

Bridging the Gap: USB Converters

Essential Components for
Today's Industrial Connections



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We're here to help! If you have any questions about your application, our products, or this white paper, contact Black Box Tech Support at 0118 965 6000 or go to www.blackbox.co.uk and click on "Talk to Black Box." You'll be live with one of our technical experts in less than 20 seconds.

Introduction:

The emergence of Universal Serial Bus (USB) has resulted in a large connectivity gap between industrial electronics and today's computers. Computer manufacturers, responding to the greater demand in the consumer market, have phased out their DB9 and DB25 connectors. This presents quite an obstacle to industrial users, who still rely on RS-232 and RS-422/485 interfaces to communicate with their computer systems.

To solve this connectivity gap, USB converters are more vital than ever.

Understanding how USB became dominant.

Prior to USB technologies, adding or subtracting peripherals to a computer system or network was time consuming. The system had to be powered down, attached to or detached from the peripheral (think: printers), and rebooted. Finally, the correct drivers had to be installed. More often than not, internal components such as PCI cards were required as well, increasing costs and further complicating installation procedures.

In 1994, a consortium of seven companies was convened to address the difficulties of traditional peripheral swapping. They combined resources to improve the ways computers connect to peripherals and other components. This consortium, called the USB Implementers Forum, Inc., (USB-IF) now includes thousands of members responsible for the development and promotion of USB technologies. The USB-IF includes Intel®, Hewlett Packard, Microsoft®, NEC, and Phillips.

In 1995, the USB-IF officially introduced USB to the world. In a short time, the new technology became the dominant choice. It radically changed the way peripheral technology worked. USB enables users to swap peripheral components — which include printers, digital cameras, scanners, and other Human Interface Devices (HIDs) — without rebooting, a process known as “hot swapping.” Device drivers still need to be installed, but only the first time a component is connected. USB technology instantly simplified the installation process.

Additionally, USB has numerous expansion capabilities. A standard DB9 connection has very little flexibility as far as controlling external components or peripherals — one connection controls one piece of equipment. In contrast, a single USB port can manage up to 127 devices, depending on the PC resources, wiring, and USB hubs. Along with making peripheral installation nearly instant, these expansion capabilities free up internal storage space on a computer, reduce external hardware costs, and eliminate the need to set up of COM ports and IRQs.

Technical Capacities and Specifications of USB

Supported Operating Systems

Virtually every operating system (OS) on the market today is USB enabled. Windows® 98 was the first to support USB right out of the box. Almost every PC that was made after 1997 supports USB.

Logos and Terms

USB technologies come in a variety of versions and speeds. Logos were created for each of the product specifications, from standard USB to SuperSpeed USB, the latest technology.



SuperSpeed USB — The most recent development in USB, also called USB 3.0. USB 3.0 has a signaling rate of 5 Gbps — 10 times higher than High Speed USB. It is backward compatible with USB 2.0 devices and platforms. Additionally, SuperSpeed USB provides improved power efficiency with no device polling, and lower active and idle power requirements.



Wireless USB — Combines the speed and security of wired technology with the convenience of wireless. This technology enables peripherals and computers to communicate without a hard connection. Wireless USB goes up to 480 Mbps at 10 feet (3 m) or 110 Mbps at 33 feet (10 m).



USB On-the-Go High Speed — This technology enables certain USB peripherals, such as cell phones and PDAs, to communicate directly with each other when no PC is available. USB On-the-Go 2.0 technology provides speeds of up to 480 Mbps.



USB On-the-Go — This technology enables direct USB communications just like USB On-the-Go High Speed, only at lower baud rates. It includes USB 1.1 and 2.0 technologies with speeds from 1.5 to 12 Mbps.



High Speed USB — Also known as USB 2.0, High Speed USB provides transfer capacities of up to 480 Mbps. Nearly all 2.0 devices are certified for high-speed transfer rates.



Standard USB — USB 1.1 has two data rates: 12 Mbps for devices, such as disk drives that need high speed throughput and 1.5 Mbps for devices such as joysticks that need much lower bandwidth.

All USB versions are backward compatible, enabling newer USB devices to work with older ones by automatically slowing down the transfer rates to match the older device. For maximum performance, high-speed and low-speed devices should be separated. However, baud and version rates can co-exist on the same bus in a pinch.

Data Transfer Rates and Terms

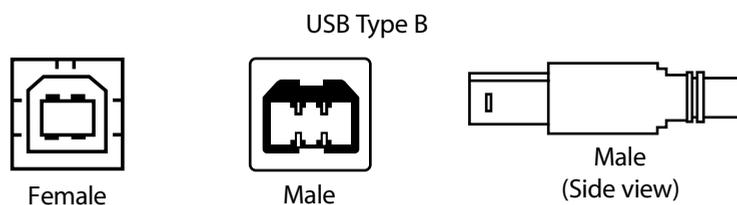
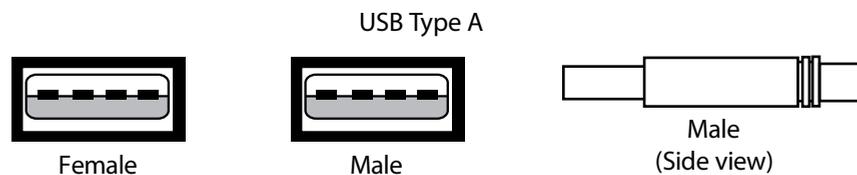
- Low or Normal Speed— 1.5 Mbps (USB 1.1)
- Full Speed — 12 Mbps (USB 1.1)
- High Speed — 480 Mbps (USB 2.0)

Technical Specifications

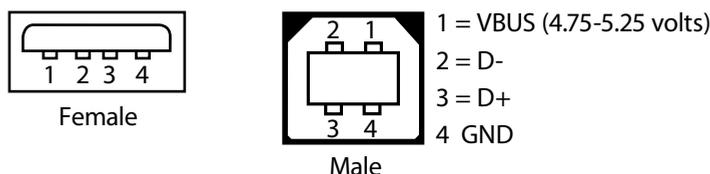
- Maximum wire length— 16. 4 feet (5 m)**
- ** Can be extended to 98.4 feet (30 m) by adding a series of hubs.
- Maximum number of hubs—5
- Maximum number of devices per USB port (hubs count as a device)— 127
- Low power device — 100 mA
- High power device— 500 mA
- Wiring configuration — Star topology
- Signal levels (volts) — 0.0–0.3 (low)
2.8–3.6 (high)
- Communication type— Half-duplex

Wiring Types

USB uses four types of wiring systems, all using shielded twisted-pair (STP) cabling.



Pin Numbers and Functions



Seven Questions to Ask Before Investing in USB Converters

For all the advances in this technology, many companies that rely on industrial applications find themselves out in the cold. The consumer market has trumped the industrial one. Fortunately, a wide range of USB converters has been developed to meet the needs of the industrial sector.

USB converters give industrial companies the flexibility to put recent developments in power and resources to work for them. These converters keep costs low by enabling the companies to retain their fully functional legacy peripherals and equipment.

Because of the variety in USB converters, it can be challenging to select the correct one. The same pin configurations do not necessarily make the desired conversions or meet the required baud rates. These differences make knowing the exact specifications for your application essential. Here are seven things to ask before you buy a USB converter:

1. Are you converting from RS-232, RS-422, RS-485, or do you need to move them all through on a USB host?
2. What are the required data-transfer rates?
3. Do you need half- or full-duplex for your RS-485 communications?
4. Which connectors are you dealing with, DB9 or DB25? Male or female?
5. Do you need optical isolation to withstand harsh environments when making the conversion?
6. What are the handshaking requirements?
7. What are the voltage needs of your RS-232, RS-422, or RS-485 device?

Once these questions are addressed and the converter is chosen, simply plug the converter into the USB port on the computer at one end and connect it to the peripheral device at the other. (Most converters are “plug-and-play.”) You’ll need to install the necessary drivers on the first connection, but after that your components will be “hot-swappable.”

Summary

- USB converters are a low-cost solution for connecting industrial equipment to an up-to-date computer system or network.
- USB converters free up your computer's internal hardware space.
- USB conversion eliminates time-consuming setup of IRQs, I/O addresses, and COM ports.
- USB connections are hot swappable, meaning that numerous peripherals can be easily added and removed.
- With USB, you can minimise cost and maximise resources by using a single USB port to manage up to 127 devices.
- USB automatically makes adjustments for various version types and baud rates, and is backward compatible.
- Converters are available for virtually any industrial situation and application.
- USB converters readily convert RS-232, RS-422, and RS-485 to USB, regardless of connector pin configuration.
- With wireless USB, peripherals can be up to 98.4 feet (30 m) from the controlling computer systems.
- Save time, money, and resources by moving to a truly “plug-and-play,” hot swappable environment.

About Black Box

Black Box Network Services is a leading datacom products and converters provider, serving 175,000 clients in 141 countries with 192 offices throughout the world. The Black Box catalogue and Web site offer more than 118,000 products including USB converters for industrial applications. Black Box also offers USB extenders, hubs, adapters, cables and more, plus cabinets and racks, KVM, digital signage, and networking products. To view Black Box's comprehensive product offering, view our Web site at www.blackbox.co.uk. Black Box is also known as the world's largest technical services company dedicated to designing, building, and maintaining today's complicated data and voice infrastructure systems.

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