

VGA cables and connectors for Projectors and monitors

This article discusses the design of long VGA cables and associated connectors and how the choice of materials and construction can enhance performance for projector and monitor systems

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VGA cables are the common analogue LCD/DLP projector and monitor cables used today, though their life may be considerably shortened by the onset of digital technology with DVI and HDMI cables in the near future.

VGA Connector

A VGA connector as it is commonly known (other names include RGB connector, D-sub 15, mini sub D15 and mini D15) is a three-row 15 pin DE-15 connector (ie a D sub-miniature connector with E size case and 15 pins).

The common 15-pin VGA connector found on most video cards, computer monitors, projectors and other devices, is almost universally called "HD-15". HD stands for "high-density", having three rows of pins which distinguishes it from similar D type connectors having only 2 rows of pins.

"VGA connectors" and their associated cabling are almost exclusively used to carry analogue component RGB and HV (Red - Green - Blue and Horizontal sync and Vertical sync) video signals along with DDC2 digital clock and data (more about DDC2 later).

Where size is a constraint (as with laptops) a mini-VGA port may sometimes be found in place of the full-sized VGA connector.



A VGA 15 pin Female connector

VGA connector HD-15		
Type	Analogue computer video connector	
Production history		
Designer	IBM based on D-subminiature	
Designed	1987	
Produced	1987 to present	
Superseded by	DVI (1999)	
Specifications		
Video signal	RGB video signal plus option H and V sync	
Data signal	I ² C data channel for DDC information	
Pins	15	
Connector	DE-15	
Pin out		
A female DE15 socket (videocard side).		
Pin 1	RED	Red video
Pin 2	GREEN	Green video
Pin 3	BLUE	Blue video
Pin 4	N/C	Not connected
Pin 5	GND	Ground (HSync)
Pin 6	RED_RTN	Red return
Pin 7	GREEN_RTN	Green return
Pin 8	BLUE_RTN	Blue return
Pin 9	+5 V	+5 V (DDC)
Pin 10	GND	Ground (VSync, DDC)
Pin 11	N/C	Not connected
Pin 12	SDA	I ² C data
Pin 13	HSync	Horizontal sync
Pin 14	VSync	Vertical sync
Pin 15	SCL	I ² C clock
The image and table details the newer 15-pin VESA DDC2 connector. Note that the pin numbering in the diagram is a female connector at the graphics adaptor; the pin numbering on the male connector, usually the cable end, is the mirror image.		

Display Data Channel

The Display Data Channel or DDC is a digital connection between a computer display such as a monitor or projector and a graphics adapter as found in PCs and laptops etc that allows the display to communicate its specifications to the adapter. The standard was created by the Video Electronics Standards Association (VESA). The latest version of the specification is "Display Data Channel Command Interface (DDC/CI) standard, Version 1.1", October 2004.

DDC allows a computer with a suitably designed graphics adapter to adjust monitor parameters such as brightness and colour balance, or to initiate degaussing. DDC/CI monitors are sometimes supplied with an external colour sensor, to allow automatic calibration of the monitor's colour balance. Some tilting DDC/CI monitors support an auto pivot function, where a rotation sensor in the monitor enables the operating system to keep the display upright as the monitor is moved between its portrait and landscape positions.

The DDC link is carried on three pins 12, 15 and 10 (data, clock and ground) in a 15-pin VGA connector, and these same connections are also used in DVI and HDMI connectors.

Cable construction for transmission of video and data signals is obviously an important feature, some VGA cables don't use coaxial cable designs for the video and synchronising signals and some don't include any wires for the data and clock signals. It is important that the impedance of the cable is 75Ω to match video equipment without serious impedance mismatch which causes losses and reflections and that the cable capacitance is as low as possible.

Another crucial component is the ability of the cable to withstand Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI)

Ferrite Beads

A Ferrite bead is a passive electric component used to suppress high frequency noise in electronic circuits. Ferrite beads employ the mechanism of high dissipation of high frequency currents in a ferrite to build high frequency noise suppression devices.



Ferrite bead on a VGA cable

Ferrite beads act as a high impedance, or "resistor" to high frequency RFI and EMI electronic noise. The absorbed energy is converted to heat and dissipated by the ferrite, but only in extreme cases will the heat be noticeable.

Ferrite beads are one of the simplest and least expensive types of interference filters to install on electronic cables.

RFI interference inside Cables

The outer surfaces of conductors in a cable act as an antenna radiating RFI so placing ferrite beads as close to the equipment as possible (at transmitting end) absorbs the interference. PCs, in particular, have several oscillators inside them which can radiate RFI down cables connected to them.

Wires inside a cable are packed closely together and so act like a single wire as far as RFI pickup is concerned. So the whole cable can be passed through a ferrite bead which suppresses the RFI transmission in all the wires.

Long projector cables connected through a faceplate would rely on a ferrite bead being included on the short cable from the computer to the faceplate so that effectively the cable run had a ferrite bead at both ends.

Using coaxial cable construction

RFI and Electromagnetic energy that reaches a video cable can be intercepted by

a screen which is typically foil or a braid or both which is then earthed. If the interference gets past the screen, and reaches the signal conductor, there's no way later to separate it from the original, intended signal. For this reason, coaxial cable, with its encompassing screen, is the best cable design for unbalanced video circuits.

Better quality and longer VGA cables include a number, usually 3 or 5 coaxial cables to carry the video RGB and horizontal and vertical sync signals.

High frequency video signals travelling down a coaxial cable are confined to the inside of the coaxial screen. But the outside of the screen acts just like any other wire; it picks up RFI and consequently this is carried to the projector or monitor. A suitable ferrite bead placed over the cable effectively suppresses this interference at video frequencies.

An ideal VGA cable for LCD/DLP projectors from 5m to 15m in length should be designed to maintain a high quality video signal employing RFI suppression with coaxial screening and ferrite beads. The use of 5 individual 75 ohm 26 or 28 AWG coaxial cables complying with UL2919 for the RGB and sync connections to maintain better defined video reproduction over the longer cable lengths, DDC2 Vesa connections, a foil screen and drain wire under the sheath together with a ferrite bead to reduce overall RFI and EMI interference.

High quality, low loss molded connector assemblies for enhanced video quality. Cable ends fitted with 15 pin HD D-Sub (HD-15) Male to 15 pin HD D-Sub (HD-15) Male or Female connectors with gold plated pins and with a ferrite bead fitted over the sheath at projector/monitor end.

About the Author

David Edis-Bates is a Chartered Electronics and Communications Engineer who has spent more than 40 years involved with the design, development, manufacture and implementation of communication products and projects in many countries around the world.