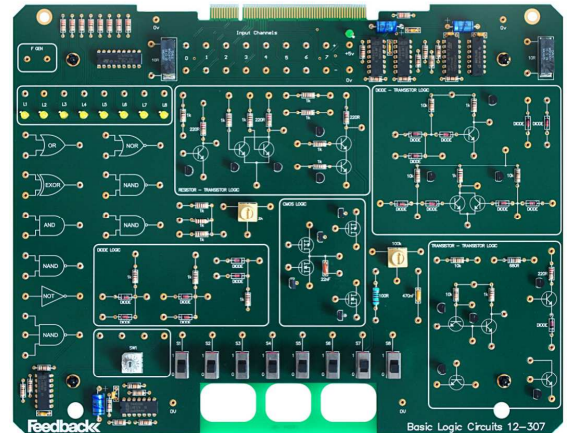# Feedback

Engineering Teaching Solutions

Basic Electronics Series - 12-307 Basic Logic Circuits

Introduction

With over 50 years of experience in the design, manufacture and supply of high quality educational products, Feedback's 12-300 series of innovative workboards and ESPIAL software set new standards in the teaching of basic electronics.

The 12-307 board provides an introduction to basic logic gates and circuits using pre-constructed circuit elements that may be connected in different ways to perform the assignments. The board connects to the NI ELVIS II/II+ console which provide power and signal acquisition.

Teaching material and pc based instrumentation are delivered by Feedback's own ESPIAL software, which teaches the student the necessary theory in order to complete the practical experiments. On-screen instructions guide the student through the set-up of the boards and the use of the on-screen instrumentation enables students to observe parameters in real time and to record their results.

ESPIAL software provides a flexible and versatile learning environment where students can use the available resources in ways that are most suitable for them. This makes the 12-300 series suitable for a wide range of courses including degree foundation and vocational learning.

Basic Logic Circuits

The 12-307 is designed to give students a thorough introduction into digital electronics by teaching the different technologies behind logic gate design. Students will require knowledge of the fundamentals of analogue electronics from using other boards in the Feedback 12-300 series.
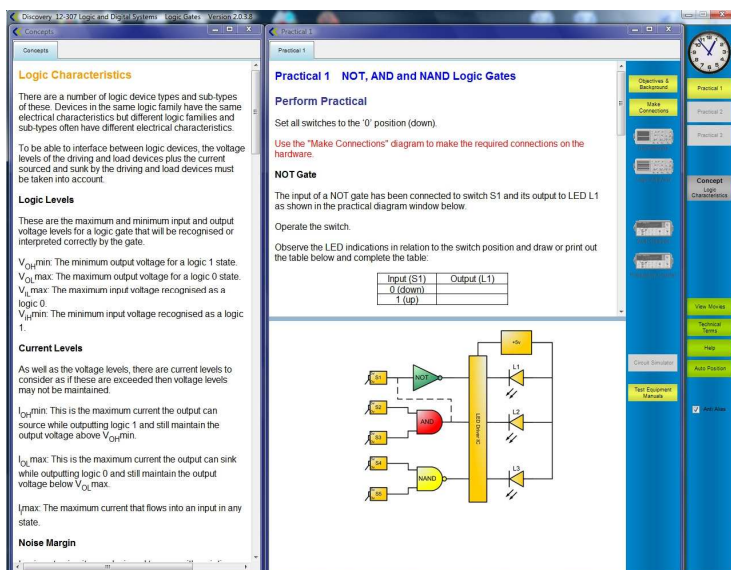
The student is introduced to a variety of digital technologies from elementary Resistor-Diode-Logic (RTL), Transistor-Transistor-Logic (TTL) and CMOS. The fundamentals of transistor operation are covered, along with application specific topics such as propagation delays, logic levels and interfacing between difference logic families.

The student is able to refer to the "Concepts" section of the ESPIAL software to reinforce their understanding of the principles of the subject before conducting the practical experiments.

Screen showing the Feedback interactive ESPIAL software, enabling the student to learn the principles of the subject and then implement practical experiments using on-screen instruments.

POWERED BY **NATIONAL INSTRUMENTS**

Basic Electronics Series - 12-307 Basic Logic Circuits

Familiarisation
Practical 1: Navigating the ESPIAL Software
Practical 2: Introduction to the NI ELVIS
Practical 3: Introduction to the 12-307 work board
Practical 4: Test circuit to check functionality of hardware

Introduction to Digital Electronics
Practical 1: Digital Electronics
Practical 2: Binary Numbers and BCD
Practical 3: Hexadecimal

Logic Gates
Practical 1: NOT, AND and NAND Logic Gates
Practical 2: OR, NOR and EXOR Logic Gates
Practical 3: Three input NAND gate

Diode Logic
Practical 1: Diode Logic OR Gate
Practical 2: Diode Logic AND Gate
Practical 3: Cascading Diode Logic Gates
Practical 4: Logic level thresholds

Transistor Characteristics
Practical 1: Transistor Familiarisation
Practical 2: Input Characteristic
Practical 3: Transfer Characteristic, ac current gain (h_{fe})
Practical 4: Output Characteristic

Resistor-Transistor Logic (RTL)
Practical 1: Transistor used as a switch
Practical 2: Simple RTL NOR Gate
Practical 3: RTL NOR Gate
Practical 4: RTL NAND Gate

Diode -Transistor Logic (DTL)
Practical 1: DTL NAND Gate
Practical 2: DTL NOR Gate
Practical 3: Two-Input DTL AOI (AND-OR-INVERT) Gate

Transistor-Transistor Logic (TTL)
Practical 1: TTL NOT and NAND Gates
Practical 2: TTL NOR Gate

TTL Output Circuits
Practical 1: TTL Open Collector Output
Practical 2: TTL with Totem Pole Output

MOSFET Characteristics
Practical 1: Field-Effect Transistor Familiarisation
Practical 2: Enhancement Mode Input Characteristic.
Practical 3: Enhancement Mode Output Characteristic.

Basic Electronics Series - 12-307 Basic Logic Circuits

CMOS Logic Circuits
Practical 1: CMOS NOT Logic Gate
Practical 2: CMOS NAND Logic Gate
Practical 3: CMOS NOR Logic Gate
Practical 4: CMOS Transmission Gate

TTL and CMOS Logic 1
Practical 1: TTL and CMOS Logic IC Characteristics
Practical 2: TTL NOT Gate Input/Output Characteristics
Practical 3: TTL NOT Gate Fan-Out
Practical 4: Logic Gate Propagation Delay

TTL and CMOS Logic 2
Practical 1: CMOS NOT Gate Input/Output Characteristics
Practical 2: CMOS NOT Gate Fan-Out
Practical 3: Logic Circuit Power Supplies

Interfacing TTL and CMOS Logic
Practical 1: TTL to CMOS Interfacing
Practical 2: Interfacing TTL gates to CMOS Logic gates
Practical 3: Interfacing CMOS gates to TTL Logic gates

Emitter Coupled Logic
Practical 1: Practical Template

NI ELVIS Console
The National Instruments ELVIS II/II+ console provide the platform for the 12-300 series, also supplying power and signal acquisition. Contact your Feedback representative for more information.

Specifications for 12-307 board
Supply voltage: From NI ELVIS II/II+ console
Dimensions: 280 mm (w) x 20 mm (h) x 215 mm (d)

Specifications for NI ELVIS II/II+ Console
Supply voltage: 110 – 230 V a.c.
Dimensions: 343 mm (w) x 76 mm (h) x 280 mm (d)

For further information on Feedback equipment please contact ...

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