

Overview

MTL Windows Control software requires a 2350 controller – and together - offer a highly integrated solution to the needs of mechanical tensile, compression and fatigue testing. MTL Windows is the single station – single channel control package. N channel Windows software is the multichannel version and capable of controlling up to 75 channels. The 2350 hardware features the test industry's highest performance control and data acquisition system, a USB based intelligent modular high performance servocontroller and data acquisition product for both single and multiple channel test control and measurement applications.

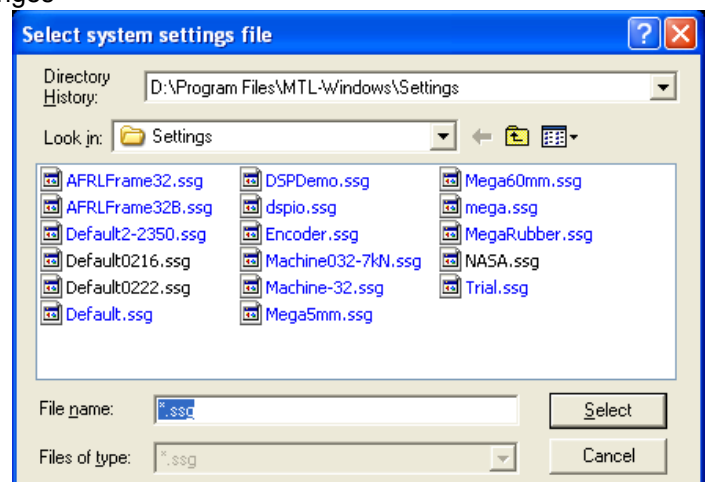
Application software products also exist and are described separately.

MTL Attributes

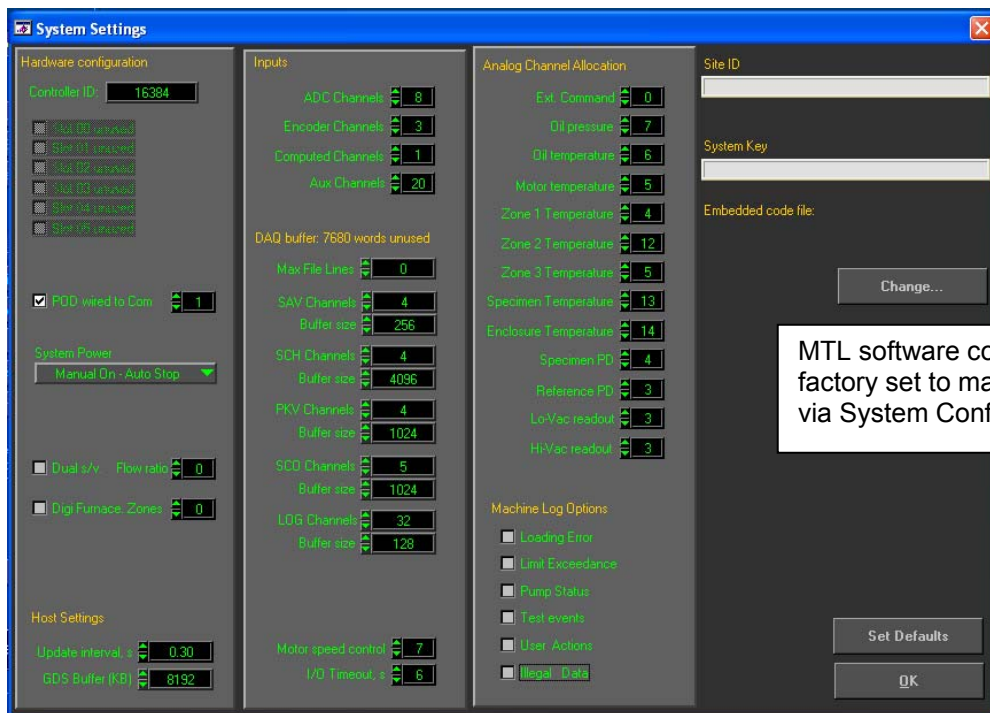
- Compatible with MS Windows 98, ME, XP, XP Pro, 2000, and NT
- Optional remote pod for local machine control.
- Multiple 2350 controllers may be connected to a single PC
- Supervisor Control
- High network performance and compatibility
 - Separate user-defined paths store settings and test data.
 - Multiple users can set up different Instance Codes and associate them with unique paths for settings and data.
 - Paths may be anywhere on the Network
 - PC connection to controller through USB cable

Features

- Easy to use global navigation rules implemented throughout all MTL 7 software products.
- Log in and log out functions (the application can run while the panel is logged off).
- All configuration and settings files are listed at top right of each panel.
- Channel readouts appear in yellow on all panels.
- Control actions are at bottom of all panels.
- Drive control can be accessed from any panel. GUI behavior depends on drive – examples follow:
 - Gray – Idle,
 - Red – Fault,
 - Green – On (Hi Pressure),
 - Yellow – On (Lo Pressure)
- Access control
- System Settings
- Load or change system settings and save changes
- Each system configuration includes a series of common panels standardized across all applications:
 - Machine Console Panel
 - Calibration Panel
 - Servo Settings Panel
 - Limit Interlocks Panel
 - Data Acquisition Panel
 - MTL-Programming Panel
 - Application specific Panels Optional

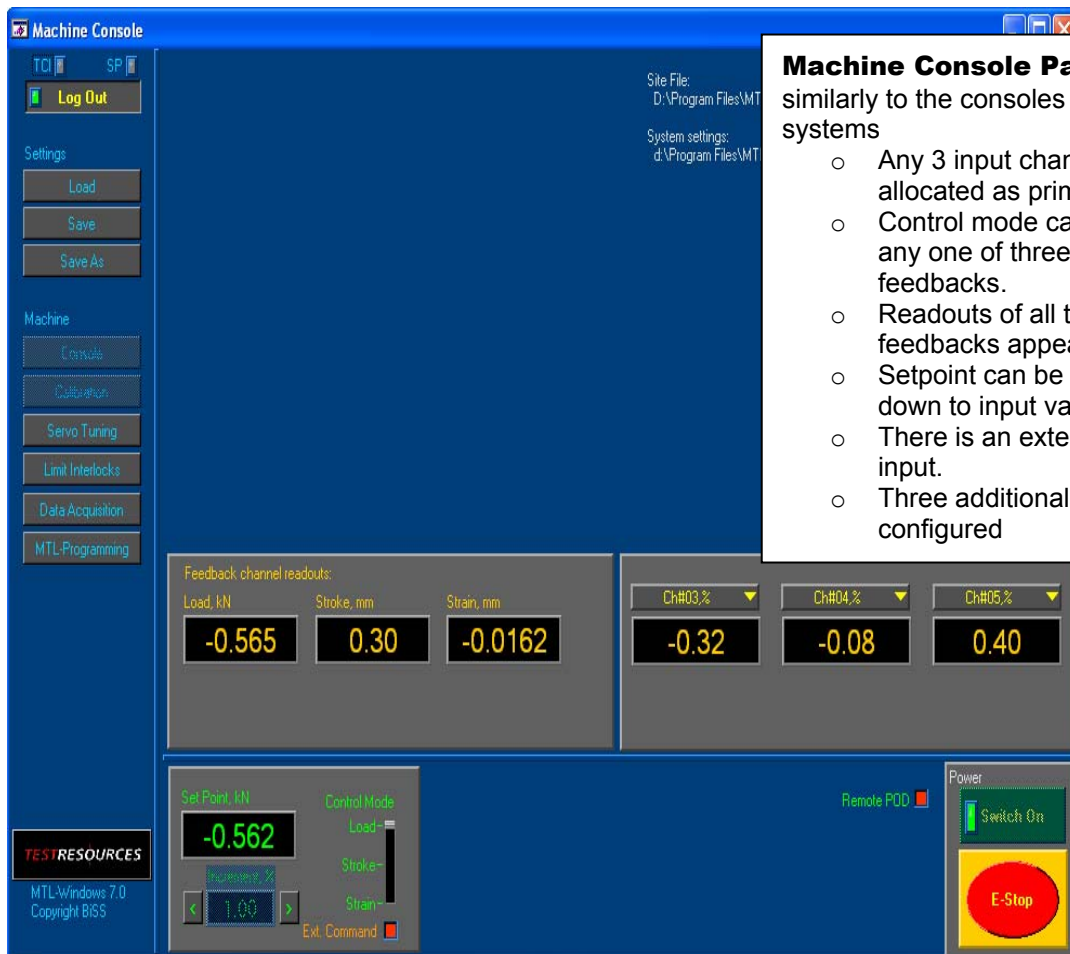


Factory Setting Panel



MTL software configurations are factory set to match 2350 hardware via System Configuration Panel

Machine Console Panel



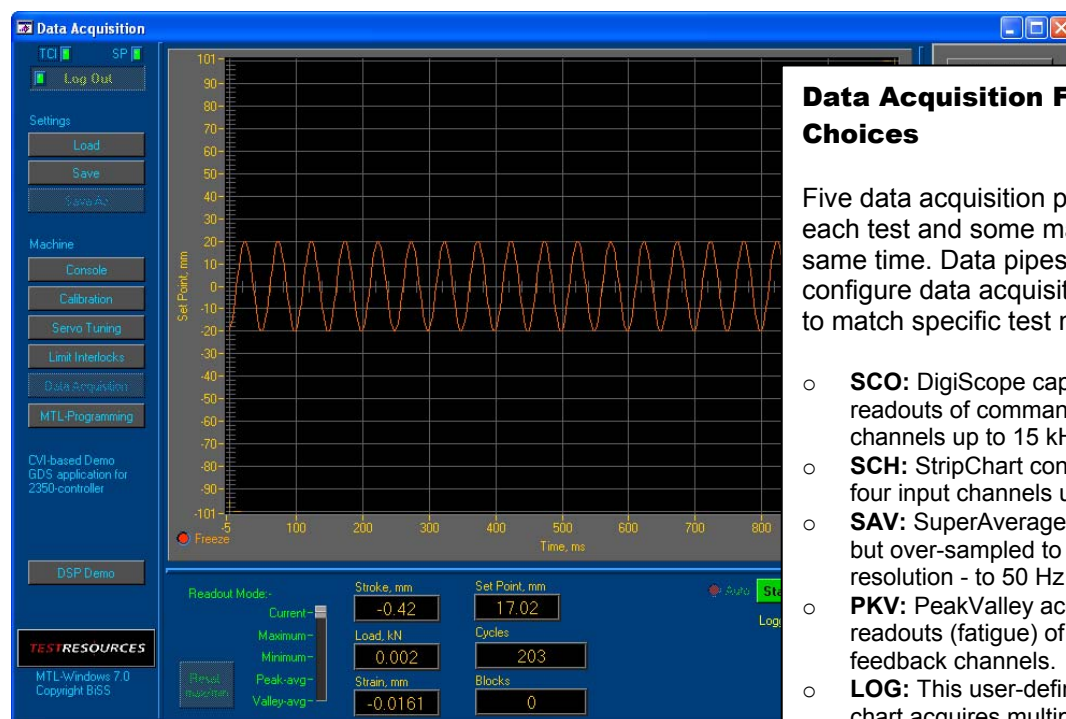
Machine Console Panel functions similarly to the consoles on analog test systems

- Any 3 input channels can be allocated as primary feedbacks.
- Control mode can be transferred to any one of three primary feedbacks.
- Readouts of all three primary feedbacks appear on Console
- Setpoint can be ramped up or down to input value.
- There is an external command input.
- Three additional readouts are user configured

Data Acquisition Panel

This panel provides a graphical user interface (e.g. 'scope') to observe and record readouts. It also sets up and manages the continuous data stream from the 2350 controller.

The 2350 DSP controller provides 8 independent DAQ channels, each with a 16-bit CODECS sigma-delta converter incorporating programmable range and provision for auto-calibration. These are referred to as Primary DAQ channels. In addition, up to 64 AUX inputs can be incorporated using plug-in cards. Each plug-in card incorporates 8 switched DAQ channels in the +/-10V range, wired to a 16-bit ADC. Each plug-in AUX card provides 4 channels of buffered +/-10V output.



Data Acquisition Features and Choices

Five data acquisition pipes are available for each test and some may be used at the same time. Data pipes enable users to configure data acquisition speed and quality to match specific test needs.

- **SCO:** DigiScope captures bursts to 1024 readouts of command plus 3 feedback channels up to 15 kHz.
- **SCH:** StripChart continuously acquires any four input channels up to 2 kHz.
- **SAV:** SuperAverage is the same as SCH, but over-sampled to increase data quality or resolution - to 50 Hz
- **PKV:** PeakValley acquires peak/valley readouts (fatigue) of command plus 3 feedback channels.
- **LOG:** This user-defined multi-channel strip chart acquires multiple channels of data from selected feedback channels at scan rate restricted by system throughput. This depends on the auxiliary channel count.

Oversampling with SCH and SAV

Averaging raw data reduces scatter. The averaging options of multiple sequential samples range from 4 to 32,000 with no restriction on sample size (odd/even). The effective precision of raw data is 12-13 bits. That can improve to 14-15 bits by increasing sample size to 4096. Increasing electronic gain of the signal conditioner improves the resolution, *but not the precision!* Strip Chart (SCH) settings adjust to set data speed and quality and can 'hog' time and space. Data packet size is set for real-time updates. Smaller size makes update 'smooth' at the cost of performance. The DAQ rate is determined by Sample Size. Applications should keep the DAQ rate < 2500 Hz to avoid data flow problems. SuperAveraging (SAV) pipe is ideal for quasi-static test applications due to the high quality of acquired data from over-sampling.

Transient data burst with SCO pipe

DigiScope (SCO) helps tune the servocontroller and performs high speed bursts where its advantageous to trigger the scope against the control waveform. The SCO DAQ rate is determined by sweep time and size of single burst of acquired data and fixed to command and 3 selected feedbacks channels. SCO data are raw data corrected for LSB against QC completion on signal processing. The DAQ rate moderated by skip count is 20 kHz max. Screen update is 2 Hz or less.

Capturing Cyclic turning points with PKV pipe

Peak-valley detection is based on Set Point quality control completion. There are 4 QC peak/valley updates under constant amplitude and two under spectrum. The PKV graph is against cycle count (not frequency).

User defined multi-channel capture with LOG pipe

LOG Pipe does not produce an on-line graphic display, but can be routed to such applications or recorded and exported to products such as MS Excel. Unlike other pipes, LOG provides flexible user-defined channel selection and allocation. Frequency of sampling is set by choosing delay values. All input channels plus cycle count are available for logging. Average or peak readouts can be logged with the option of instantaneous peak counter Reset.

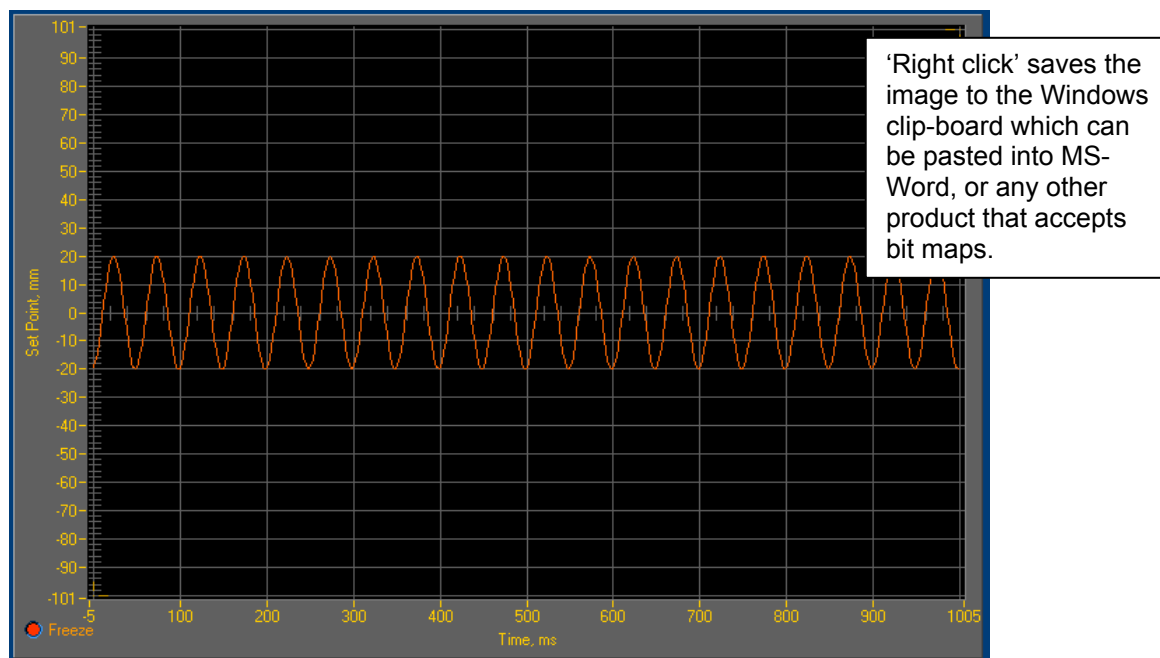
- User assigns channels (2 to 64)
- Channel options include 76 DAQ channels, min/max or average readouts, set point, cycle count, block count
- LOG data are exported to MS-Excel

Data Storage and Export

Data are recorded in real-time into binary files and exported later to MS-Excel. They are stored as 14-digit time-stamp in the sequence **yyyymmddhhmmss**. Panel displays include Set Point, Cycle Count and Block Count. Peak readouts will be displayed and can be reset. Peak/valley readouts can be selected during cycling to observe averaged readouts from the PKV pipe.

Real Time Graphics

DAQ graphics panel can display up to four traces in real-time from any one of the four primary DAQ pipes: SCO, SCH, SAV or PKV. 'Freeze' stops the display update.



Display features are comprehensive and include Pipe, Axis and Trace controls, Trace Color Selection, sweep time, setting Scope in Storage Mode and Low speed data logging. It facilitates easy tracking of

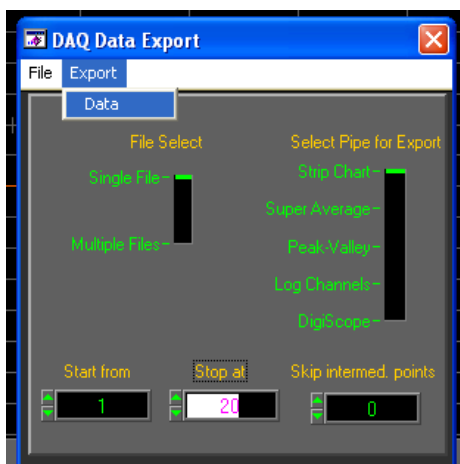
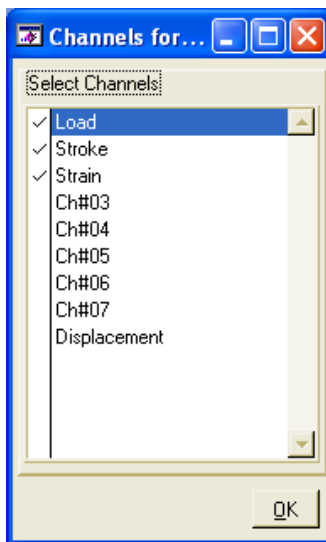
readouts on long term basis – e.g., to document signal quality, creep, or long term specimen response without a dedicated application program

D-to-A Channel Allocations

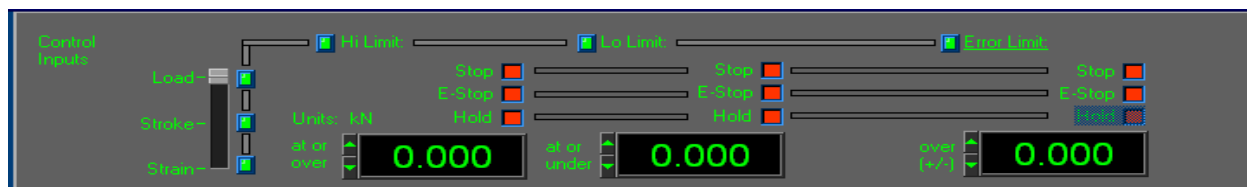
Any four available input channels and Set Point can be directed as D-to-A outputs to four 16-bit D-to-A converter buffered outputs on the 2350 AUX input/output plug-in card. These outputs can be wired to BNC connectors on the 2350 rear panel and wired to external devices including X-Y recorders, oscilloscopes, etc.

Data Export

Binary files may be exported to MS-Excel. The export option includes merged data from multiple files.



Limit Interlock Panel



The limit interlock panel enables users to set high or upper and lower limit values and an error limit, with the desired actions:

- Stop: Test and command waveform stopped
- E-Stop: Shut down drive
- Hold: Switch control to feedback that caused limit exceedance and hold

LEDs show current status against each channel:

- Green – OK
- Red – Limit Hit

LEDs at top show which limit status on current channel

Upper and lower limits can also be set on any other input channel with the actions restricted to shut down of the drive.

System Calibration

DAQ auto-calibration - Two parts of the calibration process

- DAQ calibration – 100% automatic
- Transducer calibration

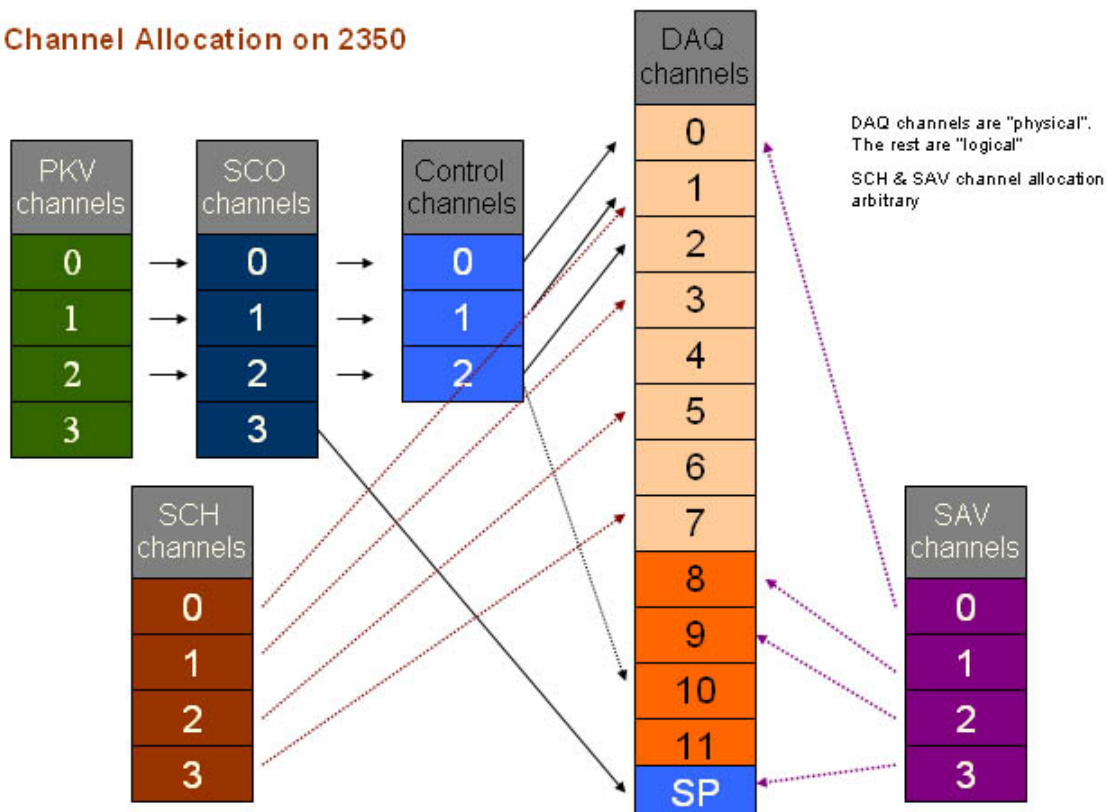
2350 Input Channel Grouping:

0 – 7: 16-bit high speed analog inputs. Up to 8 signal conditioned channels from plug-in with option of digital conditioning with auto-cal, or, high-level inputs with manual cal.

8 – 11: Digital encoder inputs from plug-in cards + computed variable. Calibration through digital constants

12-75: Auxillary inputs from plug-in cards. Manual calibration.

Channel Allocation on 2350



2350 Input Channel Grouping:

All channel definitions are performed using the two user interfaces, one for Main Channels, the other for Auxillary Channels. Use these to set up channel names, units, ranges, etc. Also, signal conditioner settings on main channels, including Vex, Gain, Offset, Polarity, Shunt, etc.

Servotuning

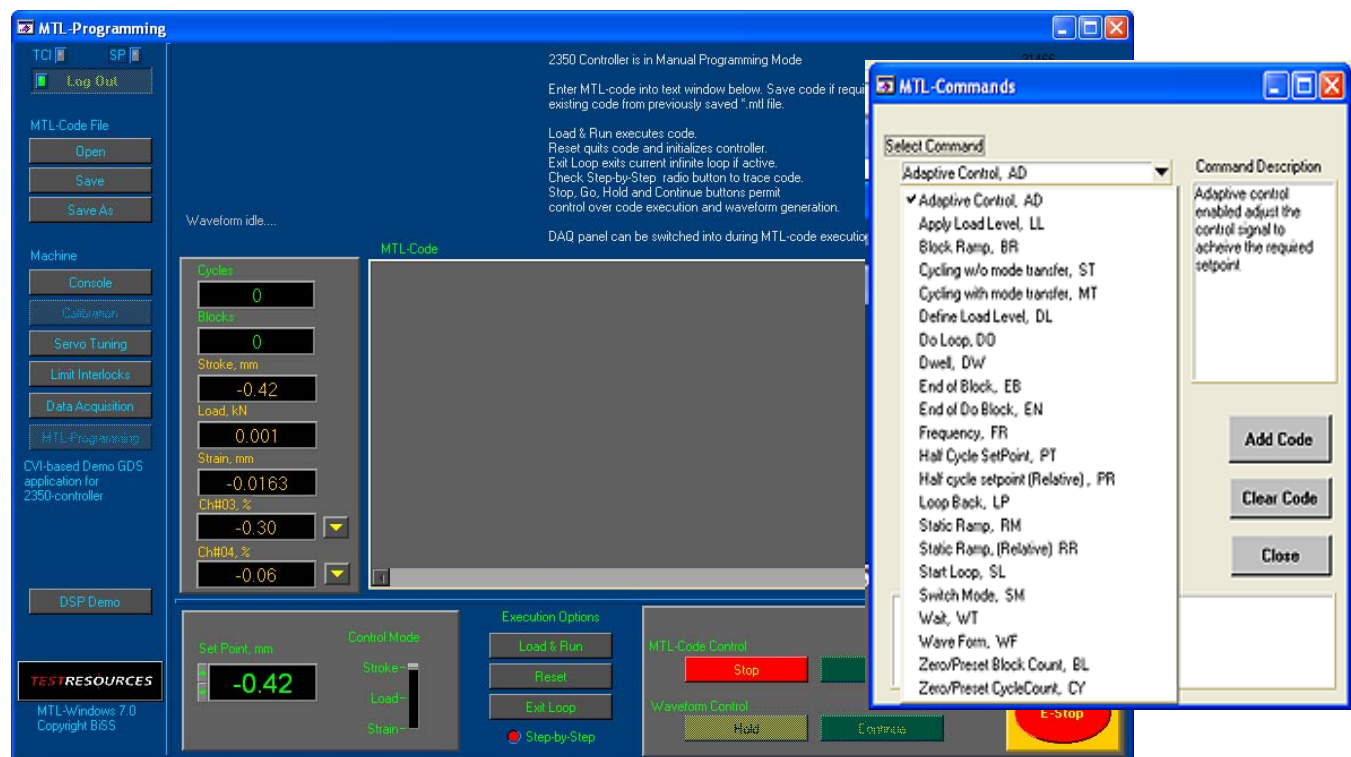
All settings associated with closed loop servocontrol including P, I and D gains, Bias or offset and dither are digitally set on the 2350 servocontroller. Supervisory adaptive control adds precision control of pre-set mean and amplitude in constant amplitude cycling applications where test conditions and sample behaviors change over time.

The Servo Tuning Panel handles all needs and includes command, feedback & servo-output displays. adaptive supervisory control settings, loop gains & time constants, advanced and basic modes of operation, mode selection, feedback readouts, waveform selection, mean, amplitude & frequency. Of course, once a sample or test setup is tuned, it can be saved as a test setup for future usage.

Polarity & Frequency Crossover settings enable polarity reversal on transducer outputs, so customer data preferences can be provided such as making compression settings in a 3 point flexural test be positive. The 2350 stores two sets of servo-loop equation constants to suit high and low frequency response requirements.

Adaptive control is triggered by an MTL panel setting or when required by application software, or, by user defined MTL-code. If adaptive control will be in used, desired sample size, gain and limit are adjustable as part of the servo tuning process and settings saved. Adaptive control is strongly recommended for cycling in excess of 30 Hz. 2350 Series controllers are equipped with digital auto null adjustment on servo drive output.

Test Programming Panel (MTL)



Customers can create custom test applications that can be saved and restored using the MTL Panel. MTL commands can involve complex control waveforms and operations including mode transfer and linked to data acquisition pipes synchronized to each segment per user desires.

