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Curve Tracer Using Atmega 2560 pro

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Abstract –The curve tracer is a useful tool for looking at semiconductor characteristic and obtain their parameters.This project is to design a semiconductor characteristic curve tracer using microcontroller.Curve tracer are useful for technician for detecting good and suitable devices for circuit design. General purpose microcontroller as they are called is a very handy computer-on-chip that can be used to simplify digital design.The circuits and programs that form the prototype of a curve tracer, operated under the control of a microcontroller are presented. The circuit that generates the signals applied to the base and collector terminals of the tracer. This board also carries out the necessary measurements to trace the characteristic curves of the device under test.A curve tracer requires a sawtooth and a staircase waveform to trace the characteristic curves of a semiconductor device on an LCD or oscilloscope screen. The microcontroller simplifies the design of these required waveform.The microcontroller used is ATmega2560 and software is based onProteus 8 andArduino IDE.

Key words: Curve Tracer, Atmega 2560.

1.INTRODUCTION

A semiconductor curve tracer is a specialized piece of electronic test equipment used to analyse the characteristics of discrete semiconductor devices such as diodes, BJT, FETs and thyristors. The device contains voltage and current sources that can be used to stimulate the device under test (DUT) and display the characteristic curve on an oscilloscope. The basic operating principle of the device is to apply a swept (automatically varying) voltage to the main terminals of the DUT while measuring the amount of current that the device permits to flow. This so-called V-I (voltage versus current) graph is displayed on an oscilloscope screen. The operator can control the maximum amount of voltage applied to the device, the polarity of the voltage applied (including the automatic application of both positive and negative polarities), and the load resistance inserted in series with the device. For two terminal devices (such as diodes and DIACs), this is sufficient to fully characterize the device. The curve tracer can display all of the interesting parameters such as the diode's forward voltage, reverse leakage current, reverse breakdown voltage, and so on. For triggerable devices such as DIACs, the forward and reverse trigger voltages will be clearly displayed. The discontinuity caused by negative resistance devices (such as tunnel diodes) can also be seen. The main terminal voltage can often be swept up to several thousand volts with load currents of tens of amps available at lower voltages. Three-terminal devices require an additional connection; this is usually supplied from a stepped voltage or current source attached to the control terminal of the DUT. By sweeping through the full range of main terminal voltages with each step of the control signal, a family of V-I curves can be generated. This family of curves makes it very easy to determine the gain of a transistor or the trigger voltage of a thyristor or TRIAC. For most devices, a stepped current is used. For field effect transistors (FET), a stepped voltage is used instead. Curve tracers usually contain convenient connection arrangements for two- or three- terminal DUTs, often in the form of sockets arranged to allow the plugging-in of the various common packages used for transistors and diodes.

2.SYSTEM OVERVIEW

I-V curves are used to characterize devices and materials through DC source- measure testing. These applications may also require calculation of resistance and the derivation of other parameters based on I-V measurements.
For example, I-V data can be used to study anomalies, locate maximum or minimum curve slopes, and perform reliability analyses.
A typical application is finding a semiconductor diode's reverse bias leakage current and doing forward and reverse bias voltage sweeps and current measurements to generate its I-V curve.
The curve tracers are professional and specialized instruments. They are indispensable for the research and development of new and better electronic equipment. This means that these instruments are required for the

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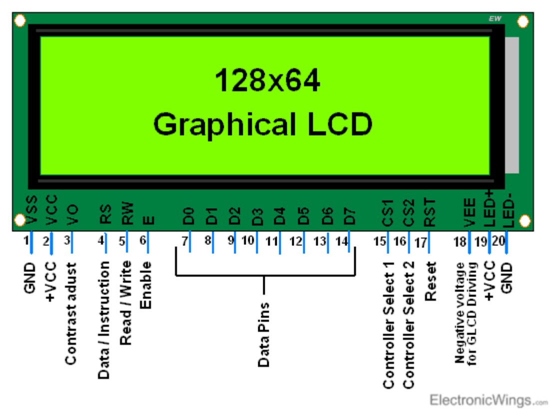
laboratories and engineers, but also for the electronic enthusiast

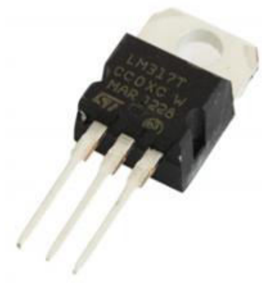
Atmega2560 Microcontroller: TheATmega2560 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega2560 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The device is manufactured using the Atmel high-density nonvolatile memory technology. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega2560 is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. The ATmega2560 AVR is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, in-circuit emulators, and evaluation kits.

USB TTL Converter:The USB TTL Serial cables are a range of USB to serial converter cables which provide connectivity between USB and serial UART interfaces. A range of cables are available offering connectivity at 5V, 3.3V or user specified signal levels with various connector interfaces.

GLCD 128x64: Graphical LCD has 128x64 pixels. It has 128 columns and 64 row segments.It uses two display segment drivers. Since segment driver has 64 channel, GLCD module contains two segment drivers to drive 128 column segments. It has one common driver which drives 64 row segments as well as it generates clock and control signals for two segment drivers.it has two segment drivers to drive 128 column segments, GLCD splits into two parts i.e. Left side and Right side. It has 20 pins.

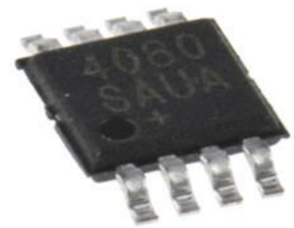


LM317: The LM317 is a popular adjustable positive linear voltage regulator. The LM337 is the negative complement to the LM317, which regulates voltages below a reference. Linear regulators inherently waste power; the power dissipated is the current passed multiplied by the voltage difference between input and output. A LM317 commonly requires a heat sink to prevent the operating temperature from rising too high. For large voltage differences, the power lost as heat can ultimately be greater than that provided to the circuit.



Digital Potentiometer ICs (DS1804-050): The DS1804 NV trimmer potentiometer is a non volatile digital potentiometer that has 100 positions. The device provides an ideal method for low-cost trimming applications using a CPU or manual control input with minimal external circuitry. Wiper position of the DS1804 can be stored in EEPROM memory on demand. The device's wiper position is manipulated by a three-terminal port that provides an increment/ decrement counter controlled interface. This port consists of the control inputs CS/ , INC/ , and U/ D/ . The DS1804 is available in three resistor grades, which include a 50kΩ. The device is provided in an industrial temperature grade. Additionally, the DS1804 will operate from 3V or 5V supplies and is ideal for portable application requirements. Three packaging options are available and include the 8-pin (300 mils) DIP.

Current Sense Amplifiers(MAX4080SAUA): The MAX4080/MAX4081 are high-side, current-sense amplifiers with an input voltage range that extends from 4.5V to 76V making them ideal for telecom, automotive, backplane, and other systems where high-voltage current monitoring is critical. The MAX4080 is designed for unidirectional current-sense applications and the MAX4081 allows bidirectional current sensing. The MAX4081 single output pin continuously monitors the transition from charge to discharge and avoids the need for a separate polarity output. The MAX4081 requires an external reference to set the zero-current output level (VSENSE = 0V). The charging current is represented by an output voltage from VREF to VCC, while discharge current is given from VREF to GND. For maximum versatility, the 76V input voltage



The rain sensor module/board is shown below. Basically, this board includes nickel coated lines and it works on the resistance principle. This sensor module permits to gauge moisture through analog output pins & it gives a digital output while moisture threshold surpasses.

SIM800l:-

The SIM800L module supports quad-band GSM/GPRS network, available for GPRS and SMS message data remote transmission. The SIM800L communicates with microcontroller via UART port, supports command including 3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands.

3.METHODOLOGY

This circuit is implemented with the use of a potentiometer connected to a transistor base to vary the base current. Arduino ATMEGA 2560 pro board is used as a main data acquisition controller that acquires the analog parameters of the base, collector and source voltages. A transistor with two resistors and one potentiometer comes under the circuitry under the test with the use of Arduino development board.

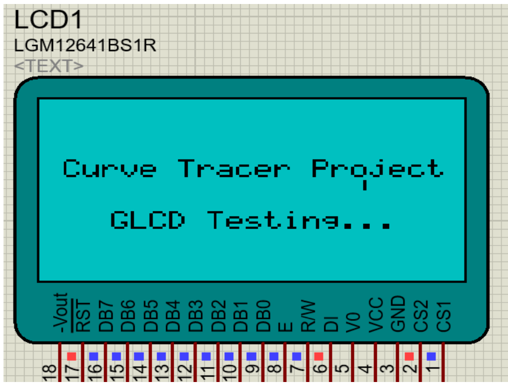
By varying the potentiometer, the base current is varied, and the base voltage, collector and emitter voltage values are read by the Arduino with an internal analog to digital converter. The Arduino program code is programmed in such a way that the acquired signals of the ADC are processed further and the results are calculated. The digitized values processed by this controller finds the below parameters.

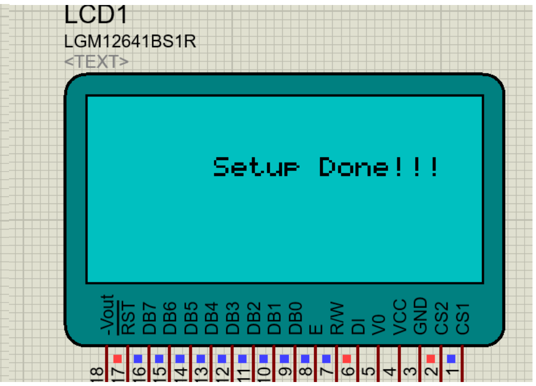
Ib is determined by (Vs – Vb) / Rb

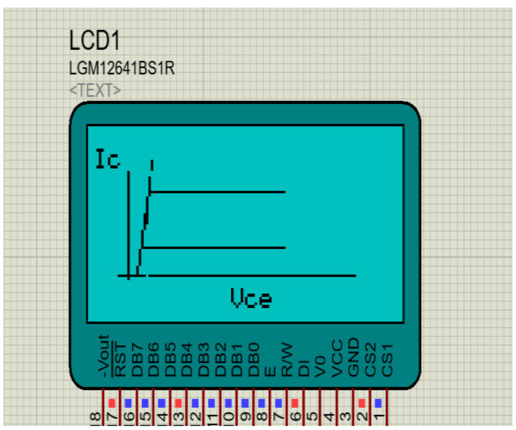
And Ic by (5V – Vc) / Rc

These values of base and collector currents must be plotted to determine the transistor's characteristics. To plot these values a GLCD (graphical) display is connected with the Arduino board.

4.RESULTS







5.CONCLUSION

The design proved to be reliable for testing Most of electronics deals with Tracing Curves, be it the characteristic transfer curve for a feedback loop, a resistor's straight VI line or a transistor's collector voltage versus current curve.

A transistor curve tracer is an instrument that measures the transistor's parameters like current gain, impedance and breakdown voltages. It generates and displays a set of curves of the collector current IC versus the collector to emitter voltage VCE for different values of the base current. From this curves, the transistor current gain can be determined.

Curve Tracer is cost effective device that is suitable for variable scales of PV research. The novelty of this equipment lies in the fact that it is capable of generating electronically the I-V and P-V characteristics of any size of PV panels at a cost less than one third of the available product

These curves give us an intuitive understanding of how a device behaves in a circuit. An analytical approach might involve plugging in discrete voltage and current values into a mathematical formula and graphing the results, commonly with the x axis representing voltage and the y axis representing current

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