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Equipment planning guide
for vocational and technical training and education programmes

Electronics

Second (revised) edition

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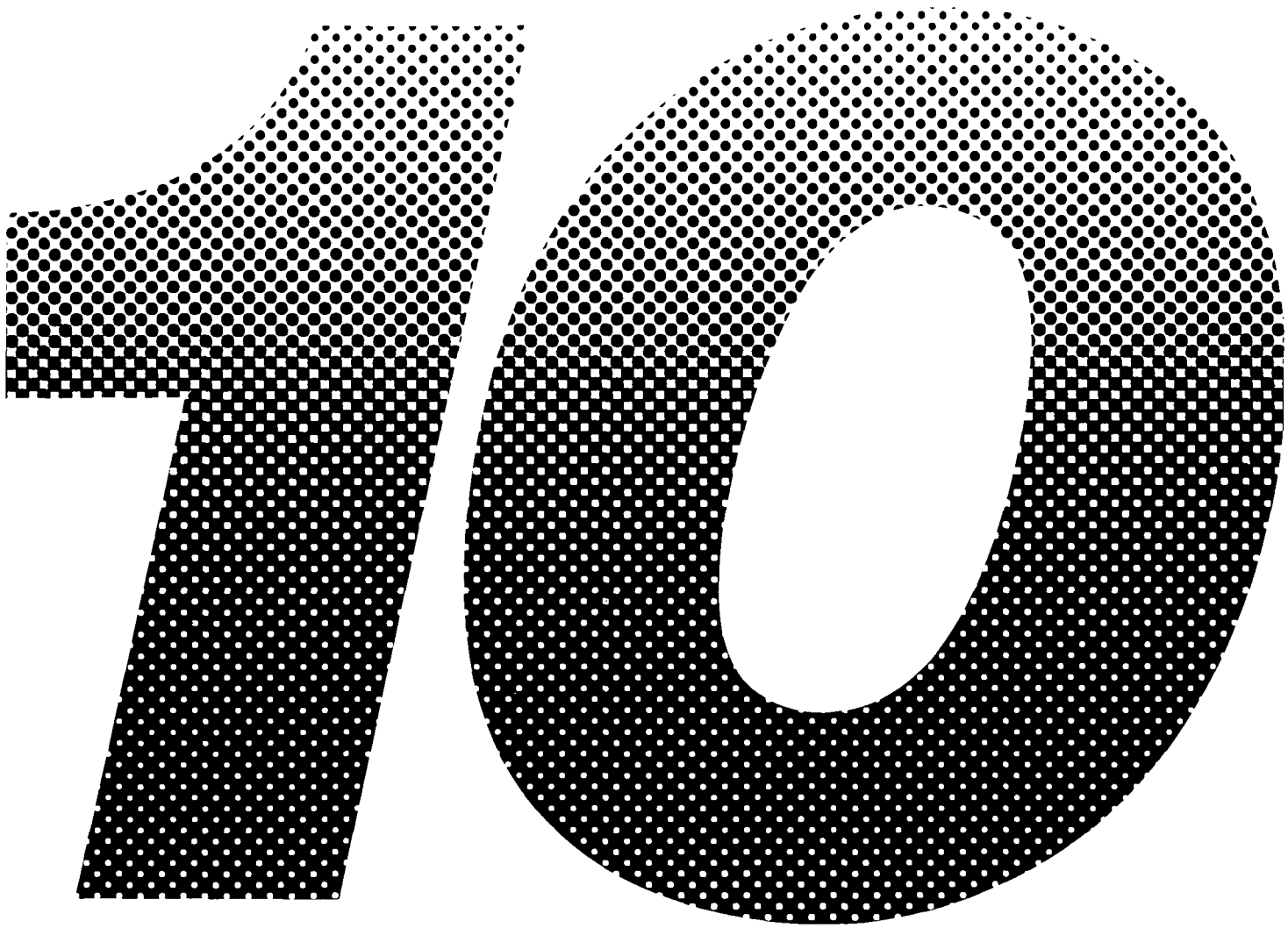

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FOREWORD

1. This second (revised) edition of Equipment Planning Guide No. 10 aims at bringing up-to-date and improving the content of the first edition with regard to latest didactic and technological developments.

2. The purpose of equipment planning guides is to provide guidance and help to:

- government departments and national institutions in the developing countries, national project directors, teachers, instructors, chief technical advisers, experts, consultants, etc., so that they may plan their equipment requirements with accuracy and speed and produce precisely defined technical specifications for equipment requests and workshop layouts;

- purchasers in developing and industrialised countries, with a view to simplifying procedures for international competitive bidding and placing orders;

- firms in developing and industrialised countries, to enable them to understand exactly what is needed when they receive invitations to tender;

- teachers and instructors everywhere, so that they may provide learners with technical specifications and information on the characteristics of items of equipment in the guide lists.

3. The text of this guide is in English. An alphabetical index of item titles included in the equipment lists is attached in English; numerical indexes are attached in English, French and Spanish. A French version of this guide is also available.

4. This planning guide is the result of a collective effort. The authors are:

- S. Schoen, Chief of ILO's Technical Co-operation Equipment and Subcontracting Branch (EQUIPRO), who developed the conceptual and editorial framework;

- V. Remesh, Technical Standards Adviser (ILO/EQUIPRO), who prepared the technical content.

- Consultants, engaged by the Government of the Canada, who prepared the layouts, illustrations, and some item specifications.

5. The authors recognise that their attempt to define and compile comprehensive equipment planning guides cannot be inclusive of all possible needs. The Technical Co-operation Equipment and Subcontracting Branch (EQUIPRO) at ILO headquarters would be grateful to the users for any comments and suggestions on how this guide may be improved further. The guides will be revised at intervals of about five years or as the need arises.

6. While every care has been taken to ensure the accuracy of the technical data in this guide, the ILO and the authors cannot accept responsibility nor may they be held liable for :

(a) any editorial or typographical errors which may have occured; and

(b) any defaults arising from manufacture, method of selection, use, etc., of the equipment described in this guide.

Specifications which are subject to change should be confirmed when placing orders with suppliers.

7. Subject to mutual agreement, users of this planning guide may also avail themselves of the experience, expertise and services which the ILO can render in planning, purchasing and delivering technical co-operation equipment. Enquiries should be addressed to:

Technical Co-operation Equipment
and Subcontracting Branch (EQUIPRO)
International Labour Office
CH-1211 Geneva 22 (Switzerland)

8. This guide has been prepared with financial assistance of the Government of Canada represented by the Canadian Commercial Corporation.

CONTENTS

HOW TO PLAN EQUIPMENT REQUIREMENTS

1. When planning equipment for vocational and technical training and education programmes, it is important to provide a clear idea of the equipment and layout features desired. Equipment lists for workshop layouts need not be as detailed as purchasing requests but they should give the architect all the information he needs to design an effective layout and to provide safe and adequate operating space.

2. The responsibility for recommending equipment should be given to experienced instructors/educators who are directly involved in the relevant programme.

3. Cost should not be the primary criterion for selection. Function, design and after-sales service are the three most important considerations; others are durability, accuracy, versatility and low operating costs.

4. Functional equipment must be well-designed, safe and easy to use. It must be selected for its compatibility with and contribution to the training/education programme to which it should form an essential complement, and it should have the capacity and degree of technical sophistication appropriate to the level of skills of those who will use it.

5. Incomplete or over-elaborate specifications in purchasing requests slow down the process and may result in late deliveries or the supply of inadequate, unnecessary or costly equipment. Requests should be carefully reviewed to ensure that equipment is in accordance with the needs of the particular programme.

6. To ensure fair competition, specifications should be so worded and detailed as to permit and encourage the widest possible market coverage. Specifications must be broad enough to allow several suppliers to submit bids whilst containing enough detail to indicate clearly the essential characteristics of each item. Such specifications enable the suppliers to understand particular requirements and to quote correctly.

7. Specifications should not list features which are not strictly necessary, otherwise certain suppliers might, quite wrongly, be discouraged from bidding or unnecessary expenditure might be incurred. It is, however, important to mention special requirements of local laws or conditions, such as tropicalisation and/or dust proofing, the system of weights and measures in use, etc.
It is important that the electricity supply system should always be described in the equipment requests.

8. In exceptional cases the programme may require equipment which is not readily available and will have to be specially made. In such cases, detailed descriptions and drawings should be provided in enough copies, depending on the type of equipment and the number of firms to be consulted. When the use to which an item of equipment is to be put is not made sufficiently clear by the mention of its name alone, it should be described fully in the equipment request.

9. It is essential that there should be an efficient inventory system on the spot, in which the records are kept of all equipment purchased. As new equipment is received it should be recorded immediately on the inventory, which should contain such information as:

(a) inventory number;
(b) name or description;
(c) serial number;
(d) purchase order number;
(e) cost;
(f) supplier or manufacturer;
(g) date of purchase;
(h) location;
(i) maintenance record.

The information in the inventory will be useful when ordering replacement items and for accounting for annual maintenance costs. It will also indicate when maintenance is required more frequently than is normal, in which case it may be time to consider the purchase of new equipment.

HOW TO USE THE EQUIPMENT GUIDE LIST

1. In general, a complete training package approach has been adopted in this guide to ensure delivery of both hardware and corresponding ready-to-use software. However, a variety of item specifications for separate testing and measuring instruments is also included in this guide to meet specific training and research requirements of particular projects. On the other hand, items for domestic and communication electronics were deleted from this issue because these items are included in full in the revised and renamed version of guide No. 11 "Communication Engineering".

Special attention has been given to microcomputer equipment, process control and printed circuits realisation systems.

2. This revised version of guide No. 10 contains main items related to Fundamentals of electronics (F), Industrial electronics (I), Electronic instrumentation (E) and Digital electronics (D). Corresponding abbreviations of these occupations (F, I, E and D) are given in the "USE" column of the guide list pages. Other items related to these occupations are listed in guides No. 9 (Electrical occupations) and 11 (Communication Engineering).

Ancillary items, which may be required for equipping an electronic laboratory or a workshop, such as metalworking machines, welding facilities, heavy handtools, sheetmetal machines, audiovisual, draughting, office and reproduction equipment can be found in guides Nos. 1, 2, 3, 6 and 15.

3. To facilitate the preparation of equipment lists, facilities, components and consumables closely related to the main items are listed in the same sections usually below the main item. However, general purpose machines, tools, components and consumables are included in separate sections.

4. The list of main equipment in this guide consists of "basic" and "optional" items commonly used in vocational and technical training and education programmes at different levels. The minimum essential items required to start a training programme for 16 learners in a particular occupation are marked with an asterisk and are regarded as "basic". To provide a maximum degree of flexibility, it is left to users of the lists to decide which of the "optional" items are necessary, taking account of local conditions, varying numbers of learners, different levels of training and the funds available.

5. The terminology in this guide relates to commonly used expressions although definitions may vary from country to country. Wherever possible internationally recognised standards were applied. Only SI Units have been used in this guide.

6. For the sake of clarity and to avoid duplication when ordering, a numerical code is used to identify each item, the first figure indicating the planning guide, the second the section and the third the individual item. For example, the code for the first item in section 1 (trainers and training kits) is 110.1.1, and for the second item 111.1.2. Based on project requirements a similar numerical code should be used whenever equipment requests are prepared (see also chapter "Equipment Request (Model)").

7. At the beginning of each section a short description of its content is provided as well as some ideas of how to use the items.

8. All items in the list have "neutral" technical specifications so that they may be used for international competitive bidding.

9. The illustrations represent equipment similar to the items described.

SECTION 1 TRAINERS AND TRAINING KITS

This section describes the selection of trainers for teaching basic and specific areas of electronics.

Each trainer has been categorised into an area of instruction.

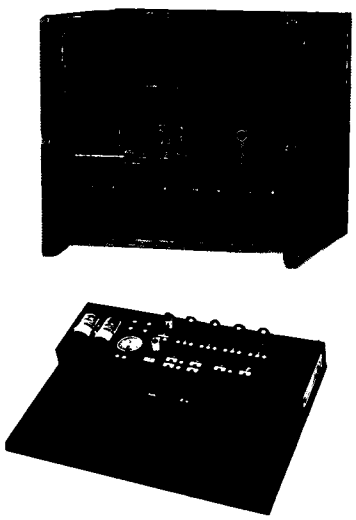
The Basic Electricity and Electronics Trainer (110.1.1) is introductory in nature and offers the trainee a basic knowledge in electronics, upon which the trainee can then build. The next four trainers classified as fundamental are:

Power supplied and amplifiers trainer (110.1.2)
Analog logic trainer (110.1.3)
Digital logic trainer (110.1.4)
Digital exercises kit (110.1.5)

The thyristor control trainer (110.1.6) deals with power control problems.

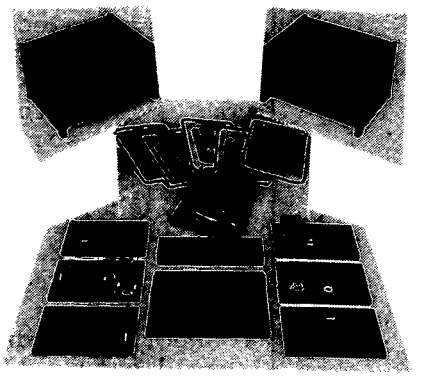
Industrial automatic regulation and control are represented by Instrumentation and process control trainer (110.1.14), Process control simulator (110.1.15), Programmable logic controller (110.1.16) and by Microprocessor trainer system (110.1.17).

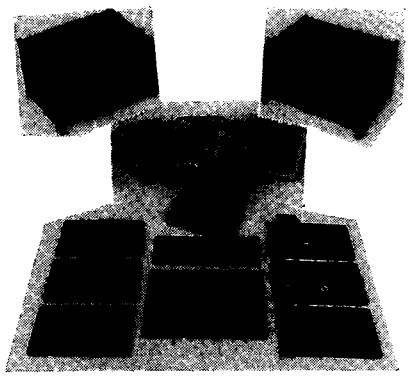
Simultaneously, the microprocessor trainer system (110.1.17) along with the microcomputer hardware trainer is intended for hardware programming training, familiarisation and isolation of malfunctions as well as for software development.
Item 110.1.19 represents a microprocessor controlled robot arm trainer kit intended for training in its assembly, as well as in operation and programming of robots.
It should be noted that many instruments overlap in areas of use, so that a complete laboratory need not contain all of the instruments described.

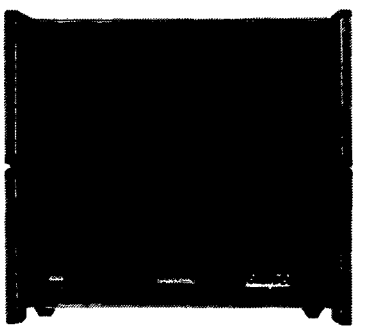
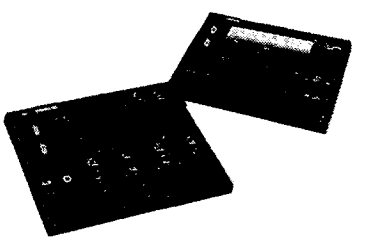
Item	Description	Quant.	Use	Illustration
110.1.1	BASIC ELECTRICITY & ELECTRONICS TRAINER for basic training and instruction in principles of electricity and electronic circuits, consisting, for example, of a panel to accommodate plug-in elements to permit different circuit configurations. Other arrangements may be considered. The trainer should cover the following subjects: - principles of electrical engineering, (Ohm's law) - DC/AC networks, RC/LC circuits - principles of electronics (semiconductor characteristics, diode and transistor circuits, rectification, voltage multiplication, filtering, stabilisation, AC/DC voltage amplification, triacs, diacs, unjunction transistors, FET's, VDR's, operational amplifiers thyristor circuits, multivibrators, Schmitt triggers, principles of analog and digital circuits) Complete with: - power supplies (DC, AC) - function generator (s) - set of plug-in components and connecting leads - set of necessary measuring instruments (oscilloscope(s), avometer(s) etc.) - set of accessories and components for two years of maintenance including those which are subject to possible damage during experiments - two sets of comprehensive manuals (handbooks) with laboratory exercises - operation and service manuals. The trainer may include special furniture.	8	F *	

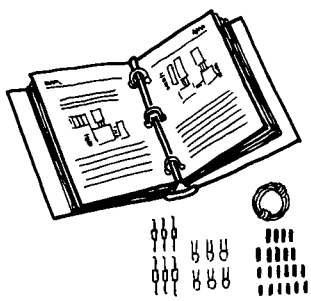
Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

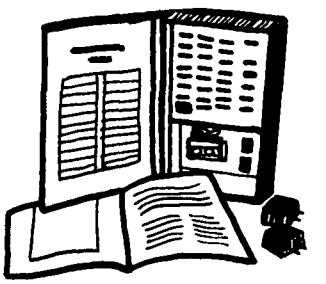
Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

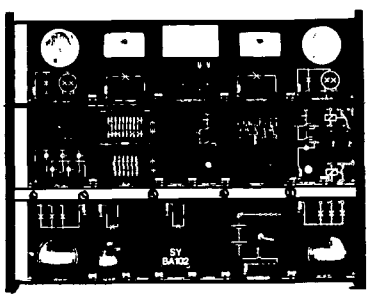
Item	Description	Quant.	Use	Illustration
110.1.2	POWER SUPPLIES AND AMPLIFIERS TRAINER an experiment-based trainer which shall present the theory and functions of various aspects of power supplies and amplification. The trainer kit shall contain all of the materials, supplies and components necessary to explore the following topics: - transformers - rectifiers (half and full wave) - filters (pi, capacitance, inductance) - voltage (dividing, multiplying regulating, stabilising) - constant current source - general purpose amplifiers. All experiments shall be breadboard capable. Minimum number of experiments: 10 Complete with: - power supply, overload protected - set of plug-in components and connecting leads to provide all basic exercices - set of corresponding measuring instruments with operation and service manuals - set of recommended spares and components for two years of operation, including those which are subject to possible damage during experiments - two sets of experiments manual - two sets of courseware describing principles of power supply, power delivery, control and modification. The trainer may include special furniture.	8	F *	

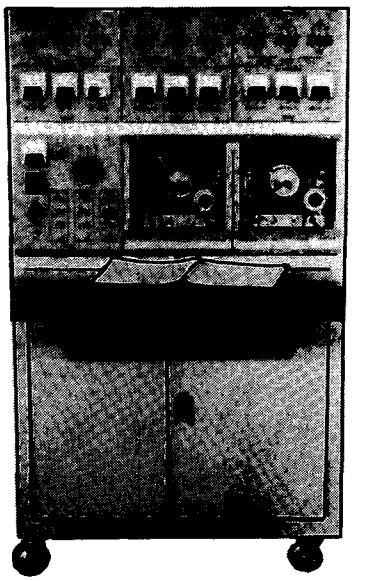
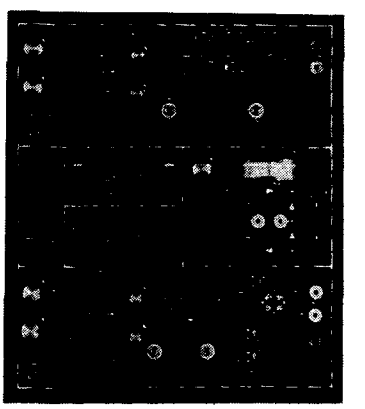
Item	Description	Quant.	Use	Illustration
110.1.3	ANALOG LOGIC TRAINER for training in analogue computing, closed/open-loop control circuits, industrial electronics and instrumentation, consisting, for example, of a panel with sockets connected with internaly fitted elements (symbolically represented on the front panel). Other arrangements may be considered. The trainer shall permit different circuit configurations by means of external connecting leads. The trainer should ensure large variety of experiments at least such as: differential amplifiers, inverter, non-inverting amplifier, impedance converter, comparator, astable multivibrator, integrator, delta and sawbooth generator, differentiator, monostable multivibrator, RC oscillator, squarer, square-root extractor, pulse length discriminator analog-to-frequency converter, analog-to digital converter, digital-to-analog converter, divider, exponential function, determining the RMS value of a voltage, analog calculation circuits. Complete with: - power supply - all necessary functional elements - set of necessary measuring instruments - accessory kit for two years of operation with connecting leads. The kit should list recommended quantity of components which are subject to possible damage during experiments - two sets of manual (handbooks) with laboratory exercices - operation and service manuals. The trainer may include special furniture.	8	F *	

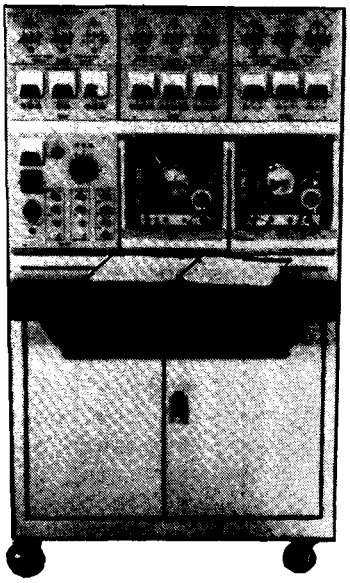
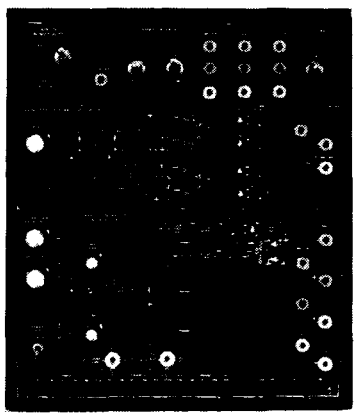
Item	Description	Quant.	Use	Illustration
110.1.4	DIGITAL LOGIC TRAINER for training in operation and application of digital logic circuits extending to complex digital systems including circuits used in computer technology; consisting, for example, of a panel with output sockets from internally fitted elements (symbolically represented on the front panel). Other arrangements may be considered. The trainer shall permit different circuit configurations by means of external connecting leads. The trainer should ensure large variety of experiments at least such as: - basic logic circuits - Boolean algebra - coding, decoding, recoding - arithmetic circuits - comparator, threshold value - selection circuits - memories - A/D-D/A conversions - digital switch - basic flipflop circuits - shift registers - synchronous counters - asynchronous counters and demultipliers - pulse edge delays, synchronization circuits, pulse gates - more complex examples of digital control, instrumentation and data technology. Complete with: - all general purpose logic elements AND/NAND, OR/NOR gates, Schmitt, J-K (master/slave), D triggers, power inverters, relays, flip flops, indicator lamps, clock pulse generators, monoflops, demultipliers shift registers, BD4CD decimal decoder adders, memories, digital switches, etc.) - power supply - accessory kit with connecting leads - set of necessary measuring instruments - set of recommended spares and components for two years of operation, including those which are subject to possible damage during experiments	8	D *	 

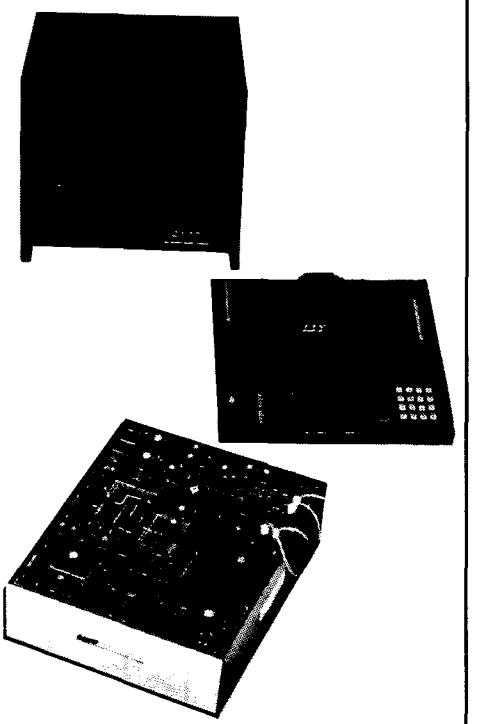
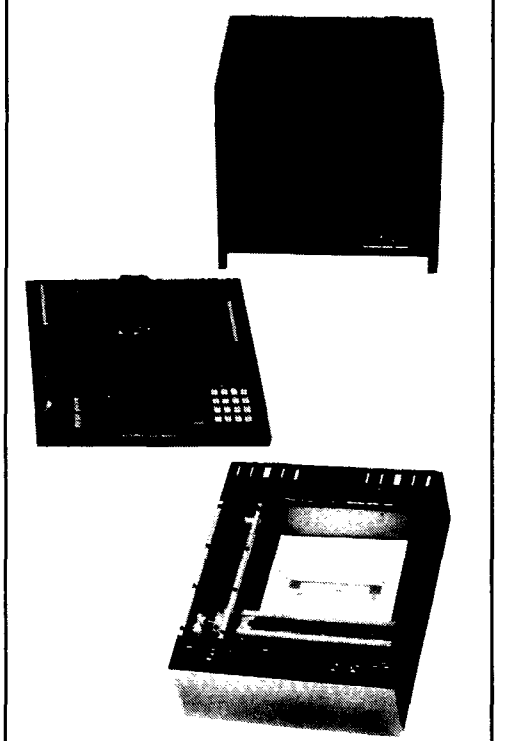
Item	Description	Quant.	Use	Illustration
	- two sets of comprehensive manuals (handbooks) describing theory of digital logic circuits - laboratory experiments manuals. The trainer may also include special furniture.			
110.1.5	DIGITAL EXERCISES KIT self-instructional, for practical experiments with integrated circuits from the two dominating types: TTL and C-MOS. The kit should comprise: - breadboard unit - two copies of exercice book containing approx. 30 to 40 exercises - a set of electronic components with data sheets ensuring all exercises described in the book - spare electronic components to cover their possible damage during experiments within two years of use.	8	D *	

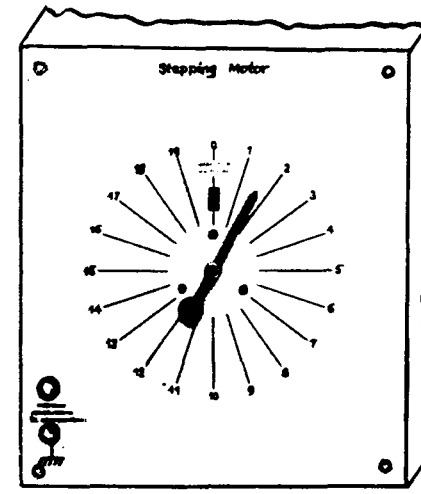
Item	Description	Quant.	Use	Illustration
110.1.6	THYRISTOR CONTROL TRAINER for practical instruction in field of conversion, instrumentation, closed and open-loop control technology; consisting, for example, of a panel with sockets (input, output, test) connected with internally fitted components (symbolically represented on the front panel). Other arrangements may be considered. The trainer shall permit different circuit configurations. The trainer should ensure at least such experiments as: - variable speed control of AC and DC motors - position control of an actuator - constant temperature control - constant temperature control with phase angle control - lighting control Complete with: - power supply - internally installed groups of thyristors and other circuits - set of necessary measuring instruments - accessory kit with connecting leads and components for two years of operation, including those which are subject to possible damage during experiments - set of units consisting of: electrical machine set (motor-generator and tachometer), servo-drive, temperature controlled loop, lighting control - two sets of manuals (handbooks) in thyristor control technology with laboratory exercices - operation and service manuals. The trainer may also include the special furniture.	4	I	

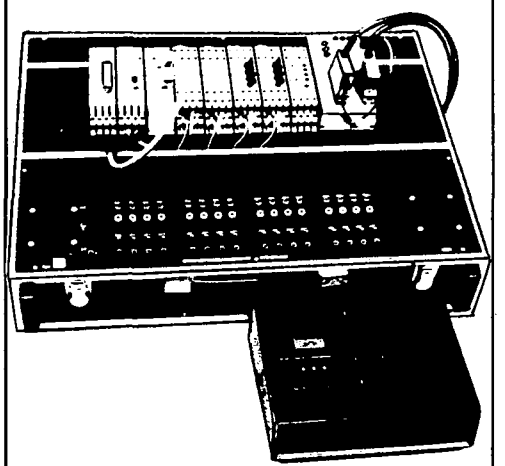
Item	Description	Quant.	Use	Illustration
110.1.7	TEMPERATURE CONTROL UNIT self-contained, trainee-orientated. The unit shall be equipped with transducers (thermocouple, thermoresistance, thermistor) to regulate temperature, for example, in a simulated oven. The unit may consist of panel(s) with components fitted internally and represented symbolically on panel(s). The unit may include special furniture such as trolley, support, frame, etc. Complete with: - control board - measuring instruments - set of connecting cables and leads - power supply - set of recommended spares for two years of operation to cover possible loss during exercises - two sets of experiments manuals - operation and service manuals.	4	I	
110.1.8	LIGHTING CONTROL UNIT self-contained, trainee-orientated. The unit may consist of panel(s) with components fitted internally and represented symbollically on panel(s). The unit may include special furniture such as trolley, support, frame, etc. Complete with: - control board - measuring intruments - set of connecting cables and leads - power supply - set of recommended spares for two years of operation to cover possible loss during exercises - two sets of experiments manuals - operation and service manuals.	2	I	

Item	Description	Quant.	Use	Illustration
110.1.9	DC MOTOR SPEED CONTROL UNIT self-contained, trainee-oriented. The unit may consist of DC motor generator set with tachometer or DC motor with tachometric unit both with electronic speed control circuitry. The unit may include panel(s0 with components fitted internally and represented symbolically on panel(s). It may also include special furniture such as trolley, support, frame etc. Complete with: - control board - two sets of educational handbooks covering DC motor speed control subject - measuring instruments - set of connecting cables and leads - power supply - recommended accessories and spares for two years of operation including those which are subject to possible damage during exercises - two sets of experiments manuals - operation and service manuals.	2	I	 

Item	Description	Quant.	Use	Illustration
110.1.10	AC MOTOR SPEED CONTROL UNIT self-contained, trainee-orientated. The operation of the unit may be based on sumultaneous frequency and voltage vary principles to affect speed and maintain power or to change both of them in a desired range. The unit may consit of a motor, tachometer and electronic control circuits. The unit may include panel(s) with components fitted internally and represented symbolically on panel(s). It may also include special furniture such as trolley, support, frame, etc. Complete with: - control board - two sets of educational handbooks covering AC motor speed control subject - measuring instruments - set of connecting cables and leads - power supply - recommended accessories and spares for two years of operation including those which are subject to possible damage during experiments - two sets of experiments manuals - operation and maintenance manuals.	2	I	 

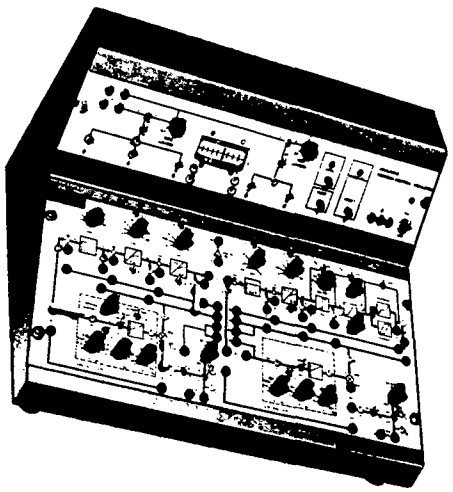
Item	Description	Quant.	Use	Illustration
110.1.11	ANGULAR POSITION UNIT self-contained, trainee-orientated. The operation of the unit may be based on the servocontrol principle involving, for example, servo amplifier, error position detector, open loop position controller. The unit may include panel(s) with components fitted internally and represented symbolically on panel(s). It may also include a special furniture such as trolley, support, frame, etc. Complete with: - control board - two sets of educational handbooks covering in detail angular position control subjects - set of connecting cables and leads - power supply - recommended accessories and components for two years of operation including those which are subject to possible damage during experiments - two sets of experiments manuals - operation and service manuals.	2	I	
110.1.12	X-Y POSITION UNIT self-contained, trainee-orientated. The unit may represent a numerically controlled position device with a marking pen, similar to the plotter. It may include autonomous control panel. Complete with: - control board - two sets of educational handbooks covering in detail two position control subject - set of connecting cables - recommended accessories and components for two years of operation, including those which are subject to possible damage during experiments - two sets of experiments manuals - operation and service manuals.	2	I	

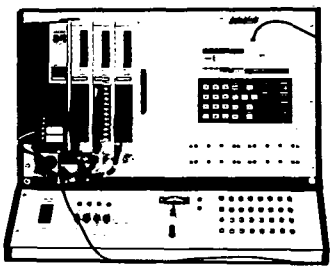
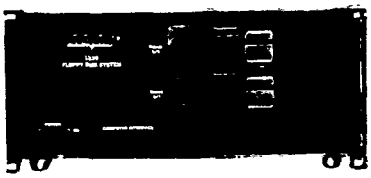
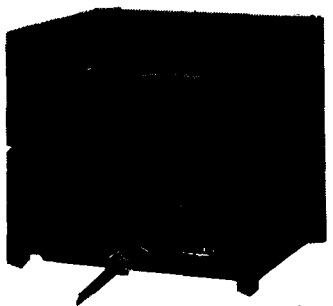
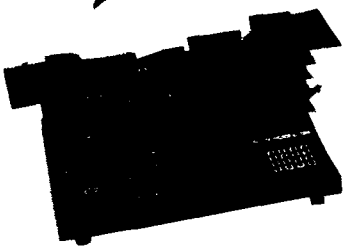
Item	Description	Quant.	Use	Illustration
110.1.13	STEPPING MOTOR CONTROL UNIT self-contained, trainee-orientated, electronically controlled electromechanical device should represent principles of driving units in robotic equipment, printers, plotters. The trainer should be designed to study a stepping motor operation, step increment control, variable speed rotation and inversion of rotation, incremental position incoding. The unit may include special furniture. Complete with: - control board - two sets of educational books on stepping motor controls - measuring instruments and/or indicating devices - set of connecting cables and leads - power supply - recommended accessories and spares for two years of operation including those which are subject to possible damage during exercises - two sets of experiments manuals - operation and service manuals.	2	I	

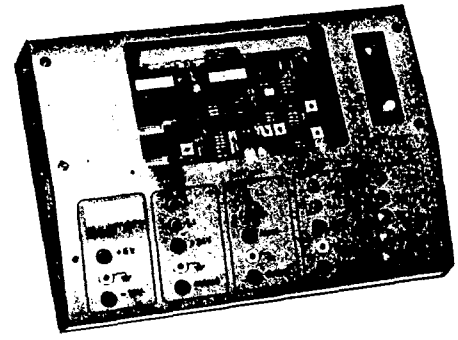
Item	Description	Quant.	Use	Illustration
110.1.14	INSTRUMENTATION AND PROCESS CONTROL TRAINER a self-contained laboratory-centered trainer designed to explain the design and control of instrument systems and process control. The trainer shall be fully programmable with the potential to input malfunctions. The following topics shall be covered as minimums: - transducers - encoders/decoders - programming control systems - programming process systems Complete with: - supply unit - supplies and components necessary for all the experiments - recommended consumables and/or spares for two years of operation including those which are subject to possible damage during experiments - two sets of handbooks on instrumentation and process control engineering - two sets of laboratory experiments manuals - operation and maintenance manuals.	1	E I *	

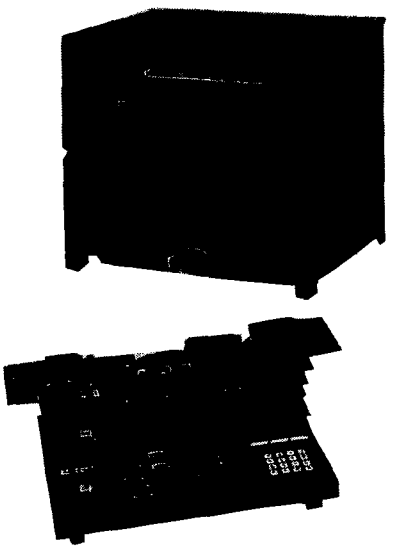
Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

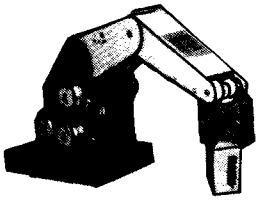
Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

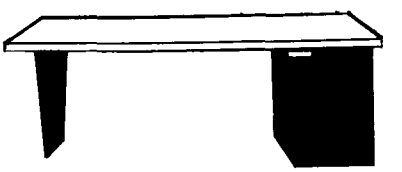
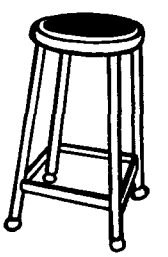
Item	Description	Quant.	Use	Illustration
110.1.15	PROCESS CONTROL SIMULATOR for teaching automatic control engineering. Approximate specifications: The simulator should represent all types of controllers Proportional (P), Integral (I), Derivative (D) and their behavior. It should be possible to examine the following phenomena: - step and sine function responses of linear and non-linear transfer functions - control performance of controlled systems and the influence of P, PI, PD and PID controllers - automatic control systems such as: fixed value control systems, ratio control systems, cascade control systems - special features such as: non-linear control loops, two points controllers, control systems of higher order. The simulator should be equipped with disturbance source and may include, for example, a panel with sockets (input, output, test) connected internally with components as well as to suit external plug-in units or plugs. Approx. range of functions: - proportional amplifying action (P)5 to 200% steplessly adjusted. - integral action (I) 0.1s to 10s with reduction possibility by 0.01 - derivative action (D) 0 to 0.5 s with reduction possibility by 0.01 Complete with: - set of plugs,cables and components - recommended spares and accessories for two years of operation, including those which subject to possible damage during experiments - two sets of courseware in control engineering related to the simulator - two sets of experiments manuals - operation and service manuals.	1	E I *	

Item	Description	Quant.	Use	Illustration
110.1.16	PROGRAMMABLE LOGIC CONTROLLER for training in an effective solution to any industrial process control tasks. Consisting of a programmable base unit (CPU and programme memory) and a programming panel. Approximately 300 step programme memory (C-MOS, RAM) with five year battery back-up. Minimum six input/output lines. Complete with supply units operation and service manuals.	2	I *	
110.1.17	MICROPROCESSOR TRAINER SYSTEM of a modular development type with provisions for inputing malfunctions to enable direct experimentation on common type(s) of microprocessor(s) and trouble shooting, as well as: - to study the operation of the microprocessor (programming I/O process, branching, procedural instructions, monitor interface DAC/ACD, RAM, ROM) - to write programs and to check their execution - to develop experimental prototypes of systems - to program and erase EPROM'S - to produce documentation - to store results The trainer shall consist of: - main unit to accept common type(s) of microprocessor(s) - emulating unit - additional memory - video terminal - keyboard - floppy disk drive - data cassette recorder with automatic start/stop facility - printer - EPROM reader/programmer - UV EPROM eraser - Basic - Pascal Complete with: - supply unit(s) - set of connecting cables and wires	8	D *	   

Item	Description	Quant.	Use	Illustration
	- two sets of educational handbooks describing microprocessor(s) - two sets of experimentation manual - initial supply of 20 datacassettes - initial supply of 50 floppy disks - set of recommended spares for two years of operation to cover possible loss during exercices - operation and service manuals.			
110.1.17A	INTERFACE WITH ANALOG UNITS should match the microprocessor trainer, preferably of universal type to control a wide range of analog units - application modules. Complete with: - set of application modules - power supply - set of connecting cables and leads - set of recommended spares for two years of operation to cover possible loss during exercices - operation and service manuals. NOTE: 110.1.17A is not a stand-alone item and may be included in the request along with microprocessor trainer. Depending upon project specialisation a list of necessary application modules should be mentioned in the request.	8	A	

Item	Description	Quant.	Use	Illustration
110.1.18	MICROCOMPUTER HARDWARE TRAINER designed to introduce subsystems, control and potential use of a microcomputer system. Activities shall include hardware familiarisation and isolation of malfunctions. Experiments shall cover the following topics as minimum: - central processing unit - control language - introduction to programming - languages - peripheral control - memory circuits - networking - system troubleshooting. The trainer shall include: main unit, video display terminal, impact printer, floppy disk system and software. Complete with: - peripheral cabling - two sets of introduction to computer systems courseware - two sets of laboratory experiments manuals - initial supply of 50 floppy disks - storage unit(s) for floppy disks - recommended spares and accessories for two years of operation, including those which are subject to possible damage during experiments - operation and service manuals.	8	D	

Item	Description	Quant.	Use	Illustration
110.1.19	ROBOT ARM TRAINER KIT microprocessor controlled educational type assembly robot arm designed for training in its own assembly as well as on assembly operation and programming of robots. Approx. specifications: - the trainer may be of DC servo powered type in four axis (2 rotational movements of an arm, one rotational and one vertical movement of a gripper) - gripper, pneumatically operated from internally fitted mini-compressor, opening 15-25 mm - 16 independent numerical inputs (0-5V) and 16 outputs (max. 30 mA, 25 V) - command entry from hand held teach pendant; provision to control from an external computer, via parallel interface may also be incorporated - approx. size of operating envelope of a partial toroid form: external radius 250-300 mm; internal radius about 100 mm, depth about 50 mm; rotational axes 270 degrees - programming capabilities: 2-3 programmable sequencies of 32 steps - resolution on rotational axes not less than 5 minutes of arc - resolution on vertical axis better than 0.2 mm - continuous positional feedback on all four numerically controlled axes by means of optical encoders, for example. Complete with: - power unit - control unit - teach pendant - two sets of teachware on robotics - two assembly manuals for the trainer kit - two programming manuals - two exercise manuals - set of accessories and components for two years of operation including those which are subject to damage during experiments	2	I	 

Item	Description	Quant.	Use	Illustration
	- operation and service manuals The trainer kit may include the special furniture. NOTE: In view of the rapid technology development in this field, other systems and configurations of robot trainers may be considered.			
110.1.20	TWO-TRAINEE TABLE heavy duty, laminated surface, for experiments and test equipment. Approx. size of working area: 75 cm x 200 cm Approx. height 70 - 80 cm	8	A D E F I	
110.1.21	TRAINEE STOOL stool of heavy steel construction, adjustable height, swivel chair, with castors.	16	A D E F I	

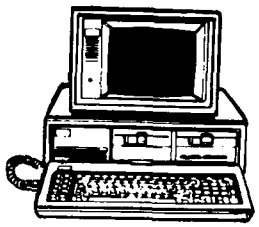
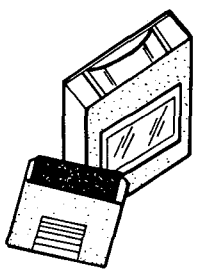
SECTION 2 MICROCOMPUTER SYSTEM

This section is intended as a guidance in designing a project microcomputer system for training in programmes development and in computer application for administration, design, engineering, statistics, analysis and manufacturing.

The section includes main hardware and software as well as main consumables and supporting facilities including special furniture and maintenance items.

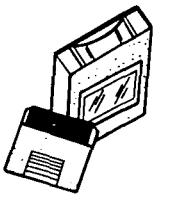
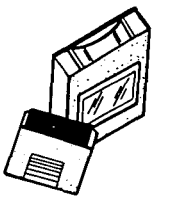
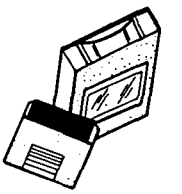
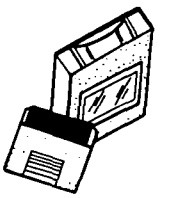
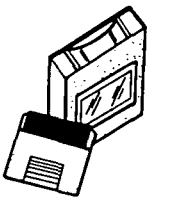
No parameters of the microcomputer system are given due to the rapid development of microcomputer technology, both in hardware and software. This is also due to the large variety of models and systems available, as well as the local regulations, requirements and service possibilities. Therefore, the exact design of the system, determination of a microcomputer model, etc., is subject to additional study at the time of the preparation of the equipment request.

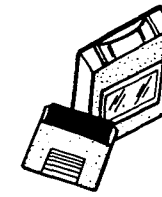
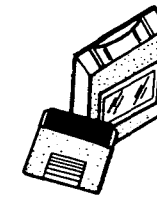
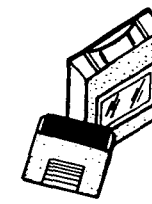
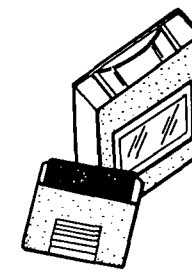
If the project site suffers from low quality of electricity supply (voltage fluctuations and spikes) it is recommended to order a suitable line voltage conditioner (110.2.38 or 110.2.39) to protect the microprocessor based equipment from damages.
If frequent power failures have been observed, the uninterruptible power supplies (110.2.40 of 110.2.41) will be a solution to save programme or data.

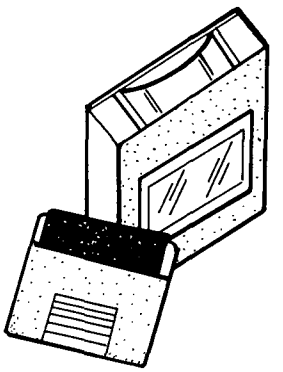
Item	Description	Quant.	Use	Illustration
110.2.1	MICROCOMPUTER SYSTEM NOTE: due to the rapid development of technology, hardware and software, as well as the large variety of existing systems and models, and taking account of local regulations, availability of service facilities and real needs, the project must specify the following: - central processing unit architecture or its type - size of RAM - graphic possibility, colour - national language character set and language of a keyboard - quantity and type of disk drives - if hard disk is needed and its capacity - if a streamer is needed and its parameters - if an optical disk drive with interface is required - type and quantity of input /output interfaces - type (colour, monochrome) and size of a monitor - format size, resolution and typing speed of printer, if critical - need and size of plotter - list of the required software - need of a power backup - special furniture.	1	D *	
110.2.2	INTEGRATED SOFTWARE containing spreadsheet, graphics and database.	1	D *	

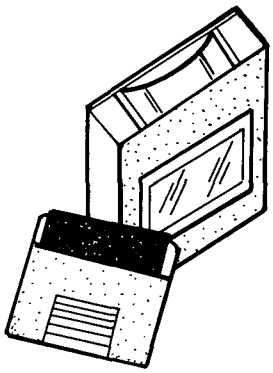
Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

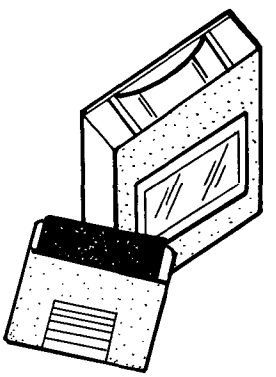
Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

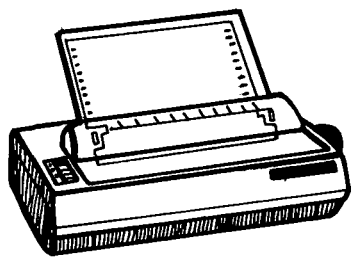
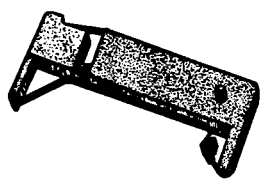
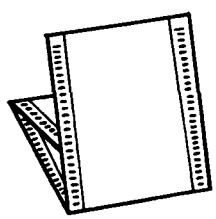
Item	Description	Quant.	Use	Illustration
110.2.3	TEXT PROCESSING SOFTWARE NOTE: the project should specify the package or describe requirements including language of the text processing package. Microcomputer technical data must be also given.	1	D *	
110.2.4	DATABASE SOFTWARE NOTE: the project should specify the package or describe requirements. Microcomputer technical data must be also given.	1	D *	
110.2.5	SPREADSHEET SOFTWARE NOTE: the project should specify the package or describe requirements. Microcomputer technical data must be also given.	1	D *	
110.2.6	PROGRAMMING LANGUAGE SOFTWARE-BASIC NOTE: the project should specify the technical data of the microcomputer.	1	D *	
110.2.7	PROGRAMMING LANGUAGE SOFTWARE-FORTRAN NOTE: the project should specify the technical data of the microcomputer.	1	D *	

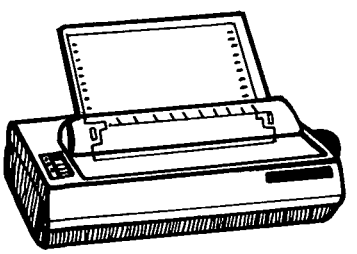
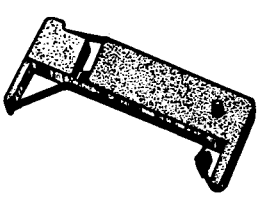
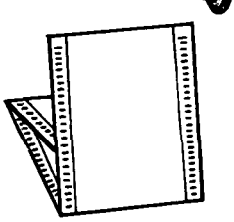
Item	Description	Quant.	Use	Illustration
110.2.8	PROGRAMMING LANGUAGE SOFTWARE-COBOL NOTE: the project should specify the technical data of the microcomputer.	1	D *	
110.2.9	PROGRAMMING LANGUAGE SOFTWARE-PASCAL NOTE: the project should specify the technical data of the microcomputer.	1	D *	
110.2.10	EMULATION PROGRAMME NOTE: the project should specify the microcomputer technical data.	1	D *	
110.2.11	COMPUTER AIDED DESIGN SOFTWARE NOTE: the project should specify the package and describe purpose(s). The technical data, model of a microcomputer must also be given.	1	D *	

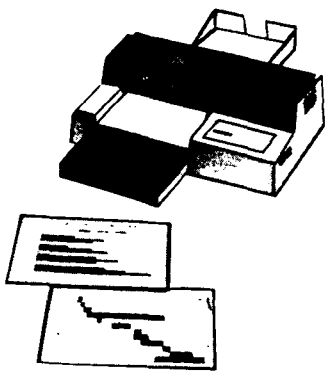
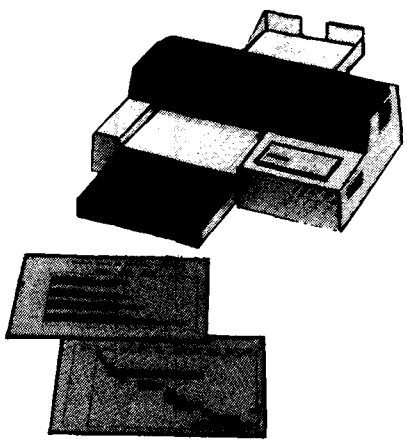
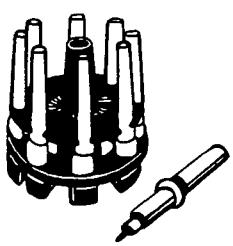
Item	Description	Quant.	Use	Illustration
110.2.12	ELECTRONICS/ELECTRICAL SOFTWARE PACK general purpose, for calculation and solving common electrical engineering problems. The pack should include such examples of calculating programs as: class A transistor amplifier design, Schmitt trigger circuit design, bridge-rectified power supply, dual-output regulated power supply, Gaussion pulse bandwith calculation, microstrip design, strip-line design, lossless transmission lines, single and two-wire transmission line, RF air-core inductor design, voltage standing wave ratio calculation and decibel conversion. There should be a possibility for modifications or additions. The pack should comprise a comprehensive user's manual.	1	D *	

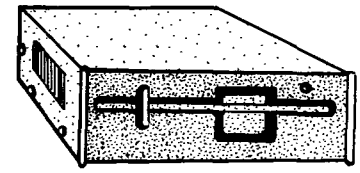
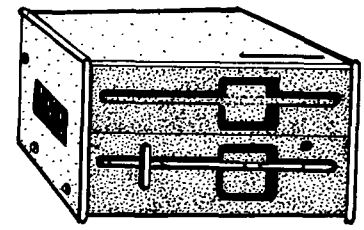
Item	Description	Quant.	Use	Illustration
110.2.13	GENERAL ELECTRONICS CAD/ANALYSING PACK for designing schematic diagrams of electronic and electrical circuits on a microcomputer monitor screen and for performing their AC, DC and transient analysis/test. The pack should include the library of drawings of usual electrical and electronic components and facilities such as: batteries, resistors, capacitors, inductors, switches, diodes, bipolar transistors, transformers, MOS devices, opamps, sinusoidal voltage sources, programmable voltage sources and polynomial sources. There should be a possibility for the user to create and to add to the library a certain number of specific circuits for later use. The microcomputer software pack should comprise a comprehensive user's manual.	1	D *	

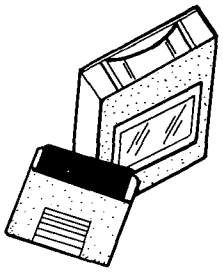
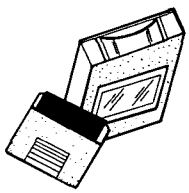
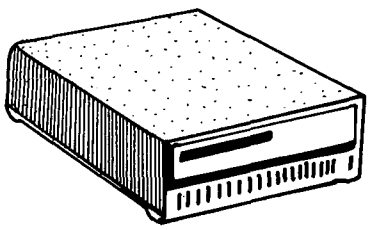
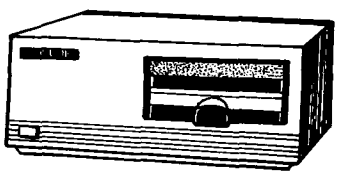
Item	Description	Quant.	Use	Illustration
110.2.14	LOGIC DESIGN AND SIMULATION PACKAGE for designing and performing simulation run of schematic diagrams of micro electronic logic facilities on a microcomputer screen. The package should include the library of logic circuits like gates, latches, flip-flops, inverters, adders etc. There should be a possibility for the user to modify and to add to the existing library a specific number of new or modified circuits for a later use. The microcomputer software package should comprise a comprehensive user's manual. NOTE: when ordering electrical/ electronic CAD software, the project should specify all microcomputer parameters including availability of graphic cards (mono and/or colour) etc.	1	D *	

Item	Description	Quant.	Use	Illustration
110.2.15	DOT MATRIX PRINTER, A4 with draft, near letter quality (NLQ) and graphics modes of printing; paper size A4, parallel/serial interface; pin paper feed; friction feed; programmable line spacing; character size in a draft mode not less than 9 x 9 matrix and in NLQ mode not less than 18 x 18 matrix. Complete with: - printer cable - detachable tractor unit for continuous perforated paper feed - detachable sheet paper feed attachment - ten ribbons - 2000 sheets A4 of perforated folded paper - operation and service manuals. NOTE: Project should specify microcomputer model and its technical data when ordering dot matrix printers.	1	D *	
110.2.16	PRINTER RIBBON FOR A4 PRINTER	1	D *	
110.2.17	PRINTER PAPER, PERFORATED, A4 folded, perforated white paper for the printer, size A4, about 2000 single sheets.			

Item	Description	Quant.	Use	Illustration
110.2.18	DOT MATRIX PRINTER, A3 with draft, near letter quality (NLQ) and graphics modes of printing; paper size A3, parallel/serial interface; pin paper feed; friction feed; programmable line spacing; character size in a draft mode not less than 9 x 9 matrix and in NLQ mode not less than 18 x 18 matrix. Complete with: - printer cable - detachable tractor unit for continuous perforated paper feed - detachable sheet paper feed attachment - ten ribbons - 2000 sheets A4 of perforated folded paper - operation and service manuals. NOTE: Project should specify microcomputer model and its technical data when ordering dot matrix printers.	1	D *	
110.2.19	RIBBON FOR A3 PRINTER	1	D *	
110.2.20	PRINTER PAPER, PERFORATED, A3 folded, perforated white paper for the printer, size A3, about 2000 single sheets.			

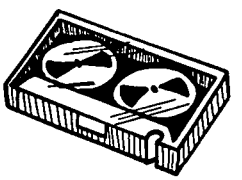
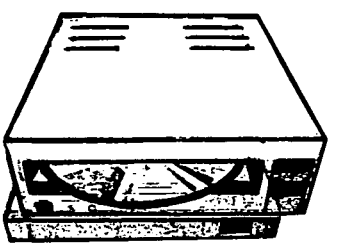
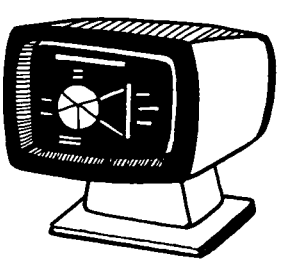
Item	Description	Quant.	Use	Illustration
110.2.21	PLOTTER, A4 six colours, long-life ball point, fibre-tip and ceramic pens; serial/parallel interface; support for Hewlett-Packard graphics language; for plotting on plain paper and on overhead transparencies. Complete with: - software package including high quality character sets - five sets of colour markers - operation and service manuals. NOTE: project should specify microcomputer model and its technical data when ordering plotters.	1	D *	
110.2.22	PLOTTER, A3 six colours, long life ball point, fiber-tip and ceramic pens; serial/parallel interface, support for Hewlett-Packard Graphics language; for plotting on plain paper and on overhead transparencies. Complete with: - software package including high quality character sets - five sets of colour markers - operation and service manuals. NOTE: project should specify microcomputer model and its technical data when ordering plotters.	1	D *	
110.2.22A	COLOUR MARKERS SET for plotters, set of different colours.	1	D *	

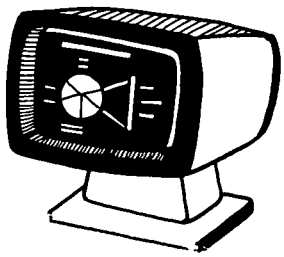
Item	Description	Quant.	Use	Illustration
110.2.23	SINGLE FLOPPY DISK DRIVE, 5.25 INCH external, complete with: - disk controller - operation and service manuals. NOTE: project should specify microcomputer model and its technical data when ordering floppy disk drives.	1	D *	
110.2.24	DOUBLE FLOPPY DISK DRIVE, 5.25 INCH external, complete with: - disk controller - operation and service manuals. NOTE: project should specify microcomputer model and its technical data when ordering floppy disk drives.	1	D *	
110.2.25	FLOPPY DISKS, 5.25 INCH for microcomputers; double sided, double density, certified and tested; 40 tracks per side; pack of 10.	16	D *	
110.2.26	FLOPPY DISKS, 5.25 INCH double-sided, ultra high density for AT microcomputers, certified and tested, pack of 10.	16	D *	

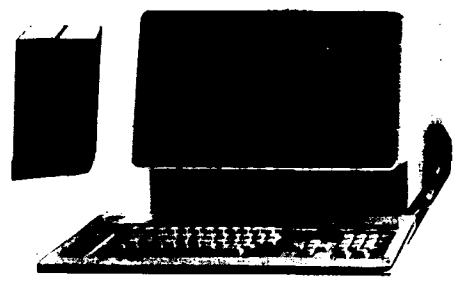
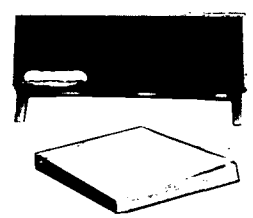
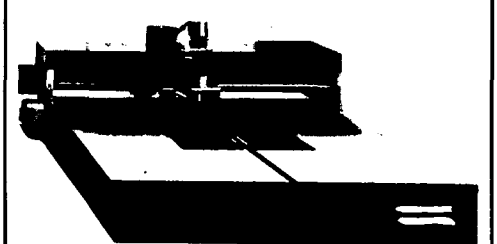
Item	Description	Quant.	Use	Illustration
110.2.27	STORAGE BOX FOR 5.25 INCH DISKS storage capacity 10 disks.	16	D *	
110.2.28	DISKS, 3.5 INCH for microcomputers, double-sided, double density, double track 135 TPI, certified and tested, pack of 10.	16	D *	
110.2.29	STORAGE BOX FOR 3.5 INCH DISKS storage capacity 10-20 disks.	16	D *	
110.2.30	HARD DISK, EXTERNAL complete with: - controller - expansion unit - operation and service manuals.	1	D *	
110.2.31	TAPE STREAMER a hard disk back up facility Complete with: - power supply - software - operation and service manuals.	1	D *	

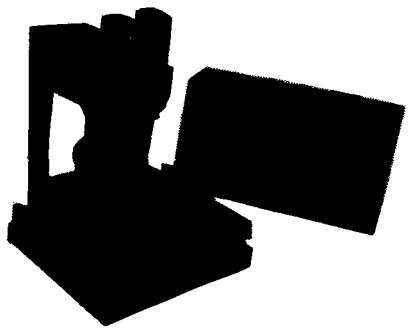
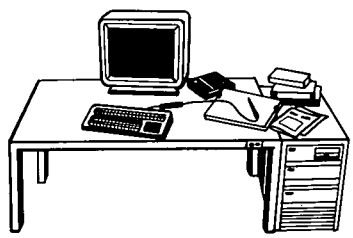
Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

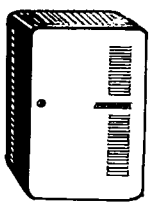
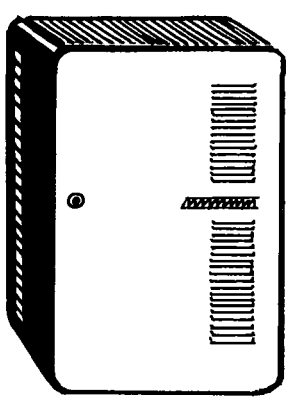
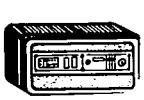
Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

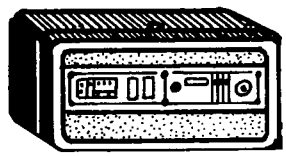
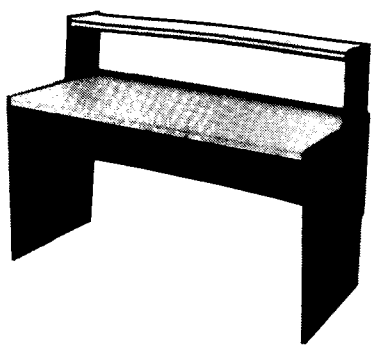
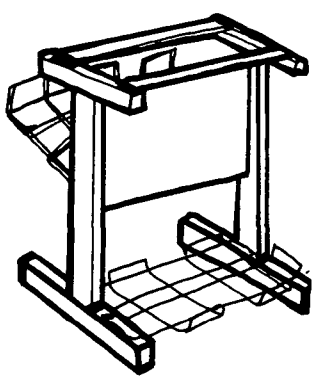
Item	Description	Quant.	Use	Illustration
110.2.31A	STORAGE CASSETTE for storage of streamer tape. NOTE: In a request for hard disk, disk drive for optical disk and tape streamer, the model needed and all micro-computer technical data should be given along with the required capacity.	1	D *	
110.2.32	DISK DRIVE FOR COMPACT OPTICAL DISK complete with: - power supply - interface - operation and service manuals.	1	D *	
110.2.33	COMPACT OPTICAL DISK write once, read mostly (worm); capacity approx. 100 MB; for permanent data storage and reading.	1	D *	
110.2.34	VIDEO DISPLAY, MONOCHROME approximate resolution 720 x 340. complete with: - connecting cable - operation and service manuals.	1	D *	

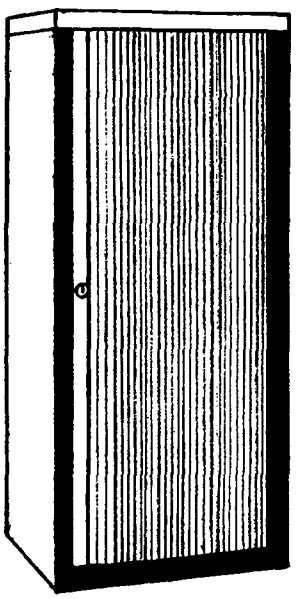
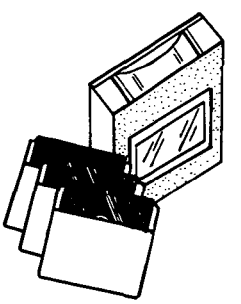
Item	Description	Quant.	Use	Illustration
110.2.35	VIDEO DISPLAY, COLOUR, RGB complete with: - connecting cable - operation and service manuals. NOTE: when ordering video displays, the project should specify screen dimension(s), model and technical data of microcomputer(s).	1	D *	

Item	Description	Quant.	Use	Illustration
110.2.36	COMPUTER AIDED PCB DESIGN AND MANUFACTURING SYSTEM for training in preparation of drawings, schematic and circuit diagrams and manufacturing experimental or master printed circuit boards. Complete with: - microcomputer (if not already available at the project) with common application software packages (Word Processing, Electronic Spreadsheet, Database, Basic) - printer - plotter - microprocessor controlled interface for engraving device - special engraving device (similar to plotter principle of operation) with set of cutters for engraving the circuit diagrams on copper clad boards; working space approximately 350 mm x 350 mm - two sets of cutters for engraving device - set of a special Computer Aided Design, Engineering and Manufacturing software to include circuit design, verification and realisation - two sets of a comprehensive courseware - operation and service documentation. The system may also include a special furniture. NOTE: If a microcomputer is available, the project request must contain precise technical data of the system in order to decide about the possibility of its use in the computer aided PCB design and manufacturing system.	1	D *	  

Item	Description	Quant.	Use	Illustration
110.2.37	CNC MACHINE SYSTEM, 3D computer numerically controlled desktop machine for practical study in programming and in an operation. The system should provide programmed milling and drilling in lightweight materials. Three axis (x, y, z) control system; standard ISO software format; linear and circular interpolation; automatic return to datum point. Approx. data: - x-y table movement: 100 mm - z(axis) spindle movement: 20-25 mm - approx. spindle motor power: 80-100 W - max. drill size: 3 mm - table and spindle movement by three stepping motors (one on each axis) - accuracy: not less than 0.25 mm Complete with: - microcomputer (if not already availale at the project) with common application software packages (Word Processing, Electronic spreadsheet, Database, Basic) - printer - plotter - interface - CNC software - power supplies - two sets of a comprehensive courseware - set of drills and endmills - set of recommended accessories and spares to cover possible loss during two years of operation - programming, operation and service manuals. The system may also include a a special furniture NOTE: If a microcomputer is available, the project request must contain its precise technical data necessary to determine the interface and the software.	1	D *	 

Item	Description	Quant.	Use	Illustration
110.2.38	LINE VOLTAGE CONDITIONER, 400 VA for microprocessor based systems and other sensitive to spikes equipment. The conditioner should provide spikes free AC stabilized voltage supply and also contain a filter to protect the equipment against conducted radio frequency interference. Input voltage instability + or - 10 %, output voltage variation + or - 2% Approximate maximum load 400 VA Complete with operation and service manuals.	1	A D E F I *	
110.2.39	LINE VOLTAGE CONDITIONER, 800 VA for microprocessor based systems and other sensitive to spikes equipment. The conditioner should provide spikes free AC stabilised voltage supply and also contain a filter to protect the equipment against conducted radio frequency interference. Input voltage instability + or - 10%, output voltage variation + or - 2% Approximate maximum load 800 VA Complete with operation and service manuals.	1	A D E F I *	
110.2.40	UNINTERRUPTIBLE POWER SUPPLY, 250 VA power backup system with set of maintenance free batteries for microcomputers and peripherals; to ensure continuity of AC supply for about 20 minutes after power failure; to provide enough time for data saving, etc., or for initiation of local emergency power system. Battery life about five years, AC power output 250 VA, Complete with operation instructions and service manual.	1	A D E F I *	

Item	Description	Quant.	Use	Illustration
110.2.41	UNINTERRUPTIBLE POWER SUPPLY, 500 VA power backup system with set of maintenance free batteries for microcomputers and peripherals; to ensure continuity of AC supply for about 20 minutes after power failure; to provide enough time for data saving, etc., or for initiation of local emergency power system. Battery life about five years, AC power output 500 VA. Complete with operation instructions and service manual.	1	A D E F I *	
110.2.42	COMPUTER DESK to accommodate a microcomputer and a VDU. The desk should consist of two independent areas. One intended for a microcomputer and a VDU (approx. size D.500 mm x W.700 mm) and the second for a keyboard (approx. size D.350 x W.700). There should be a possibility for adjusting heights of both areas for optimum visibility and ease of use. The desk top areas must be either of plastic or of wood. The desk should be on castors.	1	D *	
110.2.43	PRINTER TABLE to accommodate a large variety of printers. Complete with a paper storage shelf and a paper collection basket. The work surface should be adjustable. Work area about 600 x 800 mm Shelf about 500 x 700 mm Paper collection basket about 450 mm x 330 mm x 150 mm	1	D *	

Item	Description	Quant.	Use	Illustration
110.2.44	PERSONAL COMPUTER CABINET mobile, lockable, with levelling screws, ventilated and equipped with, at least, four power sockets with power cable of about three metres long to enable operation of the microcomputer system directly from the cabinet as well as for storage at least of central processing unit, VDU, printer and/or plotter, system documentation and software. Approx. specifications: - minimum overall dimensions: 75 x 50 x 160 cm - minimum four shelves/platforms two of which must be of telescopic type; the shelves should not be fixed and should permit height rearrangements in about 40mm steps - curtain sliding and lockable door - document holder, tiltable with clamping fixtures, line indicator, approx. size 30 x 40 cm.	1	D *	
110.2.45	FLOPPY DISK DRIVE CLEANING KIT for use with 5 1/4 inch, single and double sided disk drives.	1	D *	
110.2.46	COMPUTER CLEANING SOLVENT for cleaning all delicate computer mechanisms. It should be safe on computer heads magnetic tapes, floppy disks, tape mechanisms, springs, heads and readers, harmless to plastics, non-flammable, safe on line terminals, in aerosol cans of about 300 to 400 ml.	1	D *	

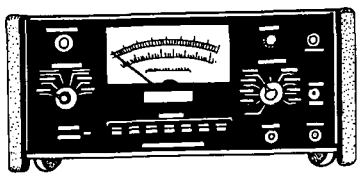
Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

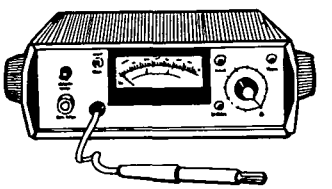
Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

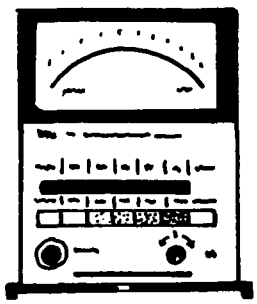
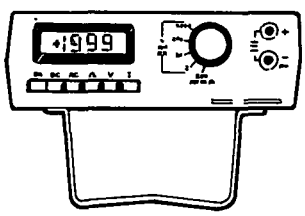
SECTION 3 TEST AND MEASUREMENT INSTRUMENTS

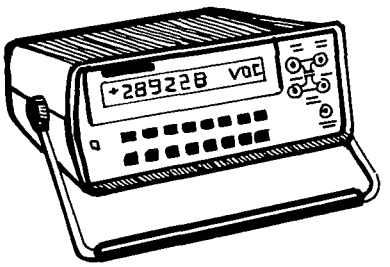
This section describes the specifications for test and measurement instruments used in fundamental electronics, analog and digital electronics, industrial electronics and electronic instrumentation.

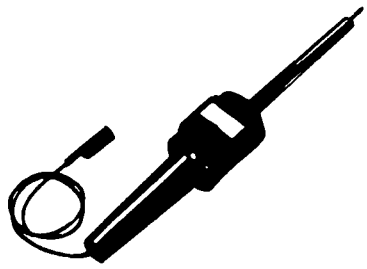
These test and measuring instruments may also be used in communication circuity but the section does not specifically include communication measuring techniques. Specifications of various accurate power supplies associated with electronics and communications are available in this section.

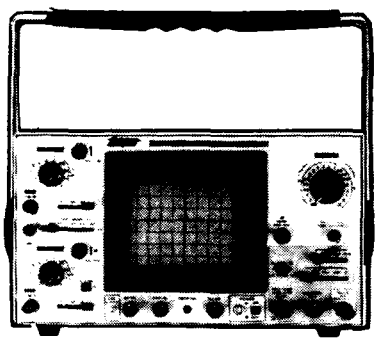
Item	Description	Quant.	Use	Illustration
110.3.1	ANALOG GENERAL PURPOSE AVOMETER for tests in electronic circuits. Approx. specifications: - DC ranges: 100 mV to at least 300V 50 micro A to 10 A - DC sensitivity: not less than 20 k Ohm/Volt - DC accuracy: not less than 1 % - AC ranges: 3 V to at least 300 V 10 mA to 10 A - AC accuracy: not less than 2 % - resistance ranges: 2 k Ohm to 20 M Ohm - Accuracy: not less than 3 % Complete with: - two sets of batteries - carrying case - operation and service manual	16	E *	
110.3.2	ANALOG ELECTRONIC AC/DC MULTIMETER for measurements in electronic circuits. Frequency range DC, 20 Hz to 200 kHz. Approx. specifications: DC voltage measurements: - 10 mV to at least 300 V - sensitivity 100 micro V - input resistance 10 M Ohm - accuracy 1 % DC current measurements: - 1 mA to at least 10 A - sensitivity 10 micro A - voltage drop 100 mV to 300 mV - accuracy 1.5 % AC voltage measurements: - 10 mV to at least 300 V - sensitivity 100 micro V - input impedance 10 M Ohm/120 pF - accuracy 1.5% f.s.d at 50 Hz - frequency range 20 Hz - 200 kHz - corresponding dB scale AC current measurements: - 1 mA to at least 10 A - sensitivity 10 micro A - voltage drop 100 mV to 300 mV - frequency range 10 Hz - 1k Hz	16	E *	

Item	Description	Quant.	Use	Illustration
	Resistance measurements: - 10 Ohm to 100 M Ohm - sensitivity 0.1 Ohm - Accuracy 1.5 % to 5 % f.s.d depending on the range The multimeter should have shut down or fuse protection. Power source: standard batteries Complete with: - measuring leads - set of spare fuses - set of batteries - operation and service manuals			
110.3.3	ANALOG AC MILLIVOLTMETER, 12 MHZ for measurements in electronic circuits. Approx. specifications: - frequency range: not less than 2 Hz to 12 MHz - measuring range: not less than 0 - 1 mV to 0 - 300 V - dB scale: - 80 dB to + 52 dB - input impedance: 1 M Ohm/40 pF - accuracy: 1% f.s.d + 1% of reading - AC and DC outputs - overload protected. Complete with: - measuring cable - set of batteries (if battery operated) - power cable (if mains operated) - operation and service manuals.	2	E	

Item	Description	Quant.	Use	Illustration
110.3.4	ANALOG DC MICROVOLTMETER for measuring in electronic circuits. Approx. specifications: - measuring ranges: 0-10 micro Volt to 0 - 300 V - sensitivity: 1 micro Volt - Accuracy: 1 % f.s.d. + 1 % of reading - input resistance: from 1 MOhm up to 30 mV range to not less than 100 M Ohm on 1 V range and higher DC output - overload protected Complete with: - measuring cable - high tension probe - set of batteries (if battery operated) - power cable (if mains operated) - operation and service manuals.	2	E	
110.3.5	DIGITAL RMS MULTIMETER, DC-20 MHZ for measurements in electronic circuits. Approx. specifications: - 4 1/2 digits display - autoranging - measuring functions: AC,DC, AC+DC - AC frequency range: 10 Hz to 20 MHz - AC voltage range: 50 micro Volt to 300 Volt - DC voltage range: 1 micro Volt to 300 Volt - accuracy: 0.1 % +/- 1 digit - resolution: 1 micro Volt - polarity display for DC - input impedance: 10 M Ohm/40 pF Complete with: - measuring cables - power cable - operation and service manuals.	2	E	

Item	Description	Quant.	Use	Illustration
110.3.6	DIGITAL RMS AND PEAK MULTIMETER for measurements in electronic circuits. Approx. specifications: - 5 1/2 digit display, autoranging automatic polarity display - measuring functions: AC (RMS) AC (peak); DC, AC + DC and resistance measurements - frequency range: not less than 100 KHz - AC/DC voltage ranges: 0-200 mV to not less than 0-600 V - resolution at the lowest range: 1 micro Volt - peak voltage range: not less than 1000 V - accuracy in AC and DC voltage measurements: 0.01 % +/- 1 digit - AC, DC and AC + DC current ranges: 2 micro Ampere to 2 A - resistance measurements by 2 and four-wire methods - resolution with 4 wire method: 1 milli Ohm - resistance measuring ranges: 0-200 Ohm to approx. 0-2 GOhm - all ranges should be overload protected Complete with: - mains cable - set of test leads - shielded measuring cable - four-wire measuring cable - operation and service manuals.	2	E	

Item	Description	Quant.	Use	Illustration
110.3.7	HIGH VOLTAGE METER, 40 kV a self-contained high voltage probe with an integral indicating meter for measurement of positive DC voltage up to 40 kV in video display monitor high tension low power circuits. Approx. specifications: - voltage range 0 to 40kV graduation - scale graduation: at least in 2 kV steps - sensitivity: 20 kOhm/V - accuracy: +/- 3 % f.s.d. Complete with: - earth connection clip - instruction manual.	2	E	

Item	Description	Quant.	Use	Illustration
110.3.8	DUAL TRACE OSCILLOSCOPE, 15 MHz for general purpose laboratory work and experiments with electronic circuits. Approx. (minimum) specifications: - screen area: 8 cm x 10 cm - accuracy: +/- 3 % or better - availability of the internal calibrating voltage - AC or AC and DC battery pack operation Vertical axis (Y): - bandwidth: 0 - 15 MHz - sensitivity: 2 mV/div to 10 V/div in calibrated steps, in 1-2-5 sequence - input impedance: 1 MOhm/30 pF - trigger sources: internal and external, - trigger slope: + or - - display modes: CHA, CHB, alternate, Chopped, Added - input coupling: AC, DC, O Horizontal axis (X): - bandwith: 0 - 1 MHz - time base modes: auto, free-run triggered - display modes: time base, X-Y operation with X deflection via YB input - deflection coefficients: 2 mV/div to 10 V/div in calibrated steps in 1-2-5 sequence - time coefficients: 0.25/div to 0.5 micros/div - accuracy: +/- 3 % or better Complete with: - contrast filter - graticule - set of recommended measuring probes - BNC to banana plug adapter - viewing hood - operating and service manuals.	8	E	

Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

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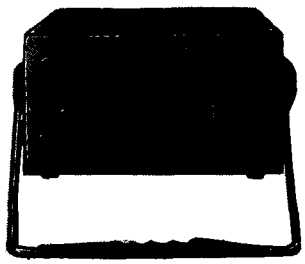
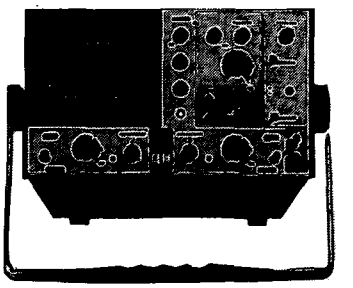
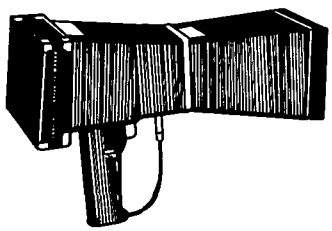
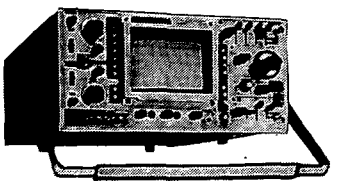
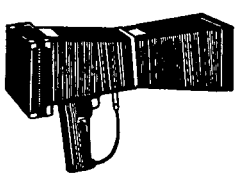
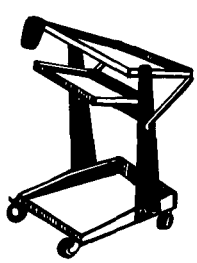
*Basic item

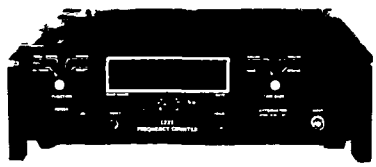
Item	Description	Quant.	Use	Illustration
110.3.9	DUAL TRACE OSCILLOSCOPE, 50-75 MHz compact field and laboratory oscilloscope. Approx. (minimum) specifications: - screen area: 8 cm x 10 cm - accuracy: not less than 3 % - main and delayed time base, external signal triggering - trigger view facility - availability of an internal calibrating voltage - Z-modulation - AC and DC battery pack operation. Vertical axis (Y): - band width: 0 - 50 - 75 MHz - sensitivity: 2 mV/div to 10 V/div in 1-2-5 calibrated sequence with continuous control between steps - input impedance: 1 MOhm/20-30 pF - display modes: CHA, CHB, CHA and CHB chopped, CHA and CHB alternate, CHA and CHB added, trigger view only, trigger view with CHA and CHB alternate, trigger view with CHA and CHB chopped, CHA and CHB inverted. Horizontal axis (X): - horizontal deflection from main time base, delayed time base or from an external signal - main time base coefficients: 0.5 s/div to 50 ns/div in 1-2-5 sequence; continuous control between steps - horizontal amplifier response: 0 - 100 kHz - delayed time base coefficients: 1 ms/div - 50 ns/div in calibrated steps, 1-2-5 sequence; uncalibrated continuous control between steps - sweep delay: continuously calibrated between 0 and 10 x main time base setting. Complete with: - two battery packs - contrast filter - set of recommended measuring probes - BNC to banana adapter - operating and service manuals.	2	E	

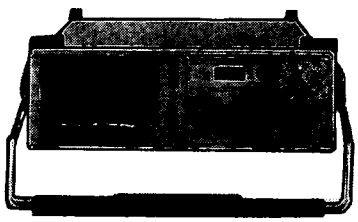
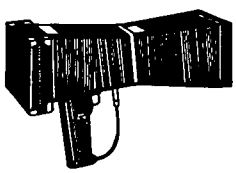
Item	Description	Quant.	Use	Illustration
110.3.10	DIGITAL STORAGE OSCILLOSCOPE, 25 MHz for advanced experiments in electronic circuits. The instrument may be used as a conventional two channel oscilloscope or in a digital storage mode and replay. Approx. (minimum) specifications: - screen area: 8 cm x 10 cm - bandwidth: direct display mode in digital storage mode not less than 10 MHz - accuracy: +/- 3 % or better - availability of internal calibrating voltage - possibility to compare live signal with a signal previously stored in the memory - analog and digital outputs - time windows (approx. 2 ms to 50 s) for single events - peak value detection Vertical axis: - two identical channels - sensitivity: 1-2 mV/div to 5-10 mV/div - accuracy: +/- 3% or better in calibrated positions - input impedance: 1 MOhm/30pF - maximum input voltage: 400 VDC or 400 V peak AC - display modes: CHA, CHB, Alternate, Added, Inverted Triggering: - trigger sources: internal, external, manual - trigger slope: + or - - adjustable manual control range Horizontal axis: - frequency response: 0 to 1 MHz - time coefficients: 0.5 s/div to 100 ns/div in 1-2-5 sequence; uncalibrated continuous control between steps - Accuracy: +/- 3 % or better Digital facilities: - memory size: 4096 x 8 bits - timebase: 0.1 micro s/div to 5 s/div	1	E	

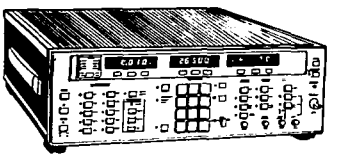
Item	Description	Quant.	Use	Illustration
	Complete with: - contrast filter - recommended set of measuring probes - recommended set of accessories - viewing hood - BNC to banana plug adaptor - operating and service manuals.			
110.3.10A	OSCILLOSCOPE CAMERA to suit digital storage oscilloscope, 25 MHz with accessories and operation manual.	1	E	

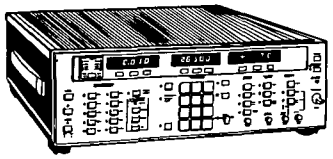
Item	Description	Quant.	Use	Illustration
110.3.11	FOUR-CHANNEL MULTIDISPLAY OSCILLOSCOPE for solving timing problems in digital electronics. Simultaneous display of signals should ensure realtime analysis both on component and system level. Approx. specifications: - screen area: 8 cm x 10 cm - internal graticule - four channels to show signal relationships in time - multi-source triggering - two timebases (main and delayed) - alternative timebase mode (simultaneous run of both timebases) - accuracy: 3% or better - availability of calibrating facilities - 'Z' modulation. Vertical axis (Y): - frequency response: DC to 35 - 100 MHz - deflection coefficients: 2 mV/div to 5 V/div in calibrated steps 1-2-5 sequence; uncalibrated continuous control between steps - input impedance: 1 MOhm/20 pF - display modes: CHA, CHB, CHC or CHD, CHA + CHB, CHC + CHD, trigger view, multiple display chopped or alternate; CHA, CHB, CHC and CHD may be inverted - maximum input voltage 400 VDC or peak AC - signal visible delay 15 ns. Horizontal axis (X) - frequency response: DC - 2 MHz - display modes: main. timebase, delayed timebase, main timebase intensified by delayed timebase, alternate (simultaneous display) - measuring accuracy: +/- 3 % - main timebase modes: auto, triggered and single shot - main timebase coefficients approx.: 1 s/div to 50 ns/div in calibrated steps, in 1-2-5 sequence; uncalibrated continuous control between steps.	1	E	

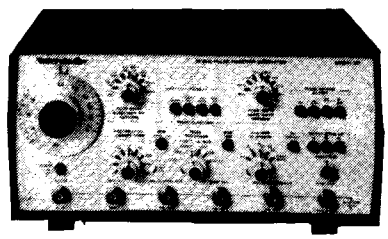
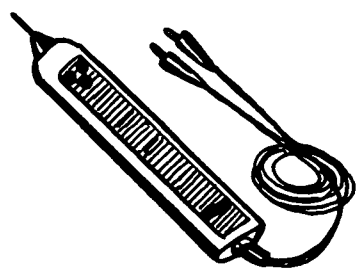
Item	Description	Quant.	Use	Illustration
	- main timebase trigger sources: internal A, B, C, D composite, time, external - slope: + or - - maximum input voltage: 400 VDC or peak AC - delayed timebase modes: start after the delay time or after delay time by the first trigger pulse. - delayed timebase triggering sources: internal and external - delayed timebase coefficients approx. 0.5 s/div to 50 ns/div in calibrated steps, in 1-2-5 sequence, uncalibrated continuous control between steps - continuous calibrated sweep delay between 0 and 10x main timebase setting. Complete with: - contrast filter - recommended set of measuring probes - recommended set of accessories - viewing hood - BNC to banana plug adapter - operating and service manuals.			
110.3.11A	OSCILLOSCOPE CAMERA to suit four-channel multidisplay oscilloscope with accessories and operation manual.	1	E	
110.3.12	OSCILLOSCOPE TROLLEY	1	E	

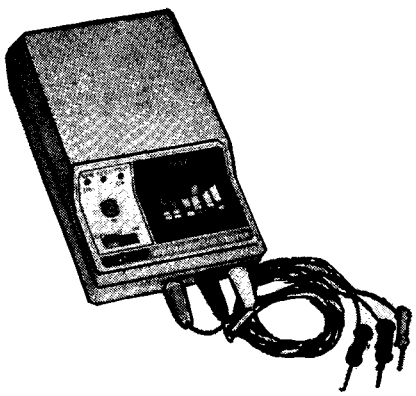
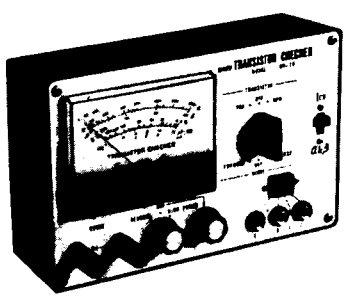
Item	Description	Quant.	Use	Illustration
110.3.13	COUNTER, 40 MHz for measurements of frequency, pulse width, period and period average. Approx. (minimum) specifications: - frequency range: 10 Hz to 40 MHz - period: 0.5 micro s to 100 ms - minimum input voltage: 50 mV to 20 MHz and 100 mV to 40 MHz (sine), 200 mV (pulse) - display: 8 digits - frequency standard: cristal oscillator 10 MHz - input impedance: 1 MOhm/60 pF - accuracy: +/- 1 digit +/- frequency standard error. Complete with: - BNC to banana adapter - recommended set of measuring probes - recommended set of accessories - operation and service manuals.	1	E	

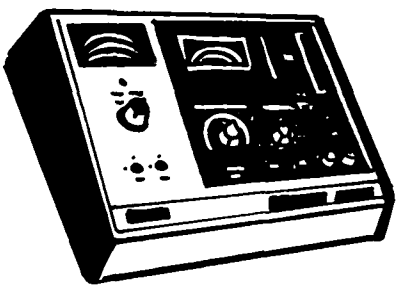
Item	Description	Quant.	Use	Illustration
110.3.14	SPECTRUM ANALYSER, 100 MHz for measuring amplitude and frequency of sinusoidal components of the electric signal of any shape. Approx. specifications: - frequency range: 30 Hz to 100 MHz - frequency measuring: by built-in electronic counter - amplitude measuring: from graticule scale - sweep modes: automatic and manual - sweep speed: 100 ms to 100 s in 1-2-5 sequence - filter bandwith: narrow (5 Hz, 50 Hz), normal (500 Hz, 5000 Hz) and wide (50 KHz) - digital storage system of spectral information - build-in frequency calibrator 10 MHz +/- 20 Hz - build-in or seperate tracking generator - display range: 100 dB - input impedance: 1 MOhm/30 pF 600 Ohm, 50 Ohm, selectable. Complete with: - set of recommended connecting cables, measuring probes and attenuator(s) - viewing hood - set of recommended accessories and spares - set of recommended adapter(s) (BNC to banana plug, etc) and plugs - operation and service manuals.	1	E	
110.3.14A	CAMERA FOR SPECTRUM ANALYSER complete with mounting accessories and operation manual.	1	E	

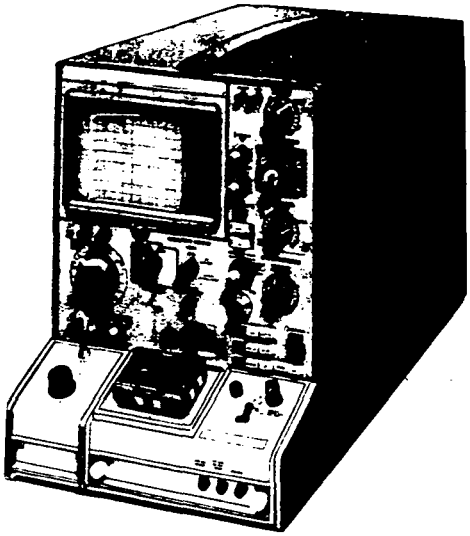
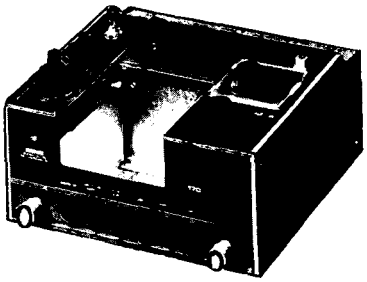
Item	Description	Quant.	Use	Illustration
110.3.15	SWEEP FUNCTION GENERATOR, 2 MHZ Approx. specifications: - frequency range: 0.01 Hz - 2 MHz 3 1/2 digit frequency and output level display - maximum setting error: 3 % +/- 1 digit - max. output voltage: 20 Vpp and 10 Vpp for pulse, continuously adjustable - output impedance: 50 Ohm and 600 Ohm, switchable - output signal forms: sine, square, triangle, positive and negative pulses with or without DC offset - duty cycle: 50% fixed and continuously variable from 10% to 90% - operating modes: single pulse, burst, sweep, normal - sweep: internal, external, linear and logarithmic - sweep period should be continuously adjustable from 5ms to 100s - sweeping modes: single-shot and continuous with possibility of triggerring either manually or from external source - independent setting of start and stop frequencies - hold and reset buttons - sine distortion: < 0.5 % (10 mHz to 200 kHz); < 2 % (200 KHz to 2 MHz) - triangle wave linearity: > 99 % - square wave rise and fall time: < 60 ns - start phase: +/- 90 % continuously adjustable. Complete with: - supply cable - measuring cables - operation and service manuals.	2	D E	

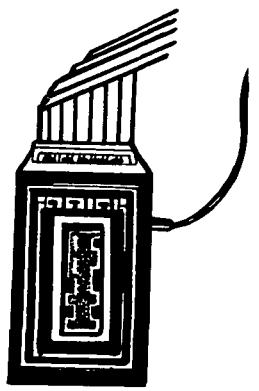
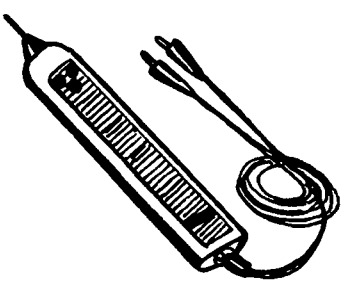
Item	Description	Quant.	Use	Illustration
110.3.16	SWEEP FUNCTION GENERATOR, 20 MHZ Approx. specifications: - frequency range: 0.01 Hz - 20 MHz 3 1/2 digit frequency and output level display - maximum setting error: 5 % +/- 1 digit - max. output voltage: 20 Vpp and 10 Vpp for pulse, continuously adjustable - output impedance: 50 Ohm and 600 Ohm switchable - output signal forms: sine, square, triangle, positive and negative pulses with or without DC offset - duty cycle: 50% fixed and continuously variable from 10% to 90% - operating modes: single pulse, burst, sweep, normal, - sweep: linear internal and external - sweep period should be continuously adjustable from 5ms to 100s - sweeping modes: single-shot and continuous with possibility of triggerring either manually or from external source - independent setting of start and stop frequencies - hold and reset buttons - internal AM: adjustable between 0 % and 100 % - internal FM: adjustable between 0 % and +/- 10 % - modulation frequency range: 0.01 Hz to 20 KHz - sine distortion: < 0.5 % (10 mHz to 200 kHz); < 3 % (200 KHz to 20 MHz) - stepped and variable attenuation: over 60 dB range - triangle wave linearity: > 99 % - square wave rise and fall time: < 20 ns - start phase: +/- 90% continuously adjustable. Complete with: - supply cable - measuring cables - operation and service manuals.	1	D E	

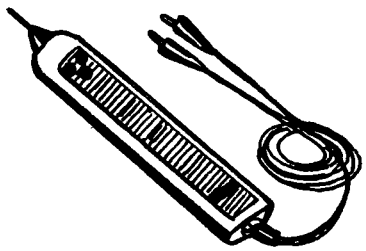
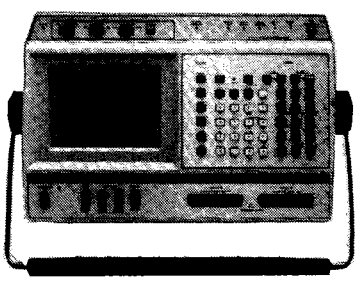
Item	Description	Quant.	Use	Illustration
110.3.17	PULSE GENERATOR, 10 MHz for experiments with electronic circuits (TTL, HNIL and MOS applications). Approx. specifications: - frequency range: 0.1 Hz to 10 MHz - outputs: one from +1V to +15V into 50 Ohm load continuously adjustable and two fixed TTL levels - source impedance: 50 Ohm and 300 Ohm, selectable - signal form: rectangular pulse positive polarity, fall and rise time about 10 ns - duty factor: from about 50% to nearly 100 % - pulse duration: from 50 ns to 500 ms continuously variable - operating modes: continuous and single shot - baseline offset: continuously variable from 0 to + 2 V - jitter: less than 0.1 %. Complete with: - supply cable - measuring cables - operating and service manuals.	2	D E	
110.3.18	LOGIC PULSER TTL/C-MOS for diagnosing faults in logic circuits operating from 5V to 15V DC supply. Equipped with 3 positions switch to select either a simple narrow pulse, or train of 4 pulses or continuous train of pulses by pressing the output button. Approx. specifications: - pulse width into C-MOS approx. 1.8 - 2 micro s and into TTL 0.8 micro s - max. output current: 0.5 A - connexions: via integral lead and miniature crocodile clips Complete with: - sprung hook - insulating tips - IC test adaptors - operation manual.	8	D E	

Item	Description	Quant.	Use	Illustration
110.3.19	IN-CIRCUIT SEMICONDUCTOR TESTER battery powered, self-checking, for locating faulty discret semiconductor devices without unsoldering in most circuit configurations. The GO/NO-GO tester should provide in-circuit test of following devices: - signal and middle power transistors - signal and low power rectifier diodes - low power thyristors (for switching action without the need for any gating signal from the equipment under test). Complete with: - leads, prods - carrying case - two sets of batteries - operating and service manuals.	2	E	
110.3.20	TRANSISTOR TESTER battery operated, self-checking facility, for measuring DC gain of PNP and NPN signal and middle power transistors. Possibility to test signal and middle power diodes and thyristors. Approx. specifications: - measuring range of Hfe: up to 2000 - collector test current range: 1, 10 ,100 micro A, 1 and 10 mA - accuracy: +/- 3 %. Complete with: - leads, prods - two set of batteries - operating and service manuals.	2	E	

Item	Description	Quant.	Use	Illustration
110.3.21	FIELD EFFECT TRANSISTOR TESTER battery operated, self-checking facility, for evaluation of parameters of the majority of junctions and Mos depletion type field effect transistors under conditions relevant to actual circuit design and device operation. Approx. specifications: - source current (Is) preset values: 100 micro A, 300 micro A, 1 mA 3 mA and 10 mA - gate source voltage (Vgs): 1.2 V, 4 V and 12 V f.s.d - gate leakage current (Ig): 12 nA, 40 nA and 120 nA f.s.d. - drain current (Idss) at Vgs = 0: 4 mA, 12 mA and 40 mA f.s.d. - pinch-off voltage (Vp) at Is = 1 micro A: 1.2V, 4V and 12V f.s.d. - transconductunce gfs: 1.2 mmho, 4 mmho and 12 mmho f.s.d. - accuracy: +/- 3% of f.s.d. Complete with: - leads, prods - two sets of batteries - operating and service manuals.	1	E	

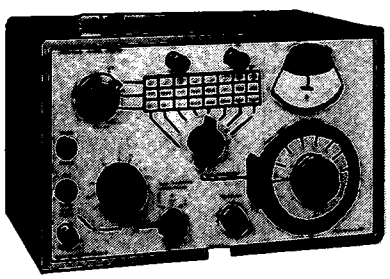
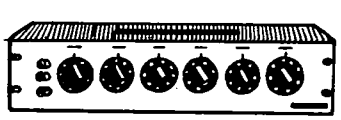
Item	Description	Quant.	Use	Illustration
110.3.22	LINEAR IC/SEMICONDUCTOR CURVE TRACER for comprehensive tests and comparison of device performance under given operating conditions. It may consist of curve tracer, standard (semiconductor) test fixture, linear IC test fixture, test cards, socket adapters, built-in power supplies, step generator, sweep generator, lead selection device and source resistances. Other configurations may be considered. The tracer should test semiconductors (PNP, NPN transistors, MOS FET, bipolar transistors, diodes, etc.) up to 100 W power, as well as operational amplifiers comparators, differential amplifiers voltage regulators. Complete with: - standard test fixture - IC test fixture - test cards - lead selection device - socket adapters - connecting cables - operating and service manuals. NOTE: Linear IC and semiconductor curve tracer is intended to deliver valuable performance data for accurate design, analysis and evaluation purposes. Therefore, it may be recommended for inclusion in equipment request for a design or research orientated project.	1	E	 

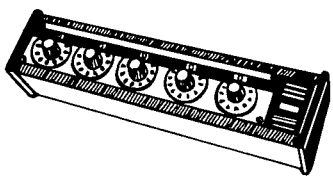
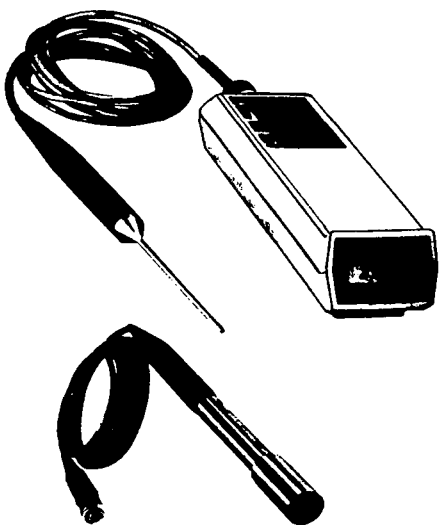
Item	Description	Quant.	Use	Illustration
110.3.23	DIGITAL IC TESTER for general functioning testing of the majority of C-MOS and TTL logic IC's; including standard TTL, LS, S, ALS, HC etc.; also for testing a wide range of interface and memory devices not less than up to 24-pin DIL. The tester should show on display pass/fail status. The test should be possible either by entry of the device type number or by automatic search and identification via its internal library or by both methods. The tester should be equipped with separate test sockets. Complete with: - comprehensive instruction manual - service manual.	2	D E	
110.3.24	TTL LOGIC PROBE for indicating the logic state, pin by pin, on any TTL or DTL circuit operating from a 5V supply. Approx. specifications: - indication of logic state: by a coloured L.E.D.'s - possibility of detecting single pulses down to 30 ns duration - operating supply voltage: from 5 to 15 V Complete with: - sprung hook and two insulating tips - operation instructions.	4	D E	

Item	Description	Quant.	Use	Illustration
110.3.25	C-MOS LOGIC PROBE for indicating the logic state of C-MOS circuity operating from a 5V to 15V supply. Approx. specifications: - indication of logic state by a coloured L.E.D's - possibility of detecting single pulses down to 100 ns - operating supply voltage 5V to 15V Complete with: - sprung hook and two insulating tips - operation instructions.	4	D E	
110.3.26	LOGIC ANALYSER, 100 MHz for timing and state analysis and for identification of faults in digital equipment. Approx. specifications: - data input: 16 channels - threshold: selective TTL, ECL, VAR (continuously adjustable) - self-test facility should be incorporated - clock source:internal or external - triggering: internal, external or manual - start source: automatic, external or manual - example memory format: 504 serial bits x 16 parallel channels - operating modes: sample, capture, compare, store and search - display modes: timing, state tables, mapping Complete with: - set of recommended probes - set of recommended spares - operation and service manuals.	2	D E	

Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

Item	Description	Quant.	Use	Illustration
110.3.27	DIGITAL LCR METER for measuring inductance (L), capacitance (C) and resistance (R). Mains or battery operated. Approx. specifications: - inductance measuring range: 2 mH to 200 H - accuracy: not less than +/- 2% +/- 1 digit up to 0.5 H, and not less than +/- 5% 1 digit between 0.5 H and up to 200 H - capacitance measuring range: 200 pF to 200 micro F - accuracy: not less than +/- 1% +/- 1 digit up to 0.5 micro F and less than +/- 2% +/- 1 digit between 0.5 micro F and up to 200 micro F - resistance measuring range: 20 Ohm to 20 MOhm - accuracy: not less than +/- 1% +/- 1 digit up to 1 MOhm and not less than +/- 5% up to the end of measuring range - display: not less than 3 1/2 digit - testing frequencies: not less than 2 (for example 100 Hz and 1 kHz). Complete with: - testing leads - 2 sets of batteries (if battery operated) - operation and service manuals.	2	A D E F I *	
110.3.28	DECADE RESISTANCE BOX for laboratory and educational use. Approx specifications: - resistance range: 0.01 Ohm to 1 M Ohm in 0.01 Ohm steps - residual resistance: less than 100 mOhm - accuracy in the range from 100 Ohm to 100 kOhm: not less than 0.1 % - power rating: 1W per resistor - maximum operating voltage:250 VDC.	8	E F I *	

Item	Description	Quant.	Use	Illustration
110.3.29	DECADE CAPACITANCE BOX for laboratory and educational use. Approx. specifications: - capacitance range: 100 pF to 10 micro F in 100 pF steps - residual capacitance: 50 pF max. - accuracy: +/- 1% +/- 5 pF - maximum operating voltage: 100 VDC or 100 Vpp AC.	8	E F I *	
110.3.30	DIGITAL THERMOMETER hand-held with wide temperature range but not less than from - 50 deg.C to + 200 deg.C, resolution 0.1 deg.C; battery operation, automatic cold junction compensation; Complete with: - surface temperature probe (with about 2m lead) for fast and accurate measurements of surface temperature of heat sinks transformers and other electronic components as well as radiators pipes etc.; probe tip dia. about 7 to 8 mm; overall length 200 to 250 mm; temperature range of a tip not less than of the main unit; time constant about 0.1s - two sets of batteries - instruction manual.	2	E	

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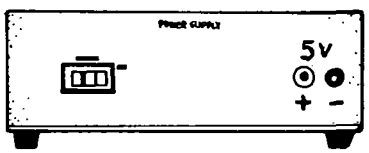
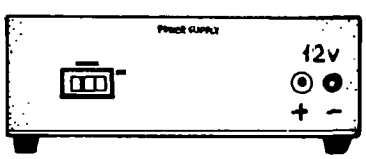
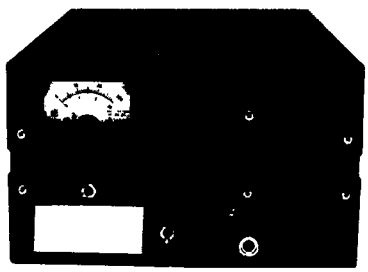
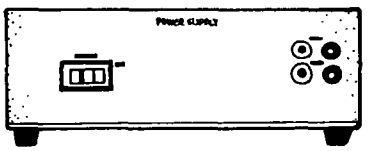
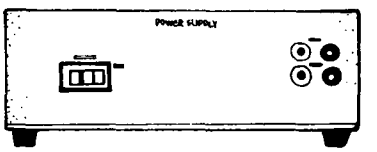
*Basic item

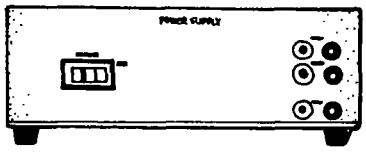
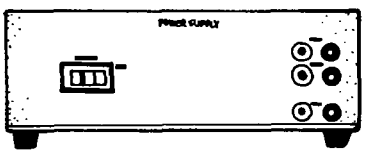
Item	Description	Quant.	Use	Illustration
110.3.31	FIXED DC POWER SUPPLY, 5 V for laboratory experiments and for different projects, utilizing semiconductors and integrated circuits. Short circuit protected output. Approx. specifications: - stability against +/- 10% mains variation: better than 0.1% - ripple voltage:less than 2 mV rms - ripple current: less than 0.5 mA rms - output data: voltage 5V; current 2 A. Complete with operation and service manuals.	8	A D F E F I *	
110.3.32	FIXED DC POWER SUPPLY, 12 V for laboratory experiments and different projects, utilizing semiconductors and integrated circuits. Short circuit protected output. Approx. specifications: - stability against +/- 10% mains variation: better than 0.1% - ripple voltage: less than 2 mV rms - ripple current: less than 0.5 mA rms - output data: voltage: 12 V; current: 2 A. Complete with operation and service manuals.	8	A D F E F I *	

Item	Description	Quant.	Use	Illustration
110.3.33	ADJUSTABLE DC POWER SUPPLY, 0-20V for laboratory experiments and for different projects, utilizing semiconductors and integrated circuits. Output should have constant current operation mode. Approx. specifications: - stability against +/- 10 % mains variation: better than 0.05% - ripple voltage: less than 1.5 mV rms - ripple current: less than 0.5 mA rms - output ranges: 0-20 V, 0-2 A. The unit should be equipped with voltmeter and ammetter to enable continuous monitoring of voltage and current. Complete with operation and service manuals.	8	A D F E F I *	
110.3.34	PROGRAMMABLE POWER SUPPLY 0-40V, 3A for laboratory experiments and for different projects, utilizing semiconductors and integrated circuits. Approx. specifications: - one voltage and current programmable output; programming steps 10 mV and 10 mA (1 mA in 1 A range) - maximum voltage output: 39.99 V - maximum constant current output: 2.99 A and 0.999 A - stability against +/- 10 % mains variation: better than 0.1 % - ripple voltage: less than 2 mV rms - ripple current:less than 0.5mA rms The unit should be equipped with digital or analog voltmeter and ammeter. Complete with operation and service manual.	8	A D F E F I *	

Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

Item	Description	Quant.	Use	Illustration
110.3.35	FIXED DC POWER SUPPLY 2x5V for laboratory experiments and different projects, utilizing semiconductors and integrated circuits. Two fixed, galvanically separated and short circuit protected outputs. Approx. specifications: - stability against +/- 10% mains variation: better than 0.1% - ripple voltage: less than 2 mVrms - ripple current: less than 0.5 mA rms - output 2 x 12 V, 2A (each output). Complete with operation and service manuals.	2	A D E	
110.3.36	FIXED DC POWER SUPPLY 2X12V for laboratory experiments and different projects, utilizing semiconductors and integrated circuits. Two fixed, galvanically separated and short circuit protected outputs. Approx. specifications: - stability against +/- 10% mains variation: better than 0.1%; - ripple voltage: less than 2 mVrms - ripple current less than 0.5 mA rms; - output: 2 x 12V, 2A (each output). Complete with operation and service manuals.	2	A D E	

Item	Description	Quant.	Use	Illustration
110.3.37	FIXED DC POWER SUPPLY, 5V, 2x12V for laboratory experiments and for different projects, utilizing semiconductors and integrated circuits. Three fixed, galvanically separated and short circuit protected outputs. Approx. specifications: - stability against +/- 10% mains variation: better than 0.1% - ripple voltage:less than 2 mV rms - ripple current: less than 0.5 mA rms - output ranges: voltage — current 5 V — 2 A 12 V — 2 A 12 V — 2 A Complete with operation and service manuals.	2	A D E	
110.3.38	FIXED DC POWER SUPPLY, 2x5V, 12V for laboratory experiments and different projects, utilizing semiconductors and integrated circuits. Three fixed, galvanically separated and short circuit protected outputs. Approx. specifications: - stability against +/- 10% mains variation: better than 0.1% - ripple voltage:less than 2 mV rms - ripple current: less than 0.5 mA rms - output ranges: voltage — current 5 V — 2 A 5 V — 2 A 12 V — 2 A Complete with operation and service manuals.	2	A D E	

Item	Description	Quant.	Use	Illustration
110.3.39	ADJUSTABLE DC POWER SUPPLY, 2x20V for laboratory experiments and for different projects, utilizing semiconductors and integrated circuits. Two continuously adjustable voltage and current outputs. All outputs should be galvanically separated and have constant current operation mode. Approx. specifications: - stability against +/- 10 % mains variation better than 0.05% - ripple voltage: less than 1.5 mV rms - ripple current: less than 0.5 mA rms - output ranges: 2 x (0-20)V, 2A (each output) The unit should be equipped with two voltammeters to enable continous monitoring of voltage or current of each output. Complete with operation and service manuals.	2	A D E I	

Item	Description	Quant.	Use	Illustration
110.3.40	ADJUSTABLE DUAL POWER SUPPLY 2x35V for laboratory experiments and for different projects utilizing semiconductors and integrated circuits. Approx. specifications: - two galvanically separated and continuously adjustable voltage and current outputs with constant current operation mode - stability against +/- 10 % mains variation: better than 0.05 % - output resistance: less than 0.005 Ohm - overload protected - voltage output ranges: 0 - 30 V - current output ranges: 0.04A (min. current setting) to 2 A - preferable unit should have switched ranges: 0 to 5 V, 5 to 10V, 10V to 15V, 20V to 25V and 25 V to 30 V, 30 V to 35 V with continuous variable control on each range - equipped with reset button - accuracy of voltage and current settings: 2 % f.s.d. - ripple voltage: less than 1 mVpp Complete with: - recommended spares - operation and service manuals	2	A D E I	

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*Basic item

SECTION 4 PRINTED CIRCUITS REALISATION AND RELATED MATERIAL

The present section offers two systems. Item 110.4.1 represents a printed circuit realisation trainer based on manufacturing technology, utilizing ultra-violet exposure apparatus and presensitized boards.

The trainer (110.4.1) along with consumables kit (110.4.2) is a self-contained system with all necessary mechanical, electrical, chemical facilities and consumables. The trainer is intended both for training as well as for small series production purposes.

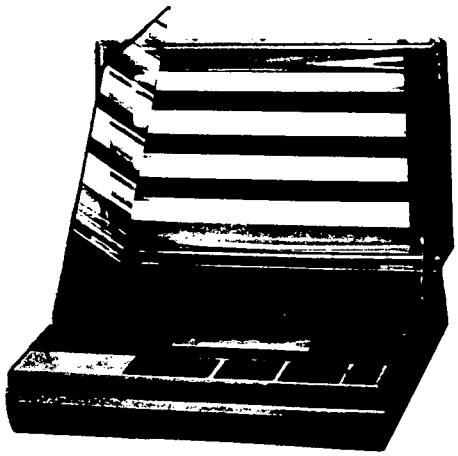
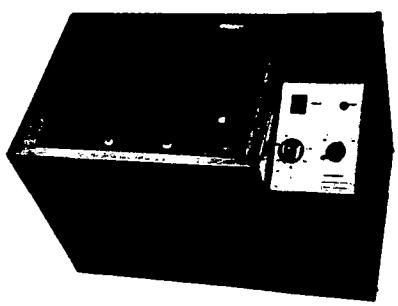
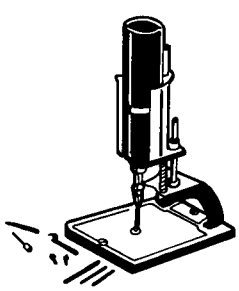
The specifications below 110.4.2 are for training in manufacturing of p.c.b. s utilizing usual etch resist transfers, etch resist ink and processing. The first priority protective items are also listed.

Equipment guide list

List number: 10

Technical field: Electronics

Date of issue
November 1986

Item	Description	Quant.	Use	Illustration
110.4.1	PRINTED CIRCUIT REALIZATION TRAINER a complete set of equipment of an ultra-violet exposure type for training in production of printed circuits as well as for small series production purposes. the trainer shall consist of: - ultra-violet exposure unit with useful surface area approx. 400 x 250 mm - printed circuits etching machine - high accuracy, high speed drill with stand for printed circuits drilling - spindle capacity: 0.2 mm to 3.5 4.0 mm - spindle speed: 16000-20000 rpm - minisaw for cutting printed circuit boards, both of phenolic laminated and in glass-epoxy hard fibre, synthetic, iron and wood. The saw may be of a belt type Complete with: - two sets of UV exposure tubes - five belts for a microsaw (if of a belt driven type) - two sets of training manuals on printed circuit realization subject - operation and service manuals for UV exposure unit, printed circuit etching machine high speed drill and for minisaw	2	A D E I	  

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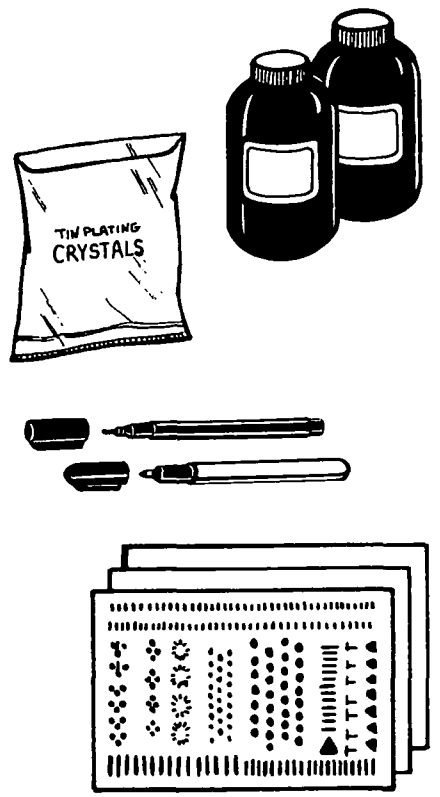
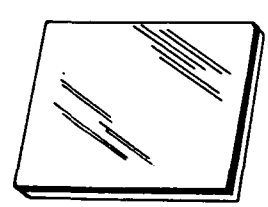
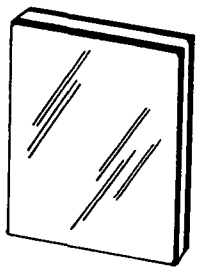
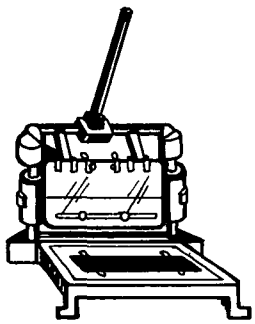
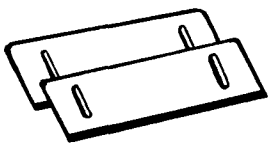
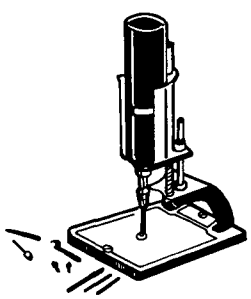
Item	Description	Quant.	Use	Illustration
110.4.2	PRINTED CIRCUITS CONSUMABLES KIT consisting of all necessary materials to produce printed circuits with photo etching method for 16 students. The kit should include: - transparent acetate sheets - set of symbols, ribbons, slots, alphabet - knives for master design - phenolic material boards about 1.6 mm thick, presensitized, single and double-sided of various sizes - glass-epoxy boards about 1.6 mm thick, presensitized, single and double-sided of various sizes - developer in bottles for development of presensitized boards - stripping liquid bottles - set of tungsten carbide drills: 0.8 - 0.9 - 1.0 - 1.2 - 1.5 mm - set of cropping mills - quartz fibre brushes for circuit cleaning - protective self-welding varnish - plastic pliers - acid-proof gloves of different but normal sizes	16	A D E I	
110.4.3	COPPER-CLAD BOARD, SINGLE-SIDED epoxy-glass, overall thickness 1.6mm; for fabrication of printed circuit boards. Approx. size: 305 mm x 457 mm Pack of 10.	16	E F I	

Item	Description	Quant.	Use	Illustration
110.4.4	COPPER-CLAD BOARD, DOUBLE-SIDED epoxy-glass, overall thickness 1.6 mm; for fabrication of printed circuit boards. Approx. size: 305 mm x 457 mm Pack of 10.	16	E F I	
110.4.5	P.C.B. GUILLOTINE hand operated, bench mounting guillotine designed to cut plain and copper laminated boards, both resin bonded paper and epoxy glass type; it may also be used to cut paper, card, plastic and light aluminium. Approx. specifications: - cutting width: 400 - 420 mm - cutting capacity: boards - 2 mm aluminium 1.5 mm, brass 1mm. Complete with five sets of replacement blades.	1	E F I	
110.4.5A	REPLACEMENT BLADES for P.C.B. guillotine; set of two.	8	E F I	
110.4.6	P.C.B. PRECISION DRILL SET equipped with 12 V DC 100-120 W motor, low shaft eccentricity, shaft lock button. No-load speed: 16000 rpm Chuck capacity: 0.6 mm to 3.0-3.2 mm Complete with: - power supply - drill stand	2	E F I	

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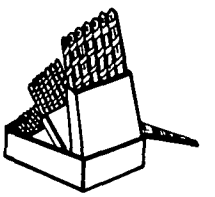
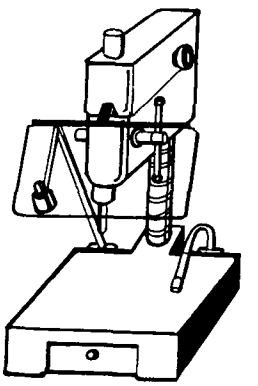
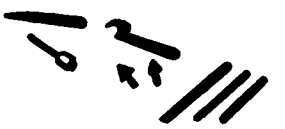
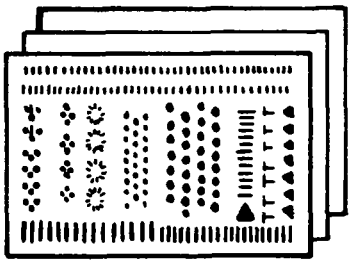
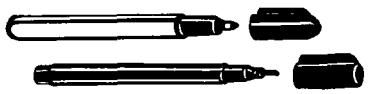
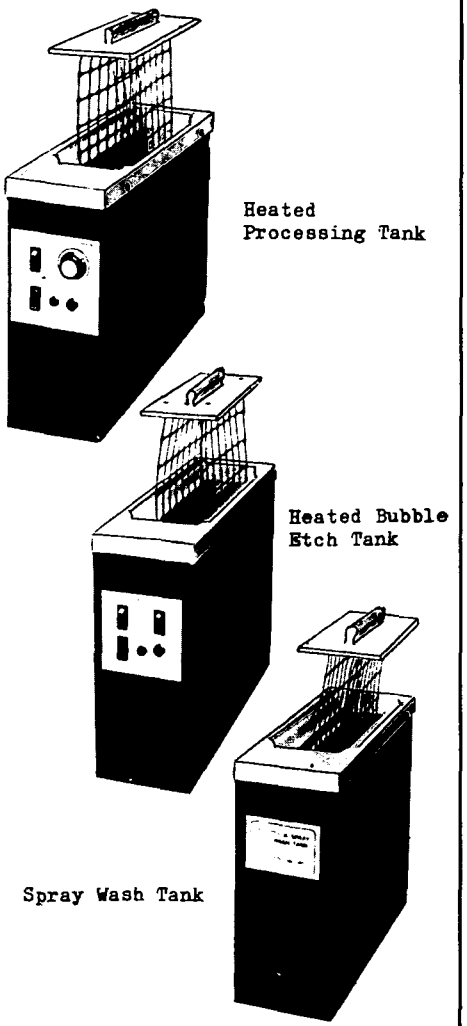
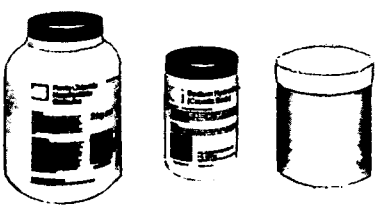
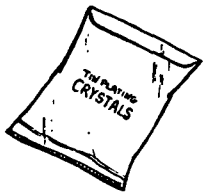
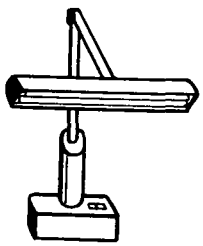
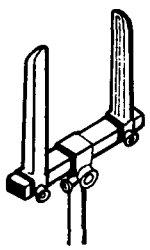
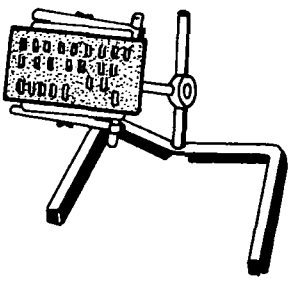
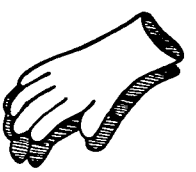
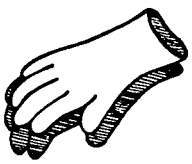
Item	Description	Quant.	Use	Illustration
110.4.6A	P.C.B HSS DRILL SET for drilling printed board cards; Approx. specifications: drill dia.: 0.4 - 0.6 - 0.8 - 0.9 1.0 - 1.3 - 1.6 - 1.7 and 2.0 mm, each one	16	E F I	
110.4.7	P.C.B. DRILLING MACHINE AC powered, for accurate drilling of printed circuits boards and routing work. Approx. specifications: - vacuum suction facility for removing drilling swarf - high speed drilling motor (15000-20000 rpm in no-load condition) - precision 3 jaw chuck: 0.4-3.0 mm capacity - plastic guard - illumination of working area - approx. daylight under chuck 40 mm - sliding stops - maximum vertical chuck movement about 30-35 mm Complete with: - instruction manual - service manual.	2	E F I	
110.4.8	DRILL ACCESSORIES SET for P.C.B drill consisting of approx. 16 mm dia. saw and mandrel, felt polishers and arrow head reamers with common shank approx. dia. 2.4 mm.	2	E F I	

Item	Description	Quant.	Use	Illustration
110.4.9	ETCH RESIST P.C.B. TRANSFERS, SET consisting of: - round pad O.D. 3.96mm-4 sheets - round pad O.D. 2.54mm-4 sheets - d.i.l. pads for 14 and 16 pin packages-4 sheets - transistor pads in large and small groups-4 sheets - edge plugs (2 pitches)-2 sheets - right-angled pattern suitable for mounting 37- 25, 15 and 9 way connectors-2 sheets, - p.c.b. mounting connector plugs with 10, 20, 26, 34, 40 and 50 ways-2 sheets, - straight track in widths of 0-.6, 1.6 and 3 mm, 2 sheets - symbols-3 sheets.	16	E F I	
110.4.10	ETCH RESIST INK PEN designed mainly for marking cladboards. May be also used for rough drawing of circuits directly on boards.	16	E F I	

Item	Description	Quant.	Use	Illustration
110.4.11	P.C.B. MODULAR PREPARATION SYSTEM consisting of three tanks: processing, etching and washing; made from plastic material; for maximum board sizes 225 x 250 mm; tank capacity approx. 4l. The system is intended both for training and for prototype development of single and double-sided printed circuit boards. It may also be used for small production purposes. The heated processing tank should incorporate thermostatically controlled heating element adjustable over the range 10-60 deg.C The p.c.b. etch tank should incorporate fixed temperature setting (40-45 deg.C) thermostatically controlled as well as a bubble agitator. The spray wash tank is for rinsing processing chemicals from the surfaces of boards between states to prevent contamination of subsequent solutions and after the final process. Complete with: - holding baskets, 3 pcs - drain fittings, 3 pcs - approx. 1 m drain pipes, 3 pcs	2	E F I	
110.4.12	PRINTED CIRCUITS PROCESSING CHEMICALS ferric chloride hexahydrate crystals suitable for copper-clad circuit boards. Pack of 2 kg.	8	E F I	

Item	Description	Quant.	Use	Illustration
110.4.13	P.C.B. TIN-PLATING CRYSTALS to produce a plated solderable finish on printed circuit copper track. Preparation of working solution should be by simple addition of water. Pack for 4 l of solution. Complete with instruction sheet.	8	E F I	
110.4.14	ELECTRICALLY CONDUCTIVE PAINT a silver-loaded conductive paint for producing and repairing p.c.b. track. It may also be used to paint-on an electrical screen or to make electrical connections to non-solderable surfaces. Touch-dry time approx. 15 min and completely dry in 12 hrs. Low volume resistivity of about 0.001 Ohm. In about 3 to 5 ml bottles.	4	E F I	
110.4.15	BENCH LIGHT, FLUORESCENT with universal bench mounting clamp. Counter-balanced floating arm action with multi-position joints; 2 standard 15W, 450 x 26 mm fluorescent tubes. Complete with 10 15W replacement tubes.	16	E F I	
110.4.16	P.C.B. RETAINER/HOLDER with a clamp max. size 70 mm.	16	E F I	

Item	Description	Quant.	Use	Illustration
110.4.17	P.C.B. INSPECTION GLASS 8x magnification lens. Complete with integral graticule indicating metric divisions 0.2 mm, enabling detailed measurements to be made.	2	E F I	
110.4.18	PRINTED CIRCUIT WORK-FRAME for holding p.c.b. during assembly. Spring loaded board retention bars. Should be suitable for construction, repair and small production runs. Approx. working area 220 x 270 mm.	16	E F I	
110.4.19	SAFETY SPECTACLES shall be expandable to protect against most eye hazards. Shall fit over prescription glasses.	16	E F I	
110.4.20A	RUBBER PROTECTIVE GLOVES, SMALL for work with p.c.b. processing chemicals as well as ensure protection against a variety of substances including most acids, alkalis, detergents, oils, fats and solvents. The gloves should retain high tensile strength and elastic properties within their lifetime.	16	E F I	

Item	Description	Quant.	Use	Illustration
110.4.20B	RUBBER PROTECTIVE GLOVES, MEDIUM for work with p.c.b. processing chemicals as well as ensure protection against a variety of substances including most acids, alkalis, detergents, oils, fats and solvents. The gloves should retain high tensile strength and elastic properties within their lifetime.	16	E F I	
110.4.20C	RUBBER PROTECTIVE GLOVES, LARGE for work with p.c.b. processing chemicals as well as ensure protection against a variety of substances including most acids, alkalis, detergents, oils, fats and solvents. The gloves should retain high tensile strength and elastic properties within their lifetime.	16	E F I	

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*Basic item

SECTION 5 MACHINES AND TOOLS

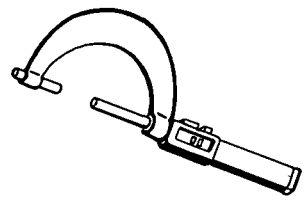
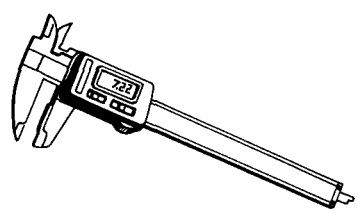
This section specifies a minimum of machines, tools and dimension measuring instruments which are necessary in electronic engineering technology for production and repair of electronic devices. If necessary, the user may obtain support utilizing specifications from related guides Nos. 9, 11 and from guides 1, 2, 3, 4, 6 and 15.

Equipment guide list

List number: 10

Technical field: Electronics

Date of issue
November 1986

Item	Description	Quant.	Use	Illustration
110.5.1	DIGITAL MICROMETER, 0-25 mm with high accuracy and resolution 0.001 mm. Should include traditional features such as spindle locking clamp, ratchet stop, vernier thimble scale and carbide tipped measuring faces, to ensure use of micrometer in a conventional manner in case of battery or electronic circuity failure. Approx. specifications: - thimble graduation: 0.01 mm - display accuracy: 0.001 mm - pre-setting to a required reference value - automatic power-off facility Complete with: - internally fitted battery - one spare battery - safe storage box - adjustable maintenance spanner - instructions manual	16	E F I	
110.5.2	DIGITAL CALIPER, 0-150 mm for accurate inside, outside depth and step measurements. Approx. specifications: - measuring range: 0 - 150 mm - resolution: 0.01 mm - automatic power-off facility - automatic wear compensation. Complete with: - safe storage box - fitted battery - one spare replacement battery - instructions sheet.	16	E F I	

Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

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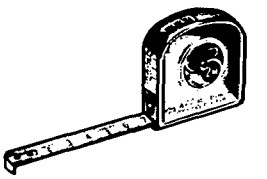
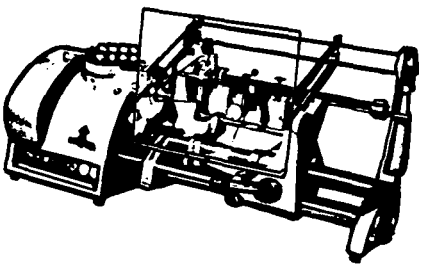
*Basic item

Item	Description	Quant.	Use	Illustration
110.5.3	RULER, 300 mm made from steel, metric.	16	E F I	
110.5.4	MEASURING TAPE, 3m made from steel, metric, scratch resistant epoxy coating, rust-proof, slide lock and automatic return.	16	E F I	
110.5.5	COIL WINDING MACHINE bench-mounted, power-driven, with clutch and brake built into the winding head, electro-magnetic traverse clutch system for setting winding length, wire pitch control system, winding speed control, five-figure turns counter with pre-set of automatic machine stop, designed for winding inductors, audio and mains transformers of small and medium power Approx. specifications: - wire range: 0.05 to 2.5 mm dia. - max. winding speed:250-5500 r.p.m in 9 speeds - coil dimensions: length 2-200 mm max. dia. 150 mm - machine control: hand or foot operated clutch - electric motor: about 0.5 kW Complete with: - reel carrier - essential accessories - operating and maintenance manuals	1	E F I	

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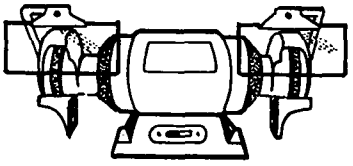
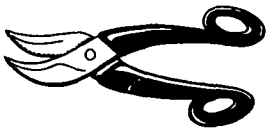
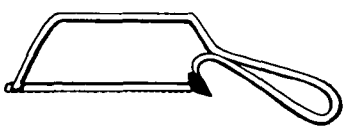
Item	Description	Quant.	Use	Illustration
110.5.6	BENCH GRINDER - 150 mm double-ended type with direct drive, totally enclosed motor with ball bearings, safety approved closed wheel guards and eye shields, adjustable tool rests, complete with control switch and six vitrified grinding wheels, three 36 grit and three 60 grit; operation manual. Approx. specifications: - dia. of wheel: 150 mm - width of wheel: 25 mm - distance between wheels: 325 mm - spindle speed: 3000 r.p.m - motor, 1-phase: 0.4 kW	1	E F I	
110.5.7	SHEARS, 190 mm general purpose, for cutting wires, metal shim, plastic, card, paper and fabrics; one blade serrated, with spring return and a safety catch to lock jaws closed.	16	E F I	
110.5.7A	SCRIBER - 175 mm with one straight and one right-angled point, knurled handle, hardened and ground. Approx. length: 175 mm	16	E F I	
110.5.8	JUNIOR HACKSAW, 230 mm adjustable tension, 150 mm long conventional hacksaw blades. Complete with 50 spare blades.	16	E F I	

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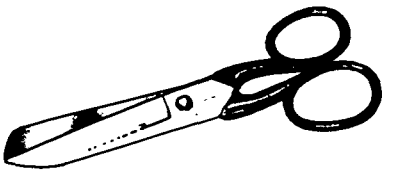
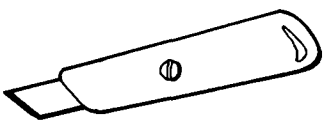
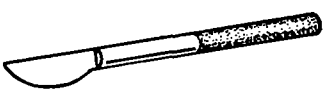
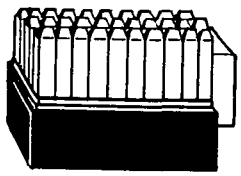
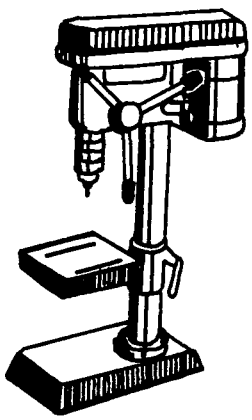
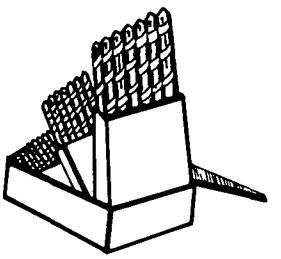
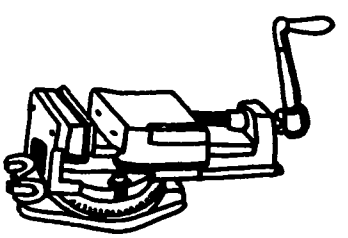
Item	Description	Quant.	Use	Illustration
110.5.8A	HACKSAW BLADES, 150 mm for junior hacksaw. Pack of 10 pcs.	16	E F I	
110.5.9	INDUSTRIAL SCISSORS, 210 mm general purpose; made from hardened carbon steel; cross over cutting action and bevelled blades. Approx. overall length: 210 mm	16	E F I	
110.5.10	TRIMMING KNIFE, 160 mm a retractable blade for cutting and scoring copper boards, plastics, etch transfers, drafting films, labels, etc. Approx. overall length 160 mm Complete with: - a set of five heavy duty blades stored in the handle - two sets of replacement blades	16	E F I	
110.5.11	SCALPEL, 140 mm with interchangeable blades. Complete with two sets of replacement blades Approx. overall length: 140 mm	16	E F I	
110.5.12	BALL PEIN HAMMER, 150 g	16	E F I	

Item	Description	Quant.	Use	Illustration
110.5.13	MARKING PUNCHES, ALPHA-NUMERICAL SET for permanent identification, marking of instrument panels, machine frames, tools etc. Consisting of alphabetical (A to Z and &) and numerical (0 to 9) set. Character height 3 mm; complete with boxes.	1	E F I	
110.5.14	AUTOMATIC CENTRE PUNCH, 120 mm	16	E F I	
110.5.15	BENCH DRILL PRESS, 6.5 mm for light engineering applications; it should ensure accurate drilling of printed card boards, electronic equipment housings and for similar activities. Spindle may be belt driven. Approx. specifications: - drill capacity: 0.8 mm to 6.5 mm - 5-6 spindle speeds in the range 800 rpm to 3500 rpm - lever operated manual feed: max. 40-45 mm - adjustable depth stop - max. chuck to base clearance: 150-180 mm - cast iron machined base plate Complete with: - two chucks with two keys - four belts, (if belt driven) - drill guard	1	E F I	

Item	Description	Quant.	Use	Illustration
110.5.15A	SET OF DRILLS, 0.8-6.5 mm, HSS for electronic workshop actitivies, consisting of: dia: 0.8 - 1.0 - 1.2 - 1.5 - 1.6 - 1.8 - 2.0 mm each 10 pcs dia: 2.1 - 2.3 - 2.5 - 2.6 - 3.0 - 3.2 - 3.3 - 3.5 - 3.7 - 4.0 - 4.1 - 4.2 - 4.5 - 4.8 - 5.0 - 5.1 - 5.5 - 6.0 - 6.5 mm each 5 pcs	4	E F I	
110.5.15B	PIN CHUCK to be supplied with three sizes of interchangeable jaws to ensure a drill shank capacity range of 0 to 2.5 mm dia. Chuck shank dia: max. 6 to 6.5 mm	2	E F I	
110.5.15C	SMALL MACHINE VICE for use in drilling and light milling operations. The vice should effectively grip round, square thin and irregular sections; for easy mounting or clamping on drill stands; jaws should be made of hardened steel and the base may be from cast iron. Approx. specifications: - jaw width 80 mm - jaw depth 30 mm - base area 150 x 150 mm	1	E F I	

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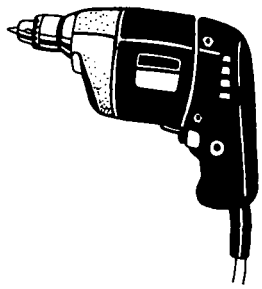
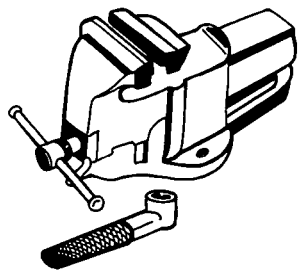
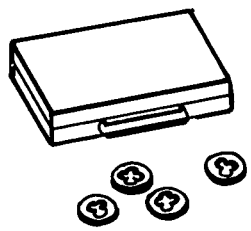
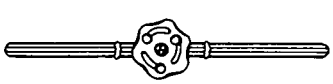
Equipment guide list

List number: 10

Technical field: Electronics

Date of issue
November 1986

Item	Description	Quant.	Use	Illustration
110.5.16	ELECTRIC HAND DRILL, 10 mm with continuous speed control, forward and reverse rotation. Maximum drilling capacity 10 mm. Drilling and hammer action. Complete with: - chuck key - drilling depth guide - instructions manual.	2	E F I	
110.5.17	G-CLAMP SWIVEL VICE Approx. specifications: - 360 deg.C swivel vice - jaw width about 60 mm - jaw opening about 40 mm - G-clamp throat max. size about 70 mm	8	E F I	
110.5.18	HAND HELD PIN VICE made from steel. - jaw width 20 mm - opening 8 mm - overall length about 125 mm	16	E F I	
110.5.19	HSS DIE SET ISO metric split form set consisting of the following: M2 - M2.5 - M3 - M3.5 - M4.0 - M5.	16	E F I	
110.5.20	DIE STOCK for ISO metric discs M2 to M5 with three setting screws.	16	E F I	

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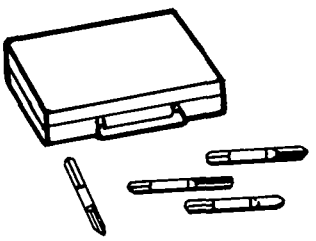
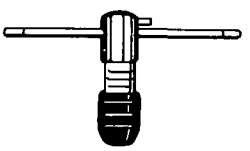
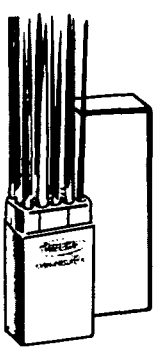
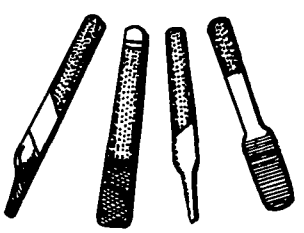
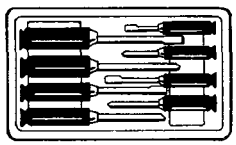
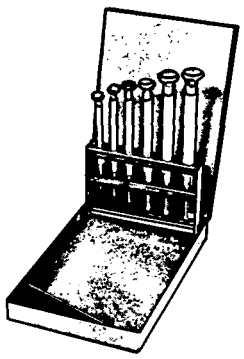
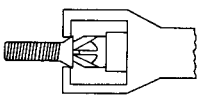
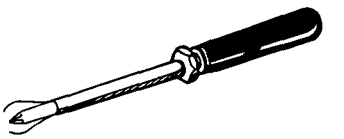
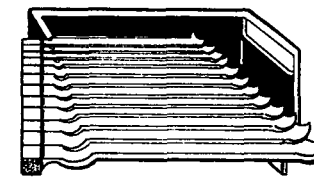
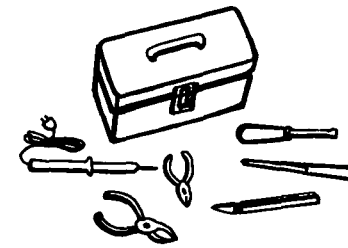
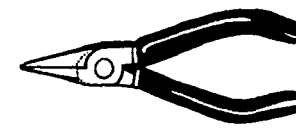
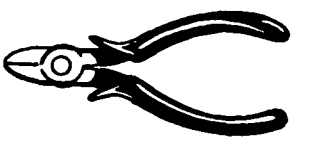
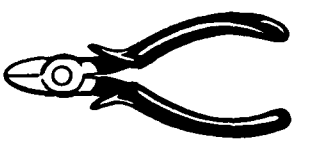
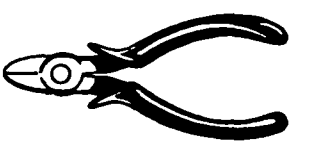
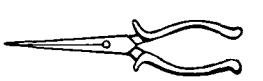
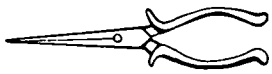
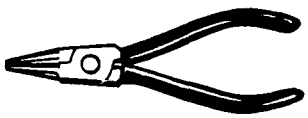
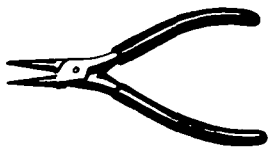
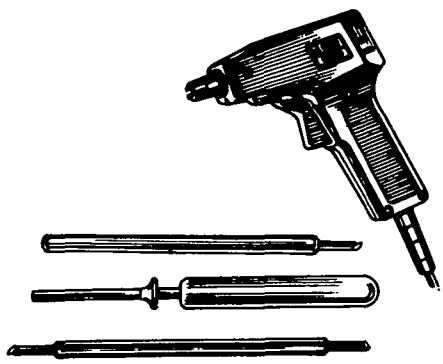
Item	Description	Quant.	Use	Illustration
110.5.21	HSS TAP SET for ISO metric straight flute ground thread taps set consisting of the following sizes: M2 - M2.5 - M3.0 - M3.5 - M4.0 - M5.0. Each size includes coarse and fine tap.	16	E F I	
110.5.22	TAP WRENCH chuck type. Jaw capacity of 2.8 mm to 5 mm. Complete with T-bar.	16	E F I	
110.5.23	NEEDLE FILE SET of six files (hand, square, warding, half-round, three-square and round) in plastic wallet. Approx. length: 140 mm Complete with handle.	16	E F I	
110.5.24	FILE SET hand files with plastic or wooden handles, for general use, double cut, 200 mm long, set consisting of 10 files: flat second cut, flat smooth cut, half-round second cut and smooth cut round second cut and smooth cut, square second cut and smooth cut, thin cut, second cut and smooth cut.	4	E F I	

Item	Description	Quant.	Use	Illustration
110.5.25	SCREWDRIVER SET consisting of four flat bed parallel tip sizes 3 mm - 4 mm - 5 mm and 8 mm and four crosshead (Phillips sizes) 0, 1, 2 and 3. Complete either with plastic wallet or with plastic box.	16	E F I	
110.5.26	JEWELLER'S SCREWDRIVER SET consisting of six parallel tip sizes 0.6 mm to 2.5 mm and four crosshead tip sizes 1.5 mm to 3 mm dia. Complete either with plastic wallet or with plastic box.	16		
110.5.27	TUNING SCREWDRIVER SET for timing cored coils, potentiometers, etc., all plastic; set comprising: parallel tip screwdrivers of three sizes approx. 2 mm x 0.4 mm 3 mm x 0.5 mm, 4 mm x 0.6 mm and crosshead tips of two sizes: No.1 and No.2.	16		
110.5.28	SCREW GRIPPING TOOL SET, PARALLEL TIP for gripping slotted head screws during location and extraction; the tool must be completely insulated along the shaft with integral finger grip. Screws should be held by their heads via a spring loaded sleeve trap ready for positioning and driving. The set should consist of following blade sizes: 2.5 mm - 3 mm - 4 mm - 5 mm and 6 mm.	16		 

Item	Description	Quant.	Use	Illustration
110.5.29	SCREW GRIPPING TOOL SET, PHILLIPS TIP for gripping crosshead screws during location and extraction; the tool must be completely insulated along the shaft with integral finger grip. Screws should be held by their heads via a spring loaded sleeve trap ready for positioning and driving. The set should consist of following blade sizes: 0, 1, 2 and 3.	16	E F I	
110.5.30	CLASP PICK-UP for picking up components and hardware from areas of difficult access; made from flexible tubing; maximum overall reach about 500-550 mm. The pick-up end of this tool should have the form of a pair of spring-loaded jaws; be controlled by a push button from the end of this tool. Max. jaw opening 15 mm.	16	E F I	
110.5.31	TWEEZERS SET four pcs, comprising straight point, curved point, reversed action and flat nose tweezers for precising work and electronic component handling. Tweezers should be from hard steel. Total length approx. 150 mm.	16	E F I	
110.5.32	MAGNETIC PICK-UP for picking up magnetic components and hardware from areas of difficult access; made from flexible tubing; maximum overall reach about 500-550 mm; to handle max. 500g weight.	16	E F I	

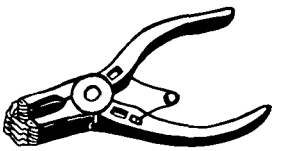
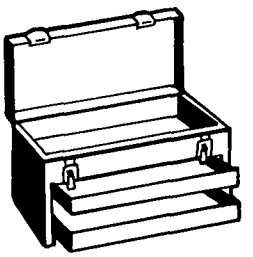
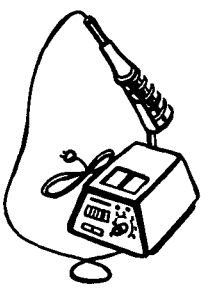
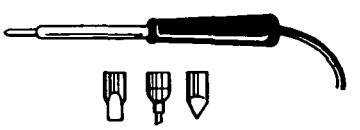
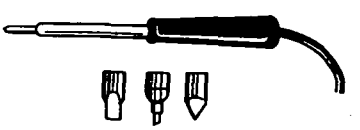
Item	Description	Quant.	Use	Illustration
110.5.33	NUT SPINNER SET seven pcs comprising sizes for the following nuts : M2 - M2.5 - M3 - M3.5 - M4 - M5 - M6.	2	E F I	
110.5.34	TOOL SET selection of high quality hand tools for electronic service works containing: - combination pliers - long nose pliers - side cutters - circlip pliers - wire stripper - box spanner kit - inspection mirror - tweezers - special scissors - Alan key set - offset screwdriver - screwdriver/voltage tester - clamping screwdriver (with screw holder) - selection of flat and Phillips bit screwdrivers with plastic handles. Complete set housed in case with appropriate compartments.	16	E F I	
110.5.35	FLAT NOSE PLIERS, 140 mm for assembly, forming, adjusting and maintenance in electronic and micro-mechanical trades. Approx. overall length: 140 mm	16	E F I	

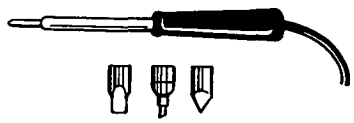
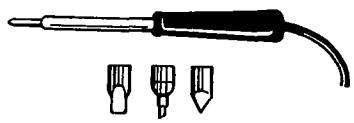
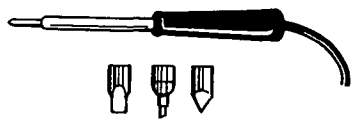
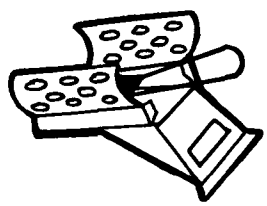
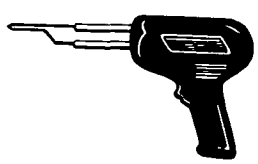
Item	Description	Quant.	Use	Illustration
110.5.36	UTILITY PLIERS, 150 mm small size, high quality slip joint, with serrated jaws and pipe grip. Made from hardened chrome-vanadium steel. Max. jaw opening 20 mm; five position selection Approx. overall length: 150 mm	16	E F I	
110.5.37	CUTTING PLIERS, 1.2 mm for intensive cutting of all types of wire, specially hard insulated copper up to 1.2 mm dia. approx. overall length 150 mm jaw length: about 20 mm	16	E F I	
110.5.38	CUTTING PLIERS, 0.8 mm for intensive cutting of all type of wire, specially hard insulated copper wire up to 0.8 mm dia. Approx. overall length 125 mm jaw length: about 16 mm	16	E F I	
110.5.39	CUTTING PLIERS, 0.5 mm for cutting of all types of wire, specially hard copper wire up to 0.5 mm dia. Approx. overall length: 110 mm	16	E F I	
110.5.40	NEEDLE NOSE PLIERS, EXTRA LONG straight jaws (about 50 mm long) Approx. overall length: 140 mm	16	E F I	

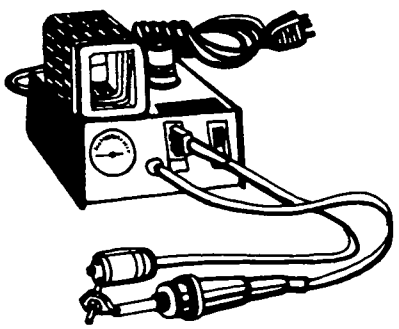
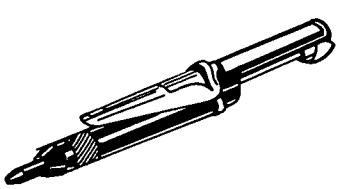
Item	Description	Quant.	Use	Illustration
110.5.41	NEEDLE NOSE PLIERS, STANDARD straight jaws (about 40 mm long); Approx. overall length: 140 mm	16	E F I	
110.5.42	NEEDLE NOSE ANGLED PLIERS, LONG jaws angled at 40 deg. to 45 deg. (about 30 mm long). Approx. overall length: 140 mm	16	E F I	
110.5.43	SHAPING PLIERS, 120 mm non-serrated jaws with chamfered inside edges for precise shaping of electronic components in position. Approx. overall length: 120 mm	16	E F I	
110.5.44	ROUND NOSE PLIERS, 120 mm for all wire shaping in the electronic and micro-mechanical fields. Overall length: 120 mm	16	E F I	
110.5.45	COMBINED WRAPPING TOOL comprising wire stripping, wrapping and unwrapping operations with 0.25 mm dia. insulated wires and 0.85 mm diagonal terminal pins. Complete with instruction sheet.	16	E F I	

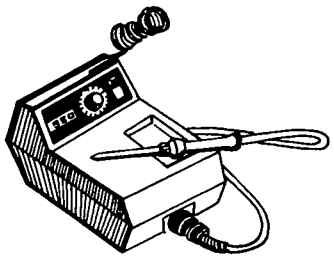
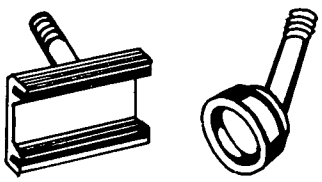
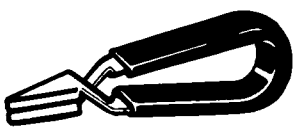
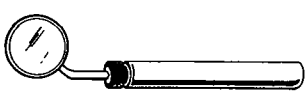
Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

Item	Description	Quant.	Use	Illustration
110.5.46	I.C. INSERTERS AND EXTRACTORS, SET general purpose, to simplify the insertion and extraction of d.i.l. packages up to 16 way. Set of two: one inserter and one extractor.	16	E F I	
110.5.47	TOOL BOX for storing trainee hand tools, four tray cautilever type. Approx. overall dimensions: L 470 mm x W 200 mm x H 230 mm.	16	E F I	
110.5.48	SOLDERING STATION with temperature control between approximately 120 and 420 deg.C; for 30-40 W low voltage soldering irons; spike free power control; antistatic earth lead for establishing guaranted local grounding; protection for MOS, C-MOS IC's. Complete with one 30W and one 40W soldering irons.	4	E F I	
110.5.48A	SOLDERING IRON, 30W low-voltage to suit a temperature controlled soldering station item 110.5.48. Complete with set of spare bits.	8	E F I	
110.5.48B	SOLDERING IRON, 40W low-voltage to suit a temperature controlled soldering station item 110.5.48. Complete with a set of replacement bits.	8	E F I	

Item	Description	Quant.	Use	Illustration
110.5.49	GENERAL PURPOSE SOLDERING IRON, 15W mains operation. Complete with a set of replacement bits.	16	E F I	
110.5.50	GENERAL PURPOSE SOLDERING IRON, 30W mains operation. Complete with a set of replacement bits.	16	E F I	
110.5.51	GENERAL PURPOSE SOLDERING IRON, 40W mains operation. Complete with a set of replacement bits.	16	E F I	
110.5.52	GENERAL PURPOSE SOLDERING IRON, 100W mains operation. Complete with a set of replacement bits.	2	E F I	
110.5.53	SOLDERING IRON STAND	16	E F I	
110.5.54	INSTANT SOLDERING GUN for fast heat application and soldering, should reach maximum tip temperature (about 350 deg.C) in about 10 seconds. Complete with: - five spare indicating lamps - five spare tips	2	E F I	

Item	Description	Quant.	Use	Illustration
110.5.55	DE-SOLDERING STATION for general purpose de-soldering including repetitive de-soldering in production environment. The station may be equipped, for example, with dry vane pump. Approx. specifications: - bit temperature continuously adjustable from about 80 deg.C to 450 deg.C - operational modes: vacuum and pressure - low level peak voltage at the de-solder tip (less than 20 mV) to ensure safe activity in MOS environment - vacuum rate at tip about 6 mm Hg - pressure rate up to 5 bar - approximate power of de-soldering station 100-110 W Complete with: - six de-soldering bits for example 0.6 mm, 0.9 mm and 1.5 mm (2 each) - set of cleaning brushes - set of filters - five solder collection facility - two replacement heating elements	1	E F I	
110.5.56	DE-SOLDERING TOOL standard, high suction single handed operation, push button release. Complete with: - two standard and two micro design replacement suction nozzles - two replacement sealing washers.	16	E F I	

Item	Description	Quant.	Use	Illustration
110.5.57	VARIABLE TEMPERATURE SOLDERING IRON a high quality, solid-state, thermostatically controlled soldering iron. Approx. specifications: - heating element about 50W - adjustable temperature range from 200 deg. to 400 deg. C - visual indication of on/off state.	2	E F I	
110.5.57A	I.C. DE-SOLDERING BITS SET pre-tinned, iron clad copper de-soldering bit for 14/16 d.i.l. packages and TO-99 cases, for use with variable temperature soldering iron 110.5.57. Each bit should be supplied with a shim.	4	E F I	
110.5.58	HEAT SINK to protect transistors and other temperature sensitive devices from excessive heat when soldering	16	E F I	
110.5.59	INSPECTION MIRROR Approx. specifications: - adjustable - approx. dia: 30 - 35 mm - overall length: about 300 mm	16	E F I	

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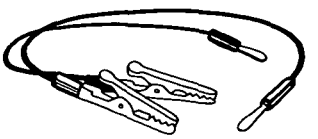
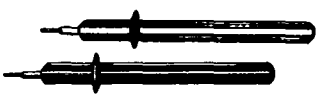
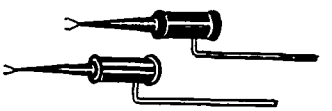
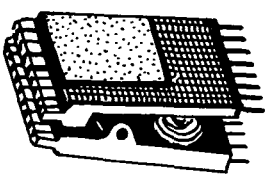
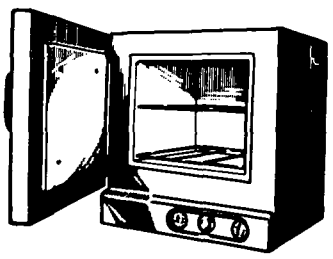
*Basic item

Item	Description	Quant.	Use	Illustration
110.5.60	ILLUMINATED INSPECTION GLASS 6 X to 8 X magnification, hand held with graticule for clear detailed inspection work. Battery supplied. Complete with five sets of batteries and two spare bulbs.	16	E F I	
110.5.61	TEST LEADS set of 2 (red and black colour); rating not less than 5.0 A and 2 kV r.m.s., extra flexible cable terminated at each end with a 4 mm on-line stackable plug. Overall length about 1m.	16	E F I	
110.5.62	TEST PRODS, 4 mm set of two (red and black) rating 5A and 2 kV r.m.s.; connection by 4 mm socket at the rear. Approx. overall length 150 mm.	16	E F I	
110.5.63	SPRING-LOADED HOOK GRIP soldered connections; consisting of a pair (red and black). Should be suitable for p.c.b. use. Working voltage not less than 50 V.	16	E F I	
110.5.64	I.C. TEST CLIPS, SET for reducing a risk of accidental shorting during measurements. Comprising three test clips to attach easily on to standard d.i.l. packages up to 16, 28 or 40 pins. All contact surfaces should be gold plated.	16	E F I	

Item	Description	Quant.	Use	Illustration
110.5.65	WORK STATION ANTI-STATIC KIT consisting of bench mat approx. 60 x 120 cm and floor mat (approx. 120 x 120 cm), wrist strap and earthing connecting cables between bench mat, floor mat and on independant earth. Mat surface resistivity about 10000 to 100000 Ohm/square cm.	16	E F I	
110.5.66	LABORATORY ELECTRIC OVEN for drying varnished coils, chokes, transformers and for testing temperature stability of electronic circuits with temperature controlled from 40 to 250 deg. C, temperature fluctuations plus or minus 1 deg. C at any setting between 40 and 250 deg. C, internal dimensions approx. 400 x 480 x 380 mm (H x W x D), rated power approx. 1 kW, complete with accessories, operation and service manual.	1	E F I	

SECTION 6 COMPONENTS AND CONSUMABLES

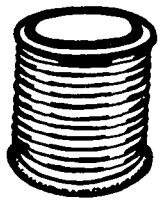
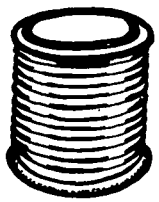
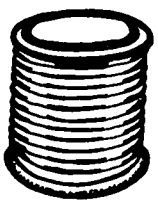
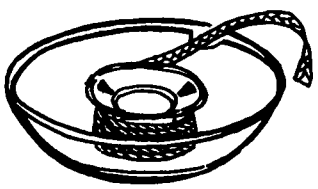
This section deals only with the general purpose first priority consumables, as well as fastening and maintenance products for all set-ups, except for trainers.

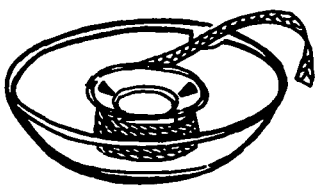
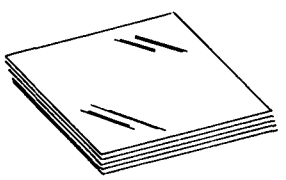
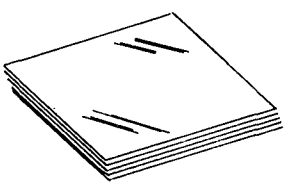
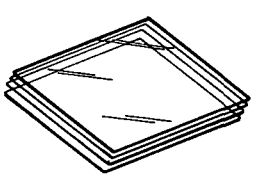
The trainers shall be supplied with set(s) of components and consumables usually for two years of operation and their reordering should be done in accordance with a recommended list of components attached to each particular trainer.

The coverage of all existing components is not possible (the semiconductor list alone would include over 300000 items) and cannot be satisfactory due to permanent modification of parameters and the appearance on the market of new devices. Therefore, depending upon the aims and level of the project, the list of necessary components must be decided based on latest manufacturers' catalogues.

However, as a general guidance the following groups of devices may be needed by projects: cables, cable accessories, connectors, equipment housings, special fasteners, filters, fuses, indicators, micromotors, opto-electronic devices, passive components such as resistors and capacitors, of different types and values, relays, sodenoids, semiconductors, sensors, special service aids, speakers, microphones, switches, timers, counters, controllers, transformers and other wound components, conduits, circuit breakers, terminals.

Electronic components as well as any electronic equipment should be stored in a dry area where the temperature does not change drastically. Storage media parameters are usually given in operation manuals and data sheets.

Item	Description	Quant.	Use	Illustration
110.6.1A	SOLDER, STANDARD 60/40 tin/lead multicore solder for experimental and production activity; five cores of non-corrosive flux; full melting temperature about 185-190 deg.C. On drums of 500 g.	16	E F I	
110.6.1B	SOLDER, LOW MELTING POINT for repairs of fabricated boards; melting point less than 180 deg.C; Approx. composition: 62% tin, 36% lead, 2% silver. On drums of 500 g.	16	E F I	
110.6.1C	SOLDER, ALL PURPOSE for jointing aluminium, tin, plate, brass, nickel, copper or stainless steel. Approx. composition: 18% tin, 80% lead, 2% silver; should contain cores of water soluble flux. Approx. temperature of full melting 270 deg. C. On drums of 500 g.	16	E F I	
110.6.2A	DE-SOLDER BRAID, 1mm WIDE flux impregnated copper braid for speed removal of solder without excess heating; length 10 m.	16	E F I	

Item	Description	Quant.	Use	Illustration
110.6.2B	DE-SOLDER BRAID, 2mm WIDE flux impregnated copper braid for speed removal of solder without excess heating; length 10 m.	16	E F I	
110.6.3A	PLAIN ALUMINIUM SHEETS, 1.2 mm for fabrication of cases, panels, chassis, etc. with a protective plastic cover to prevent scratching before use. Pack of five sheets. Approx. size: 200 mm x 300 mm	16	E F I	
110.6.3B	PLAIN ALUMINIUM SHEETS, 2.0 mm for fabrication of cases, panels, chassis, etc. with a protective plastic cover to prevent scratching before use. Pack of five sheets. Approx. size: 300 mm x 500 mm	16	E F I	
110.6.4	CLEAR PLASTIC SHEET, 3 mm for front panels, scale windows, prototype development base boards, etc. Approx. size: 300 mm x 500 mm	16	E F I	
110.6.5A	SCREW FIXING FEET, 12.5 mm DIA. for equipment housings, pack of 100 pcs.	2	E F I	

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*Basic item

Item	Description	Quant.	Use	Illustration
110.6.5B	SCREW FIXING FEET, 15.5 mm DIA. for equipment housings, pack of 50 pcs.	2	E F I	
110.6.5C	SCREW FIXING FEET, 19 mm DIA. for equipment housings, pack of 50 pcs.	2	E F I	
110.6.6	SCREW KITS, SLOTTED PAN HEAD Screws made from brass. In packs of 100 pcs. Metric: M2 - M2.5 - M3 - M3.5 - M5 Threaded length: 6 mm to 40 mm	16	E F I	
110.6.7	SCREW KITS, SLOTTED COUNTERSINK HEAD Screws made from brass. In packs of 100 pcs. Metric: M2.0 - M2.5 - M3.0 - M3.5 M4 Overall length: 6 to 20 mm	16	E F I	
110.6.8	SCREW KITS, SLOTTED COUNTERSINK HEAD Screws made from brass. In packs of 100 pcs. Metric: M2.0 - M2.5 - M3.0 - M3.5 M4 and M5 Overall length: 6 to 40 mm	16	E F I	

Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

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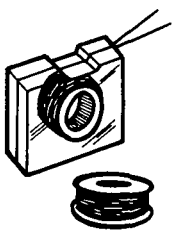
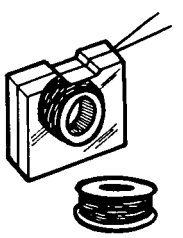
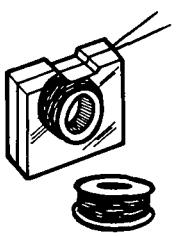
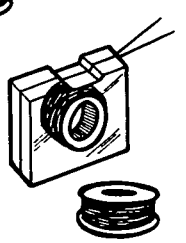
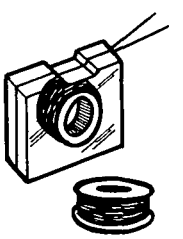
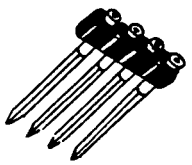
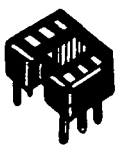
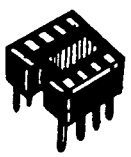
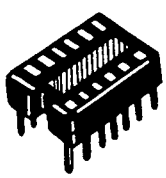
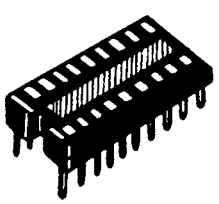
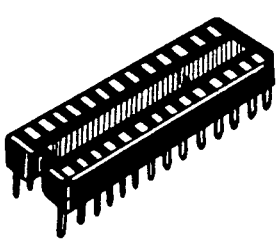
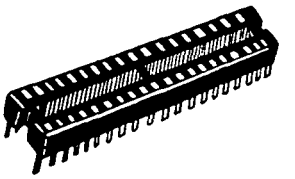
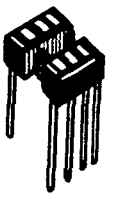
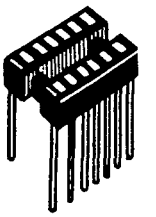
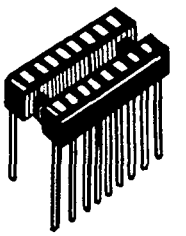
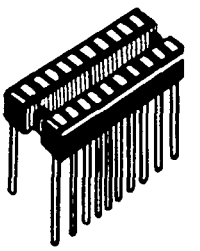
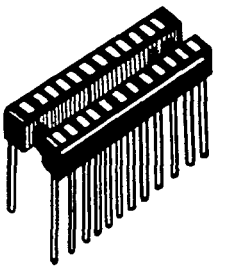
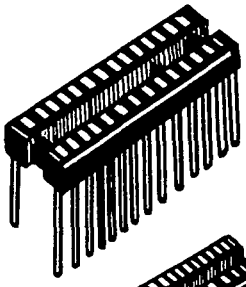
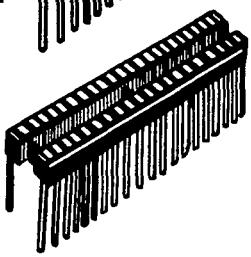
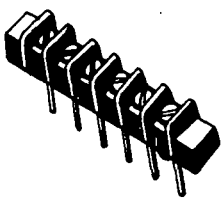
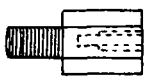
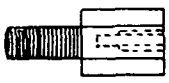
*Basic item

Item	Description	Quant.	Use	Illustration
110.6.9	NUT AND WASHER KITS, METRIC Made from brass. In packs containing nuts, plain washers and shakeproof washers about 2000 pcs in total. Metric: M2 - M2.5 - M3 - M3.5 - M4 and M5	16	E F I	
110.6.10	INSULATED WRAPPING WIRE, 0.25mm/RED length 100 m on a reel.	16	E F I	
110.6.11	INSULATED WRAPPING WIRE, 0.25mm/BLUE length 100 m on a reel.	16	E F I	
110.6.12	INSULATED WRAPPING WIRE, 0.25mm/BLACK length 100 m on a reel.	16	E F I	
110.6.13	INSULATED WRAPPING WIRE, 0.25mm/YELLOW length 100 m on a reel.	16	E F I	
110.6.14	INSULATED WRAPPING WIRE, 0.25mm/GREEN length 100 m on a reel.	16	E F I	

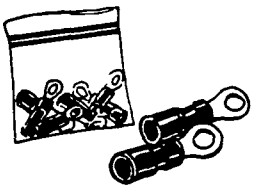
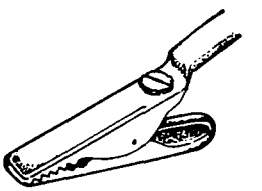
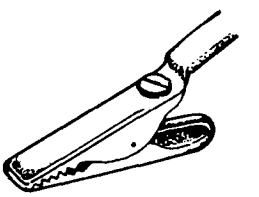
Item	Description	Quant.	Use	Illustration
110.6.15	INSULATED WRAPPING TERMINAL PINS, 18 mm press fit type, 0.85 mm diagonal, box or packet of 100 pcs.	16	E F I	
110.6.16	D.I.L. SOCKET, LOW PROFILE, 6-WAY tin-plated, for high density circuit layouts, pack of four pcs.	60	E F I	
110.6.17	D.I.L. SOCKET, LOW PROFILE, 8-WAY tin-plated, for high density circuit layouts, pack of four pcs.	60	E F I	
110.6.18	D.I.L. SOCKET, LOW PROFILE, 14-WAY tin-plated, for high density circuit layouts, pack of four pcs.	60	E F I	
110.6.19	D.I.L. SOCKET, LOW PROFILE, 20-WAY tin-plated, for high density circuit layouts, pack of four pcs.	60	E F I	
110.6.20	D.I.L. SOCKET, LOW PROFILE, 28-WAY tin-plated, for high density circuit layouts, pack of four pcs.	60	E F I	

Item	Description	Quant.	Use	Illustration
110.6.21	D.I.L. SOCKET, LOW PROFILE, 40-WAY tin-plated, for high density circuit layouts, pack of four pcs.	60	E F I	
110.6.22	D.I.L. SOCKET, WIRE WRAPPING, 8-WAY wire-wrap size 0.85 mm diagonal; tin-plated; pack of four pcs.	60	E F I	
110.6.23	D.I.L. SOCKET, WIRE WRAPPING, 14-WAY wire-wrap size 0.85 mm diagonal; tin-plated; pack of four pcs.	60	E F I	
110.6.24	D.I.L. SOCKET, WIRE WRAPPING, 18-WAY wire-wrap size 0.85 mm diagonal; tin-plated; pack of five pcs.	60	E F I	
110.6.25	D.I.L. SOCKET, WIRE WRAPPING, 20-WAY wire-wrap size 0.85 mm diagonal; tin-plated; pack of five pcs.	60	E F I	
110.6.26	D.I.L. SOCKETS, WIRE WRAPPING, 24-WAY wire-wrap size 0.85 mm diagonal, tin plated, pack of four pcs.	60	E F I	

Item	Description	Quant.	Use	Illustration
110.6.27	D.I.L. SOCKETS, WIRE WRAPPING, 28-WAY wire-wrap size 0.85 mm diagonal, tin plated, pack of four pcs.	60	E F I	
110.6.28	D.I.L. SOCKETS, WIRE WRAPPING, 40-WAY wire-wrap size 0.85 mm diagonal, tin plated, pack of four pcs.	60	E F I	
110.6.29	MULTI-WAY WIRE POSTS, SET for soldering to p.c.b. and subsequent solderless connections of wires to p.c.b. via these posts. Set of five comprising: two-way, three-way, four-way, five-way and six-way posts.	60	E F I	
110.6.30	P.C.B. PILLARS, STANDARD moulded nylon types; in packs of 25 spacers and 25 caps.	16	E F I	
110.6.31A	P.C.B. SPACERS WITH STUD, 10 mm made from brass; in packs of 50 pcs.	10	E F I	
110.6.31B	P.C.B. SPACERS WITH STUD, 15 mm made from brass; in packs of 50 pcs.	10	E F I	

Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

Item	Description	Quant.	Use	Illustration
110.6.31C	P.C.B. SPACERS WITH STUD, 25 mm made from brass; in packs of 50 pcs.	10	E F I	
110.6.32	INSULATED TERMINALS, 4 mm set of seven colours: black, blue, green, brown, red, white and yellow; in packs of five pcs of each colour. Total quantity per set is 35 pcs.	16	E F I	
110.6.33	BANANA PLUGS, 4 mm set of seven colours: black, blue, green, brown, red, white and yellow; in packs of 10 pcs of each colour. Total quantity per set is 70 pcs.	16	E F I	
110.6.34A	CROCODILE CLIPS, STANDARD in packs of 20 pcs.	16	E F I	
110.6.34B	CROCODILE CLIPS, MINIATURE INSULATED with insulating covers; in packs of 10 pcs. Set of two colours; total quantity 20 pcs.	16	E F I	

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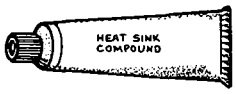
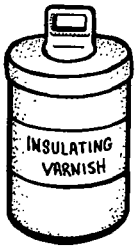
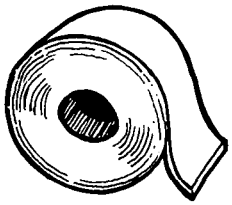
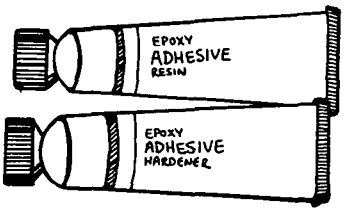
Item	Description	Quant.	Use	Illustration
110.6.35	HEAT SINK COMPOUND to provide high heat transfer between semiconductor devices and heat sinks; high insulation resistance; should be chemically inert, shock absorbing, moisture repelling with long-term stability.	16	E F I	
110.6.36	INSULATING VARNISH a quick air drying varnish suitable for insulating wound components, p.c.b.'s, transformers, etc. Touch dry in air about 15 min. Full hardening in 24 hrs. In 500 ml tins.	8	E F I	
110.6.37	CONTACT CLEANING AEROSOL general purpose degreasing agent and cleaner; should be suitable for cleaning of electronic components and hardware. In about 300 ml tins.	4	E F I	
110.6.38	SELF-AMALGAMATING TAPE to produce waterproof joints. Approx. width: 20-25 mm In 10 m rolls.	16	E F I	
110.6.39	EPOXY ADHESIVE, QUICK SET consisting of two parts resin and hardner; should be suitable for use with metals, wood, glass and most plastics; approx. setting time 5-10 min; in standard pack, containing two approx. 16g net tubes.	16	E F I	

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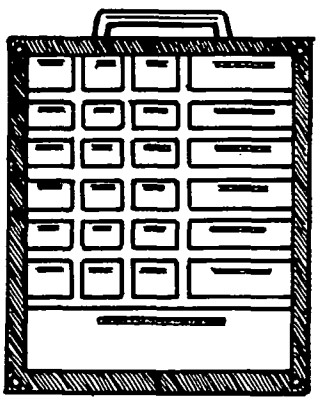
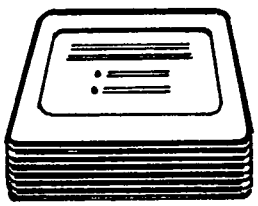
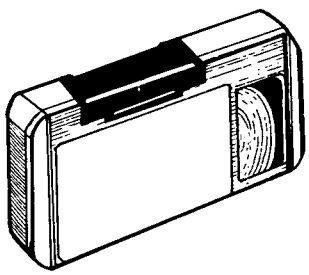
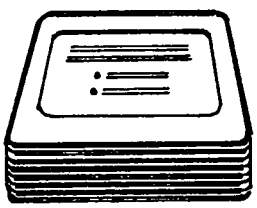
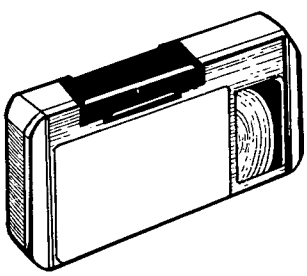
Item	Description	Quant.	Use	Illustration
110.6.40	SINGLE COMPONENT STRONG ADHESIVE based possibly on cyanoacrylate component; should form a clear bond in seconds; suitable for use with metals, most plastics, ceramics, wood and rubber. In 20 g bottles.	16	E F I	
110.6.41	STORAGE CARRYING CASE for storing electronic components for a trainee. Consisting of steel-framed rack of clear plastic drawers and a tray container for larger components and tools; front and top open for easy access; the front fasteners should be equipped with two locks, key operated. Approx. dimensions: L 380 mm x W 320 mm x D 180 mm Approx. capacity: 1 tray and 14 drawers of about three different sizes.	16	E F I	

SECTION 7 TRAINING AIDS AND REFERENCE LIBRARY

This section lists the overhead transparencies and videotapes related to the topics presented by the trainers and training kits. These audio-visual aids are helpful to the trainee for reviewing principles presented in the course, or for instructing trainees who may have missed a few classes.

The aids are also helpful to the instructor for basic reviews, while moving on to more complex theories and experiments.

Also included in this section is a reference library list consisting of semiconductors and components data books, handbooks on principles of electronics and design, standards and computer related literature (programming manuals, computer operating systems).

Item	Description	Quant.	Use	Illustration
110.7.1	OH TRANSPARENCIES, AC/DC FUNDAMENTALS one set of standard-size overhead transparencies, clearly labelled and using multi-colours to distinguish components, current, etc. Topics shall be consistent with the experiments listed in 110.1.1. Minimum number of transparencies: 10.	1	F	
110.7.2	VIDEOCASSETTES, AC/DC FUNDAMENTALS one set of videotapes, formatted to local replay capabilities, in full colour and covering the topics listed in 110.1.1. Minimum number of cassettes: six.	1	F	
110.7.3	OHT, POWER SUPPLIES AND AMPLIFIERS one set of standard-size, multi-colour overhead transparencies to present the topics listed in 110.1.2. Minimum number of transparencies: 10.	1	A F	
110.7.4	VDC, POWER SUPPLIES AND AMPLIFIERS one set of videocassettes in full colour, to present and explain the topics listed in 110.1.2. Formatted for local replay capabilities and language needs. Minimum number of cassettes: six.	1	A F	

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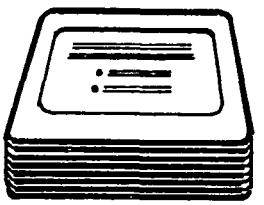
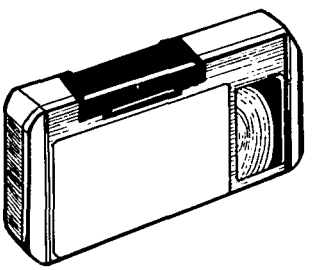
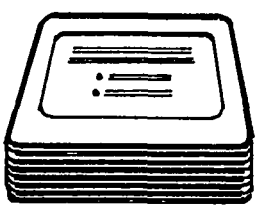
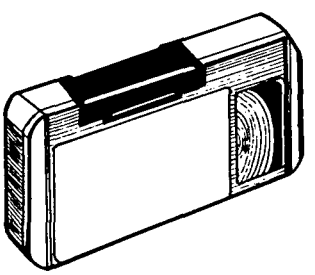
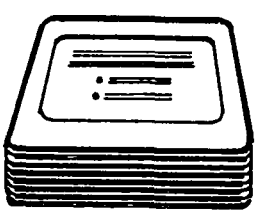
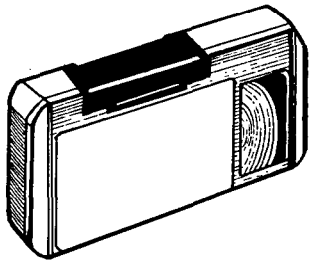
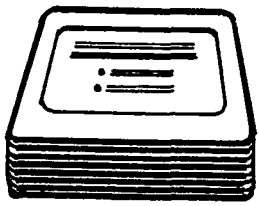
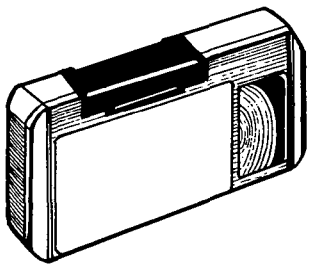
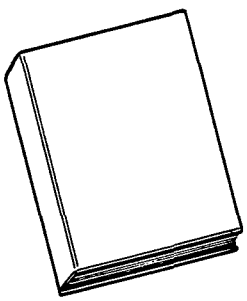
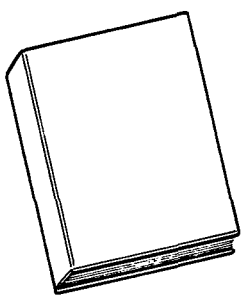
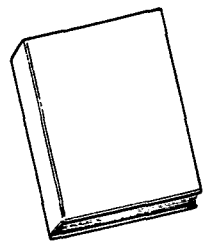
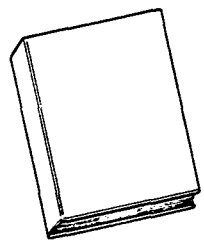
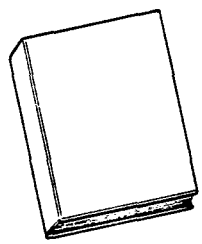
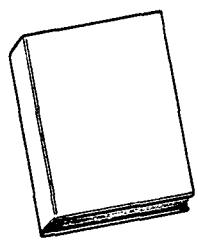
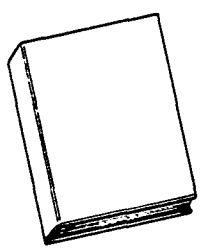
Item	Description	Quant.	Use	Illustration
110.7.5	OH, TRANSPARENCIES, ANALOG LOGIC one set of standard-size overhead transparencies, multi-coloured, clearly labelled and consistent with the topics covered in 110.1.3. Minimum number of transparencies: 10.	1	A	
110.7.6	VIDEOCASSETTES, ANALOG LOGIC one set of videocassettes in full colour which shall present and explain the topics listed in 110.1.3. Minimum hours of cassettes: 10.	1	A	
110.7.7	OH TRANSPARENCIES, DIGITAL LOGIC one set of standard-size overhead transparencies, multi-coloured, clearly labelled and consistent with the topics covered in 110.1.4. Minimum number of transparencies: 10.	1	D	
110.7.8	VIDEOCASSETTES, DIGITAL LOGIC one set of videotapes in full colour to present and explain the topics listed in 110.1.4. Minimum hours of tapes: 10.	1	D	
110.7.9	OH TRANSPARENCIES, MICROPROCESSORS one set of standard-size overhead transparencies, multi-coloured, clearly labelled and consistent with the topics covered in 110.1.7. Minimum number of transparencies: 10.	1	D	

Item	Description	Quant.	Use	Illustration
110.7.10	VIDEOCASSETTES, MICROPROCESSORS one set of videocassettes, in full colour, which shall present and explain the topics covered in 110.1.7. Minimum hours of tapes: 10.	1	D	
110.7.11	OH TRANSPARENCIES, POWER CONTROL one set of standard-size overhead transparencies, clearly labelled, multi-coloured, to be compatible with item 110.1.6. Minimum number of transparencies: 10.	1	I	
110.7.12	VIDEOCASSETTES, POWER CONTROL one set of videocassettes, in full colour, to explain power control subject and compatible with item 110.1.6.	1	I	
110.7.13	DATA BOOK, TRANSISTORS a comprehensive data book to include all electrical and mechanical data of audio, general purpose, high frequency, switching transistors and other p-n-p and n-p-n devices in use.	2	A D	
110.7.14	DATA BOOK, DIODES a comprehensive data book to include all electrical and mechanical data of signal diodes and voltage reference diodes, low power rectifiers in use.	2	A D	

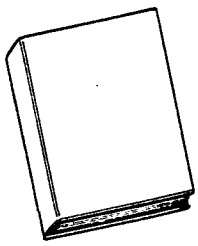
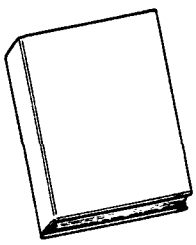
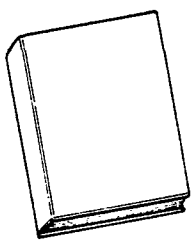
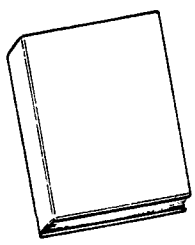
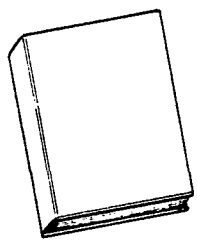
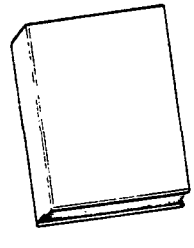
Item	Description	Quant.	Use	Illustration
110.7.15	DATA BOOK, THYRISTORS a comprehensive data book to include all electrical and mechanical data of thyristors and triacs in use.	2	I	
110.7.16	DATA BOOK, DIGITAL IC'S a comprehensive data book to include all electrical and mechanical data of all digital IC's in use with exception of microprocessors.	2	D	
110.7.17	DATA BOOK, LINEAR IC'S a comprehensive data book to include all electrical and mechanical data of operational amplifiers, comparators, connectors, video amplifiers, analog switches, etc. in use.	2	A	
110.7.18	DATA BOOK, INTERFACE IC'S a comprehensive data book to include all electrical and mechanical data of interface integrated circuits in use.	2	D	
110.7.19	DATA BOOK, MEMORY IC'S a comprehensive data book to include all electrical and mechanical data of memory integrated circuits in use.	2	D	

Equipment guide list

List number: 10

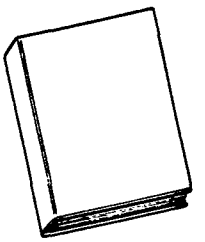
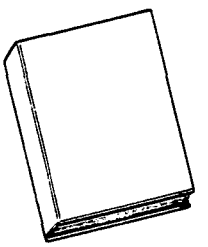
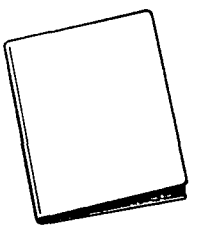
Technical field: Electronics

Date of issue
November 1986

Item	Description	Quant.	Use	Illustration
110.7.20	DATA BOOK, MICROPROCESSORS a comprehensive data book to include all electrical and mechanical data of all modern microprocessors in use.	2	D	
110.7.21	DATA BOOK, VOLTAGE REGULATORS a comprehensive data book to include all electrical and mechanical data of voltage regulators, switches, serial pass, shunt, precision voltage regulators in use.	2	F	
110.7.22	DATA BOOK, OPTOELECTRONIC DEVICES a comprehensive data book to include all electrical and mechanical data of modern optoelectronic devices in use.	2	I	
110.7.23	DATA BOOK, POWER SEMICONDUCTORS a comprehensive data book to include all electrical and mechanical data of power semiconductors in use.	2	I	
110.7.24	DATA BOOK, MICROCOMPUTER SYSTEMS a comprehensive data book covering all major microcomputer systems.	2	D	
110.7.25	DATA BOOK, CERAMIC CAPACITORS a comprehensive data book to include electrical and mechanical data of modern ceramic capacitors.	2	A D F	

Note: Any similarity in above item descriptions and illustrations with specific makes or models is purely coincidental.

Legend: F = Fundamentals of electronics, A = Analog electronics, D = Digital electronics, E = Electronic instrumentation, I = Industrial electronics
*Basic item

Item	Description	Quant.	Use	Illustration
110.7.26	DATA BOOK, ELECTROLYTIC CAPACITORS a comprehensive data book to include electrical and mechanical data of modern electrolytic capacitors.	2	A D F	
110.7.27	DATA BOOK, RESISTORS a comprehensive data book to include electrical and mechanical data of all kind of resistors.	2	A D F	
110.7.28	HANDBOOK, P.C.B. DESIGN for initial stage of electronic circuits development. The book should include the typical artwork layouts as used in modern circuity and give ground rules for preparing schematic as well as conversion into wiring diagrams and artwork. It should cover component and logic theory, optimum I.C. grouping, multilayer boards, flexible circuits, p.c.b. manufacturing techniques and requirements, ground plane rules anf r.f.i. shielding.	2	A D F	

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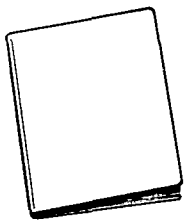
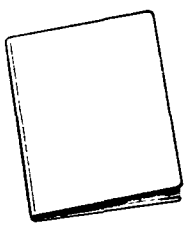
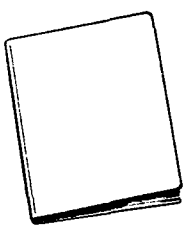
Item	Description	Quant.	Use	Illustration
110.7.29	HANDBOOK, SOLDERING IN ELECTRONICS a comprehensive reference on soldering in the manufacture and development of electronic assemblies. The book should cover solderable materials, soldering techniques, joint design, quality assessment, wetting theory, thermal aspects alloys, fluxes and fluxing, p.c.b. soldering, machine soldering including reflow, manual soldering, desoldering and resoldering. (The title of the book depicts subject only and the offered book may bear other title)	2	F	
110.7.30	HANDBOOK, PRACTICAL ELECTRONICS the book or series of books should cover fundamentals of electricity and electronics necessary for industrial application including instrumentation. It should be trainee exercise oriented and contain major laboratory exercises and introductory material.	2	F	
110.7.31	HANDBOOK, LINEAR ELECTRONICS a comprehensive guide on linear electronics circuits based on the operational amplifier. The book shall include applications of op amps, inverters, non-inverting followers, differential amplifiers, analog computing circuits, instrumentation, active filters, regulated power supplies, threshold detectors, zero detectors, d.c. amplifiers, waveform generation, D to A converters, demodulation, transducer circuits preamplifiers and methods of troubleshooting in linear circuits.	2	F	

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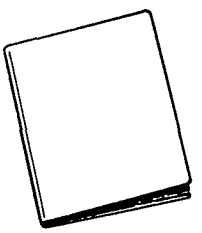
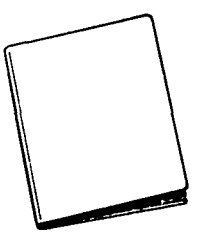
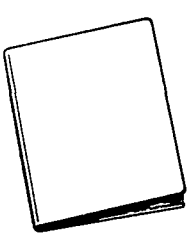
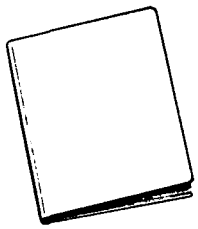
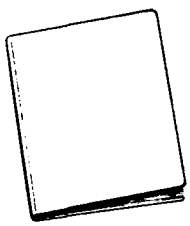
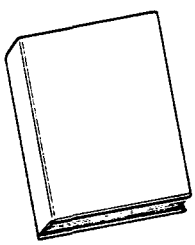
Item	Description	Quant.	Use	Illustration
110.7.32	HANDBOOK, DIGITAL ELECTRONICS the book should explain the fundamentals of conventional computing; how microcomputers and microprocessors work; input-output peripherals; machine language programming; flow charting; high level programming; data transmission and communication.	2	D	
110.7.33	HANDBOOK, CONTROL ENGINEERING the book should cover microprocessor based systems and power electronics in control engineering. It should include both theory and worked out examples of transducers, linear amplifiers and computers, power electronics, electrical machines, digital control, speed control, position control, hydraulic and pneumatic control.	2	I	
110.7.34	BOOK, SENSORS, DETECTORS, TRANSDUCERS the book should give a comprehensive coverage of sensors in common use in detection, intrumentation and control, the construction, performance and typical application of potentiometers, syncros, variable transformers, strain gauges, vibration transducers, accelerometers, crystals, pressure sensors, proximity detectors, frequency, current, power and voltage transducers, fluid level and flow meters, ultrasonic and microwave detection, photodetectors, temperature sensors.	2	I	

Item	Description	Quant.	Use	Illustration
110.7.35	HANDBOOK, DIGITAL INSTRUMENTATION the book should cover the fundamentals of the theory, design and use of digital instruments and their components, logic circuitries, counters, timers, operational amplifiers, analog to digital converters.	4	D	
110.7.36	HANDBOOK, ELECTRONIC FILTER DESIGN the book should provide a comprehensive theoretical coverage of both active and passive filter design on an electronic technician level, practice and design oriented. The book should give broad guidelines to build sophisticated filters without recourse to high mathematics. The book should include: low, high and bandpass filter including elliptical function types as well as delay lines, equalisers and LC refinements.	4	A F	
110.7.37	HANDBOOK, OSCILLOSCOPES the book should cover detailed operation of general purpose oscilloscopes, their basic circuity and applications as well as storage types, sampling, spectrum and logic state analysers.	8	A D E F I	

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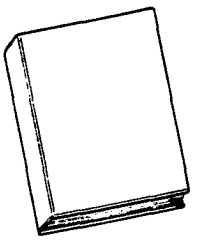
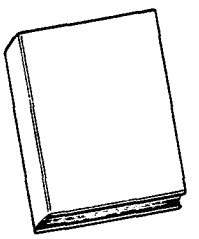
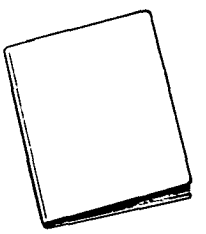
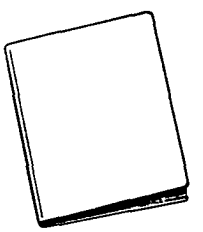
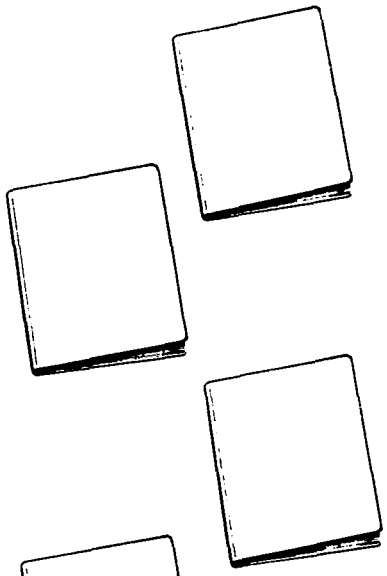
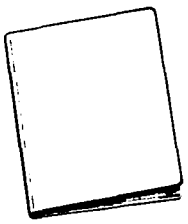
Item	Description	Quant.	Use	Illustration
110.7.38	REFERENCE BOOK, ELECTRONIC CIRCUITS the book should contain practical diagrams of proven predesigned solid-stage circuits for use in a wide number of applications: instrumentation, audio, frequency counters, automotive, clocks, alarms, lamp and motor control, protection, noise suppression, microprocessors, fibre optic, communications, etc.	8	A F D E I	
110.7.39	BOOK, STANDARD INTERNATIONAL (SI) the book containing full coverage of Standard International System of Units, their relationship to different previous systems of units, may also probably include characteristics and properties of materials related to electrical and electronic engineering.	16	A D E F I	
110.7.40	HANDBOOK, CAD PRINCIPLES, APPLICATIONS the book should give practical information on two-and-three dimensional computer aided design systems. It shall cover at least the following instructions and menus: units, properties, switches, filer, input, output, group, window, library, hatch, inquire as well as give an approach to evaluation and selection of CAD, based on requirements.	8	D	
110.7.41	PROGRAMMING MANUAL, BASIC	16	D	

Item	Description	Quant.	Use	Illustration
110.7.42	PROGRAMMING MANUAL, PASCAL	16	D	
110.7.43	PROGRAMMING MANUAL, COBOL	16	D	
110.7.44	PROGRAMMING MANUAL, FORTRAN	16	D	
110.7.45	HANDBOOK, COMPUTER OPERATING SYSTEMS the book should describe the major operating systems in use.	4	D	
110.7.46	HANDBOOK DIGITAL INSTRUMENTATION the book should cover the fundamentals of the theory, design and use of digital instruments and their components, logic circuitries, counters, timers, operational amplifiers, analogue to digital convertors.	8	D E	

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WORKSHOP LAYOUTS FOR ELECTRONICS

1. These layouts show how the required equipment items may be suitably arranged. They also show additional accomodation for storage of training equipment. However, the range of equipment and placing of individual items will depend on various local conditions, such as:

(a) accomodation at the existing site(s), (area, number of rooms, placement of utilities, etc.);

(b) training programme and its schedule: number of trainees, classes, laboratory hours;

(c) availability of furniture;

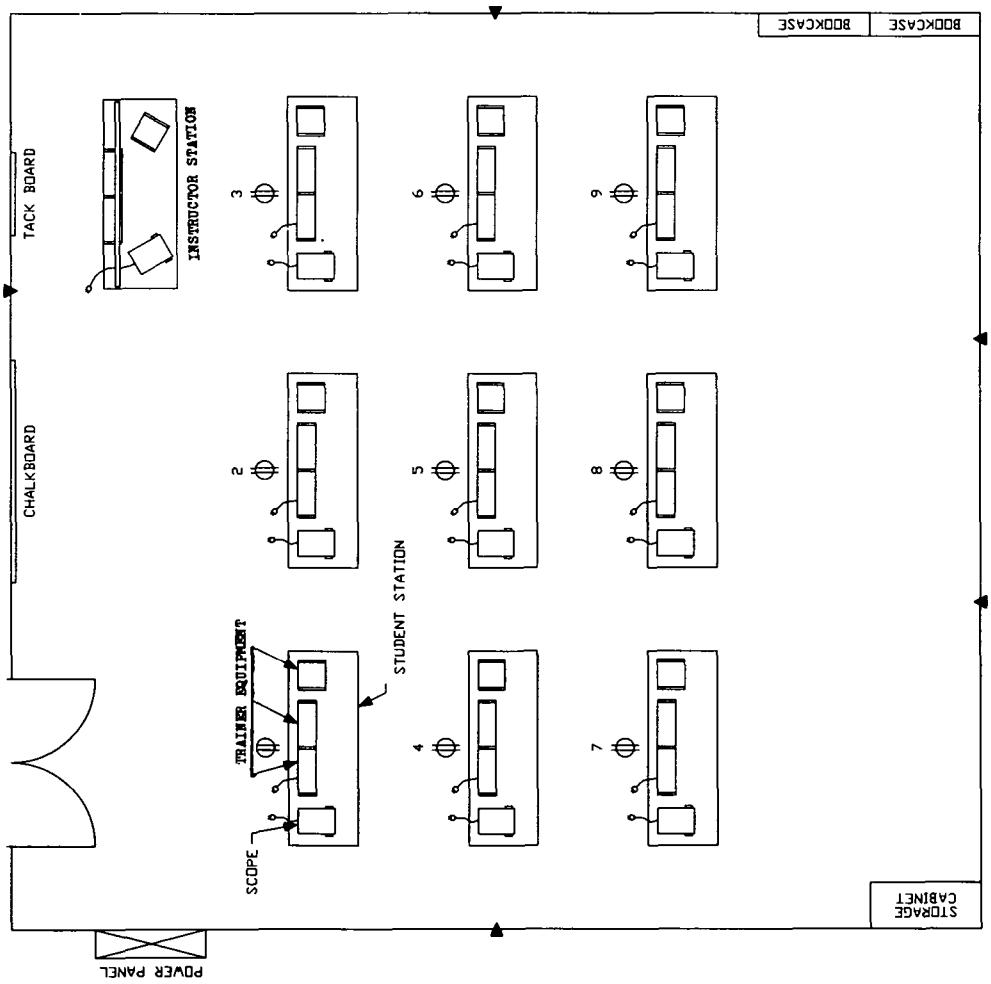
(d) climatic conditions;

(e) plans for future upgrading of training programmes.

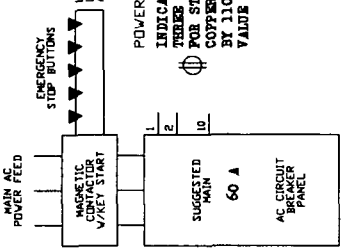
2. Workbenches should be provided with safe electrical fittings and the whole workshop should be powered via a common switch box, equipped with safety protection devices. It is further recommended in some premises that each bench be equipped with an isolating transformer (of adequate power) to ensure safe working conditions on AC mains voltage. For safety reasons, it is also recommended that the workshop floor be covered with an insulating material (wood, plastic, etc.), especially when the workbenches are supplied directly from an AC mains line.

3. In areas where the AC mains voltage is not kept constant within a tolerance of 10%, a suitable AC voltage stabiliser should be used.

TYPICAL ELECTRICITY/ELECTRONICS LAB PLAN



SUGGESTED RISER DIAGRAM

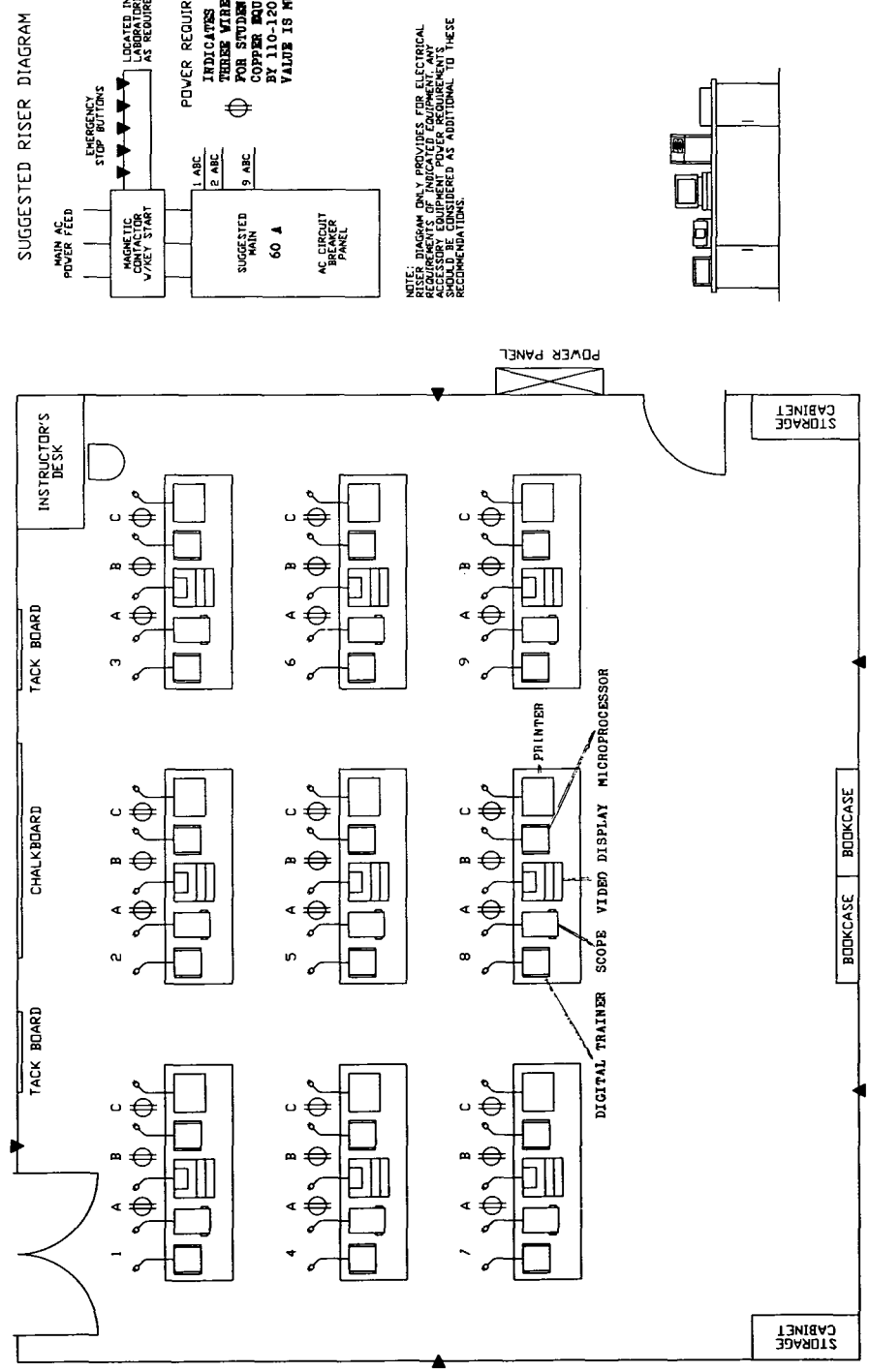


POWER REQUIREMENTS

INDICATES 10 A SINGLE PHASE THREE WIRE 220-240 V SUPPLY FOR STUDENT STATION(INCLUDING COPPER EQUIPMENT GROUND). BY 110-120 V SYSTEMS CURRENT VALUE IS MULTIPLIED BY TWO.

NOTE: RISER DIAGRAM ONLY PROVIDES FOR ELECTRICAL REQUIREMENTS FOR INSTRUCTOR STATION AND ACCESSORY EQUIPMENT. POWER REQUIREMENTS SHOULD BE CONSIDERED AS ADDITIONAL TO THESE RECOMMENDATIONS.

TYPICAL DIGITAL/MICROPROCESSOR LAB PLAN



ALPHABETICAL INDEX

ALPHABETICAL INDEX

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SECTION 2 MICROCOMPUTER SYSTEM

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110.2.26	FLOPPY DISKS, 5.25 INCH
110.2.27	STORAGE BOX FOR 5.25 INCH DISKS
110.2.28	DISKS, 3.5 INCH
110.2.29	STORAGE BOX FOR 3.5 INCH DISKS
110.2.30	HARD DISK, EXTERNAL
110.2.31	TAPE STREAMER
110.2.31A	STORAGE CASSETTE
110.2.32	DISK DRIVE FOR COMPACT OPTICAL DISK
110.2.33	COMPACT OPTICAL DISK
110.2.34	VIDEO DISPLAY, MONOCHROME
110.2.35	VIDEO DISPLAY, COLOUR, RGB
110.2.36	COMPUTER AIDED PCB DESIGN AND MANUFACTURING SYSTEM
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ILO	TECHNICAL CO-OPERATION EQUIPMENT AND SUBCONTRACTING BRANCH (EQUIPRO)	EQUIPMENT REQUEST

Date:	Request No.:	Prepared by:	Month and year required:

Project No.: _____

Country: _____

Port of entry: _____

Centre/final destination: _____

Workshop: _____

CTA's name and signature: _____

Name, title and signature of authorised Government official: _____

Proposed mode of transport:

Language of related documentation:

Electricity supply: Single Phase V AC Three Phase V AC Frequency Hz

Request Item No.	Specifications/descriptions	Qty	Remarks "equivalent to ..." e.g. EPG item no.

Request Item No.	Specifications/descriptions	Qty	Remarks "equivalent to ..." e.g. EPG item no.

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ILO Technical Co-operation Equipment
and Subcontrating Branch (EQUIPRO)
CH-1211 Geneva 22
Switzerland

Reference: ILO Equipment Planning Guide No. 10 - Electronics

The following suggestions are given to improve the guide:

Name:
Institution:
Address:

Signature:
Date: