



# NCS01W8 Series Application Note V10

## ISOLATED DC-DC CONVERTER NCS01W8 SERIES APPLICATION NOTE



**Approved By:**

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# NCS01W8 Series

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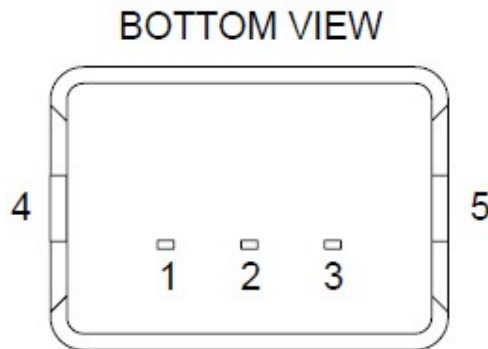
### 1. Introduction

The NCS01W8 series is a non-isolated POL converter with an ultra wide 12:1 high input voltage range 6-72VDC switching regulator with standard SIP3 package, offers output voltages of 3.3, 5, 9, 12, 15, 24VDC with industry 0.48"x0.34"x0.69" package.

High efficiency up to 95%, allowing case operating temperature range of -40°C to 105°C. Very low no load power consumption (0.5mA), an ideal solution for energy critical systems.

Fully protected against input UVLO (under voltage lock out), output over-current, continuous short circuit conditions.

### 2. Pin Function Description



Single Output

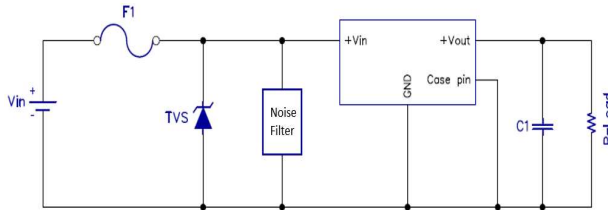
No	Label	Function	Description	Reference
1		+Vin	Positive Supply Input	<b>Section 7.1</b>
2		GND	Ground	<b>Section 7.2/7.3</b>
3		+Vout	Positive Power Output	<b>Section 7.2/7.3</b>
4		Case Pin	Connecting Ground	<b>Section 7.2/7.3</b>
5		Case Pin	Connecting Ground	<b>Section 7.2/7.3</b>



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## 3. Connection for Standard Use

The connection for standard use is shown below.



Symbol	Component	Reference
F1, TVS	Input fuse, TVS	<b>Section 9.1</b>
C1	External capacitor on the output side	<b>Section 7.3</b>
Noise Filter	External input noise filter	<b>Section 9.2</b>

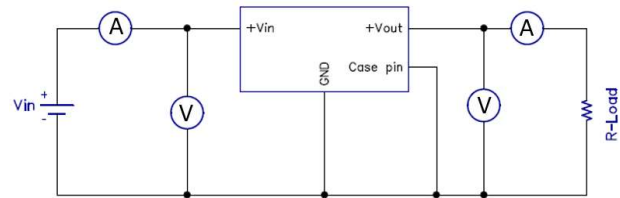
The value of line regulation is defined as:

$$Line\ reg. = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\%$$

Where:

$V_{HL}$  is the output voltage of maximum input voltage at full load

$V_{LL}$  is the output voltage of minimum input voltage at full load



**NCS01W8 Series Test Setup**

## 4. Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown below. When testing the modules under any transient conditions please ensure that the transient response of the source is sufficient to power the equipment under test. We can calculate:

- Efficiency
- Load regulation and line regulation

The value of efficiency is defined as:

$$\eta = \frac{V_o \times I_o}{V_{in} \times I_{in}} \times 100\%$$

Where:

$V_o$  is output voltage

$I_o$  is output current

$V_{in}$  is input voltage

$I_{in}$  is input current

The value of load regulation is defined as:

$$Load\ reg. = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

Where:

$V_{FL}$  is the output voltage at full load

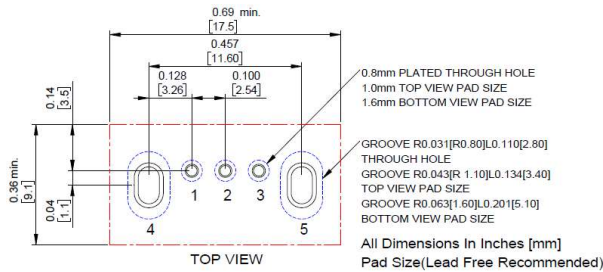
$V_{NL}$  is the output voltage at no load



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## 5. Recommend Layout, PCB Footprint and Soldering Information

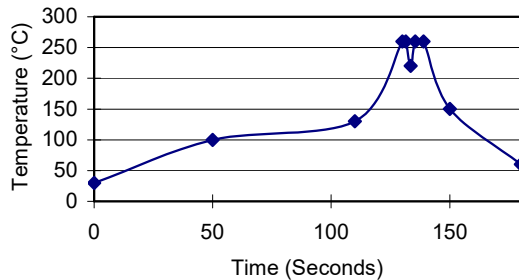
The system designer or end user must ensure that metal and other components in the vicinity of the converter meet the spacing requirements for which the system is approved. Low resistance and inductance PCB layout traces are the norm and should be used where possible. The recommended footprints and soldering profiles are shown below.



Clean the soldered side of the module with a brush, prevent liquid from getting into the module. Do not clean by soaking the module into liquid. Do not allow solvent to come in contact with product labels or resin case as this may change the color of the resin case or cause deletion of the letters printed on the product label. After cleaning, dry the modules well.

The suggested soldering iron is  $420 \pm 10^\circ\text{C}$  for up to 4-10 seconds (less than 90W) used in double PCB and multilayer PCB, The other one is used in the single PCB is  $385 \pm 10^\circ\text{C}$  for up to 2-6 seconds (less than 90W). Furthermore the recommended soldering profile is shown below.

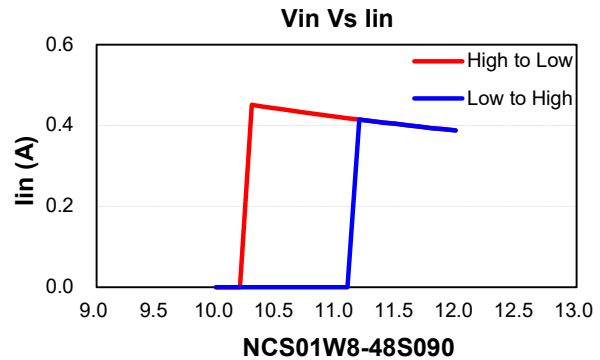
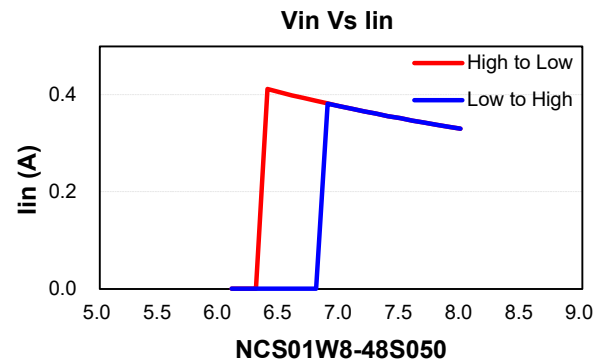
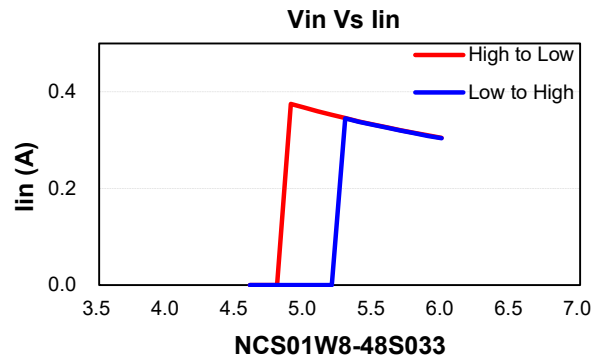
Lead Free Wave Soldering Profile



## 6. Features and Functions

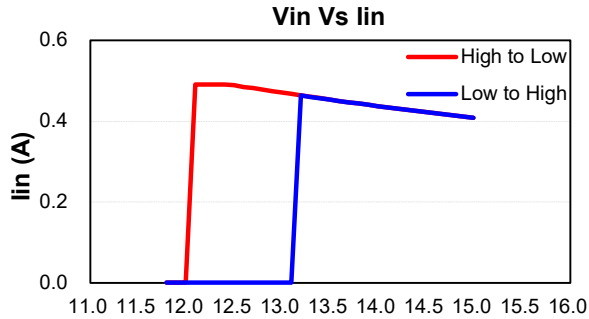
### 6.1 UVLO (Under Voltage Lock Out)

Input under voltage lockout is standard on the NCS01W8 series unit. The unit will shut down when the input voltage drops below a lower threshold, and the unit will operate when the input voltage goes above the upper threshold.

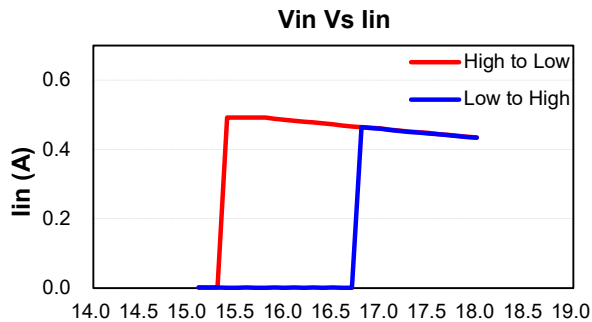




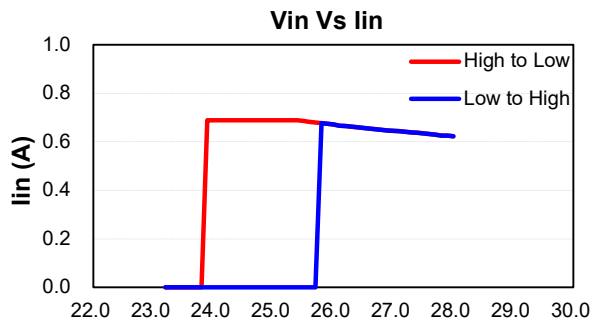
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NCS01W8-48S120



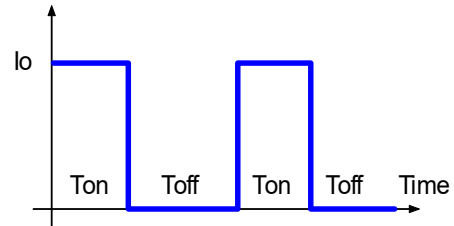
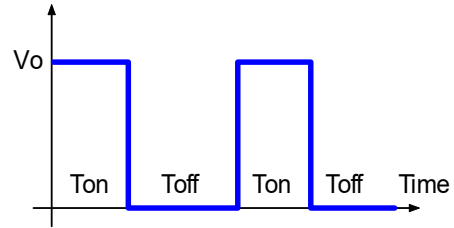
NCS01W8-48S150



NCS01W8-48S240

## 6.2 Over Current/Short Circuit Protection

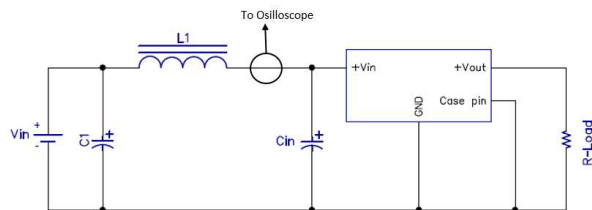
All models have internal over current and continuous short circuit protection. The unit operates normally once the fault condition is removed. At the point of current limit inception, the converter will go into hiccup mode protection.



## 7. Input / Output Considerations

### 7.1 Input Capacitance at the Power Module

The converters must be connected to low AC source impedance. To avoid problems with loop stability source inductance should be low. Also, the input capacitors ( $C_{in}$ ) should be placed close to the converter input pins to decouple distribution inductance. However, the external input capacitors are chosen for suitable ripple handling capability. Low ESR capacitors are good choice. Circuit as shown as below represents typical measurement methods for reflected ripple current.  $C1$  and  $L1$  simulate a typical DC source impedance. The input reflected-ripple current is measured by current probe to oscilloscope with a simulated source Inductance ( $L1$ ).

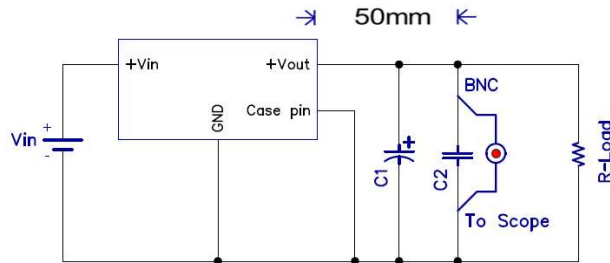


L1: 12 $\mu$ H  
C1: None  
Cin: 47 $\mu$ F ESR<0.17 $\Omega$  @100KHz



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## 7.2 Output Ripple and Noise



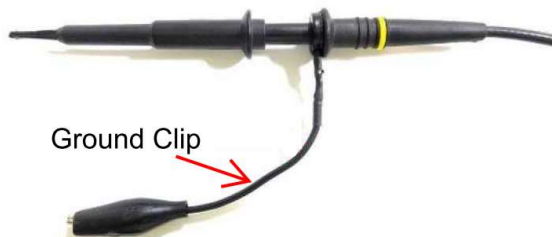
Note:

C1: None

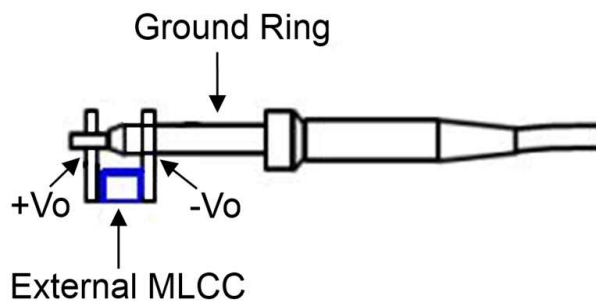
C2: 1uF ceramic capacitor

Output ripple and noise measured with 1uF ceramic capacitor across output, a 20 MHz bandwidth oscilloscope is normally used for the measurement.

The conventional ground clip on an oscilloscope probe should never be used in this kind of measurement. This clip, when placed in a field of radiated high frequency energy, acts as an antenna or inductive pickup loop, creating an extraneous voltage that is not part of the output noise of the converter.



Another method is shown in below, in case of coaxial-cable/BNC is not available. The noise pickup is eliminated by pressing scope probe ground ring directly against the -V<sub>out</sub> terminal while the tip contacts the +V<sub>out</sub> terminal. This makes the shortest possible connection across the output terminals.



## 7.3 Output Capacitance

The NCS01W8 series converters provide unconditional stability with or without external capacitors. For good transient response, low ESR output capacitors should be located close to the point of load (<100mm). PCB design emphasizes low resistance and inductance tracks in consideration of high current applications. Output capacitors with their associated ESR values have an impact on loop stability and bandwidth. Cincon's converters are designed to work with load capacitance to see technical specifications.



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## 8. Thermal Design

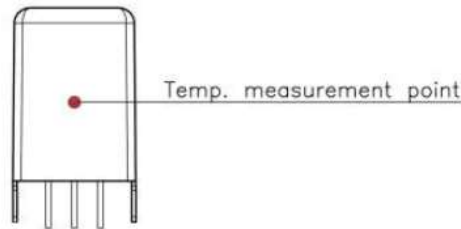
### 8.1 Operating Temperature Range

The NCS01W8 series converters can be operated within a wide ambient temperature range of -40°C to 105°C. Consideration must be given to the derating curves when ascertaining maximum power that can be drawn from the converter. The maximum power drawn from models is influenced by usual factors, such as:

- Output load current
- Forced air or natural convection

### 8.2 Convection Requirements for Cooling

To predict the approximate cooling needed for the 0.48"×0.34" module, refer to the power derating curves in **datasheet**. These derating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled in the actual system, the module's temperature should be monitored to ensure it does not exceed 105°C as measured at the center of the case (thus verifying proper cooling).



FRONT VIEW

### 8.3 Thermal Considerations

The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. The example is presented in **datasheet**. The power output of the module should not be allowed to exceed rated power ( $V_{o\_set} \times I_{o\_max}$ ).

### 8.4 Power Derating

The operating ambient temperature range of NCS01W8 series is -40°C to +105°C. When operating the NCS01W8 series, proper derating or cooling is needed. The maximum case temperature under any operating condition should not exceed 105°C (**refer to datasheet**).





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## 9. Safety & EMC

### 9.1 Input Fusing Considerations

This power module is not internally fused. An input line fuse must always be used. This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below:

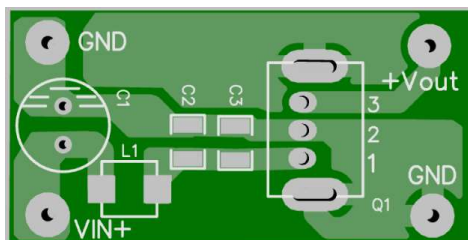
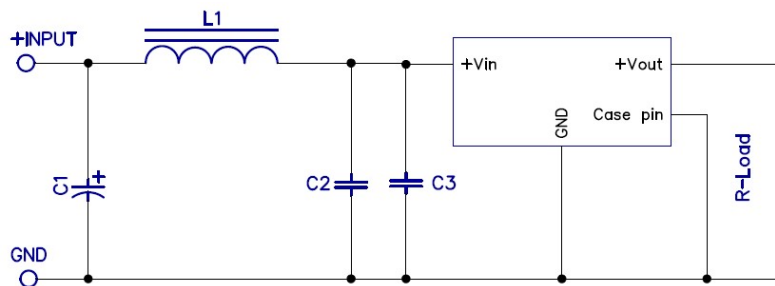
Model	Fuse Rating(A)	Fuse Type
NCS01W8-48S033	1.0	Slow-Blow
NCS01W8-48S050 NCS01W8-48S240	1.25	Slow-Blow
NCS01W8-48S090 NCS01W8-48S120 NCS01W8-48S150	1.6	Slow-Blow

### 9.2 EMC Considerations

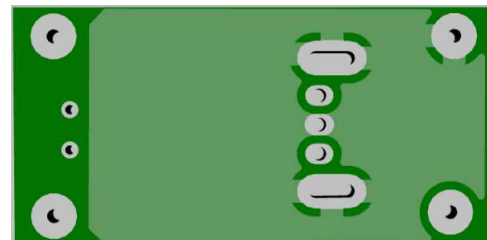
EMI Test standard: EN55032 Conducted & Radiated Emission

Test Condition: Input Voltage: Nominal, Output Load: Full Load

(1) EMI meet EN55032



PCB Top Layout Suggestion



PCB Bottom Layout Suggestion



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Model Number	Class A			
	C1	C2	C3	L1
NCS01W8-48S033	33 $\mu$ F/100V	NC	NC	HPI0503-100M-4.2A 10uH
NCS01W8-48S050				
NCS01W8-48S090				
NCS01W8-48S120				
NCS01W8-48S150				
NCS01W8-48S240				

Model Number	Class B			
	C1	C2	C3	L1
NCS01W8-48S033	33 $\mu$ F/100V	2.2uF/100V X7R 1210	2.2uF/100V X7R 1210	HPI0503-100M-4.2A 10uH
NCS01W8-48S050				
NCS01W8-48S090				
NCS01W8-48S120				
NCS01W8-48S150				
NCS01W8-48S240				

**Note:**

C1: NIPPON CHEMI-CON KZN series aluminum capacitor or equivalent

C2,C3: X7R 1210 X7R ceramic capacitor

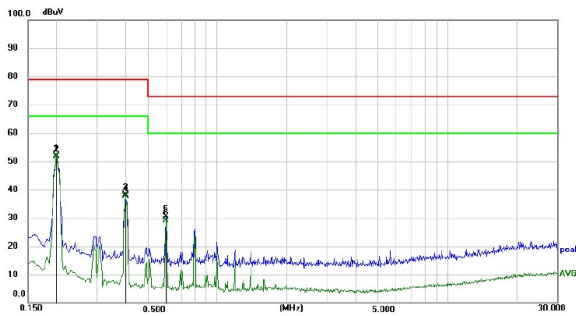


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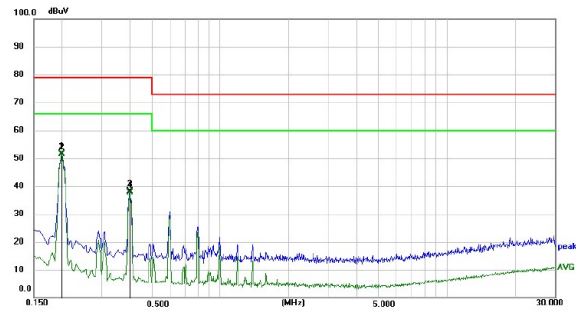
## Conducted Emission Class A:

NCS01W8-48S033

Line

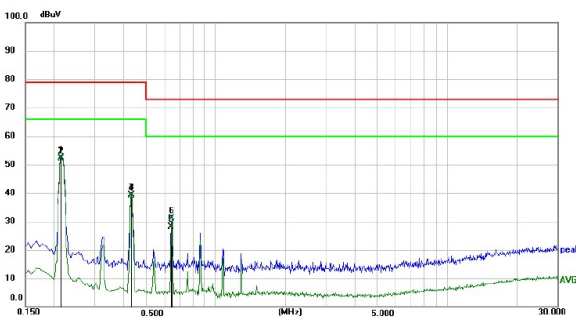


Neutral

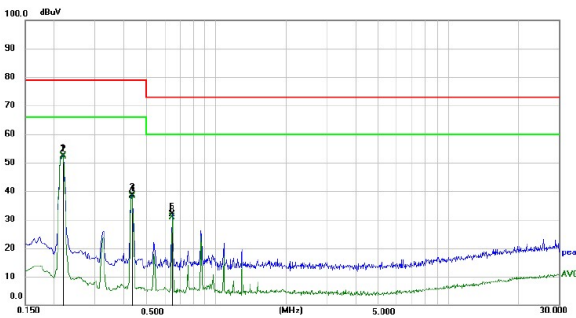


NCS01W8-48S050

Line

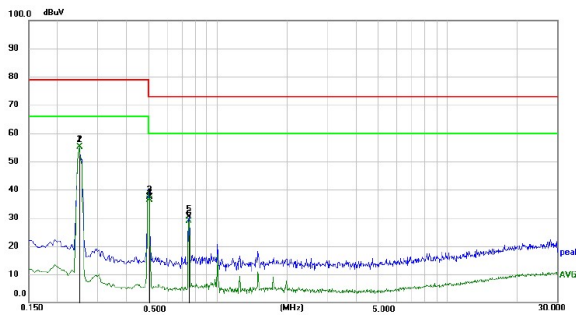


Neutral

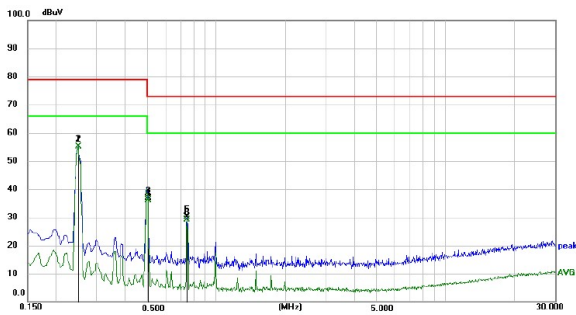


NCS01W8-48S090

Line

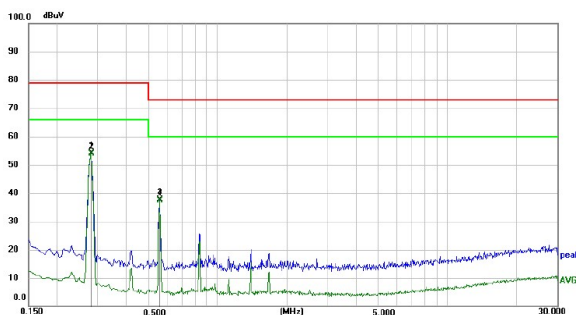


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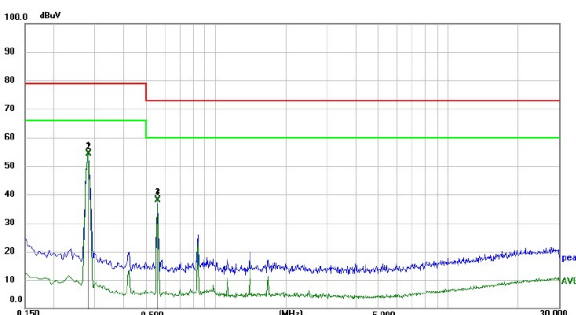


NCS01W8-48S120

Line



Neutral

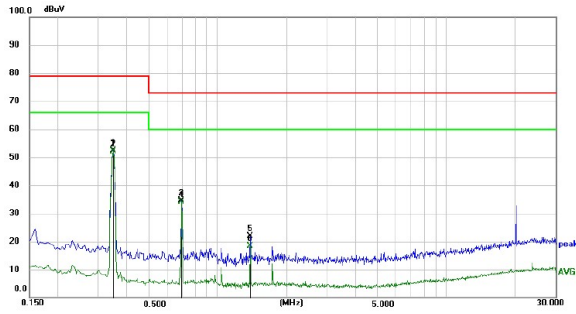




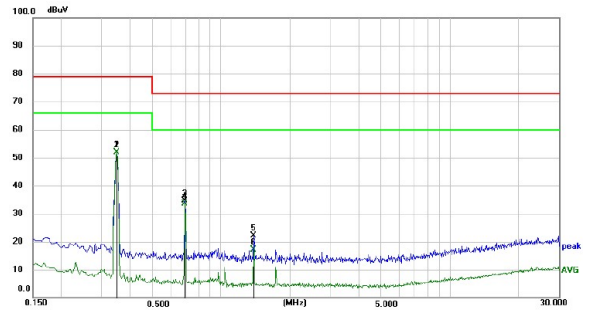
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NCS01W8-48S150

Line

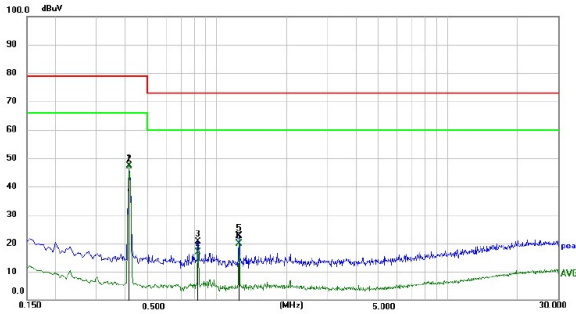


Neutral

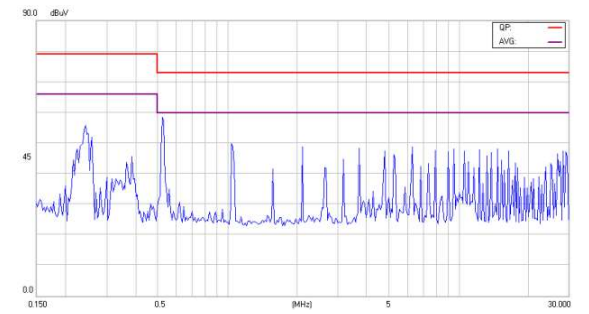


NCS01W8-48S240

Line



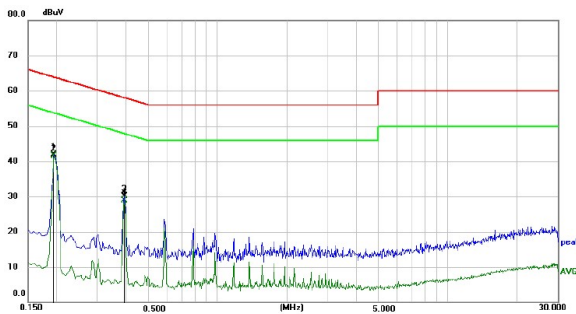
Neutral



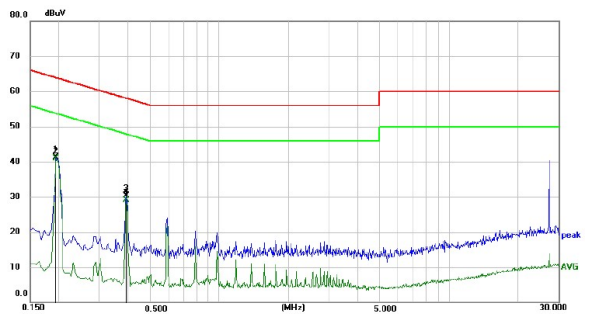
## Conducted Emission Class B:

NCS01W8-48S033

Line



Neutral

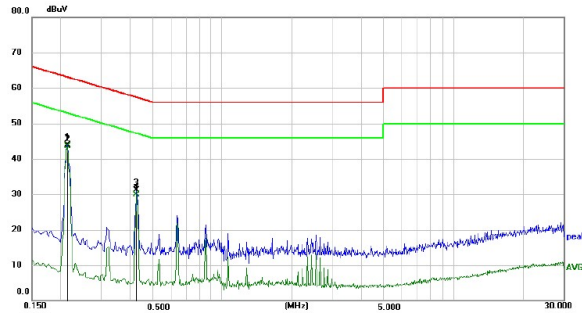




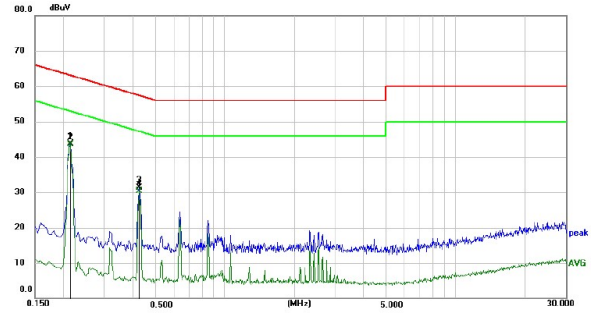
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NCS01W8-48S050

Line

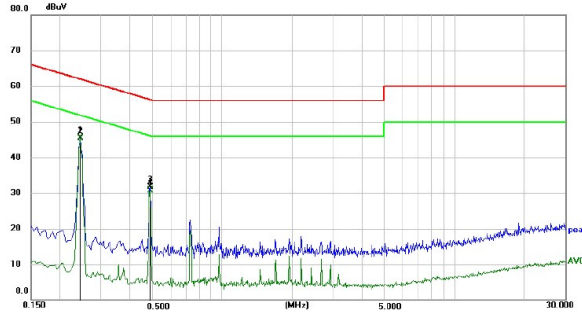


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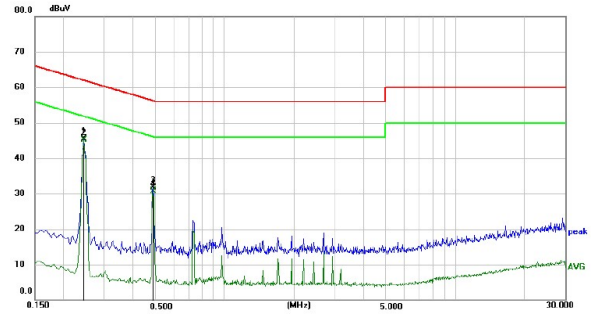


NCS01W8-48S090

Line

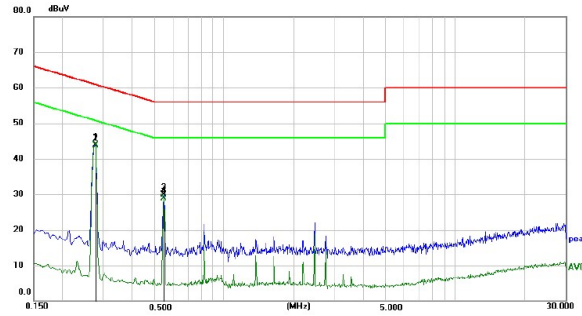


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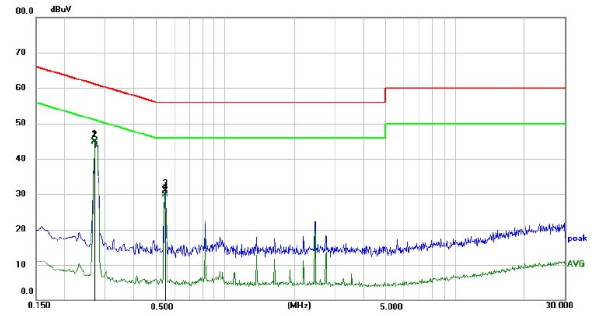


NCS01W8-48S120

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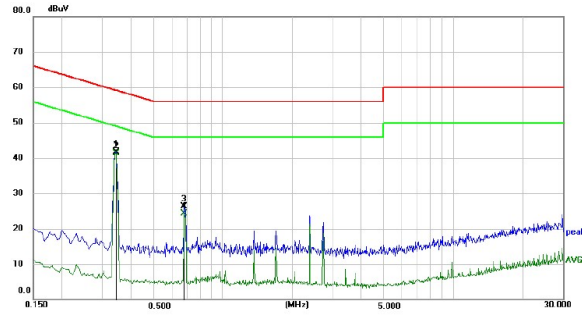


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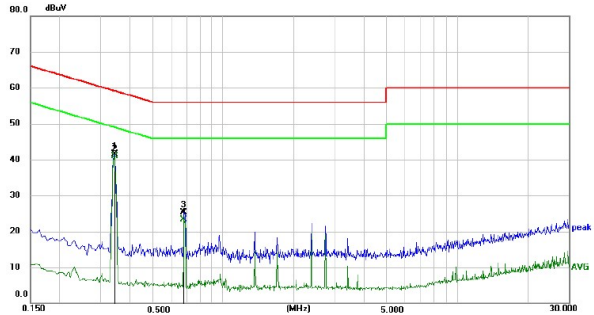


NCS01W8-48S150

Line



Neutral

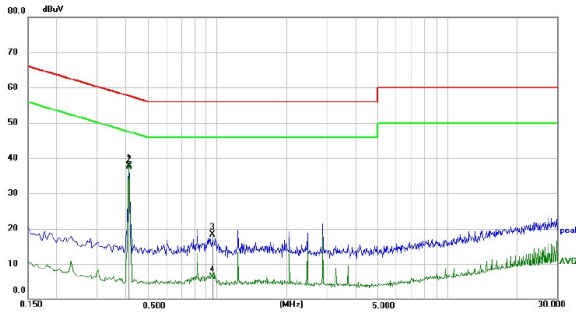




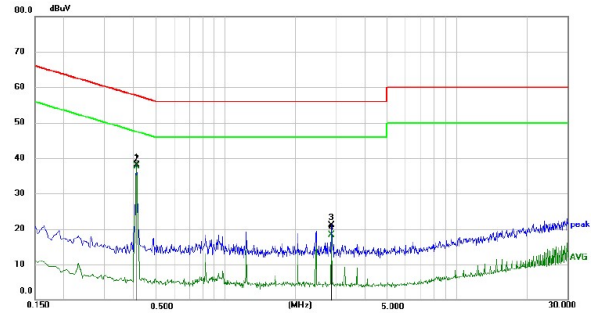
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NCS01W8-48S240

Line



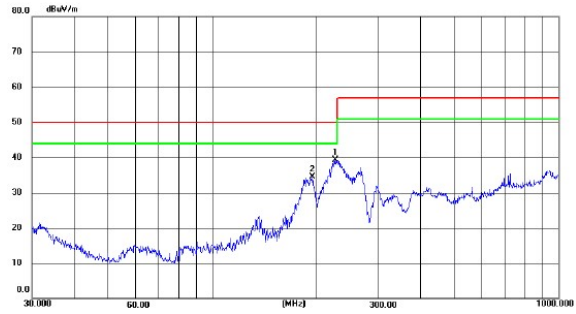
Neutral



## Radiated Emission Class A:

NCS01W8-48S033

Vertical



Horizontal

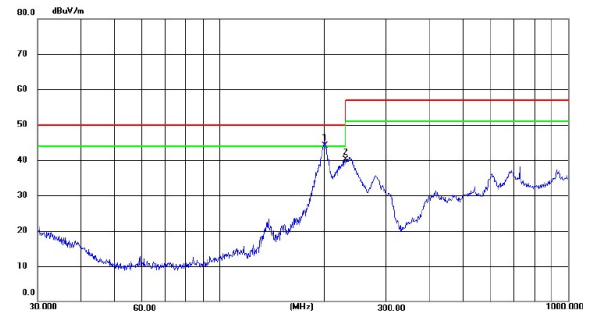


NCS01W8-48S050

Vertical



Horizontal

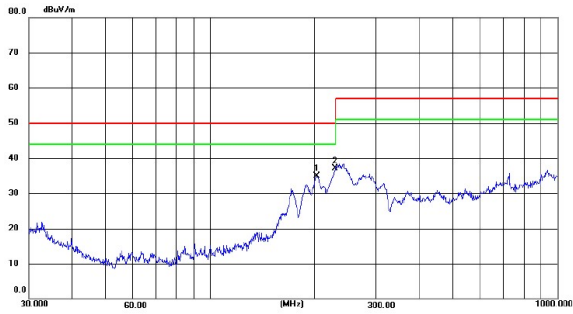




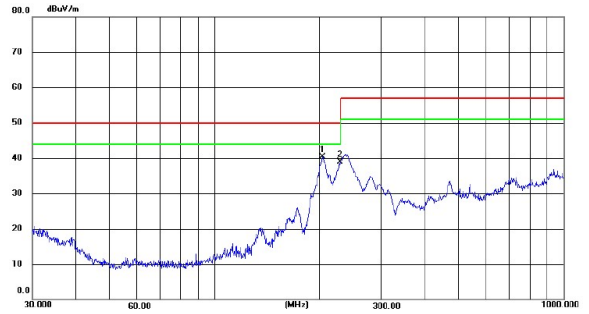
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NCS01W8-48S090

Vertical

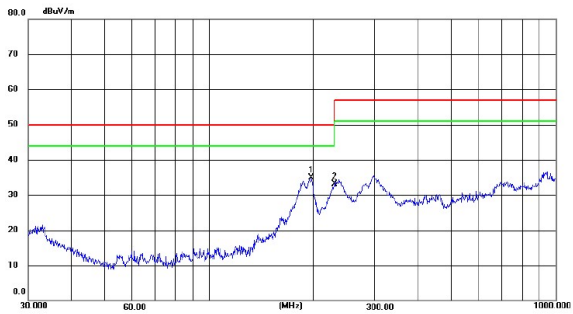


Horizontal

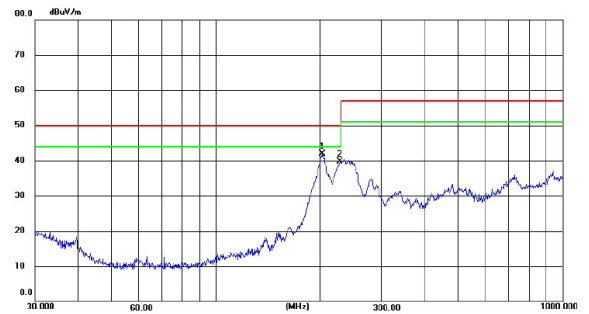


NCS01W8-48S120

Vertical



Horizontal



NCS01W8-48S150

Vertical



Horizontal



NCS01W8-48S240

Vertical



Horizontal



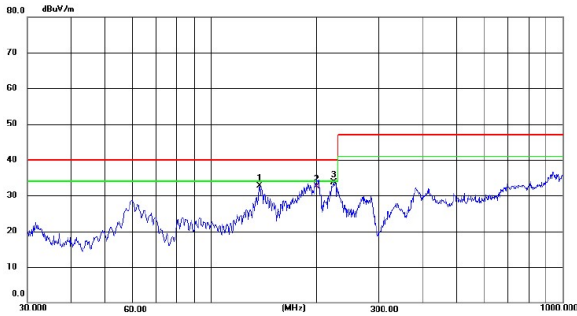


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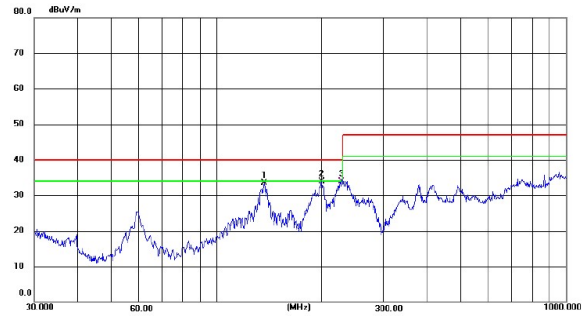
## Radiated Emission Class B:

NCS01W8-48S033

Vertical

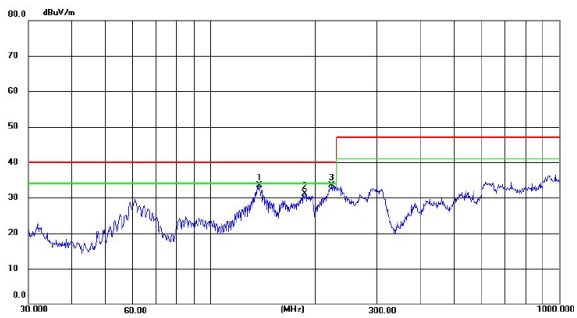


Horizontal

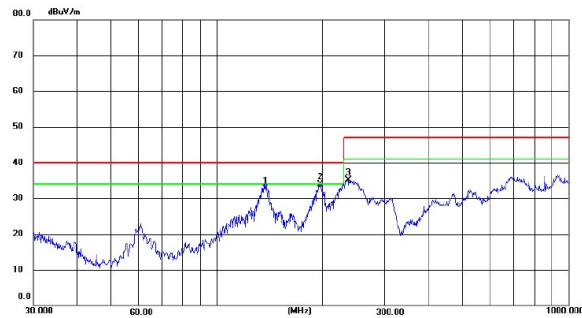


NCS01W8-48S050

Vertical

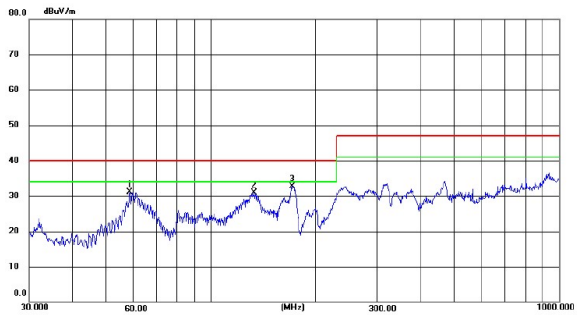


Horizontal

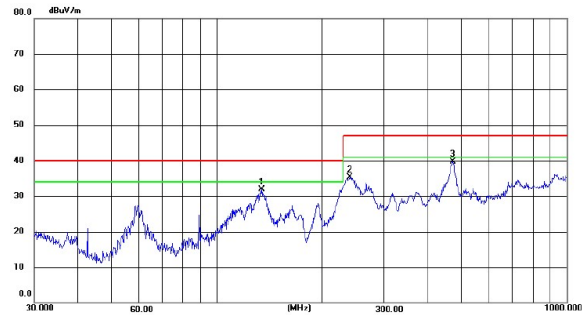


NCS01W8-48S090

Vertical

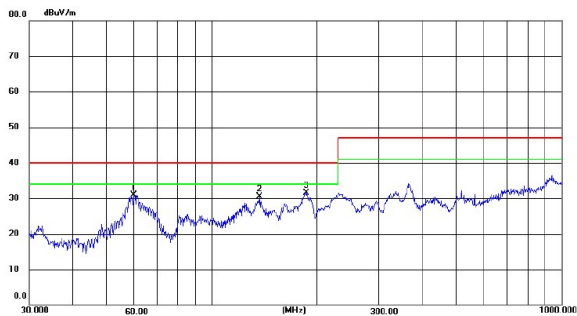


Horizontal



NCS01W8-48S120

Vertical



Horizontal



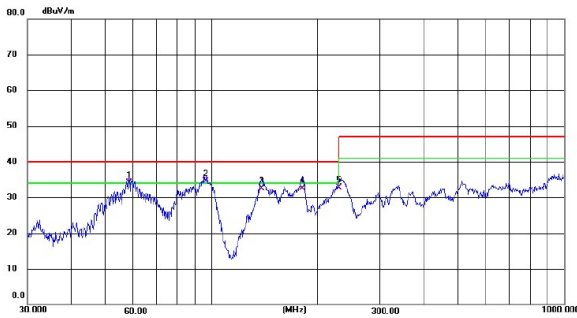




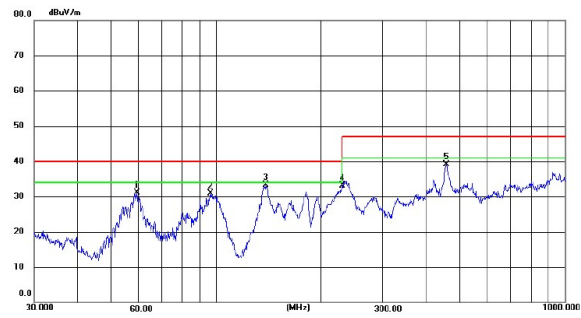
# NCS01W8 Series Application Note V10

NCS01W8-48S150

Vertical

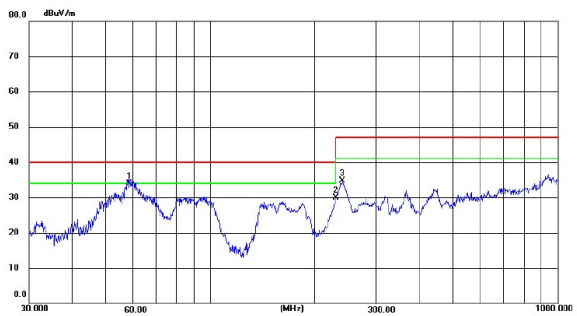


Horizontal

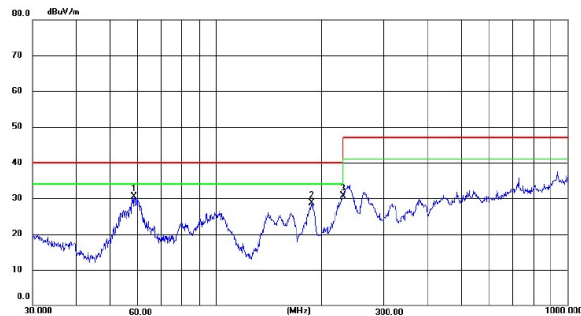


NCS01W8-48S240

Vertical



Horizontal



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