Common Mode Filter

Common mode noise suppression
For high speed data transmission
USB 2.0 and IEEE 1394
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RFCMF1632140M2T
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INTRODUCTION OF WALSIN Common Mode Filter For USB 2.0/ IEEE 1394 Application

- On USB 2.0 / IEEE 1394 interface, the frequency and strength of the noise have to be suppressed, a part called Common Mode Choke be chosen to provide the required noise attenuation, however, the higher impedance Common Mode Choke generally have a greater damaging effect and distortion on full speed and high speed signal quality.

- The Common Mode Filter designed and manufactured by multilayer technology at Walsin Technology Corporation, providing excellent noise suppression characteristics thank to high common mode impedance while with minimizing insertion loss to maintain the signal quality. Especially, most effective on meeting the EMI regulation of high speed USB 2.0 and IEEE 1394 interface circuit.

APPLICATIONS

- USB 2.0/ IEEE 1394 high speed data transmission
- PC Related, DSC, Scanner, Data Storage, CD ROM W/R, Printer

According to different chipset types, Walsin offers three models of common mode filters. In addition, each model has two-pin assignment to meet customer various requirements in the design applications. Walsin’s offers are as follows:

1. RFCMF3216090M0
2. RFCMF3216090M1T/RFCMF1632090M1T
3. RFCMF3216130M2T/RFCMF1632130M2T

APPLICATION CIRCUIT

(1). USB 2.0
(2). IEEE 1394
**Applications at USB & IEEE 1394**

**Walsin Common Mode Filter at USB HUB**

*Note: M3 model is designed to meet the chipsets application, such as NEC, at the USB hub. M2 model is invented for the chipset applications, including VIA and SIS.*

**Walsin Common Mode Filter at USB Host**

*Note: M3 model is designed for the chipsets, including INTEL and NEC, at the USB host. M2 model is invented for the chipset applications, such as VIA and SIS, at the USB host.*
Walsin Common Mode Filter at IEEE 1394

[Diagram of Walsin Common Mode Filter at IEEE 1394]
WALSIN Common Mode Filter: RFCMF1632140M2T

ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Mode Attenuation</td>
<td>Min. 9 dB @ 140MHz ~ 1GHz</td>
</tr>
<tr>
<td>Differential Mode Insertion Loss</td>
<td>Max. 0.8 dB @ 240MHz</td>
</tr>
<tr>
<td>DC Resistance</td>
<td>Max. 2.5 Ω</td>
</tr>
<tr>
<td>Rated Current</td>
<td>200 mA</td>
</tr>
<tr>
<td>Characteristic Impedance</td>
<td>(Differential) 90 Ω</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 ~ +85 deg. C</td>
</tr>
</tbody>
</table>

CONSTRUCTION and SCHEMATIC

Outline and Schematic of RFCMF1632140M2T Common Mode Filter

DIMENSION

L = 3.20 ± 0.2 mm
W = 1.60 ± 0.2 mm
T = 1.40 ± 0.2 mm
P = 1.10 ± 0.2 mm
A = 0.60 ± 0.2 mm
B = 0.50 ± 0.2 mm

ELECTRICAL PERFORMANCE
WALSIN Common Mode Filter: RFCMF1632100M3T

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<tr>
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<td>Max. 1.5 Ω</td>
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<tr>
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**CONSTRUCTION and SCHEMATIC**

**DIMENSION**

- L = 3.20 ± 0.2 mm
- W = 1.60 ± 0.2 mm
- T = 1.00 ± 0.2 mm
- P = 1.10 ± 0.2 mm
- A = 0.60 ± 0.2 mm
- B = 0.50 ± 0.2 mm

**ELECTRICAL PERFORMANCE**

- Common Mode Attenuation
- Differential Mode Loss

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Product Information: Multi-Layer Ceramic Common Mode Filter
WALSIN Common Mode Filter : RFCMF1220100M3T

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CONSTRUCTION and SCHEMATIC

DIMENSION

L = 2.00 ± 0.2 mm  
W = 1.20 ± 0.2 mm  
T = 1.00 ± 0.2 mm  
P = 0.80 ± 0.1 mm  
A = 0.45 ± 0.2 mm  
B = 0.40 ± 0.2 mm

ELECTRICAL PERFORMANCE

-50 -40 -30 -20 -10 0
-0.24 0.24 0.46 0.72 0.96 1.2

Frequency (GHz)

Common Mode Attenuation  
Differential Mode Loss
TEST RESULTS Example OF WALSIN’S COMMON MODE FILTERS

Eye-diagram Measurement
The eye-diagram is applied to assess the effect of differential mode signal attenuation, caused by the common mode noise suppression device. If the shape or position of the blue line shift to contact with the red region, which represents the signal, the common mode filter effect on signal significantly. Figure I and Figure II show that the signal do not be attenuated notably after adding Walsin’s common mode filter. Figure III illustrates that the result summary of Walsin common mode filter in the eye-patten test.

![Figure I: Measured Eye-Diagram of DUT without Common Mode Filter](image1)

![Figure II: Measured Eye-Diagram of DUT with Walsin Common Mode Filter](image2)

![Figure III: Summarized Signal Quality Test of USB 2.0](image3)

**Required Tests**
- Overall result: pass!
- Signal eye:
  - Eye Diagram Test passes
- Monotonic Property:
  - NullTesting is performed on the test limits of 15.0% and 85.0%.
  - EOP width: 16.59488ns
  - EOP width passes
- EOP width(Bits): 7.966192
  - EOP width(Bits) passes
- Measured Signalling Rate: 480.0390Mbps
  - signal rate passes

*Note: Data are measured with TDS7404 digital phosphor oscilloscope.*


**EMI Spectrum Measurement**

The spectrum measurement is conducted to evaluate the common mode noise suppression capability of a common mode filter device. In principle, the noise spectrum must be controlled under the 6 dB standard line. The noise suppression capability of Walsin’s common mode filter is demonstrated in the following figures.

**Figure IV** : The Horizontal Spectrum of DUT without Common Mode Filter

**Figure V** : The Vertical Spectrum of DUT without Common Mode Filter

**Figure VI** : The Horizontal Spectrum of DUT with Walsin Common Mode Filter

**Figure VII** : The Vertical Spectrum of DUT with Walsin Common Mode Filter
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