## DIGIAC 2000 microprocessors - system expansions

DT1B **RS232 Breakout module (for use with DT1 trainer only):**

This module allows students to investigate RS232 communication between two DT1 6502 microprocessor trainers. The module is designed to be connected between the serial ports of the microprocessor boards via a pair of serial communication leads (supplied), and provides access to data lines (TXD and RXD) and handshaking lines (CTS and RTS) via oscilloscope monitoring points.

Specially designed EPROM-based RS232 communication software is supplied for two DT1 microprocessor boards. The module also includes eight switched faults under a lockable cover and a student experiment manual. A handshaking 'loop back' switch enables the module to be used with a single DT1 board, if required.
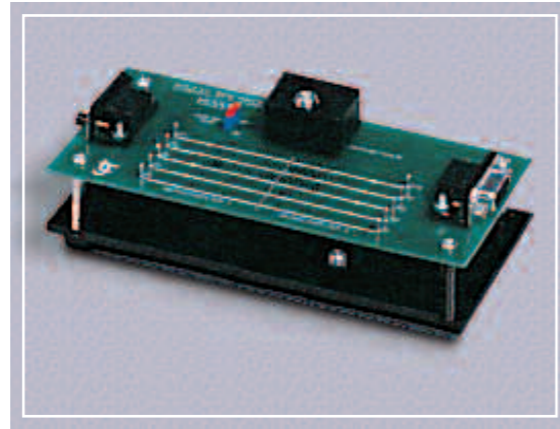
Microcontroller training from LJ Technical Systems

LJ Technical Systems also produces a range of microcontroller training systems based around the popular PIC series of microcontrollers.

Please see our **Microcontrollers brochure (CP0081)** for further information.

If you have a DIGIAC 3000 laboratory...

The microprocessor trainers described in this brochure are intended for use in a laboratory that does not contain DIGIAC 3000 equipment.

If your laboratory is equipped with DIGIAC 3000 Experiment Platforms, Intelligent Base Units or Virtual Instrument Platforms please refer to our **DIGIAC 3000 Microprocessors brochure (CP0320)**.

DIGIAC 2000
MICROPROCESSORS

LJ Technical Systems

DIGIAC 2000
MICROPROCESSORS

For any modern electronics program to effectively address today's technology, it must cover the areas of microprocessor applications and troubleshooting. Students must be provided with a competency based curriculum that introduces the concepts of microprocessors, how they are used for engineering control and how to troubleshoot microprocessor based systems.

The microprocessor training systems developed by LJ Technical Systems meet these requirements by providing students with hands-on programming and troubleshooting experience based around the Rockwell™ 6502, Zilog™ Z80 and Motorola™ 68000 educationally-proven microprocessors.

Each microprocessor training system allows students to carry out programming tasks in two different ways:
- By using a hexadecimal keypad and display to write, and run simple machine code programs.
- By using a personal computer to write programs in assembly language, and then running PC-based cross assembler software to 'assemble' these programs into machine code. This is the 'target system' approach, where programs are developed on a host PC and downloaded to the 'target' microprocessor trainer for debugging and running.

This brochure covers the **DIGIAC 2000** range of microprocessor trainers and supporting equipment, which are intended for use in laboratories that do not contain DIGIAC 3000 equipment (see the back page of this brochure for further details).

DIGIAC 2000 microprocessors - recommended teaching sets

DT01 6502 *microprocessor technology teaching set*

Comprises:

DT1........MAC III 6502 microprocessor trainer.
DT25......Keypad/display module.
DT30......6502/Z80 cross assembler development system.
DT35......Applications module.
DT60......Power supply unit.
DT100....Introduction to microprocessor technology curriculum manual.
DT102....6502 applications curriculum manual.

DT02 Z80 *microprocessor technology teaching set*

Comprises:

DT2........SAM Z80 microprocessor trainer.
DT25......Keypad/display module.
DT30......6502/Z80 cross assembler development system.
DT35......Applications module.
DT60......Power supply unit.
DT100....Introduction to microprocessor technology curriculum manual.
DT202....Z80 applications curriculum manual.

DT05 16-bit (68000) *microprocessor technology teaching set*

Comprises:

DT5........TIM 68000 microprocessor trainer.
DT25......Keypad/display module.
DT31......68000 cross assembler development system.
DT35......Applications module.
DT60......Power supply.
DT100....Introduction to microprocessor technology curriculum manual.
DT500....68000 concepts curriculum manual.
DT502....68000 applications curriculum manual.

DIGIAC 2000 microprocessors - teachware

All teachware is compatible with the optional ClassAct® computer managed learning system, allowing real-time tracking and competence-based reporting of student activities.

D3000 CAI 8.10 Introduction to microprocessor technology computer aided instruction pack

Provides introductory, on-screen theory related to microprocessors and their applications. Topics covered include microprocessors and microcomputers, programming and control applications. Please note that this CAI package requires the ClassAct® student workstation launcher software in order to run.

DT100 Introduction to microprocessor technology curriculum manual

Provides a general introduction to microprocessor-based systems for students meeting them for the first time. Topic coverage includes numbering systems and the basic elements of a microprocessor-based system. An instructor's manual is also included.

DT102 6502 applications curriculum manual

Provides a complete course in 6502 control applications programming, based around the DT1 microprocessor trainer. Topics covered include developing 6502 assembly language programs, program debugging, writing programs with loops, logical and test instructions, input and output programming, the stack, subroutines and interrupts. An instructor's manual is also included.

DT104 6502 troubleshooting curriculum manual

Provides a complete course in 6502 microprocessor troubleshooting, based around the DT1 microprocessor trainer. Topics covered include the use of a digital multimeter, oscilloscope, logic probe and logic analyzer* to diagnose system faults. An instructor's manual is also included.

DT202 Z80 applications curriculum manual

Provides a complete course in Z80 control applications programming, based around the DT2 microprocessor trainer. Topics covered include developing Z80 assembly language programs, program debugging, writing programs with loops, logical and test instructions, input and output programming, the stack, subroutines and interrupts. An instructor's manual is also included.

DT204 Z80 troubleshooting curriculum manual

Provides a complete course in Z80 microprocessor troubleshooting, based around the DT2 Z80 microprocessor trainer. Topics covered include the use of a digital multimeter, oscilloscope, logic probe and logic analyzer* to diagnose system faults. An instructor's manual is also included.

DT500 68000 concepts curriculum manual

Provides an introductory course in 68000 programming based around the DT5 microprocessor trainer. Topics covered include machine code programs, addressing modes, subroutines and input/output programming. An instructor's manual is also included.

DT502 68000 applications curriculum manual

Provides a complete course in 68000 control applications programming, based around the DT5 microprocessor trainer. Topics covered include developing 68000 assembly language programs, program debugging, writing programs with loops, logical and test instructions, input and output programming, the stack, subroutines and interrupts. An instructor's manual is also included.

*Test equipment is not included. Logic probe must be LJ product LP1 or equivalent.

It is possible to store different DATA in different LOCATIONS, and retrieve the required DATA by specifying the appropriate ADDRESS.

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■ *Computer aided instruction provides on-screen theory related to microprocessors and their applications*
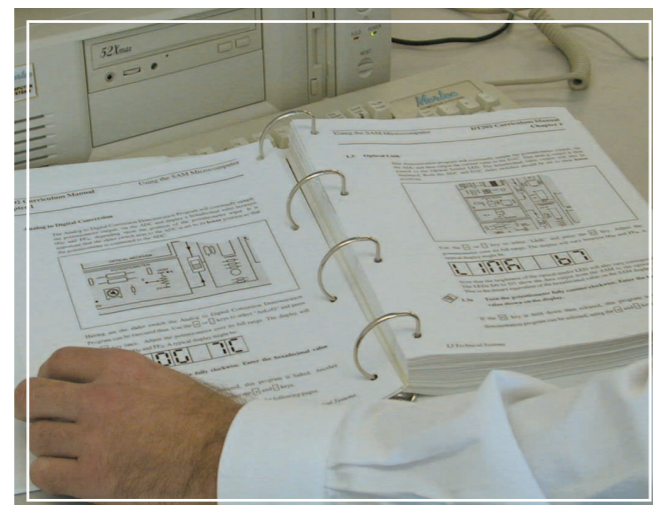
■ *All curriculum manuals are fully compatible with the ClassAct® computer managed learning system*

DIGIAC 2000 microprocessor trainers
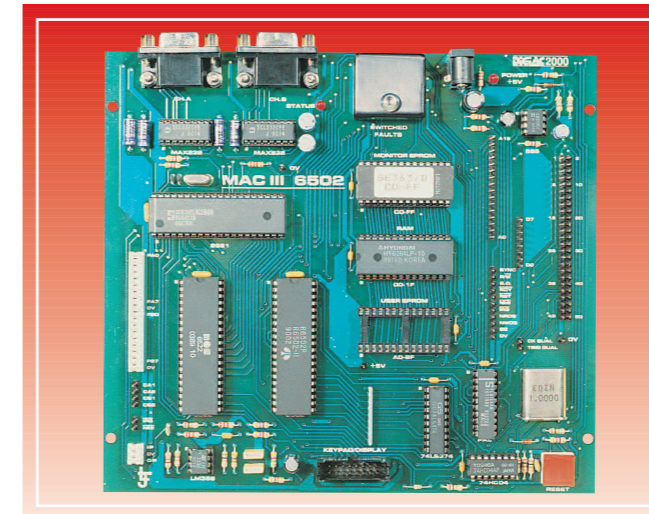
DT1 MAC III 6502 microprocessor trainer:
The DT1 microprocessor trainer is based on the Rockwell™ 6502 microprocessor. Comprising a circuit board with user and technical manuals, it is the ideal platform for students meeting microprocessors for the first time.

When used with the optional DT25 keypad/display unit (shown on page 5), the DT1 becomes an easy-to-use trainer for machine code programming.

As the student becomes more competent, they may progress to using the PC-based 6502 cross assembler software suite contained in the optional DT30 Cross Assembler Development System (see page 4).
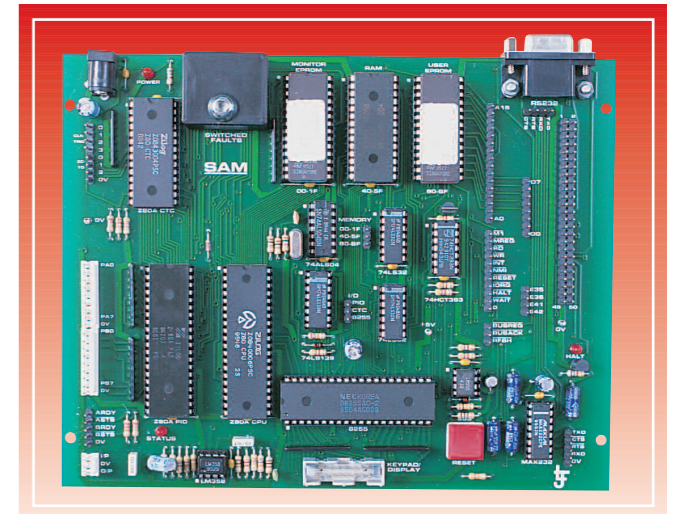
The optional curriculum text DT102, 'An Introduction to 6502 Microprocessor Applications', provides the student with a complete hands-on introduction to 6502 microprocessor applications and programming based around the optional DT35 Applications Module (see pages 5 and 6 for more information on these products).

Recommended teaching set:
DT01 6502 Microprocessor Technology Teaching Set (see page 7).

Specification:
- 6502 Microprocessor.
- 1 MHz System clock.
- 6522 providing 2 x 8-bit I/O ports terminated with 0.1" PCB pins.
- 8K RAM.
- 16K Monitor EPROM.
- 8K User EPROM space.
- Cassette interface.
- 2681 Duart providing 2 x RS232 interfaces for bi-directional communication.
- 8 Fault switches with lockable cover.
- All major system signals and address/data/control buses brought out on 0.1" PCB pins.
- Power on and manual RESET.
- 6522 contains 2 counter/timers.
- Dimensions: 190mm x 170mm (7.5" x 6.7").
- Power requirement: 5V DC @ 1A.

DT2 SAM Z80 microprocessor trainer:
The DT2 microprocessor trainer is based on the Zilog™ Z80 microprocessor that is widely used in industry. The trainer consists of a circuit board and both user and technical manuals.

The DT2 may be used with the optional DT25 keypad/display unit (see page 5) for machine code programming.

As the student becomes more competent, they may progress to using the PC-based Z80 cross assembler software suite contained in the optional DT30 Cross Assembler Development System (see page 4).

The optional curriculum text DT202, 'An Introduction to Z80 Microprocessor Applications', provides the student with a complete hands-on introduction to Z80 microprocessor applications and programming based around the optional DT35 Applications Module (see pages 5 and 6 for more information on these products).

Recommended teaching set:
DT02 Z80 Microprocessor Technology Teaching Set (see page 7).

Specification:
- Z80 Microprocessor.
- 2 MHz System clock.
- Z80 PIO providing 2 x 8-bit I/O ports terminated with 0.1" PCB pins.
- 8K RAM.
- 8K Monitor EPROM.
- 16K User EPROM.
- Cassette interface.
- Programmable RS232 interface.
- 8 Fault switches under a lockable cover.
- All major system signals and address/data/control buses brought out on 0.1" PCB pins.
- Power on and manual RESET.
- Z80 CTC containing 4 counter/timers.
- Dimensions: 190mm x 150mm (7.5" x 5.9").
- Power requirement: 5V DC @ 1A.

DIGIAC 2000 microprocessors - supporting equipment
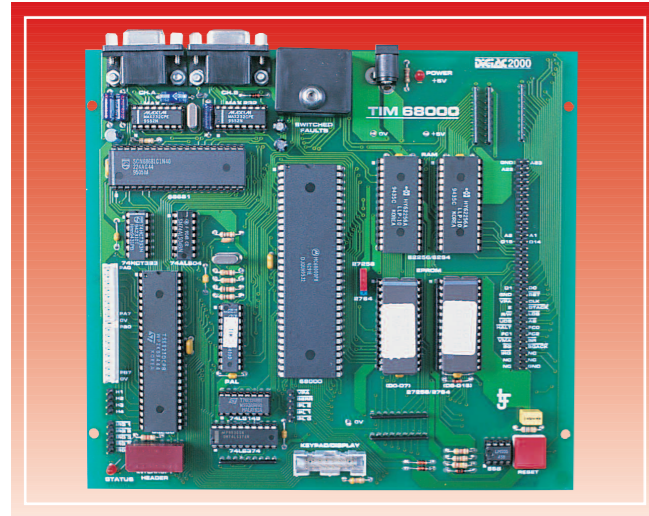
DT5 TIM 68000 Microprocessor Trainer:

The DT5 is based on the Motorola™ 68000, a 16-bit microprocessor widely used in industrial control applications. The DT5 is the ideal solution for teaching engineering students the industrial application of 16-bit microprocessors.

The optional DT25 keypad enables the user to edit memory and enter and run simple machine code programs (see page 5).

Students then progress to using the optional DT31 68000 Cross Assembler Development System, which allows a comprehensive range of advanced programming tasks to be performed.

The associated curriculum text DT502, 'An Introduction to 68000 Microprocessor Applications', provides a competency-based course of study that includes an introduction to 68000 machine code programming and an in-depth exploration of assembly language programming, based around the optional DT35 Applications Module (see page 5).

Specification:
- 68000 Microprocessor.
- 8 MHz System clock.
- 68230 PI/T providing 2 x 8-bit I/O ports terminated with 0.1" PCB pins and timer/counter functions.
- 64K RAM.
- Up to 64K EPROM space.
- 68681 Duart providing 2 x RS232 interfaces for bi-directional communication.
- 8 Fault switches with lockable cover.
- All major system signals and address/data/control buses brought out on 0.1" PCB pins.
- Power on and manual RESET.
- Dimensions: 190mm x 170mm (7.5" x 6.7").
- Power requirement: 5V DC @ 1A.

DT30 6502/Z80 Cross assembler development system:

DT30 provides an assembly language program development facility for the DT1 and DT2 microprocessor trainers. Designed to run on an IBM™ compatible PC, this suite of programs comprises the Merlin text editor, 6502 and Z80 cross assemblers, and a terminal emulation program.

The program suite provides an integrated development environment in which assembly language programs can be entered, assembled and downloaded to the target microprocessor board. The terminal emulation program enables the microprocessor board to be controlled remotely from the PC, allowing the user to execute and debug downloaded programs and examine/edit memory.

DT30 is supplied complete with RS232 serial download/control cable and comprehensive user manual.

DT31 68000 Cross Assembler Development System:

This suite of programs is designed to provide students with an integrated assembly language program development facility for the DT5 microprocessor trainer.

Designed to run on an IBM™ compatible PC, the program suite provides an integrated development environment based around the Merlin text editor, a 68000 cross assembler and a terminal emulation program.

Assembly language programs are written using Merlin, then assembled and downloaded to the DT5 board. The terminal emulation program allows the microprocessor board to be controlled remotely from the PC, providing facilities for program execution and debugging, and the examination and editing of memory.

DT31 is supplied complete with RS232 serial download/control cable and comprehensive user manual.

DT60 Power supply unit:

This unit may be used to provide power to a microprocessor board (DT1, DT2 or DT5) and either the DT35 Applications Module or DT34 Input/Output Devices Module.
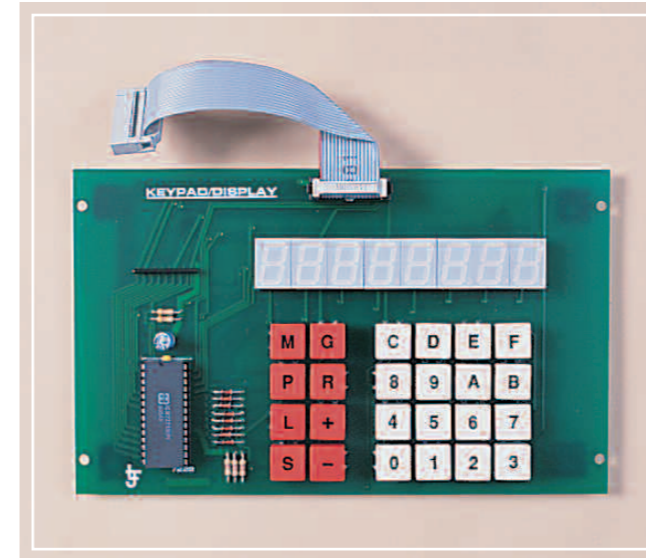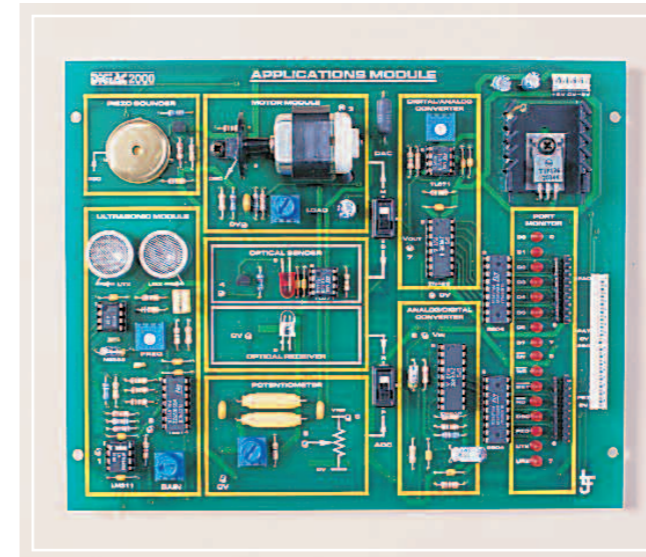
DT25 Keypad/display unit:

Designed for use with the DT1, DT2 or DT5 microprocessor trainer, this module allows users to:
- examine and edit memory
- enter and run machine code programs
- debug programs (DT1 and DT2 only)

The module incorporates an 8-digit, seven-segment display and a 24-key keypad containing both hexadecimal and control keys.

DT35 Applications module:

This module includes the following devices:
- 2x 8-bit input/output ports with LEDs to indicate input/output line status.
- Analog-digital converter.
- Digital-analog converter.
- DC motor with opto-electronic speed sensor.
- Optical sender/optical receiver.
- Variable potentiometer.
- Piezo sounder.
- Ultrasonic transmitter/receiver.

The control of the DT35 Applications Module forms the basis of the programming exercises provided in DT102, DT202 and DT502 microprocessor applications curriculum manuals (see page 6).
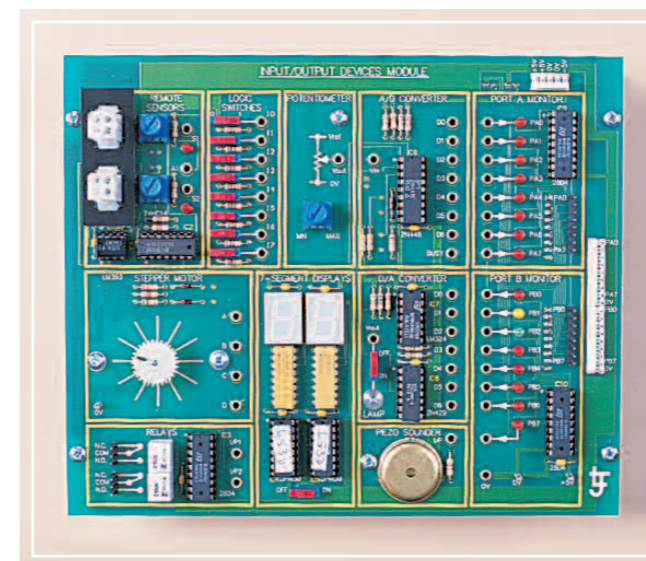
DT34 Input/output devices module:

This module is supplied with a comprehensive user manual and includes the following devices:
- Analog-digital and digital-analog converters.
- Variable potentiometer.
- Piezo sounder.
- 2 x seven-segment displays.
- Stepper motor.
- 16 port monitor LEDs.
- 8 logic switches.
- 2 changeover relays.
- Shorting links and connecting leads.
- Connection block for remote sensors.*

* A range of eight remote sensors is available for use with the DT34 module. These may be ordered separately using order code DT34 TK.

DT34 features an alternative range of microprocessor control applications from those provided by DT35.

Ideal for further student project work.