۲

EDITION 2

 \bigcirc

 \bigcirc

۲

 \odot

ELECTRONICS POWER ELECTRONICS DIGITAL SYSTEM ENG.





۲



Amtec Techniquip applies 30 years of knowledge & experience in the design, manufacture and import of educational engineering equipment, accessories, instrumentation and consumables. During this time, we have been a market leader in innovation, bringing many new concepts and products to the educational industry while expanding our comprehensive range of quality teaching equipment to a level unsurpassed by any other company in the industry.

This includes unique new methods of introducing and educating the learners in all facets of modern engineering. Our products are visual and demonstrational to best teach and explain concepts from basic engineering, all the way up to research and thesis levels in the most advanced forms of engineering.

Amtec Techniquip's commitment to the end user...

AMTEC offers a personal approach to each and every end user as we are always available to meet and discuss any requirements face-to-face basis to provide a tailor-made solution.

AMTEC have a large footprint throughout Southern Africa and regularly visit the countries and provinces we service while also keeping our customers up-to-date with any new products and innovations we bring to the market.

AMTEC supplies expert training on all our products. Our team of experts offer training at the end user or alternately at our head office in Jhb. All our products are supplied with their relevant manuals, course materials and exercise guides.

AMTEC offers unmatched after-sales service and customer support. All our equipment is supplied complete with ICT (Installation, Commissioning & Training). Our sales and support teams are at the end user's disposal should any assistance be needed during the life of a product.

AMTEC offers an extended Service and Maintenance plan to make sure that your equipment and apparatus are maintained to ensure a long lifespan with little or no downtime.

AMTEC makes use of only quality components to ensure reliability and longevity of all our manufactured equipment. This provides the end user with peace of mind and a product that will stand the test of time in an educational environment.

AMTEC has the manufacturing capability to R+D and manufacture "one-off" designs and customise any equipment within our range to meet the end users requirements. We have many accessories, add-ons and tooling that can work in conjunction with our equipment and trainers.

AMTEC offers a 24-month factory warranty on all our products supported by the backing of our local & international suppliers.



Index	Page 1
Electronic Workstation	Page 2
Electronic instruments	Page 3
Electrical instruments	Page 8
Soldering equipment	Page 9
Electronic tools and accessories	Page 10
Digital trainers and labs	Page 11
Components and consumables	Page 12
Crocodile clip software	Page 14
Simulation modules	Page 15
Continuity Trainer	Page 16
Snaptricity kit	Page 17
Electronics kit	Page 18
Electricity kit	Page 19
Electronic Time boards	Page 30
Power Electronics	Page 40
Electronic Test Benches and Labs	Page 49
PCB equipment	Page 62
DVD list	Page 65



AMTEC ELECTRONIC WORKSTATION



Typically these benches are made to house Industrial Electronics equipment or Electronic trainers and ancillaries. The unit has a single supply cable of 15A 220V with the option of an Emergency cutout and or Circuit Breaker/Earth Leakage dependent on requirements. A number of 220V supply points are available on the unit. Cabling can be supplied to power units, through the rear dummy panel. Units are also supplied with steel framework and wooden work surface, with or without rubber mat.

Amtec Standard Electronics Workstation (Part# AEWB)

- Steel Powder coated frame workstation with lockable draws cupboard & storage area for all equipment
- built in AC Variable power supply
- plug in socket point 220V built in

Amtec Complete Electronics Workstation

(Part# AEWC)





- Steel Powder coated frame workstation with lockable draws cupboard & storage area for all equipment
- built in AC Variable power supply
- plug in socket point 220V built in
- Oscilloscope
- Function Generator
- DC Power supply
- Benchtop Multimeter
- Electronics Tool Bag with Tools
- 500g Solder
- Resistance & capacitance Box
- 4 electronics Board Sets mono, multi, triac & A-Stable multi vibrators.



AMTEC MEASURING

Bluetooth Digital Multimeter

OW18A/OW18B



- + 3 5/6 bit resolution
- + Data Logger + Multimeter + Thermometer
- + BLE 4.0 wireless transmission, more stable, less power consumption
- + Chart and Diagram mode helps to analyze the data tendency
- + Flashlight function lightens the darkness
- + Support NCV non-contact voltage sense
- + True RMS test supported
- + Widely supported on Android, iOS and Windows
- + Build-in offline record function supports non-stop up to 7 days non-stop recording

		Measurement Range	Resolution	Accruacy	
DC Voltage		60.00mV / 600.0mV (EU)	0.01 mV	UD EN + D diel	
		600.0mV / 6.000V / 60.00V / 600.0V	0.1 mV	±(0.5%+2 dig)	
		1000V	1 V	±(0.8%+2 dig)	
		6.000V / 60.00V / 600.0V 1 mV		±(0.8%+3dig)	
AC voltage		750V	1 V	±(1%+3dig)	
	μA	60.00u A / 600.0µA	0.01µA	+(0.9%+24ia)	
DC Current	mA	60.00mA / 600.0mA	0.01mA	±(0.070+2019)	
	Α	20.00A	0.01A	±(1.2%+3dig)	
	μA	60.00u A / 600.0µA	0.1µA	1(10(12))	
AC Current	mA	60.00mA / 600.0mA	0.01mA	±(1%+3dig)	
102040-06073/07		20.00A	0.01A	±(1.5%+3dig)	
0		600.0Ω / 6.000kΩ / 60.00kΩ / 600.0kΩ / 6.000MΩ 0.1Ω		±(0.8%+2dig)	
Resistance		60.00MΩ	0.01 MΩ	±(2%+3dig)	
Capacitance		60.00nF/600.0nF/6.000µF/60.00µF	0.01nF	±(2.5%+3dig)	
Capacitance		600,0µF / 6.000mF / 60.00mF	0,1µF	±(3%+5dig)	
Frequency		9.999Hz / 99,99Hz/999.9Hz / 9.999kHz / 99.99kHz / 99.9kHz / 9.999MHz	0.001Hz	±(0.8%+2dig)	
Duty Batia		0.1% - 99.9% (typical value : Vrms=1V, f=1kHz)	0.44	±(1.2%+3dig)	
Duty Ratio		0.1% - 99.9% (≥1kHz)	U. 170	±(2.5%+3dig)	
Tomporature (PC/PE)		-50 °C~ +400°C	10	±(2.5%+3dig)	
Temperature (°C/°F)		-58 F- +752 F	1 T	±(4.5%+5dig)	
Display 5999					
Frequency Response	equency Response (40 - 1000) Hz				
Shift Rate 3 times/s					

Bluetooth Module	√ (only in CW1EE)	Auto Ranging	4
True RMS	4	LCD Backlight	4
Dicte Test	4	Automatic-manual Range Selection	4
Auto Power-off	4	Input Protection	4
On-off Wenting	4	Input Impedance	≥10MΩ
Low-battery Indicator	4	Safety Compliance	QUEV CATTV, 1000 CATTE
Data Hold	4	NOV	4
Rolethre Measurement	4	Dimension (W×H×D)	196 x 00.5 x56 (mm)
Flashight	4-	Weight (without package)	0.30 kg



Digital Clamp Meter

- CM240



+ Performance Specifications

	Range	Accuracy		
AC Maltana	2V / 20V / 200V	± (1.2%+5-digit)		
AC VOITage	600V	± (1.5%+5-digit)		
	200mV	± (0.8%+5-digit)		
DC Voltage	2V / 20V / 200V	± (0.8%+5-digit)		
	600V	± (1.0%+5-digit)		
	2.000A	± (4%+20-digit) ≤ 0.4A, ± (3%+15-digit)		
AC Current	20.00A	± (3%+15-digit) ≤ 0.4A, ± (2%+10-digit)		
	200.0A / 400A	± (2%+5-digit)		
	200.0Ω	± (1.2%+5-digit)		
Desistance	2.000kΩ / 20.00kΩ / 200.0kΩ	± (1%+3-digit)		
resistance	2.000ΜΩ	± (1.2%+5-digit)		
	20.00ΜΩ	± (1.5%+5-digit)		
Features				
Sisplay Count	2000			
Auto Range	√			
)ata Hold	v			
aw Capacity	28mm			
)iode	V			
Continuity Buzzer	\checkmark			
MAX Mode	1			
ow-battery Indicator	1			
Auto Power-off	1			
General				
'ower	2 x 1.5V AAA batteries			
Dimension (W x H x D)	65 x 177 x 28 (mm)			
Weight (without package)	186 g			
Safety Rating	600V, CAT III			



Dual-channel Arbitrary Waveform Generator

- DGE2000 Series



- + Up to 70 MHz frequency output, Max 300 MS a/s sample rate + Vertical Resolution 194 bits, max 8K Arb waveform length + Comprehensive waveform output : 5 basic waveforms, and 150 built-in arbitrary waveforms + Comprehensive modulation functions : MA, FM, PM, FSK, Sweep, Burst, etc. + SCPI, and LabVIEW supported + 3.6 inch TFT LCD, all settings can be fully displayed + Ultra-thin body, easy to operate

Model	DGE2035	DG E2070
Channel	2	
Frequency Output	35MHz	70MHz
Sample Rate	125MSa/s	300 MSa/s
Vertical Resolution	14 bits	
Waveform		
Standard Waveform	sine, square, pulse, ramp, and nois	e
Arbitrary Waveform	exponential rise, exponential fall, total 150 built-in waveforms, and u	sin(x)/x, step wave, and others, i ser-defined arbitrary waveform
Frequency		
Sine	1µHz-35MHz	1µHz-70MHz
Square	1µHz-15MHz	1µHz - 20 MHz
Pulse	1µHz-15MHz	1µHz-20MHz
Ramp	1µHz-1MHz	1µHz-2MHz
Noise	20MHz (-3dB, typical)	
Arbitrary Waveform	1µHz-10MHz	
Frequency Resolution	1 µHz or 7 significant figures	
Frequency Stability	±30 ppm at 0±40°C	
Frequency Aging Rate	±30 ppm per year	
Arbitrary		
Waveform Length	2 - 8K points	
Sample Rate	125Ma/s	300M a/s
Amplitude		his offer
in to 50Ω Load	1mVpp-10Vpp(≤10MHz);1mVpp-	5Vpp (≤70MHz)
DC Offset Range (AD+DC)	±(10 Vpk - Amplitude Vpp/2) high	resistance; ±(5Vpk – Amplitude Vpp/2) 50Ω
DC offset Resolution	1mVor4digits	
Load Impedance	50Ω (typical)	
DC offset Accuracy	±{1 % of setting + 1 mV + amplitue	deVpp x 0.5%)
Modulation		
Туре	AM, FM, PM, FSK, sweep, Burst	
Internal Modulation Frequency	2 mHz to 100 kHz	
Sweep		
Carrier	Sine, rectangular wave, ramp wave	e, a rbitrary wave(Except DC)
Minimum/Maximum Starting Frequency	2mHz(minimum)/ maximum frequ	ency of corresponding carrier
Minimum/Maximum Termination Frequency	2mHz(minimum)/maximum frequ	ency of corresponding carrier
Trigger Source	internal, manual	
Burst		
Waveform	Sine wave, square wave, ramp wav	e, pulse wave and arbitrary wave (Except DC)
Types	N-Cycle	
Trigger source	Internal, manual	
Carrierfrequency	1µHz ≤ Offset ≤ Maximum frequer	ncy of corresponding carrier /2
input/Output		
Display	3.6-inch TFT LCD with resolution 4	80 x 272 Pag
Communication Interface	USBDevice	r ag



SPE Series Single Channel DC Power Supply



- + Ultra-thin body, portable and easy to use
- + 150W / 200W / 300W constant power design, wide application range
- + Over voltage/over current protection
- + Power-on automatic output setting function, suitable for nattended occasions
- + Intelligent temperature control fan cooling, reduce noise
- + 4 groups of Memory shortcut parameters for quick output
- + USB Device communication port, support SCPI
- + Constant voltage CV/constant current CC mode, effectively protect the circuit

Model		SPE3051	SPE3102	SPE6102	SPE6053	SPE3103	SPE6103	
10117-00700-0077	Voltage	0 - 30V	0 - 30V	0 -60V	0-60V	0 - 30V	0-60V	
Rated Output (0°C-40°C)	Current	5A	10A	10A	5A	10A	10A	
	Output Power	150W	200W	200W	300W	300W	300W	_
Load Regulation	Voltage			≤3	0mV			
	Current		≤20mA					
	Voltage	≤30mV					_	
Power Regulation	Current	1		≤2	0mA			
202	Voltage			10)mV			
Setting Accuracy	Current			1	mA			
Voltage				10)mV			
Readback Resolution	Current			1	mA			
	Voltage	≤0.1%	± 20mV	≤0.1% ± 30mV	≤0.1%	± 20mV	≤0.1% ± 30m	v
Setting Accuracy	Current	≤0.1% ± 10mA						
Readback Accuracy	Voltage	≤0.1%	± 20mV	≤0.1% ± 30mV	≤0.1%	± 20mV	≤0.1% ± 30m	v
	Current	≤0.1% ± 10mA						
	Voltage(Vp-p)	<u>≤</u> 30n	nVp-p	≤50mVp-p	≤3 0 n	nVp-p	≤50mVp-p	
Ripple/Noise(*)	Voltage (Vrms)	≤3m	Vrms	≤5mVrms	≤3m	Vrms	≤5mVrms	
	Current			≤30r	nAp-p			
Output temperature	Voltage			1 00 p	opm/°C			
(0°C-40°C)	Current			200 p	pm/°C			
Readback temperature	Voltage			1 00 p	pm/℃			
coefficient	Current			200 p	pm/°C			
Response Time (50%-1)	00% rated load)			≤1	.0ms			
Storage		4 groups of data						
Working Temp	erature	0-40°C					_	
Display	Si			2.8 inch cold	or LCD displ	ay		
Dimensio	'n			82 x 142	226 (mm)			
Weight		Approx. 2.0kg					Pag	
Interface		USB						





SDS1000 Series

super- economical type digital storage oscilloscope

- + Bandwidth : 20MHz 100MHz
- + 2-Channel
- + Sample rate : 100MS/s 1GS/s
- + Ultra-thin body
- + 7 inch high resolution LCD
- + SCPI, and LabVIEW supported

Model	SDS1022	SDS1102				
Bandwidth	20MHz	100MHz				
Sample Rate	100MS/s	1GS/s				
Horizontal Scale (s/div)	5ns/div - 1000s/div, step by 1 - 2 - 5	2ns/div - 1000s/div, step by 1 - 2 - 5				
Rise Time (at input, typical)	≤17.5ns	≤3.5ns				
Channel	2					
Display	7" color LCD, 800 x 480 pixels					
Input Impedance	1MΩ ± 2%, in parallel with 20pF±5pF					
Channel Isolation	50Hz:100:1,10MHz:40:1					
Max Input Voltage	400V (PK - PK) (DC+AC, PK - PK)					
DC Gain Accuracy	±3%					
Record Length	10K					
DC Accuracy (average)	Average≥16 : ±(3% reading + 0.05 div) for	AV				
Probe Attenuation Factor	1X, 10X, 100X, 1000X	1X, 10X, 100X, 1000X				
LF Respond (AC, -3dB)	≥10Hz (at input, AC coupling, -3dB)	≥10Hz (at input, AC coupling, -3dB)				
Sample Rate / Relay Time Accuracy	±100ppm					
Interpolation	sin (x) / x					
Interval (△T) Accuracy (full bandwidth)	Single : ±(1 interval time + 100ppm x readi Average>16 : ±(1 interval time + 100ppm x	ing + 0.6ns), k reading + 0.4ns)				
Input Coupling	DC, AC , and GND					
Vertical Resolution (A/D)	8 bits (2 channels simultaneously)					
Vertical Sensitivity	5mV/div - 5V/div (at input)					
Trigger Type	Edge, Video					
Trigger Mode	Auto, Normal, and Single					
Trigger Level	±5 divisions from screen center					
Line / Field Frequency (video)	NTSC, PAL and SECAM standard					
Cursor Measurement	ΔV and ΔT between cursors					





AMTEC MEASURING

INSTRUMENTS

Insulation tester

Voltage Detector





Clamp meter



Digital and Analog Oscilloscope

UKOO* 5051022

2: 4



Earth Resistance tester





1-1 0

0





Phase rotation meter



LUX Meter



Sound level meter



Line and Voltage Detector







AMTEC SOLDERING EQUIPMENT

AMTEC Techniquip sells only the best quality Soldering irons that we ourselves use in our workshops.

MAGNUM 2000 Soldering Station:

- General Purpose 24V/AC 50w transformer station
- Safety spring holder
- Cleaning sponge
- Spare tip storage
- Potential Balance Socket

MAGNUM De Soldering Station 3000:

- Economic Solution to rework and repair
- Maintenance free
- Compact & Portable
- Separate temp control for de-soldering hand piece and soldering iron
- Vacuum pump ensure precision de-soldering

Solder Pot SP400:

- Heater ring 400w
- Fuse 3A
- Heater Voltage 230VAC
- Temperature range 0dg to 350dg
- Bath Capacity 1.2Kg
- Dimensions (mm) 230L x 130W x 130H

Soldering Iron 1000sp:

- 24V 50w temperature controlled soldering iron
- Designed for use with the soldering station 2000
- Range Adjustable 200dg & 420dg
- Accuracy of proportional controller +/-3%
- LED heating pulse indicator
- Zero leakage current when earthed
- Long Life Iron Plated Cable
- Operates From Any 24V 2A AC Power Source







MAGNUM

click to enlarge



AMTEC ELECTRONIC TOOLS AND ACCESSORIES

AMTEC supply a wide variety of related tools, accessories and instrumentation

- Soldering iron
- Solder sucker
- Solder Wire
- Diagnol nippers
- Crimping pliers
- Long nose pliers
- Adjustable wrench
- Wire stripper
- Utility knife
- Precision screwdrivers
- Tweezers
- Electronic side cutter
- Magnifying lamp
- "Helping hands"
- Anti-static wrist strap and mats
- Solder fume extractor
- PCB vice`











AMTEC ELECTRONICS TRAINERS

Amtec AT-801 Trainer:

This trainer can be used for Electronics training from School level to University level. The unit is an all in-one system which includes DC variable and fixed power supply, AC power supply , function generator and LED with Hi/Lo switches plus other features.

DC Power Supply:

Fixed: + 5v/1A +12v/1A -12v/1A Variable: +1.2V to 20V at 1A

AC Power supply:

17-0-17 Vac

Function Generator:

Sine, Triangular and square waveforms. Frequency range 1Hz to 100kHx in 5 decades.. Fine adjust, amplitude and DC offset control. Clock Output 1Hz to 100kHz in 5 decades.

Breadboard:with 1660 tie-points.Dimensions:W 300 x D 285 x H90 mm x 3kgs

Other:

1K and 100Kohm potentiometers 8 bit LED indicators with buffer Two logic output switches 8 Hi/Lo Data output switches

Optional Extras:

DVM module Logic probe module BCD Decoder Module Counter module Logic gate module Module Carrier





AMTEC ELECTRONIC COMPONENTS AND CONSUMABLES





AMTEC TOOLS, ACCESSORIES AND CONSUMABLES

AMTEC supply a wide variety of related tools, accessories and instrumentation



PVC fittings and conduit











Electronic components

Electrical components



Electrical Consumables



Electrical wires and cables:

- GP wire
- Solid wire
- Armored cable
- Unarmored cable
- Surfix cable
- Cabtyre
- Panel flex
- Bare copper



AMTEC CROCODILE CLIP SIMULATION SOFTWARE

Allows for the design and simulation of curcuits using over 150 types of components, with the ability to test and refine your designs as you work.

Technology

A complete simulator for electronic design. It covers...



- **Electronics** design and simulate circuits using over 150 types of component, testing and refining your design as you work.
- **PCB design** convert your circuits into 3D PCB simulations, whose layouts can be exported for manufacture.
- **PIC programming** program simulated PIC or PICAXE chips using simple flowcharts, before exporting to chips.

Mechanisms — experiment with a range of mechanical inputs

Science



A range of virtual labs that let you simulate physics and chemistry experiments safely and easily.

- **Electricity and Magnetism** simulate power generation and transmission, and analogue electrical circuits.
- **Light and Sound** experiment with sound, water and light waves, and ray diagrams.
- Force and Motion investigate projectiles, oscillations, gravity and motion.
- **Electrochemistry** experiment with electrolysis, using a range of electrodes and solutions.

Inorganic & physical chemistry - simulate reactions safely and easily with over 100 chemicals.

Mathematics



- **3D Shapes** investigate 3D shapes easily, fold and unfold nets, and measure properties.
- **Statistics** experiment with statistics and probability, using tools that include 3D games and a line-up of people.

A colourful mathematical modelling tool, which lets you experiment with statistics, probability, 3D shapes and coordinates.

Coordinates - learn about 2D and 3D coordinates, with custom games.



AMTEC SIMULATION MODULES

Amtec Techniquip offers a variety of electronic simulation trainers.





AMTEC range includes:

- THYRISTOR TRAINER
- A-STABLE MULTIVIBRATOR
- **BI-STABLE MULTIVIBRATOR**
- MONO DIMMER CIRCUIT
- SPEED CONTROL
- SOLAR USB CHARGER
- BRIDGE RECTIFICATION
- CENTER TAP TRANSFORMER
- REGULATED POWERSUPPLY
- COMMON EMITTER
- PLUG TESTER





AMTEC is able to offer PCB development and are able to produce custom PCB **KITS and PCB circuits**







AMTEC AMTB-R CIRCUITRY / CONTINUITY TRAINER



OVERVEIW:

Commonly known in South Africa as a Mystery / Trick Box, the trainer assists the user in identification, continuity testing and of various unknown connections. The trainer can be used an introduction to motor coil testing, testing various switches and methodology sequences behind testing various devices. Continuity testing is done to the various unknown connections via 4mm safety plug in sockets. User safety and ease of use was kept in mind when developing this trainer.

FEATURES:

- Supplied complete with wiring diagram & test sheet.
- Connections made to internal components via 4mm safety plug in sockets.
- Electrically insulated materials are used in manufacture.
- Epoxy powder coated enclosure.
- Safe, reliable and easy to use.
- Continuity tests can be done by digital / analogue continuity tester / multimeter.





AMTEC SNAPTRICITY TRAINING KIT

The Snaptricity set allows the reuse os electronic components to teach a variety of fundamentals in electronics.

Snaptricity set SCR750:

- 138 pages of electronics basic principles curriculum
- Student and lecturers guide
- Covers a range of topics capacitors, transistors, motors, intergrated circuits, diodes, series circuits, parallel circuits, solar energy, electromagnetism etc.
- Contents and modules of the trainer cover the following topics:
 - Basic Components and Circuits
 - Motors & Electricity
 - Resistance
 - Capacitors
 - Transistors
 - Oscillators & electronic Sound
 - Integrated Circuits
 - Electromagnetism & Radio
 - Meters, Transformers & FM Radio
 - Diodes & Applications
 - Electronic Switches
 - Electromagnetism
 - Sun Power

Summary of Components included:

Connecting Wires
Battery
Switches
Lamps
PCB
Solder
Motor
Fuse
Resistors (various)
Adjustable Resistors
Photo Resistor
Capacitors (various)
Adjustable Capacitor

LED's PNP Transistor NPN Transistor Microphone Speaker Whistle Clip Music IC Alarm IC Spacewar IC Power Amplifier High Frequency IC Inductor Antenna Ammeter Transformer FM Module Diodes 7 Segment Display Recording IC Relay SCR Solar Cell Electromagnet Vibration Switch Spring Sockets Computer Interface



DELORENZO DL 2152 ELECTRONICS TRAINING KIT



The kit includes a set of components allowing a full course on general electronics to be developed. All components are mounted on a printed circuit board fixed to metal tacks anchored on transparent plastic material modules, allowing consequently the vision of the components and the related symbol silk-screened on the PCB, the mechanical protection of the component, the electrical safety against accidental contacts and easy replacement of damaged components.

All the modules are ready to be placed on a rubber circuit designer included in the kit. The set of modules is housed in briefcases.

From the educational point of view, the student is trained in component recognition and in acquiring the manual skill necessary to realize a circuit following the diagrams reported in the handbook.

Examples of performable exercises

- Check of the fundamental laws of the electric networks
- Study of circuits in transient and steady conditions
- Characteristic measurements for different kinds of filters
- Half and full-wave rectifiers
- Applications of rectifier diodes and Zener diodes
- Measurement of pnp and npn transistor
- Study and applications of UJT and JFET transistors
- Realization of different types of amplifiers
- Study of SCR and its dc and ac applications
- Realization of circuits with DIACs and TRIACs
- Analysis of operational amplifiers and their applications

List of components

- 4 linear potentiometers
- 24 resistances, 2W
- 1 VDR
- 10 capacitors
- 3 inductances
- 4 diodes and 1 Zener diode
 - 1 switch
- 1 rectifying bridge
- 2 integrated circuits
- 1 UJT
- 1 DIAC
- 4 transistors
- 1 JFET
- 1 TRIAC
- 1 SCR
- 30 cables of different lengths (10, 25, 50 cm)
- 1 rubber circuit designer Page 18
- 2 briefcases



ELECTRICITY

DL 2160 Kit for general electricity



The kit is composed of a set of components and devices that allow a practical demonstration of the most important laws of electricity and electromagnetism.

All the components are mounted on metal or plastic bases complete with terminals for an easy connection of the test circuits through multiple jack cables.

The kit is supplied with a manual that outlines the different subjects of the practical exercises in a simple and progressive way. It is to be underlined the importance of the suggested method, which is based on the direct observation and quantification of the phenomena to highlight the fundamental scientific laws.

Due to the simplicity of its components and to the guided testing procedures contained in the manual, this kit is suitable for courses both in electrophysics and electrical engineering. The tests can be carried out by students under full safety conditions.

Example of performable exercises

- Compass
- Magnetic field
- Magnetic flux and induction
- Electromagnetism
- Magnetic circuits
- Hysteresis cycle
- Electric motor
- Electrodynamic actions
- Electromagnetic induction
- Faraday's law
- Lenz's law
- Emf of self induction





- Emf of mutual induction
- Electric current
- Direct current
- First law of Kirchhoff
- Electric current intensity
- Electromotive force (emf) of a generator
- Difference of potential or electric voltage
- Ohm's law
- Electric resistance
- Electric resistivity
- No-ohmic resistor
- Voltage drop
- Internal resistance of a generator
- Series and parallel generators
- Series and parallel resistance
- Electric power and energy
- Potentiometer
- Current shunt
- Second law of Kirchhoff
- Analysis of an electric network through Kirchhoff's laws
- Mesh currents
- Effect superposition
- Thevenin's theorem
- Electric efficiency
- Norton's theorem
- The relay
- Joule effect
- Thermoelectric effect
- Thermocouple
- Eddy currents
- Electric field
- Capacitors, capacitance
- Single phase alternate current
- Pure resistance
- Pure inductance
- Pure capacitance
- Phase shift between two signals
- Series RL and RC circuits
- Active, reactive and apparent power
- Series resonance

- Inductive reactance depending on frequency
- Capacitive reactance depending on frequency
- Parallel RL and RC circuits
- Series and parallel capacitors
- Parallel resonance
- Miniature transformer
- Electrolytic dissociation and conduction in solutions









OPEN MICROPROCESSOR TRAINER



DL ARM32BIT

TRAINING OBJECTIVES

With this board it is possible to perform experiments on the following subjects:

ARM debug develop environment, ARM assembly instruction, Thum B assembly instruction, ARM Processor working mode, C language programming, assembly and C language call each other, serial port communication, NAND flash, LED control, 7 segment display, PWM frequency, interruptions, RTC, DA, AD, SD Card Read-Write, 4x4 Key, CAN Bus, RS 485, network communication, VGA display, IIS audio frequency, TFT color LCD, touch screen, μ C/OS-II transplantation, μ C/OS-II application, establishment of Linux development environment, bootloader transplant, Linux core compile and customization, Linux drive, Yaffs file system, Linux application program transplant. This 32-bit microprocessor trainer can make students understanding ARM and becoming familiar with the programming of the microprocessor and its components.

The kit consists of a module with power supply, with different interfaces and a set of software application.

The development software can run on: Windows XP, Windows 7 or Windows 10.

TECHNICAL FEATURES

- S3C2440A with 16/32 bits RISC microprocessor, with ARM920T core, main frequency 400MHz (Max. 533MHz)
 - About 1.2V internal,1.8V/2.5V/3.3V memory
 - 3.3V external I/O
 - Microprocessor with 16K BI-Cache/16KB D-Cache/MMU
 - External memory controller (SDRAM Control and Chip Select logic)
 - LCD controller (up to 4K color STN and 256K color TFT) with LCD-dedicated DMA
 - 4-ch DMAs with external request pins
 - 3-ch UART (IrDA1.0,64-Byte TxFIFO, and 64-Byte RxFIFO)/2-ch SPIs
 - 1-ch multi-master IIC-BUS /1-ch IIS-BUS interface
 - SD Host interface version1.0&MMC Protocol version 2.11 compatible
 - 2-ch USB Host/1-port USB Device (ver1.1)
 - 4-ch PWM timers&1-ch internal timer
 - Watch Dog Timer
 - 130 general purpose I/O ports/24-ch external interrupt source
 - Power control: Normal, Slow, Idle and Sleep mode
 - 8-ch 10-bit ADC and Touch screen interface
 - RTC with calendar function
 - On-chip clock generator with PLL



- Onboard 256 MB Nand Flash
- Onboard 64MB SDRAM and 2MB Nor Flash
- General inputs and outputs with at least 64 ports
- At least 8 Interrupt inputs
- Keyboard with hexadecimal keys
- 7 segments display
- 1 RS 232 serial interface
- 10 bit A/D converter and 8 bit D/A converter
- Interfaces: CAN BUS, 485 BUS, TCP/IP, SD Card, VGA, JTAG, IIS, LCD and touch screen, USB
- Expansion bus for connecting external applications
- Development kit

Complete with technical documentation, experiments manual and software.

Dimensions of the board: 250x250mm. Weight: 1 kg.



OPEN MICROCONTROLLER DEVELOPER BASE

of

safely



DL OMCT

TRAINING OBJECTIVES

The trainer provides all the tools necessary for the fast prototyping of applications using basic electronic circuits and the opensource microcontroller Arduino.

The training objectives will depend on the type of applications developed by the student. The trainer can be provided with an optional set of BRS boards from the De Lorenzo product line to perform introductory experiments on:

- Analogue electronics •
- **Digital electronics** •
- **Microcontrollers**
- Photovoltaic solar energy

TECHNICAL FEATURES

- Power supply:
 - ± 5 Vdc, ± 15 Vdc, 1 A / 0
 - 0 ÷ + 15 V 0
 - 0 ÷ 15 V 0
- Arduino UNO with ATmega328 microcontroller and IDE programming interface.

Flexible and modular system for the study electronics, circuit theory

The use of sub-boards from our BRS (Boards Reconfigurable System) product

line allows performing simple but detailed practical experiments in the field of basic

circuit theory, electronics, digital circuits,

The modularity of the base allows the students to create, develop and validate their own experiments and ideas and to create their own prototypes quickly and

The system is compatible with Windows devices, and it can be connected to a

the opensource

using

tablet or PC through the USB port.

microcontroller programming.

and microcontrollers.

by

microcontroller Arduino.

and

- Digital and analogue I/O interface with virtual instrumentation compatible with NI Labview:
 - Dual channel oscilloscope: 1MHz bandwidth (1µs 0 sampling rate).
 - Function generator: Sine, square and triangular 0 waveforms with a max. frequency of 125kHz.
 - Digital pattern generator and logic analyzer to study 0 digital circuits.
- Multifunctional DC instrument
 - direct current voltages (range + 50 V) 0
 - direct current currents (range + 2 A) 0
 - direct current powers (range 100 W) 0



OPTIONS

Set of modules for the study of analogue electronics DL 3155BRS-BAE-OT



It includes: BJT amplifier, BJT-Darlington, class A and class AB push-pull circuits, operational amplifier, power operational amplifier, Schmitt trigger, square/triangular waveforms generator, 1st order high-pass/ low-pass passive filters, 1st order high-pass/ low-pass active filers (operational amplifier differentiator and integrator), 2nd order high-pass/low-pass active filters, JFET.

Set of modules for the study of digital electronics DL 3155BRS-BDE-OT



It includes AND, OR, NAND, NOR, XOR and NOT gates, latch & buffer circuit, Flip-Flop JK and D Master / Slave type, up/down counter, shift register, 7 segment display, multiplexer and demultiplexer, oscillators, 555 timer circuit.

TRAINING OBJECTIVES

- BJT verification of the integrity of e-b and c-b junctions.
- Common emitter circuit DC operation: Bias
 Point, DC gain, AC operation.
- Driving a led load with a single bipolar junction transistor and with a Darlington transistor pair.
- Class A output stage emitter follower circuit.
- Push-pull output stage crossover distortion.
- Operational amplifier: reduction of the offset voltage, inverting / non-inverting, slew rate, voltage follower, voltage, and current output, coupled to pushpull booster – voltage and current output.
- Inverting / non-inverting Schmitt trigger.
- Square and triangular waveforms generation.
- Active 1st order low-pass filter, operation as an integrator, active 1st order high-pass filter, operation as a differentiator.
- Active second order low-pass and high-pass filters.
- JFET-VGS off, JFET-AC Gain, JFET AC Bandwidth.
- Faults simulation.

TRAINING OBJECTIVES

- AND/OR, NAND/NOR, XOR/NOT logic gates.
- 1st and 2nd De Morgan theorem.
- Latch DC operation.
- Buffer DC operation.
- J-K and D flip-flop Truth table.
- Master-slaved flip-flop.
- Basic binary UP counter.
- UP/DOWN counter.
- Serial input-parallel output shift register 1 bit shifting.
- BCD to 7-segment led display decoder truth table.
- MUX Multiplexing and DMUX Demultiplexing.
- Oscillators TTL configuration.
- Oscillators TTL configuration with quartz.
- NE555 astable configuration, inverting buffer and bistable Flip Flop.
 - Faults simulation.



ELECTRONICS

Set of modules for the study of microcontrollers DL 3155BRS-M24-OT



It includes PIC microcontrollers, sensors, EEPROM memory and RAM, LCD display, digital inputs / outputs, inputs / outputs TTL type, input / output optoisolator, A/D and D/A converters, motor control, SPI and UART interfaces, programmer/debugger and suggested applications programs

Set of modules for the study of photovoltaic solar energy DL 3155BRS-PSE-OT



It includes photovoltaic solar cell, multifunction display, charge regulator, breadboard, battery controller with battery, light sensor, incandescent lamps and LED, voltage regulator, current regulator and relay circuit, solar panel.

TRAINING OBJECTIVES

- Binary counting up to 1111.
- Activation and deactivation of one LED, LED activation by two, LED activation 1-on-1 and setting of direction and speed.
- Operation with memory, reading or writing.
- Display of values read by digital input ports, display of resistance temperature value, of PTC sensor received value, of light intensity collected by light sensor in V and display of optoisolated inputs status.
- PWM module starting after connection to 12VDC motor, speed and rotation direction change, stepper motor starting and increase or decrease of stepper speed.
- SPI and UART use in binary operation according to the decimal value set on the display, reception and transmission of characters sequence displayed in hyperterminal via RS232.

TRAINING OBJECTIVES

- Electrical characteristics of a single solar cell.
- Electrical characteristics of two solar cells connected in parallel and series.
- Electrical characteristics of a solar panel.
- Monitoring of the charge level and analysis of the discharging process in a gel battery.
- Charging a battery by using a current regulator.
- Charging a battery by using a charge regulator.
- Analysis and comparison of two light sources.
- Smart system for energy management.
- Study of energy efficiency by means of a breadboard



KIT FOR THE STUDY OF PHOTOVOLTAIC SOLAR ENERGY



The design and construction of electronic circuits to solve practical problems is an essential technique in the fields of electronic engineering and computer engineering.

The kit is a complete configuration for photovoltaic energy study in an off grid system. Its covers the fundamentals of solar cell and its operation in a storage system mode.

DL 3155BRS-PSE

LEARNING EXPERIENCES

- Electrical characteristics of a single solar cell
- Electrical characteristics of two solar cells connected in series
- Electrical characteristics of two solar cells connected in parallel
- Electrical characteristics of a solar panel
- Monitoring of the charge level and analysis of the discharging process in a gel battery
- Charging a battery by using a current regulator
- Charging a battery by using a charge regulator
- Analysis and comparison of two light sources
- Smart energy management system
- Study of energetic efficiency by means of a breadboard

Complete with manual (theoretical and practical) and cable kit.

Dimensions of the board: 297x260mm

CIRCUIT BLOCKS

- Base board
- Solar cell mini board x2
- Battery charge regulator mini board
- Double voltmeter mini board
- Voltage regulators mini board
- Battery level monitor mini board
- Light Tester mini board Kit
- Current driver and relay mini board
- Bread Board mini board
- Battery module (12V)
- Solar panel module 5W
- Fan module (load)

ACCESSORY INCLUDED: DL 2555ALG - DC POWER SUPPLY



± 5 Vdc, 1 A ±15 Vdc, 1 A

EXPERIMENTS DESCRIPTION





Electrical characteristics of a single solar cell

With a simple, small, and cheap solar cell you can prove the concept and draw the complex I-U characteristics, including the temperature influence on it.

Electrical characteristics of two solar cells connected in series

In real life we need some time higher voltage than one single panel can provide. In simple words, by adding two cells in series we obtain higher output voltage.

Through simple experiments we get conclusions about how cells are working in different conditions.





Electrical characteristics of two solar cells connected in parallel

Parallel connection of two power supplies offer higher current capabilities. In this experiment we test the working conditions of this connection between solar cells

Electrical characteristics of a solar panel

When we have many cells, and, after we understood what effects we obtain when we are connecting them in series and parallel, we can try to see how they are working together. A commercial solar pannel offers the possibility to expand the studies for higher amount of captured energy.







Monitoring of the charge level and analysis of the discharging process in a gel battery

Storing captured energy during a sunny day and using it in the night is a necessity of every energy user. In this experiment we learn the use of an accumulator to store the energy.

Charging a battery by using a current regulator

The charge of an accumulator is not a simple procedure, the solar panel and the battery are influencing each other. The solution consists in a current regulator.





Charging a battery by using a charge regulator

I-U characteristic of the solar panel needs control for maximum power injection into the accumulator. In the same time we must control the level of voltage in accumulator to avoid over charging.

Analysis and comparison of two light sources

After learning system connections, energy storage, we now learn how we can use energy in our daily lives. Through the use of lights as loads we learn how to use our system, through the system or directly from the energy source







Smart system for energy management

A system is considered smart if it reacts according with our expectations, for instance the availability and the behaviours of the light during needed time. It is smart if we design it smart. We design it smart if we know its behaviour very well.

Through this study we understand "the limits" of its smartness through the exploitation of the energy consumption in local lighting, taking into account its effectiveness and time of use, taking into account the balance between produced and consumed solar energy.

Study of energetic efficiency by means of a breadboard

With the many ideas accumulated during the previous experiments, the student has ability and possibility to create circuits, networks and other tests for the solar system. Through a transistor in EC connection and two resistors, the student can design a simple light dimmer.





DELORENZO TIME ELECTRONIC BOARDS

The design and construction of electronic circuits to solve practical problems is an essential technique in the fields of electronic engineering and computer engineering.

Therefore, it is necessary for students to acquire an in-depth knowledge of all the basic circuits, such as amplifiers, oscillators, filters, converters, and then to test their knowledge through simple, but important applications in the field of process control and PID techniques.

The products described in this section give students all that is needed to start their first steps in this fascinating world of Electronics.

Linear circuits, digital circuits, logic gates, significant applications coming from the real industrial world, all explained in a simple, gradual way through a combination of theory and experiments.

De Lorenzo offers two different versions, one that consists of closed panels, of very robust construction and clear serigraphy on the front, and another one composed of open boards with components at sight and provided with CAI software.

ELECTRICITY AND ELECTROMAGNETISM

DC FUNDAMENTALS



DL 3155E01

THEORETICAL TOPICS

- DC power sources
- Batteries
- Conventional directions of voltages, e.m.f. and currents
- Ohm's law
 Circuit with linear resistance and non linear
- resistance
 Series/parallel resistive circuits
- Power in dc circuits
- Linear/non linear variable resistor
- Voltage/current divider circuits
- Voltage/current divider circui
- Direct current meters
- Fault simulation

CIRCUIT BLOCKS

- Batteries
- Switches
- Ohm's law
- Series circuit
- Parallel circuit
- Series/Parallel circuit
- Power
- Linear/non-Linear variable resistor
- Voltage divider
- Voltmeter/Ammeter/Ohmmeter

Complete with theoretical and practical manual.

Dimensions of the module: 297x260mm.

DC CIRCUITS



DL 3155M01R

THEORETICAL TOPICS

- Structure of the circuits
- Electric current
- Voltage and electromotive force
- Electric resistance
- Conventional sense of voltage and current
- Types of measurement and types of errors
- Types of instruments
- Measurement of e.m.f. and voltage
- Measurement of the current
- Measurement of the resistance
- Relationships among current, voltage and resistance: Ohm's law
- Conductors resistivity and temperature
 coefficient
- Circuit with linear and non-linear resistance
- Types of resistors
- Identification of the value of the resistors
- Series and parallel resistors
- Constant signals
- Variable signals
- · Wheatstone Bridge
- Fault simulation

CIRCUIT BLOCKS

- Electrical circuit: Components and measurements
- Series generators
- Parallel generators
- Ohm's law
- Application of the Ohm's law: how a resistance influences the current
- The resistivity: resistance, length, section and resistivity of a conductor
- Linear and non-linear ohmic resistance
- Linear and non-linear onmic resistance
- Series circuit: current, resistance and voltage
 Colour code of the resistors
- Wheatstone Bridge

Complete with theoretical and practical manual.

Dimensions of the board: 297x260mm

ELECTRIC NETWORKS



DL 3155M02

ELECTRIC POWER AND ENERGY



DL 3155M03

MAGNETIC CIRCUITS

THEORETICAL TOPICS

- Elements of an electrical network: node, arm, mesh
- nesn
- First Kirchoff principle
- Second Kirchoff principle
 Series resistances
- Series resista
- Parallel resistances
 Series parallel connection
- Voltage dividers
- Theorem of the effect superposition
- Thevenin theorem
- Norton theorem
- Millman theorem
- Fault simulation

CIRCUIT BLOCKS

- Series resistors and Kirchoff voltage law verification
- Parallel resistors and Kirchoff current law verification
- Series parallel resistors
- Effect superposition
- Thevenin theorem
- Norton theorem
- Millman theorem
- Voltage divider

THEORETICAL TOPICS

- The power and the electric energy
- Their measurement
- Thermal effect of the current: Joule's law
- Practical applications of the Joule's law
- Energy balance and efficiency
- Energy transfer from a supply unit to a load
- Adaptation of the load
- Fault simulation

CIRCUIT BLOCKS

- Electrical power in parallel connection
- Electrical power in series connection
- Energy: Joule's law
- Bimetallic sheet switch: thermostat
- Energy balance and efficiency



THEORETICAL TOPICS

- Characteristics of the magnetic field
- Diamagnetic, paramagnetic and ferromagnetic materials
- Soft and rigid ferromagnets
- Hysteresis cycle
- Magnetic quantities and relevant measurement units
- Hall's effect and Hall's potential difference
- Hopkinson's law
- Energy of the magnetic field
- Study of VDR
- Fault simulation

CIRCUIT BLOCKS

- Magnetic field created by a rectilinear conductor
- Magnetic field created by a circular conductor
- Magnetic field created by a solenoid conductor
- Measurement of the magnetic induction
- Magnetic switch
- Electromagnet
- Hysteresis cycle
- Resistor not linear (VDR)

Complete with theoretical and practical manual.

DL 3155M05R

ELECTRIC FIELD



DL 3155M04

THEORETICAL TOPICS:

- Fields of force
- The field vector
- The potential and the
- potential difference
- Characteristics of the electric field and its measurement units
- The electric field generated by a uniformly loaded unlimited
- plane surface
- The electric field of a double plane surface
- Capacitors: composition, identification, connection
- Charge of capacitors
- Discharge of capacitors
- Energy of the electric field in
- the capacitors
- Fault simulation

CIRCUIT BLOCKS

- Superficial electrification of the bodies
- Electrostatic machine
- Energy of the capacitors
- Type of capacitors
- Capacitors in series
- Capacitors in parallel
- Charge and discharge of a capacitoR

Page 31

ELECTROMAGNETISM



DL 3155M06

AC CIRCUITS



DL 3155M07

ELECTRIC POWER IN ALTERNATING CURRENT

THEORETICAL TOPICS

- Lorentz's force
- Force in a wire run by current in a magnetic field
- The induction phenomenon and the Faraday-
- Neumann's and Lenz's laws
- The self-induction phenomenon
- The relay
- The moving coil ammeter
- The static transformer
- Alternators and dynamos
- · Direct current electric motors
- Fault simulation

CIRCUIT BLOCKS

- Electrodynamic action
- Magnetic field of a coil: the relay
- Electromagnetic induction
- Self-induction
- Moving coil instrument
- Transformer
- · Electric motor principle
- · Direct current motor

Complete with theoretical and practical manual.

THEORETICAL TOPICS

- Sinusoidal alternating currents and voltages
- Vector and symbolic representation of the sinusoidal electric quantities
- Product of a sinusoidal quantity by a constant
- Sum and difference of sinusoidal quantities
 - Product of two sinusoidal quantities Product of a sinusoidal quantity by a
- complex number
- Elementary bipoles: R, L, C
- Series and parallel of the bipoles: R-L, R-C, R-L-C
- Oscillating circuits: frequency response of the ac circuits
- Low-pass filter, high-pass filter, pass-band filter
- Fault simulation

CIRCUIT BLOCKS

- Alternating quantities
- **Resistive circuit**
- Capacitive circuit
- R-C circuit (series and parallel) ٠
- Inductive circuit
- R-L circuit (series and parallel)
- Series resonant circuit
- Parallel resonant circuit
- Low-pass filter (R-C)
- High-pass filter (C-R)
- Low-pass filter (L-R)
- High-pass filter (R-L)
- Pass-band filter

Complete with theoretical and practical manual.



THEORETICAL TOPICS

- Active power
- Reactive power
- Apparent power
- Boucherot's theorem
- Power and energy measurements
- Phasing of a single-phase system
- Calculation of the phasing capacity
- Fault simulation

CIRCUIT BLOCKS

- Active, reactive and apparent power (ohmic,
- inductive, ohmic-inductive load)
- Active, reactive and apparent power (ohmic,
- capacitive, ohmic-capacitive load)
- Boucherot's theorem
- Phasing of an ohmic-inductive load

Complete with theoretical and practical manual.

MOTOR AND GENERATOR



DL 3155M10

THEORETICAL TOPICS

- Separate excitation dc motors
- Shunt excitation dc motors
- Series excitation dc motors
- Compound excitation dc motors
- Power and efficiency
- DC motors as generators
- DC motors as tachometric dynamo
- DC motor speed control
- Transistor operation
- Semi controlled single-phase bridge operation
- Totally controlled single phase bridge operation • Linear control and PWM control
- Closed loop control
- Fault simulation

CIRCUIT BLOCKS

- Measurement of the speed of a dc motor
- Counter electromotive force of a dc motor
- Load operation of a dc motor
- Power and efficiency
- Control circuit of a dc motor
- Adjustment of the PWM speed
- Adjustment of the closing loop speed

Dimensions of the board: 297x260mm

Complete with theoretical and practical manual.

Page 32

ELECTRONIC DEVICES



DL 3155M11

THEORETICAL TOPICS

- Physics of the semiconductors and joint P-N
- Semi conductive material
- Formation of a joint P-N
- Polarization of a joint P-N
- The ideal diode and the real diode
- Diode in dc circuits
- Check of the integrity of a diode through an ohmmeter
- Direct polarization
- Inverse polarization
- The Zener diode

- The diode as stabilizer
- The LED diode
- Fault simulation

CIRCUIT BLOCKS

- Direct and inverse polarization of a diode ٠
- Voltage at the diode ends
- Minimum and maximum voltages
- Minimum and maximum voltages with series connected diodes
- Characteristics of the Zener diode
- Zener diode as a voltage stabilizer
- Voltage value on a Zener diode
- Characteristics of a LED diode
- Seven segment digital display

Complete with theoretical and practical manual.

Dimensions of the board: 297x260mm

DIODE APPLICATIONS



DL 3155M12

THEORETICAL TOPICS

• Behaviour of the diode inserted in circuits that enclose generators of variable signals

- Simple and double clipper circuits
- Clamper circuits
- Half-wave voltage doublers
- Simple half-wave rectifier circuit
- Double half-wave rectifier circuit
- Bridge rectifier circuit
- Power supplies
- Filters
- Regulators
- Fault simulation

CIRCUIT BLOCKS

• Clipping circuit

- Clamping circuit
- One half-wave voltage doubler
- · Simple and double half-wave rectifier
- Diode bridge rectifier (Graetz bridge) with
- capacitive input filter
- Dual power supply
- Stabilized power supply

Complete with theoretical and practical manual.

Dimensions of the board: 297x260mm

DIGITAL LOGIC FUNDAMENTALS 1



DL 3155E20

THEORETICAL TOPICS

- Ideas of logic: logic connectives and fundamental theorems of the Boolean algebra
- Binary system
- Logic functions
- Algebraic description of the logic networks and the truth tables
- Theorems of the Boolean algebra
- Minimization techniques of logic functions • through theorem applications and Karnaugh maps
- Logic gates and truth tables
- Fundamental logic operators
- NOT, AND, OR logic operators
- Operation of the AND and OR operators as control devices in the transfer of logic signals
- **OR-EXCLUSIVE** logic operator
- Canonical forms of a function
- Graphic representation of functions
- AND - OR - NOT function •
- NAND and NOR logic operators •
- Operation of the NAND and NOR operators as control devices in the transfer of logic signals and carrying out of logic functions
- Generalities and definition of flip-flop
- S R flip-flop, with NOR and NAND operators
- J - K flip-flop
- Master-slave J K flip-flop
- T and D flip-flops •
- Fundamental logic families
- TTL and CMOS families
- Characteristic parameters of the logic gates Interfacing of the logic families, outputs and
- types of TTL circuits
- Interfacing from CMOS to TTL
- Interfacing from TTL to CMOS
- TTL with totem-pole outputs • The open-collector gates

CIRCUIT BLOCKS

- AND / NAND
- OR / NOR
- XOR / XNOR
- **Open Collector**
- SET / RESET Flip-Flop
- D-Type Flip-Flop
- JK Flip-Flop
- Tri-State Output
- TTL / CMOS Comparison Data Bus Control

+5 V regulated supply

Manual input signal control

Built-in clock circuit

In addition, the Circuit Board contains:

Dimensions of the board: 297x260mm

Complete with theoretical and practical manual.

Page 33

FET FUNDAMENTALS



DL 3155E18

THEORETICAL TOPICS

- Junction FET
- JFET operating characteristics
- The effect of gate bias on pinch-off
- JFET dynamic characteristic curves
- JFET amplifier fundamentals
- JFET amplifier dc operation
- JFET amplifier ac operation
- JFET used as current sources
- Dual Gate MOSFET
- MOSFET fundamentals and modes of operation
- MOSFET voltage amplifier
- Unijunction transistors fundamentals
- UJT operating characteristics UJT waveform generation
- Hartley and Colpitts oscillators fundamentals
- Hartley oscillator operation
- Colpitts oscillator operation
- Transducers fundamentals
- Thermistor operation
- Photo resistor operation
- Fibre optic light transfer
- Fault simulation

CIRCUIT BLOCKS

- IFFT
- JFET Amplifier
- JFET Current Source
- Dual Gate MOSFET Unijunction Transistor
- Thermistor
- Colpitts / Hartley Oscillator
- Photo resistor
- Fibre Optic Link

Complete with theoretical and practical manual.

Dimensions of the board: 297x260mm

ELECTRIC FIELD

POWER ELECTRONICA	ī		
	-111 0	Las II	

DL 3155E22

MULTIVIBRATORS



DL 3155M22

TRANSISTORS



DL 3155M13

THEORETICAL TOPICS

- Structure of the bipolar transistor
- The Darlington transistor
- The MOSFET
- The IGBT
- The SCR and the TRIAC
- The GTO thyristor
- Operation with resistive load
- Operation with inductive load
- The VDR and the DIAC
- Fault simulation

CIRCUIT BLOCKS

- Bipolar transistor ٠
- IGBT
- MOSFET
- SCR & TRIACS
- Darlington transistor
- GTO
- VDR & DIAC
- Driver

Complete with theoretical and practical manual.

THEORETICAL TOPICS

- BJT bistable multivibrator
- Resolution or transition time
- Bistable multivibrator using the operational amplifiers •
- BJT astable multivibrator
- Astable multivibrator using the operational amplifiers BJT monostable multivibrator
- Monostable multivibrator using the operational amplifiers
- Schmitt trigger
- Schmitt trigger using the operational amplifiers
- Fault simulation

THEORETICAL TOPICS

- The transistor currents
- Input and output characteristics
- Collector feedback polarization
- Voltage divider polarization
- Emitter polarization
- The transistor as a switch
- The transistor as a regulator
- Reading and use of technical specifications taken from the catalogues
- Fault simulation

CIRCUIT BLOCKS

- Operation modes of a BJT bistable multivibrator (flip-flop)
- BJT bistable multivibrator (flip-flop) using the operational amplifiers
- Operation modes of a BJT astable multivibrator Astable multivibrator using the operational
- amplifiers Operation modes of a BJT monostable multivibrator
- Operation modes of a monostable multivibrator using the operational amplifiers
- Operation modes of a BJT Schmitt trigger Schmitt trigger

Complete with theoretical and practical manual.

CIRCUIT BLOCKS

transistor

voltage divider

BJT transistor

- Verification of the integrity of the junctions of a BJT transistor
- Recording of the input and output characteristics of a BJT transistor in the common emitter configuration
- Recording of the output characteristics of a BJT transistor in the common base configuration
- The base polarization of a BJT transistor The emitter polarization of a BJT

The polarization of a BJT transistor with

The polarization of the collector feedback

Operation of a BJT transistor as a switch Voltage regulator with parallel transistor

Voltage regulator with series transistor Page 34 Complete with theoretical and practical manual. Dimensions of the board: 297x260mm

DIGITAL LOGIC FUNDAMENTALS 2



DL 3155E21

THEORETICAL TOPICS

- Definition and characteristics of a combinatory logic network
- The BCD code
- DEC/BCD and BCD/DEC code converters
- Encoders
- Decoders
- Multiplexer
- Demultiplexer
- Parity
- Parity logic circuits
- Nine bit 74180 parity generator/detector
- Unipolar codes
- Bipolar codes
- A/D converters
- Staircase A/D converter
- ADC converter of parallel or flash type
- ADC converter with simple slope
- ADC converter with double slope
- D/A converters (DAC)
- D/A converter with weighed resistances
- D/A converter with R–2R network
- 4 bit asynchronous binary counter
- 4 bit synchronous binary counter
- Asynchronous decimal counter
- Synchronous decimal counter
- Up/down synchronous counters
- Adders
- Half adder
- Full adder
- Parallel binary adders four-bit adder
 Quantity comparators
- Four-bit comparator
- Definition and classification of shift registers
- Operation principle
- 4 bit bi-directional shift registers
- Applications
- Fault simulation

MULTIVIBRATORS



DL 3155M18

THEORETICAL TOPICS

- Binary system
- Logic functions
- The algebraic description of the logic gates
- The truth tables
- The theorems of the Boolean Algebra
- Techniques for the minimization of the logic functions through the application of the theorems
- Fundamental logic operators
- NOT, AND and OR logic operators
- Use of the AND and OR operators as control devices for the transfer of logic signals
- OR-exclusive logic operator
- Classic form of a function
- Graphic representation of the functions
- AND-OR-NOT function
- NAND and NOR logic operators
- Use of the NAND and NOR operators as control devices for the transfer of logic signals
- The TTL family
- The CMOS family
- Characteristic parameters of the logic gates
- Definition and characteristics of a combinatory logic network
- The Karnaugh' maps
- The BCD code
- Encoders, decoders, multiplexer and demultiplexer
- Fault simulation

CIRCUIT BLOCKS

- BCD Decimal Decoder / BCD Priority Encoder
- ADC / DAC
- Multiplexer / Demultiplexer
- 7-Segment Driver / Display
- Parity Generator / Checker

In addition, the Circuit Board includes the following:

- +5 V regulated supply
- Built-in clock circuit
- Built-in pulse generator circuit
- Built-in counter circuitry
- The 74LS42 decoder and LS147 encoder
- AD673 ADC and AD558 DAC
- The LS151 multiplexer and LS155 demultiplexer
- The LS280 7-Segment decoder / driver

Complete with theoretical and practical manual.

Dimensions of the board: 297x260mm

CIRCUIT BLOCKS

- Logic gates, Boolean Algebra, Karnaugh's maps and combinatory networks
- Encoder and decoder
- Multiplexer and demultiplexer
- Electric characteristics of the TTL logic gates
- The TTL logic family
- The CMOS logic family

Complete with theoretical and practical manual.

Dimensions of the board: 297x260mm



POWER SUPPLIES **BASE FRAME WITH POWER**

SUPPLY AND INTERFACE **TO PC AND VIRTUAL INSTRUMENTATION**



DL 3155AL2RM

Power supplies:

- 0/+15 Vdc, 1 A •
- 0/-15 Vdc, 1 A
- +15 Vdc, 1 A
- -15 Vdc, 1 A
- +5 Vdc, 1 A
- -5 Vdc, 1 A
- 6 0 6 Vac, 1 A

Virtual instrumentation: Multimeter

- 3 and 3/4 digits
- dc/ac voltage: 400 mV, 4 V, 40 V, 400 V or Autorange
- resistance: 400 Ohm, 4 kOhm, 40
- kOhm, 400 kOhm, 40 MOhm
- dc/ac current: 200 mA, 8 A

Function Generator

- sinusoidal, square, triangular, dc
- frequency: 0.1 Hz 200 kHz
- output: ± 10 V
- attenuator: 0 dB, -10 dB, -20 dB

Digital oscilloscope

- dual trace oscilloscope
- input: dc/ac, 1 MOhm
- meas. ranges: 20/50/100/200/500
- mV, 1/2/5 V per division • sampling frequency: 100 Hz to 10
- MHz

Digital Pattern Generator

- output rate: from 200ms to 10s
- pattern selection: manual or
- automatic
- display: 20 states of the patterns
- Logic Wave Analyzer
- display: 20 states of the inputs



Power supplies:

- 0/+15 Vdc, 1 A
- 0/-15 Vdc, 1 A
- +15 Vdc. 1 A
- -15 Vdc, 1 A
- +5 Vdc, 1 A
- -5 Vdc, 1 A •
- 6-0-6 Vac, 1 A

Features:

- Interface board for connection to PC
- Robust structure and modern design.
- Voltage regulation and protection against over voltage or short circuit.
- Complete with a set of connecting cables.

- Features:
- Interface board for connection to PC.
- Robust structure and modern design.
- Voltage regulation and protection against over voltage or short circuit.
- Complete with a set of connecting cables.



KIT FOR THE STUDY OF RFID APPLICATIONS



DL 3155BRS-RFID

LEARNING EXPERIENCES

- Behaviour of the reader when a tag is identified
- How to read data from proximity integrated circuit card using a RFID reader
- How to read and write data blocks on a MIFARE proximity integrated circuit card
- How to write personal data to a MIFARE proximity integrated circuit card using an RFID reader
- How to read personal data to a MIFARE proximity integrated circuit card using an RFID reader
- How to activate a relay using the outputs of the microcontroller.
- How to control a display by using the microcontroller
- How to control a real time clock device by using the microcontroller
- How to connect a keypad to a microcontroller
- Simulation of a door access control system

The design and construction of electronic circuits to solve practical problems is an essential technique in the fields of electronic engineering and computer engineering.

With this board the students can study the properties of an RFID system and all components necessary to develop a door access control system.

The student will be able to interact with the hardware in a simple and intuitive way through a CAI software that explains step by step how the system works.

The system is provided with a SCADA software for the study of automation and industry 4.0 concepts, and can be combined with other trainers in the family to simulate a scaled down industry 4.0 factory.

CIRCUIT BLOCKS

- Base board
- Real time clock mini board
- LCD Display mini board
- RFID Reader/Writer mini board
- Transponder mini board
- Audio speaker mini board
- Relay mini board
- Tag receiver mini board
- Keyboard mini board
- Micro-controller mini board

Complete with theoretical and practical manual.

Dimensions of the board: 297x260mm

ACCESSORY NEEDED: DL 2555ALG - DC POWER SUPPLY



- ± 5 Vdc, 1 A
- ±15 Vdc, 1 A



THYRISTORS, TRIACS AND THEIR APPLICATIONS DL 2316

This system has been designed in 3 boards to allow both the theoretical and the practical study of thyristors and triacs for what concerns the control techniques and their typical applications within the control systems.

- **DL 2316A** Power and Control Board **DL 2316B** - Light and Temperature Control
- DL 2316C Speed and Position Control

Power and Control Board



DL 2316A

Experiments

- SCR control with alternating voltage synchronous and in phase with the anode voltage
- SCR control with alternating voltage synchronous and in phase with the anode voltage supplying the gate with and without flywheel diode
- Half-wave rectifiers with ohmic-inductive load with and without flywheel diode
- Half controlled single-phase rectifier bridge (B2HZ)
- Half controlled single-phase rectifier bridge with (B2HKF) and without (B2HK) flywheel diode
- Fully controlled single phase rectifier bridge
- Control of full-wave rectification with ohmic load and with ohmic-inductive load
- Half-wave ac/ac converter
- Full-wave ac/ac converter
- Triac control in quadrant I
- Triac control in quadrant III
- Mains alternating voltage regulation
- Pulse train control
- Triac controlled rectifier

It allows the autonomous study of the thyristors in the main single-phase bridge circuit confi guration (semi- and totally-controlled) and in the ac/ac converters as well as the study of the triac in the control of the alternating voltage and in the controlled rectifi cation. The power section includes: 4 thyristors, 1 triac, 4 diodes, 1 fl ywheel diode and 1 ohmic-inductive load.

The control section allows the realization of: proportional control, on-off control or phase control, both on the positive and negative semiwave.

Furthermore, there is a potentiometer for the manual control of the devices activation. The board is supplied complete with a set of stackable, plug-in cables of suitable lengths and colours and with a training manual.

Power supply:

24Vac,1A,50/60Hz



Light and Temperature Control



DL 2316B

Experiments

- DC operated lamp
- AC operated lamp
- Full-wave triac control
- Proportional control

This board contains two independent systems, for the control of the light and of the temperature respectively, each one complete with reference

block, error amplifi er, transducer and actuator.

Together with the DL 2316A board, that contains the power circuits complete with relevant piloting, it is possible to realize an open and closed loop control both of the lighting system (24V, 15W lamp and photoresistor) and of the heating system (47 $\mathbb{P}\Omega$, 25W heating element and integrated circuit sensor).

The board is supplied complete with a set of stackable, plug-in cables of suitable lengths and colours and with a training manual.

Power supply:

- ± 15Vdc, 100mA



Speed and Position Control

DL 2316C

Experiments

- Thyristor bidirectional converter
- Open-loop operation
- Closed-loop operation half-controlled bridge
- Closed-loop operation fully-controlled bridge

This board contains two independent systems, for the control of the position and of the speed respectively, each one complete with reference block, error amplifi er, transducer and actuator.

Together with the DL 2316A board, that contains the power circuits complete with relevant piloting, it is possible to realize an open and closed loop control both of the position system (geared motor coupled to a potentiometer) and of the speed system (variable load generator dc motor with optical transducer associated to an F/V converter).

The board is supplied complete with a set of stackable, plug-in cables of suitable lengths and colours and with a training manual.

Power supply:

± 15Vdc, 100mA



POWER ELECTRONICS BOARD DL 2317SR



This board allows the study of several power electronics circuits, as detailed here under.

Technical Features

The following components are available on the board:

- Diodes for circuit M1U, M2U, M3U, M6U
- SCR for circuit M1C, M2C, M3C, M6C
- H bridge with MOSFET
- Pulse generator for SCR control
- Generator for H bridge control (PWM)
- Function Generator
- Three-phase generator (12 Vpp)
- Single-phase source (12 Vpp)

Built-in power supply.

Experiments - DL 2317SR

- Single-phase uncontrolled rectifier M1U and B2U
- Single-phase controlled rectifier M1C and B2C
- Three-phase, single wave, uncontrolled rectifier B3U
- Three-phase, single wave, controlled rectifier B3C
- Three-phase, full wave, uncontrolled rectifier B6U
- Three-phase, full wave, controlled rectifier B6C
- Pulse Width Modulation (PWM) circuit to control direct current
- PWM to control a motor with a H bridge
- PWM on H bridge to understand the principle of inverter

Experiments ON THE DC SUPPLY

- Basic pulse width modulation (PWM) circuits
- PWM with H-circuit, DC-evaluated
- PWM with H-circuit, sine-evaluated

Experiments WITH THE GTO (GATE-TURN-OFF)

- Firing pulse conditioning for the GTO
- The GTO as a DC actuator



MOTOR BOARD DL 2318SR



Universal speed control system.

- With integrated four-quadrant display
- With variable centrifugal mass
- Dual-channel encoder
- Built-in four-quadrant amplifi er

Technical features

- Linear H bridge to have full motor control
- Dual optical sensor for speed and direction
- Main Motor/Generator 12 V, 3000 rpm, 1.2 A, 3.2 Ncm
- Load to be connected to the secondary Motor/Generator Shunt to limit and measure the current



POWER ELECTRONICS LABORATORY DL PEL



FPGA Based all-in-one Power Electronics and Electric Drives Lab

POWER ELECTRONICS INTRODUCTION

Power Electronics is the branch of Electronics that studies the devices, circuits, systems and procedures for the processing, control, and conversion of electrical energy.

Technological development in solid-state electronics and the semiconductor field has transformed power electronics providing active devices with higher switching speeds, and power handling at lower costs. The power electronic devices commonly found in the industry are Diodes, SCR, TRIAC, MOSFET, and IGBT. Their different attributes dictate how they are used in different applications, according to the type of input and output power: AC to DC, AC to AC, DC to DC, or DC to AC. This technology can be found in a wide range of settings impacting everyday life, from consumer electronics, industrial applications, transportation, telecommunications, power systems, to space technology.



DE LORENZO'S SOLUTION

Power Electronics can be defined as the application of solid-state electronics for the control and conversion of electrical power. The technological development in solid-state electronics and its integration with microcontroller technology has transformed power electronics from a static conversion technology to an essential element embedded in most of our electrical and electronic systems powering most of our every-day applications.

The PEL laboratory has been developed as a comprehensive hands-on training solution to study all the main devices and the power conversion techniques commonly used in the industry. It is divided into 5 main sections: AC to DC conversion (Rectifiers), AC to AC conversion (AC voltage controllers), DC to DC conversion (Choppers), DC to AC conversion (Inverters) and electrical drive applications for DC and AC motors.



The digital control signals are generated using state of the art FPGA technology. Thanks to its high performance, a single reprogrammable data acquisition and control module gives great flexibility and reliability to reconfigure the laboratory according to the type of converter under study. It provides all the signalling while simultaneously acquiring the experiment data and waveforms.

The laboratory is monitored and controlled through an intuitive user interface that gives access to the main parameters of the system. The software will guide the student through the different proposed experiments with clear schematics, wiring diagrams and instructions providing feedback at each step. The morphing interface will adapt to the type of converter under study showing only the parameters that are available for the type of circuit. The different acquired signals can be visualized using a dedicated multichannel virtual oscilloscope, processed using the on-board math functions or exported and stored for further analysis.



KEY CHARACTERISTICS

Modularity

•Reconfigurable lab composed of discrete elements.

•Industrial grade devices.

FPGA Based control and data acquisition

- •The full system is controlled by an FPGA based data acquisition and control module.
- •The NI Linux Real-Time processor combined with isolated I/Os, gives great flexibility and reliability to implement digitally controlled power converters.
- •A PC user interface generates the control signals for the converter under study, controls its main parameters, and acquires and processes the characteristic waveforms using the powerful embedded mathematical tools.

Didactic approach

- •All-in-one solution that gives the student a full view of power electronics.
- •Gradual course that starts from the study of the power semiconductors and the main convertion strategies, to the study of their application as power supplies and drives.
- •Hands-on, experiment-based, training platform.

Skills development

- •Students interact with real industrial equipment.
- •Study and implementation of the different power conversion techniques used in the industry.
- •Study of main power electronics applications and electrical drives.
- •The main controller SW is programmed using LabVIEW, a language widely used in the industry and academy.
- Development of analytical and troubleshooting skills through practical hands-on training.

Quality and Safety

- •Made and designed in Italy using all the quality and safety standards following the CE directives for power devices:
- •CEI EN 61010-1
- •CEI EN 61439-1
- •CEI EN 60335-1



DL PEL LABORATORY ARCHITECTURE

The laboratory is composed of a set of modules that provide a flexible and reconfigurable learning platform to study power electronics and its applications. Industrial-grade devices were integrated with dedicated drivers, isolation circuits and protections for maximum safety and reliability, providing a safe learning and experimentation environment. The laboratory was designed following CE directives for power devices, **CEI - EN 61010-1, CEI - EN 61439-1 and CEI - EN 60335-1**.

The full system is controlled by a user-reconfigurable FPGA based data acquisition and control module that integrates a processor running in NI Linux Real-Time OS, giving great flexibility to implement digitally controlled power converters.

The control and acquisition module connects to the switching devices through a D-sub connector, resulting in less cable clutter, a faster setup and a more reliable connection avoiding wiring mistakes that could damage the equipment.



The software interface is programmed using LabVIEW, a language widely used in the industry and academy. The all-in-one user interface provides a clear view of signals being created to control the semiconductor devices and powerful visualization and mathematical tools to observe the resulting waveforms to study and simulate different controllers and power conversion strategies used in the industry.



CONTROL AND ACQUISITION SYSTEM

The control and acquisition module and the software interface together form the control centre of the lab. They perform the control of the different converters, acquire physical quantities, show warnings, and protect the system.

Control and acquisition module

It controls and monitors slave modules such as switching devices and frequency converter through the Dsub connectors. It also provides general purpose IOs to improve the system flexibility: 2 AIs, 2 AOs, 2 DIs and 2 DOs.

In addition to the control function, this module acts as a data acquisition device. It integrates 6 pairs of isolated voltage-current measurement inputs so users can observe the real-time waveforms and do quick signal processing of voltages and currents. The results are displayed through the software interface. The voltage-current measurement features wide input ranges, good bandwidth and isolation.

Compared to the conventional way using oscilloscope, the proposed solution has distinct advantages:

- No need for shunt resistors or current probes
- No need for differential high voltage probes
- No need for isolated power supply required by the oscilloscope
- No restriction of common ground shared by channels



Maximum 9 signals of voltages and currents can be measured simultaneously. The signals connected to the front panel are well isolated from the controller for the purpose of reliability and anti-interference. It communicates with the control software via ethernet.

Software interface

The software interface creates a seamless connection between users and the Lab, enabling a smooth transition from preparation to completion of experiments. Realized in LabVIEW, it provides a user-friendly operation interface, conveys guidance information, translates user control commands for the FPGA-based control system, displays the measurement of the physical quantities, and supervises the operational status. This all-in-one software interface helps users focus on the experiment itself.











TRAINING OBJECTIVES

The Power Electronics trainer aims at undergraduate and graduate courses in the electrical engineering schools for the study of power converters and electrical drives. The laboratory equipment can be configured to create different exercises, which reinforces basic and advanced concepts in power electronics.

The main purpose is to study the principles of power semiconductors, power converters and their control methods, DC and AC machines, and electrical drives.

The entire system is fully configurable and can be tested under many conditions. Different experiments can be performed by rearranging the wiring and placement of the modules giving a lot of flexibility to simulate various converter topologies. Meanwhile, the control system provides classic control strategies for the converters and the electrical drive. The proposed exercises in different topics connect theoretical and practical concepts through hands-on experience.

SKILLS DEVELOPMENT



Basic

- Knowledge of power semiconductors
 Working principles of classic power converters under different conditions
- •Classical control strategies for electrical drive
- •Conduct measurement of high-voltage and highcurrent signals safely



Intermediate

- •Modulation methods and control strategies for power converters
- •Working principles of a complete power conversion system: frequency converter
- •Knowledge of DC machines and induction machines
- •Advanced control strategies for electrical drives •PID tuning



Advanced

- •Advanced power converters with their control and working principles
- •Study on drivers of switching devices
- Analysis of signals in both time and frequency domain
- •Expansion of application in your own environment



DL PEL201: AC-DC CONVERSION



The **DL PEL201** is a multipurpose bench to study the conversion from alternating current to direct current, using different configurations of non-controlled and controlled rectifiers, to later apply these concepts to drive AC and DC motor drives. The course is divided in two parts: the study of uncontrolled rectifiers using silicon diodes and the study of controlled rectifiers using Silicon Controlled Rectifiers (SCR). Its modular structure makes it easy to reconfigure the system to perform several experiments in various subjects such as uncontrolled diodes and static converter circuits, thyristors, single pulse/two-pulse midpoint converters, to name a few.

Experiments:

DIODES AND UNCONTROLLED RECTIFIERS

- Silicon diode
- Uncontrolled single-phase half-wave rectifier
- Uncontrolled single-phase centre-tapped full-wave rectifier
- Uncontrolled single-phase bridge rectifier
- Uncontrolled three-phase half-wave rectifier
- Uncontrolled three-phase centre-tapped full-wave rectifier
- Uncontrolled three-phase bridge rectifier



SCR AND CONTROLLED RECTIFIERS

- SCR
- Controlled single-phase half-wave rectifier
- Controlled single-phase centre-tapped full-wave rectifier
- Half controlled single-phase bridge rectifiers
- Fully controlled single-phase bridge rectifier
- Controlled three-phase half-wave rectifier
- Controlled three-phase centre-tapped full-wave rectifier
- Dual 3-ph centre-tapped half-wave rectifier
- Half controlled three-phase bridge rectifier
- Fully controlled three-phase bridge rectifier

Modules List DL PEL201:

CODE	DESCRIPTION	QTY
DL 2106T01	Control module	1
DL 2106T02	SCR driver	1
DL 2106T11	Silicon diode	1
DL 2106T12	Diode stack	1
DL 2106T14	SCR	1
DL 2106T15	SCR stack	1
DL 2106T21	Fuse box	2
DL 2106T25	1Ω shunts	1
DL 2106PS	DC power supply	1
DL 2106TPS	3-ph power supply	1
DL 2106RLC	RLC load	1
DL 12B12	Battery	1
DL 2109D33	RMS meter	2
DL T12090_SK	120x90 working bench	1
DL T06090	60x90 working bench	1
DL A120-3M-LED	Frame with 3 levels version with LED lamps	1
DL PCGRID	Computer All in one	1
DL 2600TTI	Three-phase isolation transformer 3kVA	1
TLDCA2.0	Kit of connecting leads	1
DL 1196	Holder for leads	1



DL PEL202: AC-AC CONVERSION



The **DL PEL202** is a multipurpose bench to study the conversion from alternating current to alternating current. Its main fields of applications are in the control of temperature, lighting, and induction motors (with phase-control, on-off control and proportional time control). The course is divided into two sections: the first part studies thyristors and controlled AC/AC converters using power components as diodes, SCR and Triacs with two and six pulse control units and the second part shows a standard application with the study of a double-time constant light dimmer circuit consisting of Triac and Diac with fault simulation. Its modular structure makes it easy to reconfigure the system to perform several experiments in various subjects such as Triac, single-phase and three-phase controllers, to name a few.

Experiments:

THYRISTORS AND AC VOLTAGE CONTROLLER

- TRIAC
- Fully controlled single-phase AC voltage controllers
- Fully controlled single-phase AC voltage controllers with TRIAC
- Half controlled single-phase AC voltage controllers
- Fully controlled 3-ph AC voltage controller
- Half controlled 3-ph AC voltage controller
- Two-phase controlled 3-ph AC voltage controller



LIGHT DIMMER FAULT SIMULATOR

- *Phase control for the regulation of lighting with fault simulation.*
- Double time-constant standard light dimmer circuit consisting of triac, diac, two control potentiometers, resistors and capacitors.
- 20 faults can be switched on using switches located behind a cover. Typical faults: interruptions, short-circuit, faulty components and faulty design.

CODE	DESCRIPTION	QTY
DL 2106T01	Control module	1
DL 2106T02	SCR driver	1
DL 2106T12	Diode stack	1
DL 2106T15	SCR stack	1
DL 2106T17	TRIAC	1
DL 2106T18	Light dimmer with fault simulator	1
DL 2106T21	Fuse box	1
DL 2106T25	1Ω shunts	1
DL 2106PS	DC power supply	1
DL 2106TPS	3-ph power supply	1
DL 2106RLC	RLC load	1
DL 4236	Load manager	1
DL 2109D33	RMS meter	2
DL 2600TTI	Isolated transformer	1
DL T12090_SK	120x90 working bench	1
DL T06090	60x90 working bench	1
DL A120-3M-LED	Frame with 3 levels version with LED lamps	1
DL PCGRID	Computer All in one	1
TLDCA2.0	Kit of connecting leads	1
DL 1196	Holder for leads	1

Modules List DL PEL202:



DL PEL203: DC-DC CONVERSION



The **DL PEL203** is a multipurpose bench to study the conversion from direct current to direct current, and its main fields of applications such as DC power supplies and DC motor drives. The course is divided into two sections. The first part covers choppers and studies the conversion from fixed DC input to a variable DC output directly with the use of SCR, MOSFET and IGBT. The second section studies switching mode power supplies and analyzes the properties of the PWM control with the use of circuits as flyback and forward converters. Its modular structure makes it easy to reconfigure the system to perform several experiments in various subjects such as step-up/step-down converters, speed control of a DC motor, asymmetric half-bridge forward converter, to name a few.



Experiments

CHOPPERS

- Switching devices (SCR with turn-off circuit, MOSFET, IGBT)
- Buck converter with SCR with turn-off circuit, PWM
- Buck converter with IGBT, PWM
- Buck converter with MOSFET, PWM
- Buck converter with MOSFET, PFM
- Buck converter with MOSFET, TPC
- Boost converter with IGBT, PWM
- Boost converter with IGBT, TPC
- Inverting converter with IGBT, PWM

ISOLATED SWITCHING MODE POWER SUPPLY

- Flyback converter with IGBT, PWM
- Forward converter with IGBT, PWM
- Asymmetric half-bridge forward converter with IGBT, PWM

Mod	ules	List	DL	PEL	203:
I VIO GI	arco	LIUU			.200.

CODE	DE DESCRIPTION	
DL 2106T01	Control module	1
DL 2106T02	SCR driver	
DL 2106T03	MOSFET	
DL 2106T04	06T04 IGBT	
DL 2106T05	JL 2106T05 IGBT STACK	
DL 2106T11	L 2106T11 Silicon diode	
DL 2106T13	Rectifier	
DL 2106T16	SCR with turn-off circuit	
DL 2106T21	Fuse box	1
DL 2106T22	EMI filter	1
DL 2106T23	2106T23 Capacitors 1	
DL 2106T24	4 Switching transformer 1	
DL 2106T25	12 shunts	
DL 2106PS	DC power supply 1	
DL 2106TPS	3-ph power supply	
DL 2106RLC	RLC load	
DL 2109D33	RMS meter 2	
DL 2600TTI	Isolated transformer 1	
DL T12090_SK	120x90 working bench	
DL T06090	60x90 working bench 1	
DL A120-3M-LED	D Frame with 3 levels version with LED lamps 1	
DL PCGRID	Computer All in one 1	
TLDCA2.0	Kit of connecting leads 1	
DL 1196	Holder for leads	Page ¹ 54



DL PEL204: DC-AC CONVERSION



The **DL PEL204** is a multipurpose bench to study the conversion from direct current to alternating current, and its main fields of applications such as AC motor drives and AC uninterruptable power supplies. The trainer is designed to study the properties of the inverter with a Pulse Width Modulation control. Its modular structure makes it easy to reconfigure the system to perform several experiments in various subjects such as four-quadrant drive with cycloconverter, control of stator voltage with three-phase AC voltage controller, variable-frequency drive with space vector PWM (SVPWM), to name a few. Page 55



Experiments:

INVERTERS

Fundamentals of inverter

- 1-ph half-bridge inverter
- 1-ph bridge DC chopper, PWM
- Single-phase inverter
- 1-ph bridge inverter, 180° conduction
- 1-ph bridge inverter, sinusoidal PWM
- 1-ph bridge inverter, square-wave PWM *Three-phase inverter*
- 3-ph bridge inverter, 180° conduction
- 3-ph bridge inverter, sinusoidal PWM

Multi-level inverter

- 1-ph neutral point clamped (NPC) 5-level inverter, unchopped
- 1-ph neutral point clamped (NPC) 5-level inverter, PWM

CODE	DESCRIPTION	QTY
DL 2106T01	Control module	1
DL 2106T05	IGBT stack	2
DL 2106T12	Diode stack	
DL 2106T13	L 2106T13 Rectifier	
DL 2106T21	106T21 Fuse box	
DL 2106T22	EMI filter	1
DL 2106T23	Capacitors	1
DL 2106PS	DC power supply	1
DL 2106TPS	3-ph power supply	1
DL 2106RLC	106RLC RLC load 1	
DL 2109D33	2109D33 RMS meter	
DL 2600TTI	Isolated transformer 1	
DL T12090_SK	120x90 working bench	1
DL T06090	60x90 working bench	1
DL A120-3M-LED	Frame with 3 levels version with LED lamps	1
DL PCGRID	Computer All in one 1	
TLDCA2.0	Kit of connecting leads	1
DL 1196	Holder for leads	1

Modules List DL PEL204:



DL PEL205: MOTOR DRIVES



The **DL PEL205** is a multipurpose bench for AC and DC motor drives where power electronics converters are studied as interfaces between input power and motors to control speed and position. The trainer dedicated to the study of different types of machine drives: the DC motors drives, AC slip-ring motor drives and AC squirrel cage motor drives, all of them with speed control. Its modular structure makes it easy to reconfigure the system to perform several experiments in various subjects such as single-phase full-bridge DC chopper/inverter (square wave or sine wave with PWM control), frequency converter, to name a few.

Experiments:

DC MOTOR DRIVE

DC motor drive by single-phase rectifiers

- Single-quadrant drive with 1-ph controlled rectifier
- Single-quadrant drive with 1-ph controlled rectifier for closed loop armature voltage control
- Single-quadrant drive with 1-ph controlled rectifier for closed loop armature voltage control with feedforward
- Single-quadrant drive with 1-ph controlled rectifier for single closed loop speed control
- Single-quadrant drive with 1-ph controlled rectifier for dual closed loop speed control
- Two-quadrant drive (I-IV) with 1-ph controlled rectifier
- Two-quadrant drive (I-III) with 1-ph controlled rectifier
- Two-quadrant drive (I-III) with 1-ph controlled rectifier for dual closed loop speed control
- Four-quadrant drive with 1-ph controlled rectifier

• Four-quadrant drive with 1-ph controlled rectifier for dual closed loop speed control *DC motor drive by three-phase rectifiers*

- Single-quadrant drive with 3-ph controlled rectifier
- Single-quadrant drive with 3-ph controlled rectifier for dual closed loop speed control



CONSTANT FREQUENCY DRIVE – SLIP RING MOTOR

Stator voltage control

- Stator voltage control with variac
- Stator voltage control with AC voltage controller
- Speed control by stator voltage control with AC voltage controller *Rotor resistance control*
- Rotor resistance control with rheostat
- Rotor resistance control with pulsed resistor
- Speed control by rotor resistance control with pulsed resistor
- Rotor resistance control with Scherbius static drive
- Speed control by rotor resistance control with Scherbius static drive

VARIABLE FREQUENCY DRIVE – SQUIRREL CAGE MOTOR

Frequency converter

- Operation of the frequency converter
- Input controlled rectifier
- Output inverter
- DC link brake chopper

Squirrel cage motor

• Preliminary investigation of the squirrel cage motor *Modulation methods of frequency converter*

- Six-step modulation
- Square wave PWM
- Trapezoidal wave PWM
- Sinusoidal wave PWM (SPWM)
- Space vector PWM (SVPWM)

Induction motor control following U/f characteristic

- Motor magnetization for linear U/f characteristic
- Extra start magnetization
- IxR compensation
- Operation in standard converter setting
- Scaled-down operation in star connection

Speed control

- Slip compensation
- Closed loop speed control



Modules List DL PEL205:

CODE	DESCRIPTION	QTY
DL 2106T01	Control module	1
DL 2106T02	SCR driver	
DL 2106T04	IGBT	
DL 2106T06	Frequency converter	
DL 2106T07	07 Three-phase power supply	
DL 2106T12	Diode stack	
DL 2106T15	106T15 SCR stack	
DL 2106T21 Fuse box		2
DL 2106PS	L 2106PS DC power supply	
DL 2106SPS	L 2106SPS Single-phase power supply	
DL 2106TPS	106TPS 3-ph power supply	
DL 2106RLC	RLC load	
DL 2637	Stabilized power supply	1
DL 2109D33	. 2109D33 RMS meter 2	
DL 4236	236 Load manager	
DL 2655	L 2655 Variable 3 phase transformer	
DL 2025DT	L 2025DT Tachometer	
DL 10200A1	. Shunt motor 1	
DL 10250A1	L 10250A1 Shunt generator	
DL 10120A1	>L 10120A1 Slip-ring motor	
DL 10120RA	L20RARotor rheostat1	
DL 10300P	Powder brake 1	
DL 2006D	Load cell	1
DL 10300PAC	Brake control unit	1
DL 10400	Base frame	1
DL 10115A1	Squirrel cage motor	1
DL 10410	Flywheel 1	
DL 2600TTI	Isolated transformer	1
DL T12090_SK	120x90 working bench	1
DL T06090	60x90 working bench	2
DL A120-3M-LED	20-3M-LED Frame with 3 levels version with LED lamps1	
DL PCGRID	Computer All in one	1
TLDCA2.0	A2.0 Kit of connecting leads 1	
DL 1196	Holder for leads	1



DL PELTOT: POWER ELECTRONICS LABORATORY



The DEL PELTOT trainer has been designed to provide students with a fully comprehensive knowledge in power electronics systems, in a compact and flexible solution.

The laboratory is subdivided into 5 major study areas:

- AC-DC Conversion
- AC-AC Conversion
- DC-DC Conversion
- DC-AC Conversione
- Motor drivers



Modules List DL PELTOT

CODE	DESCRIPTION	QTY
DL 2106T01	Control module	1
DL 2106T02	SCR and TRIAC driver	
DL 2106T03	Single MOSFET with driver	
DL 2106T04	Single IGBT with driver	
DL 2106T05	IGBT H-bridge with driver	
DL 2106T06	Frequency converter	
DL 2106T07	Three-phase power supply	
DL 2106T11	Silicon diode	
DL 2106T12	Diode stack	
DL 2106T13	Three-phase diode bridge	
DL 2106T14	SCR	
DL 2106T15	SCR stack	2
DL 2106T16	SCR with turn-off circuit	1
DL 2106T17	TRIAC	
DL 2106T18	Light dimmer - fault simulator 1	
DL 2106T21	Fuse box	2
DL 2106T22	EMI filter	1
DL 2106T23	Capacitors	1
DL 2106T24	Switching transformer	1
DL 2106T25	1Ω shunts	1
DL 2106PS	DC power supply	1
DL 2106SPS	6SPS Single-phase power supply 1	
DL 2106TPS	2106TPS Three-phase power supply 1	
DL 2106RLC	2106RLC R-L-C load	
DL 2637	537 Stabilized power supply 1	
DL 2109D33	109D33 RMS meter 2	
DL 4236	5 Load manager 1	
DL 2655	Variable 3-phase transformer	1
DL 12B12	Battery	1
DL 2025DT	Tachometer	1
DL 10200A1	Shunt motor	1
DL 10250A1	Shunt Excited DC Generator	1
DL 10120A1	Slip-ring 3-phase motor	1
DL 10120RA	Rotor rheostat	1
DL 10300P	Powder brake	1
DL 2006D	Load cell	1
DL 10300PAC	Brake control unit	1
DL 10400	Base For Machines Coupling	1
DL 10115A1	Squirrel cage motor	1
DL 10410	Flywheel	1
DL 2600TTI	Isolated transformer	1
DL T12090_SK	120x90 working bench	2
DL T06090	60x90 working bench	
DL A120-3M-LED	Frame with 3 levels version with LED lamps	2
DL PCGRID	Computer All in one	1
TLDCA2.0	Kit of connecting leads	1
DL 1196	Holder for leads	1



AMTEC PRINTED CIRCUIT BOARD TRAINING & EQUIPMENT

INTRODUCTION

Wide range of equipment for PCB etching and PCB production – the process of applying a copper sheet onto the nonconductive substrate in order to protect the PCB and create conductive pathways or tracks between the electronic components. PCB products include photoetch copper clad boards, prototyping boards for the etching of prototype PCBs, etching accessories such as etch resist pens, lightboxes, stripboard cutters, ferric chloride solution, etching tanks and spray processing tanks.





- **CUTTPCB** PCB shear/blade 34-09 - Lightboxes and fluorescent tube 34-7500 - Mini drill press bench 34-10000 - Sensitive drill 34-33000 - Sensitive drill 34-30001 - Drill bits for PCB CI-BMG10 - UV exposure unit with timer CI-BMG40 - UV exposure unit CI-BMG100 - UV exposure unit single face CI-BMG212 - UV exposure unit double face CI-MIN001 - PCB etch tank CI-MIN100 - PCB etch tank CI-MIN300 - PCB etch tank ICS-312 - Roller Tinning Machine ICB-250 - Dry Film Sheet Laminators ICF-310 - For Drilling and Isolation Routing ICR-400 - General Purpose Ovens ICA-150 - Water Treatment ICM-500 - Through-hole-planting line 34-01 - Photo etch pcb 34-02 - Economy photo etch PCB 34-03 - Plain copper-clad fibreglass circuit board 34-04 - Hard paper board CU 35 µm single sided 1.5mm **34-05** - Epoxy PCB 1.6mm grid pitch 2.54mm 34-30002 - Etch resist pen 34-10 - Electronics solder wire 34-105 - Solder grease 34-08 - Etch-resist transfers 34-0500 - PCB developer 34-0501 - Etch resist stripper 34-0502 - Ferric chloride etchant 34-0748 - Processing tray 34-071 - Universal PCB holder 34-072 - Universal PCB holder 34-073 - PCB holder 34-10002 - Desoldering suction pump 34-10003 - Solder iron stand 34-10000 - Solder dispenser 34-10001 - Soldering stand with magnifier 34-0601 - Rubber Gloves 34-0602 - Laboratory Coat 34-0603 - Squall Eyeshield
- 34-0604 Scrub Block





CUTTPCB

Powerful, cost effective shears which have the ability to accurately cut PCB laminates, plastics up to 2mm thick and aluminium up to 1.5mm.

Access to the cutting area is prevented by heavy perspex shielding extending along both sides of the blade.

A safety latch is fitted to the pivot to prevent accidental operation.

For positional accuracy the cutting bed is fitted with a metric rule which is recessed to assist in securing the PCB or sheeting whilst cutting.

The smaller unit has a cutting capacity of 203mm (8in.) for normal 1.6mm PCB laminate and is extremely compact with an overall height of only 575mm and a base of 275×140 mm.

The larger shear will cut 1.6mm PCB laminates up to 305mm (12in.) wide and has a height of 670mm and a base of 430 x 135mm.

Replacement blade sets are available separately.

LIGHTBOXES AND FLUORESCENT TUBE

These high quality lightboxes provide a valuable aid for all artwork preparation.

- Provides an even illumination over the whole viewing area
- Cool white fluorescent tubes are mounted below a perspex diffuser and protected by a toughened glass working surface
- Robust mild steel construction
- Attractive two-tone tough grey epoxy paint finish
- Louvres on all sides to ensure natural air flow
- Available in A4, A3 and A2 sizes
- The A3 and A2 versions have an on/off switch which also selects one/two tube operation. They also have a tilt facility, which adjusts the viewing angle
- Supplied with 2m UK/ICE mains lead
- Replacement tubes are available separately

MINI DRILL PRESS BENCH 34-7500

Technical specifications	
Rated Voltage	220V
Max. Drilling Diameter	6.5mm
Frequency	50Hz
No-Load Speed	7500rpm
Rated Input Power	180W ~

UV EXPOSURE UNIT WITH TIMER CI-BMG10

- 1:1 artwork, consisting of opaque transfers on translucent drafting film, is placed on the glass screen and the photo-sensitive material is placed on top
- Lid incorporates a foam pad which exerts an even pressure to hold the artwork and photo board in close contact when closed
- Exposure starts automatically when the six minute mechanical timer is rotated to the correct expose time
- Exposure area 240 x 165mm
- Incorporates two 8W actinic UV tubes, mains on/off switch and indicator, mains cable and 13A plug











UV EXPOSURE UNIT GOUBLE FACE CI-BMG212

UV exposure unit double faces with vacuum pump for exposure of photosensitive materials

Designed for double-sided printed circuit board with method of photoengraving, can also be used as a UV exposure unit single face excluding the lower ramp of lamps with a special button in the control panel.

Upper and lower floor in soft transparent material, particularly ultraviolet resistant. This ensures an equal exposition on both sides.

Vacuum control via front panel place meter commands.

Is possible memorize up to 32 exposure times, that remain in memory even in absence of power supply.

All functions are easily settable from keyboard and are displayed by means 4 displays.

PCB ETCH TANK CI-MIN001

The etch tank are suitable for etching single and double sided PCBs with most etchants. The thin, vertical standing, design uses minimal etchant. The tanks have graduations for easy measurement.

The tank can etch a maximum PCB size of 23 × 30cm without heater, or 20 × 30cm with heater. Use with 2000cc minimum, 2300cc maximum liquid. (1000cc = 1 litre)

Etch tank include three clips to suspend the PCB in the liquid etchant, and a thermometer to monitor liquid temperature.

Options include an air pump to bubble agitate the etchant, and heater to maintain optimal etchant temperature, for more efficient etching.

The etch kits include etch tank, air pump, heater and thermometer.

PCB ETCH TANK CI-MIN100

- Accepts boards up to 220 x 280mm
- The inside tank has a built-in heater and thermostat
- Rigid outer moulded protective case
- Splash-proof lid
- Mesh board holder
- Etchant capacity 2 litres
- A pump forces air through two bubble bars to provide agitation for efficient and even etching
- Splash-proof switches control mains power and the pump
- Temperature is set by adjusting the thermostat control
- The use of an RCD safety cut-out is recommended with this equipment

DRILLING AND ISOLATION ROUTING ICF-310

The ICF-310 is the smallest in a range of CNC machines for drilling and routing of PCBs and other materials. All our CNC units can be used for 'Isolation Routing' where the unwanted copper to produce a PCB is removed mechanically rather than chemically etched. The ICF-310 is the smallest and most affordable unit but it still has a processing area of 270mm x 320mm.

All CNC machines are complete with drill and profile routing software. For Isolation Routing the IsoCam or IsoCam Pro software is also needed. This special piece of software uses the data from the GERBER files to generate the corresponding outline shape. Click here for a comparison table of the differences between IsoCam and IsoCam Pro. You can also get more information on IsoCam from our downloads page. All the CNC machines include a Kavo high frequency spindle (60,000 rpm) and

software controlled Z-Axis for optimum processing. All machines accept

industry standard tools. Floor standing or bench top enclosures are available the larger of which has an inbuilt storage cabinet and lockable wheels.











AMTEC DVD LIST

Amtec Techniquip has training DVDs and manuals available for common processes in the various Engineering workshop teaching various principles from safety in the workplace to various machines.

We have the following DVD's available for the Engineering Workshop.

DVD Description	PART NO	COURSE
		-
AC & DC MACHINES DVD + 2 MANUALS	AMTECDVD001	Electrical
AC INDUCTION MOTORS DVD + 2 MANUALS	AMTECDVD002	Electrical
AIR CONDITIONING & REFRIGERATION DVD + 2 MANUALS	AMTECDVD003	AC
ANALOGUE OSCILLOSCOPE DVD + 1 MANUAL	AMTECDVD004	Electronics
AUTO ELECTRICAL TESTING DVD + 1 MANUAL	AMTECDVD005	Auto Electrical
AUTOMATIC PROCESS CONTROL DVD + 2 MANUALS	AMTECDVD006	Instrumentation
AUTOMOTIVE ELECTRICAL MAINTENANCE DVD + 1 MANUAL	AMTECDVD007	Auto Electrical
BASIC BEARING MAINTENANCE DVD + 2 MANUALS	AMTECDVD008	Mechanical
BASIC CENTRIFUGAL PUMPS DVD + 2 MANUALS	AMTECDVD009	Mechanical
BASIC HAND TOOLS DVD + 2 MANUALS	AMTECDVD010	Various
BASIC HYDRAULIC MAINTENANCE DVD + 2 MANUALS	AMTECDVD011	Mechanical
BELT AND CHAIN DRIVES DVD + 1 MANUAL	AMTECDVD012	Mechanical
BRAZING AND BRAZE WELDING DVD + 2 MANUALS	AMTECDVD013	Mechanical
COMPOUND MITRE SAW DVD + 1 MANUAL	AMTECDVD014	Mechanical
COMPRESSED AIR SYSTEMS DVD + 2 MANUALS	AMTECDVD015	Mechanical
CONFINED SPACES DVD + 2 MANUALS	AMTECDVD016	Various
DRILLING TAPPING AND THREADING DVD + 2 MANUALS	AMTECDVD017	Mechanical
ELECTRICAL ANGLE GRINDER DVD + 2 MANUALS	AMTECDVD018	Mechanical
ELECTRICAL CONSTRUCTION OPERATOR DVD + 2 MANUALS	AMTECDVD019	Electrical
ELECTRICAL TEST EQUIPMENT DVD + 2 MANUALS	AMTECDVD020	Electrical
ELECTRICITY IN THE WORKPLACE DVD + 2 MANUALS	AMTECDVD021	Electrical
ESSENTIAL KNOWLEDGE FOR WELDERS DVD + 1 MANUAL	AMTECDVD022	Welding
FIRE SAFETY SERIES DVD + 1 MANUAL	AMTECDVD023	Various
FIRE SAFETY FOR OFFICES DVD - NO MANUALS	AMTECDVD024	Various
FORKLIFT OPERATOR TRAINING 2 DVDs + CD ROM	AMTECDVD025	Fork Lift
GAS HAZARD AWARENESS DVD + 1 MANUAL	AMTECDVD026	Welding
GAS METAL ARC WELDING DVD + 1 MANUAL	AMTECDVD027	Welding
GAS SAFETY - PORTABLE CYLINDER HANDLING DVD + 1 MANUAL	AMTECDVD028	Welding
		Mechanical
GENERAL SAFETY IN THE WORKPLACE 2 DVDs + CDROM	AMTECDVD030	Various
GENERAL WELDING SAFETY DVD + 1 MANUAL		Welding
GRINDING MACHINES DVD + 2 MANUALS		Mechanical
LEAD ACID BATTERIES DVD + 2 MANUALS		Electrical
LIGHT DUTY HAND SOLDERING DVD + 1 MANUALS	AMTECDVD034	Electrical
		Electrical
		Mechanical
		Mechanical
MERSORING & MARRING (BASIC ENG SKIELS) DVD + 1 MAN	AMTECDVD037	Mechanical
		Mechanical
	AMTECDVD039	Electrical
		Liectrical
OXT/ACETYLENE BROCESS DVD + 2 MANUALS		Welding
DRECISION MEASURING INSTRUMENTS DVD + 2 MANUALS		Welding
		Weiding
PRESSURE VESSEL TESTING DVD + 1 MANUAL		iviecnanicai
PROGRAMMABLE LOGIC CONTROLLERS DVD + 2 MANUALS	AMTECDVD045	Electrical
SAFE LIFTING & MOVING 2 DVDS + CD ROM	ANTEODVD046	Various
		various
SHIELDED METAL ARC WELDING DVD + 2 MANUALS		Welding
TUNGSTEN INERT GAS WELDING DVD + 2 MANUALS	AMTEODVD049	Welding
VALVES AND VALVE MAIN I ENANCE DVD + 2 MANUALS	AMTECDVD050	Mechanical
WORKING WITH PORTABLE LADDERS DVD + 2 MANUALS	AM LECDVD051	Mechanical

 \bigcirc

۲

 (\bullet)







12	Street Address:	Unit 20 Hughes Industrial Park Cnr. Oscar and Romeo Street Hughes, Boksburg South Africa 1460
	Phone: Fax:	+27 11 823-2678 +27 11 823-1919
	Email:	sales@amquip.co.za (International/ General Sales) marco@amquip.co.za (Sales Manager) nick@amquip.co.za (Sales Manager)
	Website:	www.amtectechniquip.co.za
	Postal Address:	Postnet Suite #71, Private Bag X01 Farrarmere Benoni, 1518
G	SPS coordinates:	-26.183503 28.229474

"Please feel free to contact us should you require a Quotation or Technical information & datasheets"

AMTEC TECHNIQUIP – ENGINEERING THE FUTURE & SUPPLYING WORLD-CLASS EDUCATIONAL EQUIPMENT FOR:

- × 4th Industrial Revolution
- × Automotive Petrol, Diesel, Electric, Hybrid
- **×** Auto-Electrical & Auto-tronics
- **~ Chemical Engineering**
- ✓ Civil Engineering
- ✓ Electrical Domestic & Industrial
- Electronics Digital Systems & Process control
- **× Food Technology**
- ✓ Hydraulics & Pneumatics
- Instrumentation & Process Control
- ✓ Mechanical and Alignment
- **Mechatronics**
- 🔀 Millwright
- * Renewable Energies

SALES @AMQUIP.CO.ZA | WWW.AMTECTECHNIQUIP.CO.ZA

۲

 \bigcirc