

# Wideband Ferrite Chip Common-mode Filter For The Next-generation Digital Interface HDMI, ACM2012H-900

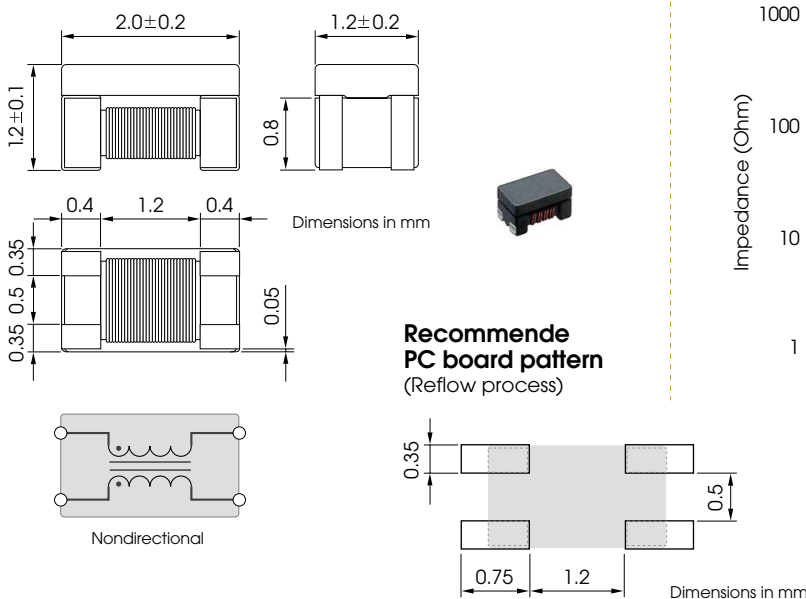
## Conforming to RoHS Directive

Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

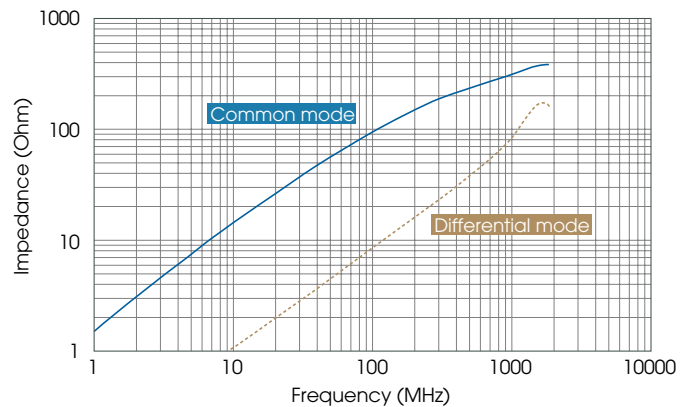
HDMI, the next-generation digital interface, allows high-speed transmission of high-resolution video signals and multi-channel audio signals without compressing them. As the first EMC component manufacturer to be registered as an Adopter, TDK has been cooperating with the makers of IC chips, devices, and connectors in the development of ideal common-mode filters for HDMI.

ACM2012H-900 is the latest achievement of the effort. While accurately reducing radiation noise, a superb frequency characteristic for transmission of HDMI's quality and speedy differential signals without any distortions is realized.

## Shapes and dimensions / Equivalent circuit



## Impedance vs. frequency characteristics

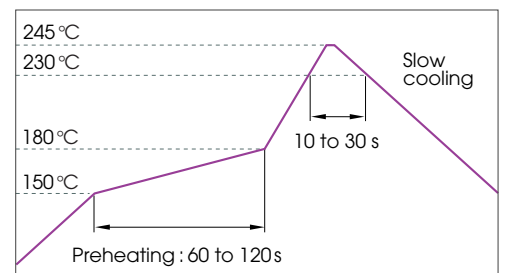


## Operating temperature range

-25 to +85°C

## Recommended soldering conditions

Lead-free solder/High-temperature reflow process



## Typical Electrical Characteristics

Common-mode Impedance	(ohm)	65 min/90 typ. (at 100MHz)
DC resistance Rdc	(ohm)	0.30 max. (1-line)
Rated current Idc	(mA)	300 max.
Rated voltage Edc	(V)	20 max.
Insulation resistance	(ohm)	20M max.
Cutoff frequency	(GHz)	6 typ.
Characteristic impedance	(ohm)	100 typ.

# Three rigorous requirements for the common-mode filter for HDMI interface



HDMI's maximum data transmission speed can be as fast as 1.49Gbps. When applying a common-mode filter as an EMC countermeasure for this rapid interface, the insertion loss characteristic (S<sub>dd21</sub>) is the first thing to be considered.

For instance, the cutoff frequency (insertion loss: -3dB) of ACM2012-900, which is optimized for USB2.0 of 480Mbps transmission speed, is 1.6GHz, although it has to be increased to 6GHz in order to achieve a good reduction effect against radiation noise without breaking HDMI's transmission waveforms.

The characteristic impedance when installed on a transmission line is also vital to consider. The standard value (TDR Standard) of HDMI is 100 ohms plus or minus 15 ohms. Being rapid means stricter (narrower) requirements than those of USB2.0.

The eye-pattern standard verifies the transmission waveform per se — a comprehensive determination test of "aptitude" for the HDMI interface. The test is considered passed if there is almost no difference between the waveforms before and after the insertion, but considered not applicable if the eye pattern crosses the transmission waveform even a little.

ACM2012H-900

## INFORMATION

HDMI, based on the DVI standard used for PC displays, is a new digital interface with additional features for the next-generation of audio visual devices in which backward compatibility is maintained.

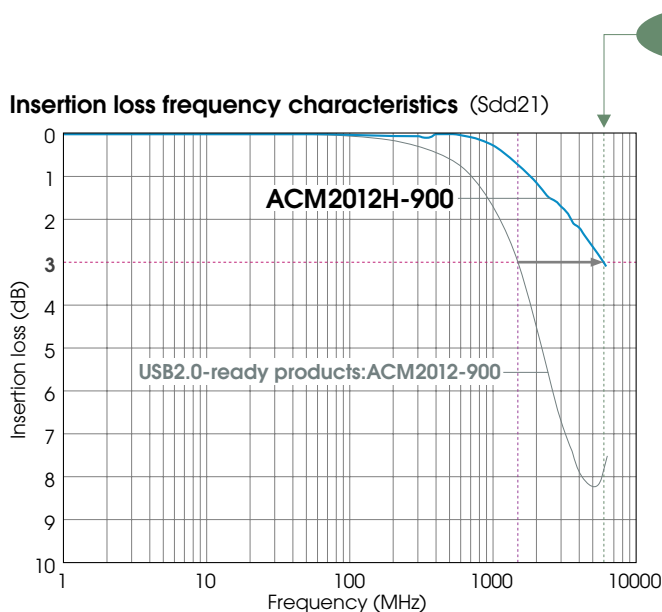
The connectors and cables are made slimmer and smaller by reducing the number of TMDS links and removing analogue RGB from the specification for cost saving and simplified inter-device connection. HDMI allows the sending and receiving of digital audio as well as digital image through one interface cable. Being digital means less degradation of the signal compared to the analogue D interface. The YCrCb connection, used frequently for many audio visual home appliances, in addition to RGB, is also supported. Currently, use of HDMI in digital TVs, harddisk TVs, DVD players, projectors, and so forth, has been becoming increasingly popular.

**HDMI**™ The website of HDMI  
<http://www.hdmi.org/>  
HIGH DEFINITION MULTIMEDIA INTERFACE

High Definition Multimedia Interface and HDMI are trademarks of HDMI Licensing, LLC.

## Feature-1

# The cutoff frequency was boosted to 6GHz



**The cutoff frequency (3dB insertion loss) was raised to 6GHz. Therefore, high-speed HDTV signals can be transmitted without distortion.**

Unprecedented high efficiency will be offered for other high-speed differential transmission interfaces.

It is applicable on both Tx and Rx sides of diverse audio visual devices with the HDMI interface, such as Set-top boxes, DVD recorders, digital TVs/hard disk TVs, LCD projectors, and so on.

It will provide the optimal effect for the EMI countermeasure against high-speed differential signal interfaces such as USB2.0, IEEE1394 and Serial-ATA, not to mention the DVI interface for PCs

## Feature-2

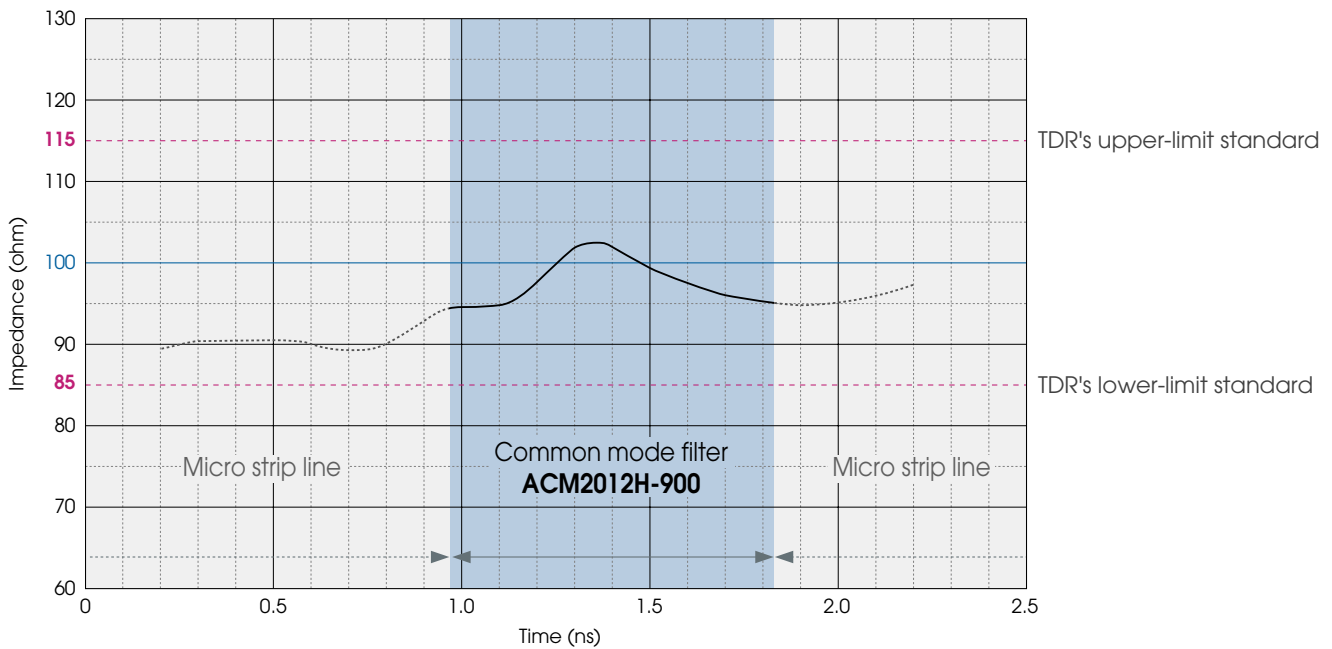
# Fully compliant with HDMI's TDR Standard

The characteristic impedance was flattened to near the 100 ohm level, clearing the severe TDR Standard of HDMI quite easily.

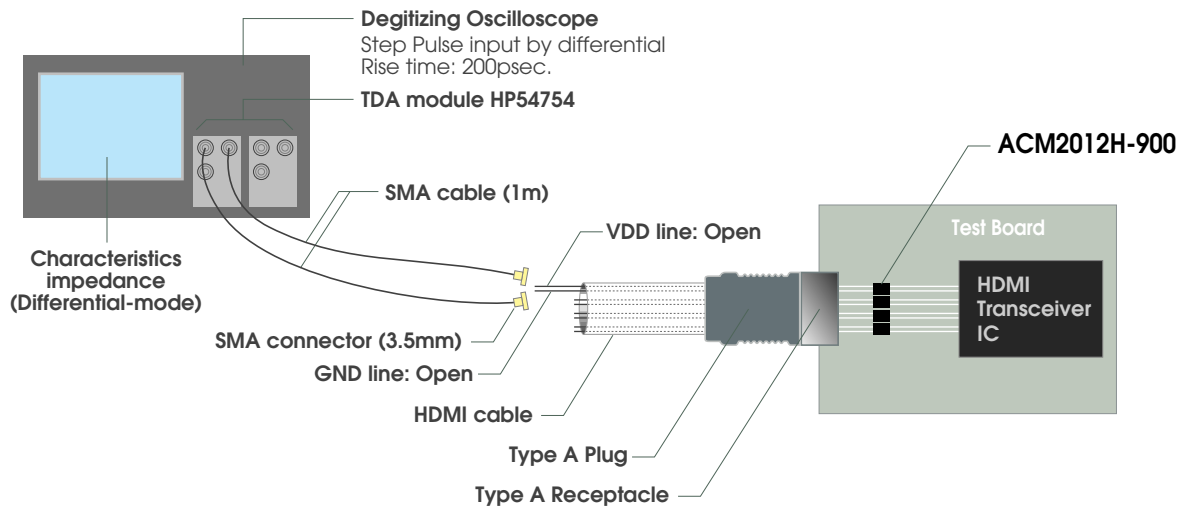
ACM2012H-900



## Actual measuring example of the characteristic impedance (TDR)



### Measurement system



Feature-3

# Fully compliant with HDMI's eye-pattern standard

As shown in the measurement result below, it complies with the eye-pattern standard of HDMI with an ideal transmission waveform.

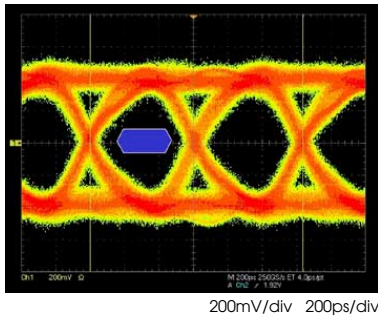
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## Eye pattern of the data signal

Comparison of before/after countermeasures

Initial condition  
(Through)

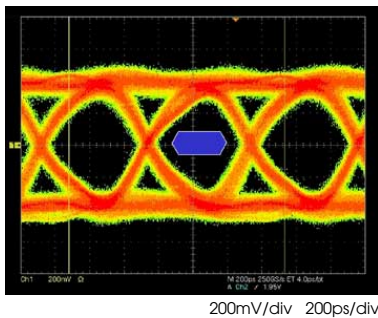


Test-1

ACM2012H-900 is integrated in each line on the Tx side.

Referential example

ACM2012-900 is integrated in each line on the Tx side.



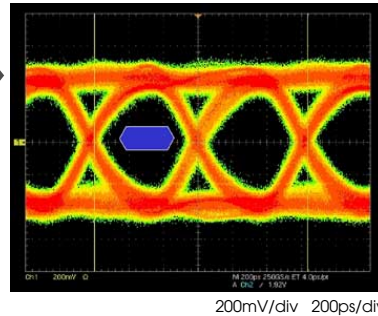
Test-2

ACM2012H-900 is integrated in each line on the Tx and Rx sides.

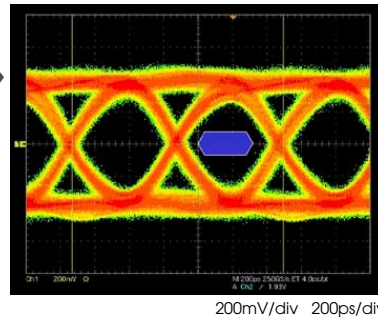
Referential example

ACM2012-900 is integrated in each line on the Tx and Rx sides.

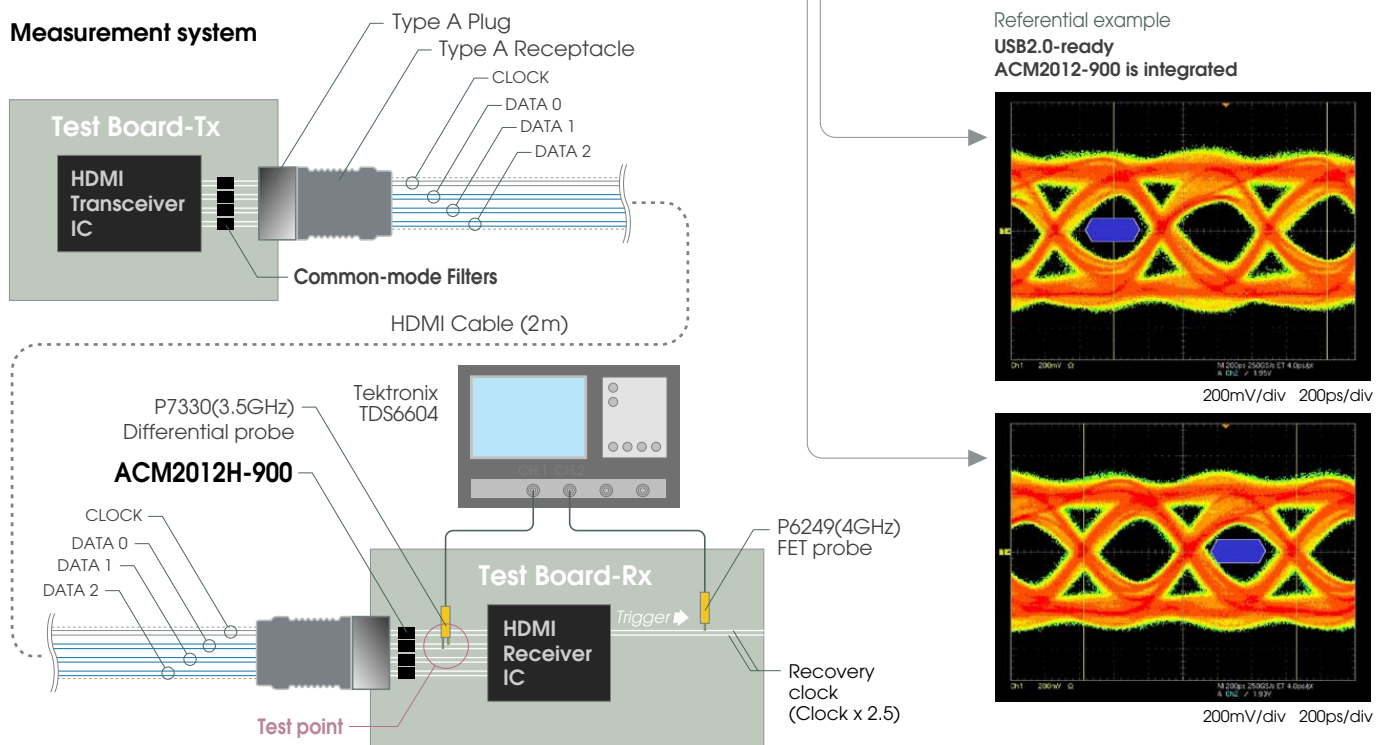
HDMI-ready  
ACM2012H-900 is integrated



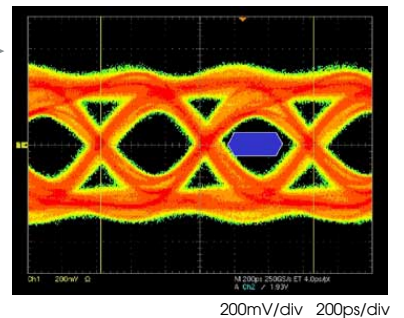
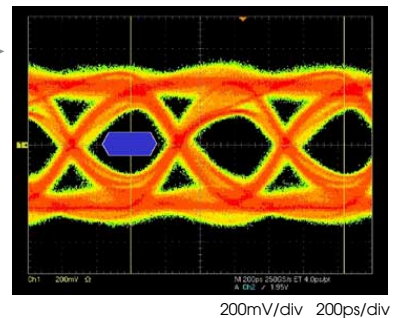
With almost no waveform distortion, transmission waveform quality that's almost equal to the initial condition is maintained.



## Measurement system



Referential example  
USB2.0-ready  
ACM2012-900 is integrated



## Feature-4

# Superb reduction effect against radiation noise

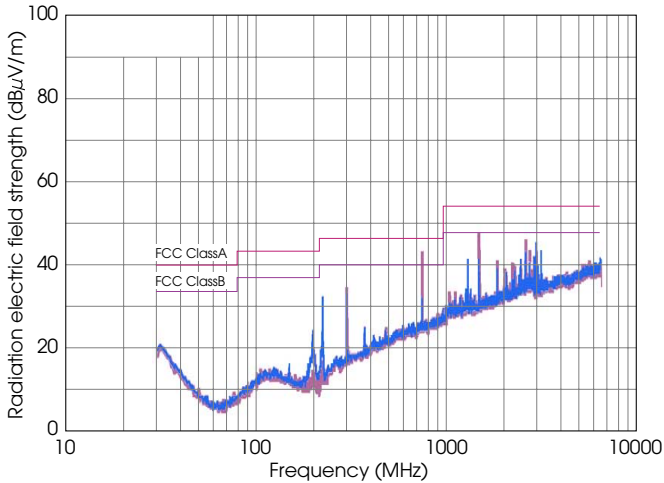
Using the 3m-test method, electric field strength radiated from the system which transmits an HDMI signal of 742.5Mbps was measured.

## Example of radiation noise reduction effect

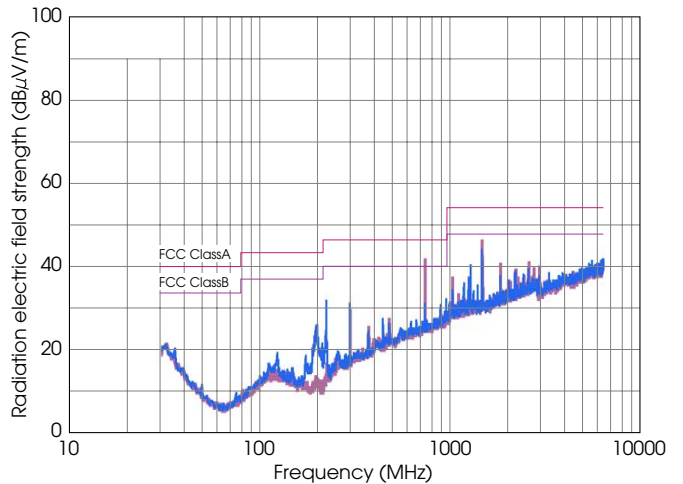
Measuring standard: The 3m-test method is used.

- Initial condition
- ACM2012H-900 is integrated in each line on the Tx side.

### Horizontal polarization



### Vertical polarization



In measuring the result before the countermeasure, a few higher harmonic peaks were observed around the fundamental wave, and GHz bands had been beyond the required level of FCC Class B. But after the countermeasure, all peaks were reduced to within an acceptable level.

### Measurement system

