



# PLC TRAINER

# PTS F1616

You are about to understand why we are considered one of the best options in the market for learning or training on Programmable Logic Controllers PLCs.

To get a wide knowledge on automation you need to be able to use equipments that can cover most of the aspects but this, in real terms and with most of the brands you find in the market, makes the solution very expensive.

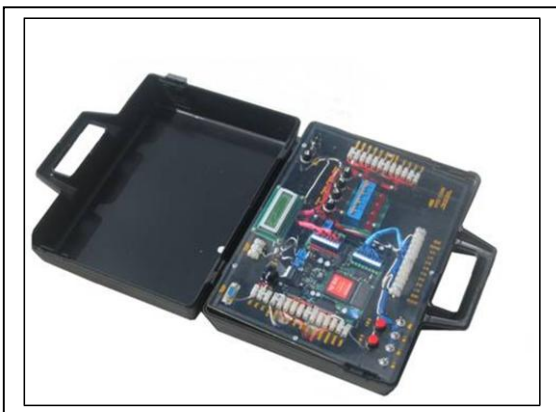
We use to call our PTS F1616 a “Super PLC trainer”, because it contains all what you need on a PLC, at affordable cost and on the same equipment.

Our customers include:

- Educational institutions all over the world
- PLC programmers and developers.
- Engineers and technicians.
- Self learners.
- Industries that develop automated machinery

In summary, if you need a powerful and high tech tool for training or quick development ...

...then you need our PTS F1616



### More New Technologies

You can learn the classical concepts or you can innovate with new approaches in the changing world of industrial automation.

### Saves You Extra Costs

Why to pay for only a PLC when you can have a complete trainer with pushbuttons, switches, relays, LEDs and power supply, for the same cost.

### Educational and Real

These PLCs are used for many multinationals. Anyone or any educational center can take his application to the real world.

### More Control Techniques

You can learn more technologies. In addition to the classical Ladder programming, you can use powerful instructions in BASIC language.

### Fixable Equipment

Yes, our training stations are fixable. We are aware that the learning process is associated to mistakes. In our PLCs all the chips are mounted on DIL Basis so you can remove/ replace defective chips for only few dollars.

### More New Topics

Could you imagine monitoring and controlling trough EXCEL ® ? You can also operate our PLCs over the Internet. Try robotics and telemetry.

### More Learning Levels

Our units allow you to work from simple applications up to highly sophisticated designs.

### More programming possibilities.

You can use it for simple ladder control programs or in advanced applications with complex mathematics.

## Advantages

- Excellent cost.
- Immediate industrial application.
- Super fast automation development.
- Software simulation.
- Programmable in ladder and BASIC.
- First internet ready PLC trainer station.
- Phone / modem support.
- Multiple protocols supported.
- You can write your own protocols.
- Excellent for complex tasks.
- Two motion channels included.
- Portable.
- Small weight and size
- Complete assembly with power supply and fuses.

A lot of educational institutions use out equipments to provide education, training and practical projects.

RMIT (Australia)  
TAFE (USA)  
Old Dominion University (USA)  
Purdue University (USA)  
State University of New York (USA)  
Sait Polytechnic (Canada)  
Torreon University (Mexico)  
University of el Paso (Texas)  
Kent State University (USA)  
Florida International University (USA)  
SENA ( Colombia)  
Miami Dade College (USA)  
and many other colleges and universities around the world

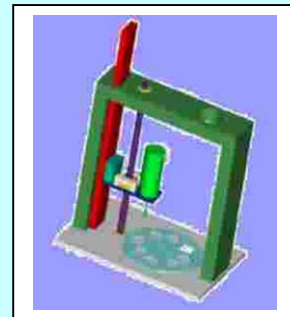


Prof. Chang, David, Tony, Wayne, Travis, Joe, Brett, and Brian from Purdue University.  
Class [IE 575](#) in Fall 2000 semester

Our PTS F1616 is a powerful tool for industrial automation developers to save time and money when quick prototyping is needed.

Educational institutions have found that our trainers are the best way to train learners in both simple and sophisticated PLC control with classic or modern control techniques.

Most of the other training equipments in the market only allow computer simulation for loads and programs. In our case, in addition to the simulation, our PLC Trainer PTS F1616 can be connected to real devices or loads.

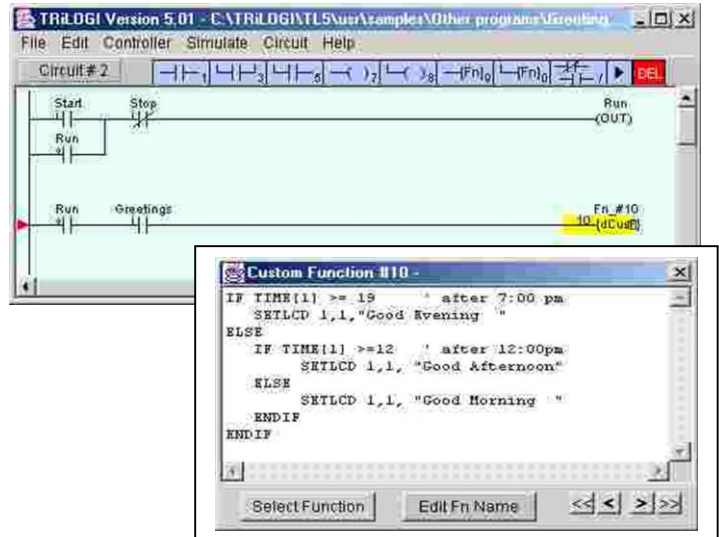


## Technical Specifications

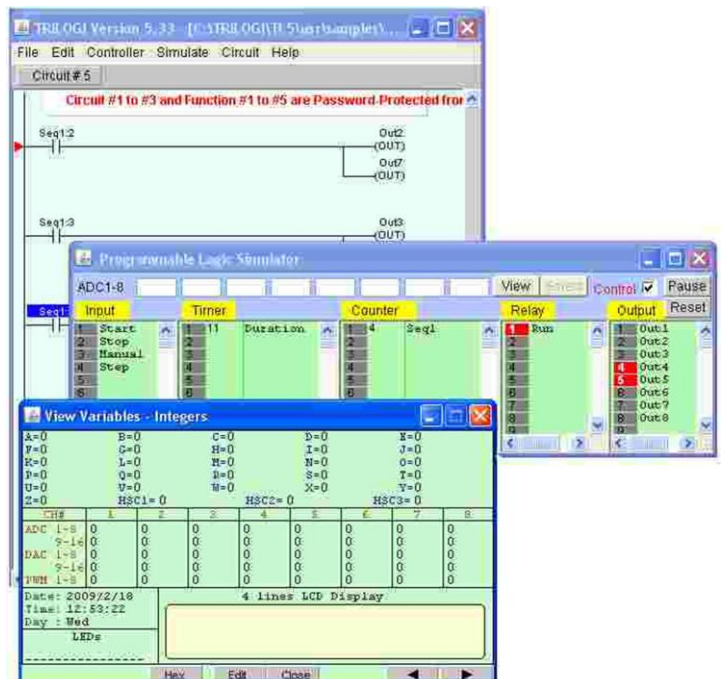
### Software

- Windows environment.  
You can install and run our programming and simulation software on any Windows: XP/NT/2000/Vista/7.
- Ladder and BASIC programming.  
Our PLC trainers allow you to use all the typical instructions used in Ladder Logic. Additionally you can learn and use a powerful set of instructions that can form part of basic language programs for any control task.
- On-line monitoring and control  
You can view or control your PLC program either from your PC or directly from the trainer.
- Ethernet / Internet connectivity  
Access your PLC trainer from anywhere in the world at no extra cost. Internet server included
- Easy program/debugging tools  
The software allows you to troubleshoot your program, either locally or from a remote place.
- Powerful set of instructions for ladder and Basic. You can replace a lot of ladder logic program and use a single instruction.

### Friendly Programming Environment



### Powerful Monitoring/Debugging Tool



### Communication capabilities

- Modbus (110 a 500Kbps)
- Omrom's C20H protocol
- Internet/ethernet EMIT 3.0
- Control/ Monitoring through EXCEL
- You can develop your own protocol

### PLC Features

- 64 Timers and 64 counters.
- 512 internal relays.
- Configurable PID instruction.
- 8K words (16-bit) of program memory stored in flash memory.
- 16K words (16-bit) of program memory stored in flash memory with FRAM-RTC.
- A to Z (32-bit Integer), A\$ to Z\$ (ASCII strings) DM[1] to DM[1000] (16-bit integer array).

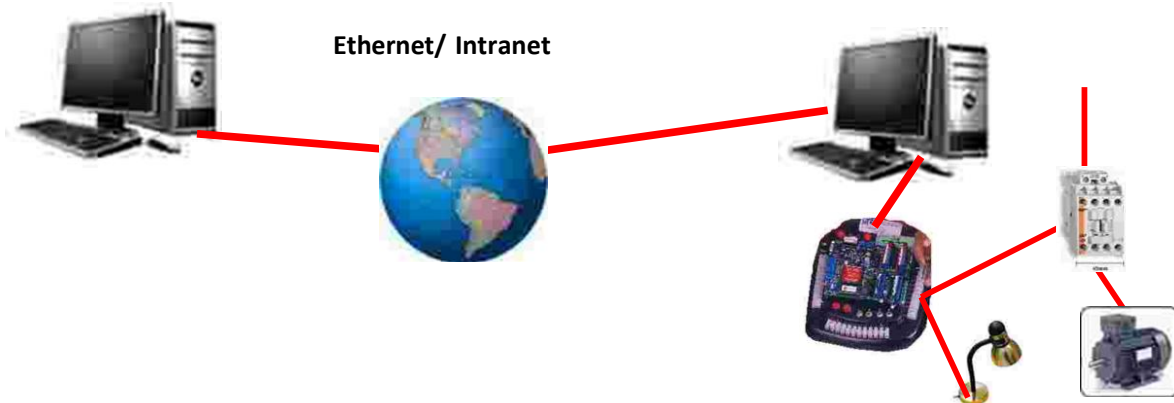
One of our first models



### Hardware

- 16 (24V npn) with LED Indicators. 2 x 32-bit High Speed Counter (quadrature: 2 D/Is per channel). 4 x user-defined interrupt (latency < 0.5ms, +ve or -ve edge triggered).
- 16 (24V npn) with LED Indicators. 4 x PWM; shares with D/O #5 to #8 (continuous frequencies, 0.1% duty cycle resolution). 3 x stepper motor control pulse/direction outputs (2 D/Os per stepper output).
- 10 Analog I/O. 8 x AI -12 bit, 0-5V. 2 x AO - 12 bit, 0-5V or 0-10V (Software selectable!). Expandable to 4 channels (0-5V)
- RS232 and RS485 ports available. They can talk in different protocols simultaneously.
- Display of 2 lines 16 characters.
- Clock / Calendar (optional).
- 4 Jumbo Indicating LEDs.
- 2 Push buttons.
- 4 Switches
- Five Protection fuses.
- Carrying case.
- Wall adapter 15VDC@250mA output/ 110VAC input.
- DC voltage supply available on connectors.
- Potentiometer of 5K ohms with knob.
- RS232C serial connection cable.

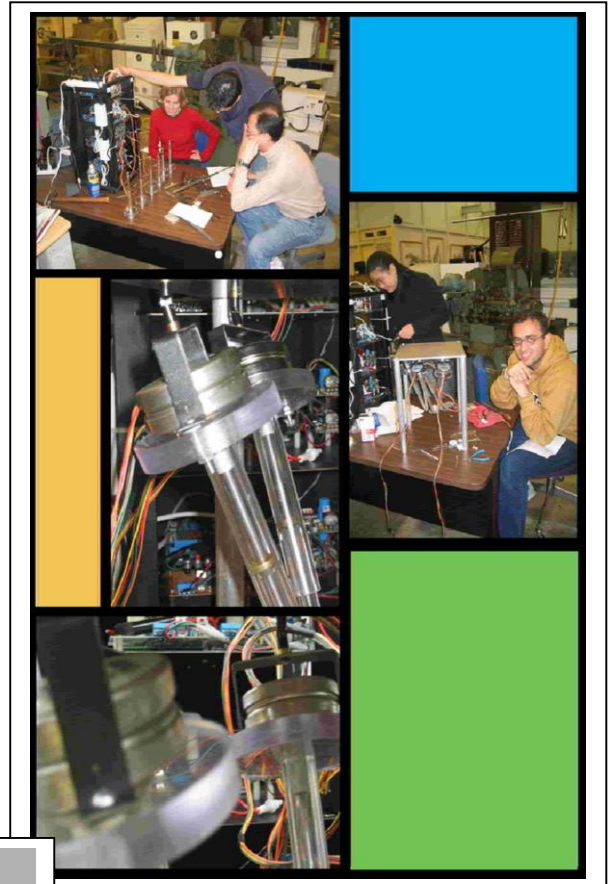
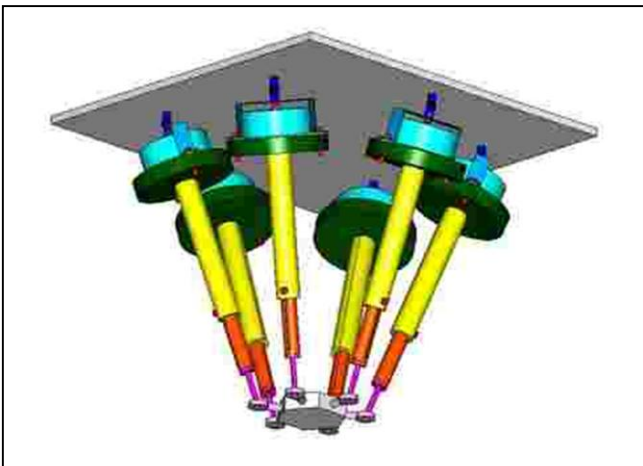
### Ethernet/ Intranet





# From just a project request ... to a real device!

**BTG2 Group 1**  
**6DF Hexapod Robot**  
**End of project review**  
December 8, 2002  
Purdue University  
School Of Industrial Engineering  
IE 575



Stefan Ivan Wonil Amir Jiesha Xiuli Bob Diana Saamil Minseok



## THE TBASIC LANGUAGE COMPONENTS

### 1. Integer Variables

The TBASIC compiler in TRiLOGI Version 4/5 supports full 32-bit integer computations. All integer constants are treated as 32-bits and there are 26 variables (A to Z) that are 32 bits in length. These variables can represent numbers between  $-2^{31}$  to  $+2^{31}$ . The remaining system variables and data memory DM[n] are all 16-bit variables which means that they can only store numbers between -32768 to +32767. These 16-bit variables are:

DM[1]..DM[4000] (Total = 4000), input[n], output[n], relay[n], timerbit[n], ctrbit[n], timerPV[n], ctrPV[n], HSCPV[n], (High Speed Counter), TIME[n], DATE[n].

However, all numeric computations in TBASIC are carried out in 32-bit signed integers, regardless of the bit-length of the variables involved in the numerical expression. All variables used in TBASIC are "GLOBAL variables" - this means that all these variables are shared and accessible by any of the 128 custom functions.

### 2. Integer Operators

a) Arithmetic Operators: +, -, \*, /, MOD

b) Bitwise Logical Operators:

**Symbol Operation Example**

& logical AND IF input[1] & &H02 ...

| logical OR output[1] = A | &H08

^ Exclusive OR A = RELAY[2] ^ B

~ logical NOT A = ~timerPV[1]

c) Relational Operators : Used exclusively for decision making expression in statement such as IF expression THEN ..... and WHILE expression ....

**Symbol Operation Example**

= Equal To IF A = 100

<> Not Equal To WHILE CTR\_PV[0]<> 0

> Greater Than IF B > C/(D+10)

< Less Than IF TIME[3] < 59

>= Greater Than or Equal

To

WHILE X >= 10

<= Less Than or Equal To IF DM[I] <= 5678

AND Relational AND IF A>B AND C<=D

OR Relational OR IF A<>0 OR B=1000

### 3. String Data

A string is a sequence of alphanumeric characters (8-bit ASCII codes) which collectively form an entity. A string constant may contain from 0 to 70 characters enclosed in double quotation marks. e.g.

"TBASIC made PLC numeric processing a piece of cake!"

"\$102,345.00"

TBASIC supports a maximum of 26 string variables A\$, B\$ ... Z\$. Each string variable may contain from 0 (null string) up to a maximum of 70 characters.

### 4. String Operators

a) Assignment Operator: A string variable (A\$ to Z\$) may be assigned a string expression using the assignment statement:

A\$ = "Hello, Welcome To TBASIC"

Z\$ = MID\$(A\$,3,5)

b) Concatenation Operators: Two or more strings can be concatenated (joined together) simply by using the "+" operator.

e.g.

M\$ = "Hello " + A\$ + ", welcome to " + B\$

If A\$ contains "James", and B\$ contains "TBASIC", M\$ will contain

the string: "Hello James, welcome to TBASIC."

c) Comparison Operators: Two strings may be compared for equality by using the function STRCMP(A\$,B\$). However, the integer comparator such as "=", "<>", etc cannot be used for string comparison.

### 5. TBASIC Statements and Functions

Most of the statements and functions of the powerful TBASIC language is tabulated below together with brief explanations for their purposes.

Command	Purpose
ABS(x)	To return the absolute value of x
ADC(n)	To return the value from the A/D Converter #n.
ASC(x\$,n)	To return the ASCII code for the nth char. of x\$.
CALL n	To call another Custom Function CusFn #n.
CHR\$(n)	To convert a number n into its corresponding ASCII character. n must be between 0 and 255)
CLRBIT v,n	To clear the Bit #n of the integer variable v to '0'.
FOR ... NEXT	To execute a series of instructions for a specified number of times in a loop.
GetCtrSV (n)	Return the Set Value (S.V) of Counter or Timer #n.
GetTimerSV (n)	returns the upper 16-bit of a 32-bit integer variable
GETHIGH16(v)	
GOTO @n	To branch unconditionally to a specified line with label @n within the present Custom Function.
HEX\$(n)	To return a hexadecimal string expression of n.
HEXVAL(x\$)	To convert hexadecimal number in string x\$.
HSTIMER n	To define PLC Timer #1 to #n as "High Speed Timers" (HST) with time-base of 0.01s.
HSCDEF ch,fn,v	Enable and set up parameters for the High Speed Counters channel ch.
HSCOFF ch	Disable High Speed Counter #ch
IF .. THEN .. ELSE	To make a decision regarding program flow based on the result returned by an expression
.. ENDIF	
INPUT\$(ch)	To get a string from communication port ch.
INTRDEF ch,fn,e	Enable Interrupt Input channel ch and the interrupt service routine CusFn #fn
INTROFF ch	Disable Interrupt Input channel ch.
LEN(x\$)	To return the number of characters in x\$.
LOAD_EEP(addr)	To obtain 16-bit integer value from the EEPROM.
LSHIFT i,n	To shift 1 bit to the left the 16-bit integer variable I.
MID\$(x\$,n,m)	To extract a string of m characters from x\$, beginning from the nth character
PAUSE	To set a breakpoint for executing the CusFn
PIDdef ch,imt, P,I,D	To set up the parameters for a Proportional, Integral and Derivative (PID) Controller function.
PIDcompute (ch,E)	Computes the output for the error E using the P,I,D value set by the PIDdef command.
PRINT# n x\$;... y; z....	To send the string formed by parameter list (x\$: y; z) to communication port #n.
PMON ch	PMON enables Pulse Measurement Function at channel #ch. PMOFF disables the channel
PMOFF ch	
PULSEFREQUENCY	Return in Hz the frequency of the last input pulse ;
PULSEPERIOD	Return in milli-seconds the width and period of the input pulses arriving at channel ch.
PULSEWIDTH	
REFRESH	To immediately refresh of the physical outputs.
RESET	To perform a software reset of the PLC
RETURN	Unconditionally return to the caller function.
REM (or ?)	Put explanatory remarks in the program.
RSHIFT i,n	To shift the integer variable i 1 bit to the right.
SAVE_EEP data, addr	To store a 16-bit integer data in the user's definable EEPROM address addr.
SETBAUD ch, baud	To set the communication "Baud Rate" of the PLC's serial channel #ch
SETBIT v,n	To set the bit #n of the integer variable v to '1'.
SetCtrSV n, val	Change the Set Value (S.V.) of the Counter #n or Timer #n to value
SetTimerSV n, val	
SETDAC n, x	To set D/A converter #n to x
SETHIGH16 v,d	To assign the upper 16-bit of a 32-bit variable v
SETPWM n, x, y	To set PWM channel #n with duty cycle x%
STEPCOUNT(ch)	Track the number of steps sent since STEPMOVE.
STEPSPEED ch, pps, acc	Set the speed pps and acc for the PLC's stepper motor controller (pulse-generator) channel #ch.
STEPMOVE ch, count, v	Activate the stepper motor pulse generator channel #ch to output count number of pulses.
STEPSTOP	Immediately terminate Stepper controller #n
STR\$(n)	Convert the number n into a string expression.
STRCMP(A\$, B\$)	Comparison of two strings: A\$ and B\$.
STRUPR\$(A\$)	To return all upper-case copy of A\$.
STRLWR\$(A\$)	To return all-lower-case copy of A\$.
TESTBIT (v,n)	To return the logic state of bit #n of the variable v.
WHILE expression	To execute a series of statements in a loop as long as a given condition is true.
.... ENDWHILE	
VAL(x\$)	To return a value of a number in the string x\$.



## Create Your Own Control Web Page.

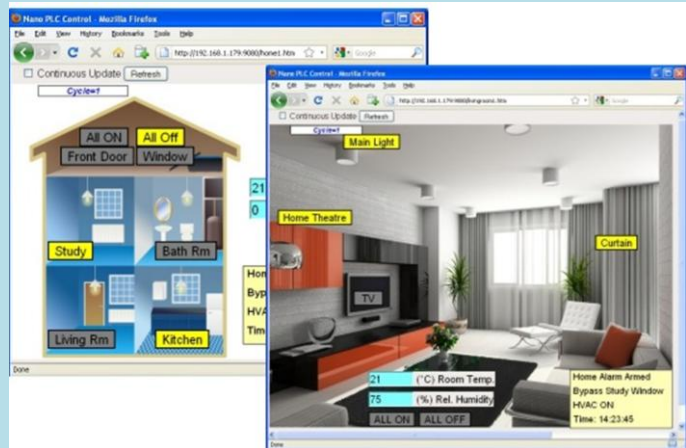
The PTS F1616 implements the same AJAX technologies that allows anyone to create a custom web page to control their equipment using any browser (including the iPhone), without needing to write a single line of Java or Javascript program code.

## Ethernet Super PLC Application Ideas

### Internet Accessible Home Control System.

You can implement a small control system to directly control some equipment in your home and add an web page interface to it in no time.

By combining with low cost Wi-Fi bridge (e.g. D-Link DAP1522), multiple Super PLCs can easily be connected to a HOME Wi-Fi Network. This allows you to easily retrofit the Super PLCs into an existing home or commercial building to implement your customized home automation. Since the PTS F1616 can perform M2M communication readily your intelligent home is therefore served by multiple brains coordinating among themselves.

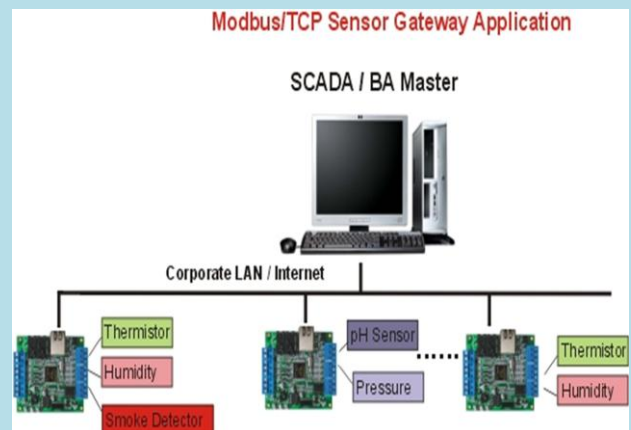


### PTS F1616 As Modbus TCP/IP Gateways for Sensors

The PTS F1616 built-in Modbus TCP/IP Server allows simultaneous connections by up to 5 Modbus TCP/IP clients. With only a few lines of program code you can immediately collect data from your current sensors and makes them available to the factory-wide SCADA or Enterprise network Host Computer.

Best of all, you can also perform some pre-processing (e.g. compute the moving average, scaling or linearization) of the data or perform local control with its powerful yet simple to learn Ladder+BASIC programming language.

Since multiple communication protocols can coexist on the Ethernet network, these super PLCs provides an instant, low cost solution for sensor manufacturers or any users to connect the sensor to the modern control system.

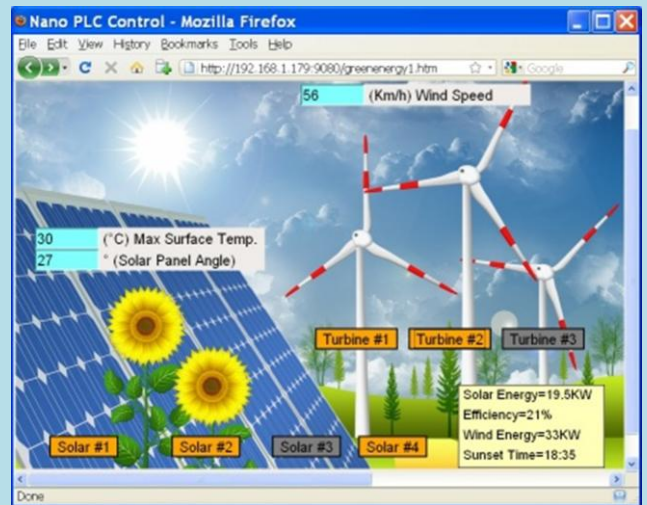


### Quickly Create A Customized Basic Control Web Page

Since the PTS F1616 built-in web services employs the AJAX technology for equipment control, it allows you to quickly create a custom web page within a few minutes to control your equipment. Your user can then use any PC or smart phone (e.g. iPhone) web browser to view the equipment, with graphical illustrations.

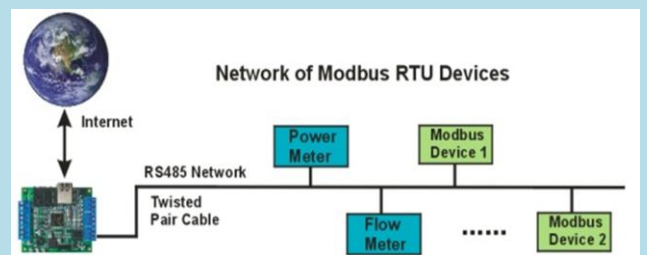
Best of all, your user does not need to install any application in order to view the operation of your equipment. So what they gain is a no-hassle, free Graphical HMI to interact with your equipment via the Internet.

Imagine how much this capability would add to the competitive advantage of your equipment!



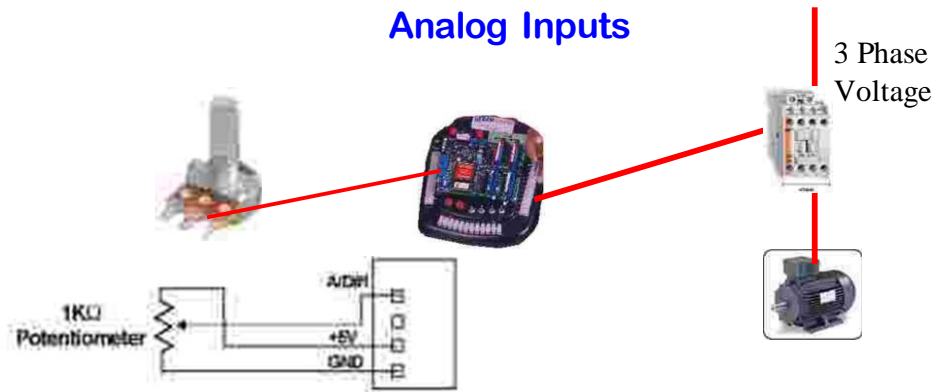
### Data Logging and Control of MODBUS Devices. Data Can Be Logged To Remote Server Via The Internet.

Since the PTS F1616 can issue Modbus-RTU or Modbus ASCII commands to access many industrial devices and sensors such as power meters connected to its RS485 port. This means it can readily acquire data from any instrument that understands Modbus protocol. In addition, since the PTS F88 can open a client connection to a remote server, it can log the acquired data to store as data files in the remote PC.





## Just Three examples of practices you can make with the PTS F1616



### Materials:

- 1 K ohm Potentiometer
- Any single or three phase load

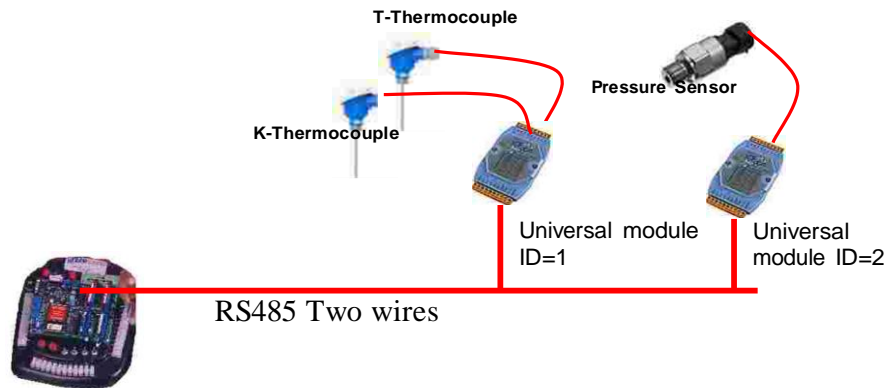
### Description:

The PLC trainer has eight analog input channels and a built-in 5 VDC power supply, you can make sophisticated controls based on a low cost potentiometer. After making the proper connections to any of the analog input channels you can simulate analog conditions, just moving the knob.

### Lab Experiments:

- Show a value from 0-100 in the LCD Display of the trainer
- Turn on an output (a Motor for instance) if the value is higher than 80.
- Set up a Minimum and a Maximum and keeping the Motor ON as long as the value is within the values of the analog window.
- Associate the analog value to a timer and be able to change the timing. As trigger you can use one the push-buttons on the trainer

## Measuring Remote Variables



### Materials:

- Any number of our Universal analog modules
- Any type of sensors (thermocouples or transmitters with voltage or current output)
- A RS232 to RS485 converter to program the Universal modules ( we provide a FREE software).
- A shielded two lines cable of any length (two meters is OK)

### Description:

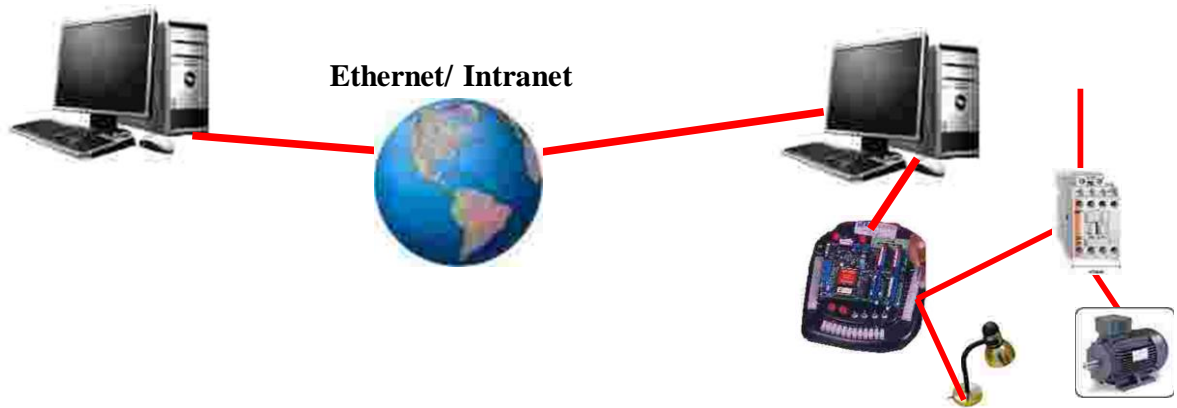
Our Universal Modules are able to measure ANY analog variable like voltage (0-1, 0-5, 0-10 VDC), current (4-20mA, 0-20mA) or any thermocouple (J, K, T, R, S, B and others). Each channel can be configured to measure any variable, no matter the rest, using our free software for that purpose. You must use an rs232 to rs485 converter to make the programming from your PC.

Once you have every universal module programmed with an ID and the same communication speed (baud rate), you are ready for the experiments.

### Lab Experiments

- Put more than one module to have a RS485 network and read variables from any remote module.
- Separate the modules within 1Km of distance and experience with different baud rates.
- Alternate the presentation of data on the LCD display

## Controlling a process from anywhere in the world.



### Materials:

- Any AC load(s)
- Two PCs with internet connection

### Description:

Imagine yourself being in any place of the world and being able to turn on or off any device in your home. The PTS F88 is internet ready, so you only need to connect your PLC trainer to a PC with internet/Ethernet connection and run the TL Server software (found in your CD ROM). From the other PC, that for practical purposes can be other of the INTRANET just use any browser to access a specific address and now you are on-line.

### Lab Experiments:

- Using the programming software connect to the PLC trainer from other PC located next room or a different PC in the network.
- Go home and make things happen on the Trainer left at the Lab.
- Send an Email form the Trainer to a particular email address notifying a failure or the end of a process.
- Saving a blank program in the Trainer and from your home make a program and download it to the trainer.
- Making a faulty program on purpose, have someone at home doing all the Troubleshooting.



### Attention Educational Institutions

Most of the educational institutions are interested in providing the best tools to their students to guarantee the right background the new professionals deserve. But , with the budget restrictions of everyday, the task of spending the money wisely becomes really difficult.

In a group of six students, who will you think that learn more?

A single group of six students  
using just a very expensive  
training equipment

VS

Three groups of two students  
each, using three of our PLC  
trainers

Our main concern was to develop a PLC trainer that will allow having more covered topics and having more trainer equipments per students.

This is a fact, for the price you pay for another trainer of a competitor, you can buy several units from us.

We offer you several advantages:

- 1) Like no other brand, our PLC trainers allows you to have one trainer per student because they are low cost. If you want to make a smart use of your budget you should try to buy several units. Imagine a lot of opportunities: Thesis projects, Industrial applications, Robotics contests, etc.
- 2) You can teach high tech topics such as Internet/ ethernet monitoring and control since this driver is included in the PTS T100 trainer or just cover the Basics of ladder programming using the PTS E10 trainer.
- 3) The software allows Simulation and your students can take the programming software and test their creations at home in their own computers. Most of the other trainer manufacturers will charge you for the software. On the other hand your lab sessions are going to be limited to the number of trainers you have.
- 4) Our units are fixable. If your students make mistakes other than blowing off fuses, we can replace all the ICs since they come on Dual In line Bases.
- 5) They include all what you need for a training: Pilot lights, Push buttons, Switches, Four 10amps relay outputs, DC Power supply, Fuse, AC cord, Programming cable. The PTS T100 also has Display , Analog inputs/outputs and two comm ports and the best of all... in a small size package that can fit in any normal desk.

To help you to make a wise decision, we have prepared this table for you to compare.

Hardware	PTS F1616	Brand 1	Brand 2	Comments
Digital Inputs	16			With special features
Digital Outputs	16			With special features
Analog Inputs	8			0-5VDC, 12 bits
Analog Outputs	2			12 bit, 0-5V or 0-10V
High speed Inputs	2			10Khz
PWM Outputs	4			Continuous frequencies
Display	2x16 LCD			To show values or messages
RS232 Port	Yes			With the included protocols
RS485 Port	Yes			With the included protocols
Clock/Calendar	Yes (Optional)			To control time/date events
Counters	64			
Timers	64			
Internal relays	512			
Variables	28 (A to Z)			Our TBASIC can use variables.
PID control	Yes			16 channels of PIDs
Program memory	6016			Large memory area
EEPROM memory	1700			Large memory area
RAM memory	4000			Large memory area
Switches	4 ( of 8)			To toggle inputs
Push-buttons	2(of 8)			With momentary action
Relays	4 (of 8)			To control loads up to 10amps
Power supplies	5VDC, 24VDC and 110VAC			Available on the side connectors
Indicating Lights	4 LED			Jumbo Ultra bright Light Emitting Diodes
Removable chips	Yes			In case that you have a damage ( factory service)
Ethernet port	Yes			Support MODBUS/TCP
Software				
Ladder	Yes			The classic methodology
Ladder + Basic	Yes			A more powerful programming technique
Sample programs	Yes			Almost every instruction has its example for quick learning
On-line monitoring	Yes			You can monitor/control either from your local PC or from any place in the world
Simulator	Yes			To test your programs without the trainer
Instructions				
Logical	Yes			
Math	Yes			Integer ,32 bit calculations
Motion control	Yes			To handle steppers or servos
Equations	Yes			Making of complex math formulas is easier than ladder
Emails	Yes			The trainer can send emails to any email address
Phone/Modem	Yes			Instruction to dial phones and modems
Internet server	Yes			To access your trainer through an internet connection
Ladder	Yes			All the common instructions

<b>Basic</b>	<b>Yes</b>			<b>Powerful set of TBASIC and Control instructions</b>
<b>Protocols</b>				
<b>Native ASCII</b>	<b>Yes</b>			<b>To send ASCII commands to any device</b>
<b>Modbus</b>	<b>Yes</b>			<b>Master or Slave ( ASCII or RTU)</b>
<b>Omrom's C20H</b>	<b>Yes</b>			<b>To connect to Omrom's PLCs</b>
<b>Ehernet/internet</b>	<b>Yes</b>			<b>TCPIP compatible</b>
<b>Your Own</b>	<b>Yes</b>			<b>To write your comm protocol</b>
<b>Construction</b>				
<b>Portable</b>	<b>Yes</b>			<b>Take it anywhere you go</b>
<b>Size</b>	<b>25x22x14cm</b>			<b>Small size to fit in your desk</b>
<b>Weight</b>	<b>3 pounds</b>			<b>Extremely Light weight</b>
<b>Op. Voltage</b>	<b>110VAC, (220 Opt) 50/60Hz</b>			<b>Universal voltage coming soon</b>
<b>Op Temperature</b>	<b>0-70°C</b>			<b>Industrial type</b>