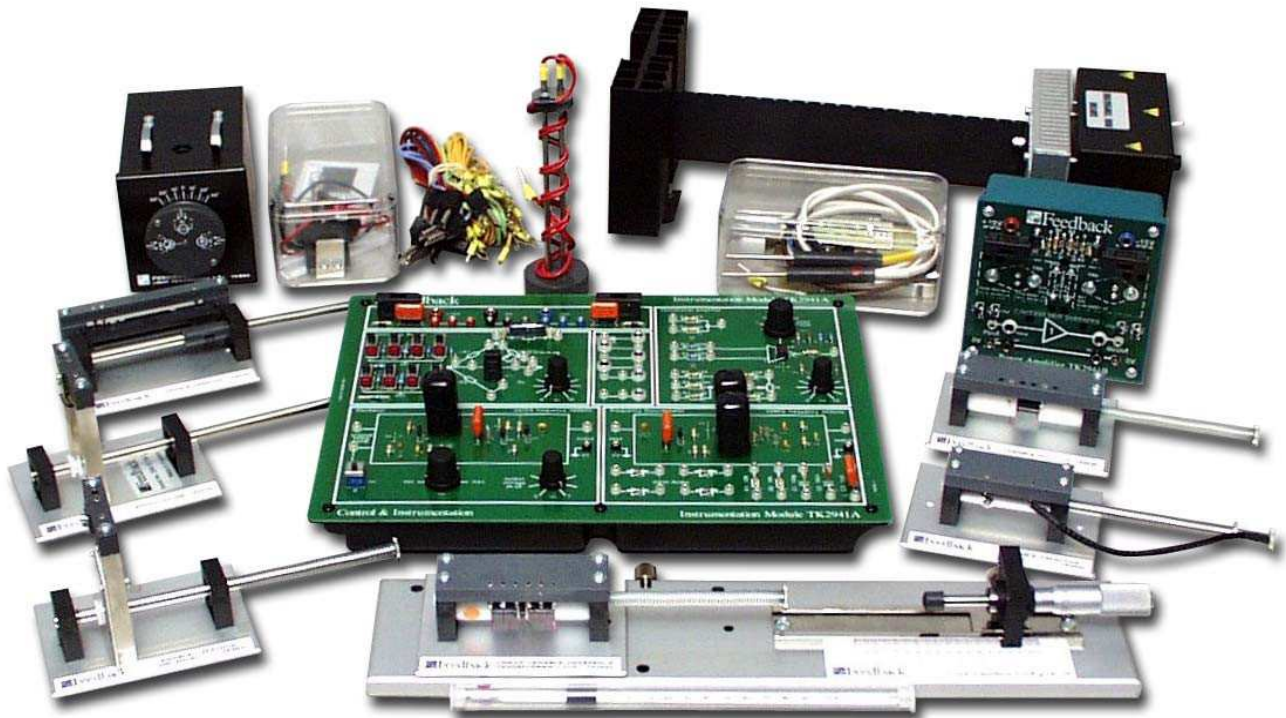


## Transducers Kits

## TK2942



### Description

The Transducers Kit TK2942 provides student assignments covering a wide range of transducers and a number of standard signal processing methods. The TK2942 range consists of a Measurements Package, containing a comprehensive Instrumentation Module, a Power Amplifier and a Test Rig, plus three self-contained Transducers Kits. The kits are available separately, for use with the Measurements Package, allowing complete transducer workstations to be built-up in stages.

**Electro-mechanical Transducers Kit TK2941E** comprises six linear displacement transducers. It is the foundation kit for the TK2942 range and introduces some basic principles about transducers and the associated instrumentation requirements. The two other kits should be regarded as extensions to it.

**Heat Transducers Kit TK2941H** provides a heat bar, three thermal transducers and a bimetal switch together with temperature measurement accessories.

**Light Transducers Kit TK2941L** contains an optical detector assembly, three photoelectric devices and a selection of optical filters.

The transducers utilise a variety of physical properties, so that in total a very comprehensive treatment of the subject is achieved. Each transducer is treated individually and then, using the measurements package, it is shown how they integrate into complete systems. Mathematics is kept to a minimum level consistent with that necessary to cover the subject adequately. The coverage is equally suitable for fields of Electronic and Electrical Engineering, Chemical Engineering, Process Control, Physics and Mechanical Engineering. The student manual contains twenty-eight assignments, covering the use of all three kits, each of which include relevant theory and practical discussions as well as the assignments. The Transducers Kit, together with all the necessary test equipment, is available as TK2942-1 Complete Transducers Kit which includes Power Supply 01-100.

## Features

- Bench-top study of transducer applications
- Twenty-eight proven student experiments
- Text covers theory, practice and industrial applications
- Employs fourteen common industrial transducers
- Inclusive ac and dc instrumentation sections
- Suitable for most engineering disciplines
- Repeatable experimental results with minimum preparation time

## Courseware

The manual contains twenty-eight assignments, each having a practical section and an applications section giving industrial examples of the use of the transducer principle under discussion.

It is divided into five topic areas:

### 1. Transducers and systems utilising variation in resistance

Topics covered are the Wheatstone Bridge, amplifiers, liquid depth and resistivity measurements, displacement and strain measurement.

### 2. Transducers and systems utilising variation in capacitance

Topics covered are the use of the Wheatstone Bridge for capacitance measurement, variable area and distance capacitive transducers and their use with an oscillator and discriminator in FM systems.

### 3. Transducers and systems utilising variation in inductance

Topics covered are electro- magnetic induction, variable inductance transducer, mutual inductance transducer, linear variable differential transformer and the circuit arrangements required for each transducer.

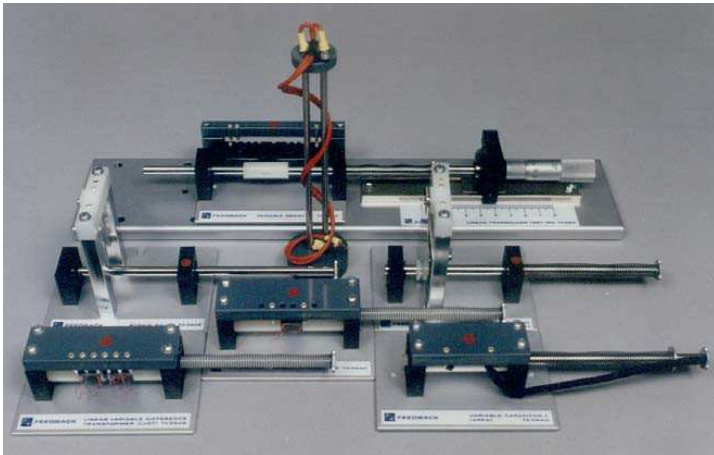
### 4. Temperature Transducers

An introductory section covers the use of the heat bar and some general heat theory. The student is then led through thermocouples, thermistors, the platinum resistance thermometer and bi- metallic switch to assignments dealing with on/off and continuous temperature control systems.

### 5. Light Transducers

An introductory assignment provides a comprehensive grounding in light theory and the operation of the light rig. Subsequent topics covered are three different types of light transducer and their spectral responses.

## Electro-mechanical Transducers



Six linear displacement transducers are provided, each of which mounts onto the Test Rig. The Test Rig carries a movable platform which supports a micrometer. This is used to provide the transducer displacement, the whole platform being moved to provide large displacements. The following linear transducers are provided:

**Linear Variable Resistor**  
**Variable Area Capacitor**  
**Variable Distance Capacitor**  
**Variable Inductor** with sliding rod carrying a ferrite slug core.

**Linear Variable Differential Transformer (LVDT)** - This uses a sliding core similar to the variable inductor and is used in conjunction with a phase-sensitive rectifier housed in the instrumentation module.

## Strain Gauge

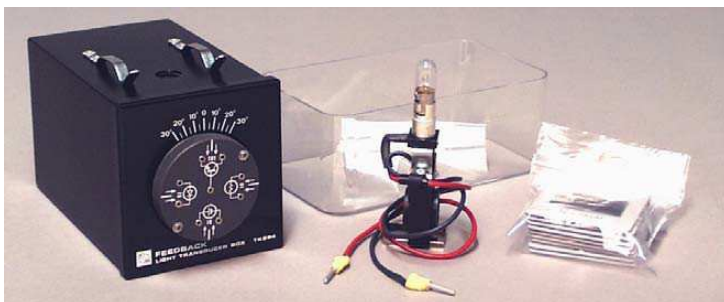
In addition to the linear displacement transducers, a Probe Assembly is provided for liquid depth measurement. This is intended to be used in salt water. Variations in depth or salt concentration vary the resistance between the probes. The resistive transducers are used either in a Wheatstone Bridge or in the feed-back loop of an operational amplifier.

The capacitive and inductive transducers are used as frequency determining elements in an oscillator circuit. The inclusion of a discriminator and amplifier in the Instrumentation Module enables a complex FM system to be constructed. TK2941E, together with the Measurements Package TK2941M is available as an Introduction to Transducers Kit TK2941.

## Tender Specification

TK2941E. An electro-mechanical transducers kit containing six linear displacement transducers and a probe assembly.

## Light Transducers



A light source is provided by a lamp which attaches to the movable platform of the linear transducer test rig. A transducer box contains:

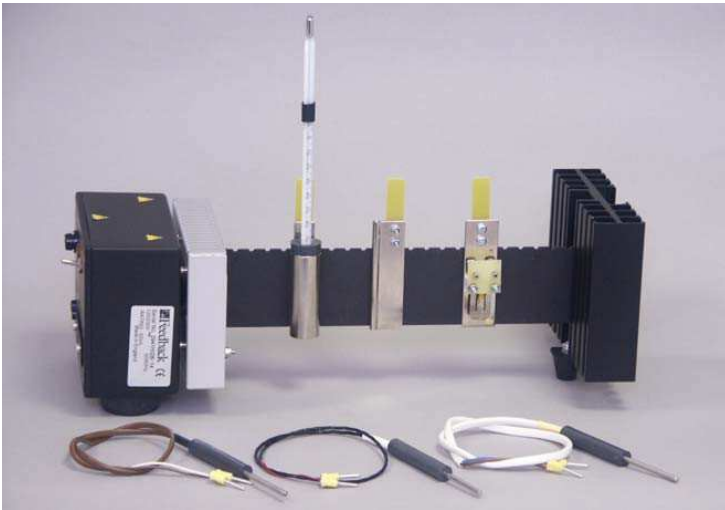
**Photoconductive cell**  
**Photodiode**  
**Phototransistor**

The mechanical arrangement permits each transducer to be rotated at right angles to the optical axis of the rig so that polar response curves can be obtained for each device. By adjusting the distance between the lamp and transducer, an output voltage/intensity characteristic may be plotted. A set of colour filters is provided. These clip over the window of the transducer box to enable the spectral responses of the various transducers to be measured. The theory and operation of each device are fully described in the manual.

## Tender Specification

TK2941L. A light transducers kit containing three photo-electric transducers, a light source, nine coloured and one heat absorbing optical filters.

## Heat Transducers



The test mount for the temperature transducers consists of a heat bar. This is equipped with a heater at one end and a multi-finned heat sink at the other. The temperature gradient produced along the bar is utilised to explore the characteristics of a number of transducers. These are attached to the bar in the desired position by a clip. Calibration is achieved by means of mercury in glass thermometer dipped into a water tank which may also be clipped to the bar.

An auxiliary heater is provided which may be used in conjunction with the power amplifier to perform closed-loop temperature control experiments.

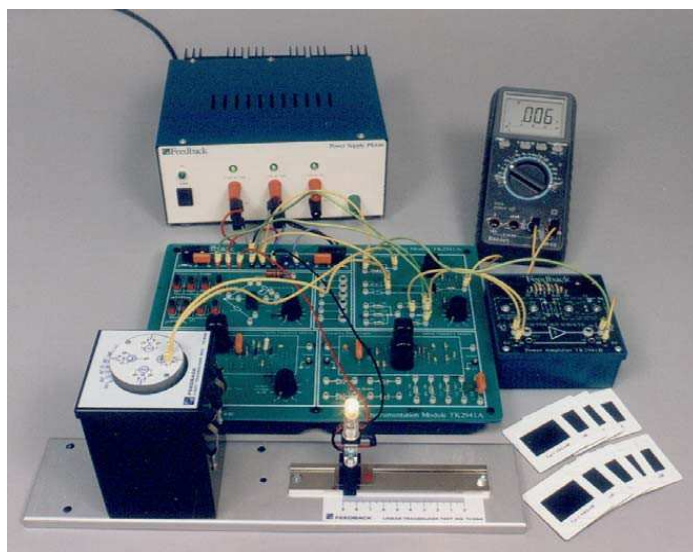
Provided for these assignments are:

- Thermistor**
- Platinum resistance**
- Thermocouple**
- Bi-metallic switch**

The manual explains the use of analogue transducers as temperature measuring devices together with the use of the thermistor in a continuous temperature control system. The switching device is used to demonstrate on-off control of a heater.

## Tender Specification

**TK2941H.** A thermal transducers kit containing four thermally operated devices, a controlled heat bar, thermometer and all necessary accessories.



*The Measurements Package, TK2941M, is shown with the Light Transducers Kit, TK2941L and the Linear Transducers Test Rig in a typical practical assignment.*

## Measurements Package

### Instrumentation Module

This contains four separate sections which may be configured to form sub-systems and systems using the patching leads provided.

### Wheatstone Bridge

This is equipped with selectable ratio arms of  $100\Omega$ ,  $1k\Omega$ ,  $10k\Omega$  and  $100k\Omega$ , a reference potentiometer and a detector short circuit push-button switch.

### Operational Amplifier

This module contains a differential amplifier with switched gains of 1, 10, 100 and 1000. The switched-gain amplifier is used as a general purpose amplifier; the differential input permitting its use with the Wheatstone Bridge.

### Oscillator

This is designed for use with the inductive and capacitive transducers as frequency determining elements. The centre frequency is 465 kHz.

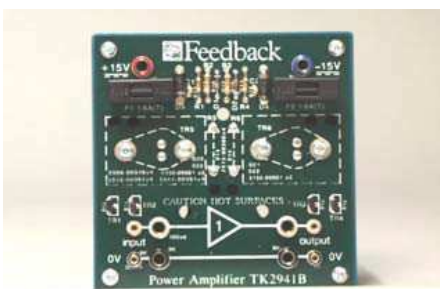
### Discriminator

A FM discriminator used in conjunction with the oscillator module. Also included are the components for a phase-sensitive rectifier.



### Power Amplifier

A unity gain power amplifier with an output capability of 4 Watts.



## Tender Specification

**TK2941M.** A Measurement Package comprising an Instrumentation module containing: Wheatstone Bridge, switched gain, differential amplifier, oscillator with 465 kHz centre frequency, an FM discriminator, a unity voltage gain 4 W power amplifier module and a Test Rig.

## Specification

### Instrumentation Module

Oscillator  
Frequency Discriminator

Wheatstone Bridge with reference potentiometer and selectable value ratio arms. Operational Amplifier with selectable gain and differential input.  
Centre frequency 465 kHz.  
FM operation and on-board phase sensitive rectifier.

### Power Amplifier

Unity voltage gain. Maximum output 4 W.

### Test Rig

Slide scale micrometer control with 25 mm range, 0.5 mm/full rotation micrometer. Sub-unit lock for Electro-mechanical Transducers and Optical Detector Assembly.

### Electro-mechanical Transducers

Variable Resistor  
Variable Capacitor (Area)  
Variable Capacitor (Distance)  
Variable Inductor  
Variable Differential Transformer  
  
Strain Gauge

10 k $\Omega$ , 0.5 W linear.  
2.5 – 20 pF.  
15 – 40 pF.  
9  $\Omega$ , 23 – 81  $\mu$ H.  
*Primary resistance:* 6.3  $\Omega$ , 140 turns.  
*Secondary resistance:* 2.5  $\Omega$ , 140 turns.  
2 off, 120  $\Omega$  resistance.

### Conductance Probe

Two parallel, conductive, supported rods with flying leads.

### Heat Transducers

Bi-metallic switch  
Thermocouple  
Thermistor  
Platinum resistance

Operating temp. 45 °C. Differential 5 °C.  
Copper constantan junction approx. 50  $\mu$ V/°C.  
Resistance at 20 °C = 2 k $\Omega$ .  
Resistance at 20 °C = 100  $\Omega$ .

### Heat Bar

100/240 V, 50/60 Hz operation.  
Main heater 50 W.  
Auxiliary heater resistance, 30 W (cold).

### Light Transducers

Photo-transistor  
Photo-diode  
Photo-resistor  
Lamp holder  
Optical Filters

BP X25.  
RS components.  
RPY33.  
MBC. 14.4 V, 0.1 A.  
9 slide-mounted. 440, 470, 490, 520, 550, 580, 600, 690, 700 nm. 1 infra-red.

### Manual supplied

Transducers Kit TK2942-1, Books 1, 2 & 3 covering all three kits. The manuals contain 28 assignments, each having a practical section and an applications section giving industrial examples of the use of the transducer principle under discussion.

### Power Supply

External  $\pm 15$  V @ 1.5 A. The Feedback d.c. Power Supply 01-100 is recommended.

### Dimensions & Weight

*Instrumentation Module:*  
Width: 295 mm (11.6"),  
Depth: 220 mm (8.7"),  
Height: 72 mm (2.8"),  
Weight: 1 kg (2.2 lb).  
  
*Power Amp:*  
Width and Depth: 107 mm (4.25"),  
Height: 76 mm (3"),  
Weight: 0.45 kg (1lb).

### Ancillary Test Equipment

The following items of standard laboratory equipment are required in addition to the TK2942-001:

*Function Generator:* Sinusoidal, 10V pk-pk, 200Hz to 600kHz; 600 Ohm. Feedback FG601 is recommended.

*Frequency Meter:* Digital, 1MHz range.

*Oscilloscope:* Two-channel, dc coupled, 20MHz.

*Other equipment:* Decade resistance box. Decade capacitance box. Voltmeters, ammeters and general laboratory glassware.

### Tender Specification for TK2942

A Transducers Kit with at least 14 different types of transducers, demonstrating measurement of linear displacement, temperature and light. To include instrumentation and power modules together with all necessary accessories and connecting leads. Comprehensive manual with twenty-eight assignments.

### Ordering Information

|   |            |
|---|------------|
| Complete Transducers Kit (TK2941E, TK2941H, TK2941L, TK2941M, includes Power Supply 01-100, Function Generator, Timer Counter, Oscilloscope, Capacitance and Resistance Boxes and a Multimeter) | TK2942-1   |
| Transducers Kit (TK2941E, TK2941H, TK2941L, TK2941M, includes Power Supply 01-100)  | TK2942-001 |
| Introduction to Transducers Kit (TK2941E, TK2941M, without Power Supply)  | TK2941     |
| Measurements Package (requires Power Supply)  | TK2941M    |
| Electro-mechanical Transducers Kit  | TK2941E    |
| Heat Transducers Kit  | TK2941H    |
| Light Transducers Kit   | TK2941L    |
| Power Supply  | 01-100     |



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