

### IT.MLD900

The Transducers and Instrumentation Trainer introduces students to input sensors, output actuators, signal conditioning circuits, and display devices through a wide range of hands-on practical activities. This self-contained trainer has all the necessary power supplies, light sources and compressed air supplies to carry out a wide range of hands on experimental work. It is possible to build and test complete closed loop control systems for rotary speed and position, making the trainer ideal for use in control engineering teaching

#### Topics include:

- Positional Resistance Transducers
- Wheatstone Bridge Measurements
- Temperature Sensors
- Light Measurement
- Linear Position or Force Applications
- Rotational Speed or Position Measurement
- Signal Conditioning Amplifiers
- Signal Conversions Comparators, Oscillators and Filters



#### Signal Conditioning Circuits:

Buffers, Inverters, Comparator with switchable hysteresis,

Amplifiers with gain and offset control, Current amplifier, Summing amplifier, Differential amplifier, Oscillator, Filter, Precision full-wave rectifier, Sample and hold circuit, Integrator with switchable time-constant, Differentiator with switchable time constant, V/F and F/V converters, V/I and I/V converters.



#### Input Transducers:

- Carbon track
- Wirewound & precision rotary potentiometers
- Slide potentiometers
- NTC thermistors
- Type 'K' thermocouples
- I.C. temperature sensor
- Photoconductive cell
- Photovoltaic cell
- Phototransistor
- PIN diode
- Linear variable differential transformer
- Linear variable capacitor
- Strain gauge
- Air-flow sensor
- Air pressure sensor
- Slotted opto-sensor
- Reflective opto-sensor
- Inductive Proximity Sensor
- Hall Effect sensor
- Precision servo-potentiometer
- Tacho-generator
- Humidity sensor
- Dynamic microphone

#### Output Devices:

- Heater
- Filament Lamp
- DC Motor
- Solenoid Air Valve
- Ultrasonic transmitter
- Buzzer
- Loudspeaker
- Relay
- Solenoid

#### Measuring Devices:

- Counter / Timer
- 10-Point LED Bar Display
- Moving Coil Meter
- 3 ½ Digital Voltmeter LCD
- 3 ½ Digital Ammeter LCD

#### Power supply:

- -5V, +5V /1A
- -12V, +12V /1A

#### Item Included:

- Trainer
- Accessory and lead kit
- Manuals

### Accessories included



BNC-CLIPS CABLE



2mm TEST LEADS



MICROPHONE



OSCILLOSCOPE PROBE



USB CABLE



### DATA ACQUISITION UNIT INTERFACE SOFTWARE



#### FEATURES:

##### Channels

2 independent channels  
sampled simultaneously

Sampling Frequency

20MSamples/second maximum

Vertical Resolution

10 bits per channel (1:1024)

Vertical Bandwidth

2 MHz

Vertical Input Range

±250mV to ±25V full scale

Vertical/Horizontal Scale

10 major divisions

Triggering

Digital comparison with input signal

Software Features

Spectrum Analysis (FFT) X-Y Plot Auto Measurements etc.

Memory Depth

Refresh Rate 1K Samples each channel > 2 updates/second

Display

##### Waveform Generator

Frequency Range

0.1Hz to 3MHz

Frequency Resolution

0.1Hz

Output Amplitude

+/-3V

Vertical Resolution

8 bits at all amplitude settings

Waveforms

Sine, Square, Triangle, Ramp (Sawtooth) and others

Arbitrary Waveform

8 bit resolution vertical, 256 time points

Noise

Pseudo-random, 8 bit analog noise, sample rate 12.5Mz, sequence length 21 seconds

##### Digital I/O

Output

8 bits, GUI (Graphical User Interface) controlled, 5 volt

Input

8 bits, GUI indicators, 5 or 3 volt

Pulse waveform

Variable duty cycle at constant frequency

35Hz to 72kHz in steps of x2

Interrupt

Selectable level and slope, illuminates 'Interrupt' indicator

##### Virtual Instruments

Air Pressure

Measure Pressure on channel A or B input.

Temperature

Measure Temperature on channel A or B input.

Weight

Measure Weight on channel A or B input.

Grey Coded Disk

Show position of needle against grey code value.

Voltmeter

Show volts against each channel of scope.

##### Others

Indicators

Power LED (Green) Activity LED (Red)

Interface

USB 2.0

## EXPERIMENTS INCLUDED

### Basic Control Systems Equipment and Terms Used

Study the difference between open loop and closed loop systems  
Expression for the overall gain of a negative feedback closed loop system  
Calculation of overall gain of a negative feedback closed loop system from given information  
Basic components of a closed loop system and explain their functions  
Meaning of terms associated with control system equipment

### Positional Resistance Transducers

Basic construction of rotary and slider variable resistors  
State that the resistance section may be either a carbon track or wirewound  
Difference between a logarithmic and a linear track  
Characteristics of output voltage against variable control setting  
Comparison of a carbon track variable resistor to the wirewound type

### Wheatstone Bridge Measurement

Basics of Wheatstone Bridge circuit for resistance measurement.  
Describe the term "null balance".  
Calculation of an unknown resistance from the Bridge values at balance  
Factors affecting the resolution and accuracy of measurements  
Discuss the reason for the three-wire resistance circuit

### Temperature Measurement

Characteristic of an IC temperature sensor  
Construction and characteristics of a platinum RTD resistance transducer  
Construction and characteristics of an NTC Thermistor  
Characteristic of NTC Thermistor bridge circuits  
Construction and characteristics of a Thermocouple  
Deduce temperatures from a voltage reading across a transducer

### Light Sensors

Characteristics of a filament lamp  
Construction and characteristics of a photovoltaic cell  
Construction and characteristics of a phototransistor  
Construction and characteristics of a photoconductive cell

Construction and characteristics of a PIN photodiode

### Linear Position or Force Applications

Construction, principal and characteristics of a Linear Variable Differential Transformer (LVDT)  
Construction and Characteristics of a Linear Variable Capacitor  
Construction and Characteristics of a Strain Gauge

### Environmental Measurements

Construction and characteristics of an air flow transducer  
Construction and characteristics of an pressure transducer  
Construction and characteristics of a humidity transducer

### Rotational Speed and Position Measurements

Slotted Opto Transducers for Counting and Speed Measurement  
Reflective Opto Transducers and Gray Coded Disc for Position Measurement  
Inductive Transducers for Speed Measurement  
Hall Effect Transducers to Speed and Positional Measurement  
Construction, Principles and Application of a Tacho-Generator to Speed Measurement

### Sound Measurements

Construction and characteristics of a microphone  
Construction and characteristics of an ultrasonic receiver and transmitter  
Comparison of various methods of measuring sound signals  
Sound Output  
Construction and characteristics of a moving coil Speaker  
Construction and characteristics of a buzzer

### Linear or Rotational Motion

Construction and characteristics of a DC solenoid  
Construction and characteristics of a DC relay  
Construction and characteristics of a DC solenoid air valve  
Construction and characteristics of a DC permanent magnet motor

### Display Devices

Characteristics and application of the Timer/Counter  
Characteristics and application of the LED Bargraph display  
Characteristics and application of the Moving Coil Meter  
Calculate the requirement to extend the voltage range of a Moving Coil Meter

Selection of a suitable device for a particular voltage measurement

### Signal Conditioning Amplifier

Characteristics and application of DC amplifiers  
The term "Offset" and the need for offset control  
Characteristics and application of an AC amplifier  
Characteristics and application of a power amplifier  
Characteristics and application of a current amplifier  
Characteristics and application of a buffer amplifier  
Characteristics and application of an inverter amplifier  
Characteristics and application of a differential amplifier

### Comparators, Oscillators and Filters

Characteristics of a comparator  
Effect of hysteresis on the operation of a comparator  
Characteristics of an alarm oscillator  
The term "latch" applied to an alarm oscillator  
Characteristics of an electronic switch  
Characteristics of a 40KHz oscillator  
Characteristics of band pass filters  
Characteristics of low pass filters  
**Mathematical Operations using OP AMPS**  
Characteristics of a summing amplifier  
Characteristics of an integrator  
Characteristics of a differentiator  
Characteristics and application of a "sample and hold" circuit

### Control Systems Characteristics

Characteristics of an ON/OFF system  
Characteristics of a Proportional system  
Characteristics of an Integral system  
Characteristics of a Derivative system  
Practical system 3-term (or PID) controller  
**Practical Control Systems**  
Characteristics of an ON/OFF temperature control system  
Characteristics of a light controlled ON-OFF system  
Characteristics of a speed control system  
Characteristics of a positional control system having:  
Proportional  
Proportional + integral  
Proportional + derivative  
Proportional + integral + derivative control

### IT.TT1/LV

#### Description

The Trainer introduces students to input and output of LVDT transducer, signal conditioning circuits and display devices through a wide range of practical activities. The study module includes transducers and instrumentation trainer and a curriculum manual

#### Features

- Sensors installed on-board
- Transducers installed on-board
- Control Circuits Installed
- Drivers Installed
- Protection Circuits Installed
- Display Devices Installed
- Measuring Devices Installed

#### Transducer

- Linearly Variable Differential Transformer (LVDT)

#### Measuring Devices

- 3 1/2-Digit Digital Voltmeter LCD Type

#### Accessories

- Power Cord
- User Manual
- Experiment Manual
- 2mm Patch Cords



#### LVDT TRANSDUCER TRAINER

##### Technical Features:

Fixed Supply DC: +5V, -5V, +12V, -12V  
Signal Conditioning Circuits:  
Amplifier with Switchable Gain and Offset Control  
Differential Amplifier  
Instrumentation Amplifier  
AC amplifier  
Oscillator 40KHz  
Filter 40KHz  
Precision Full-Wave Rectifier  
Wheatstone Bridge



##### Experiments Included:

###### ü Basic Control Systems Equipment and Terms Used

1. Study the difference between open loop and closed loop systems
2. Expression for the overall gain of a negative feedback closed loop system
3. Calculation of overall gain of a negative feedback closed loop system from given information
4. Basic components of a closed loop system and explain their functions
5. Meaning of terms associated with control system equipment

###### ü Wheatstone Bridge Measurement

1. Basics of Wheatstone Bridge circuit for resistance measurement.
2. Describe the term "null balance".
3. Calculation of an unknown resistance from the Bridge values at balance
4. Factors affecting the resolution and accuracy of measurements
5. Discuss the reason for the three-wire resistance circuit

###### ü Linear Position or Force Applications

1. Construction, principal and characteristics of a Linear Variable Differential Transformer (LVDT)

###### ü Signal Conditioning Amplifier

1. Characteristics and application of DC amplifiers
2. The term "Offset" and the need for offset control
3. Characteristics and application of an AC amplifier
4. Characteristics and application of a power amplifier
5. Characteristics and application of a differential amplifier

###### ü Comparators, Oscillators and Filters

1. Characteristics of a 40KHz oscillator
2. Characteristics of 40KHz Filter



### IT.TT1/SG

The Trainer introduces students to Strain Gauge transducer, signal conditioning circuits and display devices through a wide range of practical activities. The study module includes transducers and instrumentation trainer and a curriculum manual.

#### Features

- Sensors installed on-board
- Transducers installed on-board
- Control Circuits Installed
- Drivers Installed
- Protection Circuits Installed
- Display Devices Installed
- Measuring Devices Installed

#### Transducer

- Rotary Wirewound
- Load Cell 150g

#### Measuring Devices

- 3 ½-Digit Digital Voltmeter LCD Type

#### Accessories

- Power Cord
- User Manual
- Experiment Manual
- 2mm Patch Cords



### STRAIN GAUGE TRANSDUCER TRAINER

#### Technical Features:

Fixed Supply DC: +5V, -5V, +12V, -12V

Signal Conditioning Circuits:

Amplifier with Switchable Gain and Offset Control

Instrumentation Amplifier

X100 Amplifier



#### Experiments Included:

##### ü Basic Control Systems Equipment and Terms Used

1. Study the difference between open loop and closed loop systems
2. Expression for the overall gain of a negative feedback closed loop system
3. Calculation of overall gain of a negative feedback closed loop system from given information
4. Basic components of a closed loop system and explain their functions
5. Meaning of terms associated with control system equipment

##### ü Linear Position or Force Applications

1. Construction and characteristics of Strain Gauge

##### ü Signal Conditioning Amplifier

1. Characteristics and application of DC amplifiers
2. The term "Offset" and the need for offset control
3. Characteristics and application of an AC amplifier

##### ü Practical Control Systems

3. Construction of a Weight Pan using Strain Gauge

### IT.TT1/PR

The Trainer introduces students to Pressure transducer, signal conditioning circuits and display devices through a wide range of practical activities. The study module includes transducers and instrumentation trainer and a curriculum manual.

#### Features

- Sensors installed on-board
- Transducers installed on-board
- Control Circuits Installed
- Drivers Installed
- Protection Circuits Installed
- Display Devices Installed
- Measuring Devices Installed

#### Transducer

- Rotary Wirewound

#### Sensors

- Air-Flow Sensor
- Air Pressure Sensor

#### Measuring Devices

- 3 ½-Digit Digital Voltmeter LCD Type

#### Accessories

- Power Cord
- User Manual
- Experiment Manual
- 2mm Patch Cords



### PRESSURE TRANSDUCER TRAINER

Fixed Supply DC: +5V, -5V, +12V, -12V  
Pneumatic Supply: Internal Pneumatic Pump  
Output Devices: Solenoid Air Valve  
Signal Conditioning Circuits:  
Amplifier with Switchable Gain and Offset Control  
Instrumentation Amplifier  
X100 Amplifier



#### Experiments Included:

##### ü Basic Control Systems Equipment and Terms Used

1. Study the difference between open loop and closed loop systems
2. Expression for the overall gain of a negative feedback closed loop system
3. Calculation of overall gain of a negative feedback closed loop system from given information
4. Basic components of a closed loop system and explain their functions
5. Meaning of terms associated with control system equipment

##### ü Positional Resistance Transducers

1. Basic construction of rotary and slider variable resistors
2. State that the resistance section may be either a carbon track or wirewound
3. Difference between a logarithmic and a linear track
4. Characteristics of output voltage against variable control setting
5. Comparison of a carbon track variable resistor to the wirewound type

##### ü Environmental Measurements

1. Construction and characteristics of an air flow transducer
2. Construction and characteristics of an pressure transducer

##### ü Sound Output

1. Construction and characteristics of a moving coil Speaker
2. Construction and characteristics of a buzzer

##### ü Linear or Rotational Motion

1. Construction and characteristics of a DC solenoid
2. Construction and characteristics of a DC relay

##### ü Signal Conditioning Amplifier

1. Characteristics and application of DC amplifiers
2. The term "Offset" and the need for offset control
3. Characteristics and application of an AC amplifier

##### ü Control Systems Characteristics

1. Characteristics of an ON/OFF system
2. Characteristics of a Proportional system
3. Characteristics of an Integral system
4. Characteristics of a Derivative system
5. Practical system 3-term (or PID) controller

##### ü Practical Control Systems

1. Characteristics of an ON/OFF pressure control system

### IT.TT1/OT

The Trainer introduces students to Optical transducer like Photovoltaic cell, photo transistor etc. signal conditioning circuits and display devices through a wide range of practical activities. The study module includes transducers and instrumentation trainer and a curriculum manual.

#### Features

- Sensors installed on-board
- Transducers installed on-board
- Control Circuits Installed
- Drivers Installed
- Protection Circuits Installed
- Display Devices Installed
- Measuring Devices Installed

#### Transducer

- Rotary Wirewound
- Slide Potentiometer
- Buzzer, Relay
- Solenoid

#### Sensors

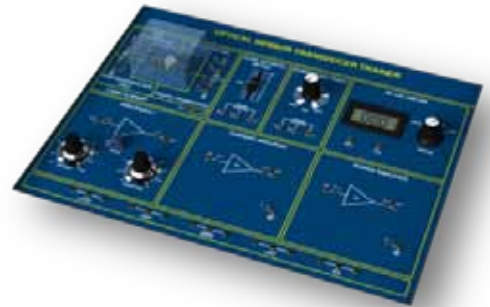
- NTC Thermistors
- Type 'K' Thermocouples
- I.C. Temperature Sensor
- Photoconductive Cell
- Humidity Sensor



### OPTICAL TRANSDUCER TRAINER

#### Technical Features:

Fixed Supply DC: +5V, -5V, +12V, -12V  
Measuring Devices: 3 ½-Digit Digital Voltmeter LCD Type  
Output Devices: Heater  
Signal Conditioning Circuits:  
Amplifier with Switchable Gain and Offset Control  
Current Amplifier  
Electronic Switch  
Comparator with Hysteresis



#### Experiments Included:

- ü **Basic Control Systems Equipment and Terms Used**
  1. Study the difference between open loop and closed loop systems
  2. Expression for the overall gain of a negative feedback closed loop system
  3. Calculation of overall gain of a negative feedback closed loop system from given information
  4. Basic components of a closed loop system and explain their functions
  5. Meaning of terms associated with control system equipment
- ü **Positional Resistance Transducers**
  1. Basic construction of rotary and slider variable resistors
  2. State that the resistance section may be either a carbon track or wirewound
  3. Difference between a logarithmic and a linear track
  4. Characteristics of output voltage against variable control setting
  5. Comparison of a carbon track variable resistor to the wirewound type
- ü **Signal Conditioning Amplifier**
  1. Characteristics and application of DC amplifiers
  2. The term "Offset" and the need for offset control
  3. Characteristics and application of an AC amplifier
- ü **Practical Control Systems**
  1. Characteristics of a Light Controlled ON/OFF System.

#### Accessories

- Power Cord
- User Manual
- Experiment Manual
- 2mm Patch Cords

### IT.TT1/TM

*Trainer introduces students to Temperature transducers, signal conditioning circuits and display devices through a wide range of practical activities. The study module includes transducers and instrumentation trainer and a curriculum manual.*

#### Features

- Sensors installed on-board
- Transducers installed on-board
- Control Circuits Installed
- Drivers Installed
- Protection Circuits Installed
- Display Devices Installed
- Measuring Devices Installed

#### Transducer

- Rotary Wirewound
- Slide Potentiometer
- Carbon Track
- Solenoid

#### Measuring Devices

- 3 ½-Digit Digital Voltmeter LCD Type

#### Accessories

- Power Cord
- User Manual
- Experiment Manual
- 2mm Patch Cords



### TEMPERATURE TRANSDUCER TRAINER

#### Technical Features:

- Fixed Supply DC: +5V, -5V, +12V, -12V
- Signal Conditioning Circuits:
  - Amplifier with Switchable Gain and Offset Control
  - Current Amplifier
  - Electronic Switch
  - Comparator with Hysteresis



#### Experiments Included:

##### ü Basic Control Systems Equipment and Terms Used

1. Study the difference between open loop and closed loop systems
2. Expression for the overall gain of a negative feedback closed loop system
3. Calculation of overall gain of a negative feedback closed loop system from given information
4. Basic components of a closed loop system and explain their functions
5. Meaning of terms associated with control system equipment

##### ü Characteristics & Construction

1. Discuss the characteristics of a filament lamp.
2. Describe the construction and characteristics of a photovoltaic cell.
3. Describe the construction and characteristics of a phototransistor.
4. Describe the construction and characteristics of a photoconductive cell.
5. Describe the construction and characteristics of a PIN photodiode.

##### ü Signal Conditioning Amplifier

1. Characteristics and application of DC amplifiers
2. The term "Offset" and the need for offset control
3. Characteristics and application of an AC amplifier

##### ü Comparators, Oscillators and Filters

1. Characteristics of a comparator
2. Effect of hysteresis on the operation of a comparator

##### ü Practical Control Systems

1. Characteristics of a Light Controlled ON/OFF System.