



Features

- Wide range of AC and DC experiments
- Configurable AC side transformers
- Up to 2.0KW DC output available
- Direct reading of firing delay angle
- Three and single phase operation
- Gate pulse monitoring
- Load current and voltage monitoring
- Inversion experiments
- External control option
- Interphase transformer
- Smoothing inductor
- Clear mimic diagram
- Excellent manual includes theory summary
- Configurable bridge components
- Six thyristors, Six diodes
- Snubber and fast fuse protection
- Two year warranty

Introduction

Power semiconductor devices are used extensively throughout electrical engineering applications. Since these devices generally provide the final amplification function between low power electronic control logic and the high power output, knowledge of their basic properties and circuitry is of utmost importance to electrical engineers even if not specialising in power electronics. In producing the NE9023 Thyristor and Diode Teaching Unit it is the aim of TQ to provide such knowledge and understanding by practical experimentation and guided study. Developed in consultation with Loughborough University in the United Kingdom the equipment covers those circuits supplied from an AC source.

Seventeen experiments are listed in the description but many more experiments can be set up by the innovative lecturer and the equipment lends itself readily to student project work.

Further scope presents itself if multiple units are installed in the laboratory; by using two units, for example, a 12 pulse bridge can be constructed and, by connecting the two outputs in series, a High Voltage DC Link convertor station simulated. Connecting them in parallel can simulate an electrochemical supply rectifier. Throughout the experimental manual reference is made to such practical applications.

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Description

A free standing, mobile, unit forming an extremely versatile laboratory teaching aid designed to provide a sound understanding of the principles of diode and thyristor circuits commutated by an AC supply including circuits for AC control using the firing delay method. Static loads of resistance or combined resistance and inductance can be used and it is possible to supply dynamic loads, for example the armature of a DC motor and in this way evolve open loop control characteristics by controlling the speed of the DC machine. Inverted mode operation is made possible by the wide range of firing angle control available. Each of the three 1.0KVA single phase transformers included in the unit has a primary winding with a 1/Ö3 tapping (58%) and a secondary with two separate halves which are linked on the mimic for all but the double three phase star connection. The overall secondary also has a 1/Ö3 tapping and these tappings allow an unusually wide selection of bridge connections, both controlled and uncontrolled. Figures 1 and 2 overleaf list significant features of the bridges with varying primary side transformer configurations.

Uncontrolled and controlled rectification can be investigated using the six rectifiers and six thyristors included and it is also possible to construct half controlled bridges by combining the two types of device with or without a diode across the load for freewheeling.

Thyristors are fired at the desired point on the AC waveform by gate pulses having their timing controlled by electronic phase shifting that is operated by a mimic mounted potentiometer fitted with a protractor dial to give direct reading of firing delay angle.

An external 0-5v DC supply may also be used to control the firing delay angle. Single or three phase gate pulse sequencing is controlled by mimic mounted selector switch that provides for single pulse triggering for single phase circuits but for a second pulse delayed by 600 for three phase circuits. Pulsing the three phase circuit twice ensures start up and enables easier handling of discontinuous load currents. A selector switch on the mimic chooses the gate pulse to be monitored, a feature that permits rapid change of the selected gate. Thyristors and diodes are generously rated and are protected against transient overvoltages and excessive dv/dt by snubber networks with transformer switching surge suppression also being provided. Overcurrent protection is by fast acting 20amp fuses with additional fuses, 12amp and 33amp, being provided on the mimic diagram for connection by the student on the DC side, these being particularly important during inverted operation.

A centre tapped load circuit smoothing inductor is included together with a centre tapped reactor that is used as an interphase transformer in double three phase star circuits or as an inter-circuit reactor when phase displaced rectifier circuits are paralleled. Three current shunts are provided for monitoring the current waveforms.

Components connections are brought to sockets on the mimic diagram and are clearly identified with component symbols which are used in the comprehensive instruction manual. Circuits are completed by the student, in accordance with instructions in the experimental manual, using the supplied safety leads with simple push in connectors.

Typical Experiments

Experiments are graded in difficulty and significance of sequence in the associated study course and each experiment stands alone although cross referencing between them occurs from time to time. Each experiment is intended for a three hour laboratory session but discretion can be used by the supervisor to omit certain sections if there is less time available

- 1 Single phase diode rectifier circuits
- 2 Polyphase half-wave diode rectifier circuits
- 3 Double three phase star diode rectifier circuits
- 4 Three phase diode bridge full wave rectifier circuits
- 5 Single phase thyristor bridge circuit. Fully controlled bridge.
- 6 Three phase thyristor bridge circuit. Fully controlled bridge.
- 7 Half controlled bridge rectifier circuits
- 8 Single phase AC control using thyristors
- 9 Rectifier output smoothing methods
- 10 Harmonics generated by rectifier circuits
- 11 Commutation effects in single phase rectifiers
- 12 Commutation effects in polyphase rectifiers

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- 13 Inverted operation of a rectifier
- 14 AC power components with rectifiers
- 15 DC motor speed control using rectifiers
- 16 Rectifiers in parallel
- 17 Rectifiers in series

There is a bibliography and recommendations for further experimentation in the instruction manual.

Ancillaries

Measuring equipment needed for most of the listed experiments is of the type commonly found in the laboratory and to ensure cost effectiveness we have deliberately not incorporated dedicated instrumentation. In many cases digital multimeters are sufficient but in some experiments more extensive equipment is needed. Should the suggested equipment not already be available in the laboratory we would be pleased to offer a complete supporting package.

- 1- 100v AC Voltmeter
- 1- 300v AC Voltmeter
- 1- 10a AC Ammeter
- 2- 200v DC Voltmeter
- 1- 25a DC Ammeter
- 1- Dual trace 20MHz oscilloscope
- 1- 3.75KW Resistive Load bank

Services Required

One 4KVA three phase incoming supply is the only input required for the unit. State the available supply voltage and frequency when ordering.

Dimensions and Weights

Nett: 1500 x 600 x 600mm; 350Kg

All dimensions and weights are approximate and for guidance only.

Tender Specification

NE9023 is a complete apparatus dedicated to the study of rectifier bridges when uncontrolled, half controlled, fully controlled or operating in inverted mode. A clear mimic diagram is provided containing safety sockets to which all significant internal equipment is connected thus allowing interconnection by the student using safety connecting leads.

In detail the equipment consists of :

A free standing, mobile, console with a work surface and flat top to accommodate external instrumentation.

Mounted on and within this enclosure would be:-

- 1- Main isolator
- 1- Supply on indicator lamp
- 1- Supply conditioning transformer
- 1- Main mimic diagram containing all sockets and control equipment.
- 3- 1KVA single phase double wound transformers each having a 1/3 primary side tapping and a dual wound secondary having an overall 1/3 tapping
- 6- Diodes rated 600v 16amp mean, complete with heatsinks and snubbing circuits. Connected to mimic terminals
- 6- Thyristors rated 600v 20amp mean, complete with heatsinks and snubber circuits. Connected to mimic terminals
- 1- Seven position gate pulse monitoring selector switch
- 1- Single/three phase operation selector switch
- 1- Firing delay angle control potentiometer with protractor dial indicating the firing angle
- 1- Internal/external control selector switch
- 1- Tapped load inductor. Rated 35amp. Connected to mimic terminals
- 1- Tapped iron cored interphase transformer. Rated 18amp. Connected to mimic terminals
- 3- Current shunts. Non inductive rated 150mV at 30amps. Connected to mimic terminals
- 1- Mimic mounted DC fuse rated 13amps

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- 1- Mimic mounted DC fuse rated 33amps
 - 1- Set of firing angle control equipment including phase sequence derivation
 - 3- Blown fuse indicator lamps
 - 2- Double switched socket outlets for auxiliary supplies.
 - 1- Set of fuses for transformers and semiconductor devices. Fast acting as appropriate.
- The equipment would be complete with operation and maintenance instructions.
Equipment to be supplied with a two year parts and labour warranty.