EE 302
Electronic Equipment Repair

3.0 Test Equipments

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Analogue and Digital Multimeter

- include features such as the ability to measure voltage (V), current (I) and resistance (OHM).
- used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies, and wiring systems.

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Analogue and Digital Multimeter

- **Advantage of analogue multimeter**
  - Easy to use for capacitor test
  - Suitable for transistor (Base, Emitter and Collector) identification and test
  - Cheaper

- **Advantage of digital multimeter**
  - Measure resistance (Ω) less than 1Ω
  - Easy/fast reading
  - Measure forward and reverse polarity voltage (V) with negative (-) symbol.
  - Variable/automatic measurement range adjustment

- **Note:**
  - You should have both multimeters for more affective maintenance works.

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An **oscilloscope** is a type of electronic test instrument that allows observation of constantly varying signal voltages, usually as a two-dimensional graph of one or more electrical potential differences using the vertical or 'Y' axis, plotted as a function of time, (horizontal or 'x' axis).
Oscilloscope

Oscilloscopes are commonly used to observe the exact wave shape of an electrical signal. In addition to the amplitude of the signal, an oscilloscope can show distortion, the time between two events (such as pulse width, period, or rise time) and relative timing of two related signals.

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Oscilloscope

Analogue oscilloscope
- Need calibration before each experiment
- User need to manipulate all the required volt/div, time/div, vertical and horizontal knob to obtain suitable wave on screen.
- Reading accuracy depend on user ability to collect and calculate final measurement.
- Much cheaper than digital oscilloscope.

Digital oscilloscope
- No or less calibration needed.
- Automatic measurement for time, frequency and voltage.
- Suitable for professional usage
- More precise reading
- Expensive

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Oscilloscope

- Do you know oscilloscope that suitable for your maintenance works?
- Want to buy an oscilloscope?
- What are the criteria before you get one?
  - Maximum frequency reading
  - Maximum voltage reading
  - Total channel (e.g. 2-channel or 3 channel oscilloscope)
  - Analogue or digital
  - Cheap or expensive
  - Brand
  - Oscilloscope probe capability

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Audio generator/Function generator / RF Generator

- The frequency range often specified for audio components is between 20 Hz to 20 kHz, which broadly reflects the human hearing range (the highest audible frequency for most people is less than 20 kHz, with 16 kHz being more typical).

- Signal generators, also known variously as audio generators, function generators and RF signal generators are electronic devices that generate repeating or non-repeating electronic signals (in either the analog or digital domains). They are generally used in designing, testing, troubleshooting, and repairing electronic devices.

- There are many different types of signal generators, with different purposes and applications (and at varying levels of expense); in general, no device is suitable for all possible applications.

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A function generator is a device which produces simple repetitive waveforms. Such devices contain an **electronic oscillator**, a circuit that is capable of creating a repetitive waveform.

**The most common waveform is a sine wave, sawtooth, step (pulse), square, and triangular waveform.**

If the oscillator operates above the audio frequency range (>20 kHz), the generator will often include some sort of modulation function such as amplitude modulation (AM), frequency modulation (FM), or phase modulation (PM) as well as a second oscillator that provides an audio frequency modulation waveform.

Function generators are typically used in simple electronics repair and design; where they are used to stimulate a circuit under test. A device such as an oscilloscope is then used to measure the circuit's output. Function generators vary in the number of outputs they feature, frequency range, frequency accuracy and stability, and several other parameters.
Audio generator/Function generator / RF Generator

- Audio Generator
  - Sine or square wave only audio signal.

- Function Generator.
  - Sine, square, saw tooth, FM, AM signal.

- RF Generator
  - More to AM/FM/FM STEREO signal
  - Precise modulation control

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Transistor Tester

**BJT**

- A **bipolar (junction) transistor (BJT)** is a three-terminal electronic device constructed of doped semiconductor material and may be used in amplifying or switching applications. *Bipolar* transistors are so named because their operation involves both electrons and holes. Charge flow in a BJT is due to bidirectional diffusion of charge carriers across a junction between two regions of different charge concentrations. Used to identify Base, Emitter, and Collector of a Bipolar Transistor.

**Transistor tester**

- Used to identify NPN or PNP type transistor.
- Easy and fast to track transistor failure.
- Usually come with LED indicator to show the right C,B,E pin polarity.

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Colors in television

- The image in a color television receiver is obtained by the emission of light that results from the excitation of a phosphor layer that covers the interior of the glass screen, when it is hit by an electron beam that periodically scans the visible surface.
- If we speak about “emission of light” we must immediately think of “Additive Processes”, which leads us to the conclusion that the Primary Colors in television are Red, Green and Blue (RGB).
- Actually, three electron beams are generated inside a television tube (CRT, Cathode Ray Tube), each of them hit a particular kind of phosphor on the screen, which will generate a characteristic color, depending on the chemical structure of that phosphor. Naturally, this three colors are Red, Green and Blue.
- All the rest of the colors can be obtained by the adequate combination of these three primary colors.
A **PAL TV + video pattern generator** basically an instrument used to identify or to check the ability of TV screen to display the right video colour according to the video recording sources.

The colour pattern used as a reference to adjust the colour display on TV set by adjusting the electron gun intensity.

A **pattern generator** should be capable not only to produce the RGB components but also to generate the corresponding composite video signal, with all its components: synchronism pulses, luminance, modulated color subcarrier, etc.

useful for repairing and adjusting television receptors.

**to know the color information of an object, we only need to know the relative amount of the three basic colors:** Red, Green and Blue (RGB). By this reason, these three colors are known as **Primary Colors**, because we can make any other color by combining them in the adequate proportion.
Refresh:
- When we learned the colors at school our teacher probably told us that the primaries were **Red, Yellow and Blue**.
- This “confusion” results from the existence of two groups of primary colors: the **Additive Primaries** and the **Subtractive Primaries**. In order to understand the difference between them let’s see a couple of examples.
  - Suppose that we illuminate a white wall with a green light. Obviously we will see green, because this is the color reflected by the wall.
  - If we now turn the light into red, again we will see red. But, if we illuminate the wall with **both colors (green and red)** at the same time, the resulting color will be **yellow**, which comes from the sum or addition of the two original colors.
  - As we can observe, the sum of this colors gives a new, secondary, color. By this reason, the colors **Red, Green and Blue are called Additive Primaries**.

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Colour TV test pattern generator

- RED LIGHT + GREEN LIGHT + BLUE LIGHT = WHITE LIGHT
  - If we add only two of them:
    - RED LIGHT + GREEN LIGHT = YELLOW LIGHT
    - RED LIGHT + BLUE LIGHT = MAGENTA LIGHT
    - GREEN LIGHT + BLUE LIGHT = CYAN LIGHT
- CYAN + MAGENTA + YELLOW = BLACK

- Basic color bar generator
  - A basic color bar generator should be like this:
    - it should have three outputs, one for each primary color
    - each of these outputs should be connected to the corresponding input of the TV

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Colour TV test pattern generator

- the set should generate combinations of its outputs, as shown on the following chart:

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<th>Blue</th>
<th>Red</th>
<th>Green</th>
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Colour TV test pattern generator

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Colour TV test pattern generator

- Pattern generator will be capable of producing these patterns:

  - Bars
  - Raster
  - Cross-hatch
  - Points
  - Bars: B off
  - Bars: R off

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PAL, short for Phase Alternating Line, is an analogue television colour encoding system used in broadcast television systems in many countries.

NTSC, named for the National Television System Committee, is the analog television system that is used in most of North America, most of South America (except Brazil, Argentina, Uruguay, and French Guiana), Burma, South Korea, Taiwan, Japan, the Philippines, and some Pacific island nations and territories. The first NTSC standard was developed in 1941 and had no provision for color television.

SECAM (Sequential Color with Memory), is an analog color television system first used in France. It is, historically, the first European color television standard.