# Electrical Drive Trainers

In every industry there are industrial processes where electrical motors are used as a part of process equipment. For many instances the speed, torque or position variable need to be adjusted for the desired optimal operation of the process.

With recent advances of power semiconductor and converter topologies, electric variable speed drives are witnessing a revolution. Embedded Controllers are advancing rapidly in features, especially for power Electronics & Drives applications. Most of these controllers are ideal for motor control applications with latest PWM and Control Technique for AC Motor, DC Motor, BLDC Motor, PMSM Motors & Switched Reluctance Motor etc.

**NITech** offers varies types of Embedded Controllers based Drives for various types of Motors with various types of machines set up for advanced drives laboratory & research works.

NITech

# National Infotech

A way to Power Electronics and Embedded Systems Solutions..

## Developed By:

## National Infotech


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## : Authorized Distributor:

# NIED01 Microcontroller Based Three Phase Induction Motor Drive

Trainer for studying Sinusoidal Pulse Width Modulated (SPWM) as well as Space Vector Modulated (SVM) inverter fed variable frequency drive operation.

## Specifications:

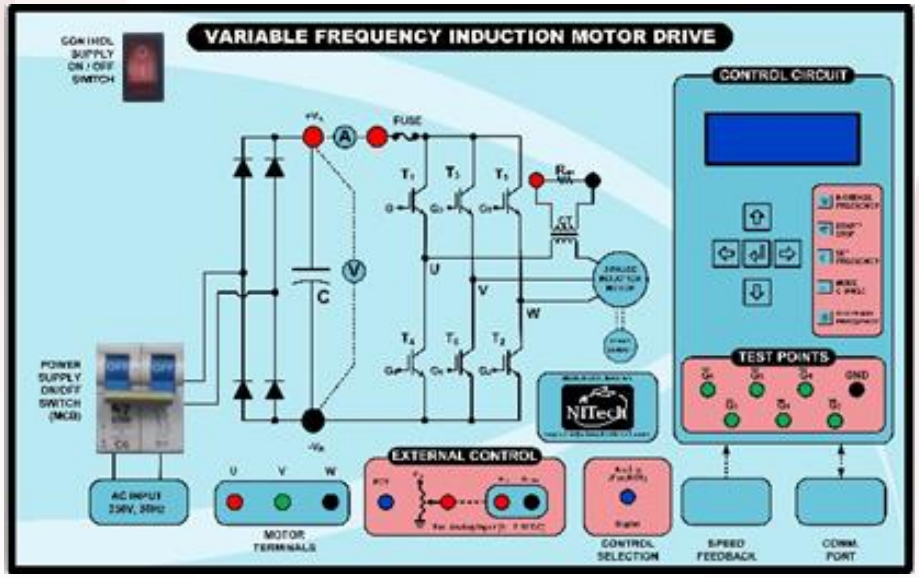
- The kit comprise of single phase uncontrolled rectifier, three phase inverter, 1 HP, 415 V, 50 Hz, 1440 RPM three phase induction motor with proximity as speed sensor and 32-bit Cortex M4 ARM Microcontroller based control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Both Digital and Analog mode of control is possible. External circuit interfacing through analog mode of control.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply. Proper isolation between control and power circuit is provided.
- Observation of stator current through current transformers.

## Motor Controller:

- STM32F407VGT6 ARM Cortex-M4 Board featuring 32-bit ARM Cortex-M4F core, 168 MHz, 1 MB Flash, 192 KB RAM in an LQFP100 package.
- On-board ST-LINK/V2 with selection mode switch, Power supply: through USB bus or from an external.
- 8 General purpose input lines, 8 General purpose output lines, 16x2 LCD interface, 5 keys interface.
- 3 high speed digital outputs and 2 High speed digital input lines. 6 PWM outputs, 3 QEI inputs.
- 9 Analog inputs are level shifted to 1.65V for AC signal interface.

## List of Experiments:

- Study ofprinciple of Variable Frequency Drive (VFD).
- Study of SPWM control technique.
- Study of Relationship between Control Voltage, Modulation Index, frequency and Inverter Output Voltage in SPWM Inverter. (Digital/Analog Mode Control).
- V/f control of Induction Motor with SPWM Inverter.
- Study of SVM controltechnique.
- Study of Relationship between Control Voltage, Modulation Index, frequency and Inverter Output Voltage in SVM Inverter. (Digital Mode / Analog Mode Control).
- V/f control of Induction Motor with SVM Inverter.
- To study harmonic spectrum and THD of output waveforms.
- Comparison of SPWM and SVM control techniques.



# NIED02 Microcontroller Based BLDC Motor Drive

Trainer for studying Brushless DC (BLDC) drive operation and control.

## Specifications:

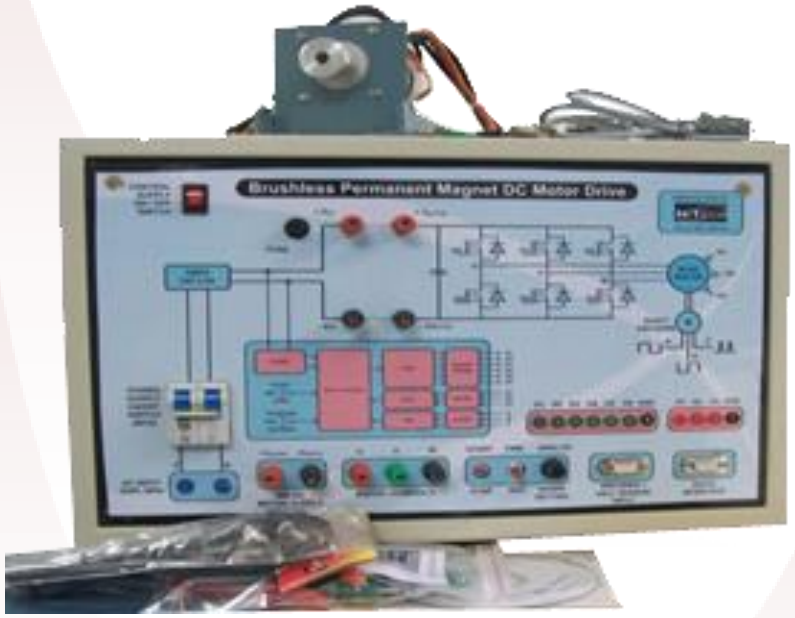
- The kit comprises of 48 V SMPS, three phase inverter, 36V, 4000rpm BLDC motor, 500ppr encoder (speed sensor) and 32-bit Cortex M4 ARM Microcontroller based digital controller.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of hall sensor outputs, encoder pulses and gate pulse generation for BLDC motor.
- Open loop and closed loop speed control of BLDC motor.
- Speed estimation and closed loop control using hall sensor feedbacks and using encoder feedbacks.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

- STM32F407VGT6 ARM Cortex-M4 Board featuring 32-bit ARM Cortex-M4F core, 168 MHz, 1 MB Flash, 192 KB RAM in an LQFP100 package.
- On-board ST-LINK/V2 with selection mode switch, Power supply: through USB bus or from an external.
- 8 General purpose input lines, 8 General purpose output lines, 16x2 LCD interface, 5 keys interface.
- 3 high speed digital outputs and 2 High speed digital input lines. 6 PWM outputs, 3 QEI inputs.
- 9 Analog inputs are level shifted to 1.65V for AC signal interface.

## List of Experiments:

- To study gate pulse generation for BLDC motor using Hall Sensor Feedback.
- To study BLDC motor speed control using PWM technique.
- To study open loop speed control of BLDC motor with Hall sensor feedback.
- To study closed loop speed control (PI control) of BLDC motor with Hall sensor feedback.
- To study closed loop speed control (PI control) of BLDC motor with encoder feedback.
- Understanding effect of Gain factor and Integral Factor in closed loop control of BLDC motor.



# NIED03 PMSM Vector Control Drive with PMSM Motor

Trainer designed for studying sensored and sensor-less control of Permanent Magnet Synchronous Motor (PMSP) drive operation.

**Specifications:**

- The kit comprises of 48V SMPS, three phase inverter, 36 V, 4000rpm PMSM motor, 500ppr encoder and 32-bit ARM Microcontroller based control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Scalar Control, Sensorless Vector Control and Sensored Vector Control.
- Observation of intermediate stage waveforms of gate pulse generation.
- Open loop and closed loop speed control of motor.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply. Proper isolation between control and power circuit should be provided.

**Motor Controller:**

- STM32F407VGT6 ARM Cortex-M4 Board featuring 32-bit ARM Cortex-M4F core, 168 MHz, 1 MB Flash, 192 KB RAM in an LQFP100 package.
- On-board ST-LINK/V2 with selection mode switch, Power supply: through USB bus or from an external.
- 8 General purpose input lines, 8 General purpose output lines, 16x2 LCD interface, 5 keys interface.
- 3 high speed digital outputs and 2 High speed digital input lines. 6 PWM outputs, 3 QEI inputs.
- 9 Analog inputs are level shifted to 1.65V for AC signal interface.

**PMSM scalar controlled drive (V/f control)**

- Motor Ratings: 36V, 4000 RPM
- 32 bit DSC based v/f control in steps of 0.1 Hz
- Frequency range: 2 Hz to 50 Hz
- MATLAB interfacing
- SVPWM based control

**PMSM sensored vector controlled drive**

- Motor ratings: 36V, 3000 RPM
- 32 bit DSC based v/f control in steps of 0.1 Hz
- Incremental encoder as speed & position sensor.
- Programmable and observable various quantities on DSO; Like, iα, iβ, id, iq etc…
- MATLAB interfacing
- User settable PI control parameters in a defined range
- Loading arrangement
- Frequency range: 2 Hz to 50 Hz in steps of 0.2 Hz
- Motor current/voltage signals available on front panel for observation on DSO
- Speed loop timing: 20 ms
- Current loop timing: less than 1ms

**Sensor less vector controlled PMSM drive**

- Motor ratings: 36V, 4000 RPM
- 32 bit DSC based v/f control in steps of 0.1 Hz
- Programmable and observable various quantities on DSO; Like, iα, iβ, id, iq etc…
- MATLAB interfacing
- User settable PI control parameters in a defined range
- Loading arrangement
- Frequency range: 2 Hz to 50 Hz in steps of 0.2 Hz
- Motor current/voltage signals available on front panel for observation on DSO
- Speed loop timing: 20 ms
- Current loop timing: less than 1ms
- EKF (Extended Kalman Filter) based sensor less algorithm

**List of Experiments:**

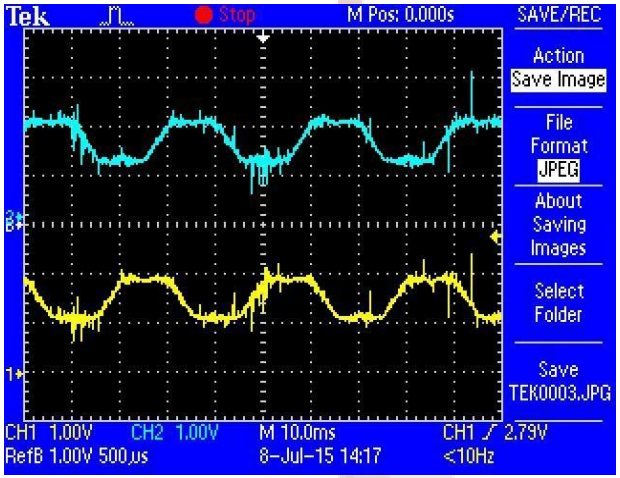
- To study gate pulse generation using rotor position sensor feedbacks.

- To study estimation of rotor angle using rotor position sensor feedbacks.
- To study scalar (v/f) control of PMSM motor.
- To study vector control of PMSM motor using rotor position sensor feedbacks (sensored).
- To study Sensorless vector control of PMSM motor.
- To study the waveforms at an intermediate stage of control circuit (Clarke / Park Transformation, Rotor angle etc.)

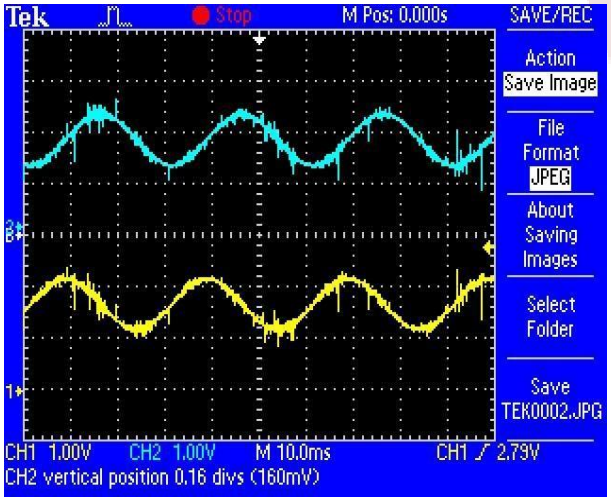

## Observed Waveforms:

### Observation of PMSM scalar controlled drive (V/f control):

**Ia,Ib 1000 CCW**

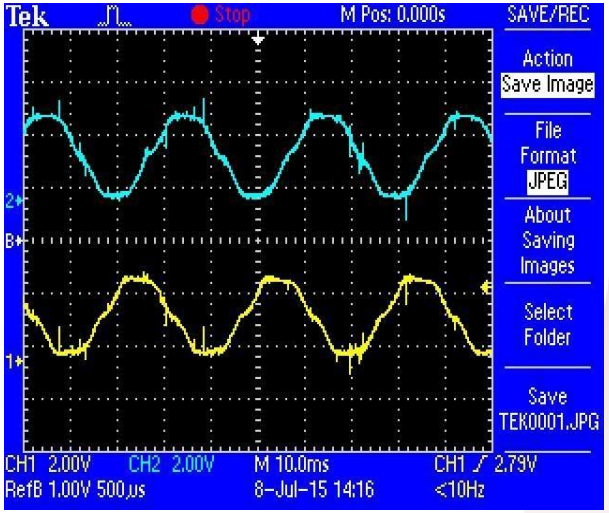



**Va,Vb 1000 CCW**



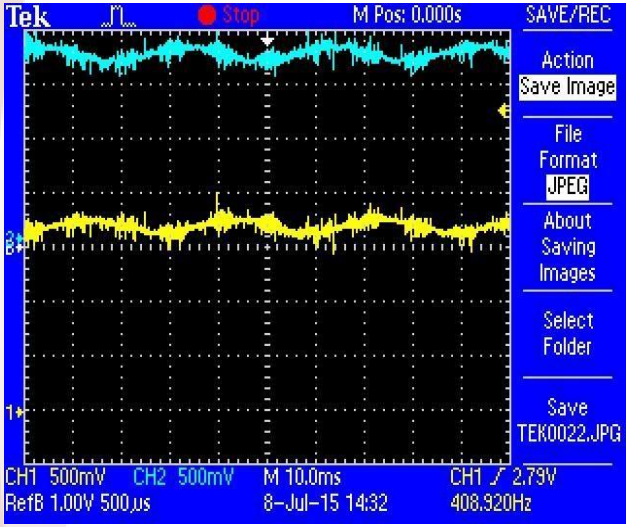

**Sector theta 1000 CCW**


**Valpha,Vbeta 1000 CCW**

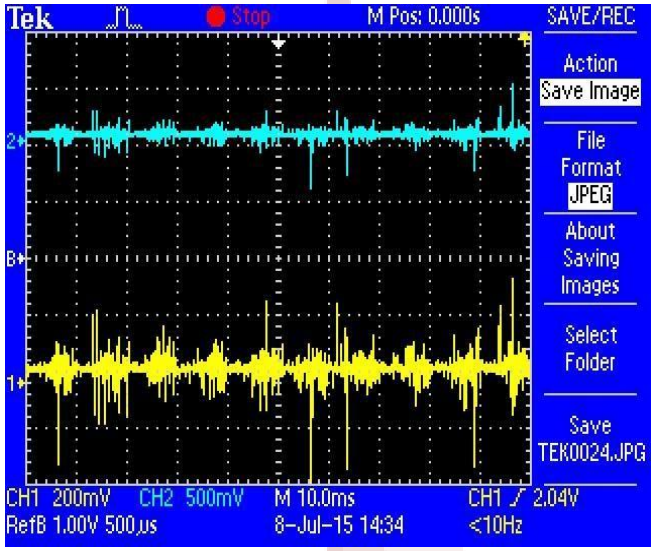


## Observation of PMSM sensored vector controlled drive:

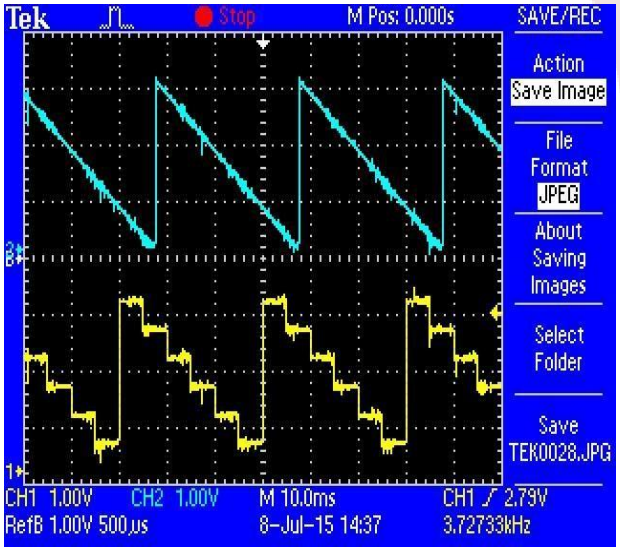
### Ia&Ib 1000 CW



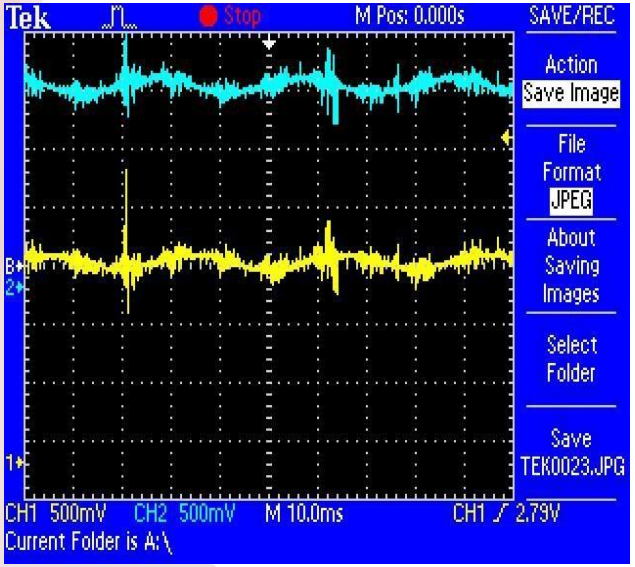

### Iq& Id 1000 CW



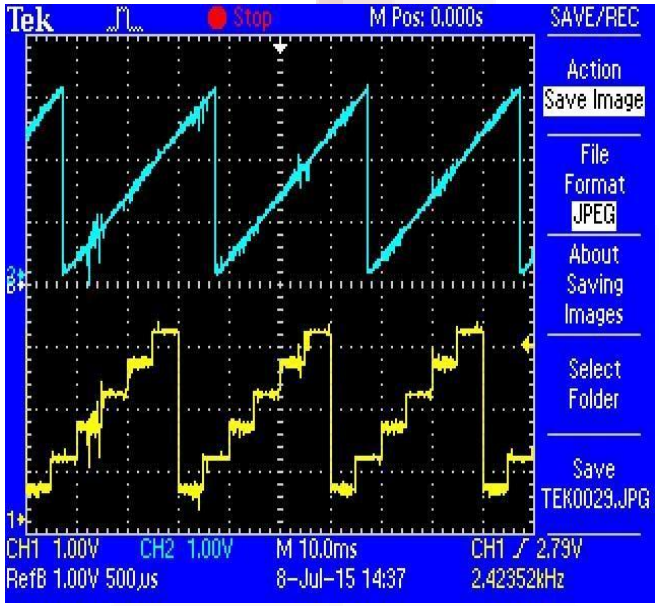

### sector& theta 1000 CW



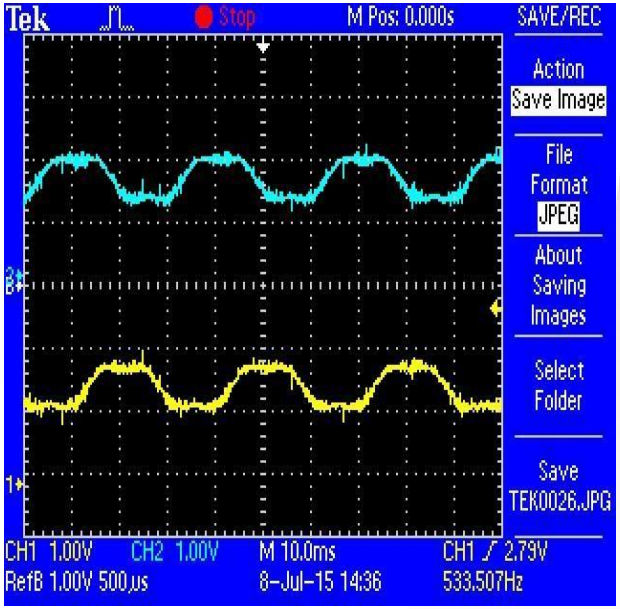

### Ialpha&Ibeta 1000 CW



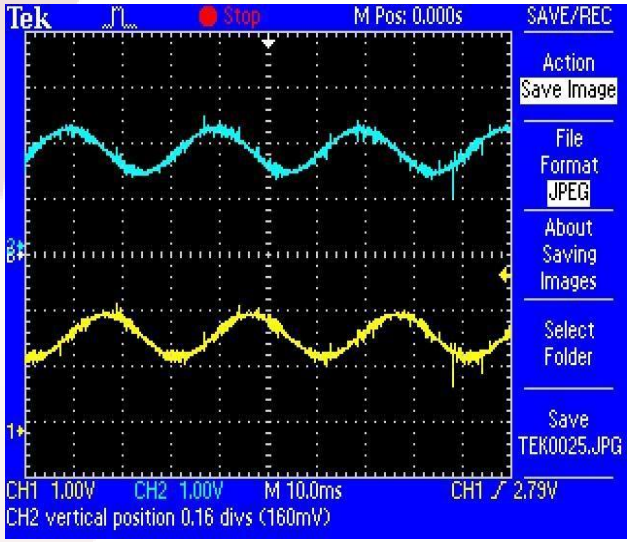

### Sectors & theta 1000 CCW



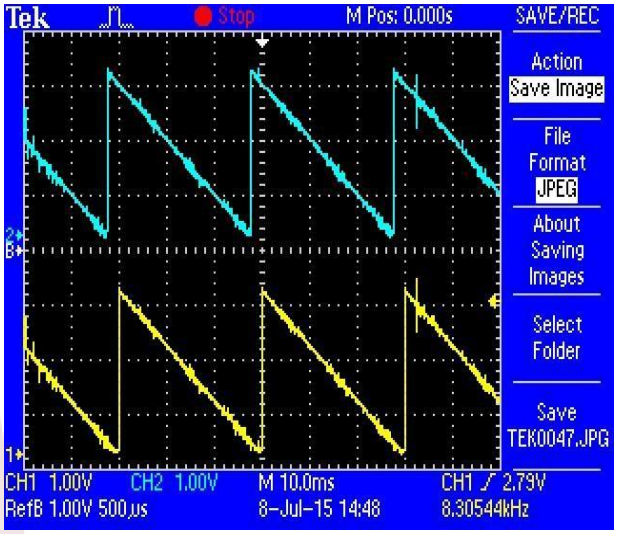

### Va&Vb 1000 CW



Valpha&Vbeta 1000 CW




Est. Theta & Enc. Theta (CW, 1000 RPM)




## Observation of Sensor less vector controlled PMSM drive:

Est. Theta & Enc. Theta (CCW, 1000 RPM)

# NIED04 Switched Reluctance Motor Drive

Trainer for studying Switched Reluctance Motor (SRM) drive operation.

## Specifications:

- The kit comprises of power module, 0.5 HP, 3000rpm SRM motor, 500ppr encoder and 32-bit ARM Microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Open loop and closed loop speed control of motor.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

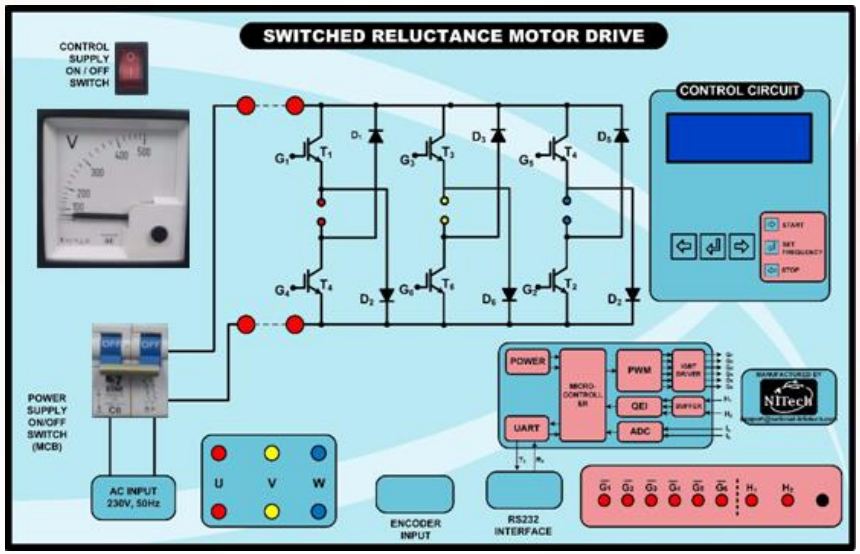
- STM32F407VGT6 ARM Cortex-M4 Board featuring 32-bit ARM Cortex-M4F core, 168 MHz, 1 MB Flash, 192 KB RAM in an LQFP100 package.
- On-board ST-LINK/V2 with selection mode switch, Power supply: through USB bus or from an external.
- 8 General purpose input lines, 8 General purpose output lines, 16x2 LCD interface, 5 keys interface.
- 3 high speed digital outputs and 2 High speed digital input lines. 6 PWM outputs, 3 QEI inputs.
- 9 Analog inputs are level shifted to 1.65V for AC signal interface.

## SRM Power Module (IGBT Based):

- The power module is designed for Switched reluctance Motor speed control application up to 1 HP ratings.
- External PWM controller can be interfaced with this power module for SR-Motor open / closed loop speed control Application.
- IGBT-power module with heat sink and snubbercircuit-forms Split-DC link power circuit for SR motor control, High-speed opto Isolation for all IGBT - PWM isolation (1200V, 30A IGBTs - STGW30NC120HD).
- Current sensor with signal conditioning circuit- provided for output and DC input current measurement, SR-position-sensor signal conditioning circuit, Speed sensor circuit provided for closed loop operation. Test points in front panel for PWM and current waveform observation.

## List of Experiments:

- To study gate pulse generation using rotor position feedbacks.
- To study SRM motor speed control using PWM technique (CW/CCW switching pattern).
- To study open loop control of SRM motor using rotor position feedback.
- To study closed loop speed control (PI control) of SRM motor using rotor position feedback.
- Understanding effect of Gain factor and Integral Factor in closed loop control.



# NIED05 Microcontroller Based Chopper Fed Separately Excited DC Motor Drive

Trainer for studying chopper fed Separately Excited DC (SEDC) motor drive operation.

## Specification:

- The kit comprise of a 0.5HP, 180V, 1500RPM SEDC motor, control module consist of IGBT H-Bridge to drive the DC motorwithproximity sensor as speed sensor and microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Open loop and closed loop speed control of motor.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

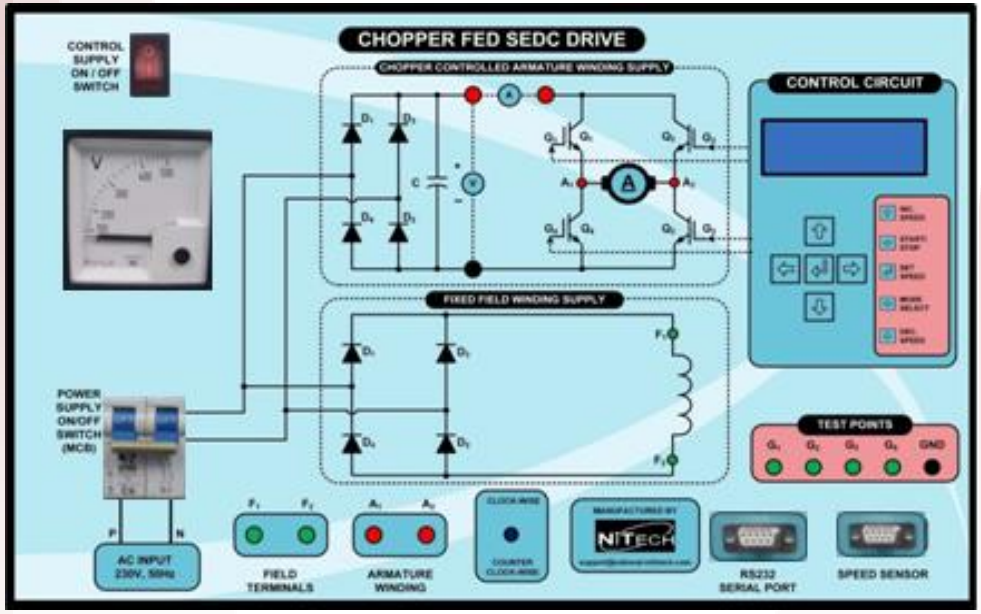
- SST89E516RD 8-bit MCU clocked @18.432MHz
- Buffered I/O Ports using 74HC573
- 5 Interface Keys
- 16x2 LCD (JHD162A) display
- UART section (IC Max 232)

## Power card:

- Rating: 300V, 5A
- 1200V, 30A IGBTs - STGW30NC120HD
- Fast acting diodes MUR460

## List of Experiments:

- Study of four quadrant chopper circuit with its gate-pulses generation mechanism.
- Open-loop control of SEDC Motor.
- Bidirectional control of SEDC Motor (CW/CCW switching pattern).
- Close-loop control of SEDC Motor with speed sensor feedback.
- Understanding effect of Gain factor and Integral Factor in closed loop control.
- Measurement of speed of SEDC Motor with speed sensor feedback.
- **MATLAB** interfacing for viewing and controlling speed response of motor.



# NIED06 Microcontroller Based Control Rectifier Fed Separately Excited DC Motor Drive

Trainer for studying controlled rectifier fed Separately Excited DC (SEDC) motor drive operation.

## Specifications:

- The kit comprises of a 0.5HP, 180V, 1500RPM SEDC motor, control module consist of thyristor bridge to drive the DC motorwithproximity sensor as speed sensor and microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Open loop and closed loop speed control of motor.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

- SST89E516RD 8-bit MCU clocked @18.432MHz
- Buffered I/O Ports using 74HC573
- 5 Interface Keys
- 16x2 LCD (JHD162A) display
- UART section (IC Max 232)

## Power card:

- Rating 300V, 5A
- SCR 25TT12 (25A, 1200V)
- Diode 1N5408 (4 Nos.)
- Snubber circuit

## List of Experiments:

- Study of controlled rectifier circuit and its gate pulse generation mechanism.
- Open-loop control of SEDC Motor.
- Close-loop control of SEDC Motor with speed sensor feedback.
- Understanding effect of Gain factor and Integral Factor in closed loop control.
- Measurement of speed of SEDC Motor with speed sensor feedback.
- **MATLAB** interfacing for viewing and controlling speed response.

# NIED07 Microcontroller Based dual converter FED SEDC Motor Drive

Trainer for studying **DualConverter fed** Separately Excited DC (SEDC) motor drive operation.

## Specifications:

- The kit comprises of a 0.5HP, 180V, 1500RPM SEDC motor, control module consist of dual converter to drive the DC motor withproximity sensor as speed sensor and microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Open loop and closed loop speed control of motor.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

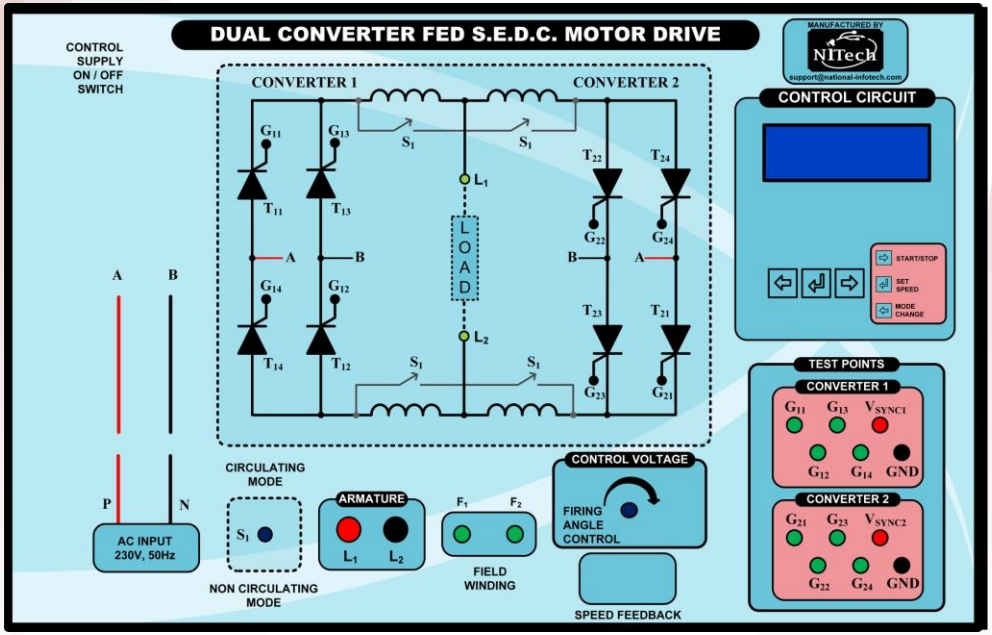
- SST89E516RD 8-bit MCU clocked @18.432MHz
- Buffered I/O Ports using 74HC573
- 5 Interface Keys
- 16x2 LCD (JHD162A) display
- UART section (IC Max 232)

## Power card:

- Rating 300V, 5A
- SCR 25TT12 (25A, 1200V)
- Diode 1N5408 (4 Nos.)
- Snubber circuit

## List of Experiments:

- Study of dual converter circuit and its gate pulse generation mechanism.
- Non-circulating and circulating mode of operation
- Bidirectional control of SEDC Motor (CW/CCW switching pattern).
- Open-loop control of SEDC Motor.
- Close-loop control of SEDC Motor with Sensor.
- Understanding effect of Gain factor and Integral Factor in closed loop control.
- Measurement of speed of SEDC Motor with speed sensor feedback.
- **MATLAB** interfacing for viewing and controlling speed response.



# NIED08 Microcontroller Based Chopper FED PMDC Motor Drive

Trainer for studying chopper-fed permanent magnet DC (PMDC) motor drive operation.

## Specifications:

- The kit comprises of a 0.5HP, 180V, 1500RPM Permanent Magnet DC motor, control module consist of IGBT based H-Bridge to drive the DC motor with proximity sensor as speed sensor and microprocessor based digital controller.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Single phase rectifier with capacitive filter as input DC source.
- Open loop and closed loop speed control of PMDC motor.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

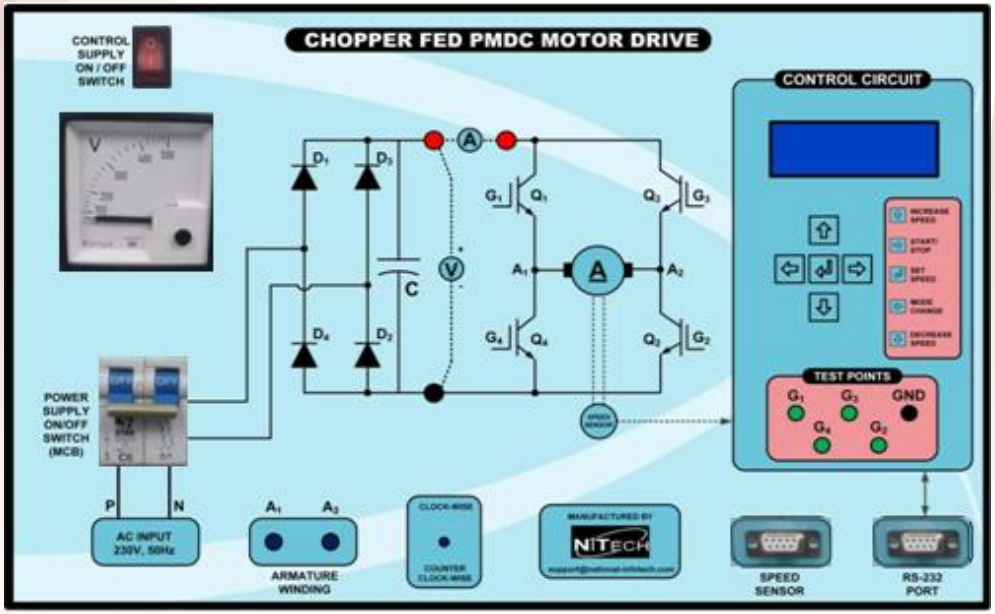
- SST89E516RD 8-bit MCU clocked @18.432MHz
- Buffered I/O Ports using 74HC573
- 5 Interface Keys
- 16x2 LCD (JHD162A) display
- UART section (IC Max 232)

## Power card:

- Rating: 300V, 5A
- 1200V, 30A IGBTs - STGW30NC120HD
- Fast acting diodes MUR460

## List of Experiments:

- Study of gate pulse generation for chopper circuit.
- Open-loop control of PMDC Motor.
- Bidirectional control of PMDC Motor (CW/CCW switching pattern).
- Close-loop control of PMDC Motor with speed sensor feedback.
- Understanding effect of Gain factor and Integral Factor in closed loop control.
- Measurement of speed of PMDC Motor with speed sensor feedback.
- To study**MATLAB**utility for viewing and controlling speed response of motor.



# NIED09 Microcontroller Based Controlled rectifier FED PMDC Motor Drive

Trainer for studying **Controlled Rectifier fed** permanent magnet DC (**PMDC**) motor drive operation.

## Specifications:

- The kit comprise of a 0.5HP, 180V, 1500RPM Permanent Magnet DC motor, control module consist of Thyristor bridge to drive the DC motor with proximity sensor as speed sensor and microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Open loop and closed loop speed control of motor
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

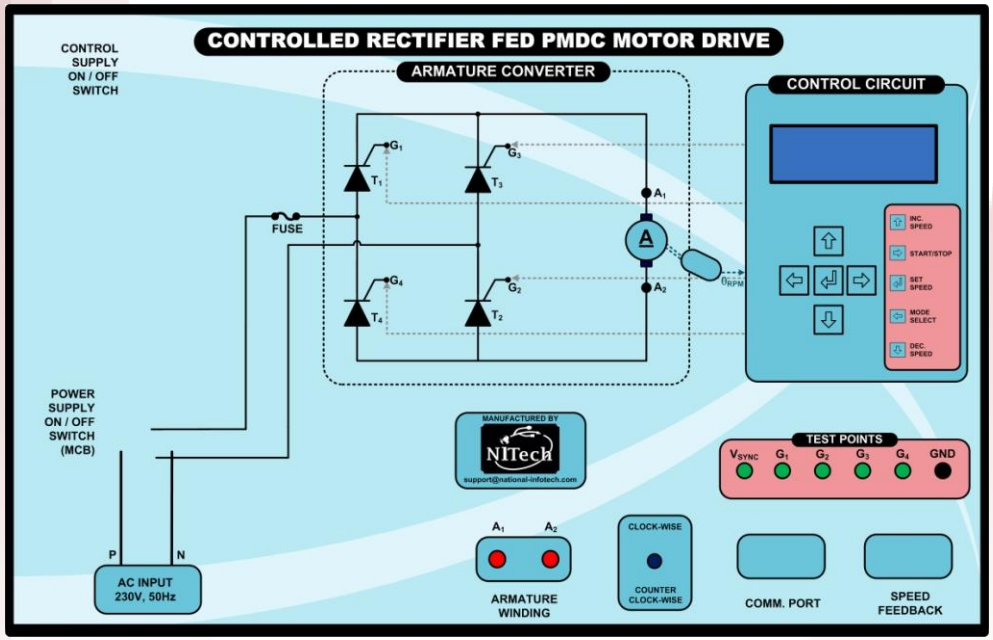
- SST89E516RD 8-bit MCU clocked @18.432MHz
- Buffered I/O Ports using 74HC573
- 5 Interface Keys
- 16x2 LCD (JHD162A) display
- UART section (IC Max 232)

## Power card:

- Rating 300V, 5A
- SCR 25TT12 (25A, 1200V)
- Diode 1N5408 (4 Nos.)
- Snubber circuit

## List of Experiments:

- Study of controlled rectifier circuit and its gate pulse generation mechanism.
- Open-loop control of PMDC Motor.
- Close-loop control of PMDC Motor with speed sensor.
- Understanding effect of Gain factor and Integral Factor in closed loop control.
- Measurement of speed of PMDC Motor with speed sensor feedback.
- **MATLAB** interfacing for viewing and controlling speed response of motor.



# NIED10 Microcontroller Based dual converter FED PMDC Motor Drive

Trainer for studying **Dual Converter fed** permanent magnet DC (**PMDC**) motor drive operation.

## Specifications:

- The kit comprise of a 0.5HP, 180V, 1500RPM Permanent Magnet DC motor, control module consist of dual converter to drive the DC motor with proximity sensor as speed sensor and microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- Open loop and closed loop speed control of motor.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

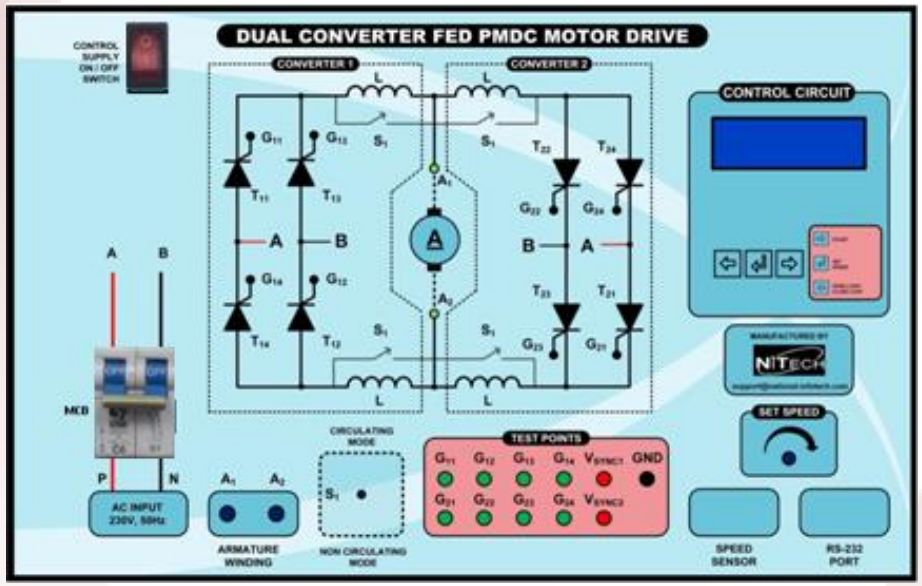
- SST89E516RD 8-bit MCU clocked @18.432MHz
- Buffered I/O Ports using 74HC573
- 5 Interface Keys
- 16x2 LCD (JHD162A) display
- UART section (IC Max 232)

## Power card:

- Rating 300V, 5A
- SCR 25TT12 (25A, 1200V)
- Diode 1N5408 (4 Nos.)
- Snubber circuit

## List of Experiments:

- Study of dual converter circuit and its gate pulse generation mechanism.
- Non-circulating and circulating mode of operation.
- Bidirectional control of PMDC Motor.
- Open-loop control of PMDC Motor.
- Close-loop control of PMDC Motor with speed sensor.
- Understanding effect of Gain factor and Integral Factor in closed loop control.
- Measurement of speed of PMDC Motor with speed sensor feedback.
- **MATLAB** interfacing for viewing and controlling speed response of motor.



# NIED11 Microcontroller Based SINGLE PHASE INDUCTION Motor Drive

Trainer for studying Sinusoidal Pulse Width Modulated (SPWM) inverter fed variable frequency Single phase Induction motor drive operation.

## Specifications:

- The kit comprise of single phase uncontrolled rectifier, single phase inverter, 0.5 HP single phase induction motor withproximity sensor as speed sensor and microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply. Proper isolation between control and power circuit should be provided

## Motor Controller:

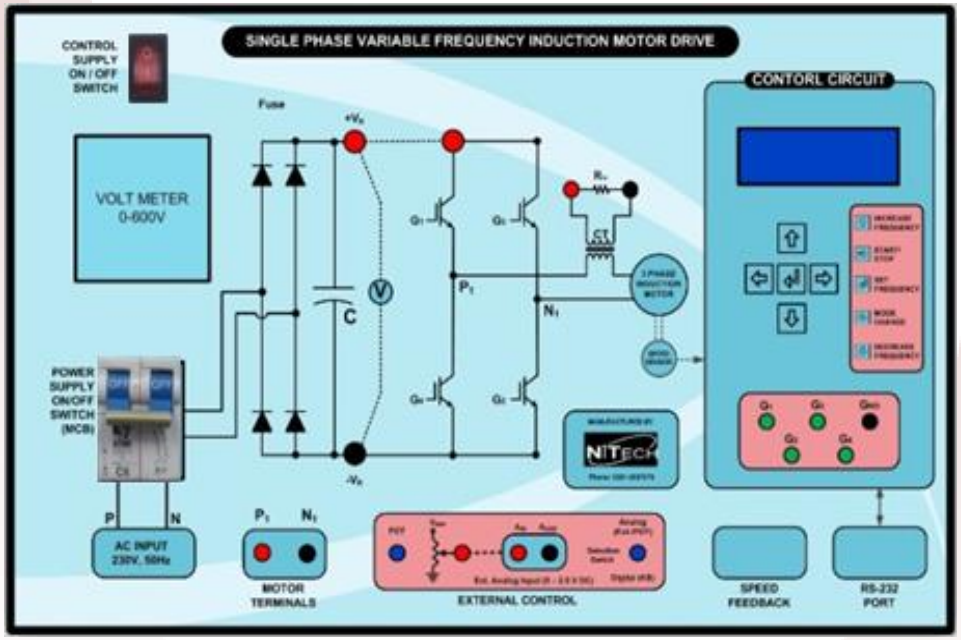
- STM32F407VGT6 ARM Cortex-M4 Board featuring 32-bit ARM Cortex-M4F core, 168 MHz, 1 MB Flash, 192 KB RAM in an LQFP100 package.
- On-board ST-LINK/V2 with selection mode switch, Power supply: through USB bus or from an external.
- 8 General purpose input lines, 8 General purpose output lines, 16x2 LCD interface, 5 keys interface.
- 3 high speed digital outputs and 2 High speed digital input lines. 6 PWM outputs, 3 QEI inputs.
- 9 Analog inputs are level shifted to 1.65V for AC signal interface.

## Power card:

- Rating: 300V, 5A
- 1200V, 30A IGBTs - STGW30NC120HD
- Fast acting diodes MUR460

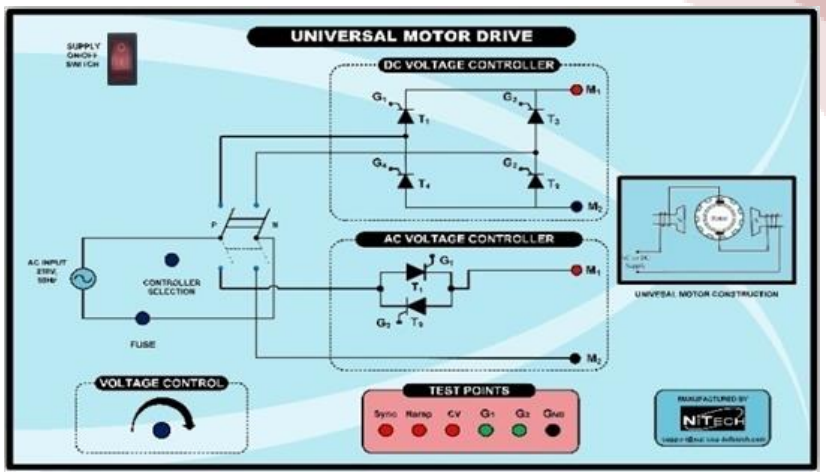
## List of Experiments:

- Study ofprinciple of Variable Frequency Drive (VFD).
- Study of SPWM control pulse generation scheme.
- Study of Relationship between Control Voltage, Modulation Index, frequency and Inverter Output Voltage in SPWM Inverter.
- V/f control of Induction Motor with SPWM Inverter.
- Study of harmonic spectrum and THD of output waveforms.



# NIED12 UNIVERSAL Motor Drive

Trainer for studying Universal motor drive operation.




## Specifications:

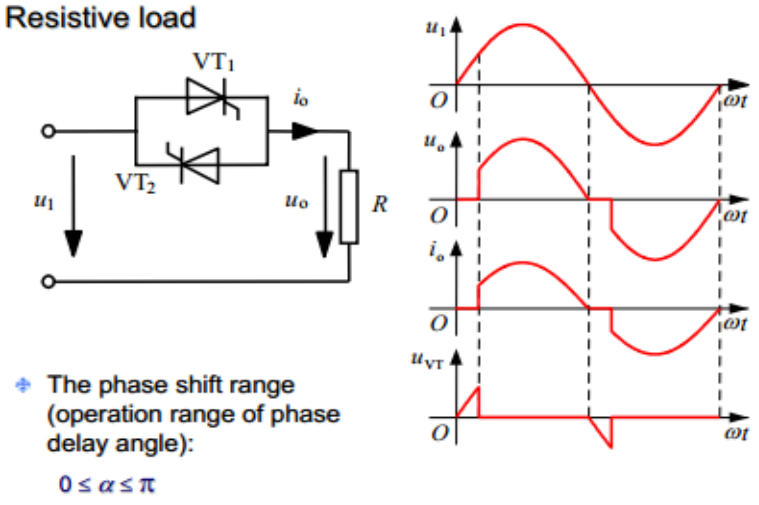
- The kit comprise of a fraction HP universal motor, control module consist of single phase thyristor controlled rectifier, single phase AC voltage controller, selector switch to run motor with AC/DC supply and thyristor gate pulse controller.
- Observation of intermediate stage waveforms of gate pulse generation.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

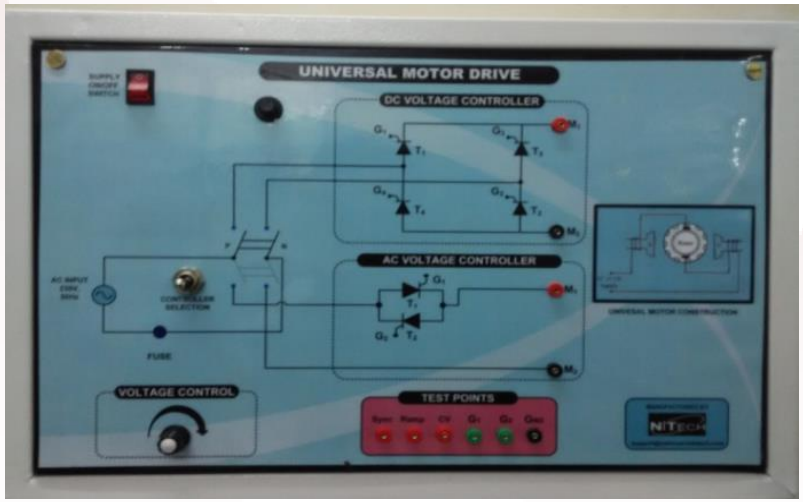
## Power card:

- Rating 300V, 5A
- SCR 25TT12 (25A, 1200V)
- Diode 1N5408 (4 Nos.)
- Snubber circuit

## List of Experiments:

- Study of single phase controlled rectifier operation with R-load.
- Study of single phase AC voltage controlled operation with R-load.
- Study of Relationship between control voltage, firing angle, and output voltage of Motor.
- Controlling of Universal Motor with single phase controlled rectifier.
- Controlling of Universal Motor with single phase AC voltage controller.
- Study of gate pulse generation circuit for controlled rectifier and ac voltage controller.



# NIED13 Microcontroller Based Stepper Motor Drive

Trainer for studying different modes of controlling stepper motor.

## Specifications:

- This experiment setup consists of 12V, 5kg-cm stepper motors, control module consist of MOSFET to drive the motor andmicrocontrollerbased control circuit for gate pulse generation.
- Half step, Full step, micro stepping (Quarter step / Sixteen step) mode.
- Observation of intermediate stage waveforms of gate pulse generation.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

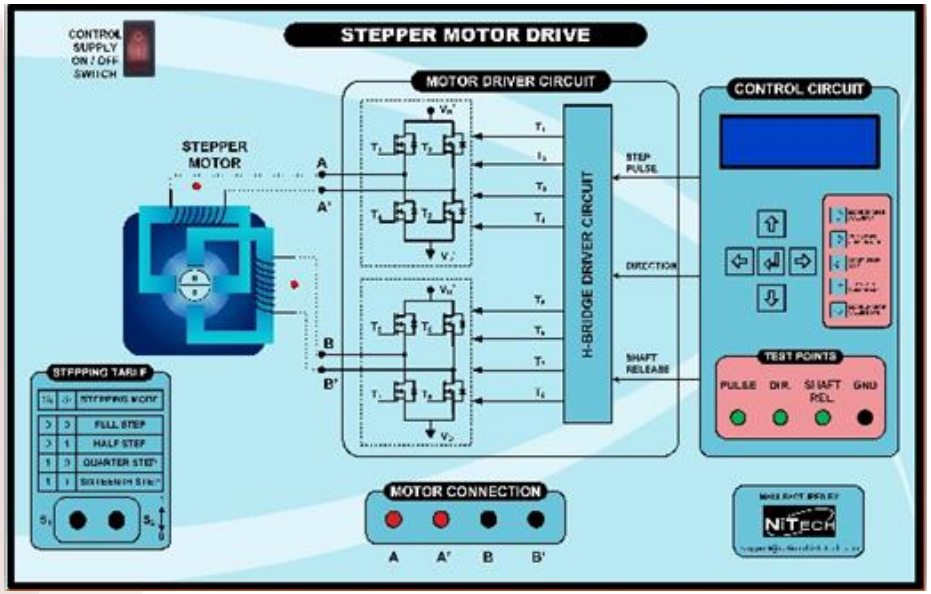
- SST89E516RD 8-bit MCU clocked @18.432MHz
- Buffered I/O Ports using 74HC573
- 5 Interface Keys
- 16x2 LCD (JHD162A) display
- UART section (IC Max 232)

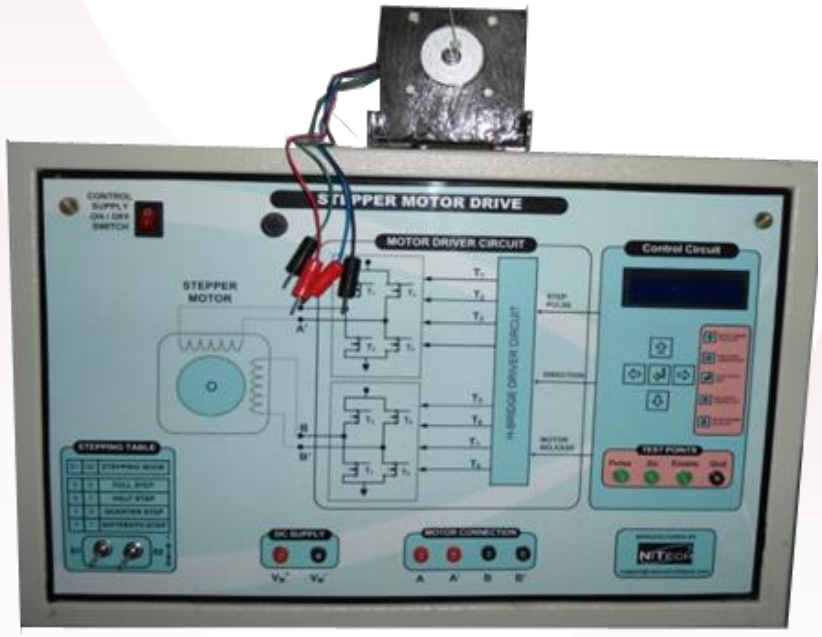
## Power card:

- Rating: 100V, 5A
- MOSFET IRF840 (400V, 8A)

## List of Experiments:

- Study of control circuit of stepper motor drive.
- Study of controlling stepper motor in half-step mode.
- Study of controlling stepper motor in full-step mode.
- Study of controlling stepper motor in micro stepping mode. (Quarter step / Sixteen step)
- Study of controlling stepper motor rotation in forward / reverse direction.



# NIED14 MULTI-LEVEL INVERTERBASED THREE PHASE INDUCTION MOTOR DRIVE

Trainer for studying three phase diode clamed multi-level inverter based, Sinusoidal Pulse Width Modulated (SPWM) as well as Space Vector Modulated (SVM) inverter fed variable frequency drive operation.

## Specifications:

- The kit comprise of single phase uncontrolled rectifier, three phase diode clamped multilevel inverter, 1 HP three phase induction motor and microcontroller based digital control circuit.
- Microcontroller based control circuit with LCD and keyboard interface is provided for selecting different operating modes.
- Observation of intermediate stage waveforms of gate pulse generation.
- **MATLAB** utility for viewing and controlling speed of the motor from personal computer.
- The kit works directly with 230 V, 50 Hz, AC supply.
- Proper isolation between control and power circuit is provided.

## Motor Controller:

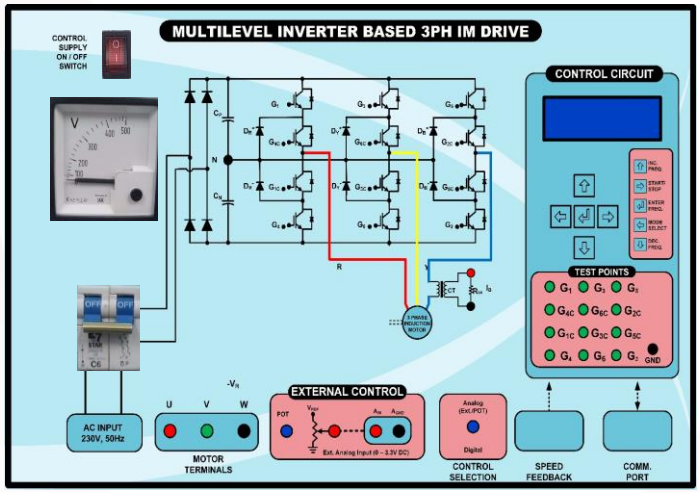
- STM32F407VGT6 ARM Cortex-M4 Board featuring 32-bit ARM Cortex-M4F core, 168 MHz, 1 MB Flash, 192 KB RAM in an LQFP100 package.
- On-board ST-LINK/V2 with selection mode switch, Power supply: through USB bus or from an external.
- 8 General purpose input lines, 8 General purpose output lines, 16x2 LCD interface, 5 keys interface.
- 3 high speed digital outputs and 2 High speed digital input lines. 6 PWM outputs, 3 QEI inputs.
- 9 Analog inputs are level shifted to 1.65V for AC signal interface.

## Power card:

- Rating: 300V, 5A
- 1200V, 30A IGBTs - STGW30NC120HD
- Fast acting diodes MUR580

## List of Experiments:

- Study of principle of Variable Frequency Drive (VFD).
- Study of SPWMcontroltechnique.
- Study of Relationship between Control Voltage, Modulation Index, frequency and Inverter Output Voltage in SPWM Inverter. (Digital Mode /Analog Mode).
- V/f control of Induction Motor with SPWM Inverter.
- Study of SVMcontroltechnique.
- Study of Relationship between Control Voltage, Modulation Index, frequency and Inverter Output Voltage in SVM Inverter. (Digital Mode / Analog Mode)
- V/f control of Induction Motor with SVM Inverter.
- To study harmonic spectrum and THD of output waveforms.
- Comparison of SPWM and SVM control techniques.



# NIED15 Servo Motor Trainer

This Trainer kit is to demonstrate professional servo drive operation:

- 400 Watt, 3000 RPM, AC Servo Motor
- Incremental Encoder with resolution 17-bit or more
- Electromagnetic Brake
- Power supply: Single-phase 200 to 230 VAC, 50/60 Hz
- Position, Speed, Torque Control Mode
- Regenerative Resistor
- Pulse/Analog Input
- Tuning software

# NIED16 Three phase AC voltage Controller with Induction motor load.

## Specifications:

- The kit comprise of three phase AC Voltage controller, 1 HP three phase induction motor and microprocessor based digital controller.
- This kit provides platform for rigorous experimentation on three-phase AC voltage controller.
- All possible configurations of three-phase AC voltage controlled should be experimented.
- The kit works directly with three-phase 440V; 50Hz AC supply and all measuring meters connected externally.
- Proper isolation between control and power circuit should be provided.
- Test points for observing intermediate waveforms of gate pulse generation should be provided for observation.

The setup will consist of following cards:

## Three phase firing card

- On board ZCD
- TCA785 synchronize with ZCD
- TIP 122
- Pulse transformer
- Gate resistor with anti-parallel diode

## Three phase power card

- SCR 25TT12 (25A, 1200V) (6 Nos.)
- Diode 1N5408 (6 Nos.)
- Snubber circuit

## List of Experiments:

- Study of Three-phase, three-wire line controlled AC voltage controller with motor.
- Study of gate pulses respect to SCR and other control circuits and their signals.
- Three phase line controlled AC voltage controller with delta loads,
- Three- phase AC voltage controller with inside delta controlled loads.
- Three-phase, four-wire line controlled AC voltage controller with star loads.
- Control speed of a 3-phase induction motor with stator voltage.