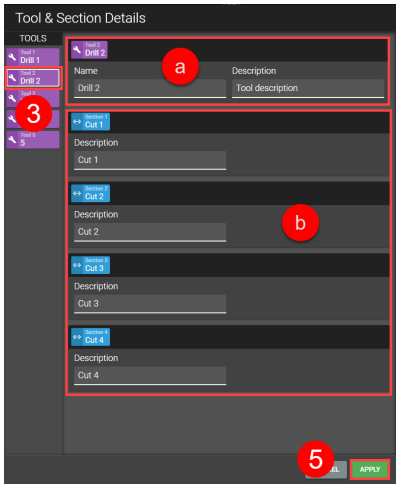

Figure 7-62: Job Editor Tool and Section Details Steps 3-5

Features

The following sections document the features available in the Job Editor. As certain features are enabled, the fields available in the Job Editor may change. These changes are documented specifically in the feature description. Some features that require more extensive documentation are documented in separate chapters of the manual. These features are as follows:

- Time Increment Editor
- Limits and Delays
- Adaptive Control
- Approach Override

See Also:

"Time Increments" Page 130

"Limits and Delays" Page 142

"Adaptive Control" Page 121

"Approach Override" Page 128

Learn Once

The Learn Once feature permits TMAC to re-learn a specific operation. During the next execution of the part program, TMAC will enter learn mode for the designated operation. Once the operation is complete, TMAC updates the learn parameters and disables the Learn Once feature automatically.

Enabling Learn Once

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Activate the Learn Once feature by clicking its check-box. The Learn once check-box is located in the **Learn Mode Options** section of the Job Editor.
3. Click **SAVE**.

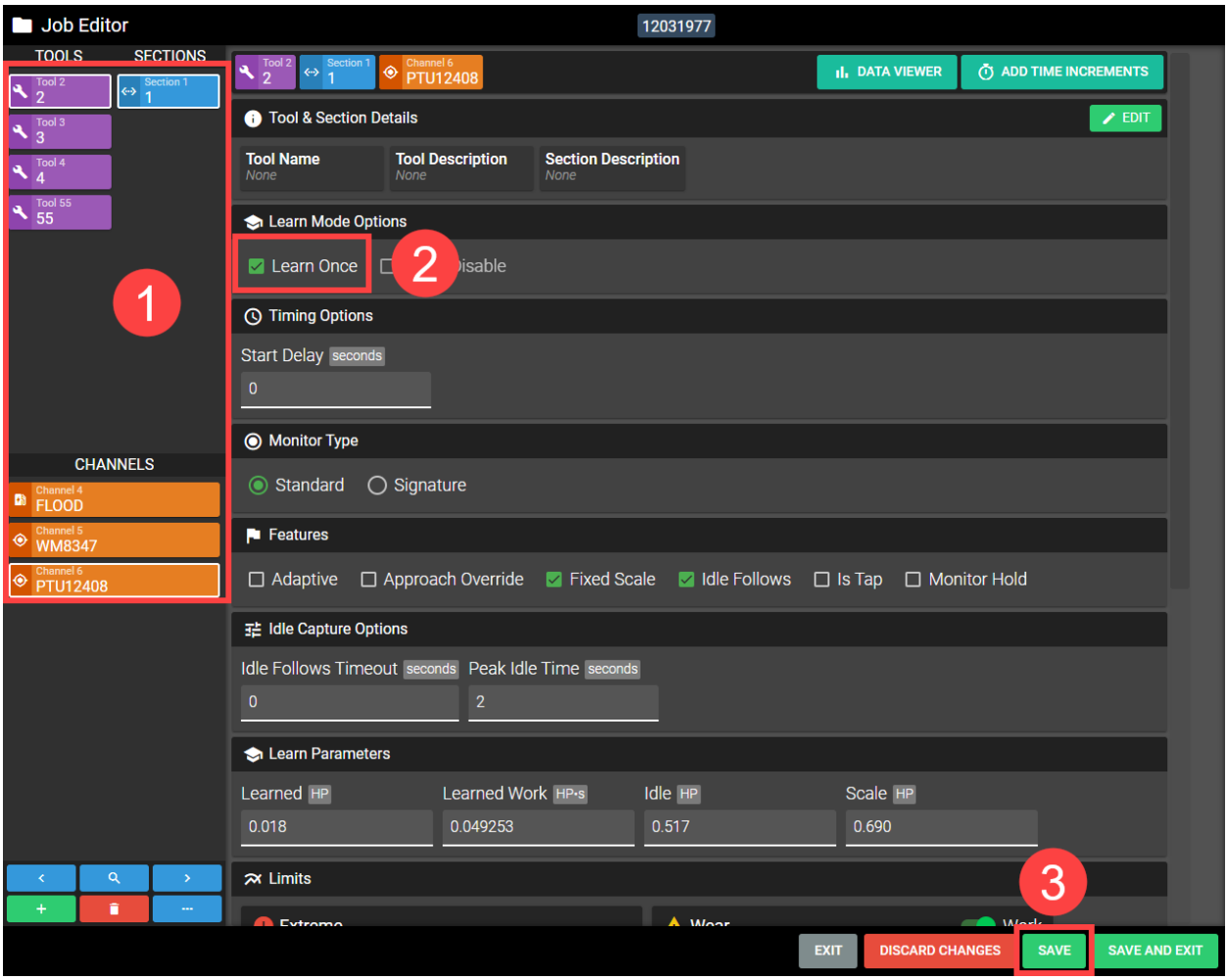

Figure 7-63: Learn Once

During the next execution of the part program, TMAC will re-learn the operations for which Learn Once is activated.

Learn Disable

Learn Disable disables learn mode for the specified operation.

Utilizing Learn Disable

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Activate the Learn Disable feature by clicking its check-box. The Learn Disable check-box is located in the **Learn Mode Options** section of the Job Editor.
3. Click **SAVE**

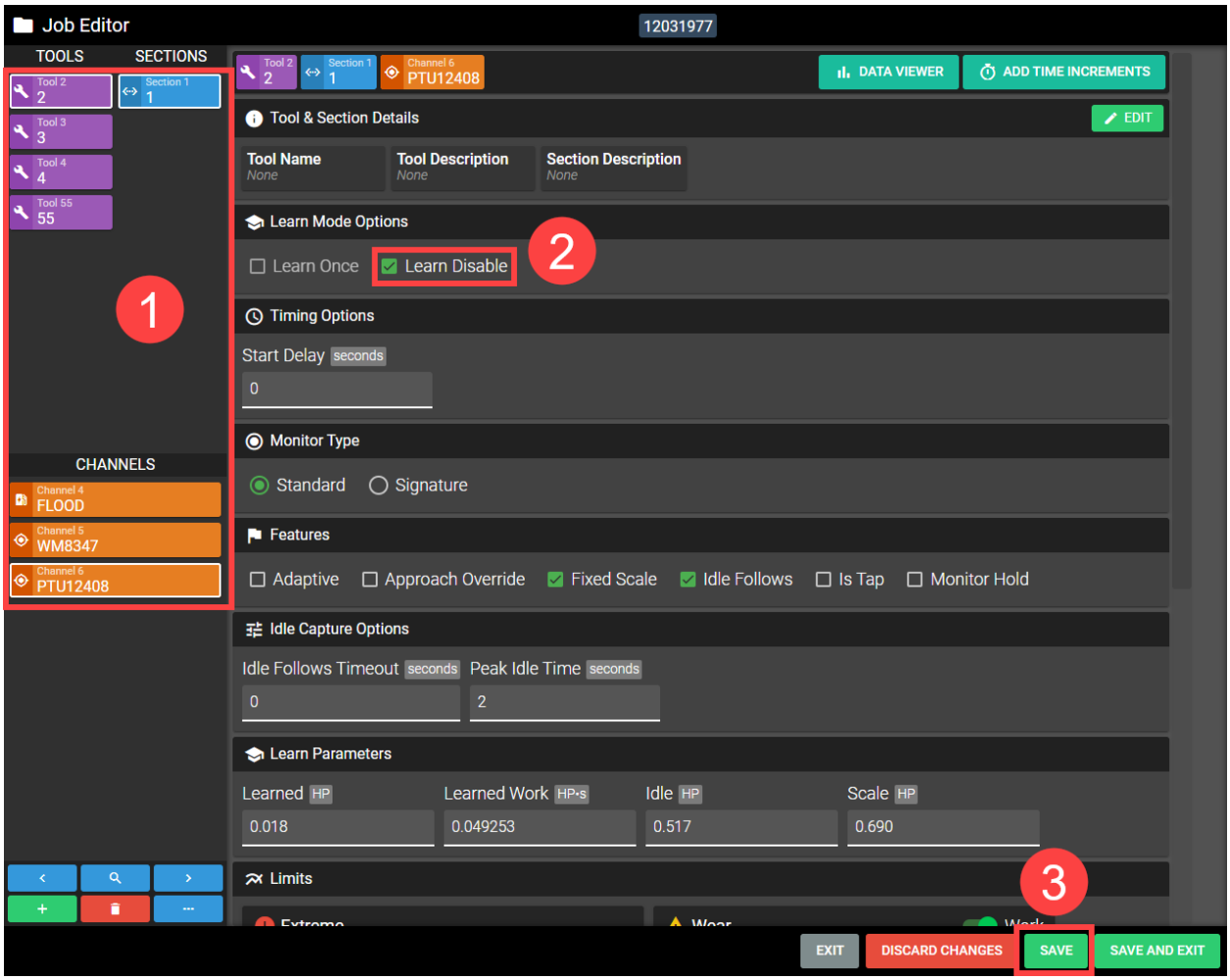

Figure 7-64: Learn Disable

Each time the operation is called while TMAC is in Learn mode, TMAC will switch to monitoring mode for the duration of the operation. After the operation is complete TMAC returns to learn mode.

Dither

In some machine tool operations, tool chatter can occur from harmonic vibrations during the cut. Oscillating the spindle speed over a period of time disrupts the harmonics that causes tool chatter. Enabling the Dither feature allows TMAC to control and oscillate the spindle speed.

The dither settings are as follows:

- **Mode**: Designates one of two dither modes; Step and Ramp.
- **Period**: The amount of time in seconds to oscillate the spindle speed between the highest and lowest variation and back to the normal spindle speed.
- **Delta**: The oscillation percentage above and below spindle speed. For example, if the spindle runs at 1000 rpm and the delta percentage is set to 10%, the spindle speed will oscillate between 1100 rpm and 900 rpm over the time period.

Note: TMAC does not need to be configured to monitor spindle speed to use the Dither feature.

Step Mode

When using Step Mode, the spindle speed is increased and decreased rapidly at certain time increments. When Dither Step mode is enabled and a start command is issued, the spindle speed immediately increases to the positive delta percentage for half of the programmed period. The spindle speed then drops to the negative delta percentage for the second half of the period. Refer to Figure 7-39 for a graphical representation of spindle speed in step mode.

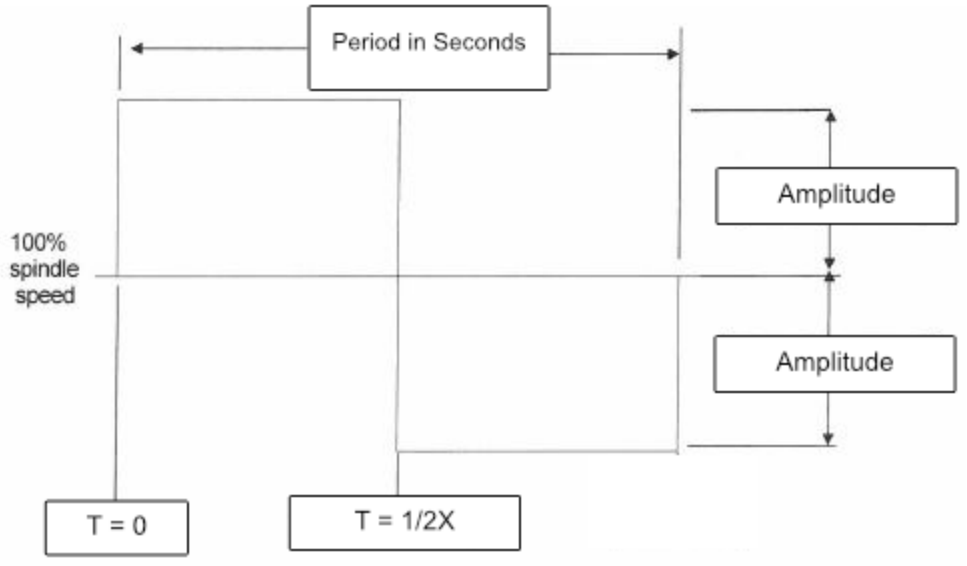

Figure 7-65: Dither Step Mode

Ramp Mode

When using Ramp Mode, the spindle starts at 100% speed and increases over time to the positive delta percentage programmed. It then decreases to the negative delta percentage, followed by an increase back to 100%. Refer to Figure 7-40 for a graphical representation of spindle speed in Ramp mode.

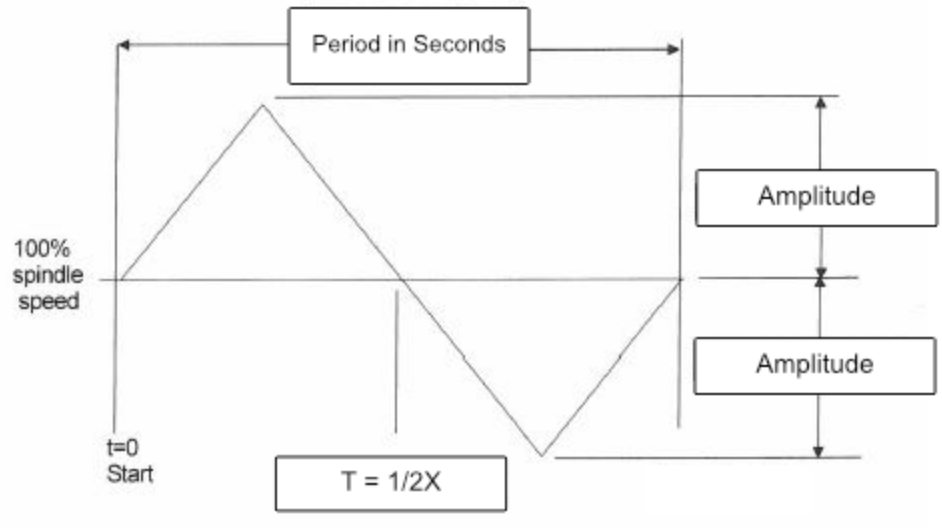

Figure 7-66: Dither Ramp Mode

Fixed Scale

TMAC utilizes a combination of learned values and programmed limits to automatically determine the scale for an operation. There may be instances where fixing the scale for an operation is more desirable. In those instances, it is helpful to set a fixed scale. Enabling Fixed Scale in the Job Editor unlocks the scale field found in the Learn parameters.

Setting a Fixed Scale

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Activate the **Fixed Scale** feature by clicking the check-box. The **Fixed Scale** check-box is located in the **Features** section of the Job Editor.
3. Click the **Scale** field in the **Learn Parameters** section of the Job Editor and enter the desired scale

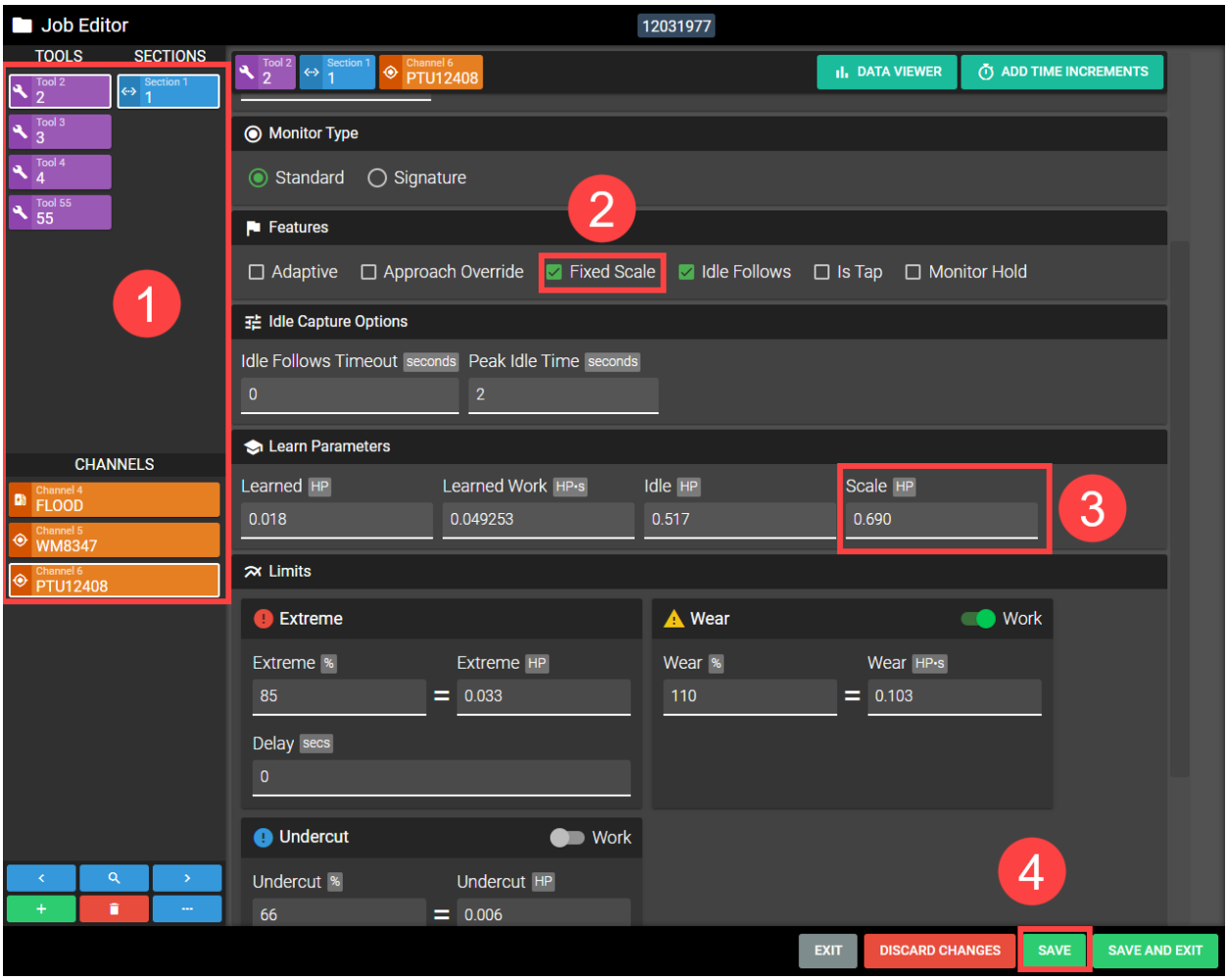

Figure 7-67: Fixed Scale

4. Click **SAVE**

Monitor Hold

The Monitor hold feature disables monitoring for a specific operation. This is useful for temporarily disabling monitoring when fine-tuning the monitoring limits for a operation. During Monitor Hold, the TMAC process continues to monitor all other operations where Monitor Hold is not specified. Data for the specified operation is still collected for purposes of review, but the signal is not tested against the programmed limits.

Enabling Monitor Hold

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Activate the **Monitor Hold** feature by clicking the check-box. The **Monitor Hold** check-box is located in the **Features** section of the Job Editor.
3. Click **SAVE**.

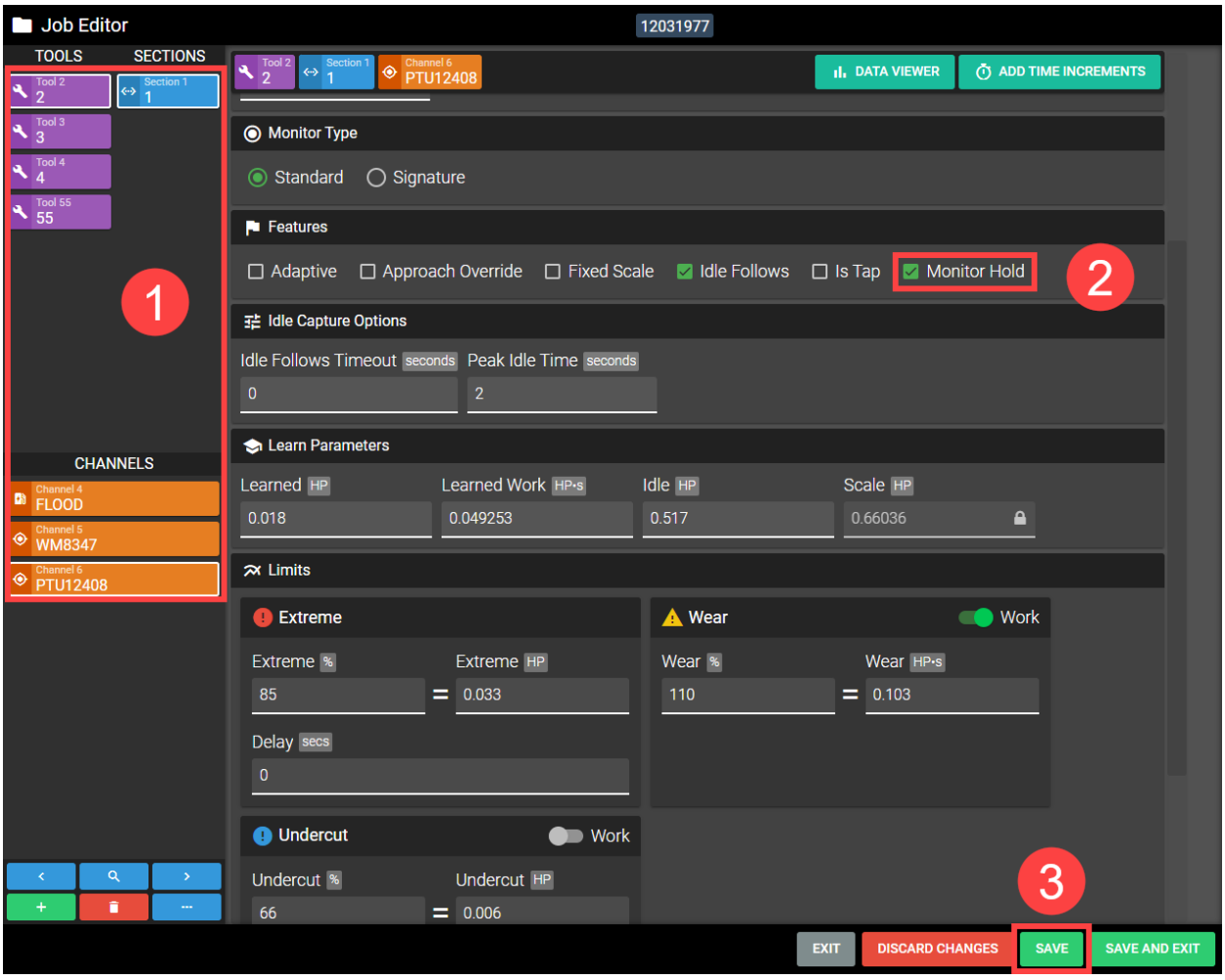

Figure 7-68: Monitor Hold

When the part program is executed, TMAC enters a disabled state for the duration of the operation. Once the operation is complete, TMAC returns to monitor mode.

Idle Follows

The Idle Follows feature re-captures the idle value any time the motor value decreases below the previously captured idle. This can prevent TMAC from storing an incorrect idle when a machine is first started. Idle Follows is commonly used on machines with large spindles that tend to use more power to get up to speed. Using Idle Follows allows TMAC to recapture the idle value after the spike in power, thus properly monitoring the tool. The Idle Follows Timeout disables the feature after the amount of time specified. For example, if the Idle Follows Timeout is 5 seconds, TMAC will no longer re-capture the idle five seconds after the start command.

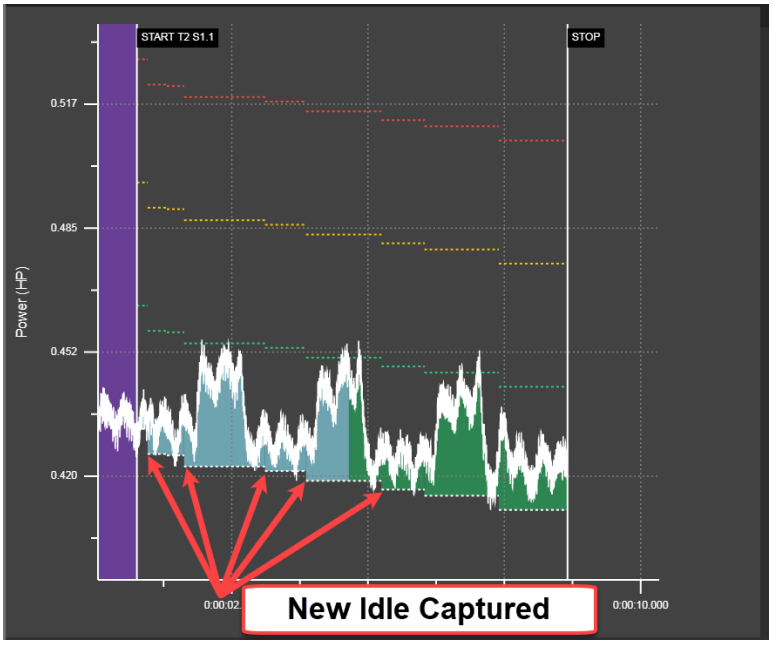

Figure 7-69: Idle Follows

Note: Be sure to re-learn any operation where idle follows is specified.

Specifying Idle Follows

In the Job Editor:

1. Specify the operation by selecting the channel, tool and Section from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Activate the **Idle Follows** feature by clicking the check-box. The **Idle Follows** check-box is located in the **Features** section of the Job Editor.
3. If desired, set an Idle Follows Timout
4. Click **SAVE**.

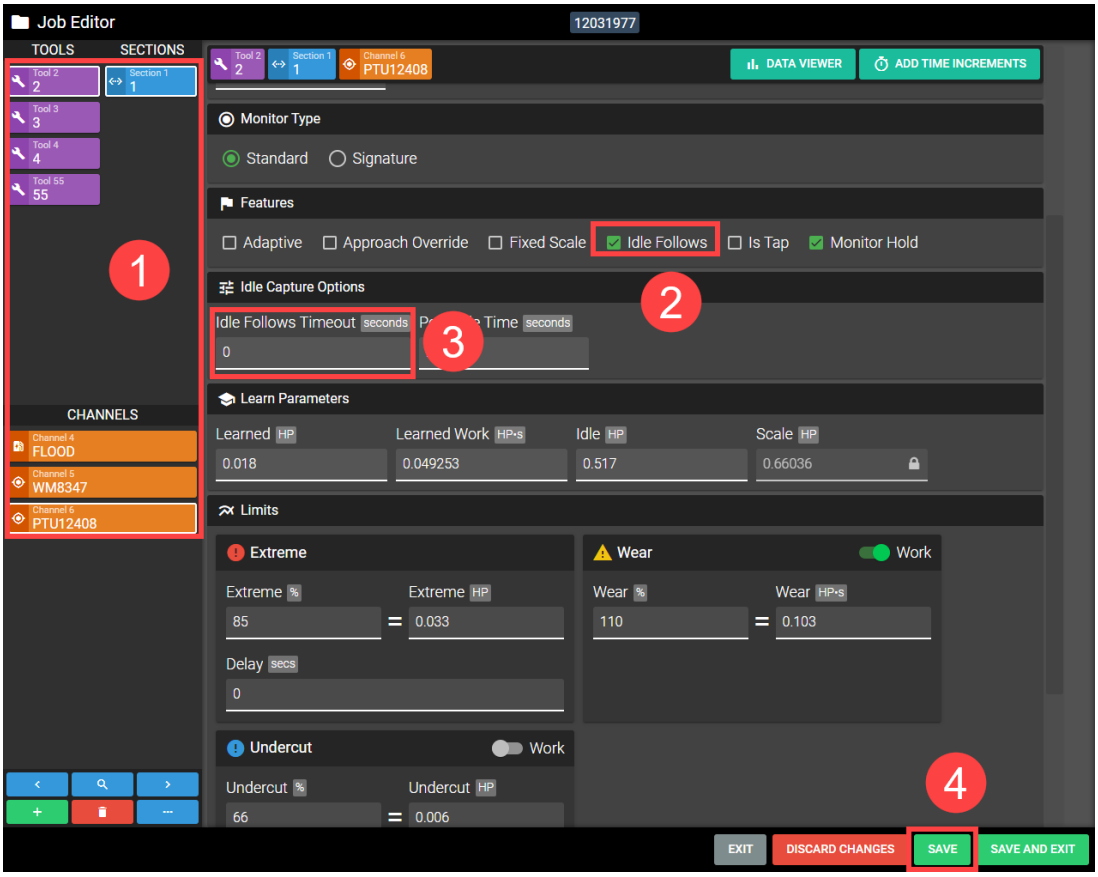

Figure 7-70: Idle Follows

Idle Reset

Idle Reset is a feature specific to time increments. If Idle Reset is specified for a time increment, TMAC automatically samples the monitored value at the instant the time increment begins. The system then uses that sampled value as the new idle value for all subsequent time increments unless Idle Reset is specified for a subsequent time increment. Refer to "Time Increments" Page 130 for information regarding adding time increments to a Job.

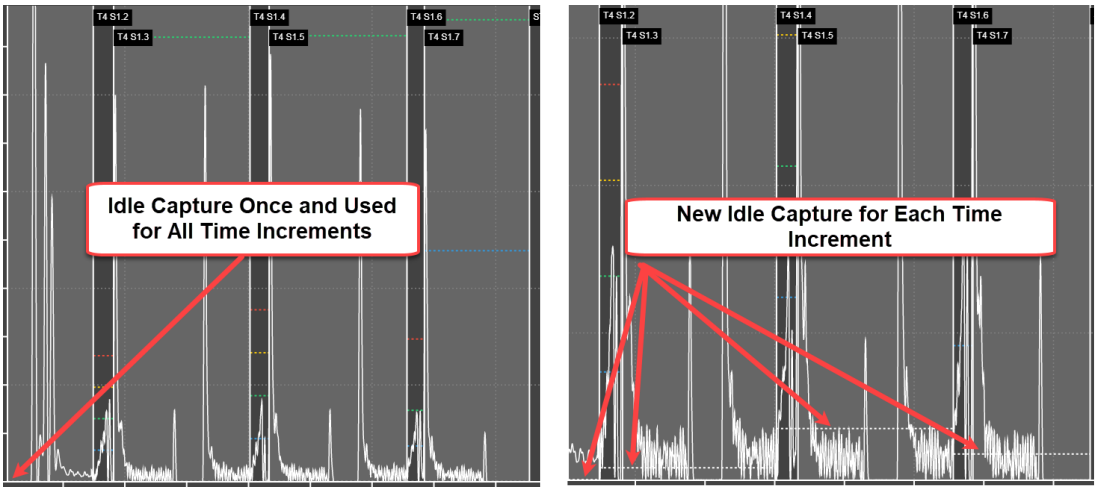

Figure 7-71: Operation w/o Idle Reset (left) vs Operation w/ Idel Reset (right)

Specifying Idle Reset

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Specify the time increment by selecting it from Time Increment Time-line. The selected time increment is displayed to the left of the time-line.
3. Activate the **Idle Reset** feature by clicking the check-box. The **Idle Reset** check-box is located in the **Features** section of the Job Editor.
4. Repeat steps 2 and 3 for any additional time increments, if necessary, then Click **SAVE**.

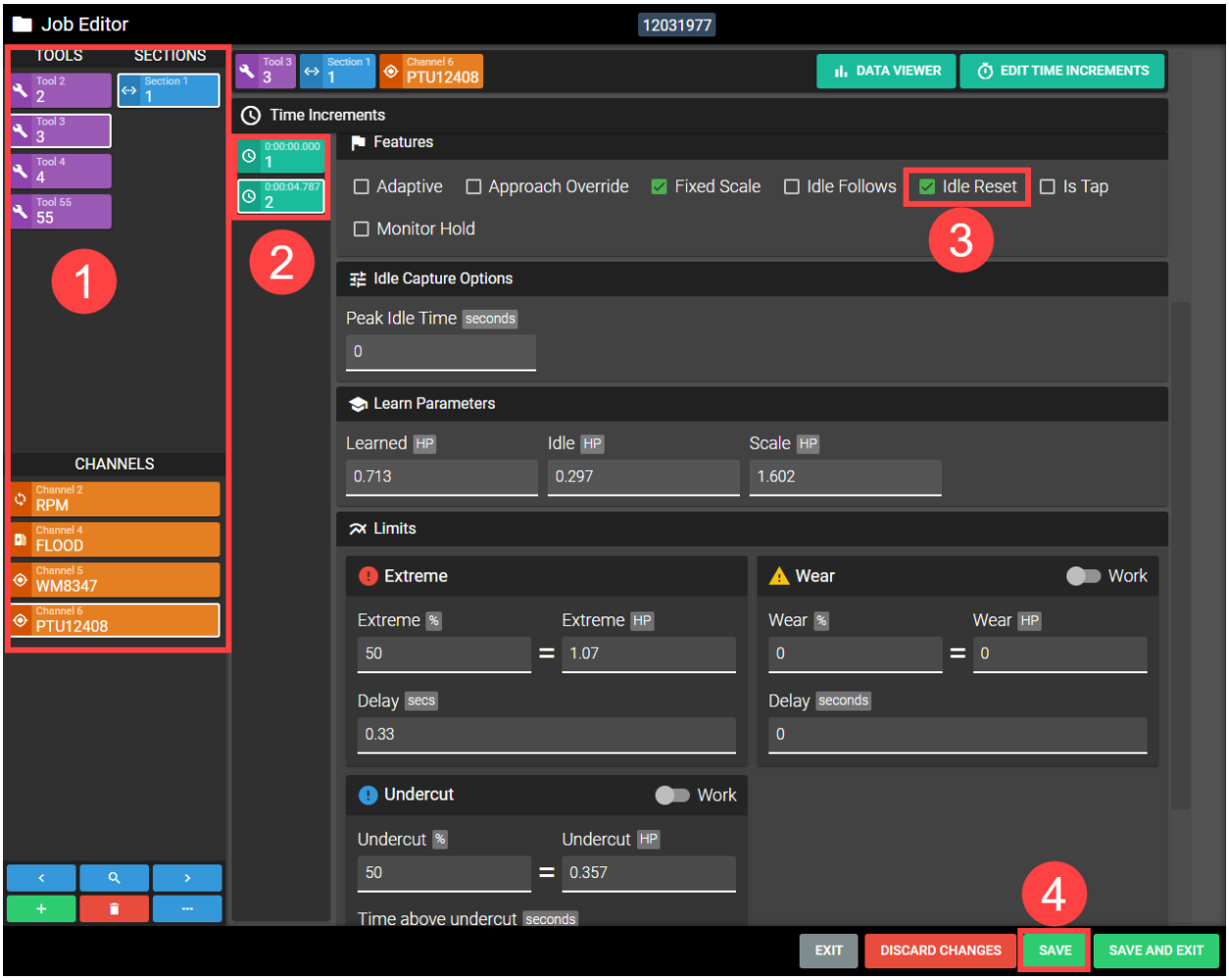

Figure 7-72: Idle Reset

Filters

TMAC can utilize filters to reduce unwanted signal noise. TMAC has the following options for filters:

- **Averaging Filter**: Centers the signal at zero and averages the total magnitude of the signal. Typically used with vibration monitoring.
- **Low Pass Filter**: Passes low-frequency signals but reduces the amplitude of signals with frequencies higher than the cutoff frequency
    - Filter Cuttoff Options: .075 Hz, 1.5 Hz, 3 Hz, 6 Hz, 12 Hz, 18 Hz, 24 Hz

Setting a Filter

In the Job Editor:

1. Specify the operation by selecting the channel, tool and Section from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the **Filter Options** section of the Job editor, select a filter mode from the drop down
    a. If selecting Averaging continue to step 3
    b. If selecting a low pass filter, select a cutoff frequency from the drop down menu
3. Click **SAVE**

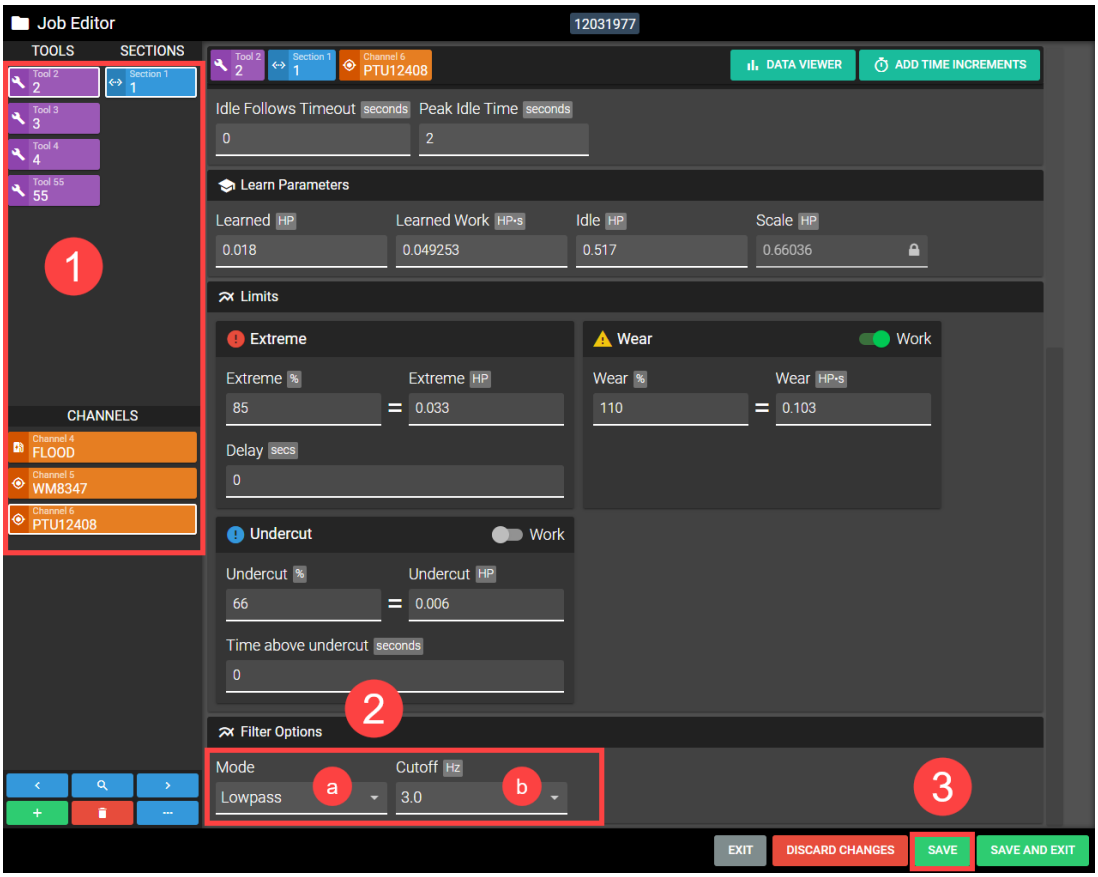

Figure 7-73: Filters

Start Delay

A Start Delay inhibits monitoring during a specified start delay period. There are many situations in which a start delay helps avoid an unnecessary alarm by delaying the capture of the idle value.

Note: All limits are inoperative while the start delay is in progress. No other delays begin until the start delay has timed out.

Setting a Start Delay

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Enter the desired delay in the **Start Delay** field. The Start Delay field is located in the **Timing** Section of the Job Editor.
3. Click **SAVE**

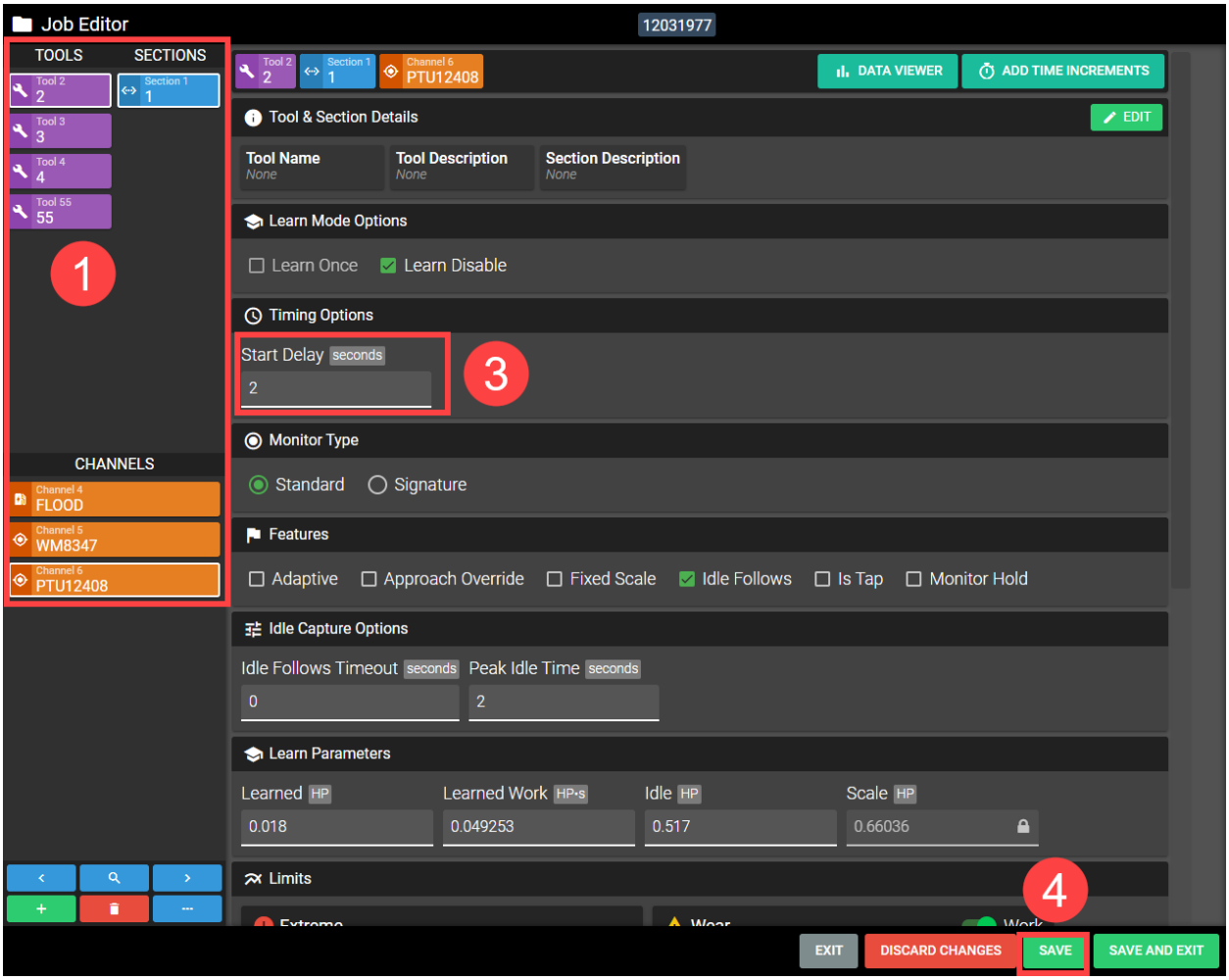

Figure 7-74: Start Delay

Is Tap

If the control is configured to support this feature, a tapping operation can be specified. This feature permits a special case extreme alarm called a "**tap alarm**" to be issued when the programmed extreme limit is reached for that operation. A tap alarm causes the machine to reverse the tap out of the part before the machine is put into an interrupt or alarm state. How the tap alarm behaves is determined by alarm settings located in the Instance parameters (See "Alarms Tab" Page 68). The settings are as follows:

- **Tap Extreme Delay**: Sets a delay between when the Tap Output turns off and when TMAC is put in extreme alarm that triggers a feed hold or interrupt.
- **Output Off Delay**: This setting determines how long the Tap Alarm Output stays on. This timer determines how long the machine has to finish reversing the tap out of the part before an alarm is triggered.
- **Adaptive On Follows tap**: This is an optional setting that turns on the adaptive output when the Tap output turns on. This parameter is for specific use cases.

Note: These settings are typically set by integrators and only available for specific machines.

Specifying Is Tap

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Click **Is Tap** check-box. The **Is Tap check-box** is located in the **Features** section of the Job Editor.
3. Click **SAVE**.

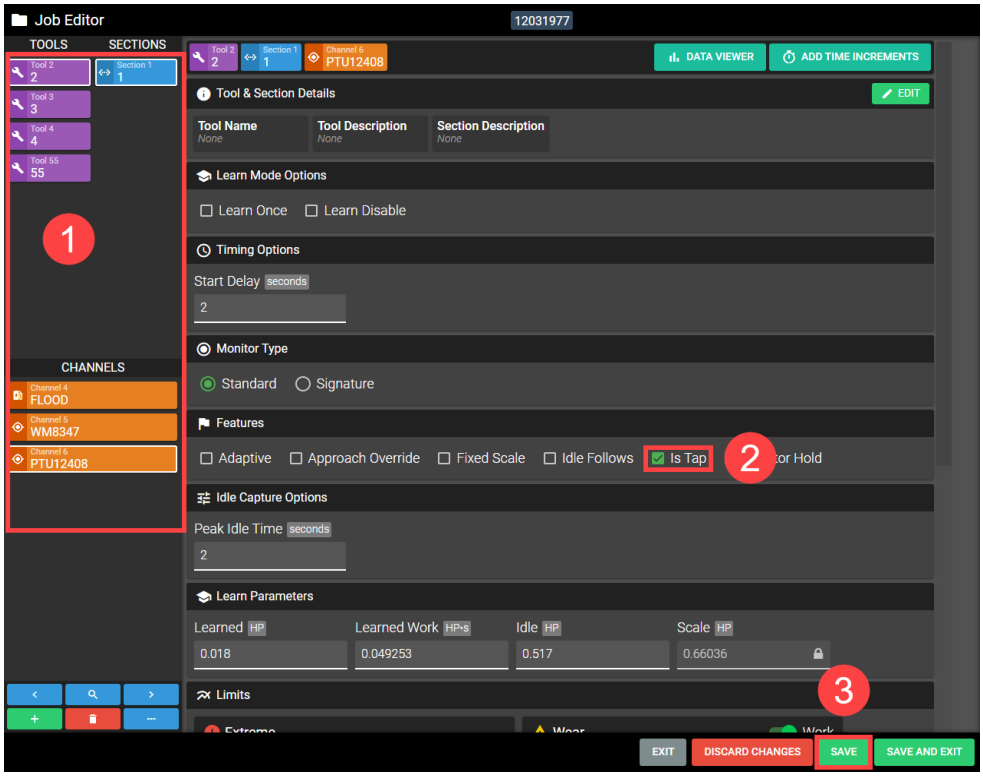

Figure 7-75: Specifying Is Tap

Peak Idle Time

When **TMAC** receives a start command, it measures the current sensor value and uses the captured value as the idle value for the operation. Some machining operations can cause the signal from the sensor to be noisy and this can cause TMAC to capture the idle value incorrectly. When peak idle time is disabled, the idle sample can be taken at any point on the signal noise imposed over the monitored signal. Therefore, the sampled idle value becomes dependent on when it is taken; with a total potential variance in the measured signal (idle) equal to the peak-to-peak value of the noise. The peak idle time feature allows **TMAC** to examine up to 5 seconds of signal data before the start command and select the idle based on the peak sensor value. Setting the peak idle parameter to zero disables the peak idle detect function. *It is important that the peak idle period not extend back into the acceleration ramp of the spindle motor.*

Peak idle time feature will not sample data from a previous cutting operation if starts and stops are closer to each other than the peak idle time. For example, if the peak idle time is set to 3 seconds for a cutting operation and the last cutting operation's stop monitor was 2 seconds before the current start monitor, TMAC will only use the 2 second monitoring gap to determine the peak idle.

Note: Peak Idle Time is available for primary channels that have the always streaming feature enabled.

Specifying Peak Idle Time

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Click the **Peak Idle Time** field and enter the amount of time prior to the start command TMAC should use to sample the idle value.
3. Click **SAVE**.

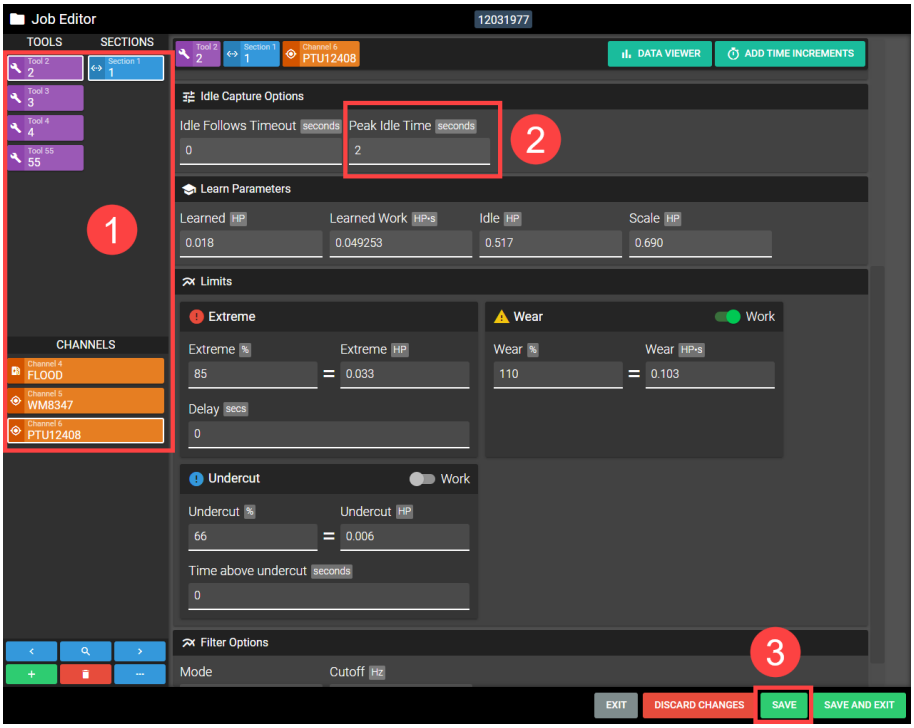

Figure 7-76: Specifying Peak Idle Time

Chapter 8: Learn Mode

Overview:

When a TMAC instance is set to Learn mode, TMAC continuously learns every operation. Each run of the part program in learn mode records new learned values for every operation. Use learn mode when establishing a new process or installing TMAC. To select Learn mode, use the Learn/Monitor toggle button in the TMAC action bar. The TMAC process remains in learn mode until returned to Monitor mode. The process of learning an operation allows TMAC to record the following data for each operation:

- Tool and Section numbers
- Peak Values
- Accumulated work
- Target values
- Target Value and Tooth Period for sawtooth operations

Note: When learning an operation, TMAC uses the Learn Scale set in the instance parameters. If the scale set in the instance parameters is not desired for a process, a Fixed Scale can be used. Refer to "Fixed Scale" Page 109 for fixed scale functionality.

See Also:

"Learn Once" Page 105

"Learn Disable " Page 106

Important Steps Before Learning an Operation

When the part programs have been modified to issue start and stop commands to TMAC, the user may begin learning operations.

Before learning an operation, ensure that:

- A new tool is being used.
- All feedrate and spindle overrides are set to 100%.
- The machining process is proven prior to learning the peak values for an operation

Creating Jobs Automatically Using Learn Mode

TMAC can create jobs and operations automatically using learn mode. Some find it more convenient to create jobs and operations in this manner. To automatically create a job and its associated operations, use the following steps:

1. Ensure TMAC is in Learn mode
2. Add calls for the job, channels, tools and sections in a proven part program
3. Run the part program

After the part program is complete, TMAC adds the job and its associated operations to the database. Limits and parameters for each operation can be specified using the Job Editor. This method can also be used to add new operations to an existing job.

New Tooling

The use of new tooling while in the learn state ensures that further comparisons between learned and tool wear are accurate, allowing optimum performance from both TMAC and the tooling. TMAC bases its limits on a programmed percentage above or below these learned values. If a partially worn tool is learned, the learned value and limit values will be greater than desired.

Chapter 9: Feedrate Override

Overview:

TMAC is capable of controlling the feedrate override of a control. This capability is utilized with the following features:

- Adaptive Control
- Approach Override

Adaptive Control and Approach Override can be utilized separately or together. The manner with which TMAC controls the feedrate override for an operation is dependent on the parameters set in the Adaptive and Approach settings. The feedrate override value is displayed on the right side of the live graph during Adaptive Control and Approach Override operations.

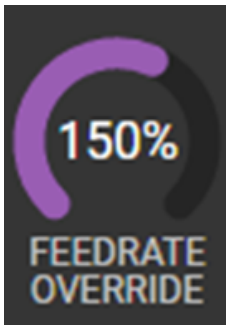

Figure 9-1: Feedrate Override Gauge

Note: The color filling the Feedrate Override Gauge will match the active feedrate override feature; purple for Adaptive Control and blue for Approach Override

See Also:

"Adaptive Control" Page 121

"Approach Override" Page 128

Adaptive Control

The Adaptive Control feature allows **TMAC** to regulate feedrate override while maintaining a constant target value during an operation.

Adaptive Control allows the user to:

- Reduce cycle time by automatically increasing feedrates in soft areas or voids.
- Extend tool life by automatically reducing feedrates in unpredictable hard spots.
- Maintain an ideal target value even if feedrates are programmed incorrectly.
- Optimize part programs by determining the best feedrates for standard operations

Note: See the *TMAC System Integrator's Manual* for instructions on setting system parameters to enable Adaptive Control.

See Also:

"Adaptive Tuning" Page 126

"Specifying an Operation as Adaptive" Page 122

How Adaptive Control Works

The main principle of adaptive control is maintaining a target value. Adaptive control optimizes operations by adjusting the feedrate in response to machining conditions. **TMAC** can provide feedrate override control from 0 to 255% in 1% increments.

For example:

- In free air or a soft spot, when the signal value is less than the target value, **TMAC** increases the feedrate within specified parameters until the target value is reached.
- In a hard spot when the signal value exceeds the target value, **TMAC** decreases the feedrate within specified parameters to achieve the target value.

Note: Not every control is capable of employing the 0 to 255% feedrate override range. TMAC can only increase the feedrate up to the maximum feedrate of the control.

Job Editor for Adaptive Operations

When enabling adaptive control for an operation, the following changes occur in the Job Editor:

- The following adaptive parameters become accessible:
  - Max Feedrate
  - Sawtooth Cut
  - Adaptive Tuning
- Learned Value is replaced by Target Value
- The Wear Limit is replaced and the Feedrate Wear Limit is added
- The Extreme Feedrate Limit is added

Note: Adaptive control is only available for the *last* time increment in an operation.

Specifying an Operation as Adaptive

Adaptive control can be applied to any primary channel operation using the Job Editor.

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Enable adaptive by clicking its check-box. The adaptive check-box is located in the features section of the Job Editor.
3. Click **SAVE**

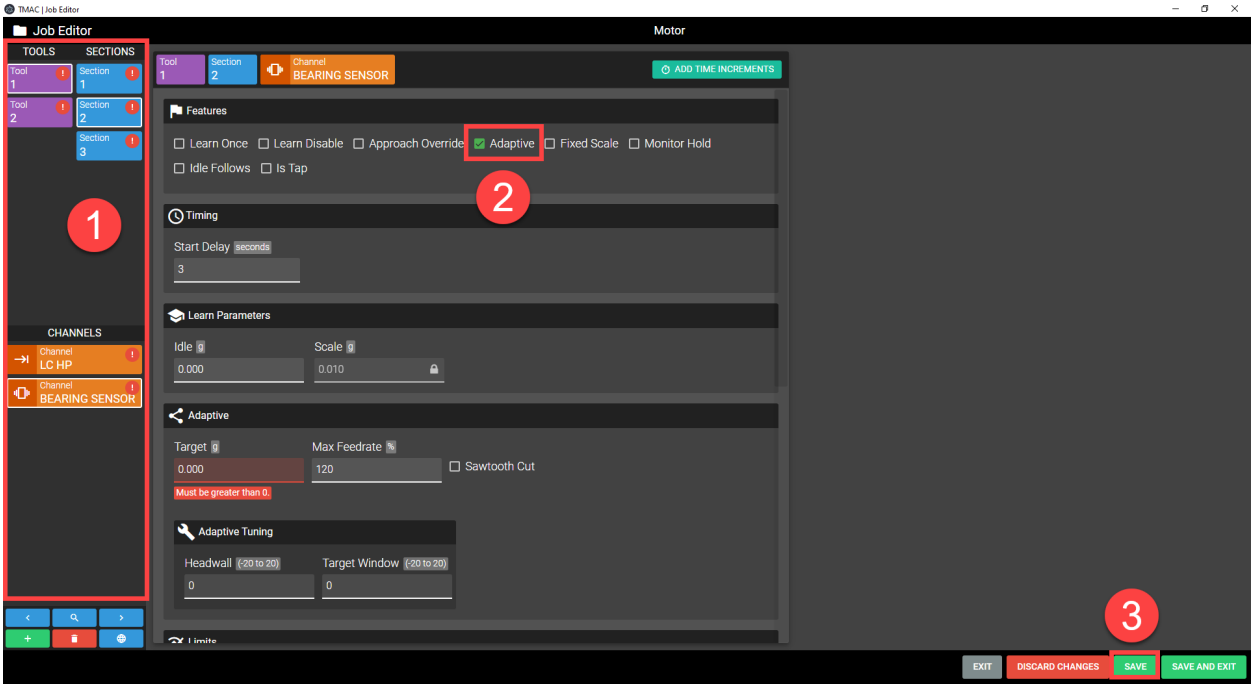

Figure 9-2: Enabling Adaptive

Max Feedrate

The Max Feedrate is the highest feedrate value that TMAC will outputs to the machine for the specified operation. When using Max Feedrate, prove out the adaptive control process using a conservative value. Increase the value incrementally as the operation of the machine is observed and use good judgment to arrive at a safe and reasonable Max Feedrate.

Note: TMAC manages the feedrate override control when learning an adaptive operation. The feedrate is held at 100% with standard feeds and speeds in the program.

To specify a Maximum Feedrate use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Ensure adaptive control is specified for the enabled operation
3. Specify a Maximum Feedrate. Max Feedrate is located in the adaptive section of the Job editor.
4. Click Save.

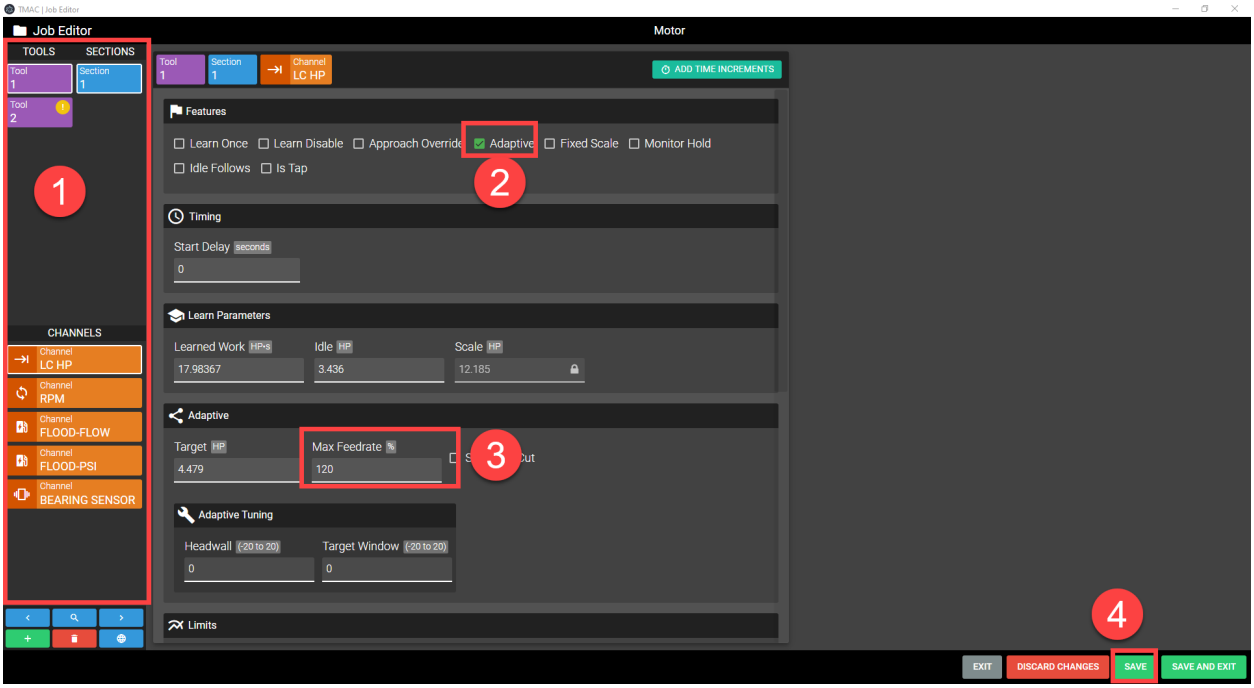

Figure 9-3: Setting Max Feedrate

Adaptive Sawtooth

Adaptive control can be applied to sawtooth cuts. A sawtooth cut uses inserts, resulting in a periodic signal. When learning an adaptive cut, TMAC can discern whether a cut has a sawtooth signature or not. If TMAC determines that the learned cut has a sawtooth signature, the learned tooth period and sawtooth target load are automatically populated in the job.

Note: In order for TMAC to recognize an operation as a sawtooth operation, the signal needs to be at least one-tenth of the scale. Caron Engineering recommends adjusting the scale so that the cut signal is one-half of the scale.

When working with a job containing a sawtooth cut, the learned value determines extreme and undercut limits. The sawtooth target value is the average value of the sawtooth signal used by adaptive control.

Note: The learned value should always be higher than the sawtooth target power with a sawtooth operation.

Using the sawtooth feature will prevent the feedrate from changing rapidly. The difference between using adaptive sawtooth and not using adaptive sawtooth for an operation can be seen in Figures 9-3 and 9-4.

Figure 9-4: Adaptive Cut With Sawtooth Enabled

Figure 9-5: Adaptive Cut Without Sawtooth Enabled

In the Figure 9-3, notice that the feedrate is smooth and well maintained throughout the whole cut. In Figure 9-4, the feedrate tries to adjust with the rapidly changing power, causing it to oscillate wildly.

Specifying Sawtooth for an Operation

To set an operation as a sawtooth operation use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Ensure Adaptive control is enabled for the operation
3. Enable Sawtooth by clicking its check-box. The Sawtooth check-box is located in the adaptive settings of the Job editor.
4. If TMAC has learned the operation and recognized it as a sawtooth cut, the Sawtooth Target and Period fields should be populated automatically. Make adjustments to these fields, if necessary.
5. Click Save.

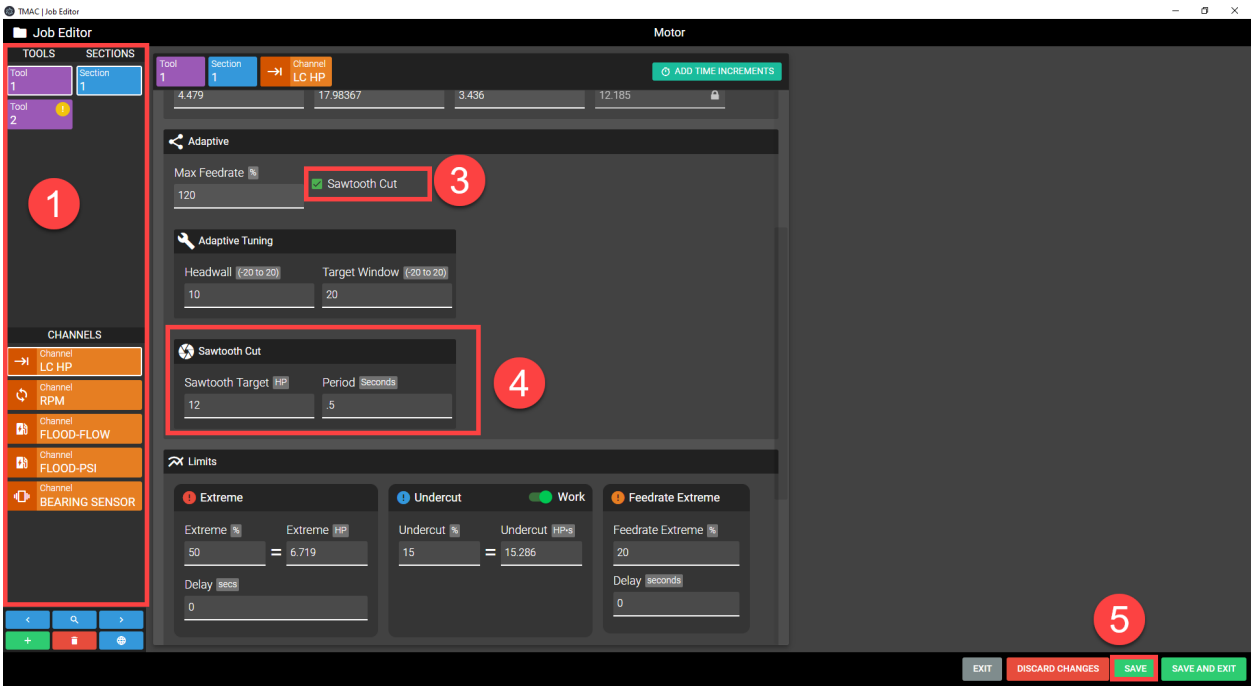

Figure 9-6: Sawtooth Steps

Adaptive Tuning

Once an adaptive cut is learned and completed, small adjustments can be made to fine tune the regulation of feedrate override. These adjustments can affect the magnitude of feedrate adjustments and how much the feedrate can vary from the target value.

Adaptive Headwall

Adaptive Headwall response is used to determine how quickly adaptive control alters the feedrate after a tool makes contact with a part. Adaptive control normally increases the feedrate in free space during a cut. Depending on certain factors, the feedrate may need to be adjusted faster or slower than normal after contacting a part. For example, if the material is very hard, contacting the part at high speed could cause damage to the part, cutting tool or machine. In this case, adjusting the headwall response causes the feedrate to respond much quicker so that the machine can slow down after contacting the part.

To set adaptive headwall use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Ensure Adaptive Control is enabled for the operation
3. Click the Adaptive Tuning Headwall field
    a. Enter a value in the range of -20 to +20. Increasing the headwall setting causes the feedrate to adjust more quickly when contacting the material
4. Click Save.

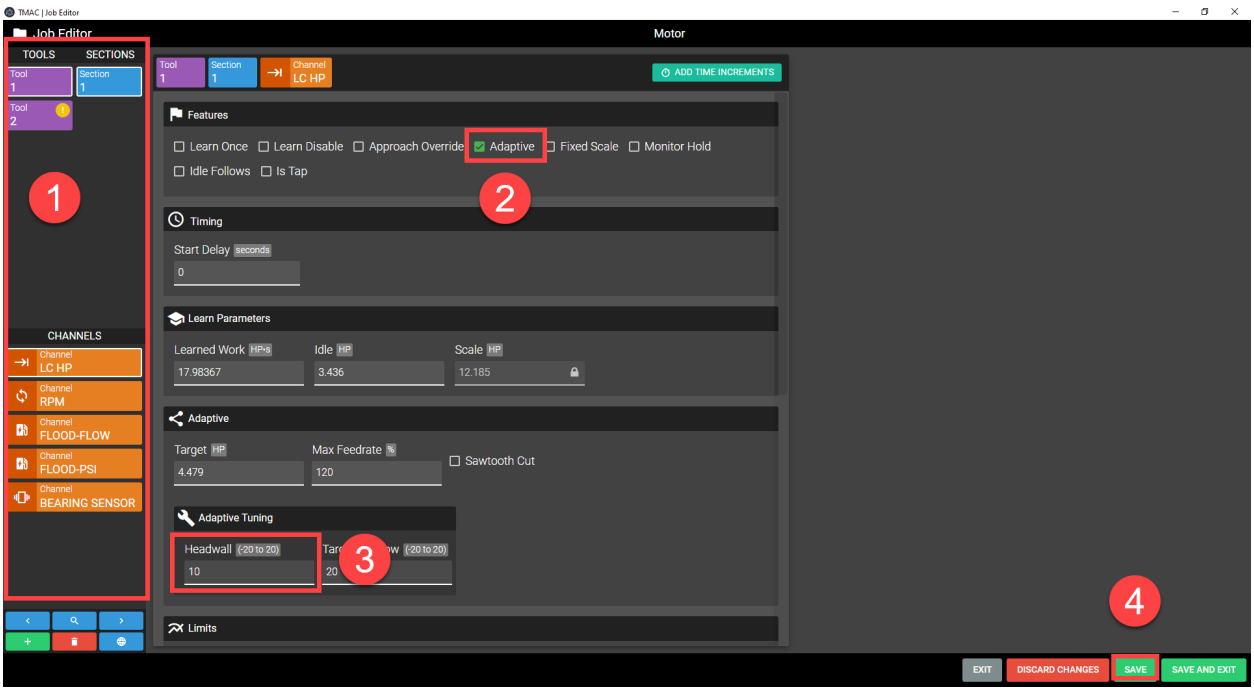

Figure 9-7: Learn Once

Arriving at an ideal setting for a cut may take trial and error, so make small adjustments first and observe how the cut is affected.

Adaptive Target Window

The adaptive target window defines an area around the target value that the signal value is allowed to deviate from before TMAC makes an adjustment to the feedrate. Minimizing the target window allows less deviation from the target whereas maximizing the window allows the signal value to have more freedom from the target value.

To set the Target Window use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Ensure Adaptive Control is enabled for the operation
3. Click the Target Window field
    a. Enter a value in the range of -20 to +20.
4. Click Save.

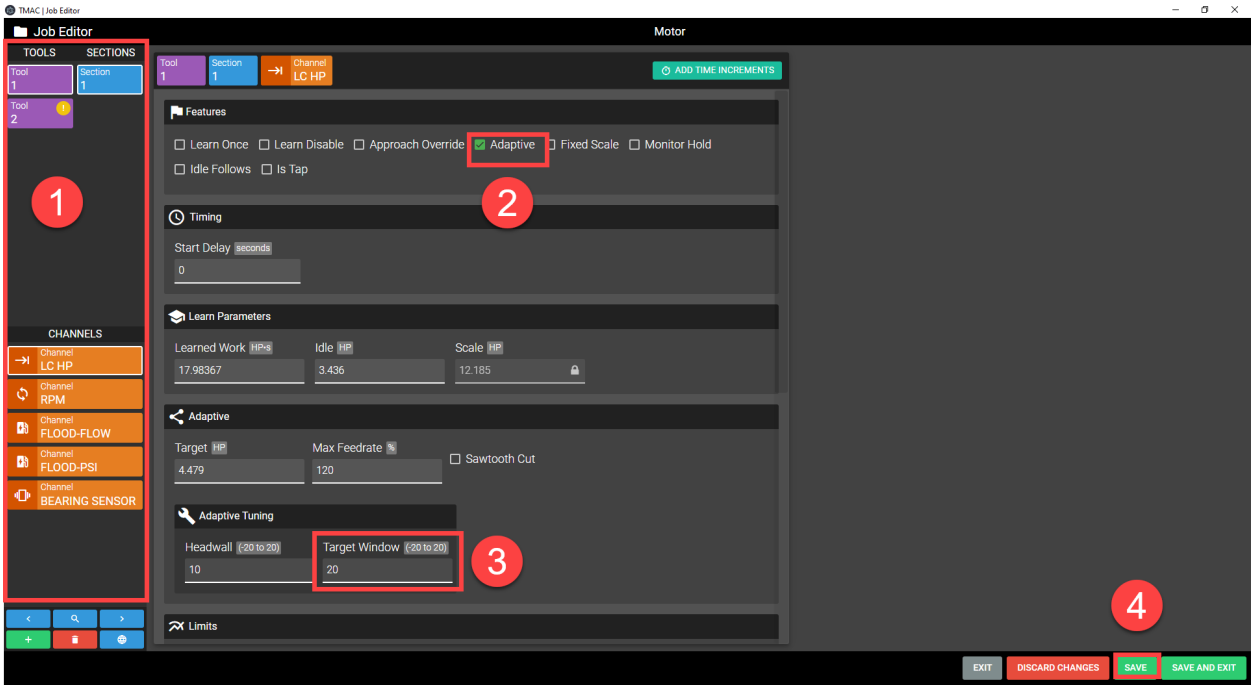

Figure 9-8: Adaptive Target Window

Arriving at an ideal setting for a cut may take trial and error. Make small adjustments to observe how the cut is affected by the changes until a desired result is achieved.

Approach Override

The Approach Override feature allows TMAC to control the Feedrate Override of a control as the tool approaches and exits the material. When Approach Override is enabled, the approach override settings become available in the Job Editor. These settings are as follows:

- Approach Feedrate
- Approach Off
- Approach On
- Approach On Delay

The approach feedrate is a percentage that TMAC uses to override the feedrate set in the part program. TMAC turns the approach feedrate percentage on and off based on the values set in the Approach On and Approach Off fields. When the signal value rises above the Approach Off value, TMAC sets the feedrate override of the control back to the default. When the signal value falls below the Approach On value for the amount of time specified by the Approach On Delay, TMAC sets the feedrate override of the control to the Approach Feedrate percentage.

Figure 9-9: Approach Override

Enabling Approach Override

Use the following steps to utilize the Approach Override Feature:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Activate the Approach Override feature by clicking its check-box. The Approach Override check-box is located in the Features section of the Job Editor. This adds the Approach Override settings to the Job Editor.

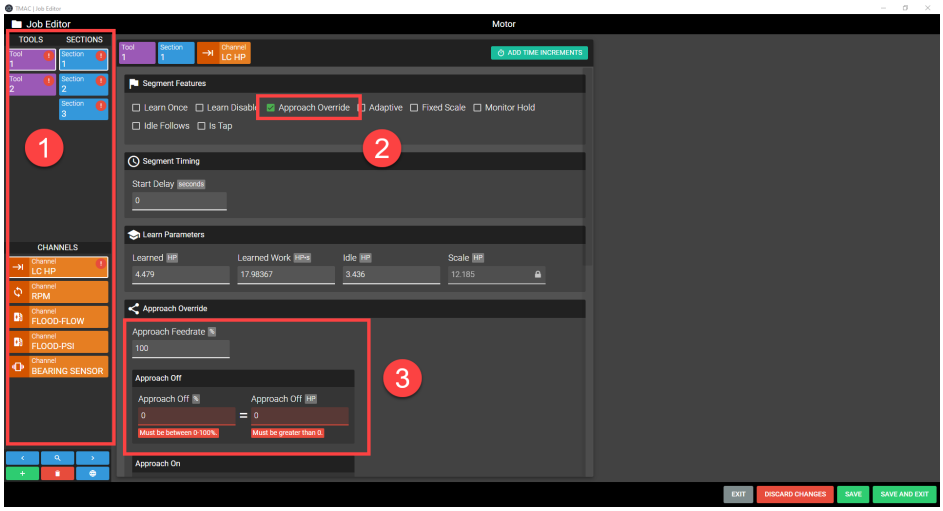

Figure 9-10: Approach Override Steps 1-3

3. Set the Approach Feedrate, Approach Off and Approach On settings. The Approach Off and Approach On must be set between 0 and 100% of the adaptive target value.
4. If desired, set an Approach On Delay
5. Click Save

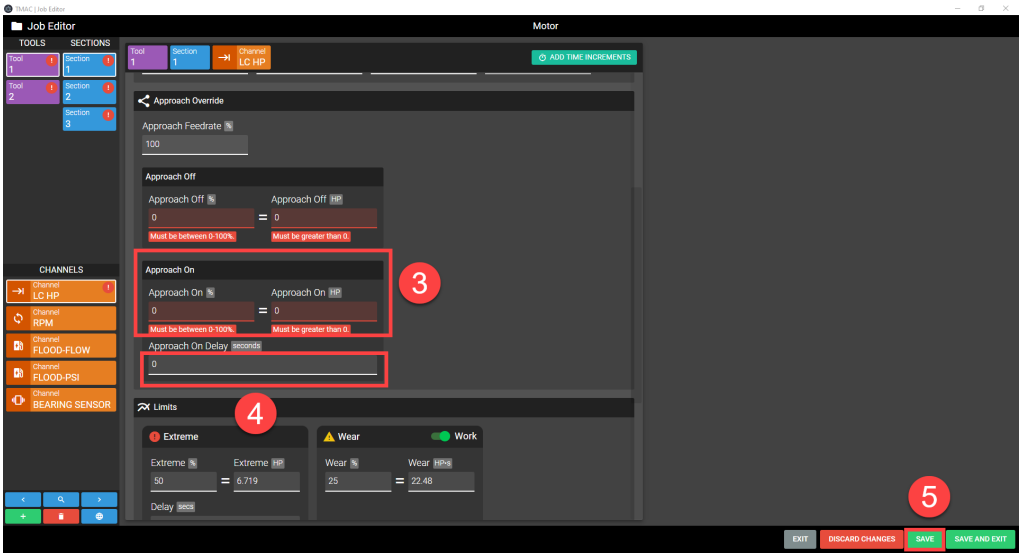

Figure 9-11: Approach Override Steps 3-5

Note: Ensure the approach feedrate is being set at an appropriate level for the machine, part, and tool.

Chapter 10: Time Increments

Overview: What is a Time Increment?

The Time Increments feature is useful when monitoring complex operations initiated by a single line in a part program (e.g, canned cycles, step drilling, and multiple hole drilling). During such operations, the CNC may not be able to communicate start and stop monitoring commands to the TMAC. Time increments allow different limits to be applied during different segments of complex operations. Time increments have the following properties:

- The idle value from the first time increment is used as the default idle value for all increments in the sequence. The Idle Reset feature overrides this property. See "Idle Reset" Page 112 for more information.
- The same channel must be monitored for all time increments in a operation.
- Time increments are of a specified duration (excluding the last time increment in a sequence). The duration is determined by the start time of the subsequent time increment.
- Adaptive Control can only be applied to the last time increment in a sequence.
- Start delays are not used with time increments, although the first increment in a sequence may have a start delay.
- For any sequence of increments, the tool, section, and channel numbers are always identical.
- Each time increment starts at a specified point in time during the operation. No two start times can be the same.
- The first time increment always starts at 0 seconds of the operation
- Time increments are only available for primary channel operations

Time increments represent subsections of a continuous operation, with limits and parameters specified for each.

Note: Time increments are not available in Millivolt operations.

Time Increment Editor

TMAC provides an intuitive Time Increment Editor for the creation of time increments. The Time Increment Editor is launched from the Job Editor and utilizes recordings of operations to aid in the creation of time increments. When the time increment editor is opened, the most recent recording is automatically loaded.

Launching the Time Increment Editor

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Click the Add Time Increments button

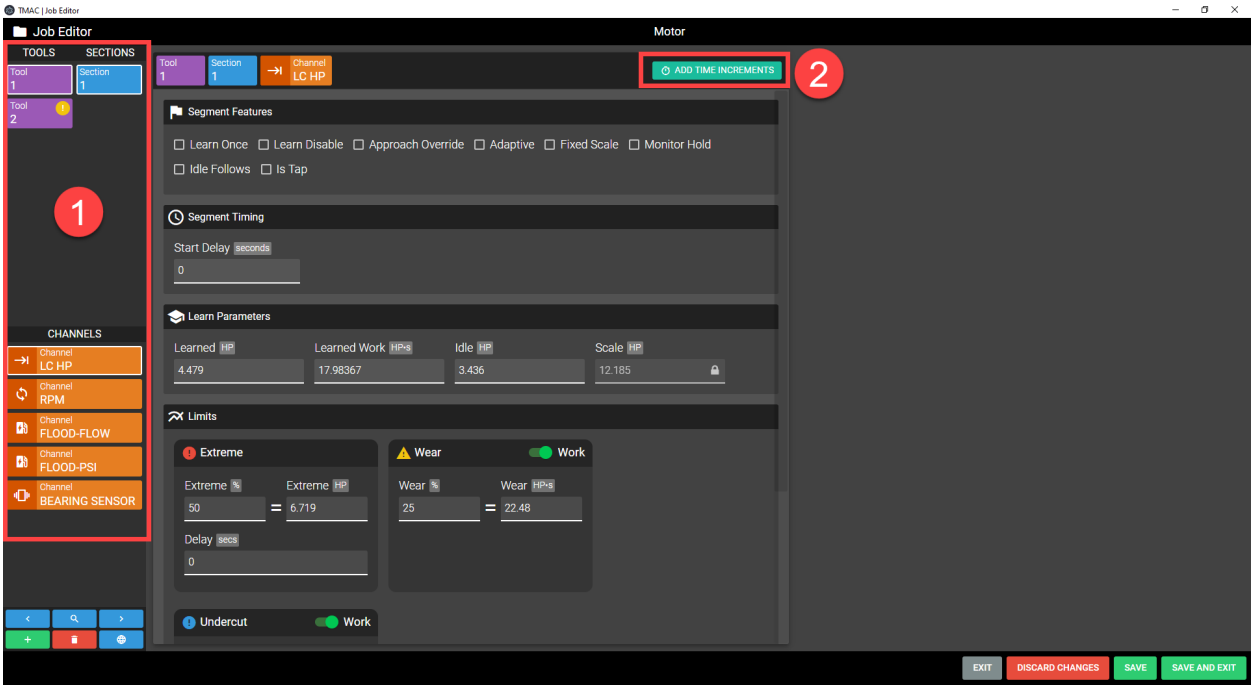

Figure 10-1: Launch the Time Increment Editor

3. Select a recording from the list
4. Click Open Recording

Using the Time Increment Editor

The Time Increment Editor is broken into two major sections: A tool bar and the Recording Viewer. The tool bar provides various data about the operation and time increments added. It also provides several tools that can manipulate the Recording Viewer to aid in creation of time increments.

Recording Viewer

The Recording Viewer portion of the Time Increment Editor offers a graphical representation of the selected operation. The recording of the operation can be manipulated with a set of buttons available at the bottom of the Recording Viewer. Refer to Table 10-1 for descriptions of the functionality of these buttons.

Recording Viewer Button Functions	
Button	**Description**
	Returns the recording to the default position
	Shifts the recording snapshot 3 seconds to the left
	Shifts the recording snapshot 3 seconds to the right
	Zooms out of the recording
	Zooms into the recording
	Functions the same as the Pan tool in the Editor Toolbar
	Functions the same as the Pan tool in the Editor Toolbar

Table 10-1: Recording Viewer Button Functions

Time Increment Editor Tool Bar

The Time Increment Editor Tool Bar has the following tabs:

- Recording
- Time Increments
- Details
- Events
- Tools

Recording Tab

The Recording tab displays specific information about the selected recording. The following information is displayed:

- Job, Instance, Channel and Machine Names
- Channel, Tool and Section Numbers
- Part and Serial IDs
- Duration
- Date and Time stamp

In addition to the recording data, a new recording can be opened using the following steps:

1. Click the Open Recording button
2. Select a new recording from the list. If a large number of recordings populate the list, a filter can be applied to limit the recordings to Learn operations or Monitor operations.
3. Click Open

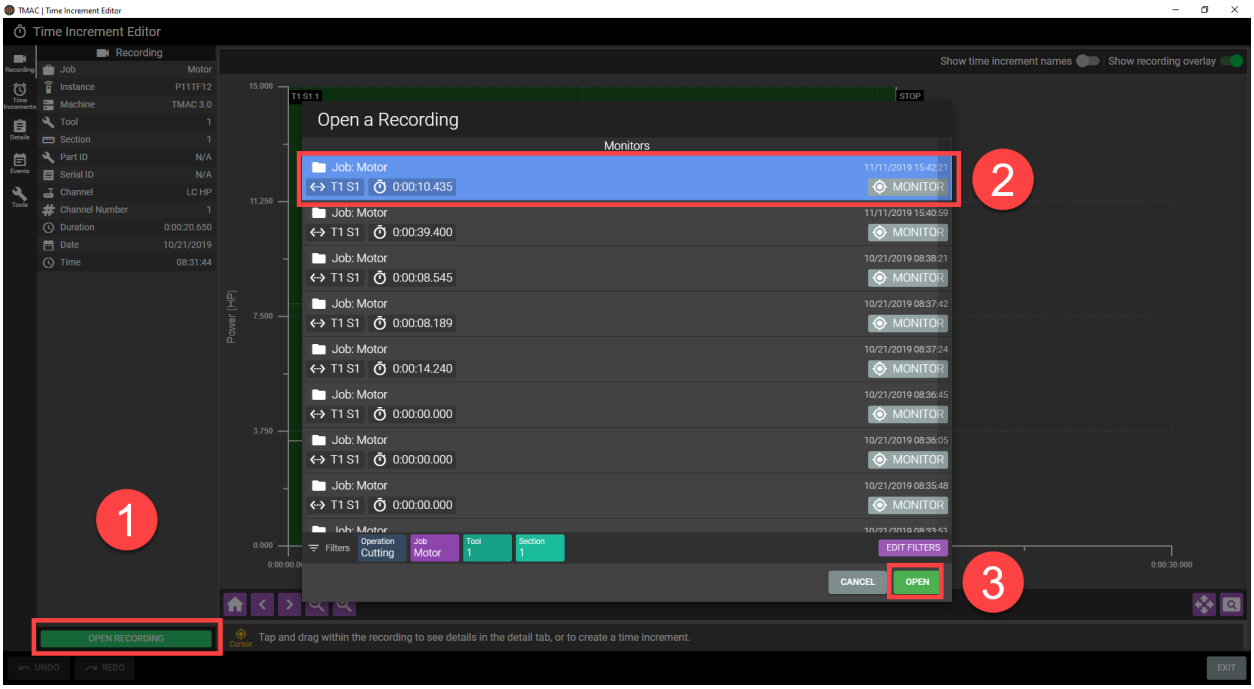

Figure 10-2: Opening a Recording-Time Increment Editor

Time Increments Tab

The Time Increments tab displays a list of all time increments that have been added to the operation. Each time increment in the list can be selected. When a time increment is selected from the list, the selected increment is highlighted on the Recording Viewer. In addition, the following buttons become available:

- **Edit**: Allows the selected increment to be named
- **Adjust**: Allows the placement of the selected increment to be adjusted
- **Delete**: Deletes the selected increment

Each time increment in the list is labeled in the following format:

T<tool number> S<section number>.<time increment number>

Additionally, the name (if applicable) and start time of each increment is displayed. See Figure 10-3

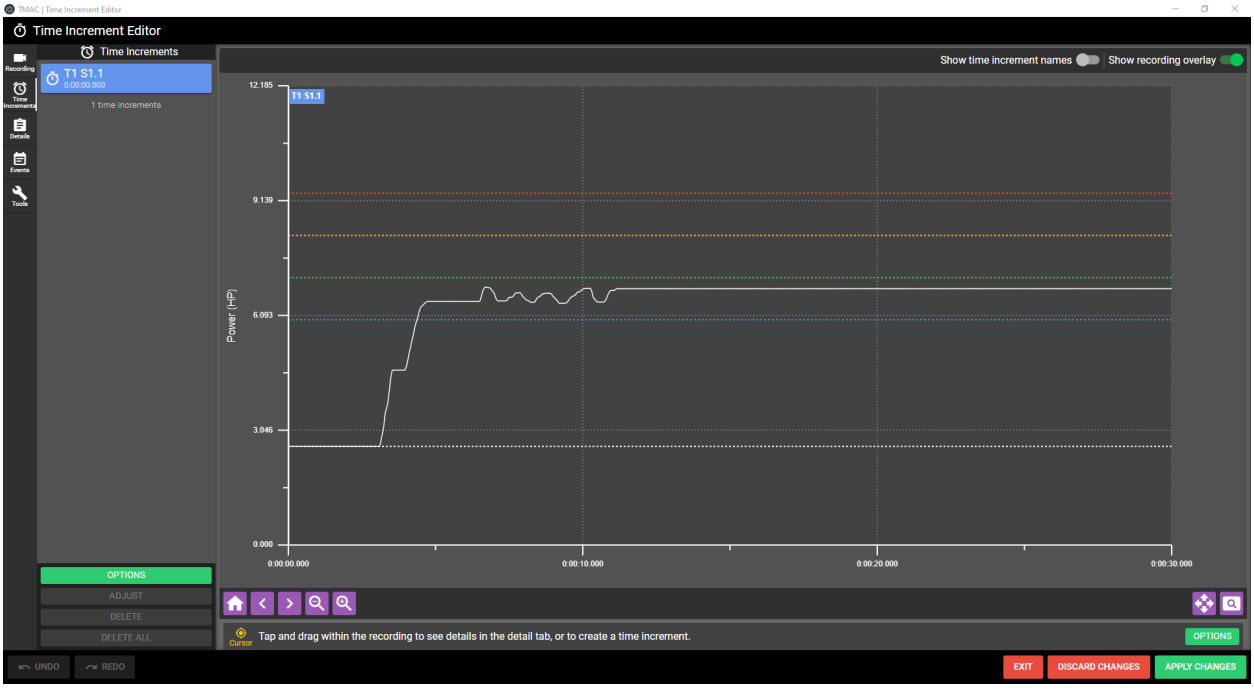

Figure 10-3: Time Increments Tab

Naming a Time increment

To name a time increment, use the following steps:

1. Select the Time Increments tab on the Time Increment Editor Toolbar
2. Select the time increment from the list

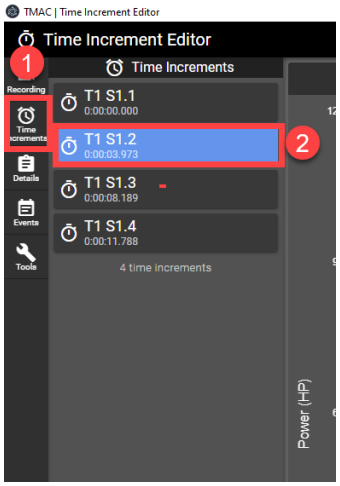

Figure 10-4: Naming a Time Increment Steps 1-2

3. Click the **EDIT** button
4. Enter the desired name
5. Click **Apply**

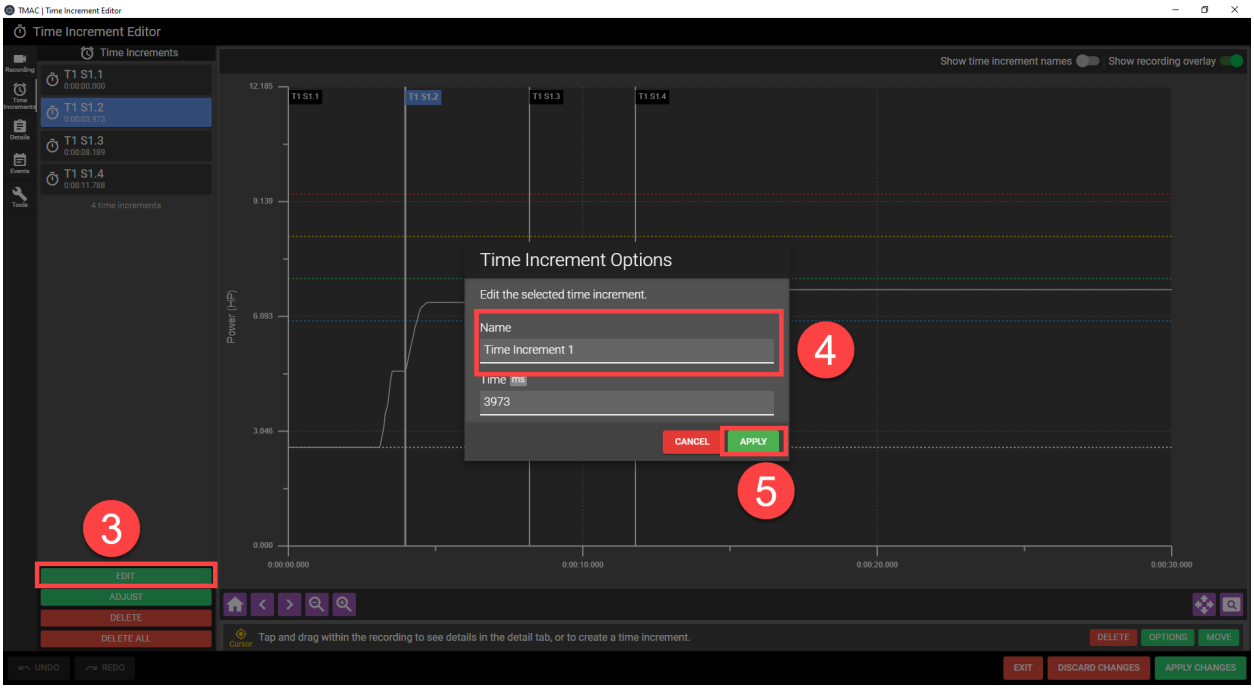

Figure 10-5: Naming a Time Increment Steps 3-5

Adjusting a Time Increment

To adjust placement of a previously created time increment use the following steps:

1. Select the Time Increments tab on the Time Increment Editor Toolbar
2. Select the time increment from the list
3. Click the Adjust button
   On the viewer portion of the Time increment Editor, a button appears on the designated time increment
4. Click and drag the time increment to a new location on the recording
5. Click Apply

Figure 10-6: Adjusting a Time Increment

Note: The time increment can only be adjusted between the previous and subsequent increments. If the increment needs to be adjusted beyond those bounds, then the other increments will need to be adjusted first.

Deleting a Time Increment

To delete a time increment use the following steps:

1. Select the Time Increments tab on the Time Increment Editor Toolbar
2. Select the time increment from the list
3. Click the **DELETE** button

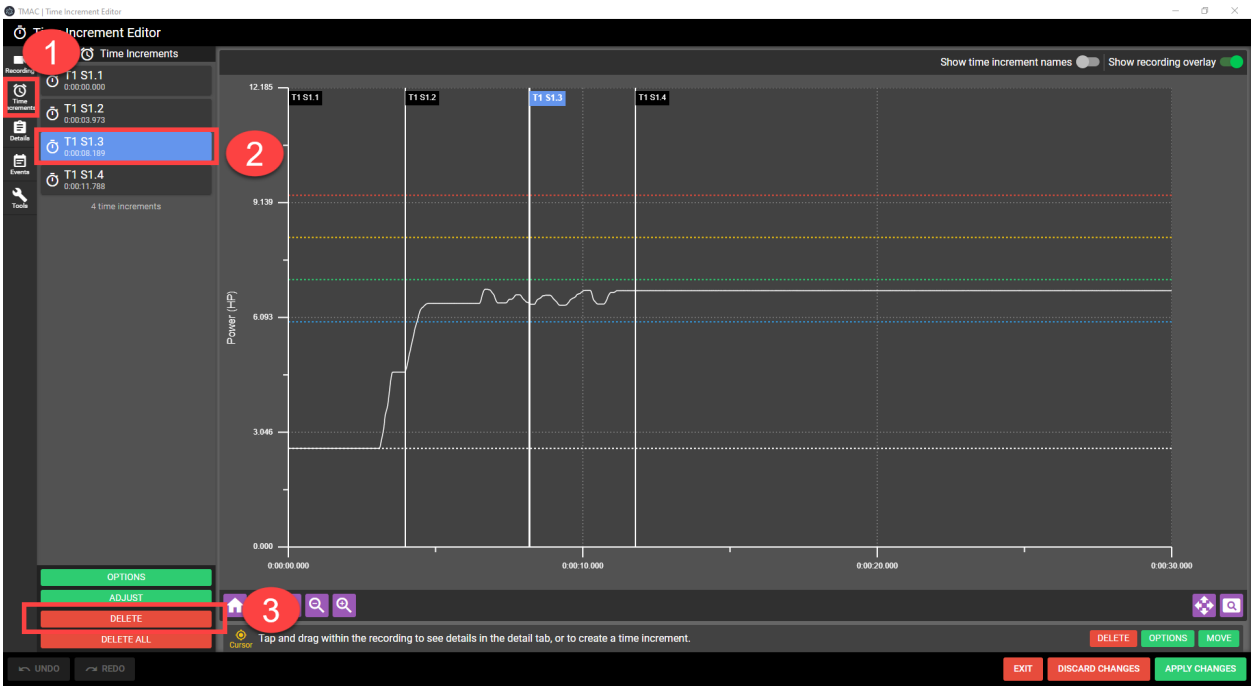

Figure 10-7: Deleting a Time Increment

Details Tab

The Details tab provides additional data about the recording and any selected time increment. Additionally, a cursor can be placed by clicking on the recording. Placing the cursor displays additional data including but not limited to channel data, limits and cut time at the cursor location.

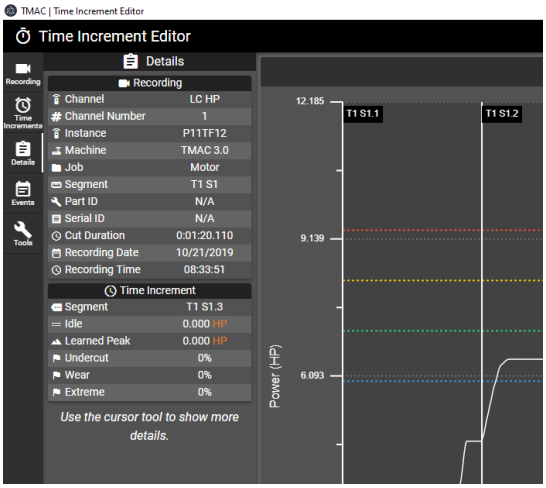

Figure 10-8: Details Tab

Events Tab

The Events tab displays a list of events including, start monitors, stop monitors, alarms, and custom events. The time at which these events occurred during the operation is displayed below the event name. Additionally when an event is selected from the list, the Recording Viewer snaps to the location of the selected event. This feature makes it easier to locate specific data in long recordings.

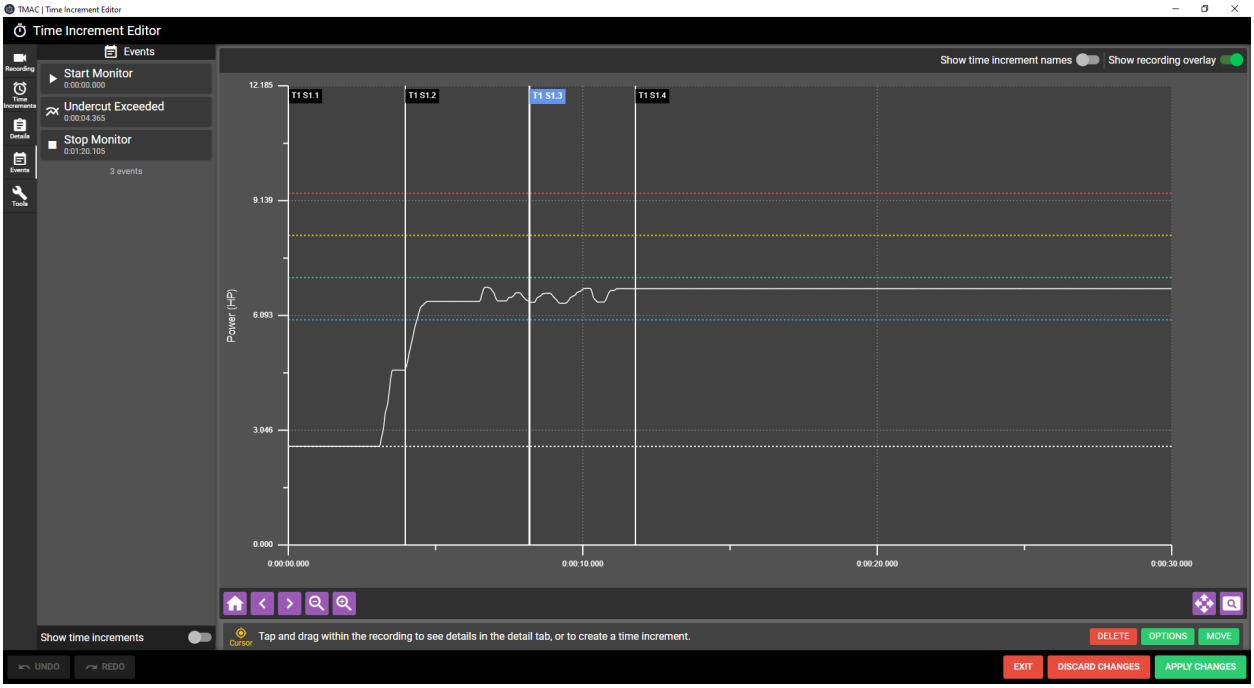

Figure 10-9: Events Tab

Tools Tab

The Tools tab provides access to tools that manipulate the recording. The following tools are available:

- **Cursor**: Place a cursor on the recording to display cut data or create a time increment
- **Pan**: Click and drag the recording to a specific spot
- **Zoom**: Zoom in on a highlighted portion of the recording

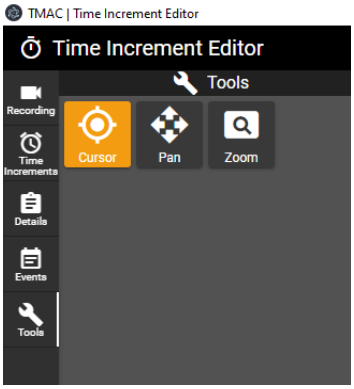

Figure 10-10: Tools Tab

Using the Cursor tool

The cursor tool has two functions; viewing information on the Details tab and to create time increments. To view details on the Details tab, select the cursor tool and place a cursor by clicking on the recording. Once the cursor is placed, it can be clicked and dragged to the desired location. To view the details at cursor location, select the details tab. Additionally, the cursor is used to add time increments to the recording. To add a time increment to a recording user the following steps:

1. Select the cursor tool from the Tools tab
2. Click on the recording to place a cursor
3. Drag the cursor to the desired location
4. Click the ADD button

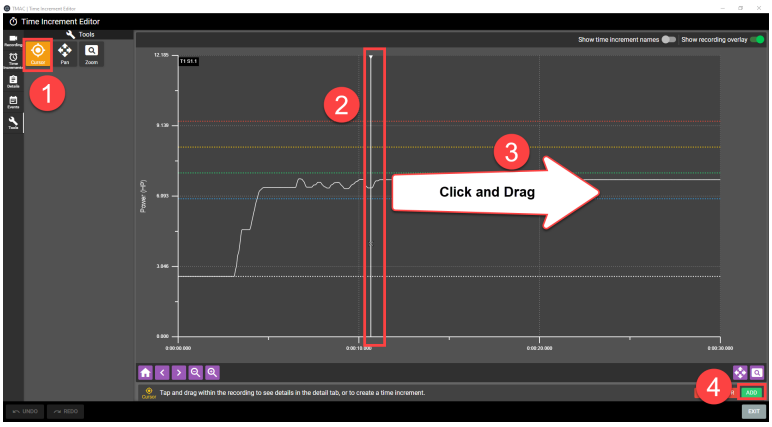

Figure 10-11: Adding a Time Increment

5. If desired, enter a name for the time increment (optional)
6. Click Add

Figure 10-12: Adding a Time Increment

7. Repeat steps 2-6 for any additional time increments
8. Click Apply Changes

Using the Zoom Tool

The Zoom tool is used to zoom to a specific portion of the recording. To use the Zoom tool use the following steps:

1. Select the Zoom tool from the tools tab
2. Highlight the portion of the recording to zoom in on by clicking and dragging on the recording. This draws a rectangle around the portion of the recording.

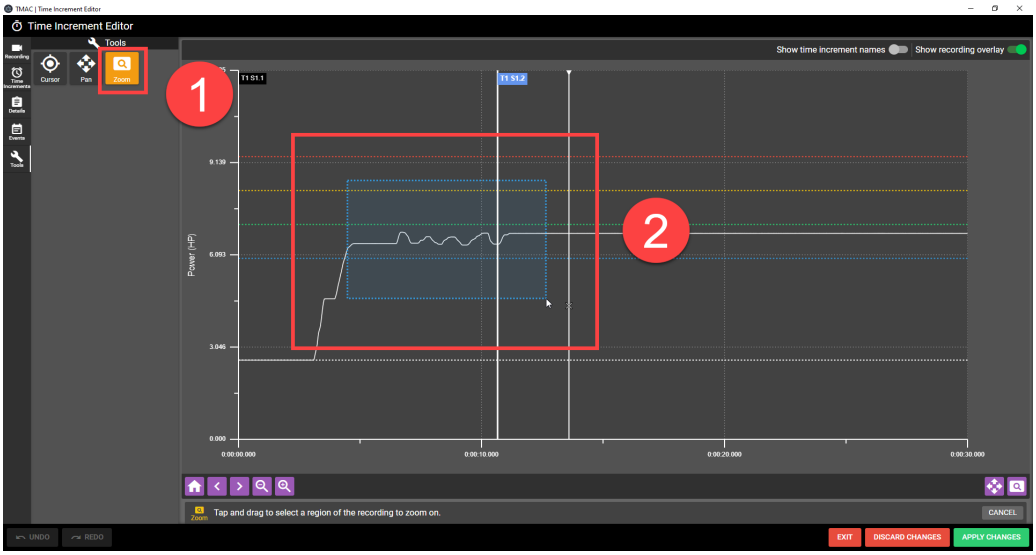

Figure 10-13: Using the Zoom Tool Steps 1-2

3. Release the click-drag to zoom in on the highlighted portion of the recording

The selected portion of the recording is now enlarged to the size of the recording viewer. This feature aids in placing time increments in more exact locations.

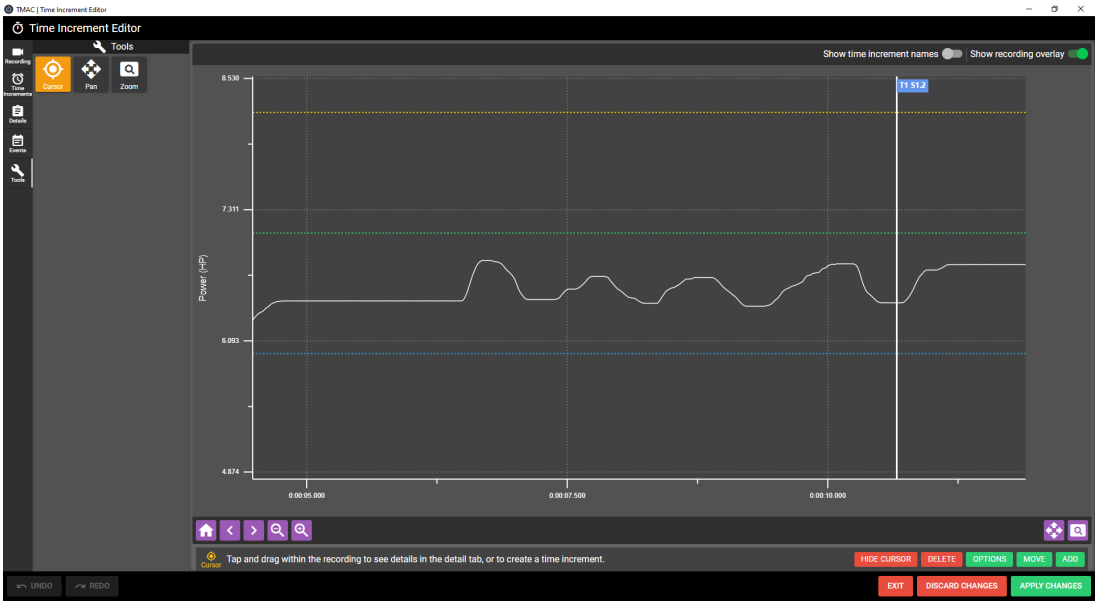

Figure 10-14: Using the Zoom Tool

Using the Pan Tool

The Pan tool is used to move to specific parts of the recording. After selecting the Pan tool, click on the recording and drag in any direction to scroll the recording. This feature is particularly useful on touchscreens.

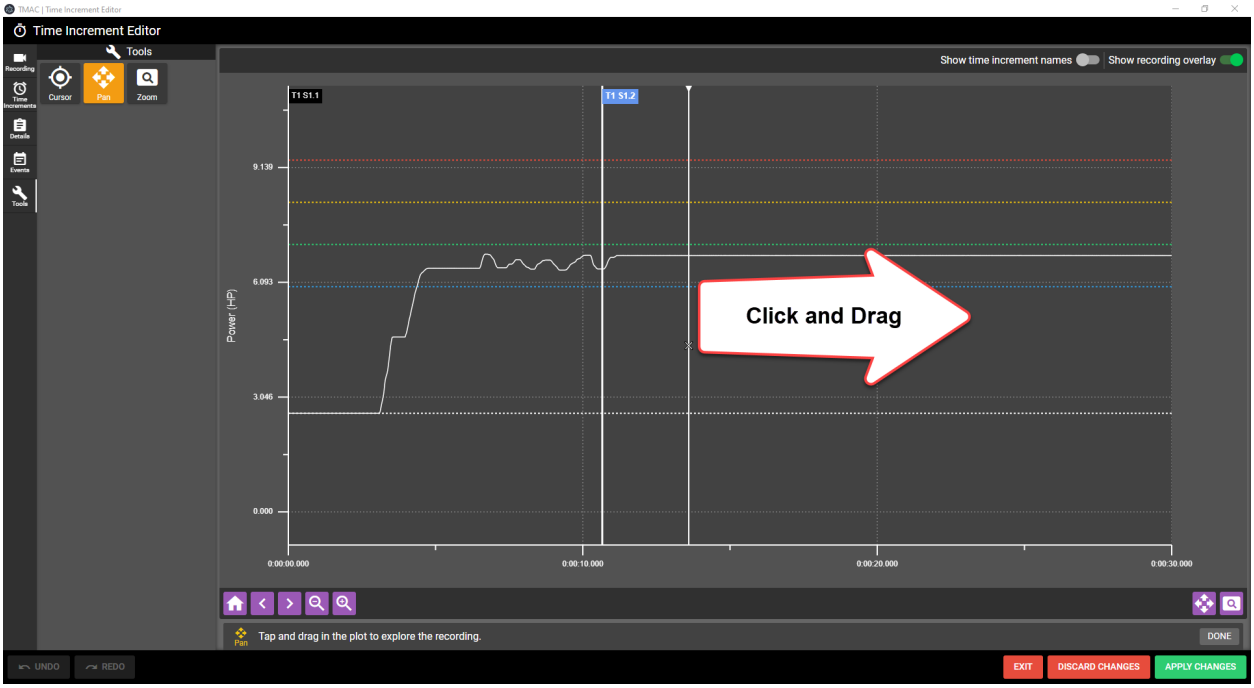

Figure 10-15: Pan Tool in the Time Increment Editor

Chapter 11: Limits and Delays

Overview

Every limit and delay programmed for an operation is stored in the job. Limits and delays can be edited at any time. The available limits for an operation depend on the channel class being monitored and if adaptive control is enabled. Refer to Table 11-1 for a list of Limits and their availability for various channel classes.

Note: The limits and delays described in this chapter are not applicable to Millivolt operations. Refer to "Millivolt Mode" Page 30 for information on Millivolt limits and delays.

TMAC Limit and Delays for Channel Classes					
Limit or Delay	**Primary**	**Spindle**	**Coolant**	**Adaptive Specific**	**Signature Specific**
Extreme Limit	x				
Wear Limit	x				
Work Wear Limit	x				
Undercut Limit	x				
Work Undercut Limit	x				
Time Above Undercut	x				
Upper Limit		x			
Lower Limit		x			
Coolant High			x		
Coolant Low Warning			x		
Coolant Low			x		
Maximum Feedrate	x			x	
Extreme Feedrate	x			x	
Wear Feedrate	x			x	
Upper Extreme	x				x
Upper Warning	x				x
Lower Warning	x				x
Lower Extreme	x				x

Table 11-1: Limits and Delays Per Channel Class

Note: If no limits are set for an operation, TMAC does not monitor the operation and enters data collection mode for the duration of the operation.

Work (HP/s, kW/s) Limits

TMAC has the capability of using a work value for undercut and wear limits. Work limits (also known as "area under the curve") use signal value over time instead of peak values learned during an operation. Spikes in signal can satisfy undercut limits or trigger wear alarms unnecessarily. This can be prevented by using work limits. For example: If a power spike reaches a value over the undercut limit but immediately comes back down under the limit, the undercut limit is satisfied, and the process continues. If the power stays below the undercut limit after the spike, the desired output is an alarm condition. Work limits can only be applied to primary channel operations.

Extreme Limit

The Extreme Limit signals a catastrophic event (e.g., a severely worn or broken tool). When the signal value exceeds the extreme alarm for the amount of time specified in the Extreme Alarm Delay, TMAC halts monitoring and triggers an Extreme Alarm. The extreme limit is set at a percentage above the learned value for a given operation.

Setting the Extreme Limit

To set an Extreme Limit use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Click the Extreme Limit % field and enter the percentage above the learned value that will trigger an extreme alarm condition.
    - Allowable values range from 1% to 999%
    - Entering a value of 0 disables the Extreme Limit
4. Click **SAVE**

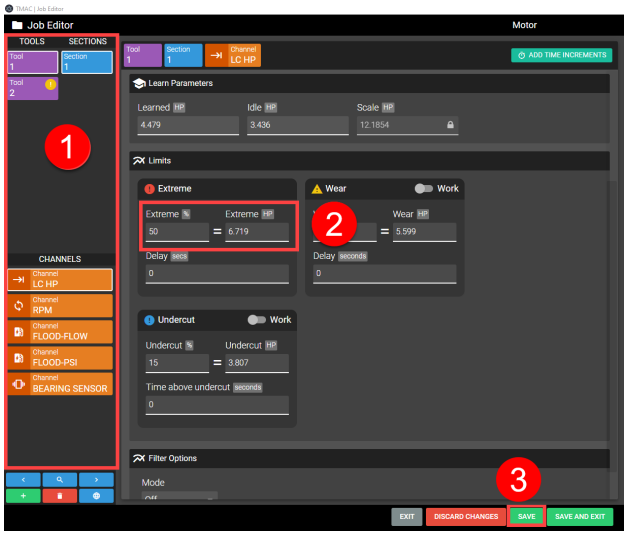

Figure 11-1: Setting Extreme Limit

Note: Although the above step list specifies entering a percentage for the limit, a direct value may be entered in the other field outlined in step 3 in the figure above. When a limit is set in either field, the other field is automatically populated.

Extreme Alarm Delay

The extreme alarm delay specifies a time period during which the signal value exceeds the extreme limit without triggering an alarm. This allows for brief spikes without unnecessary alarms.

Setting an Extreme Alarm Delay

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Extreme Limit section of the Job Editor, click the Delay field
3. Enter the duration of the extreme delay
    - Allowable values range from 0.1 to 320 seconds in 0.1 second increments
    - Entering a value of 0 disables the Extreme alarm delay
4. Click **SAVE**

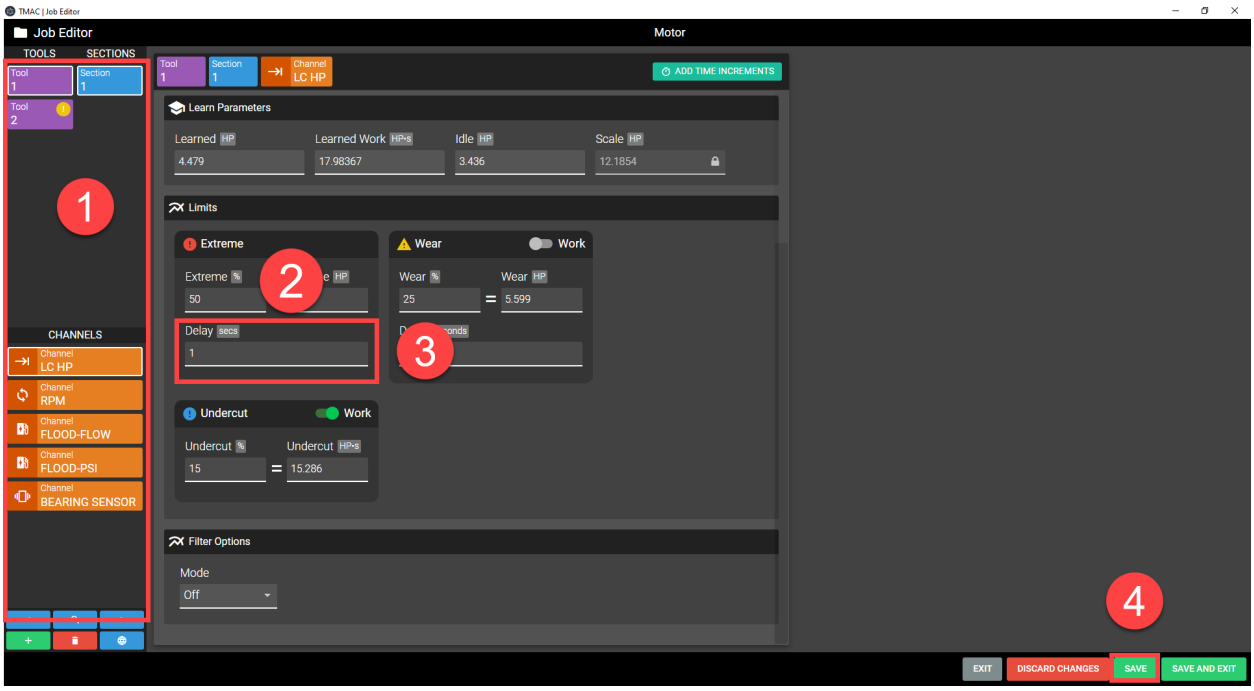

Figure 11-2: Setting Extreme Delay

Wear Limit

The Wear Limit alerts the operator that a tool has reached its optimum wear point and should be changed. An alarm activates immediately when signal value exceeds the Wear Limit, unless a Wear Alarm Delay is set. The Wear Limit is a percentage value above the learned value for an operation.

The user may need to experiment with different tools and parts to arrive at the best Wear Limit for a given set of conditions. Once appropriate limits are determined for all the machining processes, a direct and repeatable relationship to tool condition will be noticeable.

Setting the Wear Limit

To set a Wear Limit:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the Wear Limit % field
3. Enter the percentage above the learned value that will trigger an wear alarm condition.
    - Allowable values range from 1% to 999%
    - Entering a value of 0 disables the Wear Limit
4. Click **SAVE**

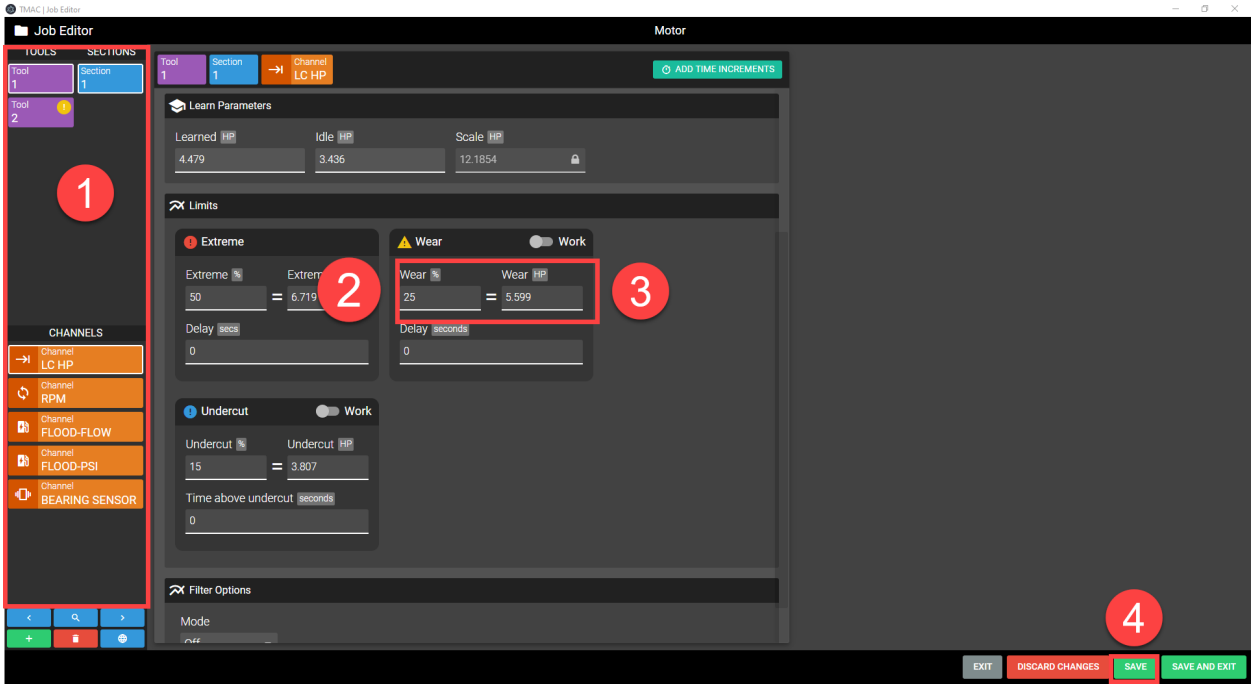

Figure 11-3: Setting Wear Limit

Note: Although the above step list specifies entering a percentage for the limit, a direct value may be entered in the other field outlined in step 3 in the figure above. When a limit is set in either field, the other field is automatically populated.

Wear Alarm Delay

The Wear Alarm Delay specifies a time period during which the signal value for an operation may exceed the wear limit without triggering an alarm. This allows for brief signal spikes without unnecessary alarms.

Setting a Wear Alarm Delay

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Wear Limit section of the Job Editor, click the Delay field
3. Enter the duration of the wear delay
    - Allowable values range from 0.1 to 320 seconds in 0.1 second increments
    - Entering a value of 0 disables the Wear Alarm Delay
4. Click **SAVE**

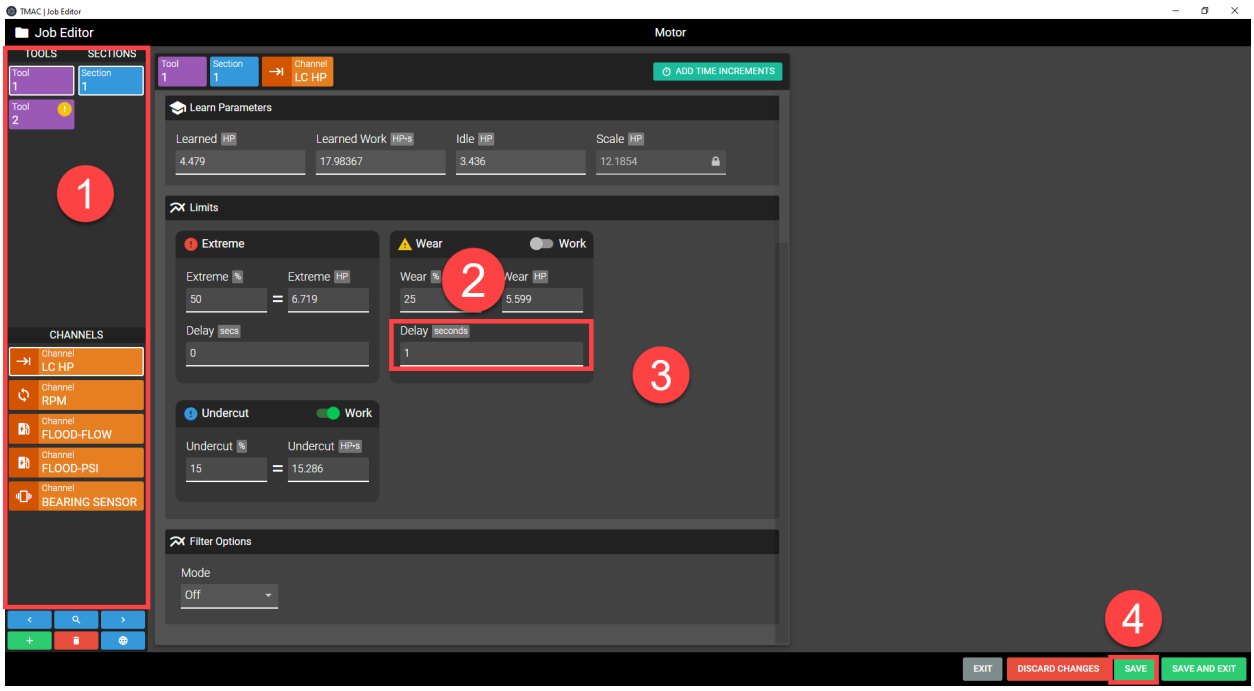

Figure 11-4: Setting Wear Alarm Delay

Setting a Work Wear Limit

To set a work wear limit use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the Work toggle switch
3. Enter the percentage above the Learned Work value that will trigger an alarm.
    - Allowable values range from 1% to 999%
    - Entering a value of 0 disables the Wear Limit
4. Click **SAVE**

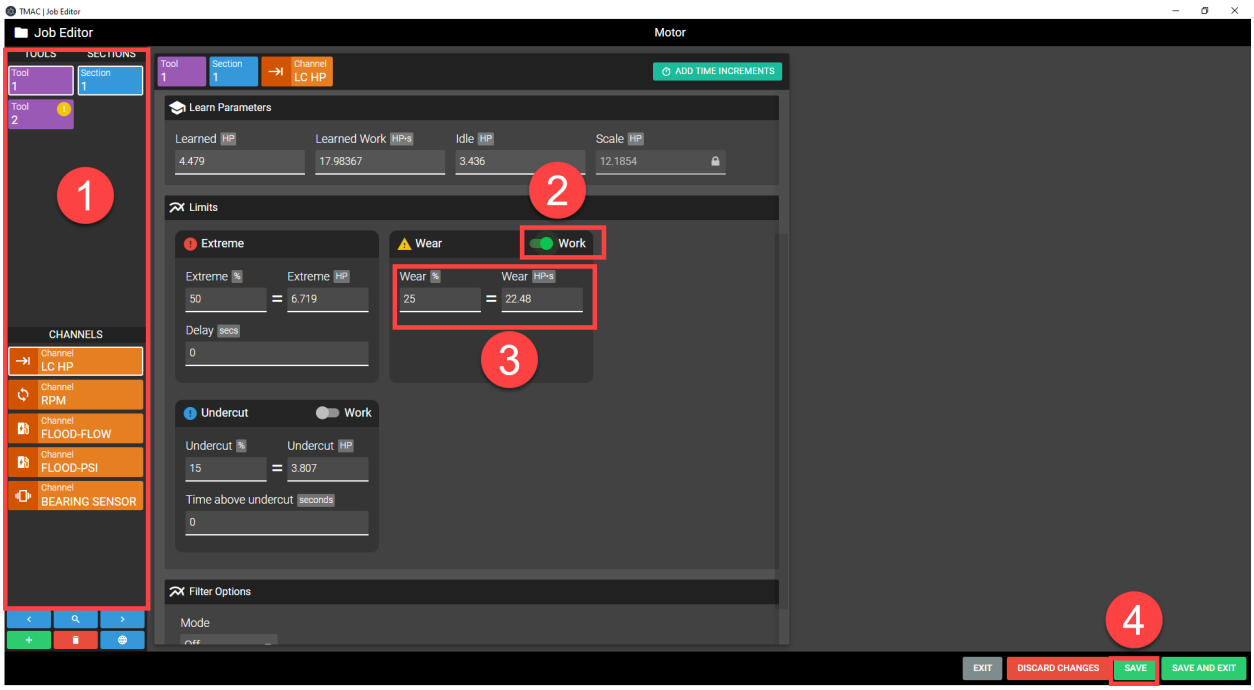

Figure 11-5: Setting Work Wear Limit

Undercut Limit

The Undercut Limit alerts the user to an incomplete machining process (e.g., a broken or missing tool).

The Undercut Limit is programmed as a percentage below the learned value for an operation. If the signal value fails to exceed the undercut limit for the amount of time specified in the Time Above Undercut field, TMAC generates an undercut alarm when it receives a stop command.

Note: If using time increments, the undercut alarm is generated at the end of the time increment instead of the next stop monitor command.

Setting the Undercut Limit

To set an Undercut Limit:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the undercut Limit % field
3. Enter the percentage below the learned value that will trigger an undercut alarm condition.
    - Allowable values range from 1% to 99%
    - Entering a value of 0 disables the Undercut Limit
4. Click **SAVE**

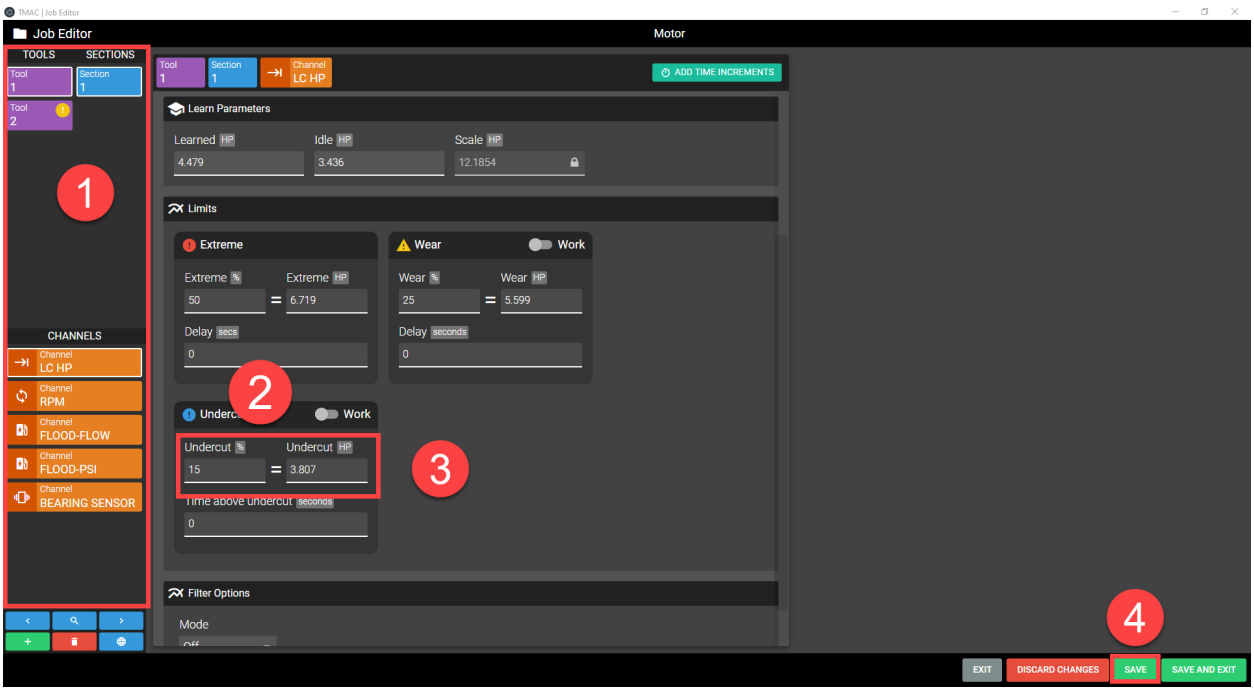

Figure 11-6: Setting the Undercut Limit

Note: Although the above step list specifies entering a percentage for the limit, a direct value may be entered in the other field outlined in step 3 in the figure above. When a limit is set in either field, the other field is automatically populated.

Time Above Undercut

The Time Above Undercut feature is a timer that adds an additional requirement to trigger an undercut alarm. When using Time Above Undercut, an undercut alarm is triggered when the signal value fails to exceed the undercut limit for a specified duration. The Time Above Undercut limit is cumulative. TMAC accumulates the time while the signal value exceeds the undercut limit.

If the time is equal to or greater than the limit, no alarm is triggered. An alarm is generated only when the total time the signal value exceeds the undercut limit is less than the programmed time above undercut. The best way to arrive at an undercut time is to use the Data Viewer and measure the duration that the signal value exceeds the undercut limit.

Setting a Time Above Undercut

In the Job Editor

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Undercut Limit section of the Job Editor, click the Time Above Undercut field
3. Enter the desired Time Above Undercut time
    - Allowable values range from 0.1 to 320 seconds in 0.1 second increments
    - Entering a value of 0 disables the Time Above Undercut Feature
4. Click **SAVE**

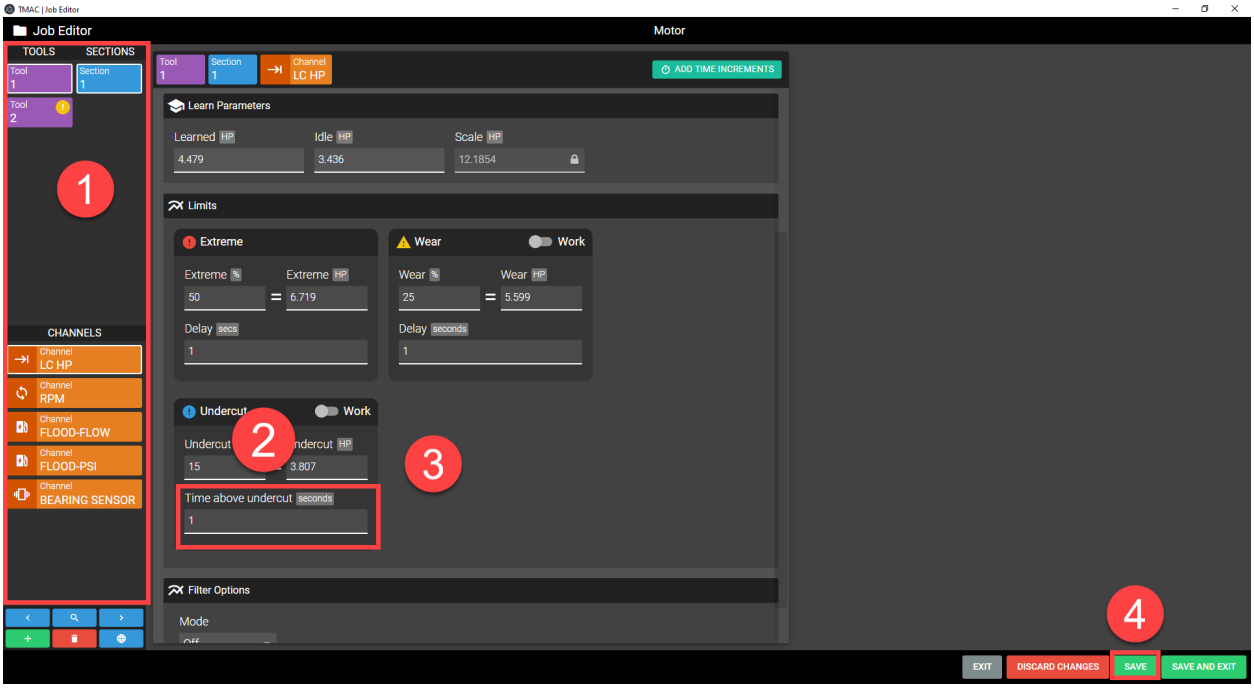

Figure 11-7: Setting Time Above Undercut

Setting a Work Undercut Limit

To set a work undercut limit use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the Work toggle switch
3. Enter the percentage below the learned work value that will trigger an alarm.
    - Allowable values range from 1% to 99%
    - Entering a value of 0 disables the Undercut Limit
4. Click Save

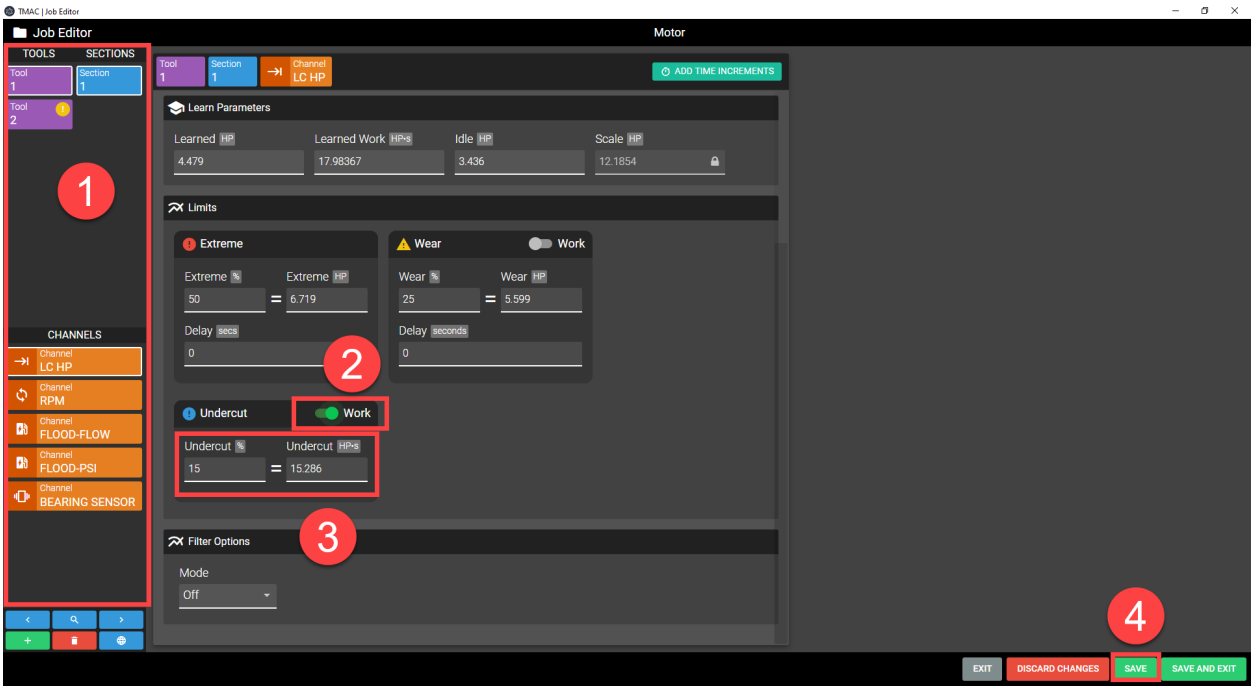

Figure 11-8: Setting Work Undercut Limit

Spindle Speed Limits

Spindle Speed monitoring tests the measured spindle speed of the machine against an upper and lower limit. TMAC checks the spindle speed between every Start and Stop monitor command. If the speed exceeds the upper limit or falls below the lower limit by the specified percentage:

- An alarm is triggered
- Tool monitoring is halted

Note: If a start delay is used, the spindle speed threshold does not take effect until the start delay has timed out.

Setting an Upper Spindle Limit

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the parameters section of the Job editor, click the Spindle Speed field
3. Enter a target spindle speed for the operation. Typically this matches the spindle speed set in the part program
    - Valid values are 0-99999
4. In the Limits section of the Job Editor, click the Upper Limit % field
5. Enter the percentage above target spindle speed that will trigger an Upper alarm condition.
    - Allowable values range from 0% to 99%
    - Entering a value of 0 disables the Upper Spindle Limit
6. Click Save

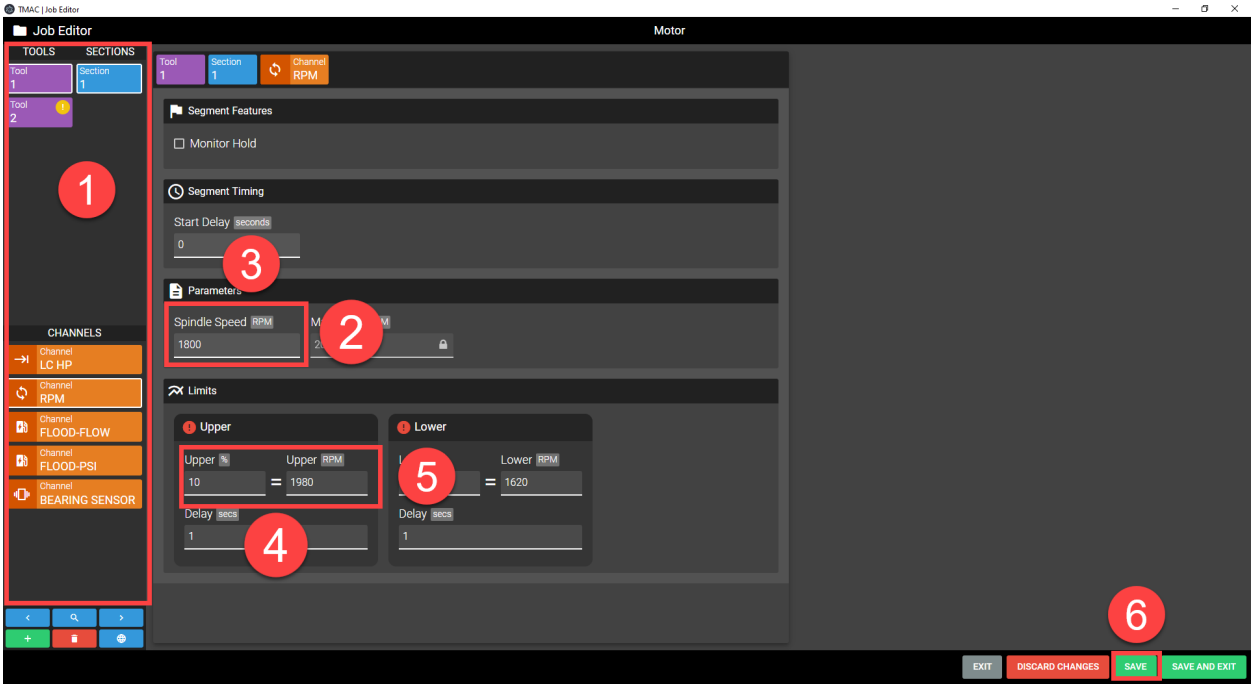

Figure 11-9: Setting Upper Spindle Limit

Setting an Upper Limit Delay

An Upper Limit Delay allows the spindle speed to surpass the upper limit for a specified amount of time before an alarm is triggered. To set an Upper Limit Delay use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click Upper Delay field
3. Enter the amount of time the spindle speed is allowed to exceed the upper limit
4. Click **SAVE**

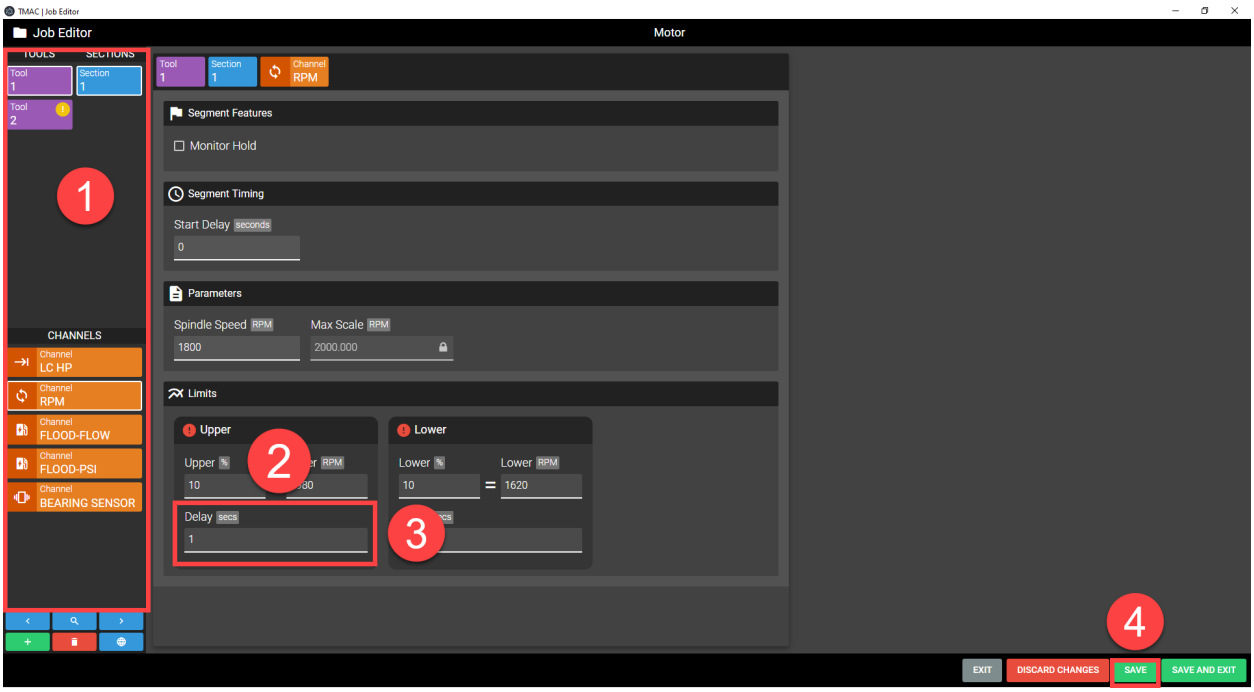

Figure 11-10: Setting Upper Limit Delay

Setting a Lower Spindle Limit

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the parameters section of the Job editor, click the Spindle Speed field
3. Enter a target spindle speed for the operation. Typically this matches the spindle speed set in the part program
    - Valid values are 0-99999
4. In the Limits section of the Job Editor, click the Lower Limit % field
5. Enter the percentage below the target spindle speed that will trigger an Lower alarm condition.
    - Allowable values range from 0% to 99%
    - Entering a value of 0 disables the Lower Spindle Limit
6. Click **SAVE**

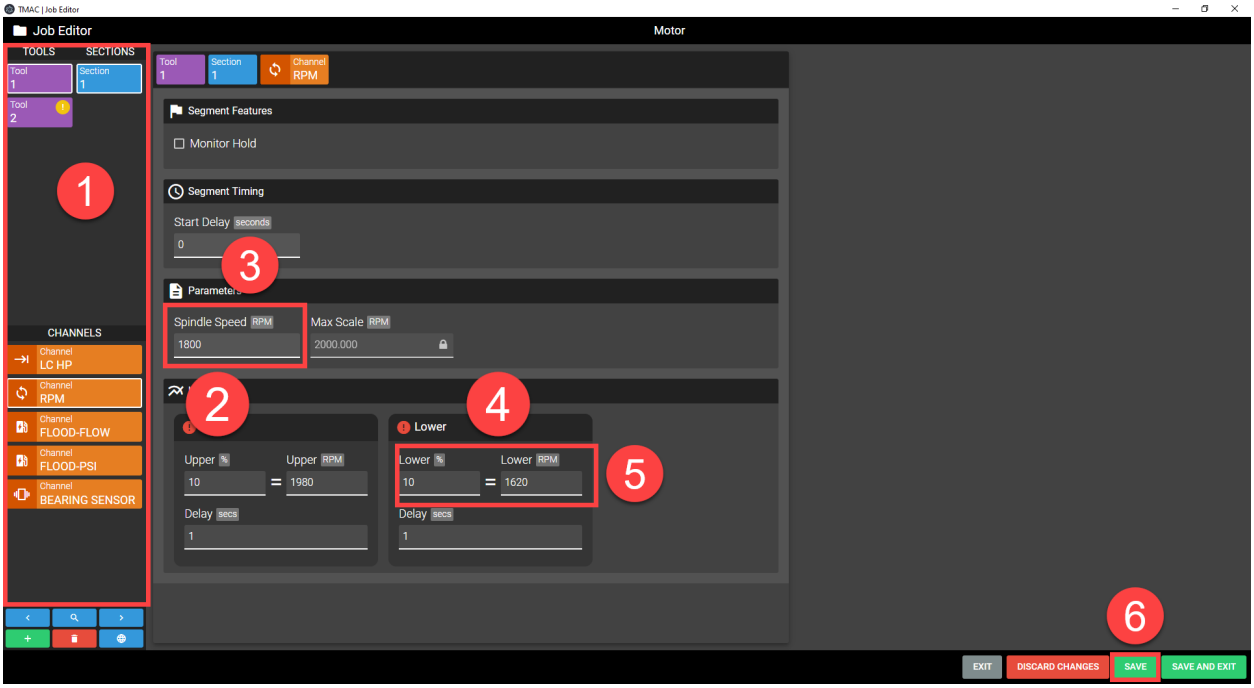

Figure 11-11: Setting Lower Limit

Setting a Lower Limit Delay

A Lower Limit Delay allows the spindle speed to fall below the lower limit for a specified amount of time before an alarm is triggered. To set a Lower Limit Delay use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the Lower Delay field
3. Enter the amount of time the spindle speed is allowed to fall below the lower limit
4. Click **SAVE**

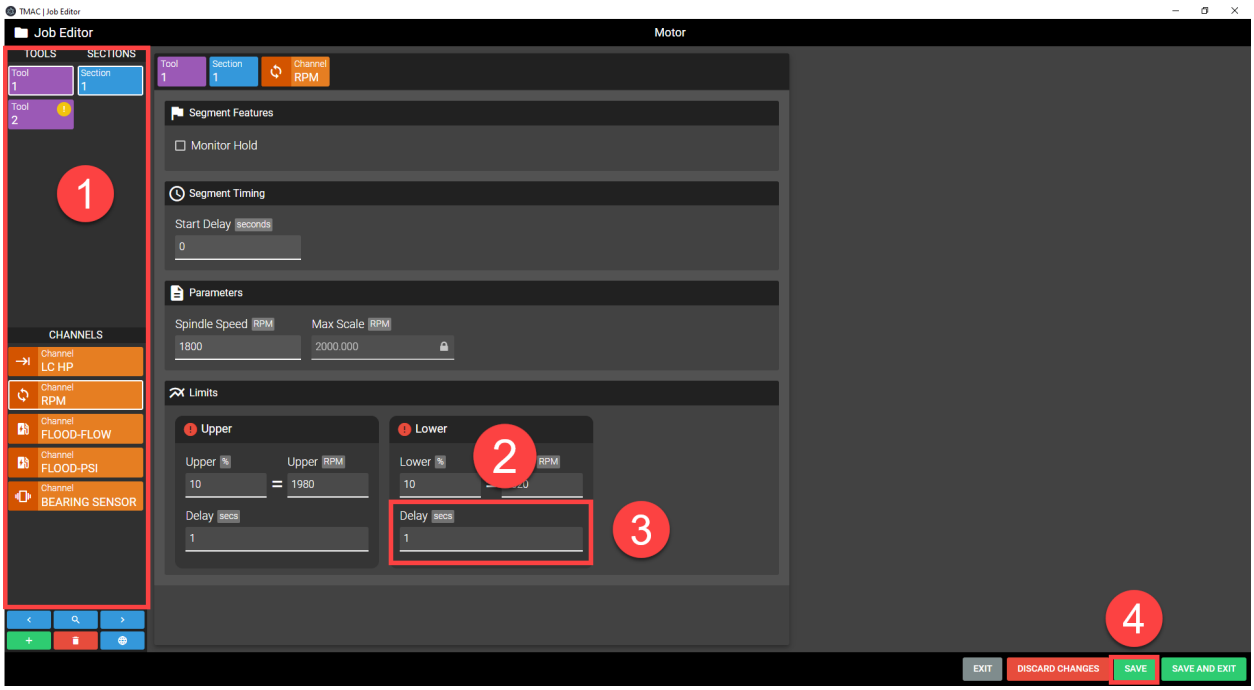

Figure 11-12: Setting Lower Limit Delay

Coolant Limits

Coolant monitoring measures either coolant flow or coolant pressure against programmed limits. Alarms are triggered when the coolant flow/pressure deviates outside of the programmed limits. The available limits are as follows:

- **High**: When coolant flow or pressure exceeds the limit, TMAC halts monitoring and issues a High Coolant Alarm
- **Low Warning**: When coolant flow or pressure falls below the limit, TMAC issues an alarm and continues to monitor the operation
- **Low**: When coolant flow or pressure falls below the limit, TMAC halts monitoring and issues a Low Coolant Alarm

Note: The learned value that coolant limits are based on, is the lowest value recorded during the learn operation.

Setting a High Coolant Limit

To set a High Coolant Limit use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the High Limit % field
3. Enter the percentage above the learned coolant flow/pressure that will trigger a High alarm condition.
4. Click Save

Figure 11-13: Setting a High Coolant Limit

Setting a Low Warning Coolant Limit

To set a Low Warning Coolant limit, use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the Low Warning Limit % field
3. Enter the percentage below the Learned Coolant Flow/Pressure that will trigger a Low Warning alarm condition.
4. Click Save

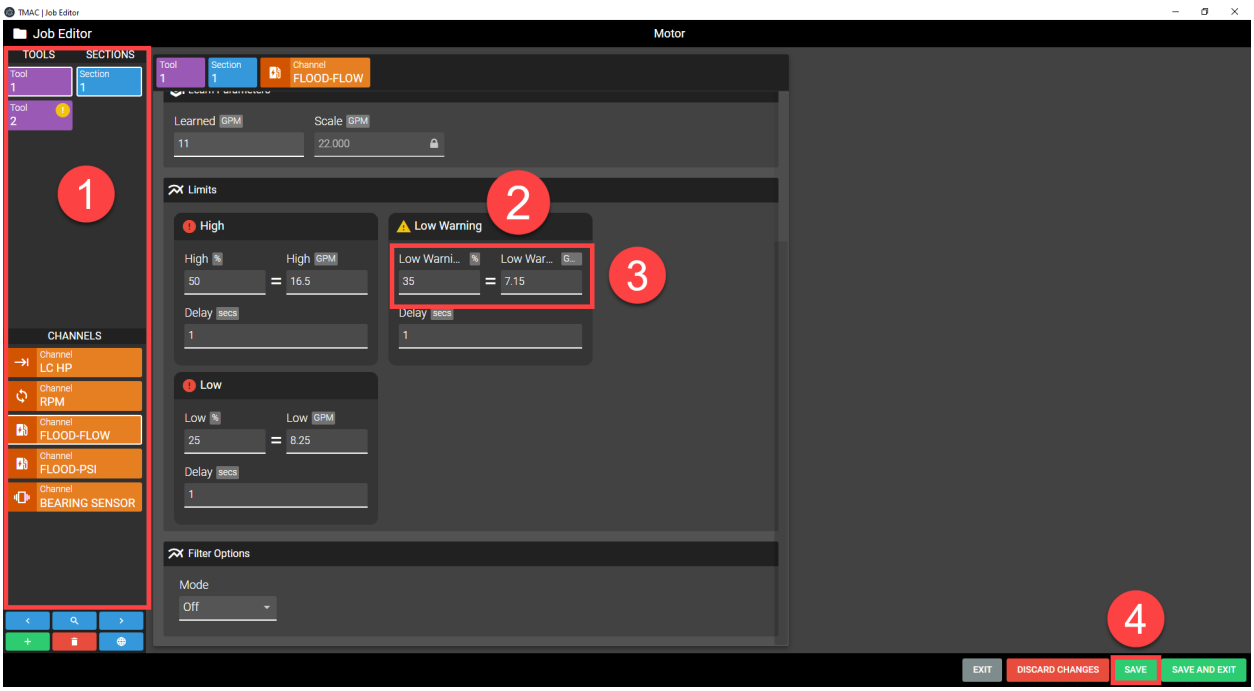

Figure 11-14: Low Warning Coolant Limit

Setting a Low Coolant Limit

To set a low coolant limit use the following steps:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, click the Low Limit % field
3. Enter the percentage below the Learned Coolant Flow/Pressure that will trigger a Low alarm condition.
4. Click **SAVE**.

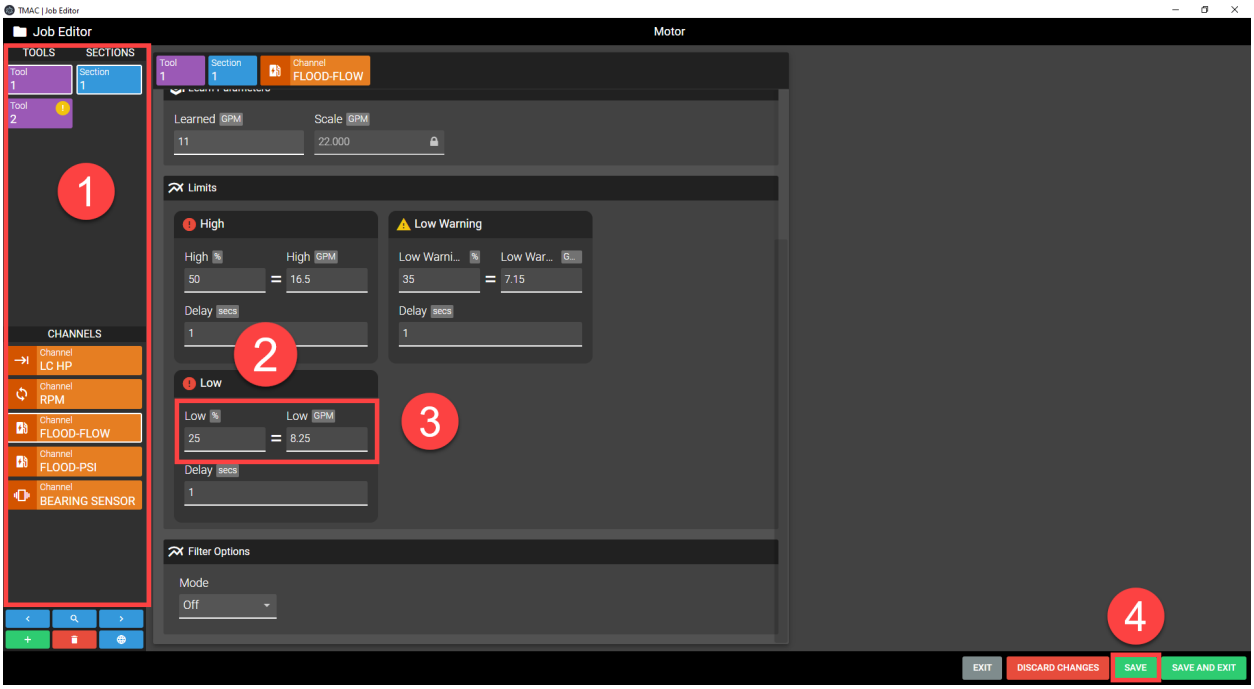

Figure 11-15: Setting Low Coolant Limit

Coolant Alarm Delay

The Coolant Alarm Delay specifies a period of time which the measured coolant flow/pressure may exceed (High) or fall below (Low Warning and Low) the programmed limits before triggering an alarm condition.

Setting Coolant Alarm Delays

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Limits section of the Job Editor, Click the Delay field for the desired limit
3. Enter the time in seconds for the alarm delay
    - Allowable values range from 0.1 to 320 seconds in 0.1 second increments
    - Enter 0.0 to disable the coolant alarm delay
4. Click Save
5. Repeat steps 2-4 for each limit that requires a delay

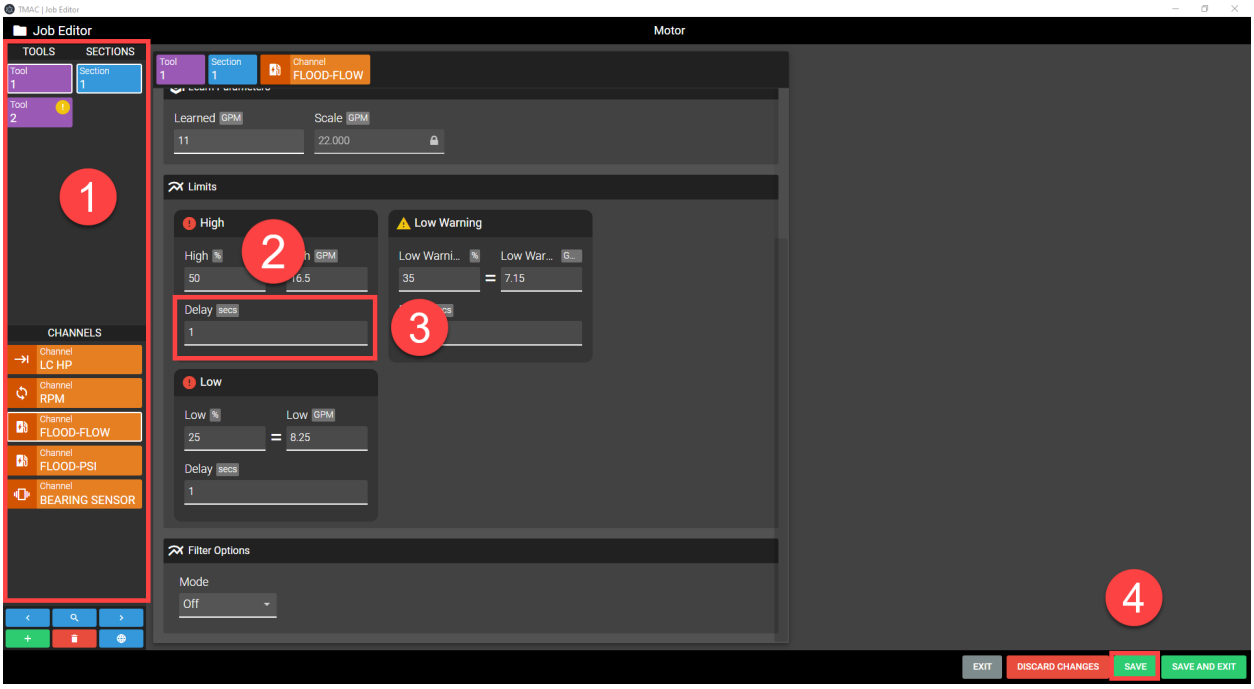

Figure 11-16: Setting Coolant Alarm Delays

Extreme Feedrate Limit

The Extreme Feedrate limit is used to monitor excessive tool wear or breakage in adaptive control. In an adaptive operation, the commanded feedrate is inversely proportional to the signal value. As the signal value increases, TMAC reduces the feedrate to maintain a constant target signal value. When the feedrate override falls below the programmed Extreme Feedrate Limit for the time specified by the Extreme Feedrate Alarm Delay, TMAC triggers an extreme feedrate alarm. The Extreme Feedrate Limit function cannot be disabled. The default value is 20%.

Setting the Extreme Feedrate Limit

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the segment features section click the Adaptive check-box
3. In the Limits section of the Job Editor, click the Feedrate Extreme % field
4. Enter the percentage feedrate that will trigger an Extreme Feedrate Alarm condition.
    - Allowable values range from 1% to the max feedrate of the machine
    - Must be less than Wear Feedrate % Limit
5. Click Save

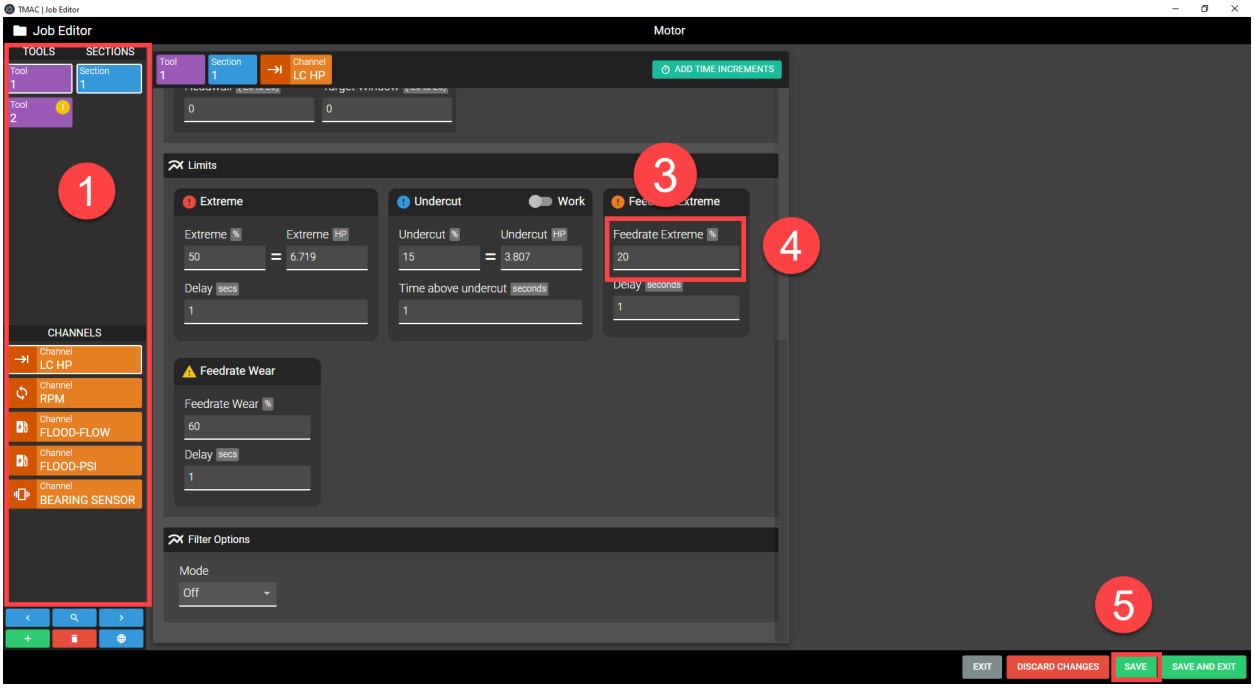

Figure 11-17: Setting Extreme Feedrate Limit

Extreme Feedrate Alarm Delay

The Extreme Feedrate Delay specifies a time period during which the feedrate can fall below the Extreme Feedrate Limit without triggering an alarm..

Setting an Extreme Feedrate Alarm Delay

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Feedrate Extreme Limit section of the Job Editor, click the Delay field
3. Enter the duration of the feedrate extreme delay
    - Allowable values range from 0.1 to 320 seconds in 0.1 second increments
    - Entering a value of 0 disables the Feedrate Extreme alarm delay
4. Click **SAVE**

Figure 11-18: Setting an Extreme Feedrate Alarm Delay

Wear Feedrate Limit

The Wear Feedrate Limit is used to monitor tool wear in adaptive control. Adaptive control determines tool wear by controlling the feedrate override. In an adaptive operation, the commanded feedrate is inversely proportional to the signal value. As the signal value increases, TMAC reduces the feedrate to maintain a constant target signal value. When the feedrate override falls below the wear feedrate limit for the time specified by the Wear Feedrate Alarm Delay, TMAC triggers a wear feedrate alarm.

Setting a Wear Feedrate Limit

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the features section click the Adaptive check-box
3. In the Limits section of the Job Editor, click the Feedrate Wear Limit % field
4. Enter the percentage feedrate that will trigger a Wear Feedrate alarm condition.
    - Allowable values range from 1% to the max feedrate of the machine
    - Must be greater than Extreme feedrate limit
5. Click **SAVE**

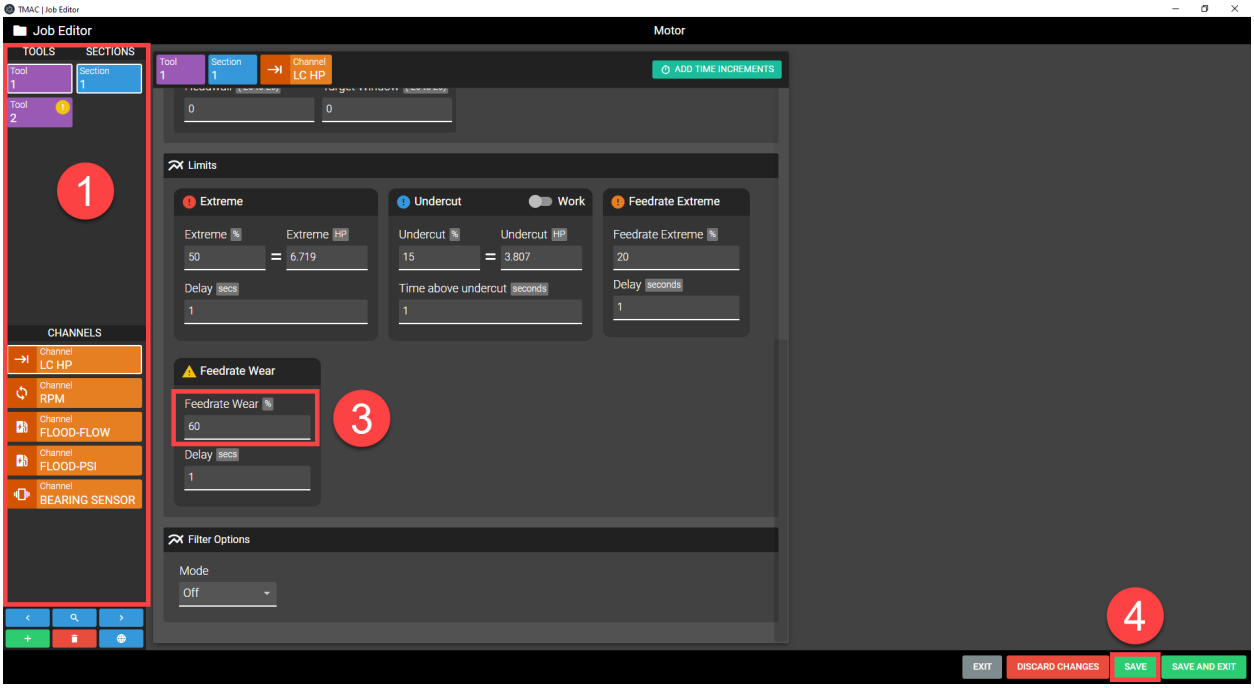

Figure 11-19: Setting the Wear Feedrate Limit

Note: Use trial and error to determine the best setting. Remember, the lower the programmed wear feedrate, the longer the tool will cut before generating a wear feedrate alarm.

Wear Feedrate Alarm Delay

The Wear Feedrate Alarm Delay can prevent an instantaneous signal spike and associated feedrate drop from triggering the wear feedrate alarm. These spikes may occur if the tool encounters a hard spot in the material and may not necessarily indicate tool wear. This delay allows the feedrate to drop below the wear feedrate without generating an alarm for the time specified . The Data Viewer can help determine the duration of the spike, and the appropriate value for this delay.

Setting a Wear Feedrate Alarm Delay

In the Job Editor:

1. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. In the Feedrate Wear Limit section of the Job Editor, click the Delay field
3. Enter the duration of the Feedrate Wear delay
    - Allowable values range from 0.1 to 320 seconds in 0.1 second increments
    - Entering a value of 0 disables the feedrate Wear alarm delay
4. Click **SAVE**

Figure 11-20: Setting a Wear Feedrate Delay

Slope Limits

Slope limits are available for operations that employ time increments. Some complex machining operations, such as constant surface speed lathe operations, can be monitored more accurately with slope limits. An operation where the load increases or decreases from start to finish is not accurately monitored with horizontal limits. Slope limits that parallel the slope of the signal value permit more accurate and sensitive monitoring. The following is true when implementing slope limits:

- The operation must employ time increments
- The last time increment in an operation cannot have a slope limit
- Slope parameters define the learned slope value for the operation
- Slope limits are calculated as a percentage above or below the learned slope

Figure 11-21: Slope Limits versus Standard Limits

See Also:

"Setting Slope Limits" Page 164

"Slope Sensitivity Examples" Page 166

Setting Slope Limits

Use the following steps to set slope limits for an operation:

1. If the operation does not employ time increments, use the Time Increment Editor to add time increments to the associated operation. For more information on adding time increments to a job, refer to "Time Increment Editor" Page 131
2. Specify the operation by selecting the tool, section, and channel from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
3. Select the time increment that requires slope limits
4. Select the **Slope** monitor type

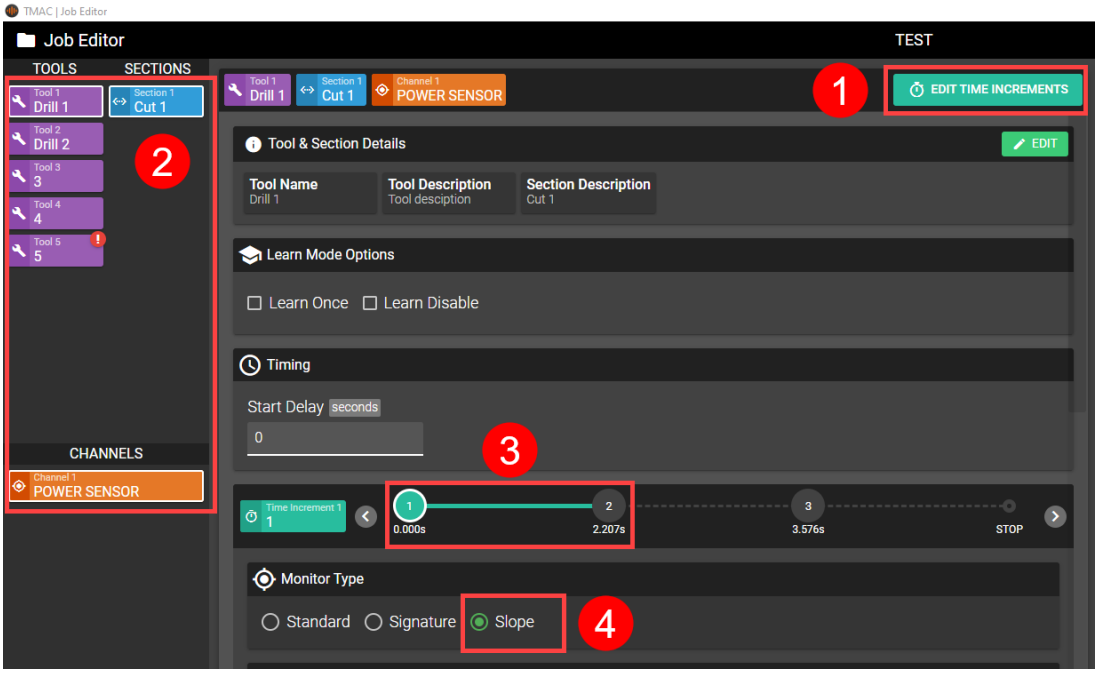

Figure 11-22: Setting Slope Limits Steps 1-4

5. Enter the Slope parameters
    a. **Slope Start**: Defines the learn value at the start of the time increment
    b. **Slope End**: Defines the learn value at the end of the time increment
    c. **Limit Sensitivity**: Determines the slope of the slope limits; Increasing the value of this setting makes less parallel to the learned slope, allowing the user to fine tune slope limits

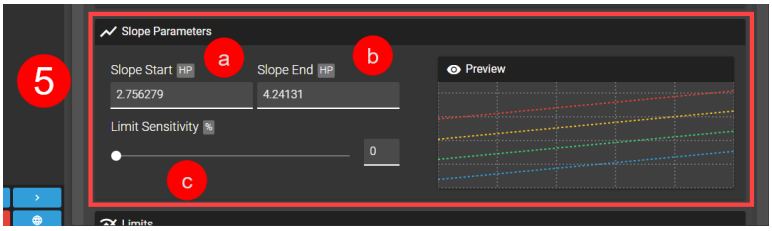

Figure 11-23: Setting Slope Limits Steps 5a-c

6. Set desired limits:
    - **Slope Extreme**: Set as a percentage above the learned slope; An alarm is triggered when the signal value exceeds the limit.
    - **Slope Wear**: Set as a percentage above the learned slope; An alarm is triggered when the signal value exceeds the limit.
    - **Slope Undercut**: Set as a percentage below the learned slope; An alarm is triggered if the signal value fails to exceed the limit.
7. Set any desired alarm delays
    a. If an alarm delay is set for slope extreme or wear, an alarm is triggered when the signal value exceeds the limit for the amount of time set in the delay.
    b. If the **Time Above Undercut** is set, the signal value must exceed the undercut limit for the amount of time set.
    c. If the **Immediate** switch is toggled, the functionality of the Undecut limit changes; An alarm is triggered when the signal value falls below the undercut limit.

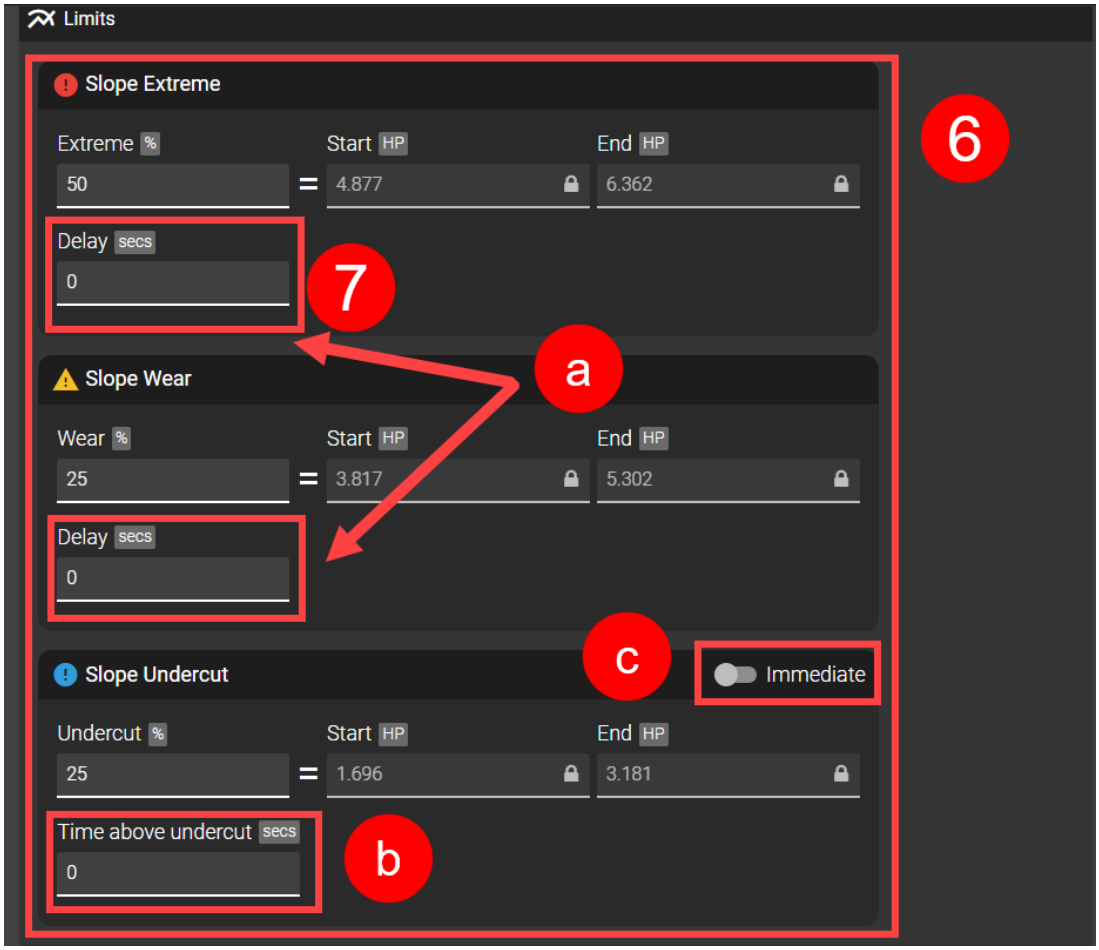

Figure 11-24: Setting Slope Limits Steps 5a-c

Slope Sensitivity Examples

Slope Sensitivity allows the user to fine-tune the behavior of slope limits. Slope limits without limit sensitivity set run parallel to the learned slope value. Increasing the sensitivity causes the limit to be calculated from learned load data samples across the entire time increment. This makes the limits proportional to the learned slope, so that at lower load values in the slope the limits are closer to the learned load limit. Slope limit sensitivity impacts wear and extreme slope limits. If the **Immediate** switch is toggled for the undercut slope limit, the limit sensitivity will also impact the undercut limit. This is displayed in the following examples:

Example 1: Start HP = 1; End HP = 4; Immediate = OFF

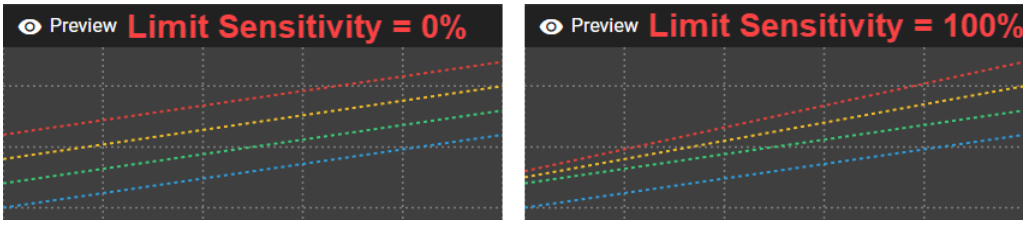

Figure 11-25: Slope Limit Sensitivity Comparison Example 1

Example 2: Start HP = 1; End HP = 4; Immediate = ON

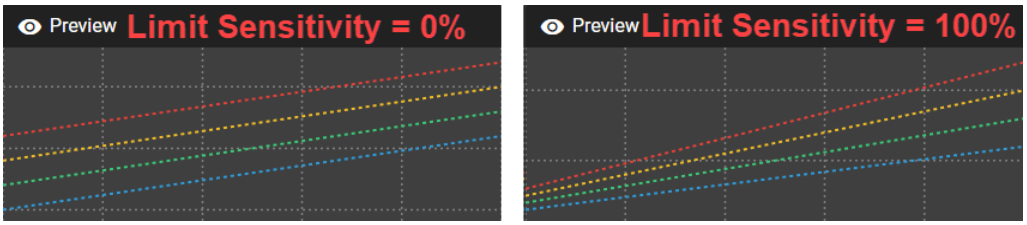

Figure 11-26: Slope Limit Sensitivity Comparison Example 2

Example 3: Start HP = 4; End HP = 1; Immediate = OFF

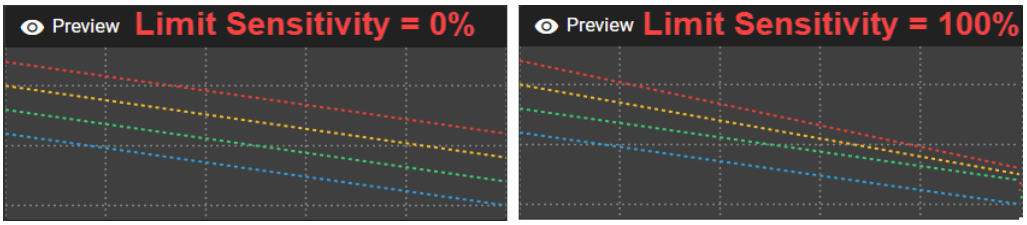

Figure 11-27: Slope Limit Sensitivity Comparison Example 3

Example 4: Start HP = 4; End HP = 1; Immediate = ON

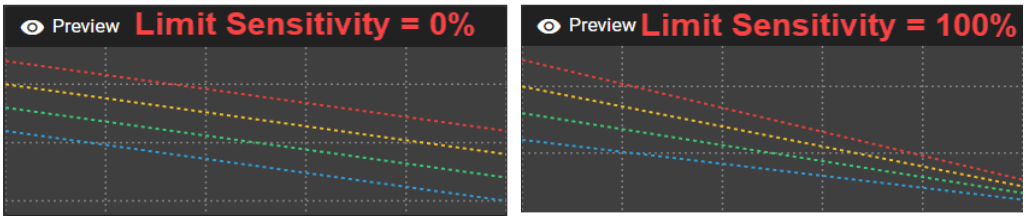

Figure 11-28: Slope Limit Sensitivity Comparison Example 4

Signature Limits

Signature limits offer an alternative to standard monitoring limits. When using standard monitoring limits, the sensor signal is measured against a set value as a percentage above or below the learned peak value. Signature limits are based on a learned signature profile. TMAC accesses the learned profile to build limits that mirror the monitored operation (See Figure 11-29 for an example). Alarms are triggered when the sensor signal deviates from the learned profile by the value set for the limit. The following signature limits are available:

- **Upper Extreme**: When the sensor signal exceeds the learned profile by the value set for the limit, a critical alarm is triggered.
- **Upper Warning**: When the sensor signal exceeds the learned profile by the value set for the limit, a warning alarm is triggered.
- **Lower Warning**: When the sensor signal falls below the learned profile by the value set for the limit, a warning alarm is triggered.
- **Lower Extreme**: When the sensor signal falls below the learned profile by the value set for the limit, a critical alarm is triggered.

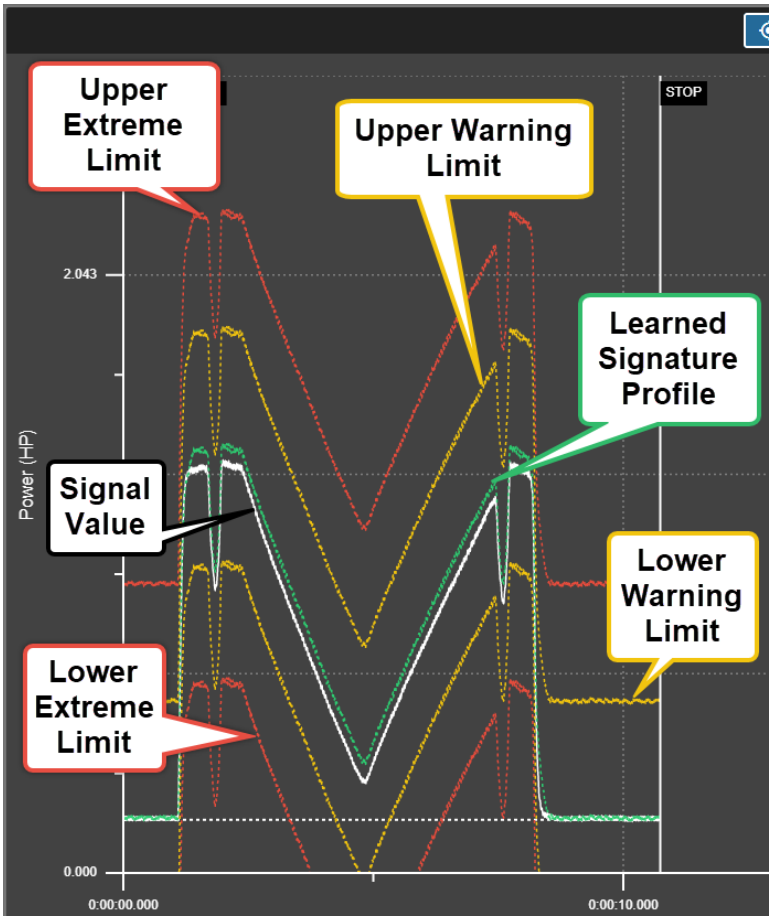

Figure 11-29: Signature Limit Example

Setting Signature Limits

Use the following steps to set signature limits for an operation:

1. Specify the operation by selecting the tool, section, channel and time increment (optional) from the lists on the left side of the Job Editor. The selected operation is displayed at the top of the Job Editor.
2. Select the signature monitor type.

   Note: When selecting the signature monitor type, the operation should be re-learned using the Learn Once feature

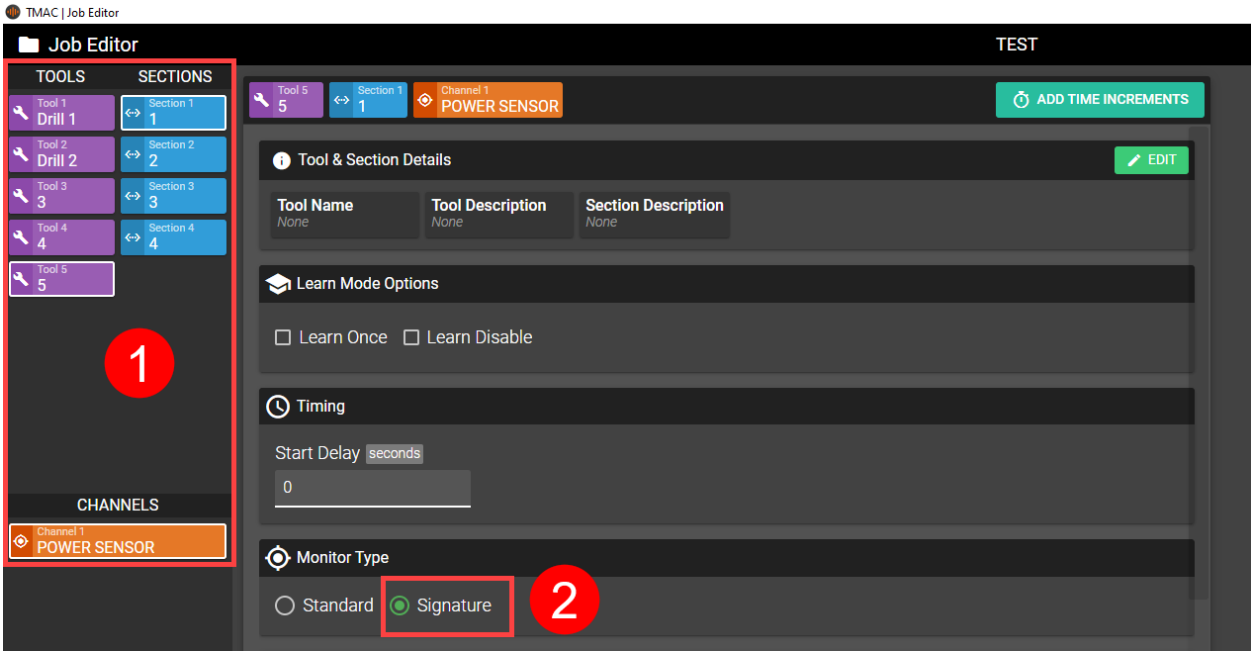

Figure 11-30: Setting Signature Limits Steps 1-2

3. Set desired limits:
   - **Upper Extreme**: Set as a value above the learned profile; A critical alarm is triggered when the signal value exceeds the limit.
   - **Upper Warning**: Set as a value above the learned profile; A warning alarm is triggered when the signal value exceeds the limit.
   - **Lower Warning**: Set as a value below the learned profile; A warning alarm is triggered when the signal value falls below the limit.
   - **Lower Extreme**: Set as a value below the learned profile; A critical alarm is triggered when the signal value falls below the limit.
4. Set any desired alarm delays
   a. If an alarm delay is set for the upper extreme or upper warning limits, an alarm is triggered when the signal value exceeds the limit for the amount of time set in the delay
   b. If an alarm delay is set for the lower extreme or lower warning limits, an alarm is triggered when the signal value falls below the limit for the amount of time set in the delay

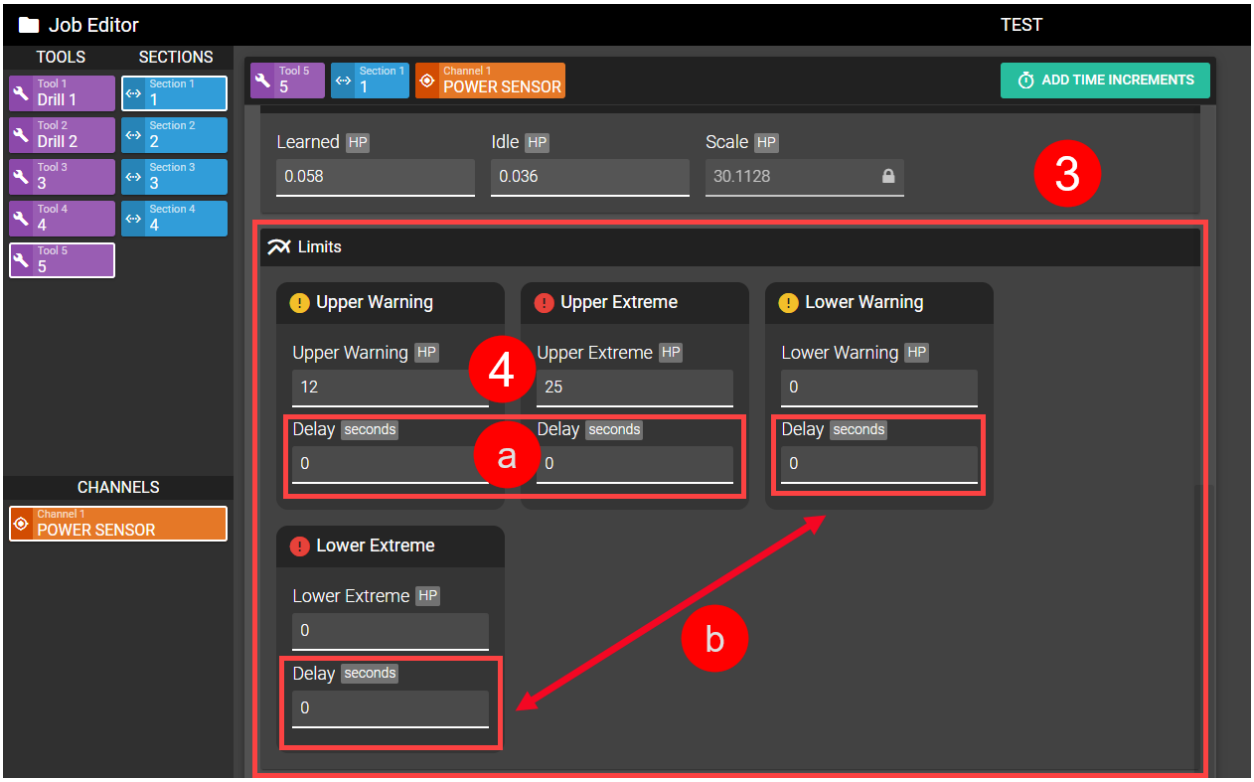

Figure 11-31: Setting Signature Limits Steps 3-4

Chapter 12: Event Log

Overview:

The Event Log button in the TMAC action bar opens a separate window displaying data pertaining to system events. System events include but are not limited to alarms, system resets, job loads, starts and stops. The user can add additional data columns beyond the defaults for the events displayed in the Event Viewer. Additionally, the user can apply filters to columns that limit the events displayed based on configured logic statements.

See Also:

"Columns and Filters" Page 172

"Event Viewer Interface" Page 171

"Exporting Event Log Data" Page 182

Event Viewer Interface

The Event Viewer interface is split into the following three sections:

1. **Events**: A tabulated list of system events based on the columns and filters chosen.
2. **Filters**: A list of applied filters.
3. **Data**: Additional data displayed for a selected event. A specific event can be selected from the list of events by clicking anywhere in the row of the specified event. The additional data displayed is dependent on the type of system event selected.

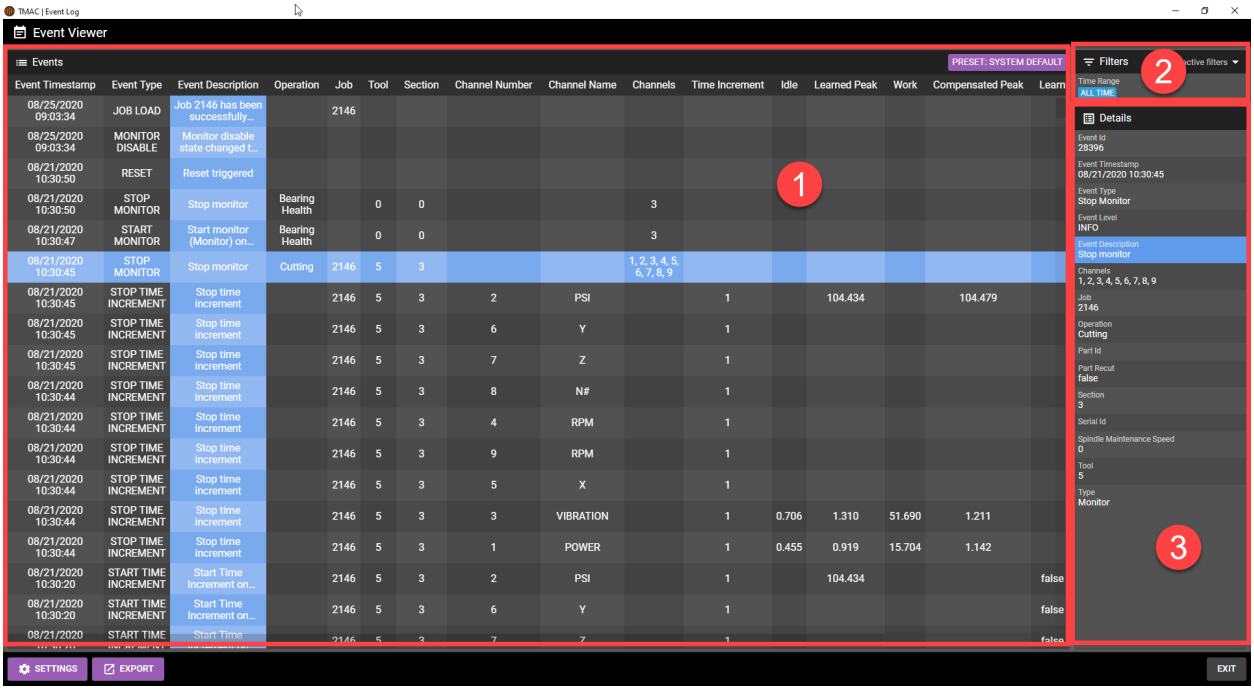

Figure 12-1: Event Log Interface

Columns and Filters

TMAC stores a large amount of event data, but not all event data is displayed in the Event Viewer by default. Users may want to display more data or specific events that meet certain criteria. This can be done utilizing Columns and Filters.

Adding a column amends the event viewer by displaying the additional data correlated with that column for each event. For example if a user desires to have alarm descriptions displayed in the Event Viewer, adding the "Alarm Description" column amends the column to Event Viewer (See Figure 12-2).

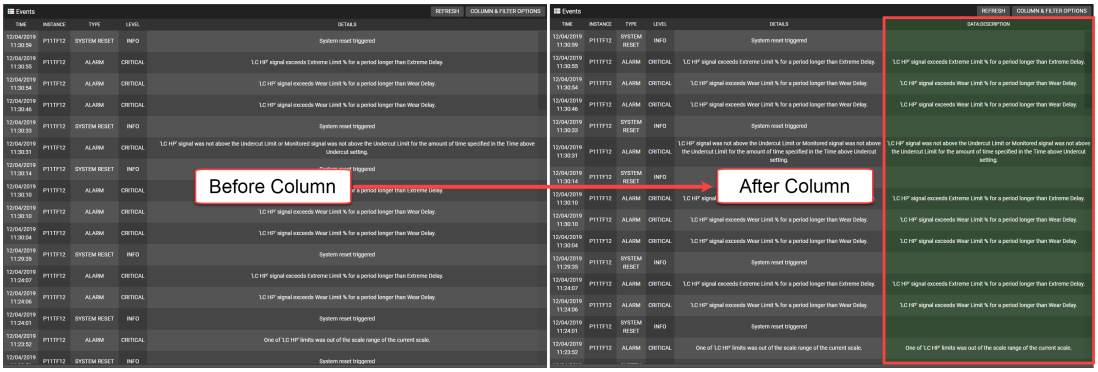

Figure 12-2: Adding a Column Before and After

Filters allow the user to remove undesired events from the Event Viewer. Filters work in conjunction with columns by utilizing filter conditions to remove data that doesn't satisfy the proposed conditions. For example, if a user wants to view only "Alarm" type events, a filter needs to be applied to the "Type" column. Setting a filter with the condition "Equal to ALARM" displays only events that contain "ALARM" in the "Type" column (See Figure 12-3)

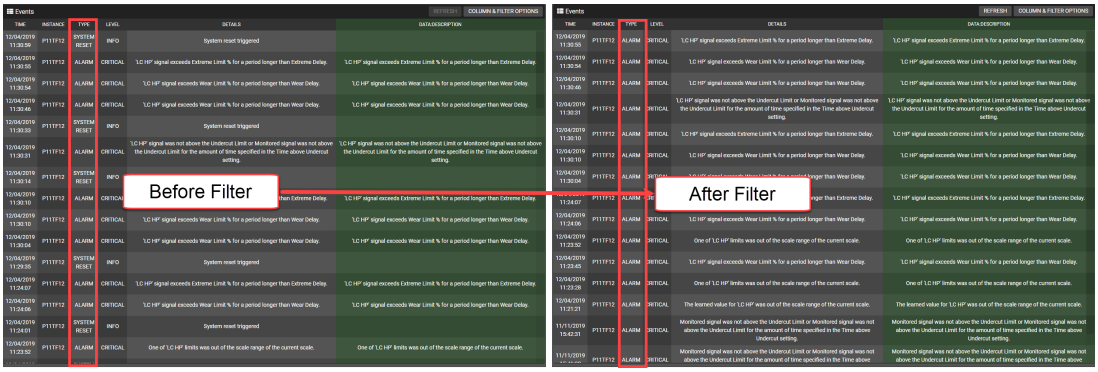

Figure 12-3: Adding a Filter Before and After

Note: The **RESET** button resets the column and filter options to the default settings.

Adding Columns to the Event Viewer

To add columns to the Event Viewer, perform the following steps:

1. Click the **Settings** button
2. Click the Select Columns button to open a list of column types

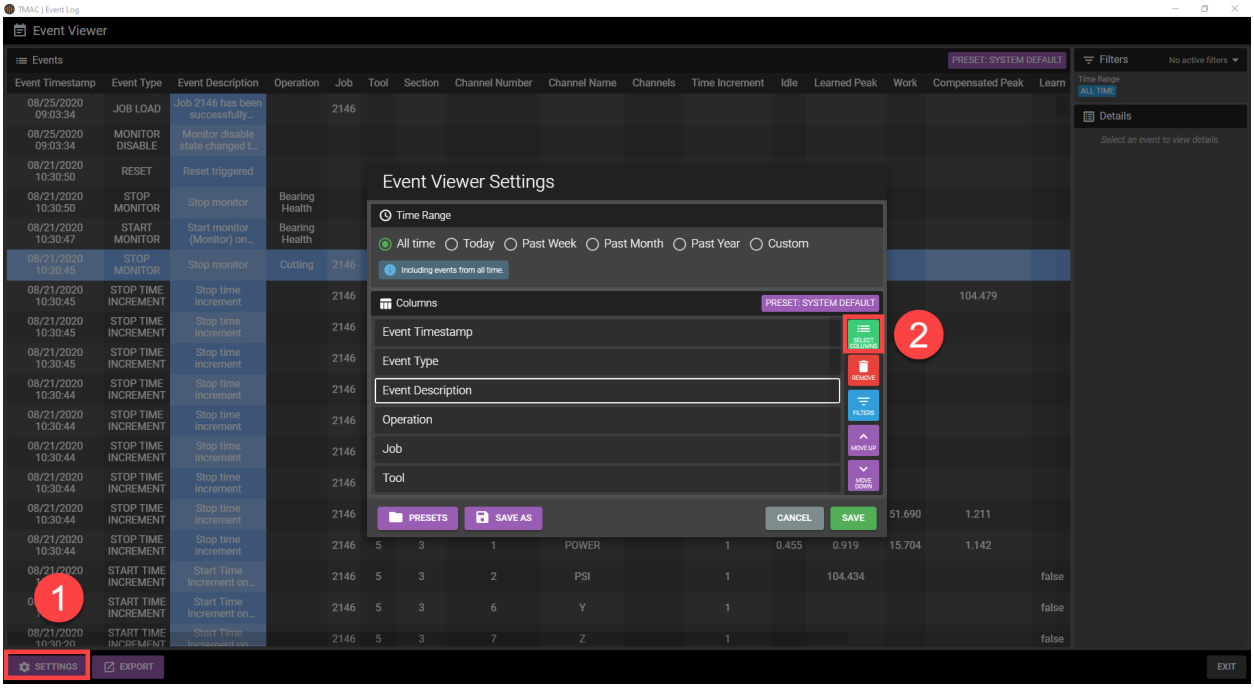

Figure 12-4: Adding Columns Steps 1-2

3. Each column type has an associated check-box. Mark all desired columns by clicking the associated check-boxes.

Note: The Data Columns list can be filtered using the drop-down menu. Columns for all event types are displayed by default. Additionally the DESELECT ALL and SELECT ALL buttons can be used mark all columns for selection.

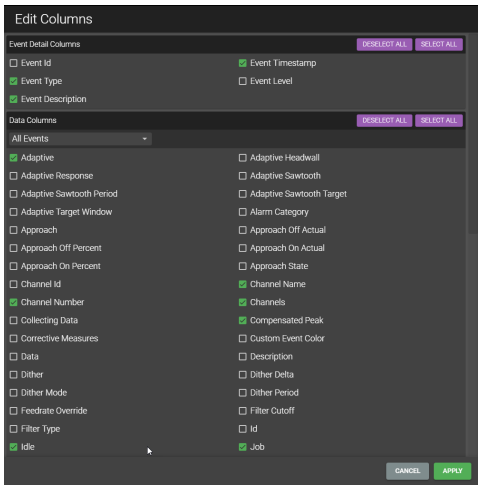

Figure 12-5: Adding Columns Step 3-4

4. Click **Apply** to close the Edit Columns Window
5. Click **SAVE** to close the Event Viewer Settings window

All selected columns are added to the Event Viewer as seen in Figure 12-5 (Green Columns).

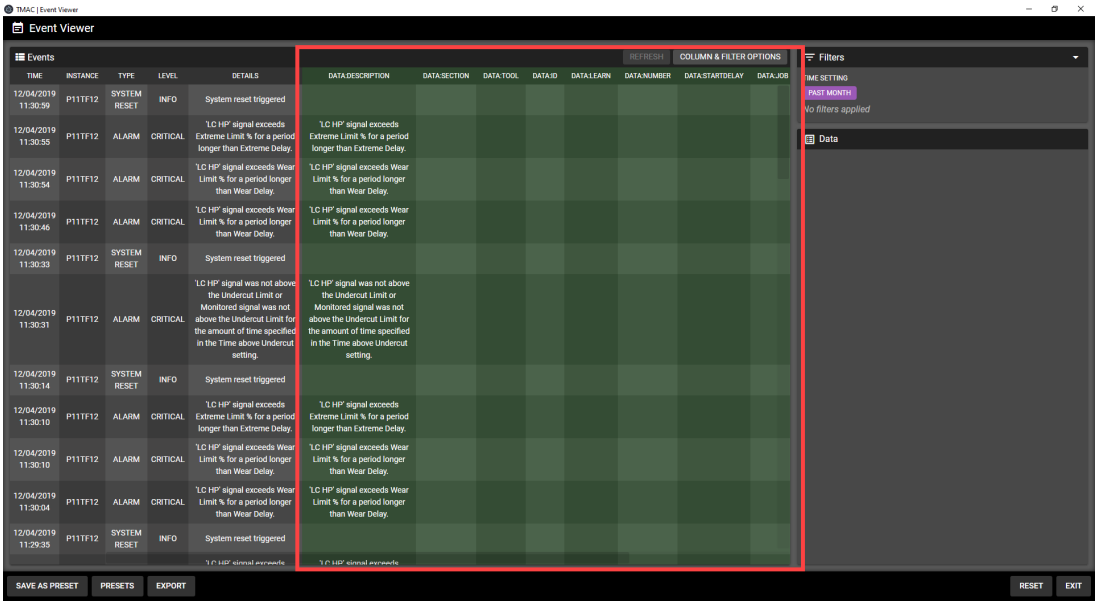

Figure 12-6: Column Selection Window

Reordering Columns

After adding a column to the event log, the column is amended at the end of the list of columns by default. The list of columns in the Event Viewer Settings window are listed in the order they appear in the event log (left to right). If desired, a column can be moved up or down the list using the following steps:

1. Select a column from the list in the Event Viewer Settings
2. Move the column to the desired position using the **MOVE UP** or **MOVE DOWN** buttons
3. Press **SAVE**

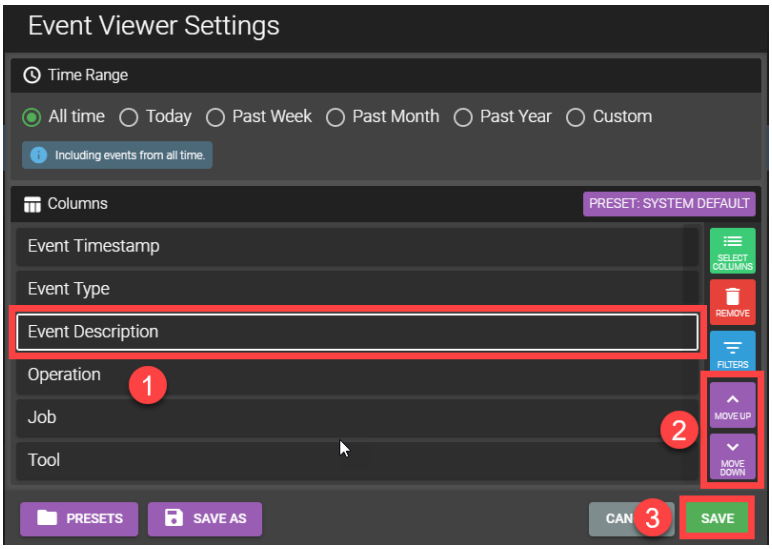

Figure 12-7: Moving Columns Steps 1-3

Adding a Filter to a Column

To add a filter to a column, perform the following steps:

1. Click the **SETTINGS** button
2. Select a column to apply a filter to
3. Click the **FILTERS** button

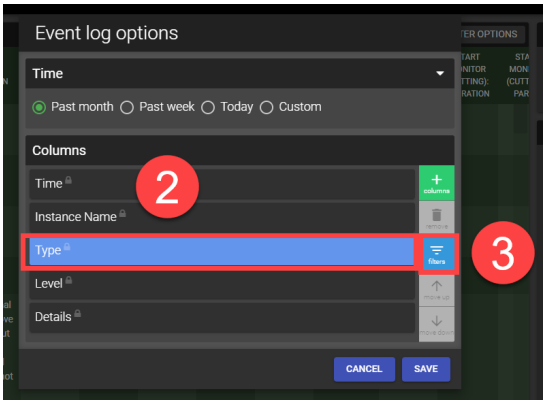

Figure 12-8: Adding Filters Steps 2-3

4. Click the **ADD** button

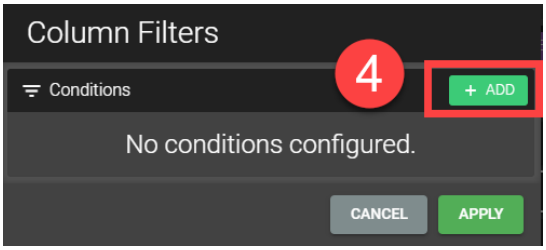

Figure 12-9: Adding Filters Step 4

5. Select a filter condition from the drop-down menu. The following options are available:
    - Equal To
    - Less Than
    - Greater Than
    - Between
6. After a filter condition has been selected, complete the logical expression by entering a value

Note: When utilizing the Between filter condition, the user must input a minimum and maximum value.

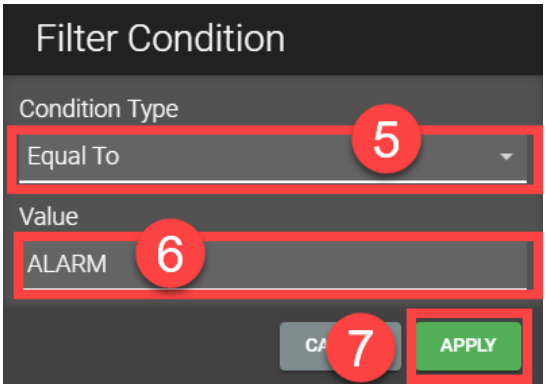

Figure 12-10: Adding Filters Steps 5-7

7. Click **APPLY**

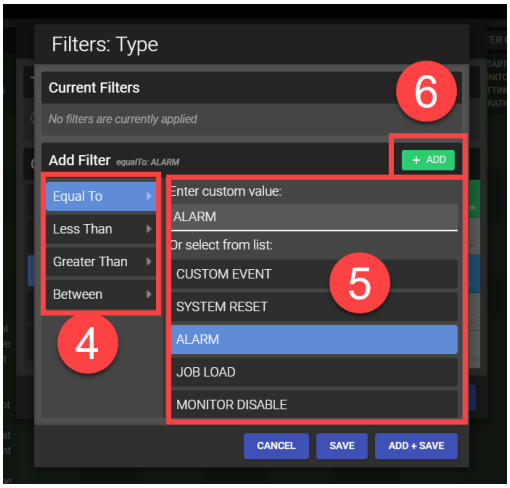

Figure 12-11: Adding a Filter

8. Repeat steps 4-7 for any additional filters that need to be applied or continue to step 9
9. Click **SAVE** to close the Event Viewer Settings window

The filter looks for event data in the column that the filter was applied to and removes all events that do not satisfy the filter conditions. Figure 12-8 displays an example of a filter applied to the "Type" column so that only Alarm events are displayed in the Event Viewer (Equal to ALARM).

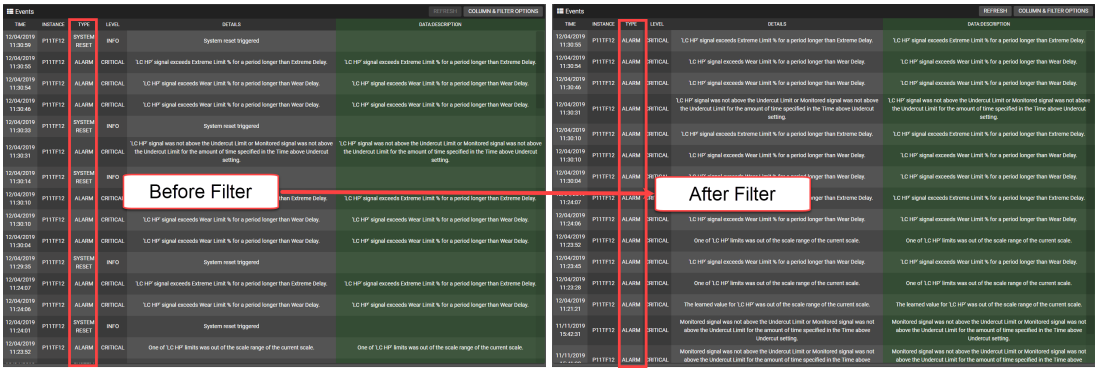

Figure 12-12: Before and After Adding a Filter

Time Filters

The Event log can be filtered based on time and date, in addition to columns and row filters. After opening the Event Viewer Settings, the following time filters can be selected:

- **All Time**: Displays all events recorded since system installation or the last data purge.
- **Today**: Displays events that occurred on today's date.
- **Past Week**: Displays all events that have occurred in the past week.
- **Past Month**: Displays all events that have occurred in the past month.
- **Past Year**: Displays all events that have occurred in the past year.
- **Custom**: Allows the user to input a date range, limiting the displayed events to those that have occurred inside of the date range.

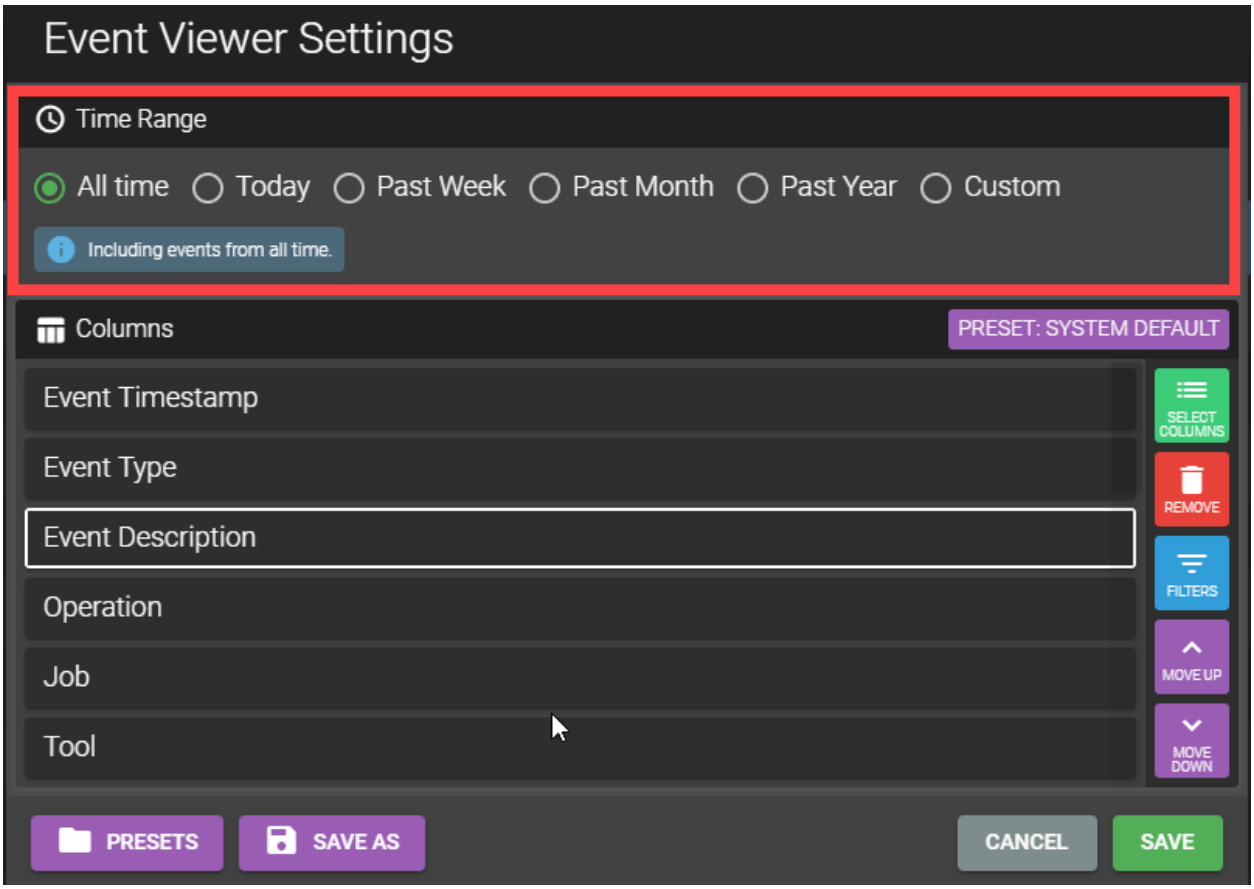

Figure 12-13: Event Log Time Filters

Presets

Presets allow the user to save applied columns and filters to easily switch between specific data sets. For example, a user could have a preset that displays only alarm events and a preset with only Job Load events. Switching between presets prevents the user from having to remove and re-add the columns and filters every time different data needs to be viewed. TMAC is installed with a system default preset.

A user created preset can also be set as the default in place of the system default.

Note: Presets are stored in the HMI software they are created on and will not persist across devices.

Saving a Preset

Perform the following steps to save a preset:

1. Add or remove any data columns desired for the custom preset
2. Apply any filters to eliminate unwanted events
3. Click the **SAVE AS** button

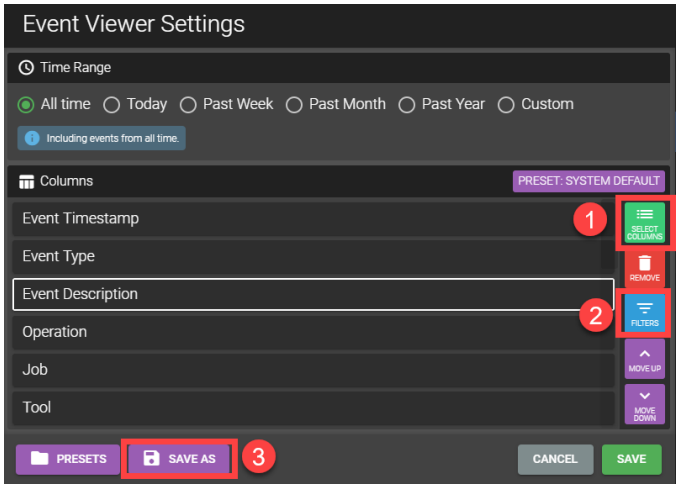

Figure 12-14: Saving a Preset Steps 1-3

4. Enter a name for the preset
5. Click **SAVE**

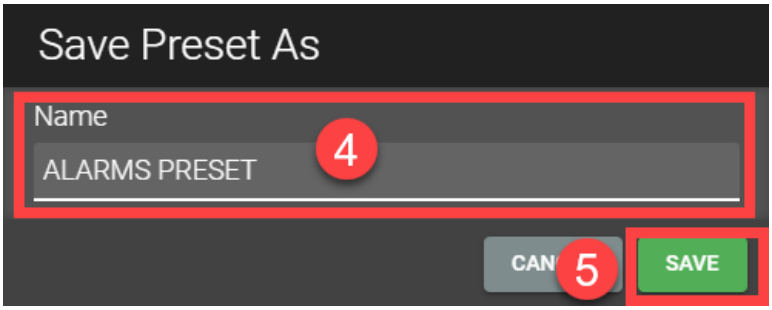

Figure 12-15: Saving a Preset

Manage Presets

Pressing the **PRESETS** button opens the Manage Presets window. In this window, users can open, delete, import, and export presets. Additionally, any user created preset can be set as the default preset.

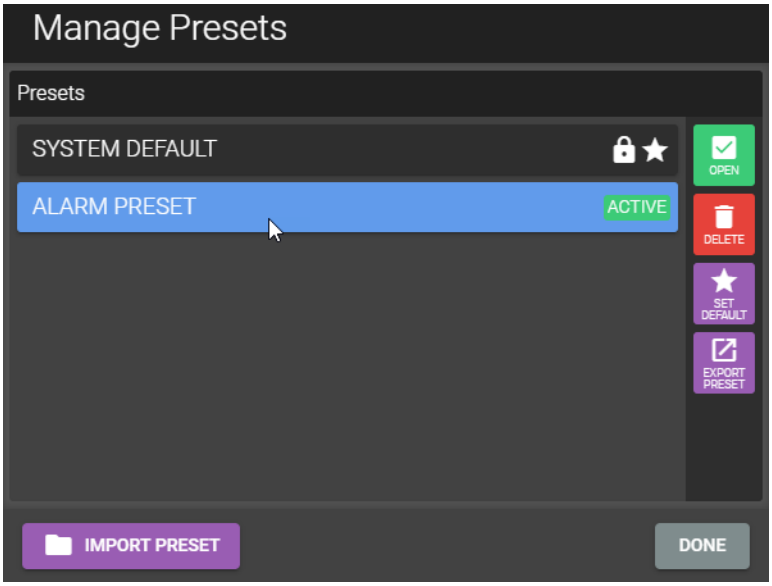

Figure 12-16: Manage Presets Window

Manage Presets Toolbar	
Button	**Functionality**
OPEN	Opens the selected preset in the Event viewer settings
DELETE	Deletes the selected preset from the available list of presets
SET DEFAULT	Sets the selected preset as the default preset for the PC or browser TMAC is being viewed on.
EXPORT PRESET	Prompts the user to create and save a preset file for the selected preset.
IMPORT PRESET	Imports a preset file for use in the Event Log

Table 12-1: TMAC HMI Action Bar Functionality

Exporting a Preset

Use the following steps to export preset:

1. In the Manage Presets window, click the **EXPORT PRESET** button
2. Navigate to the desired directory and name the preset file
3. Click **Save**

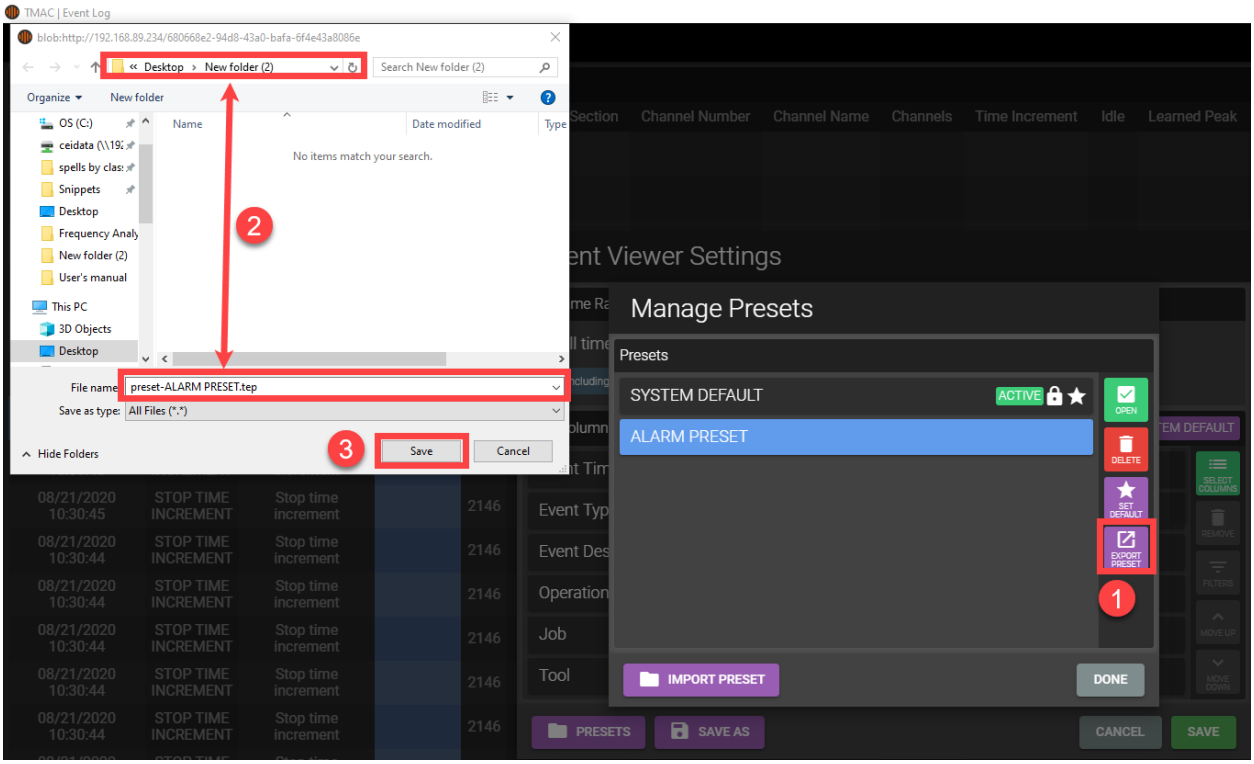

Figure 12-17: Exporting a Preset Steps 1-3

Importing a Preset

Use the following steps to import preset for use in the Event Log:

1. In the Manage Presets window, click the **IMPORT PRESET** button
2. Browse to and select the desired preset file
3. Click **Open**

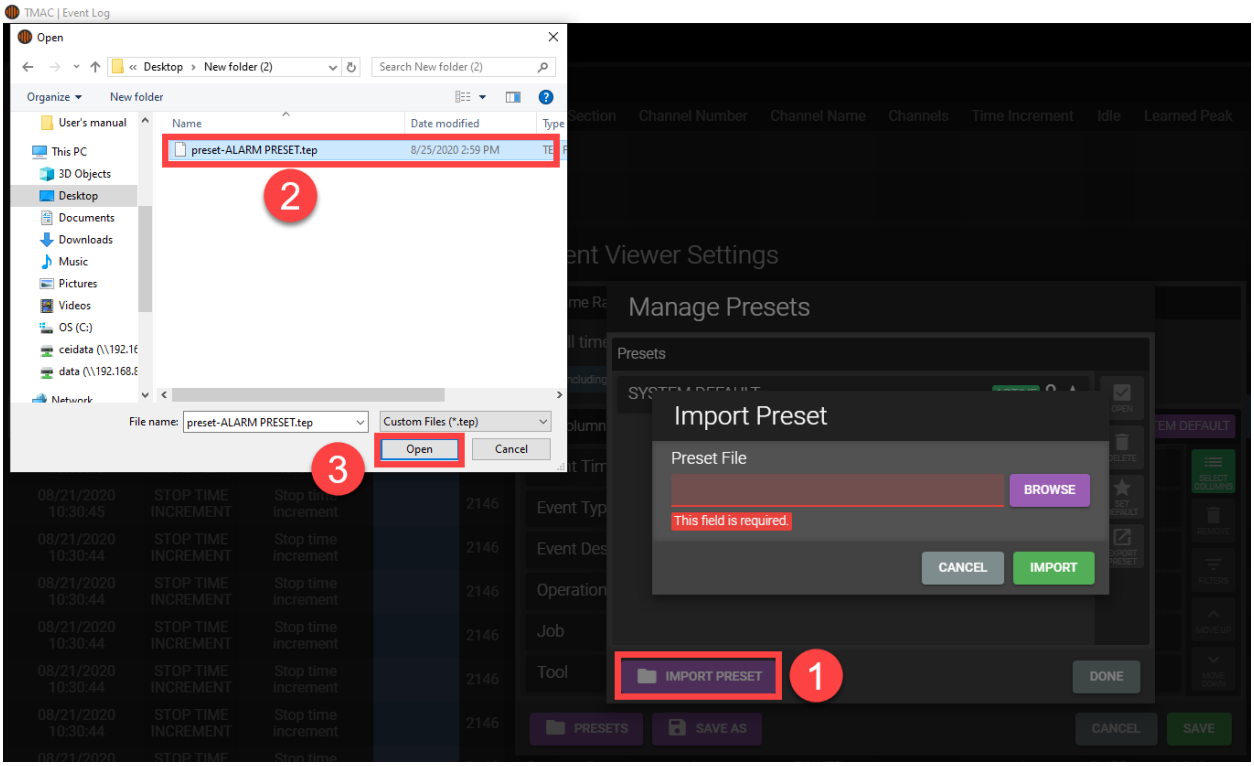

Figure 12-18: Importing a Preset Steps 1-3

Exporting Event Log Data

The data from the event log can be exported to a file. To export event log data, use the following steps:

1. Click the **EXPORT** button
2. Select a time frame from the following options:
    a. All Time
    b. Today
    c. Past Week
    d. Past Month
    e. Past Year
    f. Custom: Enter a custom date range
3. Select a Format
    a. CSV: Exports the event log data to a .csv file
    b. HTML: Exports data to a file in HTML format
4. Select additional options
    a. **Export all columns**: If enabled, TMAC exports data from all columns instead of the currently configured columns.
    b. **Export all events**: If enabled, TMAC exports data from all events within the selected time frame, ignoring any applied filters.
5. Click **EXPORT**

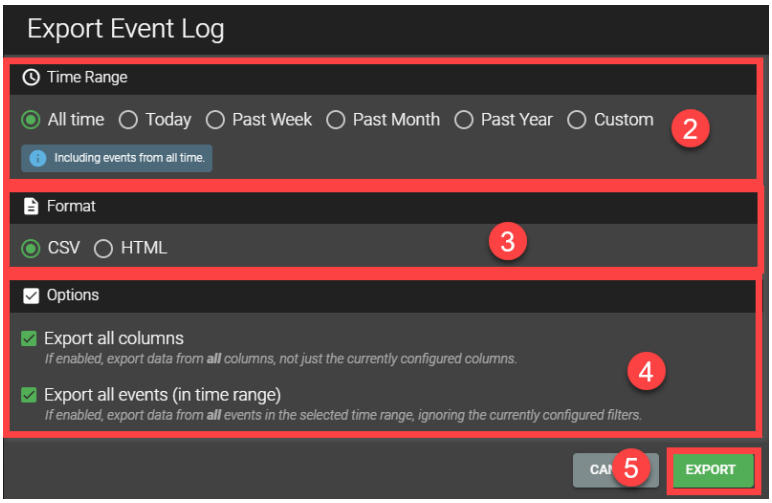

Figure 12-19: Exporting Event Log Data Steps 2-5

6. Navigate to the desired directory and name the file
7. Press Save

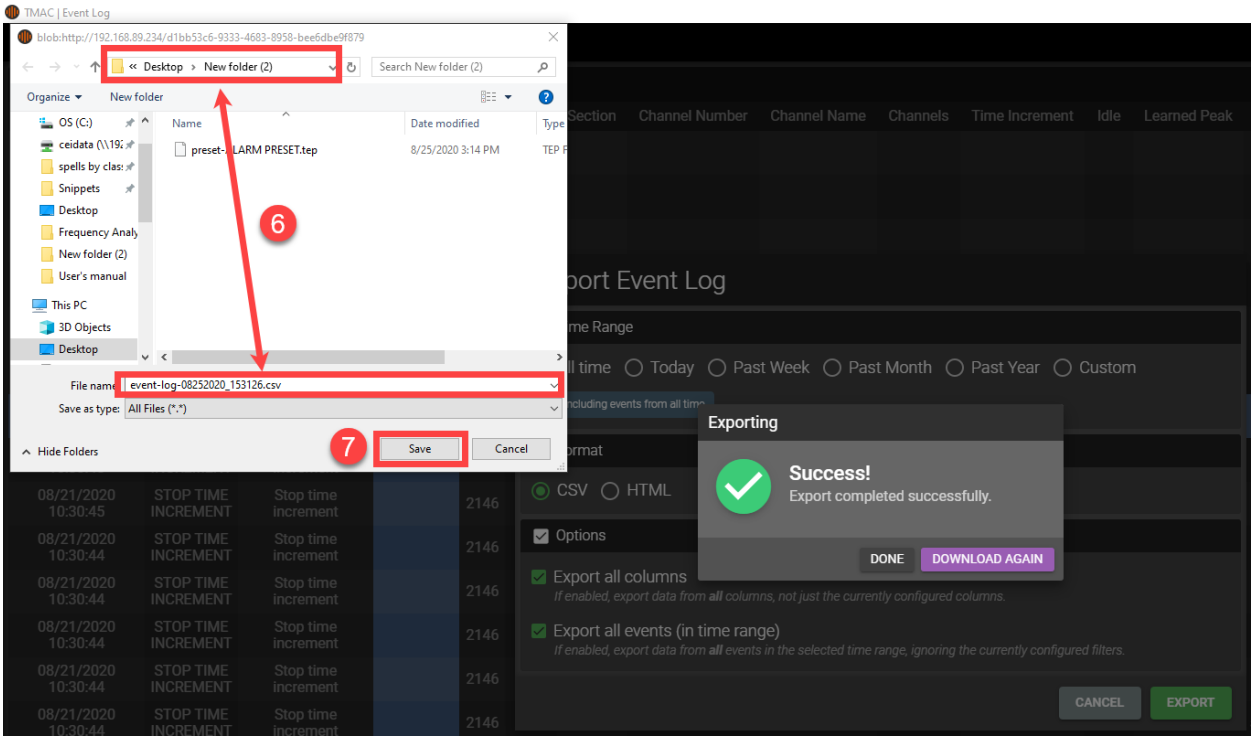

Figure 12-20: Exporting Event Log Data Steps 6-7

8. Click **DONE** to close the window.

Chapter 13: Data Viewer

Overview

The TMAC Data Viewer is a diagnostics tool for analyzing historical data. The Data Viewer allows graphical viewing of TMAC recordings. Various tools are available in the Data Viewer to analyze data. The Data Viewer interface and functionality varies based on the mode of operation selected at launch. The following modes of operation are available:

- Cutting Mode
- Bearing Health
- Millivolt Mode

Note: The Change Mode button allows the user to switch between modes in the Data Viewer.

See Also

"Data Viewer: Cutting and Millivolt Modes" Page 185

"Data Viewer: Bearing Health Mode" Page 204

Data Viewer: Cutting and Millivolt Modes

The interface and functionality of the Data Viewer are the same for Cutting Mode and Millivolt Mode. Minor differences occur in the units displayed on the recording and in the data reported in the Details Tab. (See "Details Tab" Page 190.

When Cutting Mode or Millivolt Mode is selected, the Data Viewer opens the most recent recording for the selected mode. The Data Viewer interface is split into two sections: A tool bar and a graphical display of the operation recording. The tool bar provides information about the operation and provides several tools for analyzing recordings.

The Data Viewer tool bar has the following tabs:

- Recordings
- Details
- Events
- Tools
- More

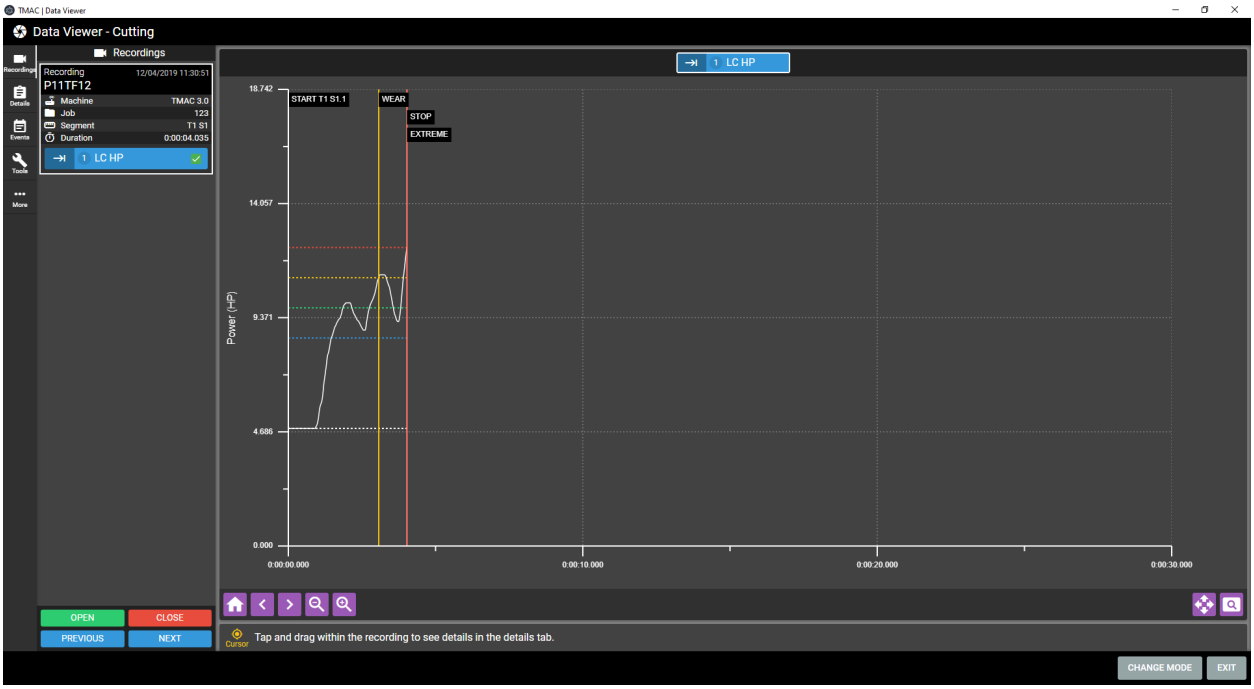

Figure 13-1: Data Viewer - Cutting and Millivolt Modes

Recording Viewer

The Recording Viewer portion of the Data Viewer offers a graphical representation of the selected operation. The recording of the operation can be manipulated with a set of buttons available at the bottom of the Recording Viewer. Refer to Table 13-1 for descriptions of the functionality of these buttons.

Recording Viewer Button Functions	
Button	**Description**
	Returns the recording to the default position.
	Shifts the recording snapshot 3 seconds to the left
	Shifts the recording snapshot 3 seconds to the right
	Zooms out of the recording
	Zooms into the recording
	Functions the same as the Pan tool in the Editor Toolbar
	Functions the same as the Pan tool in the Editor Toolbar

Table 13-1: Recording Viewer Button Functions

Recordings Tab

The Recording tab is used to open recordings for viewing. Multiple recordings can be opened simultaneously. Open recordings are listed on the left of the recording viewer. Each open recording is represented by an information card that includes additional data. Any number of recording cards can be opened simutaneously. Figure 13-2 displays the Recordings Tab.

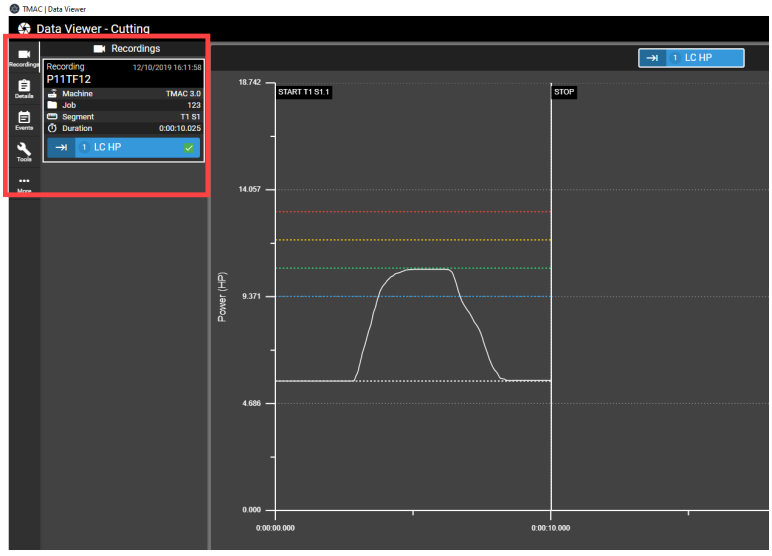

Figure 13-2: Recordings Tab

Recording Cards

The recording cards display the following information about the recording:

- Date and Time Stamp
- Instance Name
- Machine Name
- Job Name (Cutting Mode only)
- Tool Number
- Section Number
- Cut Duration
- Channel Name(s)

Each recording card has check-boxes for each channel associated with the recording. Marking these check-boxes adds a Channel button above the recording viewer for the associated channel. When multiple channel check-boxes are marked, the data for each channel overlays in the recording viewer. This allows for quick and easy comparisons of data. Up to four channels can be marked for comparison.

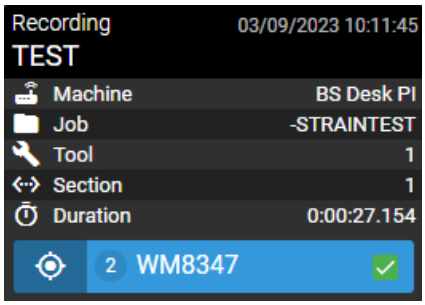

Figure 13-3: Recording Card

Note: Recording cards may have multiple channel check-boxes. This occurs when the recorded operation included a multichannel start.

In addition to the recording cards displayed, there are buttons available that manipulate the list.

Recording Card Buttons	
Button	**Description**
OPEN	Opens a window to select recordings to open
CLOSE	Closes the selected recording card
PREVIOUS	Cycles the selected card to the previous recording of the same operation.
NEXT	Cycles the selected card to the next recording of the same operation.

Table 13-2: Recording Card Button Descriptions

Note: Active recording filters affect the behavior of the Next and Previous button, when cycling through recodings. Only recordings that meet the filter conditions are displayed.

Opening a Recording Card

Clicking the **OPEN** button on the Recordings tab opens a window displaying a list of available recordings and a list of open recordings. This window offers a simple interface to open multiple recordings at once in the Data Viewer. To open recordings in the Data Viewer, use the following steps:

1. Click the **OPEN** button on the Recordings tab
2. Available recordings are on the left hand side of the window. Select the recording(s) to open by clicking the check-boxes next to the desired recordings.
3. Click the ADD button to move the selected recordings to the Open Recordings list.

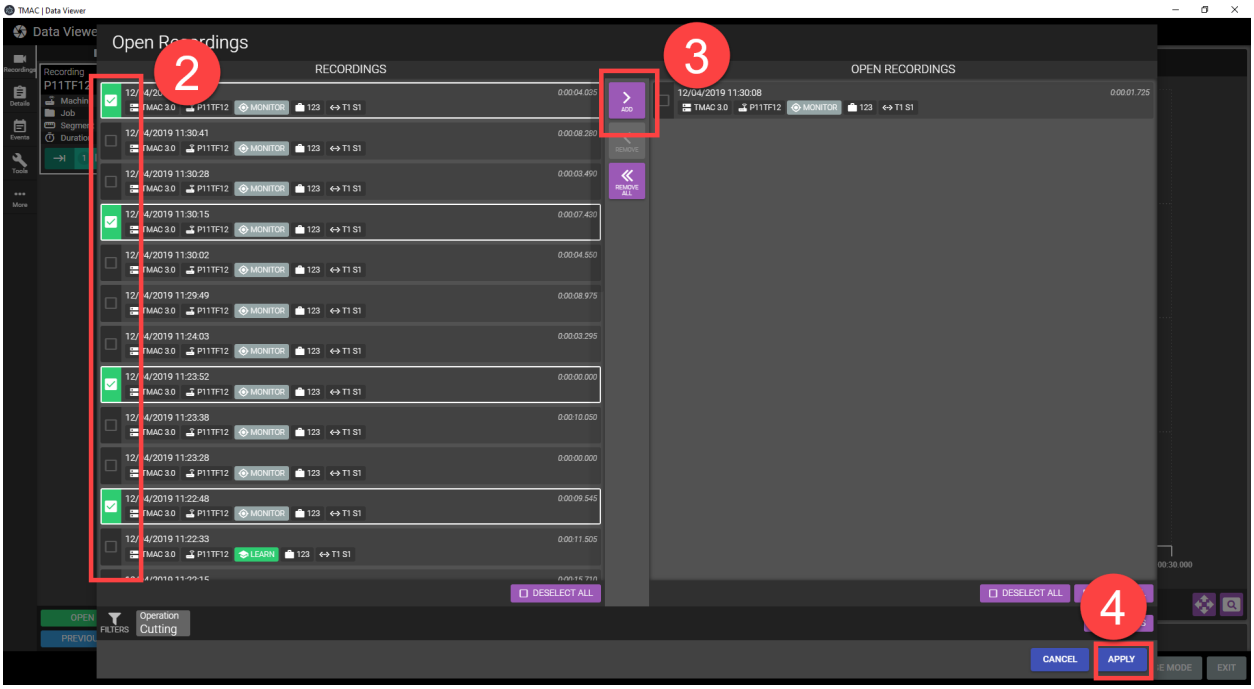

Figure 13-4: Opening Recording Cards

4. Click **APPLY** to open the recordings in the Data Viewer

The selected recordings are added to the list of recordings in the Data Viewer and are available for viewing.

Figure 13-5: Open Recording Cards w/ Applied Filters

Applying Recording filters

The list of available recordings may be very large. Filters are available when selecting a recording to open. To access the recording filters, click the **EDIT FILTERS** button. The following filters are available:

- **Machine**: Select from a list of machines names. Only recordings from the selected machine will be displayed
- **Instance**: Select from a list of instances. Only recordings from the selected instance will be displayed
- **Time Range**: Select from a list of preset time frames or set a custom time frame. A custom time frame is defined by the user by specifying a date and time for the start and end of the time range. Only recordings within the selected time frame will be viewable in the list of recordings.
- **Alarm**: Filter recordings by alarm type. Only recordings containing the selected alarm condition are displayed. Selecting **No Alarm** displays only recordings without alarm conditions.
- **Monitor mode**: Select Monitor mode or Learn mode. Only recordings of the selected mode will be displayed.
- **Serial ID**: Filter recordings by Serial ID set in the instance parameters
- **Part ID**: Filter recordings by Part ID set in the instance parameters
- **Tool**: Enter a tool number. Only recordings of the selected tool will be displayed.
- **Section**: Enter a section number. Only recordings of the selected section will be displayed.
- **Job**: Enter a Job name. Only recordings of the job entered will be displayed

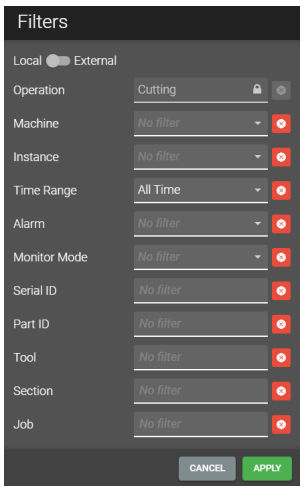

Figure 13-6: Recording Filters

Any number of recording filters may be used. To enable a filter, select an option from the filter's drop-down menu. Once all filters have been selected, click the **APPLY FILTERS** button to apply the filters to the recordings.

Note 1: The Local/External toggle switch in the filter window determines which recordings are affected from the filters. External recordings are recordings that have imported from other TMAC systems.

Note 2: Filters applied here persist in the Data Viewer after the recording(s) are opened. The applied filters are displayed in the bottom left of the interface as seen in Figure 13-5. These filters are applied when cycling through recording using the Next and Previous buttons.

Channel Buttons

The Channel buttons above the Recording Viewer allow easy access to channel data from a recording. The data associated with each channel button are all displayed on the recording viewer. When a channel button is selected, the button's associated data is displayed on top of the other channel data. This feature provides quicker access to switch between recordings. It is also useful for comparisons between iterative recordings of the same channel's operation.

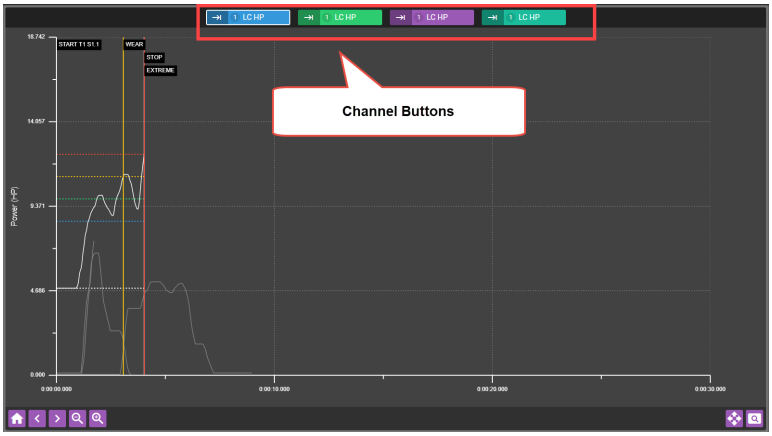

Figure 13-7: Channel Buttons

Details Tab

The Details tab provides additional data about the recording. Placing the cursor displays additional data dependent on the mode selected.

- **Cutting Mode**: Placing a cursor displays channel data, limits, cut time, etc. at cursor location.
- **Millivolt Mode**: Placing a cursor displays scale, absolute and relative sensor values, cut time etc... at cursor location.

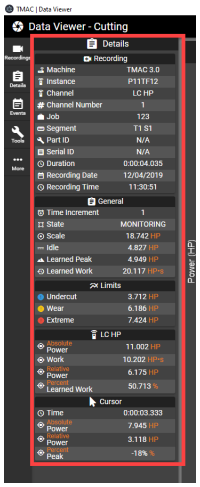

Figure 13-8: TI Editor Details Tab

Note: The Details tab is where CNC data is viewable. Refer to Appendix A "Reference Tables" Page B-1

Events Tab

The Events tab displays a list of events including start monitors, stop monitors, alarms, and custom events. The time at which these events occurred during the operation is displayed below the event name. Additionally when an event is selected from the list, the recording viewer snaps to the location of the selected event. This feature makes it easier to locate specific data in long recordings.

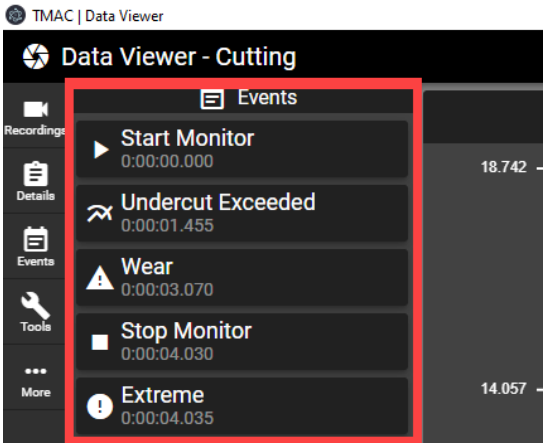

Figure 13-9: Events Tab

Tools Tab

The Tools tab provides access to tools that manipulate the recording. The following tools are available:

- **Cursor**: Place a cursor on the recording to display cut data or create a Time increment
- **Pan**: Click and drag the recording to a specific spot
- **Zoom**: Zoom in on a highlighted portion of the recording
- **Delta**: Display differences between two selected data points on the recording
- **P.O.I**: Add a custom point of interest to the recording
- **Find Preak**: Locates an upper or lower peak signal value based on search parameters

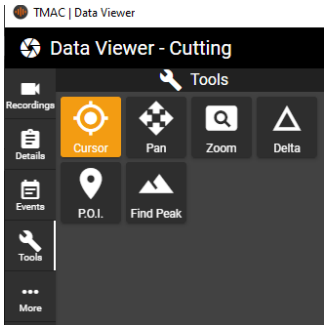

Figure 13-10: Tools Tab

Note: Each tool in the Tools tab can be used in conjunction with one another.

Using the Cursor Tool

The cursor tool allows a cursor to be placed on the recording. Placing a cursor on the recording adds data at cursor location to the Details tab. Once the cursor is placed, it can be clicked and dragged to the desired location. To view the details at cursor location, select the details tab. Clicking the HIDE CURSOR button removes the cursor from the Recording Viewer.

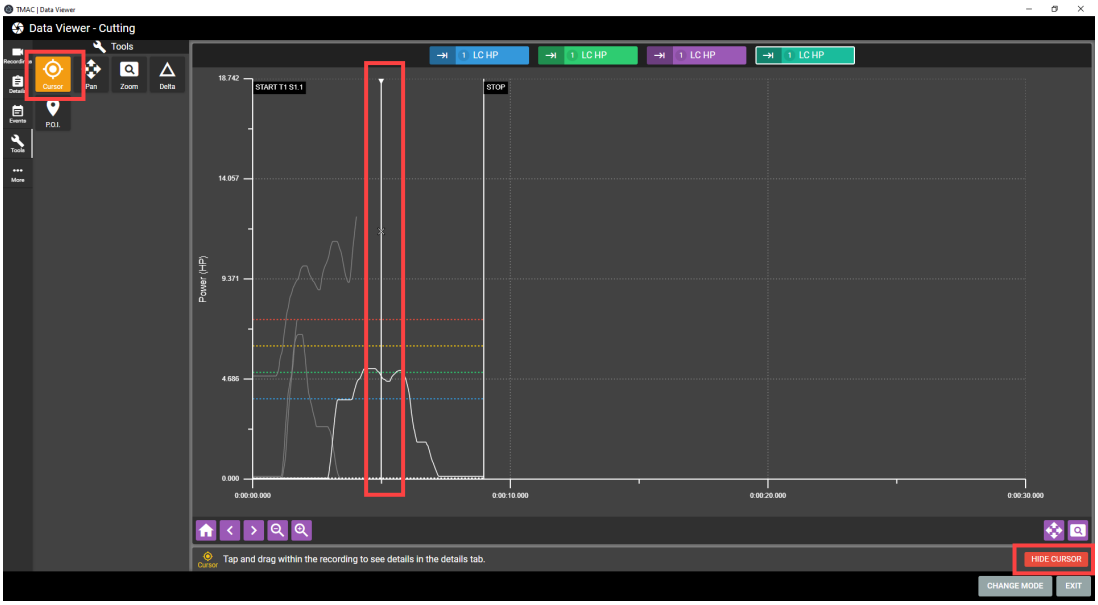

Figure 13-11: Cursor Tool

Using the Pan Tool

The Pan tool is used to move to specific parts of the recording. After selecting the Pan tool, click on the recording and drag in any direction to scroll the recording. This feature is particularly useful on touchscreens. click the DONE button to stop using the pan tool.

Figure 13-12: Pan Tool

Using the Zoom Tool

The Zoom tool is used to zoom to a specific portion of the recording. To use the Zoom tool use the following steps:

1. Select the Zoom tool from the tools tab
2. Highlight the portion of the recording to zoom in on by clicking and dragging on the recording. This draws a rectangle around the portion of the recording.
3. Release the click to zoom in on the highlighted portion of the recording

Figure 13-13: Zoom Tool

The selected portion of the recording is now enlarged to the size of the recording viewer.

Using the Delta Tool

The Delta tool is used to view the difference in signal value and time between two selected points on the recording. To use the Delta tool use the following steps:

1. Select Delta from the tools tab
   Note: The Details tab is automatically displayed.
2. Click on the recording viewer at the first data point
3. Click on the recording viewer at the second data point
   The viewer draws a right triangle on the recording that displays the difference in time and signal value between the two points.
4. Click **DONE**

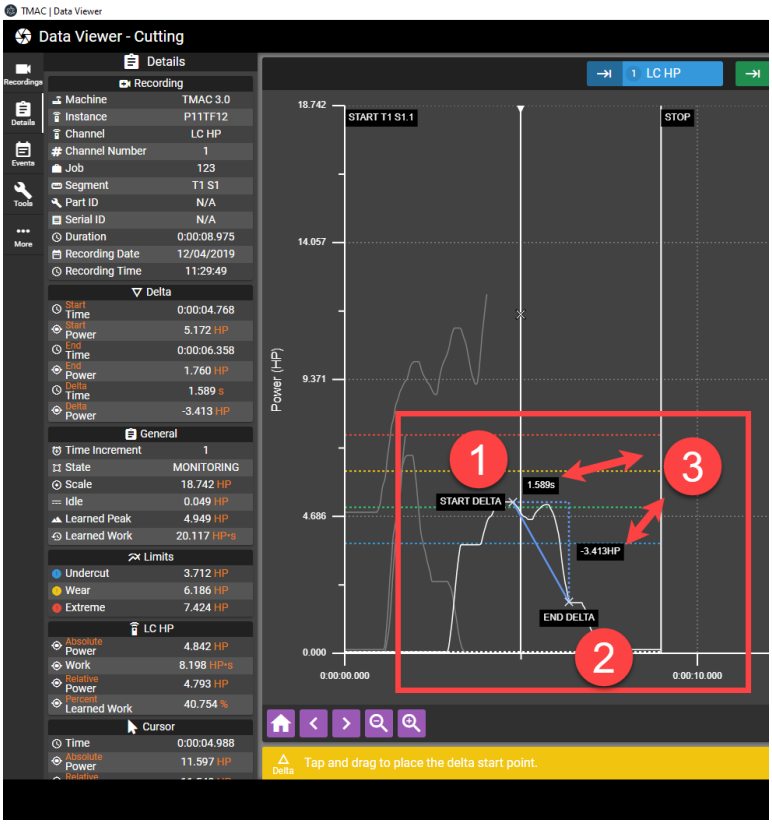

Figure 13-14: Delta Tool

The delta triangle remains on the recording until the Delta tool is used again. Any delta placed on the recording does not persist if the recording is closed.

Using the P.O.I. Tool

The Point of Interest tool (P.O.I.) is used to mark specific spots in the recording for further analysis. To add a P.O.I. marker to a recording, use the following steps:

1. Select the P.O.I. tool from the Tools tab
2. Click on the recording to place a P.O.I. cursor
3. Drag the cursor to the desired location

Figure 13-15: POI Tool

4. Click the **EDIT** button
5. Enter a name for the P.O.I.
6. Select a color to represent the P.O.I.
7. Click **APPLY**

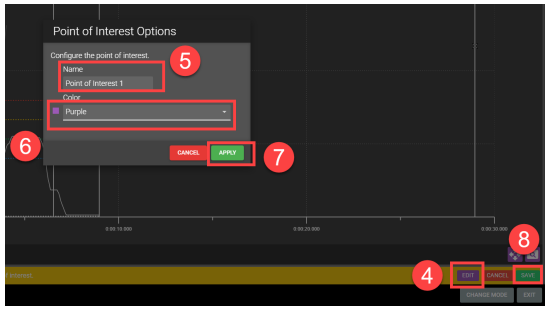

Figure 13-16: POI Tool

8. Click Save

The P.O.I is now saved with the recording. Points of interest can be edited and deleted on the Events tab of the Data Viewer.

Using the Find Peak Tool

The Find Peak tool locates the upper or lower peak of the signal in a recording. When the peak is found, a cursor is placed at the peak and the Data Viewer switches to the details tab. Use the following steps to locate a peak in a recording:

1. Press the Find Peak button on the Tools tab

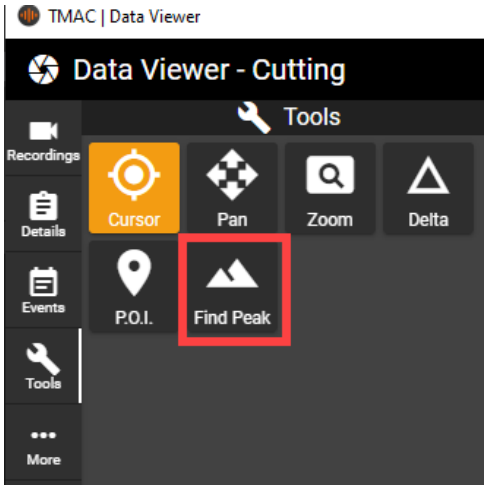

Figure 13-17: Find Peak Tool

2. Select a peak type
    a. **Upper Peak**: Locates the highest signal value within the specified parameters
    b. **Lower Peak**: Locates the lowest signal value within the specified parameters
3. Specifiy a Search Region
    a. **Entire Recording**: Searches the entire recording for the peak value. Continue to step 5
    b. **Time Increment**: Searches the specified Time Increment for a peak value. Continue to step 6
    c. **Custom Time Range**: Allows the user to define a cut time range to search for the peak value. Continue to step 7
4. Press **CONTINUE**

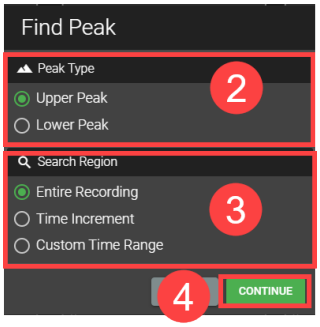

Figure 13-18: Find Peak Tool Search Parameters

5. A cursor is placed on the peak of the recording

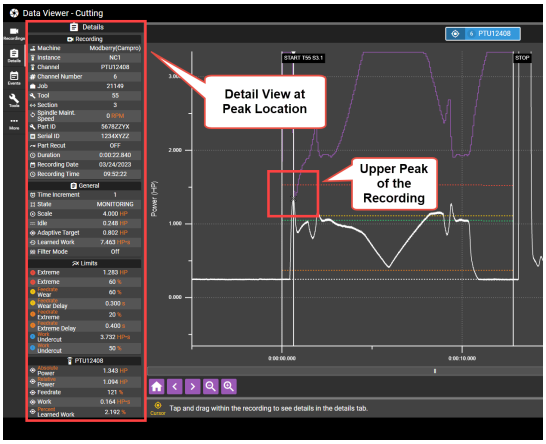

Figure 13-19: Find Peak Entire Recording Option

6. Select a Time Increment from the list and press **SELECT**

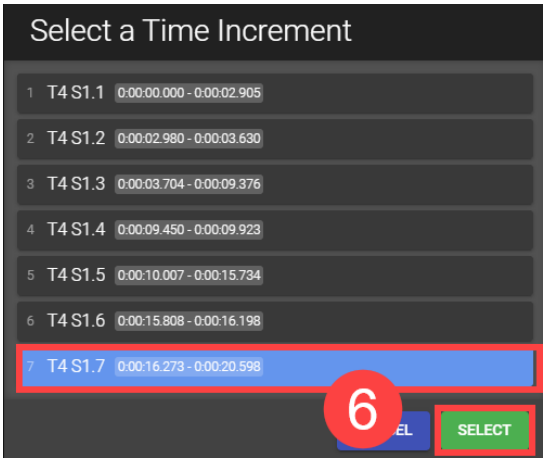

Figure 13-20: Find Peak Time Increment Option

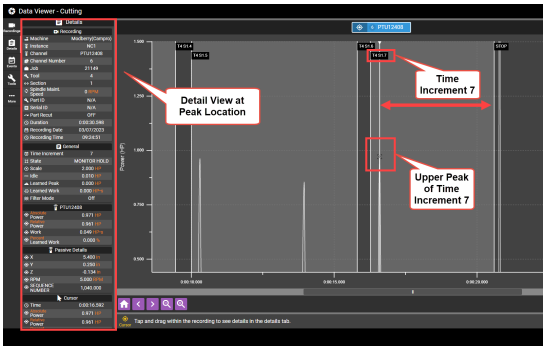

Figure 13-21: Find Peak Time Increment Option

7. Place two cursors on the recording graph to define the search region. The search region of the recording is light green
8. Press **SEARCH**

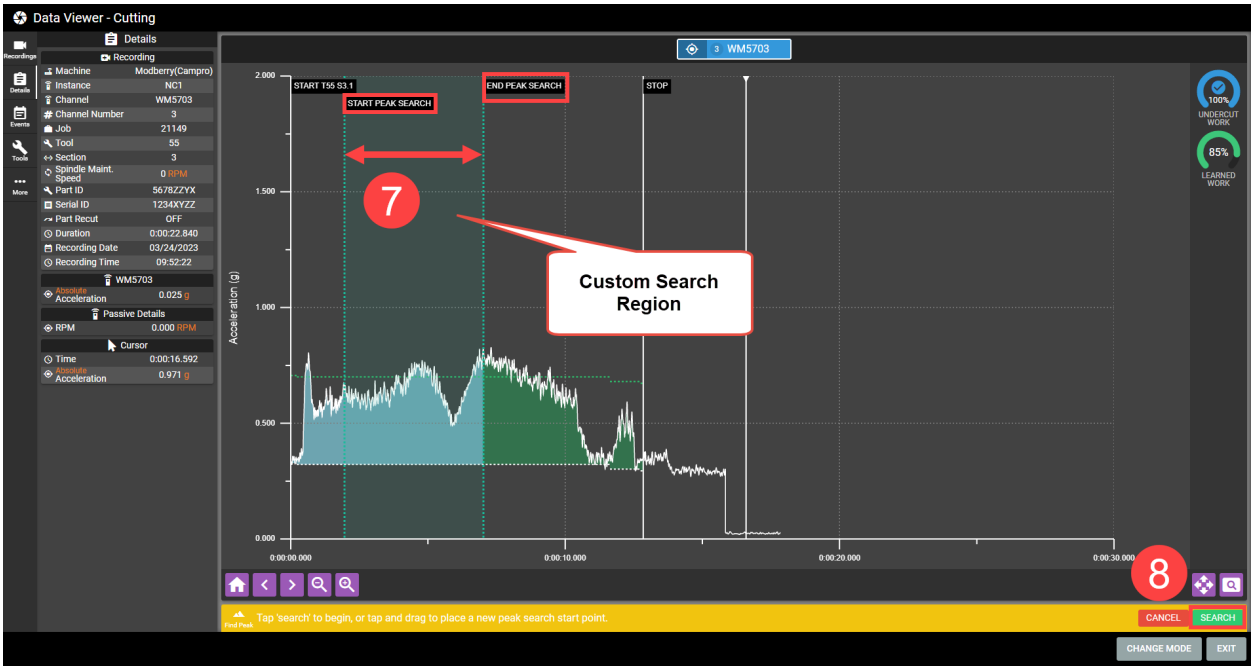

Figure 13-22: Find Peak Custom Time Range Option

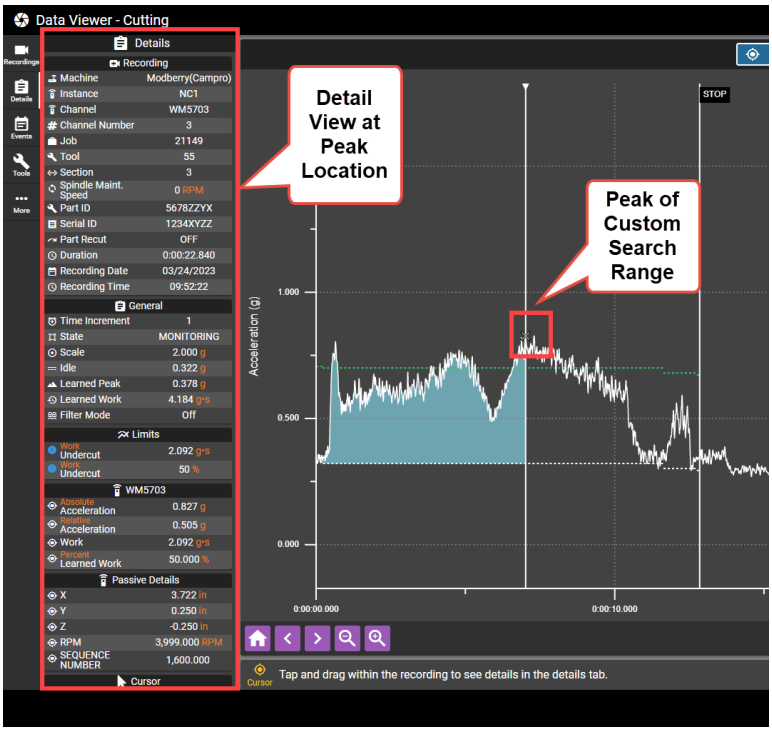

Figure 13-23: Find Peak Custom Time Range Option

More Tab

The More tab provides an interface to import and export recordings for use in the Data Viewer. Exported recordings are saved in a text file with the .tmd extension. Exported recordings can be imported into any TMAC 3.0 system for review in the Data Viewer.

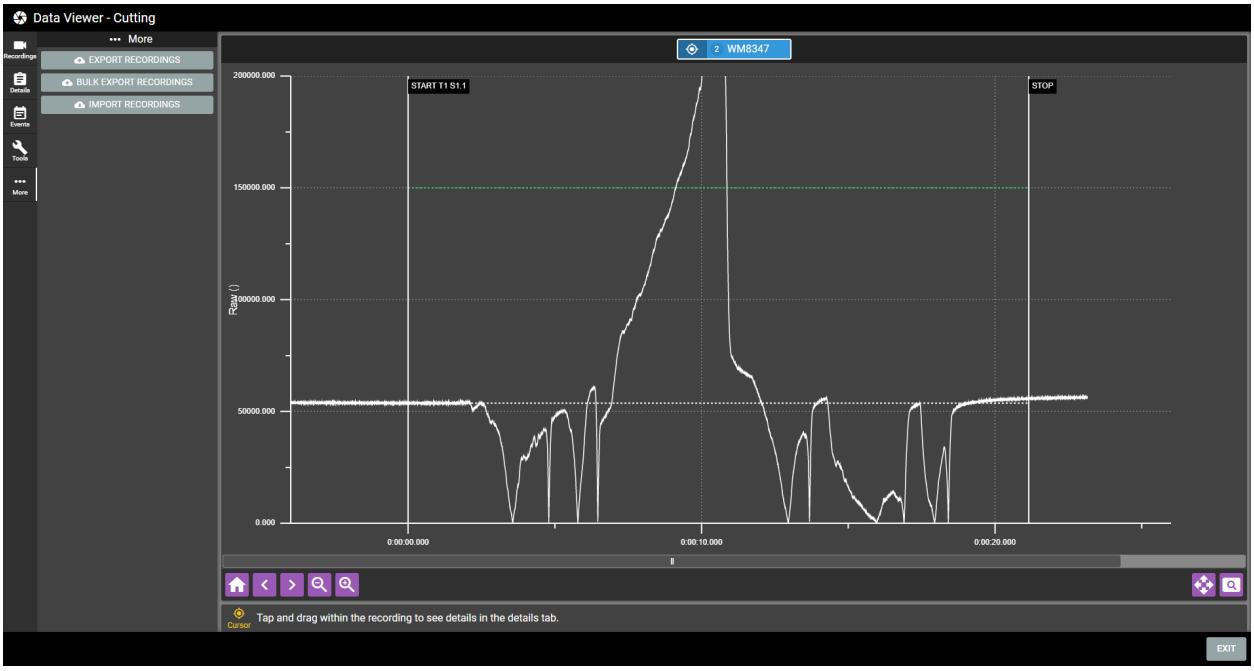

Figure 13-24: More Tab

Exporting Recordings

Perform the following steps to export chart data as a text file:

1. In the More tab, click the **EXPORT RECORDINGS** button
2. Select recordings to be exported from the list by marking the associated check-boxes. The recording list can be filtered in the same manner as when opening recordings. See "Applying Recording filters" Page 189
3. Click the ADD button

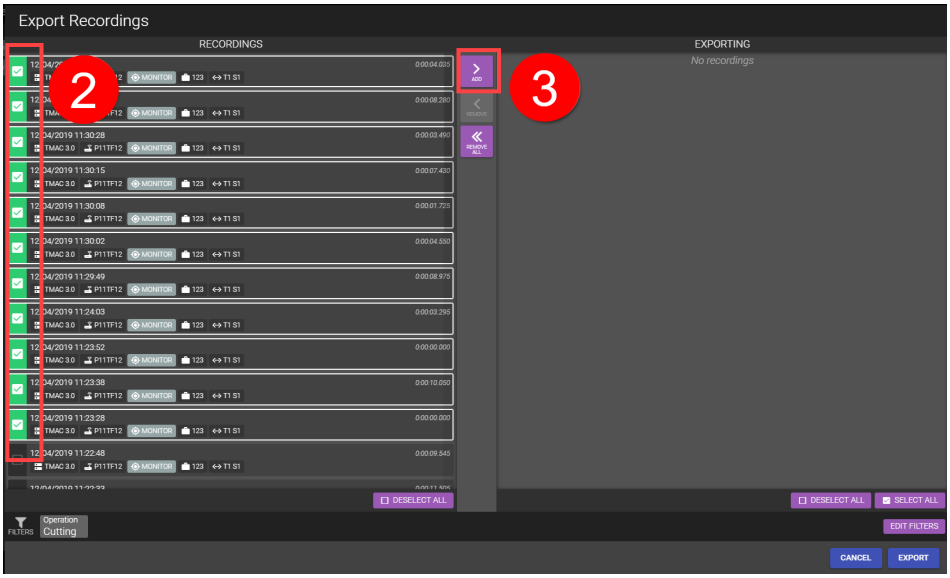

Figure 13-25: Exporting Chart Data Steps 1-3

4. Click Export. TMAC processes the selected recording data and builds a .tmd file

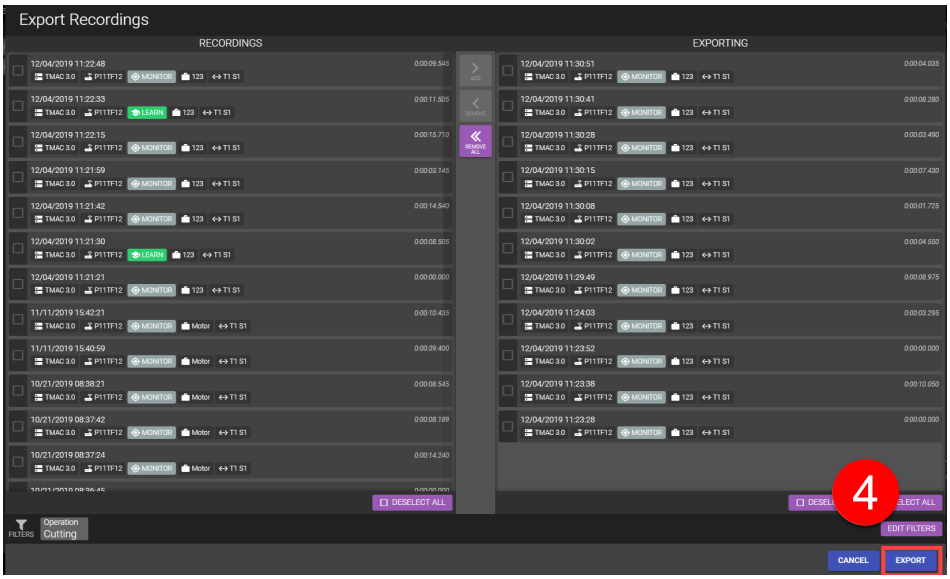

Figure 13-26: Exporting Chart Data Steps 4

5. When the export operation is complete, click DOWNLOAD to save the text file to the desired file location.

Bulk Export Recordings

The data viewer's bulk export feature is used to export a large number of recordings from a TMAC system to a .TMD file. Filters can be applied to the list of recordings to allow only recordings that match specific conditions determined by the user. Use the following steps to perform a bulk export of recordings to a .TMD file:

1. Press the **EXPORT RECORDINGS** button

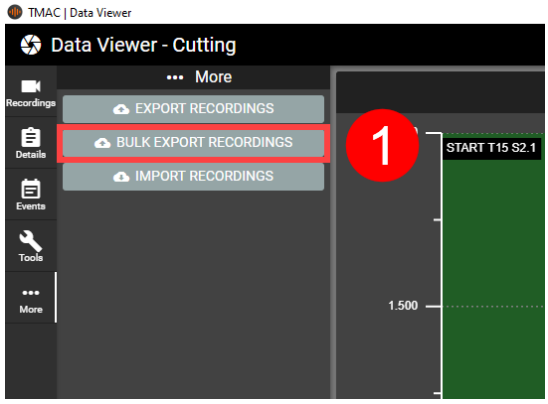

Figure 13-27: Bulk Export Recordings Step 1

2. Apply any desired filters. For recording filter descriptions, see "Applying Recording filters" Page 189

Note: The Local/External toggle switch in Figure 13-20 (Outlined in blue) determines which recordings are displayed in the list. External recordings are recordings that have been imported from a different TMAC system.

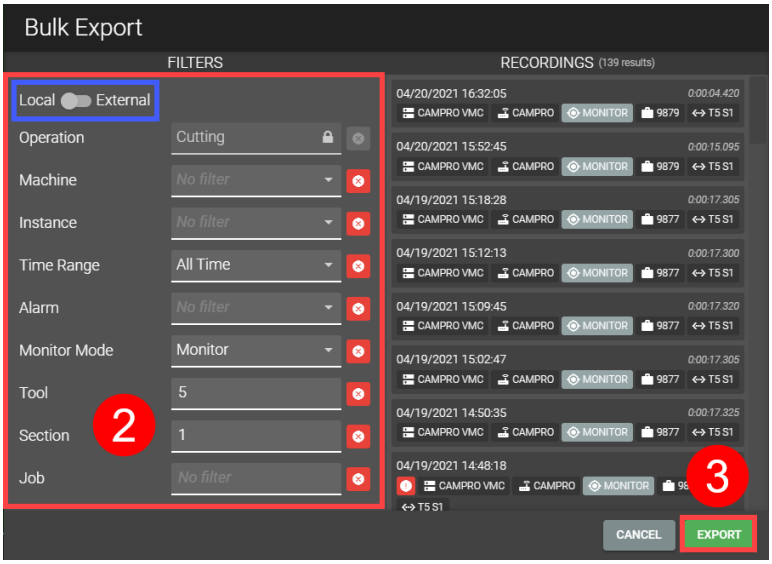

Figure 13-28: Bulk Export Recordings Steps 2-3

3. Press **EXPORT**

Importing Recordings

Perform the following steps to import chart data for review in the Data Viewer:

1. In the More tab, click the IMPORT RECORDINGS button
2. Browse to and select the .tmd file

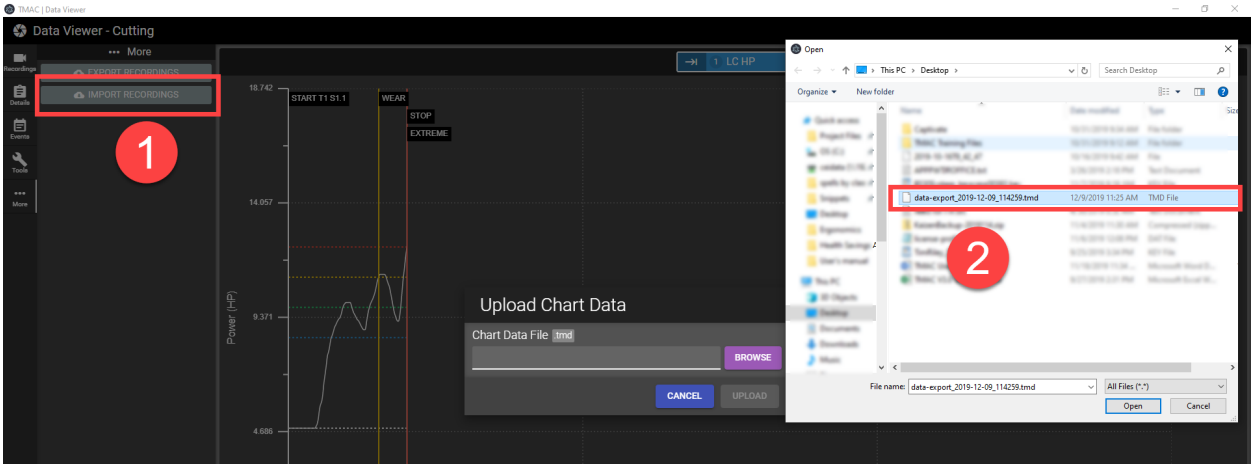

Figure 13-29: Selecting Recording File

3. Select recordings to import from the list of recording
4. Click **ADD**. Alternatively, all recordings can be added to the import list immediately by click the **ADD ALL** button.
5. Click **IMPORT**.

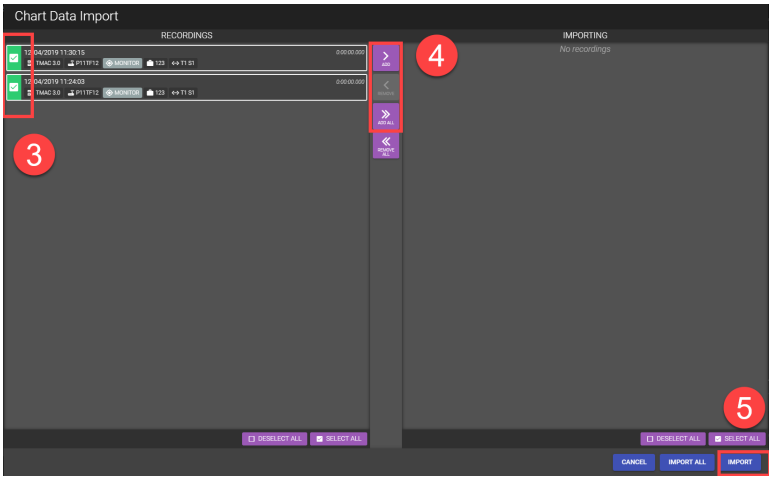

Figure 13-30: Selecting Recordings for Import

The selected recordings are imported and are available for use in the Data Viewer.

Note: If all recordings from the .tmd file are desired, clicking the Import All button imports all recordings from the selected file. The user does not need to specify individual recordings.

Opening Imported Chart Files

Once recordings have been imported from an outside source, the recordings can be opened in the Data Viewer. Imported recordings are opened in the same manner as local recordings, but a few additional steps are required. Use the following steps to open external recordings in the viewer:

1. On the Recordings tab, click **OPEN**
2. The recordings listed by default are the local recordings. To view the imported or external recordings click the **EDIT FILTERS** button

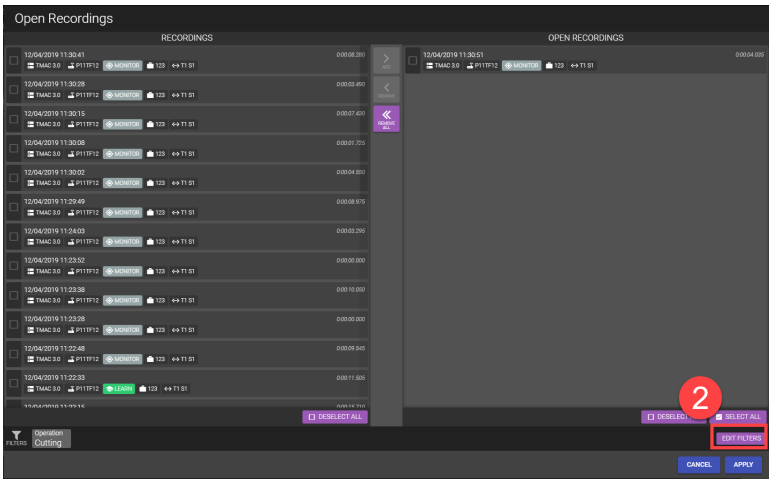

Figure 13-31: Edit Filters

3. Click the **LOCAL/EXTERNAL** toggle button
4. Click **APPLY**

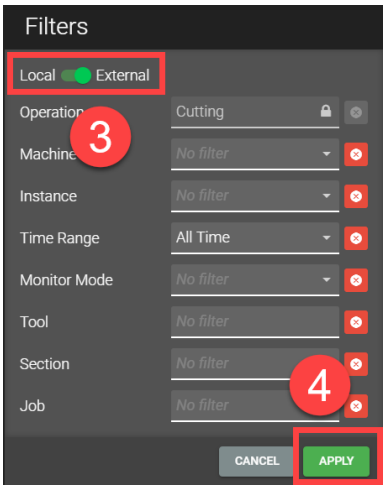

Figure 13-32: Local/External Toggle

The recording list is filtered to only display recordings that have been imported using the Data Viewer Import tool. The recordings can be opened in the Data Viewer using the steps documented in "Opening a Recording Card" Page 188.

Note: Both local and external recordings can be opened at the same time. Users can select local files to add to the list of open recordings, then apply the external recording filter to select imported recordings to open.

Data Viewer: Bearing Health Mode

When Bearing Health mode is selected, the Data Viewer opens displaying a plot of the last six months of Bearing Health Acceleration results. The Data Viewer interface is split into two sections: A tool bar and a chart displaying bearing health results over time. Additionally, two bars display bearing results for the bearing health recording selected in the list of recordings. The tool bar provides various data regarding the results of the selected recording as well as the ability to export and delete bearing health recordings.

The Data Viewer tool bar has the following tabs in Bearing Health mode:

- Recordings
- Details
- More

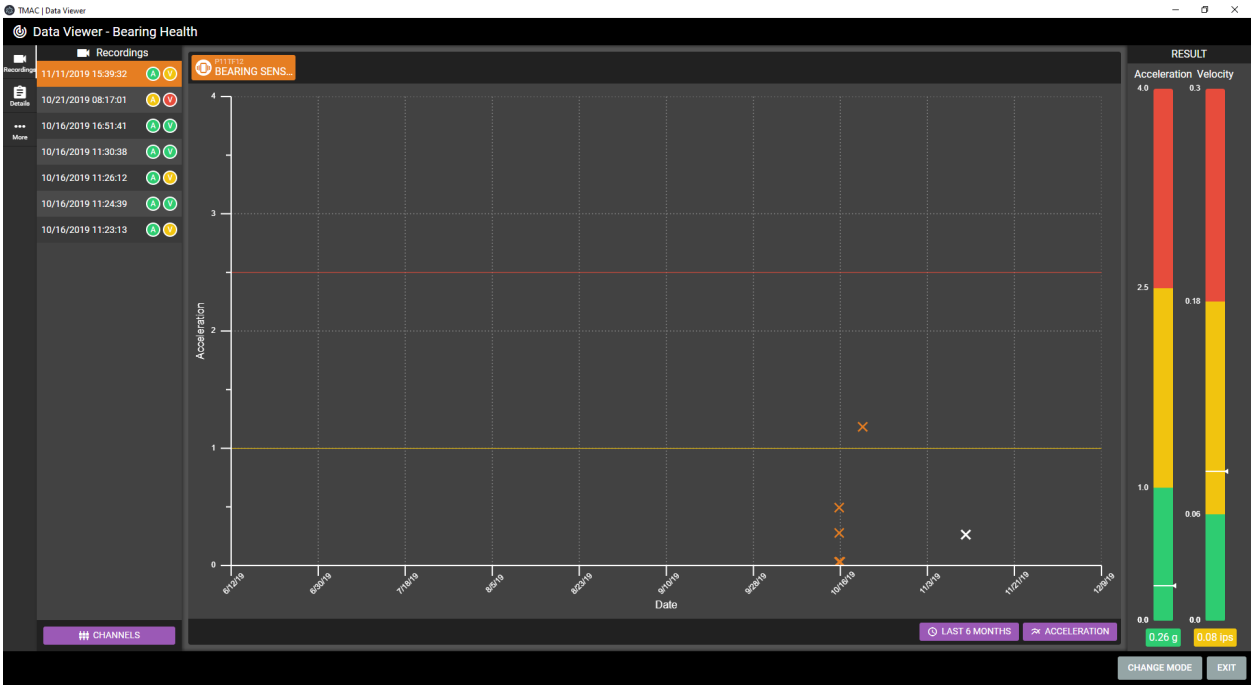

Figure 13-33: Bearing Health Mode Data Viewer

Recordings Tab

The Recordings tab displays a list of all Bearing Health recordings for the channel displayed at the top of the chart. Each recording in the list displays date and time stamps of the recording. Additionally, the color of the icons represents the results of the recording. Selecting a recording from the list does the following:

1. Updates the results bars with the acceleration and velocity results for the selected recording
2. Changes the recordings mark on the chart to white
3. Displays additional data on the **Details** tab

Figure 13-24 displays the Recordings tab. Refer to "Bearing Health Mode" Page 28 for information on interpreting the results of Bearing Health.

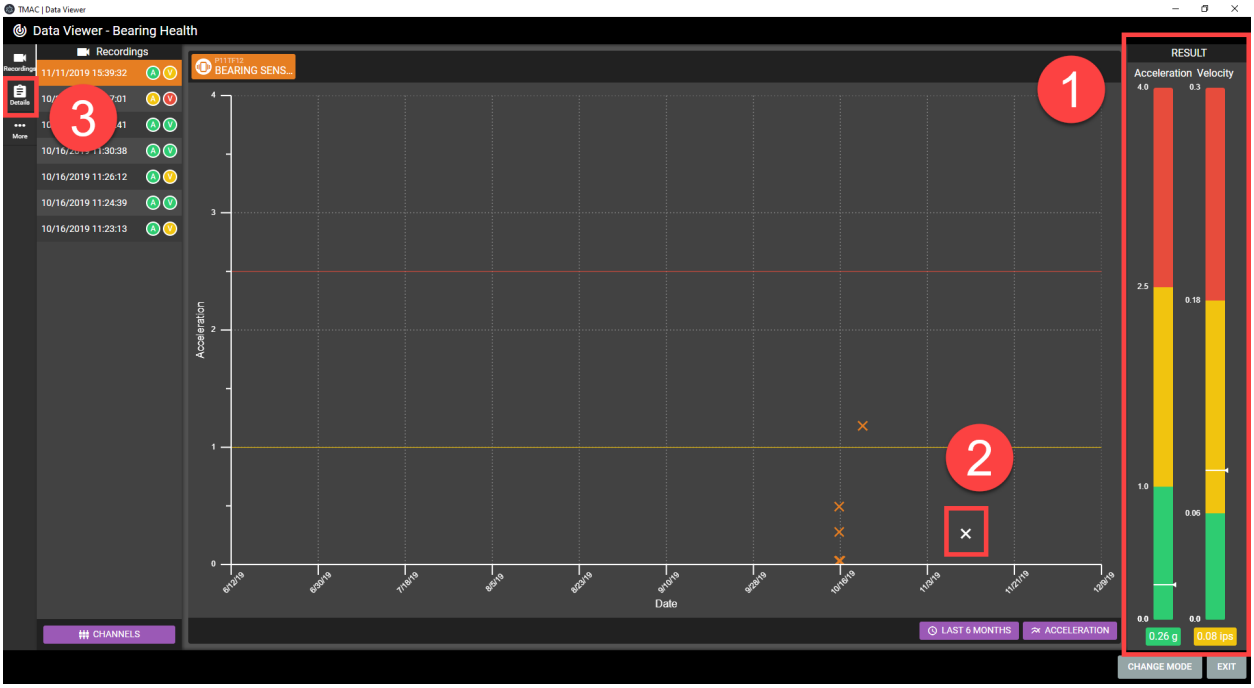

Figure 13-34: Recordings Tab

Details Tab

The Details tab provides additional data about the selected bearing health recording. The following data is provided:

- Channel Name
- Channel Number
- Instance
- Machine
- Acceleration Result
- Acceleration RMS
- Crest Factor
- High Pass Acceleration
- Peak Temperature
- Sampling Frequency
- Time Wave Form Peak
- Velocity Result
- Velocity RMS

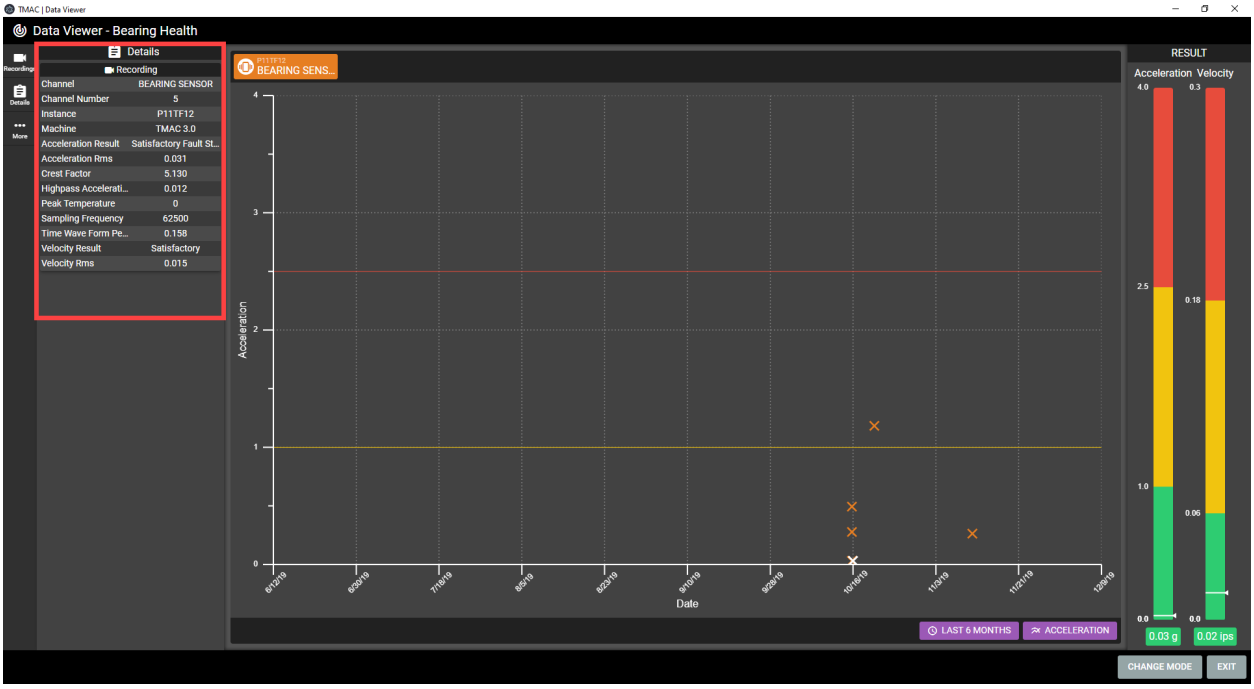

Figure 13-35: Details Tab

Additional Interface Buttons

While in Bearing Health mode, the Data Viewer has thee buttons that impact the data displayed on the chart. Refer to Table 13.3 for functionality descriptions of these buttons.

Bearing Health Chart Button Functions	
Button	**Description**
	Toggles display of acceleration or velocity results on the chart
	Changes the time frame of results shown on the chart. Options are last week, last 30 days, last 3 months, last 6 months, last year and all time.
	Sets the channels for which bearing health data is displayed. Multiple channels may be selected

Table 13-3: Recording Viewer Button Functions

Chapter 14: Commands

Overview

Based on how TMAC is interfaced with the control, commands can be issued to TMAC in the following methods:

- **RS232 Commands**: Commands are passed through RS232 protocol using ASCII command strings
- **File drop**: Commands are passed using ASCII command strings in a text file that is dropped into a file directory monitored by TMAC
- **Variable**: Commands are passed through variables in the part program
- **Parallel I/O**: Commands are passes to TMAC using configured I/O bits

The following sections provide a list of commands for various TMAC interfaces. Example command string formats and rules are also provided for each command type.

Note: CEI may be able to supply CNC specific macros to build the command strings discussed in this chapter.

See Also:

"RS232 Commands" Page 209

"Variable Commands" Page 214

"Parallel I/O Commands" Page 224

"Issuing RS232 Commands for Multichannel Starts" Page 209

"Issuing Variable Commands for Multichannel Starts" Page 215

RS232 Commands

In an RS232 command interface, a command is a string of characters that is built by the CNC and is sent to and parsed by TMAC. These character strings can indicate a monitoring or non-monitoring/function command. The character string format for non-monitoring/function commands can be seen in Figure 14 -1. Refer to "Non-Monitoring/function RS232 Commands" Page 213 for descriptions of non-monitoring command options.

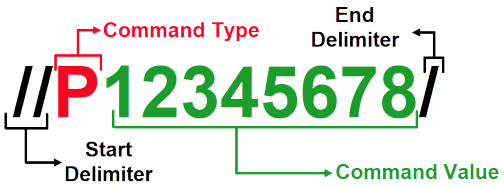

Figure 14-1: RS232 Non-Monitoring Command String Format

For monitoring commands, the letters and subsequent numbers in the command string each represent a necessary piece of information that TMAC needs to monitor an operation. At a minimum, this entails the following characters:

- **T########** - designates the tool number for the operation; Maximum of eight digits
- **S##** - designates the section number for the operation; Maximum of 2 digits
- **CA########** - designates the single-digit channel numbers(Channel 1, channel 2, Channel 3, etc...) for the operation. A maximum of 8 channels can be designated in this manner.
- **CB########** - designates the double-digit channel numbers (Channel 11, channel 12, Channel 13, etc...) for the operation. A maximum of 4 channels can be designated in this manner. TMAC also parses double digit channels in the command string as CC, CD, CE...etc.
- **M1** - designates a start monitor, must be at the end of the command string

Figures 14 -2 display the format for a single channel RS232 monitoring command. This RS232 command string format is used for both RS232 and file drop command interfaces.

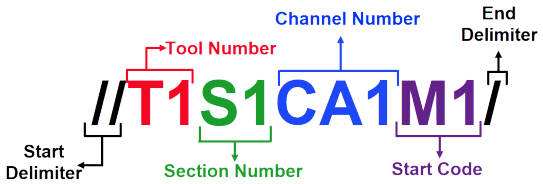

Figure 14-2: RS232 Monitoring Command String Format

Note: TMAC is capable of parsing commands that use the legacy channel designator "MA" See Table 14-1 in "RS232 Monitoring Commands" Page 212.

Issuing RS232 Commands for Multichannel Starts

TMAC allows a single command to start monitoring for multiple channels at the same time. Multichannel RS232 commands can be issued using two methods:

- using a channel group or
- by including each channel in the command string

If a channel group(s) has been created, a multichannel start command can be issued using the channel group ID as seen in Figure 14-3. When using a channel group, the start command is issued for all channels set in the group.

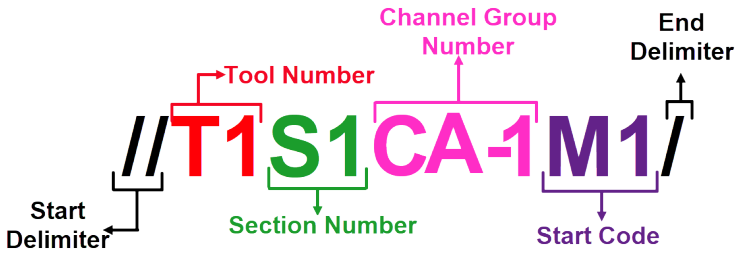

Figure 14-3: Multichannel Start Command format w/ Channel Groups

Note: To issue a command using channel groups, a channel group must first be created in the TMAC HMI. See "RS232 Commands" Page 209

When issuing a command without a channel group, each channel must be included in the character string. The following examples display character string formats for two different multichannel start commands.

Example 1

This command starts TMAC and monitors Tool 1, Section 1 for channels 1,5 12 and 13.

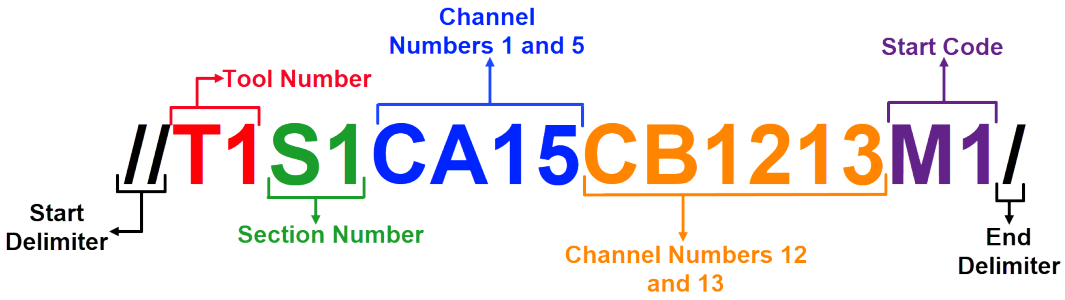

Figure 14-4: Multichannel Start Command Format

Example 2

This command starts TMAC and monitors Tool 1, Section 1 for channels 1-12. Due to the character limit for CA, channel 9 must be passed with CB.

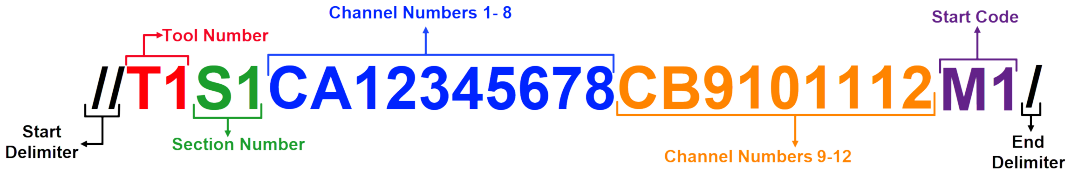

Figure 14-5: Multichannel Start Command Format

Note: If a single digit channel is passed in a double digit designator (CB, CC, CD...etc), the order in which the channel numbers appear in the string matters. When the single digit channel number is first in the channel designator, the channel number does not need a leading zero (See figure above). If the single digit channel is not first in the designator, it must have a leading zero ("09").

RS232 Monitoring Commands

TMAC RS232 Commands (Monitoring Commands)		
Designator	**Description**	**Range**
Mx	Standard Start/Stop	0 to 9
MVx	Millivolt Start/Stop	0 to 9 (Millivolt Only)
MCx	Change Operation Mode	0-2; 0 = Cutting Mode, 1 = Bearing Health Mode, 2 = Millivolt Mode
LM	Learn Mode	n/a
MM	Monitor Mode	n/a
QM	Preload Start	0 or 1 (1 = Preload Start, 0 = Preload Stop)
Tx	Tool	0 to 99999999
Sx	Section	0 to 99
MAx	Legacy Channel Designator	1 to 7
CA	Single Digit Channel Designator	Up to 8 digits, Used to designate single digit channels
CB	Double Digit Channel Designator	Up to 8 digits, Used to designate double digit or single digit channels
CC	Double Digit Channel Designator	As above; Additional double-digit designators may be used as CD, CE, etc...
Dx	Start Delay	0.0 to 60.0 Seconds (Millivolt Mode only)
Rx	RPM	0 to 100000 + Optional [0.1 = Gear One / 0.2 = Gear Two / 0.3 = Gear Three]
Kx	Learn Once	1 = On, 0 = Off
Bx	Peak Hold	1 = On, 0 = Off
Cx	Peak Clear	1 = On, 0 = Off
Ex	Extreme Millivolt Limit	0 to 9999 (Millivolt Mode Only)
Wx	Wear Millivolt Limit	0 to 9999 (Millivolt Mode Only)
Ux	Undercut Millivolt Limit	0 to 9999 (Millivolt Mode Only)
UHx	Part Re-cut	1 = On, 0 = Off
F1x	Coolant One Value	0 to 32000
F2x	Coolant Two Value	0 to 32000
F3x	Coolant Three Value	0 to 32000
F4x	Coolant Four Value	0 to 32000
BA	Starts a Bearing Analysis	

Table 14-1: RS232 Monitoring Commands

Non-Monitoring/function RS232 Commands

TMAC RS232 Commands (Non-Monitoring Commands)		
Designator	**Description**	**Range**
/	CNC serial delimiter	Not applicable
UE	User Event number	1 to 255
ED	Event Data	Used to pass additional data to a custom event (must be passed with UEx)
Z	System Reset	1
MD	Monitor Disable	1 = Enable / 0 = Disable
NS	Serial Number	1 to 24 ASCII characters
NP	Part Number	1 to 24 ASCII characters
NR	Data Storage Reset	1
P	Job Load	1 to 24 ASCII character program name
SM	Spindle Maintenance	0 to 100000 Spindle Idle Power at x RPM

Table 14-2: RS232 Non-monitoring Commands

Variable Commands

In a variable interface, TMAC utilizes a command variable set in the configuration to receive commands from a CNC part program. Depending on the command type, TMAC may utilize several variables to issue commands. For single channel monitoring commands, TMAC only utilizes the command variable set in the configuration. If no channel is specified in the command variable, TMAC

For non-monitoring commands TMAC utilizes the command variable and a parameter variable. The parameter variable is the next consecutive variable from the designated command variable. For example if the command variable is set as 90, the parameter variable is 91.

Note: The parameter variable must be populated before the command variable because the values passed to the command variable utilize the data stored in the parameter variable.

Figures 14 - 6 and 14 - 7 display the format for both monitoring and non-monitoring variable command lines.

Figure 14-6: Variable Monitoring Single Channel Command String Format

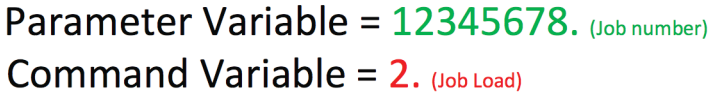

Figure 14-7: Variable Non-Monitoring Command String Format

Issuing Variable Commands for Multichannel Starts

TMAC allows a single command to start monitoring for multiple channels at the same time. Multichannel variable commands are similar to single channel variable commands with a few differences. Multichannel variable commands utilize one command variable and at least one consecutive variable. The additional variable(s) designate which channels to start in the command and are referred to as channel designation variables in the documentation. The channel designation variables must be set using the following rules:

- Single digit channel numbers are stored in the first variable;
- Double digit and single digit channel numbers are stored in the second variable
- Channel groups are designated by a negative value

TMAC utilizes the command passed through the command variable to determine whether the command is a multichannel start or not. If not channel number is specified in the command variable, TMAC polls the additional variables for the multichannel start. The following examples display various ways multichannel commands can be implemented in a Variable interface:

Example 1

Consider the following example multichannel command:

- The command variable is 90 and the channel designation variables are 91 and 92
- The designated operation requires a multichannel start for channel numbers 1, 5 and 12
- The operation is using Tool 1 and Section 1

To issue this command, values must be stored in the command and channel designation variables as seen in Figure 14-8

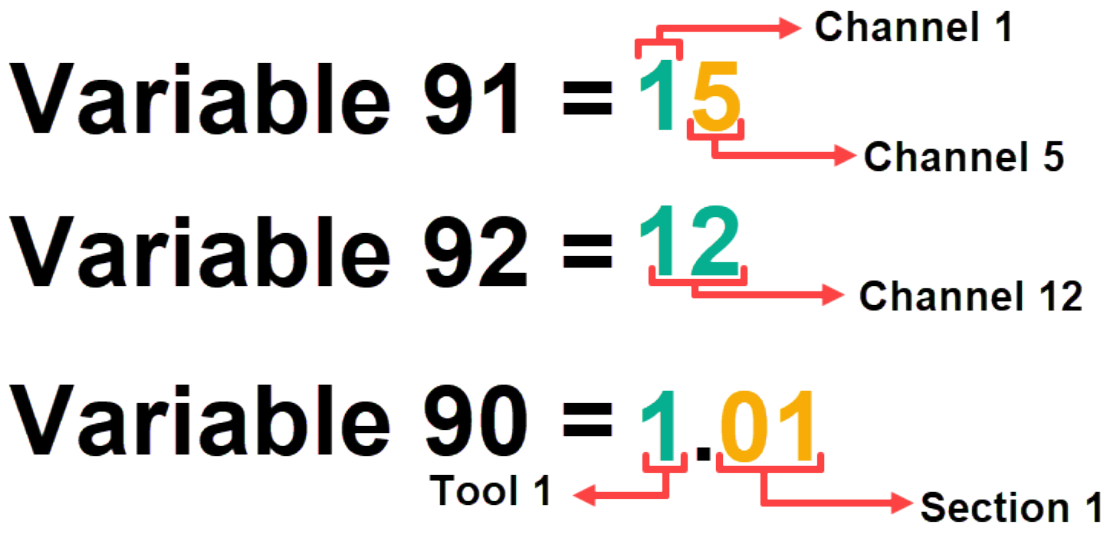

Figure 14-8: Multichannel Start Variable Command Format Example 1

Note: Values must be stored in the Channel designation variables before any values are stored in the command variable.

Example 2

The following example displays a multichannel start that requires more than 8 single digit channels:

- The command variable is 90 and the channel designation variables are 91 and 92
- The designated operation requires a multichannel start for channel numbers 1-12
- The operation is using Tool 1 and Section 1
- The 9th single digit channel is stored first in the second channel designation variable

To issue this command, values must be stored in the command and channel designation variables as seen in Figure 14-9. Note that channel 9 is passed through the second channel designator variable in single digit format, when it is the first channel in the string.

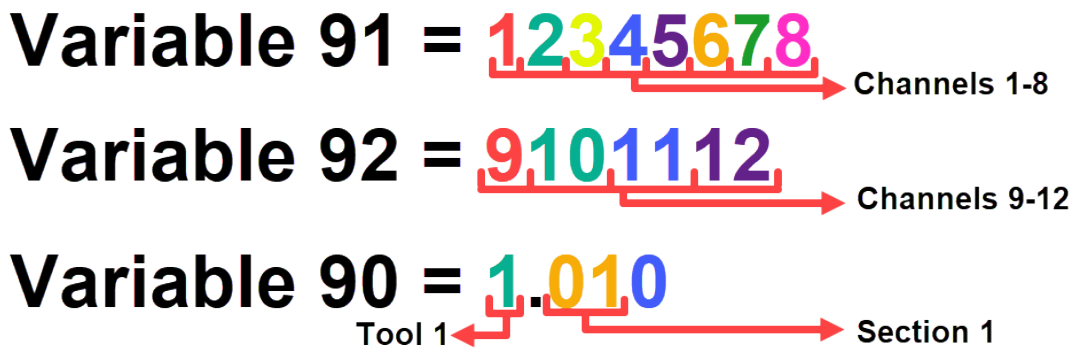

Figure 14-9: Multichannel Start Variable Command Format Example 2

Note: Values must be stored in the Channel designation variables before any values are stored in the command variable.

Example 3

The following example displays a multichannel start that requires more than 8 single digit channels:

- The command variable is 90 and the channel designation variables are 91 and 92
- The designated operation requires a multichannel start for channel numbers 1-12
- The operation is using Tool 1 and Section 1
- The 9th single digit channel is **not** stored first in the second channel designation variable

To issue this command, values must be stored in the command and channel designation variables as seen in Figure 14-10. Note that channel 9 is passed through the second channel designator variable in double digit format ("09") when it is not the first channel in the string.

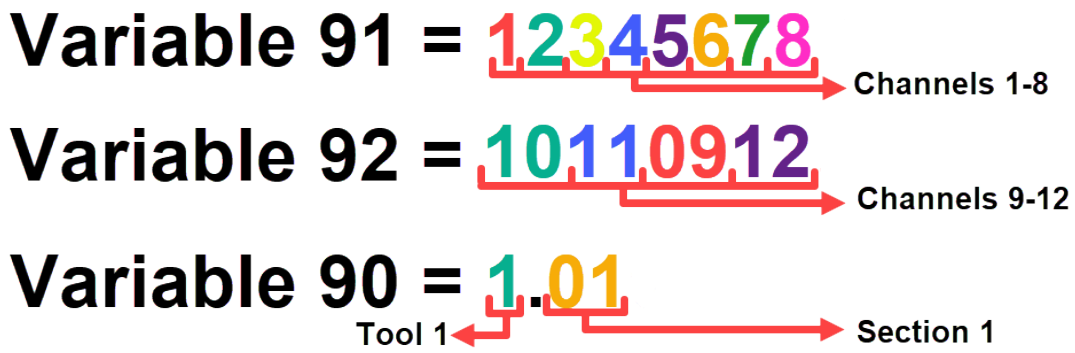

Figure 14-10: Multichannel Start Variable Command Format Example 3

Note: Values must be stored in the Channel designation variables before any values are stored in the command variable.

Example 4

Consider the following example multichannel command:

- The command variable is 90 and the channel designation variable is 91
- The designated operation requires a multichannel start for channel group 1
- The operation is using Tool 1 and Section 1

To issue this command, values must be stored in the command and channel designation variables as seen in Figure 14-11

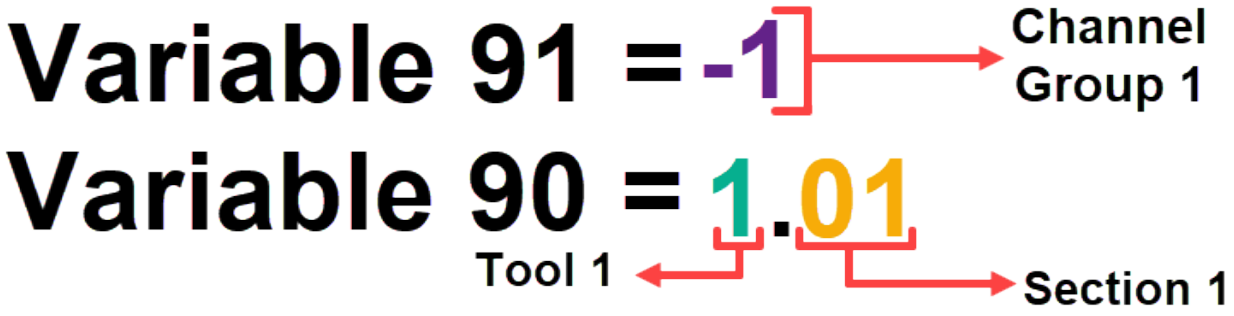

Figure 14-11: Multichannel Start Variable Command Format Example 4

Note: Values must be stored in the Channel designation variables before any values are stored in the command variable.

Example 5

Consider the following example multichannel command:

- The command variable is 90 and the channel designation variables are 91 and 92
- The designated operation requires a multichannel start for channel numbers 1, 5 and channel group 11
- The operation is using Tool 1 and Section 1

To issue this command, values must be stored in the command and channel designation variables as seen in Figure 14-12

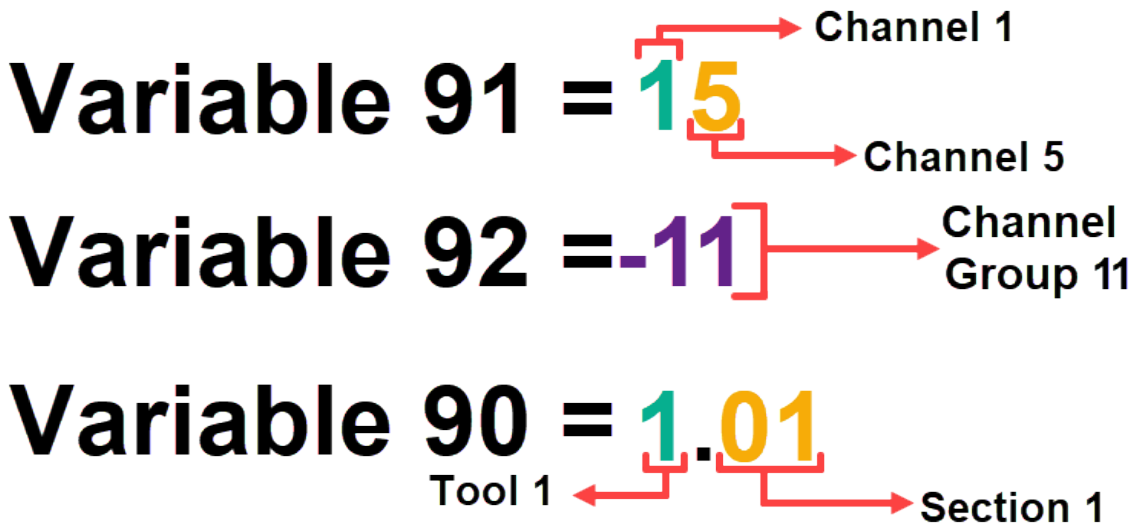

Figure 14-12: Multichannel Start Variable Command Format Example 5

Note: Values must be stored in the Channel designation variables before any values are stored in the command variable.

Variable Monitoring Commands

TMAC Variable Commands (Monitoring)		
Designator	**Description**	**Parameter Variable Range**
4	Part Re-cut	1 = On, 0 = Off
7	Peak Hold	1 = On, 0 = Off
8	Peak Clear	1 = On, 0 = Off
10	Learn Once	1 = On, 0 = Off
15	Preload Start	0 or 1 (1=Preload Start, 0=Preload Stop)
17	Bearing Analysis Start	
40	Learn Mode	
41	Monitor Mode	
42	Change Operation Mode	0 = Cutting Mode, 1 = Bearing Health Mode, 2 = Millivolt Mode

Table 14-3: TMAC Variable Monitoring Commands

Variable Non-Monitoring Commands

TMAC Variable Commands (Non-Monitoring)		
Designator	**Description**	**Parameter Variable Range**
2	Job Load	1 to 24 numeric values
3	TMAC Reset	Resets TMAC System
6	Serial ID	1 to 24 numeric values
9	Monitor Disable	1 = Enable, 0 = Disable
11	User Event	1 to 255
12	Spindle Maintenance	0 to 100000 Spindle Idle Power at x RPM
13	Part ID	1 to 24 numeric values

Table 14-4: TMAC Variable Non-Monitoring Commands

Preload Commands

In some machining processes, timing issues in the part program can prevent TMAC from executing commands at the correct time. This can cause tools to not be monitored or to be monitored incorrectly. To prevent this, TMAC is capable of "preloading" a command. Preload is set by doing the following:

- **Variable Command**: Passing a negative value in the command variable
- **RS232 Command**: Passing a command string in the same format as Figure 14-14

> **Note:** CEI may be able to provide CNC specific sub-programs to build the preload RS232 command string.

When TMAC receives a preload command, it prepares but does not immediately execute the command. TMAC then waits for a configured CNC output to set the preload input on the TCU high. When the preload input is set high, TMAC immediately executes the preloaded command. This allows more flexibility when adding TMAC commands in the CNC part program, eliminating any timing issues.

Figure 14-13: Variable Monitoring Single Channel Preload Command Example

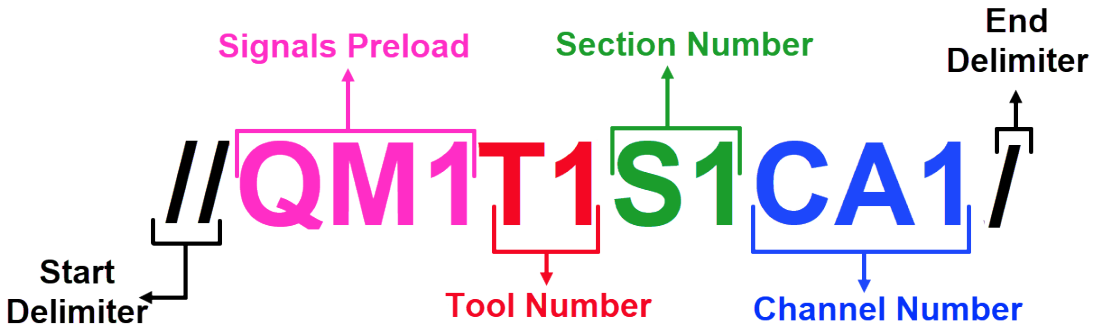

Figure 14-14: RS232 Monitoring Preload Command String Format Example

Millivolt Command String Example

The command designator for Millivolt commands is 30.

TMAC constantly polls the CNC Command Variable for this value if mV commands are enabled in the configuration. When 30 is stored in the programmed CNC Command Variable, TMAC polls the next 11 variables for values to use for various monitoring parameters. Each parameter variable is associated with a certain monitoring parameter.

For this example, let the CNC Command Variable be 90. The parameter variables are 91-101 and are associated with monitoring parameters as seen in Table C-5 below.

mV Parameter Variable Description		
Parameter Variable	**Parameter**	**Command String**
91	Tool Number	T
92	Section Number	S
93	Channel Number	MA
94	Extreme Limit	E
95	Wear Limit	W
96	Undercut Limit	U
97	Spindle Limit	R
98	Coolant 1 Limit	F1
99	Coolant 2 Limit	F2
100	Coolant 3 Limit	F3
101	Coolant 4 Limit	F4

Table 14-5: Parameter Variable Descriptions

The Millivolt command string is as follows:

```
config COMMAND30 //T*S*MA*E*W*U*R*F1*F2*F3*F4*MV1/
```

Figure 14-15: Millivolt Command String Format

The asterisks in Figure C-15 represent the values stored in the parameter variables.

Note: When using Millivolt mode, the length field of the Millivolt Command Variable settings must be set to 12 in the configuration.

Example: Issuing a Millivolt Command

When a Millivolt command is issued through a part program, TMAC polls the parameter variables and replaces the asterisks seen in Figure C-15 with the values stored in the parameter variables.

For this example, let the values stored in the parameter variables be represented by Table C-6.

Millivolt Command Example Variable Values	
Variable	**Value Stored**
R91	1
R92	1
R93	1
R94	500
R95	250
R96	0
R97	1500
R98	25
R99	123
R100	234
R101	100
R90	30

Table 14-6: Millivolt Command Example Variable Values

If a parameter variable has a stored value of "0", the associated parameter is removed from the command string. In this case the Undercut Limit parameter variable has a value of "0", so the command received by the TMAC process is as follows:

```
config COMMAND30//T1S1MA1E500W250R1500F125F2123F3234F4100MV1/
```

Figure 14-16: Command String Example-No Extreme Limit

Notice in Figure C-16 that the Undercut Limit is removed from the command string sent to TMAC.

Parallel I/O Commands

When TMAC is configured with a Parallel I/O command interface, commands are issued to TMAC by setting I/O bits high to define the commands. When TMAC is configured, the system integrator assigns a number of bits to input banks for channels, channel groups, tools, sections and jobs. These bits have a value of "1" when set high and a value of "0" when set low. The combination of bit values make a binary number that instructs TMAC which Tool, Section, Channel, Channel Group, or job numbers to insert into the command. Additionally a bit is assigned to a data strobe that sends the command.

Example: Starting and Stopping TMAC for Single Channel Commands

Consider the following TMAC configuration:

- Tool bits assigned: 4
- Section bits assigned: 4
- Channel bits assigned: 3

To issue a start command for Channel 1, Tool 5, Section 4 set the bits as follows:

Issuing a Start Command Example			
Bit	**High or low**	**Binary Value**	**Decimal Value**
Tool Number Bit 1	High	0101	5
Tool Number Bit 2	Low		
Tool Number Bit 3	High		
Tool Number Bit 4	Low		
Section Number Bit 1	Low	0100	4
Section Number Bit 2	Low		
Section Number Bit 3	High		
Section Number Bit 4	Low		
Channel Number Bit 1	High	001	1
Channel Number Bit 2	Low		
Channel Number Bit 3	Low		

Table 14-7: Parallel I/O Start Command Example

Once the Tool, Section and Channel number are set using the input banks, the command is sent by setting the strobe bit from low to high. In order to issue a stop command to TMAC, all Tool, Section, and Channel bits need to be set low. The stop command can then be issued by setting the data stobe bit from low to high.

Example: Starting and Stopping TMAC for a Channel Group

Consider the following TMAC configuration:

- Tool bits assigned: 4
- Section bits assigned: 4
- Channel Group bits assigned: 2;

Note: In order to utilize Channel groups in a Parallel I/O command, the channel group(s) must be created first. See "Channels Tab" Page 66 for more information. Additionally, when defining the number of bits allocated to channel groups during system configuration, each existing channel group must be assigned to a specific bit.

To issue a start command for Channel group 2, Tool 7, Section 3 set the bits as follows:

Issuing a Start Command Example			
Bit	**High or low**	**Binary Value**	**Decimal Value**
Tool Number Bit 1	High	0111	7
Tool Number Bit 2	Low		
Tool Number Bit 3	High		
Tool Number Bit 4	Low		
Section Number Bit 1	Low	0011	3
Section Number Bit 2	Low		
Section Number Bit 3	High		
Section Number Bit 4	Low		
Channel Group Bit 1	Low	10	2
Channel Group Bit 2	Low		

Table 14-8: Parallel I/O Start Command Example

Once the Tool, Section and Channel number are set using the input banks, the command is sent by setting the strobe bit from low to high. In order to issue a stop command to TMAC, all Tool, Section, and Channel group bits need to be set low. The stop command can then be issued by setting the data stobe bit from low to high.

Loading a Job With Parallel Commands

Job load parallel commands only require the Job Number bits and data strobe bits. The assigned tool, section and channel number inputs should be set low, because Job Load commands do not utilize this information. The Job name must be a decimal number that can be represented by the number of bits assigned during system configuration. For example to load Job 6, set the assigned Job bits 1-3 as follows:

- Job Bit 1 = high
- Job Bit 2 = high
- Job Bit 3 = low
- Set the Data Strobe bit from low to high

TMAC interprets the state of the bits (110) as a decimal (6) and executes the job load.

Appendix A: Alarms and Error Messages

Overview:

TMAC has a variety of system alarms that can occur. Each alarm, its description and the corrective actions to take are documented in the tables of this chapter. TMAC alarms consist of the following types:

- Critical
- Warning
- Informational

Note: During system integration, TMAC can be configured to issue a machine response for any system alarm that is triggered. Machine responses available depend on the machine or control that TMAC is installed on. See System Integrator Manual for more information on mapping alarms to machine responses.

Alarm Variable Feedback: Alarm Category Codes

If TMAC is configured for alarm variable feedback, TMAC writes an alarm category code to the variable specified during configuration whenever TMAC enters an alarm state. The table below displays TMAC's alarm categories with the associated alarm category code.

Alarm Category Codes	
Alarm Category	**Code**
None	0
Job	1
Extreme	2
Wear	3
Undercut	4
Tap	5
Spindle Speed	6
Coolant Warning	7
Coolant Extreme	8
System	9

See Also:

"Critical Alarms" Page A-2

"Warning Alarms" Page A-7

"Informational Alarms" Page A-7

Critical Alarms

Critical alarms signify an error that requires immediate attention and interrupts any running operation. The following occurs when a critical alarm is triggered:

- Triggers TMAC to stop monitoring
- Prevents future commands from being executed until the alarm is reset.

One exception to critical alarm behavior occurs with the Tap Extreme alarm. When the Tap Extreme Alarm is triggered the following occurs:

- TMAC does not stop monitoring until the tap alarm delay expires
- Prevents future commands from being executed until the alarm is reset.

Critical Alarms				
Alarm Name	**Category**	**Code**	**Description**	**Possible Solutions**
Job Load While Monitoring	JOB	1	Jobs cannot be loaded while the system is monitoring.	Try loading the job when system is in idle mode.
Job Not Found	JOB	1	The given job (JOB NAME) is not configured.	Make sure the job name is correct and is configured in TMAC.
Job Forcefully Unloaded	JOB	1	The previously loaded job has been forcefully unloaded because it has been deleted.	
Operation Not Configured	JOB	1	Operation (OPERATION) is not configured in the current job	Make sure the given operation (OPERATION) is configured in the current job or that the system is in learn mode to learn the operation.
Job Configuration Error	JOB	1	The job (JOB NAME) was incorrectly configured for the requested operation: (ERROR DETAILS)	
Job Start Error	JOB	1	Unable to perform a start error: '(ERROR DETAILS)'	
Job Invalid Dither Parameters	JOB	1	The job (JOB NAME) dither parameters are invalid	Please verify dither parameters are set in the job
Job Invalid Monitor Type	JOB	1	The job (JOB NAME) monitor type is invalid	Verify the configured monitor type is valid in the job
TMAC Backend Crash	EXTREME	2	The TMAC backend has suffered a crash. Communication has been recovered however any running process may have been interrupted.	
(CHANNEL NAME) Channel Timeout	EXTREME	2	The requested channel (CHANNEL NAME) has timed out.	Verify that the hardware associated with the channel is properly connected and configured.
No Channels Started	EXTREME	2	No applicable channels in start monitor.	Verify that the correct channels were selected for the start monitor.
Invalid Channel (CHANNEL NAME) for Operation	EXTREME	2	Channel is not applicable to the active operation	
Too Many Channels for Operation	EXTREME	2	Channel type is present too many times from the command.	

Critical Alarms				
Alarm Name	**Category**	**Code**	**Description**	**Possible Solutions**
Invalid channel group (CHANNEL GROUP NAME) for Operation	EXTREME	2	Group is not applicable to the active operation	
(CHANNEL NAME) Missed Time Increment	EXTREME	2	(CHANNEL NAME) has missed next time increment	Time increments may be spaced too closely together - extend time in between time increments to ensure they are not missed
Invalid RS232 Command Missing Start Code	EXTREME	2	The RS232 command is missing a start code	Verify start command and associated start code are correct.
Invalid RS232 Command Missing Tool Number	EXTREME	2	The RS232 command is missing a tool number	Verify start command and associated tool number are correct.
Invalid RS232 Command Missing Section Number	EXTREME	2	The RS232 command is missing a section number	Verify start command and associated section number are correct.
Invalid RS232 Command Missing Command type	EXTREME	2	The RS232 command is missing a command type.	Verify command exists.
Invalid RS232 Command Missing Parameters	EXTREME	2	The RS232 command is missing parameters	Verify all parameters exist with the associated command.
Invalid RS232 Command Missing Parameter Value	EXTREME	2	The RS232 command is missing a parameter value.	Verify all parameters in the command contain values.
Invalid RS232 Command Missing Channel	EXTREME	2	The RS232 Command is missing a channel	Verify start command contains a channel.
Invalid RS232 Command Missing Channel Value	EXTREME	2	The RS232 command is missing a channel value	Verify start command contains a channel with a value.
Invalid RS232 Command Channel Value Out of Range	EXTREME	2	The RS232 command channel value is outside of the acceptable range.	Verify channel value is within the allowed channel range.
Invalid RS232 Command - Parameter Value Out of Range	EXTREME	2	The RS232 command contains a parameter value that is outside of the acceptable range.	Verify parameter value is within the allowed range.
Invalid Tool Number (TOOL NUMBER) Out of Range	EXTREME	2	Tool number is outside of the acceptable range.	Verify tool number is <= 99999999
Invalid section number (SECTION NUMBER) Out of Range	EXTREME	2	Section number is outside of the acceptable range.	Verify section number is <= 99
(CHANNEL NAME) Scale Exceeded by Limits	EXTREME	2	One of (CHANNEL NAME) limits was outside of the scale range of the current scale.	
(CHANNEL NAME) Feedrate Scale Exceeded by Limits	EXTREME	2	One of (CHANNEL NAME) feedrate limits was outside of the max feedrate range	
(CHANNEL NAME) Scale Exceeded by Idle	EXTREME	2	The idle value for (CHANNEL NAME) was outside of the scale range of the current scale.	
(CHANNEL NAME) Scale Exceeded by Learned	EXTREME	2	The learned value for (CHANNEL NAME) was outside of the scale range of the current scale.	
(CHANNEL NAME) Learned Value Zero	EXTREME	2	The learned value for (CHANNEL NAME) is invalid.	
(CHANNEL NAME) Scale Out of Range	EXTREME	2	The scale value for (CHANNEL NAME) was outside of range of min/max scale	Check job scale to make sure the sure a valid scale is provided

Critical Alarms				
Alarm Name	**Category**	**Code**	**Description**	**Possible Solutions**
(CHANNEL NAME) Feedrate Override No Limits.	EXTREME	2	Feedrate override is enabled on (CHANNEL NAME) without limits defined.	Check job and feedrate limits if feedrate override is required
(CHANNEL NAME) Adaptive Max Feedrate Invalid	EXTREME	2	Adaptive maximum feedrate for (CHANNEL NAME) is outside of range of the allowed maximum feedrate value.	Check job adaptive max feedrate to make sure a valid value is provided
(CHANNEL NAME) Adaptive target is zero	EXTREME	2	Adaptive target (CHANNEL NAME) cannot be zero	Check job adaptive target to make sure a valid value is provided
(CHANNEL NAME) Approach Max Feedrate Invalid	EXTREME	2	Approach maximum feedrate for (CHANNEL NAME) is out of range of the allowed maximum feedrate vvalue	Check job approach max feedrate to make sure a valid value is provided
(CHANNEL NAME) Approach On / Off Invalid	EXTREME	2	Approach on value for (CHANNEL NAME) is greater than approach off value in the job	Check job approach on / off values
(CHANNEL NAME) Extreme Invalid	EXTREME	2	Invalid extreme limit for CHANNEL provided	Check extreme limit in Job of command
(CHANNEL NAME) Extreme Exceeded	EXTREME	2	(CHANNEL NAME) signal exceeds Extreme Limit % for a period longer than Extreme Delay.	Check tool condition. If tool is okay adjust the limit or alarm delay.
(CHANNEL NAME) Extreme Delay Invalid	EXTREME	2	Invalid extreme limit delay for (CHANNEL NAME) provided	Check extreme limit delay in job or command
(CHANNEL NAME) Extreme Feedrate Invalid	EXTREME	2	Invalid extreme feedrate limit for (CHANNEL NAME) provided	Check extreme feedrate limit in job or command
(CHANNEL NAME) Extreme Feedrate	EXTREME	2	(CHANNEL NAME) feedrate override drops below Extreme Feedrate % for a period longer than extreme delay during an adaptive operation.	Check tool condition. If tool is okay adjust limit or alarm delay.
(CHANNEL NAME) Extreme Feedrate Delay Invalid	EXTREME	2	Invalid extreme feedrate limit delay for (CHANNEL NAME) provided	Check extreme feedrate limit delay in job or command
(CHANNEL NAME) Wear Invalid	EXTREME	2	Invalid wear limit for (CHANNEL NAME) provided	Check wear limit in job or command
(CHANNEL NAME) Wear Delay Invalid	EXTREME	2	Invalid wear limit delay for (CHANNEL NAME) provided	Check wear delay limit in job or command
(CHANNEL NAME) Wear Feedrate Invalid	EXTREME	2	Invalid wear feedrate limit for (CHANNEL NAME) provided	Check wear feedrate limit in job or command
(CHANNEL NAME) Wear Feedrate Delay Invalid	EXTREME	2	Invalid Wear feedrate limit delay for (CHANNEL NAME) provided	Check wear feedrate limit delay in job or command
(CHANNEL NAME) Undercut Invalid	EXTREME	2	Invalid undercut limit for (CHANNEL NAME) provided	Check undercut limit in job or command
(CHANNEL NAME) Undercut Time Above Invalid	EXTREME	2	Invalid undercut time above for (CHANNEL NAME) provided	Check undercut time above in job or command
(CHANNEL NAME) No Limits	EXTREME	2	The (CHANNEL NAME) command contains no limits	Check your command syntax and make sure one limit is present
(CHANNEL NAME) Spindle Speed Invalid	EXTREME	2	Invalid spindle speed for (CHANNEL NAME) provided	Check spindle speed value in job or command
(CHANNEL NAME) Spindle Speed Low Invalid	EXTREME	2	Invalid spindle speed low for (CHANNEL NAME) provided	Check spindle speed low value in job or command
(CHANNEL NAME) Spindle Speed Low Delay Invalid	EXTREME	2	Invalid spindle speed low delay for (CHANNEL NAME) provided	Check spindle speed low delay value in job or command

Critical Alarms				
Alarm Name	**Category**	**Code**	**Description**	**Possible Solutions**
(CHANNEL NAME) Spindle Speed High Invalid	EXTREME	2	Invalid spindle speed high for (CHANNEL NAME) provided	Check spindle speed high value in job or command
(CHANNEL NAME) Spindle Speed High Delay Invalid	EXTREME	2	Invalid spindle speed high delay for (CHANNEL NAME) provided	Check spindle speed high delay value in job or command
(CHANNEL NAME) Coolant Low Warning Invalid	EXTREME	2	Invalid coolant low warning for (CHANNEL NAME) provided	Check coolant low warning value in job or command
(CHANNEL NAME) Coolant Low Warning Delay Invalid	EXTREME	2	Invalid low warning delay for (CHANNEL NAME) provided	Check low warning delay value in job or command
(CHANNEL NAME) Coolant Low Invalid	EXTREME	2	Invalid coolant low for (CHANNEL NAME) provided	Check coolant low value in job or command
(CHANNEL NAME) Coolant Low Delay Invalid	EXTREME	2	Invalid low delay for (CHANNEL NAME) provided	Check low delay value in job or command
(CHANNEL NAME) Coolant High Invalid	EXTREME	2	Invalid coolant high for (CHANNEL NAME) provided	Check coolant high value in job or command
(CHANNEL NAME) Coolant High Delay Invalid	EXTREME	2	Invalid high delay for (CHANNEL NAME) provided	Check high delay value in job or command
(CHANNEL NAME) Signature Lower Extreme Invalid	EXTREME	2	(CHANNEL NAME) Invalid lower extreme limit provided	Check signature lower extreme limit value in job
(CHANNEL NAME) Signature Lower Extreme Delay Invalid	EXTREME	2	(CHANNEL NAME) Invalid lower extreme delay provided	Check signature lower extreme delay value in job
(CHANNEL NAME) Signature Lower Warning Invalid	EXTREME	2	(CHANNEL NAME) Invalid lower warning limit provided	Check signature lower warning limit value in job
(CHANNEL NAME) Signature Lower Warning Delay Invalid	EXTREME	2	(CHANNEL NAME) Invalid lower warning delay provided	Check signature lower warning delay value in job
(CHANNEL NAME) Signature Upper Extreme Invalid	EXTREME	2	(CHANNEL NAME) Invalid upper extreme limit provided	Check signature upper extreme limit value in job
(CHANNEL NAME) Signature Upper Extreme Delay Invalid	EXTREME	2	(CHANNEL NAME) Invalid upper extreme delay provided	Check signature upper extreme delay value in job
(CHANNEL NAME) Signature Upper Warning Invalid	EXTREME	2	(CHANNEL NAME) Invalid upper warning limit provided	Check signature upper warning limit value in job
(CHANNEL NAME) Signature Upper Warning Delay Invalid	EXTREME	2	(CHANNEL NAME) Invalid upper warning delay provided	Check signature upper warning delay value in job
(CHANNEL NAME) Signature Extreme Exceeded	EXTREME	2	(CHANNEL NAME) signal exceeds signature extreme tolerance for a period longer than Signature Extreme Delay	Check tool condition. If OK adjust limit or alarm delay or relearn cutting signature
Signature Start Error	EXTREME	2	There was an error during the signature monitoring start procedure: {{error}}	Check the job parameters or refer to the manual for more information
Signature Run-time Error	EXTREME	2	An unrecoverable error occurred during signature monitoring	Check the job parameters or refer to the manual for more information
Passive Channel Monitor	EXTREME	2	Start monitor contains only passive channels	Select at least one non-passive channel for the start monitor
(CHANNEL NAME) Undercut Not Met	UNDERCUT	4	(CHANNEL NAME) signal was not above the Undercut Limit or monitored signal was not above the Undercut limit for the amount of time specified in the Tima Above Undercut setting	Verify tool and part are present. If present check offsets, otherwise adjust limit or time above undercut

Critical Alarms				
Alarm Name	**Category**	**Code**	**Description**	**Possible Solutions**
(CHANNEL NAME) Spindle Speed Low	SPINDLE SPEED	6	(CHANNEL NAME) spindle speed signal value out of range of the low limit for a period longer than the alarm delay	
(CHANNEL NAME) Spindle Speed High	SPINDLE SPEED	6	(CHANNEL NAME) spindle speed signal value out of range of the high limit for a period longer than the alarm delay	
(CHANNEL NAME) Coolant Low	COOLANT EXTREME	8	(CHANNEL NAME) coolant low value out of range of the Low Limit for a period longer than Alarm Delay	
(CHANNEL NAME) Coolant High	COOLANT EXTREME	8	(CHANNEL NAME) coolant high value out of range of the High Limit for a period longer than Alarm Delay	
Unknown Runtime Error	SYSTEM	9	An unrecoverable error occurred during monitoring:{{error}}	Check the job parameters or refer to the manual for more information
(CHANNEL NAME) Tap Extreme	TAP	5	(CHANNEL NAME) tap signal exceeds Tap Extreme Limit value	

Warning Alarms

Warning alarms signify an error that is significant to note, but will not interrupt a running process. The following occurs when a warning alarm is triggered:

- Does not trigger TMAC to stop monitoring
- Does not prevent future commands from being executed, even if alarm is not reset

Warning Alarms				
Alarm Name	**Category**	**Code**	**Description**	**Possible Solutions**
(CHANNEL NAME) Wear Exceeded	WEAR	3	(CHANNEL NAME) signal exceeds Wear Limit % for a period longer than Wear Delay.	Check tool condition. If tool is okay adjust limit or alarm delay.
(CHANNEL NAME) Wear Feedrate Exceeded	WEAR	3	(CHANNEL NAME) feedrate override drops below Wear Feedrate % for a period longer than wear delay during an adaptive cut.	Check tool condition, If OK adjust limit or alarm delay.
(CHANNEL NAME) Signature Warning Exceeded	WEAR	3	(CHANNEL NAME) signal exceeds Signature Warning Tolerance for a period longer than Signature Warning Delay	Check tool condition. If OK adjust limit or alarm delay, or relearn cutting signature
Signature Data Exhausted	WEAR	3	Data from the learned reference cut was exhausted before the stop monitor was recieved	If machining operation has changed, relearn cutting signature
(CHANNEL NAME) Coolant Low Warning	COOLANT WARNING	7	(CHANNEL NAME) coolant low warning value out of range of the Low Warning Limit for a period longer than Alarm Delay.	
Unable to Record Data	SYSTEM	9	Data recording failed with error: {{error}}	Reboot the TMAC PC and make sure that the recording storage drive is not full.

Informational Alarms

Informational alarms signify an error that is not significant enough to stop or prevent a running process. The following occurs when an info alarm is triggered:

- Does not trigger TMAC to stop monitoring
- Does not prevent future commands from being executed, even if alarm is not reset

Info Alarms				
Alarm Name	**Category**	**Code**	**Description**	**Possible Solutions**
No Job Loaded	JOB	1	No Job is current loaded.	Verify Job exists. Load Job manually or check Job Load command in part program.
Disk Too Full to Record Data	SYSTEM	9	The disk is nearing the maximum set usage and is unable to record data.	Perform a data purge and reboot the TMAC PC.

Appendix B: Reference Tables

Profile Permissions

The following table describes each permission available to profiles and depicts which permissions are granted to each of TMAC's default profiles. Custom profiles can be granted any permission available to the creator of the profile.

Profile Permissions				
Permission	**Integrator**	**Supervisor**	**Operator**	**Description**
Alarm Mapping	x			Can access the alarm mapping menu in the instance parameters
Custom Events	x	x		Can create custom events
Data Purge	x	x	x	Can access and change data purge settings
Data Storage Settings	x	x	x	Can access and change data storage settings
Diagnostics	x	x	x	Can access features in the diagnostics menu
Instance Channel Settings	x	x		Can access channel tab in the instance parameters
Instance General Settings	x	x		Can access the general tab in the instance parameters
Job Edit	x	x	x	Can edit jobs
Job Load	x	x	x	Can load jobs
Monitor Disable	x	x	x	Can enable the Monitor disable feature
Monitor Mode	x	x	x	Can toggle between learn and monitor modes
System Backup	x	x	x	Can access the system backup feature
System Configuration	x			Can access the system Configurator
System Update	x	x	x	Can access the system update feature
View Editor	x	x	x	Can access the view editor

Table B-1: Profile Permissions

Details Tab

The details tab in the Data Viewer provides a large amount of additional data for a recording. The fields that appear vary due to cursor placement and the type of operation being reviewed. The tables below offer descriptions of the fields that may appear on the details tab.

Note: The values in the Recording Details table always appear in the Details Tab of the Data Viewer, but the value and presence of the fields in the other tables may change based on the placement and position of the cursor.

Recording Details Fields	
Field	**Description**
Machine Name	Displays the machine name set in the configuration
Instance Name	Displays the instance name for the operation
Channel Name	Displays the channel name for the selected operation
Channel Number	Displays the channel number for the selected operation
Job Name	Displays the name of the job that contains the operation
Tool Number	Displays the tool number for the operation recording
Section Number	Displays the section number for the operation recording
Spindle Speed	Displays the spindle speed set for the operation
Part ID	Displays the Part ID set in the instance parameters
Serial ID	Displays the Serial ID set in the instance parameters
Part Recut	Displays whether Part Recut is enabled or not for the operation
Duration	Show the length of tim of the recording from start monitor to stop monitor
Start Delay Time	Displays the length of time of the start delay of the operation
Recording Date	Displays the date that the data was recorded
Recording Start Time	Displays the time the data started recording

Table B-2: Recording Details

General Details Fields	
Field	**Description**
Time Increment Number	Displays the time increment number
Monitor State	Displays the monitoring state of TMAC (Monitor mode, Learn mode, monitor hold, start delay etc...)
Max Scale	Displays the max scale set for the operation
Idle	Displays the idles value captured for the operation
Adaptive Target	Displays the target value for adaptive operations
Learned Peak	Displays the learned value for the operation
Learned Work	Displays the learned work value for the operation
Filter mode	Diaplys the filter selected for the operation, if any

Table B-3: General Details

Channel Details Fields	
Field	**Description**
Absolute Signal Value	Displays the value of the signal from channel type being viewed (power, vibration, strain, etc...)
Relative Signal Value	Displays the value of the signal relative to the captured idle
Feedrate Value	Displays the feedrate percentage for the operation or at cursor location
Accumulated	Displays the accumulated work value for the operation

Table B-4: Channel Details

Cursor Details Fields	
Field	**Description**
Cursor Time Position	Displays the absolute time from cursor position
Cursor Data Position	Displays the absolute signal value at cursor position (relative to the data axis)
Cursor Relative Data Position	Displays the signal value relative to the captured idle
Percent Peak	Displays the signal value at cursor as a percentage of the peak signal value
Cursor Feedrate Position	Displays the feedrate value relative to the feedrate axis

Table B-5: Cursor Details

Limits Details Fields	
Field	**Description**
Undercut	Displays the calculated undercut limit
Wear	Displays the calculated wear limit
Extreme	Displays the calculated extreme limit
Feedrate Wear	Displays the calculated feedrate wear limit
Feedrate Extreme	Displays the calculated feedrate extreme limit
Work Wear	Displays the calculated work wear limit
Work Undercut	Displays the calculated work undercut limit
Coolant Low Warning	Displays the calculated coolant low warning limit
Coolant Low	Displays the calculated coolant low limit
Coolant High	Displays the calculated coolant high limit
Spindle Low	Displays the calculated spindle low limit
Spindle High	Displays the calculated spindle high limit

Table B-6: Limits Details

System State Variable Feedback

If TMAC is configured for variable feedback, TMAC can write details related to the system state of TMAC to a control varible. The value written to the variable is updated anytime the system state of the TMAC changes. The value written to the variable is interpreted as binary to relay the system's state. The table below describes which system state each bit represents based on it's value.

System State Variable Feedback		
Bit Number	**Bit is 0**	**Bit is 1**
Bit 0	Idle	Monitoring
Bit 1	Monitor Enable	Monitor Disable
Bit 2	Monitor Mode	Learn Mode

Table B-7: Variable Feedback System State

Example: If the system state feedback variable is 5 (0b101 - binary), this relays that the system is Monitoring, with Monitor Enable, and is in Learn mode.