EXPERIMENT NO.7

Objective: To control the pulse width modulation (PWM) voltage source inverter (VSI) fed 3-phase AC drive with DSP controller.

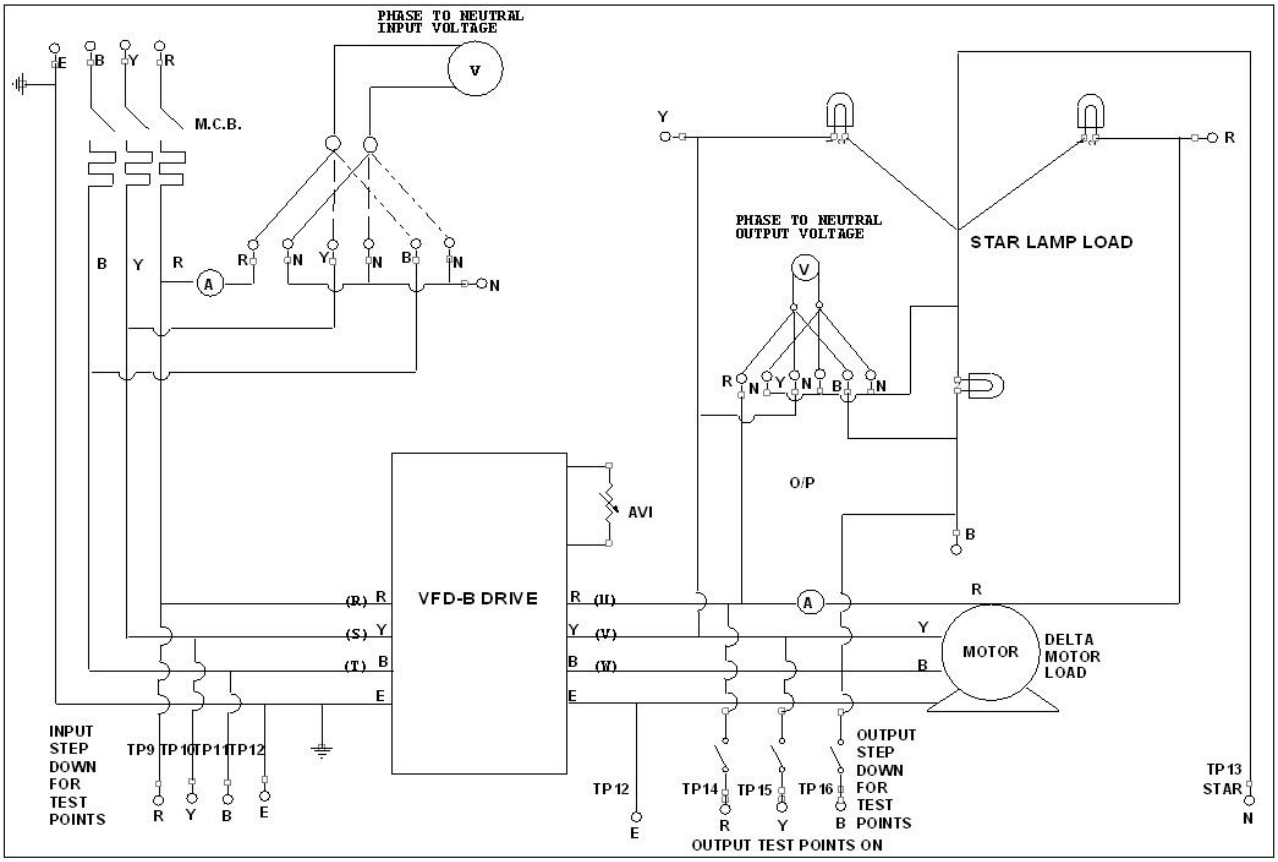
Apparatus required:

1) DSP based Industrial Grade Drive Module [VFD-M] with control and power module kit.
2) Three phase Induction motor[1HP] and D.C.Generator[1HP] coupled together.
3) C.R.O. Dual Trace. (unearthed CRO)
4) Four 100 watt lamps for loading.
5) Attenuator type C.R.O. probe.

Cautions:

6) Use unearthed CRO only to observe the waveforms.
7) Do not watch control & power signals simultaneously on oscilloscope.

Circuit diagram:



THEORY:-

A device that converts dc power into ac power at desired output voltage and frequency is called an inverter. Some industrial applications of inverters are for adjustable speed ac drives, induction-heating, stand by air craft power supplies, UPS for computers, HV dc transmission lines

etc. forced commutated inverters provide an independent ac output voltage and adjustable frequency and have therefore much wider applications.

The variable frequency converters which acts as interface between utility power System and induction motor must satisfy following basic requirement:

1) Ability to adjust frequency according to the desired output speed.

2) Ability to adjust output voltage so as to maintain a constant air gap flux in a constant torque region.

3) Ability to supply rated current on a continuous basis at any frequency.

Variable frequency drives illustrates the basic concept where utility input is converted into dc by means of either controlled or uncontrolled rectifier and then inverted to provide three phase voltages and currents to the motor. These converters are classified based on the type of rectifier and inverter.

1) Pulse-width-modulated voltage-source inverters (PWM-VSI) with a diode rectifier.

2) Square-wave voltage-source inverter (square-wave-VSI) with a thyristor rectifier.

3) Current-source inverter (CSI) with thyristor rectifier.

PWM-VSI scheme is implemented here. PWM inverter controls both the frequency and magnitude of the voltage output. One possible method of generating the inverter Switch control signals is by comparing three sinusoidal control voltages(at the desired output frequency and proportional to the output voltage magnitude)with a triangular waveform at a selected switching frequency.

PARAMETER SETTINGS:

Parameter	Explanation	Settings
Pr.00	Source of Frequency command	**00**: Master frequency determined by digital keypad(LC-M02E) **01**: Master frequency determined by 0 to +10 V input on AVI terminal with jumpers. **02**: Master frequency determined by 4 to 20mA input on ACI terminal with jumpers. **03**: Master frequency determined by RS-485 communication port. **04**: Master frequency determined by potentiometer on digital keypad.
Pr.01	Source of operation command	**00:** Operation determined by Digital keypad. **01:** Operation determined by external control terminals, keypad STOP is effective. **02:** Operation determined by external control terminals, keypad STOP is ineffective. **03:** Operation determined by RS-485 communication port, keypad STOP is effective. **04:** Operation determined by RS-485 communication port, keypad STOP is ineffective.

PC CONNECTIVITY

1. Connect serial cable between PC com port to the VFD- B unit RS 232 (DB 25) port.
2. Switch on the 3 phase supply to the unit.
3. Switch on MCB. (neon glows).
4. Change set parameter as per given in table II - **RS232 setting**.
5. In PC select program-----Delta ------- CVFD
6. Select create option. Communication format setting menu will get open.
7. Select parameter of VFD B as shown in fig. Press Start and make auto detection succeed.
8. PC will come to the next menu i.e. connection :- VFD-B, slave address …
9. Press PLAY button ▶ and give **Run** command and Stop command through PC and check motor response .
10. Give arbitrary command through PC and check motor response.
11. User can see the waveform on PC by selecting Fig. option.
12. User can try various options through PC .

PROCEDURE: - 1

INTRODUCTION TO UNIT-

NOTE: Connect 4 core wire input supply to the unit in proper R-Y-B-N sequence.

1. Connect the 3 ph plug to 3 ph supply. Ensure the Earthing before using the Kit to avoid electrical shocks.
2. Connect a lamp load [15 watt x 3 nos on left panel] They are not compulsory.
3. Keep POT at mid position 5.
4. Make sure that all switches are in OFF position before starting unit.
5. Connect the motor [any induction motor 1/4 hp] to the unit through the Jone's plug provided on front panel.
6. Switch on the 3 ph on wall and on unit by MCB.
7. Set the parameter as shown in table.
8. Press FWD , hold it pressed. O/p increases slowly & motor runs slowly reaching to high speed with soft start. Release start o/p goes to zero.
9. Press REV- hold it pressed, motor runs slowly anticlockwise.
10. Turn ON FWD switch, O/p increases slowly & motor runs slowly reaching to high speed with soft start. Turn OFF FWD switch o/p goes to zero.
11. Turn ON REV switch, motor runs slowly anticlockwise. Turn OFF REV switch o/p goes to zero and motor stops.
12. Try turning ON MI-1 to MI-6 one by one see the Freq Display.

PROCEDURE: - 2
LOADING IN FLUX VECTOR CONTROL MODE: -

1. Connect the Unit, Drive, 3-ph & Motor as per procedure-1.
2. Put the FWD switch in ON condition.
3. Keep freq =5 using MI-1.
4. Note the speed of motor using tachometer.
5. Observe the parameters like Frequency,Amperes, instantaneous Frequency(H), & o/p voltage.
6. Measure the speed after fully loading the motor.
7. Take similar readings at frequency 10, 15 & 20 using MI2,MI3,MI 4 switches or by variable pot on front panel of the kit.
8. Switch off MI1 to MI4.
9. Keep POT at Min.
10. Note set freq = 0.00 to 0.05. Practically zero freq.
11. Check that the motor is free running.
12. Connect the CRO across any o/p test pts from Tp14 to Tp16.
13. Give start command.
14. Sense the motor shaft. It will show HOLDING TORQUE . That is , It will require some force to rotate the shaft from is steady position.
15. Comment on observations.

OBSERVATIONS:

Frequency(HZ)	Load	O/P Voltage(volts)	O/P Current(A)	Speed(RPM)	Regulation

Conclusions:

CONTROLS ON PANEL **METERS & INDICATIONS ON PANEL**

CONTROLS	FUNCTION
FWD/STOP	MOTOR RUNS FWD TILL PRESSED OR STOP
REV/STOP	MOTOR RUNS REV TILL PRESSED OR STOP
PHASE SELECTOR	SELECT I/P PH TO VOLTMETER
PHASE SELECTOR	SELECT O/P PH TO VOLTMETER
SPEED POT	SET SPEED IF CONFIGURED
MCB	ON-OFF 3 PH SUPPLY TO UNIT
SW MI - 1	SPEED selection Bit 1
SW MI - 2	SPEED selection Bit 2
SW MI - 3	SPEED selection Bit 3
SW MI - 4	SPEED selection Bit 4
SW MI - 5	PAUSE operation
SW MI - 6	RUN PLC program
FWD	MOTOR RUNS IN FWD DIRN.
REV	MOTOR RUNS IN REV DIRN.
RS 232	To control Drive through PC

INDICATION	FUNCTION
I/P VTG	INDICATES I/P VOLTAGE L TO N AS SELECTED
I/P CURRENT	SHOWS I/P LINE CURRENT IN R LINE
O/P VTG	INDICATES O/P VOLTAGE L TO N AS SELECTED
O/P CURRENT	SHOWS O/P LINE CURRENT IN R LINE
DISPLAY ON PANEL	
F	MASTER FREQUENCY
H	O/P FREQUENCY x K CONSTANT)
A	O/P CURRENT
U	USER DEFINED UNIT, WHERE (U=F x K CONSTATNT)
MULTIFUNCTION DISPLAY	CAN DISPLAY 16 DIFFERENT VALUES AS SET BY PARAMETER 00-04