SDMM Multilayer Common Mode Filter

2013.12.10
MIPI can transmit low speed and high speed signal at the same time, so it saves FPC space and is widely used as camera and screen interface of smart phone and tablet.

When high speed signal transmitting in MIPI, RF signal may interrupt it, therefore common mode filter is a good idea for EMI suppression.
Conventional wire wound CMC

- Conventional wire wound common mode choke has low differential impedance due to the closed magnetic circuit.

- Conventional wire wound CMC has low stray capacitance and high cut off frequency due to the low permittivity material between each electrodes.

- The smallest wire wound CMC is 1.6mm × 0.8mm, that is too big to be used in smart phone.
Small size common mode filter, 0806 size (0.85mm × 0.65mm × 0.40mm) at present, can be made based on multilayer process.

<table>
<thead>
<tr>
<th>Type</th>
<th>L</th>
<th>W</th>
<th>T</th>
<th>SL</th>
<th>SW</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>0806</td>
<td>0.85± 0.05</td>
<td>0.65± 0.05</td>
<td>0.40± 0.05</td>
<td>0.20±0.05/-0.10</td>
<td>0.27± 0.05</td>
<td>0.50± 0.05</td>
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</tbody>
</table>

Unit (mm)
Sunlord SDMM Part Number

1. SDMM: Multilayer Common Mode Filter
2. 0806: 0.85mm*0.65mm
3. S: Standard
4. -2: 2 lines
5. 300: 30ohm
6. T: Tape & Reel
Based on different material co-firing technology, SDMM common mode filter shows “工” type magnetic core and the electrode is within non-magnetic material, which make high performance possible.

- **Ferrite**: “工” type core, helpful to high common mode impedance.
- **No-magnetic, low permittivity ceramic**: helpful to low stray capacitance and high cut-off frequency.
- **Silver**: construct the coil electrode, can co-fire with ferrite and ceramic.
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Common Mode Impedance (100MHz)</th>
<th>Max. DC Resistance</th>
<th>Max. Rated Current</th>
<th>Rated Voltage</th>
<th>Min. Insulation Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>Ohm</td>
<td>Ohm</td>
<td>mA</td>
<td>Volts</td>
<td>Mohm</td>
</tr>
<tr>
<td>Symbol</td>
<td>Z</td>
<td>RDC</td>
<td>Ir</td>
<td>Vdc</td>
<td>IR</td>
</tr>
<tr>
<td>SDMM0806S-2-300T</td>
<td>30 ± 20%</td>
<td>1.5</td>
<td>100</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
Sunlord SDMM series common mode filter has high common mode impedance to suppress common mode noise well at high frequency due to open magnetic circuit structure design.

“工” type magnetic core can constraint magnetic field and help to generate low differential impedance to keep differential mode signal integrity.

Monolithic structure base on multilayer process keeps high reliability.

Multilayer process is very suitable for large volume mass production and thus SDMM series have advantage at cost and manufacturing capacity.
Common mode filter has one pair coils:

- Common mode signal current (the same direction currents flow in two lines) generates the superposed magnetic field to result in high impedance which can suppress the common mode noise.
- Differential mode signal current (the opposite direction currents flow in two lines) generates the counterbalanced magnetic field to result in low impedance which can avoid differential mode signal attenuation.

Magnetic field superpose by common mode current

Magnetic field counteract by differential mode current
- MIPI transmits low frequency single-ended signal (lower than 10MHz) and high frequency differential mode signal (80MHz~1GHz) at the same time to save FPC space.

Requirements for common mode filter:
- High common mode impedance and attenuation below 2GHz to suppress common mode noise;
- Low differential mode impedance and insertion loss below 1GHz to avoid differential mode signal loss.
Requirements of CMC in MIPI

- High common mode impedance below 2GHz
- Low differential mode impedance below 1GHz
• The higher common mode insertion loss is, the better. As for differential mode insertion loss, it is opposite.

Low differential mode insertion loss below 1GHz

High common mode insertion loss below 2GHz
Thin film common mode filter has spiral coils in one layer and behaves good electrical characteristics.

Thin film CMC shows high cost because of the high cost manufacturing process.
Some competitors’ multilayer common mode filter is open magnetic circuit type with multiple coil in one layer.

This kind of product has high common mode impedance at low frequency. However, its low cut-off frequency cause low common mode insertion loss at high frequency due to the high stray capacitance.
### Benchmarking Comparison

**Common mode impedance and insertion loss**

<table>
<thead>
<tr>
<th>Company</th>
<th>Part Number</th>
<th>Type</th>
<th>Zcm (max)</th>
<th>Zcm (2GHz)</th>
<th>Scc21 (max)</th>
<th>Scc21 (2GHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunlord</td>
<td>SDMM0806S-2-300T</td>
<td>Multilayer</td>
<td>620</td>
<td>300</td>
<td>-22 dB</td>
<td>-17 dB</td>
</tr>
<tr>
<td>Mxx</td>
<td>0806-28ohm</td>
<td>Thin Film</td>
<td>420</td>
<td>90</td>
<td>-20 dB</td>
<td>-15 dB</td>
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<tr>
<td>Axx</td>
<td>0806-90ohm</td>
<td>Multilayer</td>
<td>570</td>
<td>270</td>
<td>-22 dB</td>
<td>-12 dB</td>
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</table>
## Benchmarking Comparison

### Differential mode impedance and insertion loss

<table>
<thead>
<tr>
<th>Company</th>
<th>Part Number</th>
<th>Type</th>
<th>Zdm (100MHz)</th>
<th>Zdm (1GHz)</th>
<th>Sdd21 (1GHz)</th>
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</thead>
<tbody>
<tr>
<td>Sunlord</td>
<td>SDMM0806S-2-300T</td>
<td>Multilayer</td>
<td>8</td>
<td>100</td>
<td>-1.0 dB</td>
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<tr>
<td>Mxx</td>
<td>0806-28ohm</td>
<td>Thin Film</td>
<td>7</td>
<td>85</td>
<td>-0.8 dB</td>
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<tr>
<td>Axx</td>
<td>0806-90ohm</td>
<td>Multilayer</td>
<td>11</td>
<td>110</td>
<td>-1.5 dB</td>
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### Manufacturing Plan

#### SDMM0806 Capacity Plan (Unit: KK)

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<th>Sample</th>
<th>Low Volume Production</th>
<th>Mass Production</th>
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Thank You!