GCTS
TESTING SYSTEMS

CATS-ADV and CATS-STD
Computer Aided Testing Software
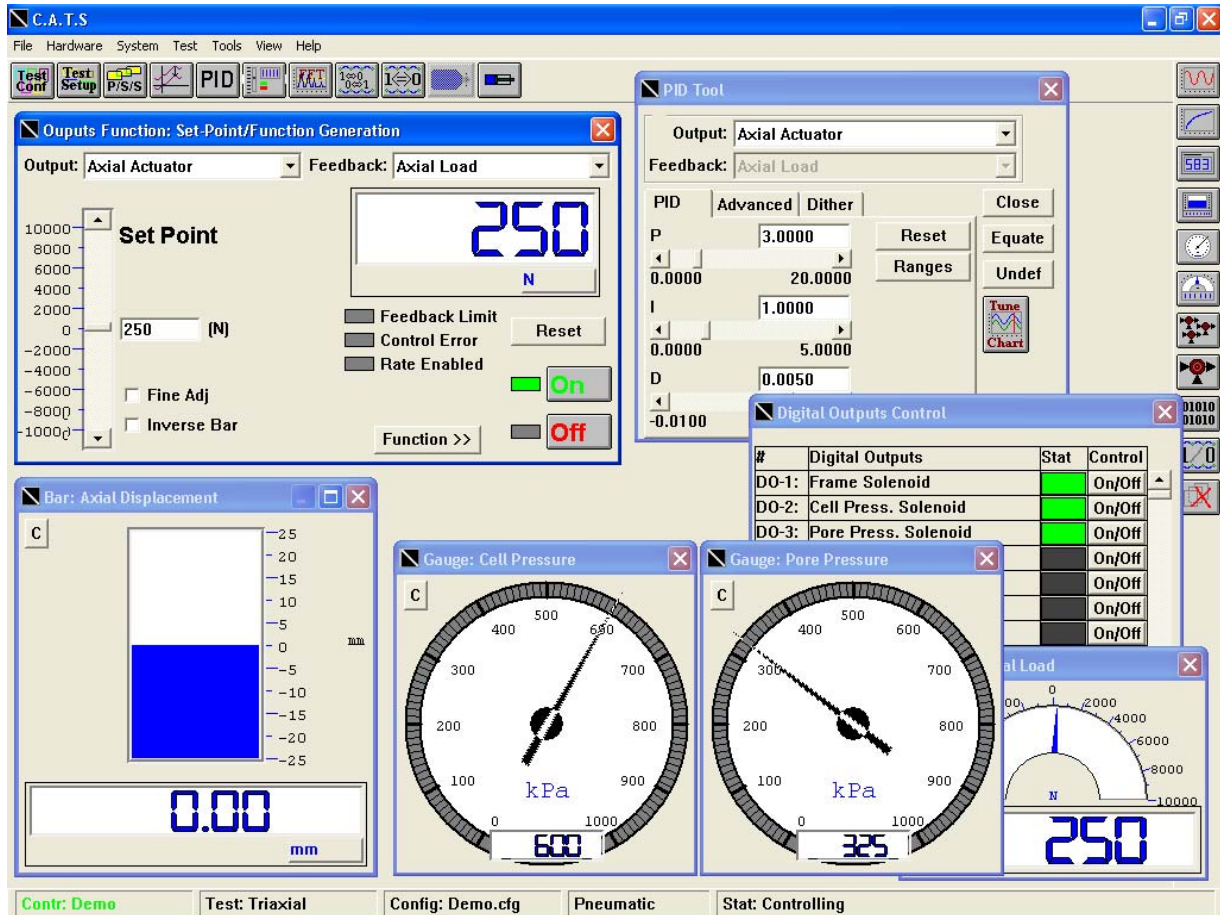
- Software compliant with Windows^{TM} XP/7

- Full sensor management

- Remote monitoring of test through network

- Projects/samples/specimens database

- Advanced servo control

- Complete units library

- Easy to use

- Secure environment

- Easily created cyclic and static customized test procedures

- Real time sensor linearization

- Unlimited variety of waveforms with constant or variable frequency and/or amplitude

DESCRIPTION

The GCTS 32-bit Windows™ software, CATS (Computer Aided Testing System), is the most advanced testing software available today. It operates on Windows XP / 7 platforms. This software has simplified the operation of instruments and conduction of tests by allowing the user to directly program test calculated parameters in the units of interest (e.g. stress, strain) based on the specimen dimensions. These parameters are calculated in real time and are available for display, graphing and/or control. Using calculated test parameters directly eliminates complex and lengthy pre-calculations when designing test programs. This allows the user to concentrate on the material behavior rather than on the electronics and equipment operation.

The CATS Standard software is very easy to use and includes all of the necessary tools to perform a fully automatic servo controlled test. The CATS Advanced software includes tools for the advanced user including the FFT Signal Analysis Chart, use of Thermocouples, use of non-linear sensors and other enhancements to the CATS Standard.
The CATS software runs on the GCTS SCON controllers. The SCON-2000 includes the CATS Advanced software, while the SCON-1500 and SCON-300 includes the CATS Standard software.

The CATS Advanced software allows for multiple users with different access levels with password protection: high-level access for administrators; low-level access for operators and students; CATS Standard has only one user. The CATS software has the ability to use different configuration files, so each user can have his/her unique software settings.
The software contains full management of sensors, with the ability to handle various sensors listed in Table 1. The Thermocouple and Counter sensors are only available in CATS Advanced, which also includes the use of non-linear sensors. In fact, the only requirement for accurate measurements and control in CATS Advanced is the use of repeatable sensors. This allows the use of less expensive non-linear sensors, which are good in repeatability.

Table 1. Sensor Information

Type	Description	Examples
DC	Direct Current	Deformation Sensors, Amplified Transducers, etc.
SG	Strain Gauge	Strain gages, Load cells, Pressure Sensors, etc.
AC	Alternating Current	LVDTs, RVDTs, Pressure Sensors, etc.
TC	Thermocouple	Types T, K, J, & E
Counter	Counter	Tachometers, Vehicle count Angular velocity, etc

For Analog Inputs, a digital filter with selectable frequency can be defined as well as Warning Limits and corresponding Warning Actions. Abort Limits for the Analog Inputs can also be defined which if triggered cause the System & User Defined Abort Actions to occur. User Defined Function Inputs can be defined which can be simple functions of two or more inputs (average of two inputs, etc.), or within CATS Advanced User Defined Correction Inputs can be defined which are corrections to one input with a 3rd degree polynomial function of another input. Add-on test modules (Triaxial, Direct Shear, etc.) automatically define most common parameters (strain, stress, etc.) specific to each test mode and based on current specimen dimensions. These test inputs are calculated in real-time and are available for display and/or control.

Volume Change Tools
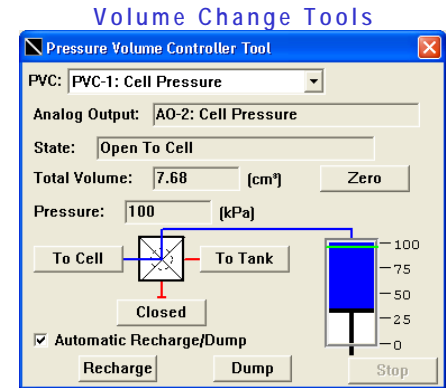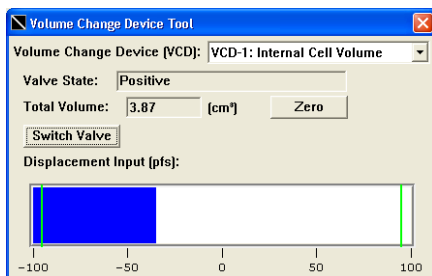
Pressure-Volume Controller Tools

Other predefined tools include Volume Change and Pressure/Volume Controllers that keep track of the direction of the valves to automatically calculate total flow volumes even after these instruments are recharged or flow direction is reversed.

The Analog Control Outputs parameters include Maximum Static Control Rate, which sets the maximum rate of change for the output in manual mode. This prevents accidental "jumps" when the software slide bar for control is unintentionally moved quickly. Within CATS Advanced, there are Temperature Control Outputs as well, which are optimized for the control of temperature. The advanced PID Tuning Control Parameters allow the system to better optimize the control. When changing the controlling feedback, the change is "smooth" or "bump-less" to avoid any discontinuities with the command. With the Forward Gain and Loop Filter, phase shift between the output and the feedback can be eliminated. Optional stabilization input with gain selection allows the stabilization of the current feedback with another independent input for better, more stable control. The Peak & Valley Compensation allows dynamic signals to match the programmed function more precisely even under specimen response degradation.

For a simple system performance check, CATS offers a quick access function generator, the Outputs Function Tool. This tool allows a set-point to be specified for any output with respect to any feedback. Basic dynamic waveforms (sine, triangular and square wave) can be generated with a simple mouse click, and with "on-the-fly" selection of amplitude, frequency, and offset. More complex procedures can be programmed with the CATS Universal Module.
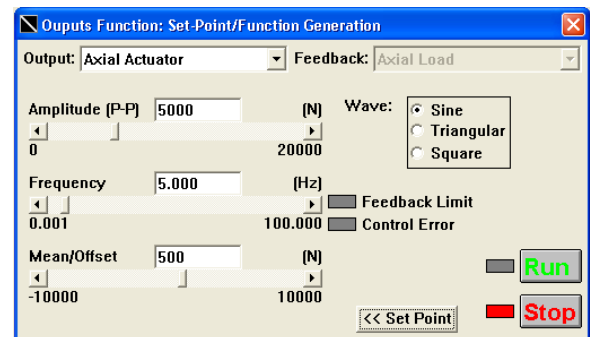
Manual Set Point/Function Generation Tool

The Hydraulic Tool allows for an interface to a hydraulic pump. In the configuration window, control parameters can be established, as the software is able to control single or dual pressure pumps, and has optional feedbacks to measure the motor, the pump power, the filter as well as the oil pressure, temperature, and level. Another nice feature is the Pump Run Time, where the consecutive hours that the pump has been running is displayed, and the CATS software will give a warning when it is time to replace the pump oil filter. The CATS Advanced software includes the Signal Analysis Chart Tool, which performs an FFT (Fast Fourier Transforms) analysis of a real time signal.

The views allow the user to see the status of the channels, and these include the Chart and the Plot with linear, semi-log and
log plotting capabilities, and also include the Digital, Bar, Gauge and Meter displays to see the current status of any input. There are even views that display the status of the outputs, so the user has ready access to see the number of cycles that an output has completed. Any screen setup can be saved and then loaded latter so less time is wasted by the user in setup of the view screens. With CATS extensive unit library, the inputs can be displayed in any SI, Metric and English units that the user wants, and even user defined units can be specified.

The CATS software also has a database type management of projects/samples/specimens. Along with the project, the customer information can be saved, and with the sample, the boring information can be saved as well. In this format it is easy to keep track of where the test specimen belongs. File names are given based upon the specimen ID, so there is no need to enter a file name before testing. You can even use the same sample folder to keep specimens for different tests, and the program will keep track of which specimen belong to which test.

At GCTS, all of our testing systems have been designed to take full advantage of our new CATS software, so that all test stages can be automatically performed from beginning to end with minimal user intervention. However, the CATS software can also be used to update old GCTS and non-GCTS testing systems as well. With the use of advanced sensor calibration that can include nonlinear conversion factors and/or automatic environmental corrections applied in real time, the GCTS CATS software provides superior results unmatched in the servo controlled testing field.

The Universal test program and test module within the CATS software is very versatile, as it allows the test setup to control in synchronization all of the available Analog, Temperature and/or Digital Outputs. The CATS Advanced test program can be made up of virtually unlimited independent phases, with each phase having its own unique output definition, data acquisition and data saving parameters. With these capabilities, the user has full control over the test sequence allowing him/her to program even the most complex testing procedures. CATS Standard has only one phase per Universal test program. A Universal Test program is made up of test phases, with each phase' duration being controlled by either time and/or input threshold value. Data can be

recorded at constant or variable periods by specifying the time interval, change in input signal level, the peak and valley of an input signal, or a combination of the above methods. The data recording can be turned on or off for specific cycles defined by the user in linear, logarithmic, and CAT Advanced even features an arbitrary (user defined table) mode. The CATS Advanced data buffers can be made Single, Continuous or Circular, while for CATS Standard they are set at Continuous.

For any phase, all or none of the outputs can be defined for control from the available outputs, with each one defined separately and independently. The selected defined outputs will be synchronized in their control for that phase. The user can choose from the Constant, Ramp, Ramp & Dwell, Sine, Triangular, Square waves, as well as run Random and User Defined wave sequences in CATS Advanced. For the Sine, Triangular and Square waveforms in CATS Advanced, the amplitudes and frequencies can be made variable, so a "sweep" of the amplitudes and/or the frequencies can be accomplished. Also, compensations, such as the Peak & Valley Compensation, can be established. For the User Defined waveform, a file will be read containing the points for the command, so that a digitized earthquake record can be played back as the command for the output.

The resulting specimen data file can be graphed within the results graph feature of the CATS program, or it can be exported to any spreadsheet program, like Excel.
The Universal test module of the CATS software is a very versatile and powerful module that allows the user to establish any test procedure that they wish. If used as a stage of another test (Triaxial, Direct Shear, etc.), the Universal Module becomes even more powerful because of the availability of the test inputs specific to the particular test. The Universal Module can be used to control general test systems, such as the Simple Shear or Poly-axial, without any modifications to the module.
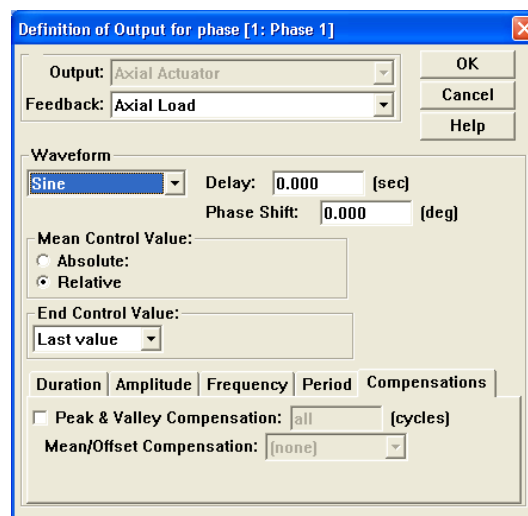
Universal Output Definition Screen

For the CATS Standard user, who want to take advantage of the CATS Advanced, GCTS does offer the CATS Advanced upgrade.

CATS SPECIFICATIONS (STANDARD AND ADVANCED)

- Advanced PID feedback control with adaptive control as a function of any sensor input or calculated input.
- Peak/Valley compensation on system control.
- Stabilization by any associated input in control, not only the feedback control sensor.
- Automatic "smooth" or "bump-less" control transfer from/to any sensor or calculated input.
- Configurable unit library to automatically perform unit conversions.
- Linear, log, and semi-log plotting capability with user specified plot parameters.
- Unlimited user configurable view tools (plot, chart, digital, meters, gages, bars, etc.)
- Ability to define user defined inputs as a function of other inputs – User Function Inputs
- Automated test procedures.
- Phase duration selections (2): Time, and/or Input Threshold
- Phase data acquisition modes (3): Timed, Level Crossing, and Peak/Valley

CATS	Standard	Advanced
Analog Inputs (sensors)	12	28
Counter Inputs	0	1
User Function Inputs	2	5
User Correction Inputs	0	5
Analog Outputs	4	8
Temperature Outputs	0	2
Volume Change Devices	0	2
Pressure Volume Controllers	0	3

CATS STANDARD SPECIFICATIONS

- Sensors: DC, AC, and SG
- One (1) phase per test universal program
- Independent and Synchronized control of up to 4 Analog Servo Outputs
- Phase data saving buffer: Continuous
- Data cycle saving modes (3): Every Cycle, Linear, or Logarithmic
- Waveform library including Ramp, Ramp + Dwell, Sine, Triangular, and Square

CATS ADVANCED SPECIFICATIONS

- User management with different access levels and passwords
- Third degree polynomial conversions from sensor inputs in real time.
- Signal analysis tool showing the FFT of any system signal on real time.
- 2 independent temperature controls (outputs) with dual cascaded feedbacks and optimized algorithms to minimize "overshoot"
- User Correction Inputs. Ability to apply a correction to any input as a function of another input via a third degree polynomial - view/control in real time –
- Sensors: DC, AC, SG, Thermocouple and Counter
- Up to 99 phases per test program
- Independent and Synchronized control of up to 10 Outputs: 8 Analog Control Outputs, and 2 Temperature Control Outputs
- Four Phase data saving buffer selections: Single, Continuous, Circular, or none
- Four Phase data cycle saving modes: Every Cycle, Linear, Logarithmic, or User Defined
- Waveform library including Ramp, Ramp + Dwell, Sine, Triangular, Square, Random, and User Defined (i.e. User-generated profiles such as a digitized earthquake record)
- Frequency and Amplitude sweeping

TEST SYSTEMS CONTROLLED USING CATS SOFTWARE

- Triaxial Test Systems
- Resilient Modulus Test Systems
- Direct Shear Test Systems
- Resonant Column Test Systems
- Simple Shear Test Systems
- Poly-Axial (True-Triaxial)
- Unsaturated Soil Test Systems
- Ultrasonic Velocity Test Systems