

# POWER PROTECTION FOR CNC SYSTEM'S SERVODRIVE AND MOTOR

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**Abstract** - Computer numerical control (CNC) machines are used to shape the metal parts by cutting, milling, drilling, boring. Its consists of a servo-drives, servo-motors, and other motor. It can be programmed by control panel. The electronic components of a CNC machine are sensitive. Sometime machine is damage by lightning strikes or the overvoltage. So production loss is increase and repair bills are also increase. With the more use of CNC machines in the whole world, these problems are become a financial concern to CNC machine users and their electric companies. This paper explore the over voltage and protection technique. Finally a recommended powering and its methods are presented to help eliminate power quality related operating problems with machines and protect the drives and the motor from the overvoltage and the different issues.

**KeyWords:** 1,servodrive 2,servomotor 3,filters(rc,rlc,sinewave 4,igbt 5,inverter 6,powercable

## 1.INTRODUCTION

As We know CNC Machines is very useful to shape the different types of metal by cutting, boring, drilling, and milling, and for this work different equipment is used which are servo drives, servo motor, spindle motor, and many more. This all equipment is very expensive and placed in CNC machines. A different types of abnormal conditions like over voltage, surges, flowing of fault current, short circuit, this types of conditions are damage the all parts of CNC machine which is servo motor, servo drives, spindle motor, cables, and many more equipments of drives also which are inverter, rectifier and the all types of semiconductor devices which are in the servo drives. So from the use of different types of filters, reactors this problem can be solved or the minimize. By the placing of such types of filters and reactors in the servo systems or the servo drives here we try to remove the overvoltage problem at the servo motor as well as electromagnetic interference problem at the servo drives with use of filters and reactors

## 2. FAULTS AND ABNORMAL CONDITION IN SERVO MOTOR AND TROUBLE SHOOT

1. CAN'T ROTATE: this problems are take place because of the motor connections are loose or open. The motor is over load. The bearings of motor are damaged
2. MOTOR GOING TO OVERHEAT: this problems are take place due to Motor current very high and motor voltage is high
3. MOTOR IS NOISE: this problems are take place due to motors parts loose or bolt barring are loose or The bearings are damaged.
4. OPERATION OF MOTOR IS ERRAGULAR: this problems are take place due to motor locks into position, runs without control, motor Phases 1 & 2, 1 & 3 or 2 & 3 reversed.
5. OVERVOLTAGE AT MOTOR TERMINAL: this problems take place due to Load changes and Mismatch of cable and motor terminal impedance

## 3. Protection of Servo Drive from overvoltage and surges Using Filter And Reactor

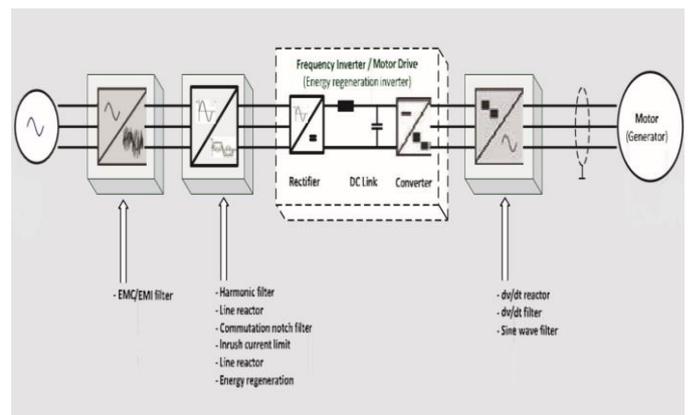


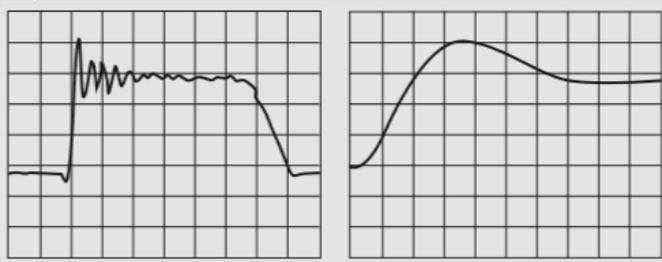
Fig.1 Protection of Servo Drive Using Filter and Reactor

As the figure shows the different types of filters and the reactors are placed on between the source and drives and between the drives and motor which are given below,  
**EMI FILTER:** There is electromagnetic interference occurs in the servo system and it causes, interference with operation of electronics equipments, errors in measurements and in sensors' outputs, and electrical overstress to sensitive components of drives so

from the use of EMI filter in order to suppress conducted interference that is present on a signal or power line .

DV/DT REACTOR: A reactor on the line side will do two things: protect the drive’s electronics equipments from power disturbances and protect the power supply from disturbances created by the drive.

DV/DT FILTER:



Without dv/dt filter

With dv/dt filter

The Filter from reduces the high output voltage dv/dt from servo drives and limits the peak voltage. It protects the motor insulation windings from premature aging and destruction and increases significantly the service life of electric motors.

SINE WAVE FILTER: it is a low pass filters which is use to convert the rectangular pulse width modulation output signal of motor drives into a smooth sine wave voltage with lower value of ripple.

#### 4. USE OF HIGH SWITCHING FREQUENCY

The frequency is an important factor when selecting output filter. Depending on the type of filter, THERE IS three different frequencies are available which are.

Supply frequency: The frequency of the AC mains supply network, typically 50 or 60 Hz.

Depending on the frequency characteristic of the capacitor, it might be possible to operate a filter at a higher frequency but with a reduced input voltage.

Switching frequency: The frequency used to switch the IGBTs in the output stage of a frequency converter. This frequency has a direct relation to the power loss in the converter. It is useful to,

Increasing the switching loss of the semiconductors, Reduce the noise level, Increase the leakage currents, Reduce the harmonic current and motor temperature.

### 5. MATLAB SOLUTION MODEL OF THE SYSTEM for THE PROTECTION OF THE SERVO MOTOR FROM THE OVER VOLTAGE

#### 5.1 model and output waveform without use of filter.

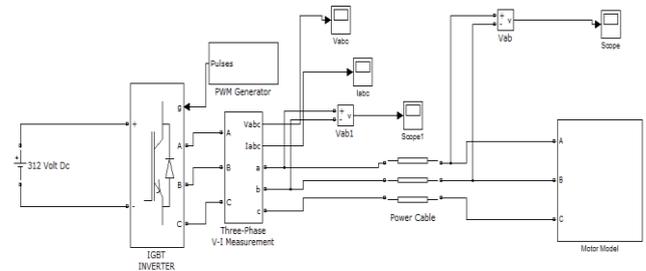


Fig.2 simulation of system without filter at motor terminal

From the simulation modeling show in the figure The DC-bus voltage is 312V and the switching frequency is 1080Hz. The simulation runs for 0.01s in order to several pulses from the PWM inverter and  $T_r=0.1\mu s$ ,  $I_c=100m$ .

The output waveform as a result is given below,

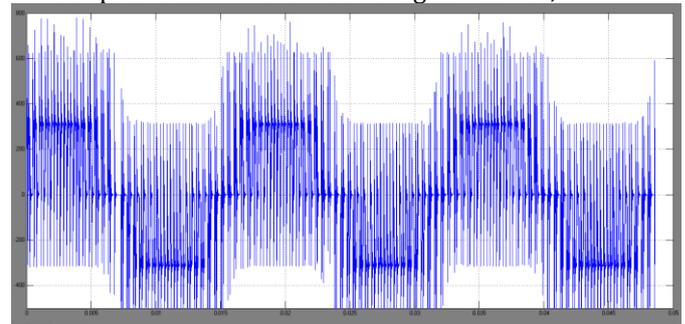


Fig.3 Overvoltage at Motor without Filter

As the result of the simulation show the waveform with the overvoltage with th erragular waveform with the over damping under damping and the critical damping of voltage.

#### 5.2 Model and output waveform with use of filter

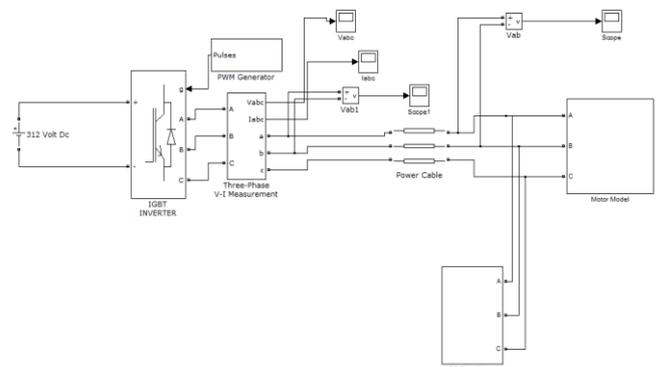


Fig.4 simulation of system with RC filter at motor terminal

Now do the simulation of the model with the use of RC filter at the motor terminal as we can see in fig.3 with the same data that we used at first simulation but as here a use of RC filter, The filter capacitance was set with 0.1  $\mu$ s rise time and turns out to be 16 nF with  $R_f = 58\Omega$

[4] Google, Wikipedea

The output waveform as a result is given below,

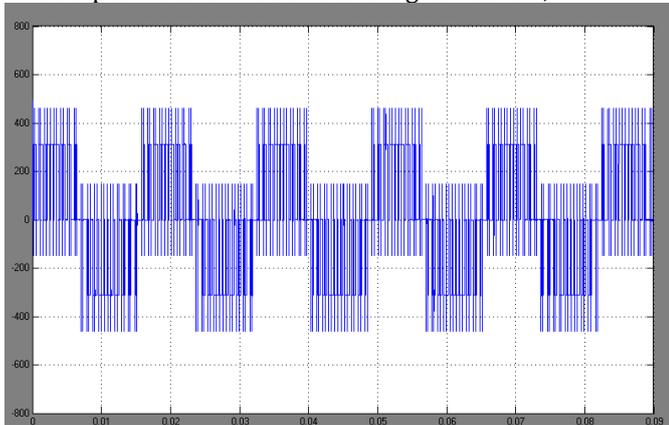


Fig:5 Overvoltage at Motor without Filter

A RC filter is an electric circuit which is consist of resistors and capacitors drive by a voltage or current source. In the PWM drive the RC filter acts as a low pass filter and blocks all the high frequency oscillation voltage and current, it is providing a low impedance path to the Inrush current to motor so, its reducing the over voltage at motor terminals.

From waveform at fig3. we can conclude that with the same cable length and the same rise time, the overvoltage is strongly reduced.

## 6. CONCLUSION

After implementing the different types of filters and the reactors and study the all things we conclude that the CNC machine's which parts are very expensive and very sensitive which is servo drives motors etc. can be protect by the use of above methods and from this method an output of equipments of CNC machine is good and CNC machines parts can be protect. Also the repairing cost is going to decrease and production going to increase an economical.

## 7. REFERENCE

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