



## Medium Voltage High-Pass Filter Resistor Compartment



**ROOF MOUNTED MEDIUM VOLTAGE  
HIGH-PASS FILTER RESISTORS**

### **General**

Northeast Power Systems, Inc. (NEPSI's) High-Pass Resistors provide harmonic resonant damping and high-pass filtering for medium voltage filter systems. The High-Pass Filter Resistors are available for new equipment as well as for field installation on existing Notch or Single-tuned filters.

The High-Pass Filter Resistor is typically installed in parallel (or across the filter reactor terminals) with the filter reactor to provide resonant damping and a low impedance path for high frequency harmonic currents. The resistor assembly includes a well ventilated enclosure, thermostatically controlled transformer cooling fans (on rear wall mounted enclosures), medium voltage jumper cables, through-wall bushings, and standoff insulators to facilitate connection and installation.

### **Product Scope and Benefits**

- Designed for application on new and existing single-tuned and multi-tuned notch harmonic filter banks to 38kV.
- Low Inductance Resistors with Power Ratings to 150kW per Phase.
- Outdoor, well ventilated enclosure.
- Increases high-frequency filtering capability of standard notch harmonic filter banks.
- Dampen system resonance due to parallel capacitance from medium voltage cables or other shunt capacitor banks.
- Easy to install. The Resistor banks come fully assembled and ready for interconnection. Medium Voltage cables, supports, and through wall bushings to facilitate connections are supplied with the equipment.
- Engineering support and analysis services on resistor application and rating is available from our experienced engineering staff.



## Standard Features

### Enclosure

Free standing, well ventilated, outdoor rated, all-welded, 12 gauge 409 stainless steel construction with stainless steel hinged access doors.

Enclosure is designed for rear wall mounting or roof mounting depending on the application, resistor rating, and filter design.

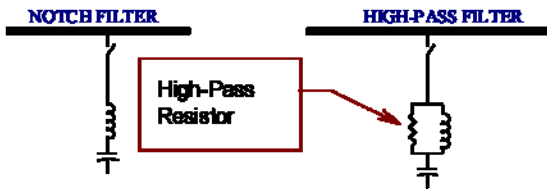
Rear mounted enclosures are equipped with thermostatically controlled ventilation fans.

### Transformer Cooling Fan

A thermostatically controlled Krenz-Vent Transformer Cooling Fan is supplied for rear wall mounted resistor banks. These fans are wired to a junction box for connection to the filter bank control power.

### High-Pass Resistors

Low Inductance, filter rated resistors are supplied as part of the equipment. Resistor Watt rating, amp rating, and ohm rating must be specified when ordering. These ratings are determined by detailed harmonic analysis and can be provided by NEPSI.



*A High-Pass Filter is formed by connecting a power resistor of appropriate rating across a notch-tuned harmonic filter reactor as shown to the left.*

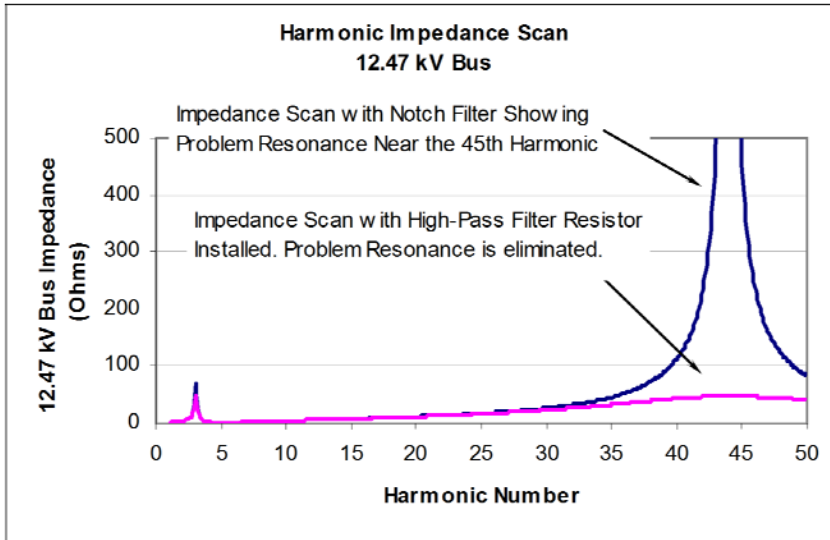




## Application Notes

### Resonant Damping

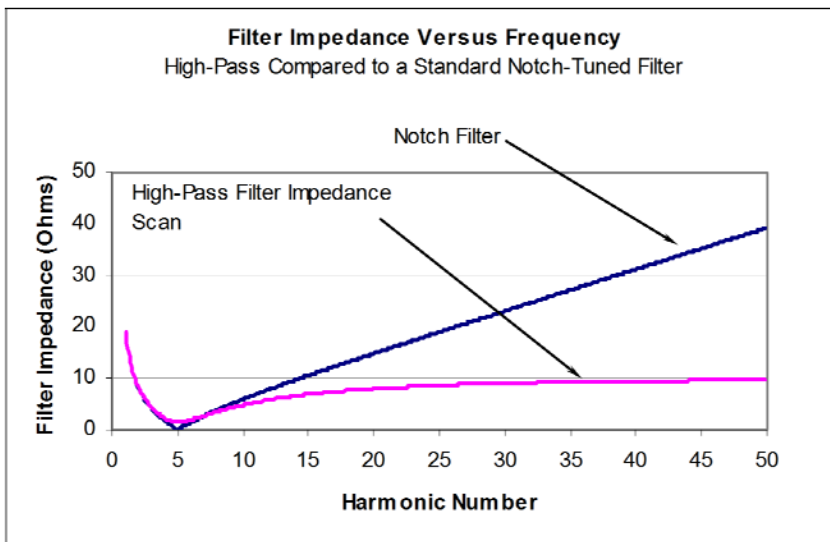
Notch-Tuned Filters applied on electrical system's containing other shunt capacitor banks or cable resonance are subject to system resonance at a frequency above the notch filter's tuning point. If the cable's or other shunt capacitors cannot be removed, high-pass filter resistors are a viable option. The figure below shows how the system impedance near the 45th harmonic is significantly reduced with the application of a High-Pass Filter Resistor.



*The impedance scan to the left shows how a High-Pass filter is effective at damping higher frequency resonances caused by system capacitance. When this capacitance cannot be removed, High-Pass Filters become advantageous.*

### High-Frequency Filtering

High-Pass Filter Resistors provide a low impedance path around a standard notch harmonic filter as its impedance does not rise with frequency. The figure below shows how the impedance of the High-Pass Filter at high frequency is reduced with the application of a High-Pass Resistor.



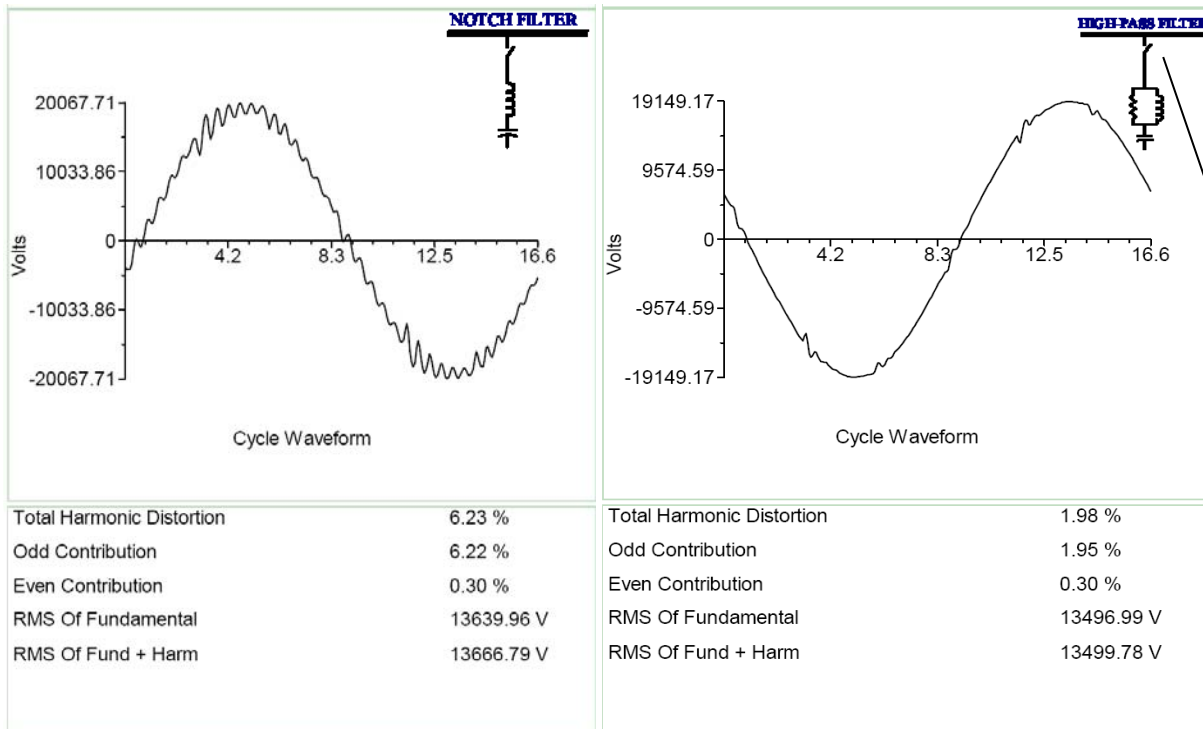
*The impedance scan to the left shows how a High-Pass filter is more effective at filtering high frequency harmonics. The High-Pass Filter Impedance is significantly less at higher harmonic frequencies.*



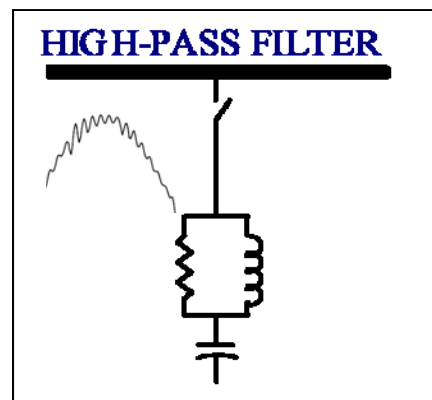
## Field Results

The figure below illustrates actual waveforms taken on a 22.86kV, 4-Stage 10 MVAR Multi-tuned harmonic filter bank installed at a chemical processing facility. The chemical process utilized a 10MW 6-pulse rectifier. This rectifier had the usual harmonic current injections for a 6-pulse rectifier, and as such was equipped with a multi-tuned harmonic filter. The electrical designers, however, did not account for resonance caused by a small amount of cable capacitance (on the order of 150kvar) that was responsible for a resonance in the 25th to 60th harmonic frequency range.

As a result of this resonance, the chemical processing facility could not come up to full power and encountered nuisance trips and equipment failures. After the field installation of a 45kW, 3-phase 100 ohm resistor, the facility's voltage distortion significantly dropped as shown below.



*In addition to high frequency damping, the High-Pass Filter Resistors provide a low impedance path around the filter reactor at high frequencies, thereby reducing high frequency current injection into the source impedance. The waveforms above, show the high-pass filter resistor reduced the system voltage distortion from 6.23% to 1.98%. Before the application of the high-pass filter resistors, the chemical processing facility at this installation was not able to operate due to nuisance equipment miss-operations.*





## High-Pass Filter Resistor Ordering Guide

In order to quote a High-Pass Filter Resistor, NEPSI's will require the following information in the table below. It is recommended that calculated resistor duty be doubled. For High-Pass Resistor that are to be installed on existing equipment, NEPSI recommends pictures as well as drawings be supplied so that connection details and components may be quoted.

|                           |       |  |       |
|---------------------------|-------|--|-------|
| System Voltage (kV)       | _____ | Desired Resistor KW Rating (per phase) | _____ |
| Resistor Ohms (per phase) | _____ | Resistor RMS amps                      | _____ |

Other requirements or constraints:

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Fax or email above information to NEPSI for a quote. Firm quotes are returned within one business day. Budgetary quotes can be provided verbally on request.

See our website for more technical information on our Metal-Enclosed Capacitor Banks. The following is a short list of what you will find.

- Guide form specifications in regular and CSI format.
- Elevation and Pad drawings in DXF and AutoCAD format.
- Budgetary pricing, weights, and dimensions.
- Instruction manuals and cut-sheets for major components.

Metal-Enclosed Automatic Capacitor Bank URL: <http://www.nepsi.com/acb.htm>



**NOTES**