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Installation best practices for SMART products

SMART®

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Chapter 1

Welcome

This document provides guidance for installing the following SMART products:

- SMART Board® interactive whiteboards
- SMART Board interactive whiteboard systems (with projectors)
- SMART Board 4000, 8000i-G3 and 8000i-G4 series interactive flat panels
- SMART Room System™ for Skype® for Business
- SMART Room System™ with SMART Meeting Pro® software
- LightRaise® interactive projectors
- SMART kapp® boards
- SMART Table® interactive learning centers

It describes best practices and the standard tasks and equipment needed for a successful equipment installation.

NOTE

For similar information about newer SMART products, refer to those SMART products' "Installing and maintaining" sections in smarttech.com/support.

This document also provides guidance for those who wish to deviate from a standard installation by including third-party equipment. SMART describes an installation that deviates from a standard equipment installation as a "non-standard installation."

Because SMART has no control over products manufactured by a third party, SMART can not make recommendations regarding the use of specific third-party equipment with SMART products. However, SMART has compiled a list of companies that are likely to be able to provide assistance in these areas. These referrals are found in *Appendix A: Third-party referrals* on page 69.

Contact your installer, reseller or equipment manufacturer for support with equipment you use as part of a non-standard installation. SMART can not provide support beyond that which is presented in this document.

 IMPORTANT

- Modifications to any SMART product, accessories, components or included cables voids the SMART product's warranty.
 - The use of any third-party product in combination with a SMART product is at your own risk.
 - SMART strongly recommends that you test third-party components or adapters before installation. Consult your certified reseller for assistance.
-

Chapter 2

Installing the product

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Transporting the SMART product

After your organization receives the SMART product, you need to transport it to the place where you plan to install it.

On occasion, you might also need to move the SMART product to another location after initially installing it.

 IMPORTANT

- Transport the SMART product at your own risk. SMART cannot accept liability for damages or injury that occur during the SMART product's transportation.
 - When transporting the SMART product, do the following:
 - Follow local safety regulations and standards.
 - Keep the SMART product in its original packaging.
 - Move the SMART product so that its top frame faces up.
 - Have at least two people move the SMART product.
-

 TIP

SMART product packaging may be labeled to indicate which side is the front. Look for “FRONT” on the packaging to help orient the box during transportation.

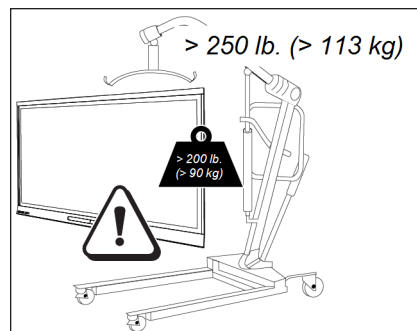
Using transportation aides

You can use the following aides to transport the SMART product:

- Cart
- Furniture dolly
- Mechanical lift

 NOTE

Larger, heavier models feature eyebolt mounting holes for use with a mechanical lift. Refer to these models' installation instructions for information about using a mechanical lift.



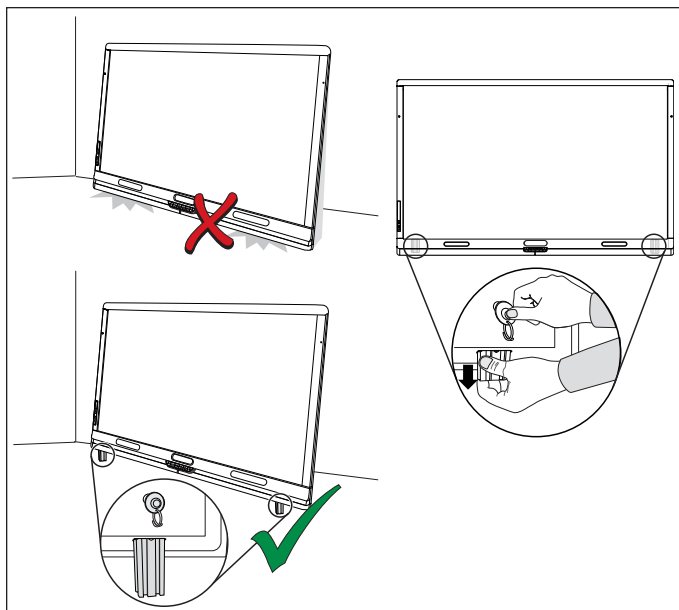
Accommodating doorways, hallways and elevators

In some situations, you might need to remove the SMART product from its packaging to move it through narrow doorways or hallways or on to an elevator. In these situations, SMART recommends that you keep the foam pieces on the bottom corners of the SMART product. These foam pieces protect the SMART product if you need to set it down during transport.

You might also need to rotate the SMART product so that its top frame faces to the side. You can do this during transportation, but when you install the SMART product, it must be in landscape orientation (with the top frame facing up).

▲ CAUTION

Never rest a SMART Board 8000i-G4 series interactive flat panel directly on its bottom edge. This can damage the interactive flat panel's speakers or touch system. Feet attached to the bottom of the interactive flat panel must be extended past the bottom frame before the interactive flat panel is set down.



Dealing with cracked, chipped or shattered glass

The SMART product contains safety-tempered glass. Although this glass is heat-strengthened to help withstand impacts, the glass can crack, chip or shatter if struck with enough force. (Safety glass is designed to break into small pieces rather than sharp shards if it is broken.) Temperature changes can cause a minor crack or chip to become worse, possibly causing the glass to shatter. See the knowledge base article, [Shattered glass on an interactive display](#), for information about conditions that can cause the SMART product's glass to shatter even when it's not in use.

If the SMART product's glass is cracked or chipped, have it professionally inspected and repaired at a SMART authorized repair center. If the SMART product's glass shatters, carefully clean up the area and have the SMART product repaired or replaced.

CAUTION

For safety and to prevent further damage, do not continue to install or use the SMART product if its glass is cracked, chipped or shattered.

Saving the original packaging

Save the original packaging to repack the SMART product with as much of the original packaging as possible in case you need to transport the SMART product again after you initially install it. This packaging was designed to provide the best possible protection against shock and vibration.

CAUTION

Transport the SMART product only in the original packaging or replacement packaging purchased from your authorized SMART reseller. Transporting the SMART product without correct packaging can lead to product damage and voids the warranty.

NOTE

If the original packaging isn't available, you can purchase the same packaging directly from your authorized SMART reseller (smarttech.com/where).

Installing the SMART product on a wall

Typically, you install the SMART product on a wall in a classroom or meeting space.

Choosing a location

A SMART product is typically installed at the room's focal point, such as at the front of a classroom or meeting space.

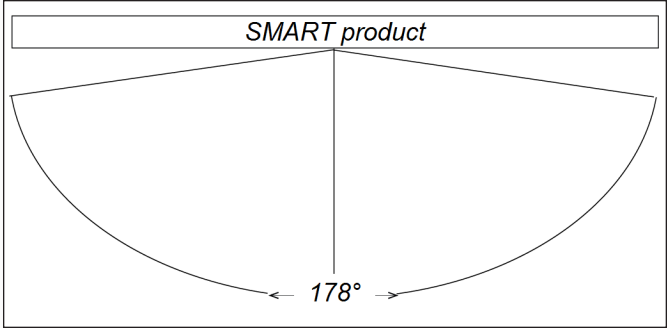
Selecting an appropriate location for the SMART product is crucial for ensuring the best possible experience with the product. Consider the following factors as you choose a location:

Factor	Considerations
Room setup	• The location allows users, including those in wheelchairs, access to the SMART product. Refer to local regulations regarding accessibility. • The location allows for multiple users to access the SMART product at a time. • The location accommodates room traffic patterns, and there are no tripping hazards. • The SMART product is not installed where it could be hit by a door or gate. • There are no nearby shelving units, desks or other furniture that has doors or drawers that could hit the SMART product. • Furniture, wall décor and other room features, such as light switches and thermostats, do not block the SMART product or are blocked by it. (You might be able to move some of these room features to accommodate the SMART product.)
Power and other connections	• The location is close to the following: ◦ A power outlet ◦ A network outlet (if you plan to use a wired network connection) ◦ A room computer (if you plan to connect a room computer) ◦ Speakers and other devices that you want to connect to the SMART product

 **NOTES**

- If the location is not near a power outlet, consult an electrician for the power setup you need.
- Determine if you'll need additional equipment, such as power bars, additional cables or cable extenders.

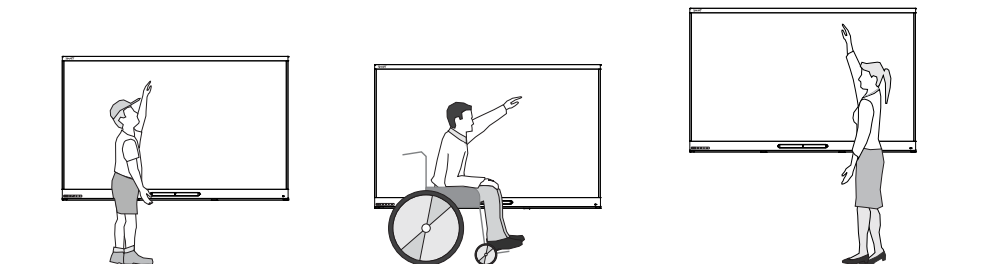
- The location is not where the mains power supply enters the building.

Factor	Considerations
Visibility	The SMART product's screen is clearly visible to all users in the room. SMART recommends users sit within a 178° viewing area:  NOTE The viewing area depends on the SMART product's resolution and a variety of other factors. For more information, see the knowledge base article, Recommended viewing distances and viewing angles for SMART Board interactive flat panels.
Lighting	The location is not near bright light sources, such as windows or strong overhead lighting. Risks of light Interference include: ◦ Reduced visibility: Light sources can cause glare on the SMART product's screen, reducing its visibility. ◦ Touch system interference: Many SMART products use infrared (IR) light as a key component of the touch system. Strong light that hits the SMART product's screen directly can cause interference with the touch system and prevent the SMART product from working properly. TIP To reduce light interference, install blinds or shades on windows or skylights and install switches to dim or turn off any lights shining directly on the SMART product's screen. Keep in mind that sunlight can come through windows at different angles at different times of the year.
Acoustics	The room has good acoustics (see <i>Room acoustics</i> on page 24).

Factor	Considerations
Environment and ventilation	• The location meets the environmental requirements in the SMART product's specifications. • The SMART product isn't subjected to strong vibrations or dust. • Ventilation systems don't blow air directly on the SMART product. • There is adequate ventilation or air conditioning around the SMART product so that heat can flow away from it and the mounting equipment. SMART recommends at least 2" (5 cm) of space on all sides of the SMART product for proper airflow. • If you plan to install the SMART product in a recessed area, there is at least 4" (10 cm) of space between the SMART product and the recessed walls to enable ventilation and cooling.

Choosing a height

Consider the general height of the user community when you choose the height for the SMART product.



SMART recommends that you mount the SMART product so that its top is 6' 5" (1.9 m) from the floor.

NOTE

If participants will be sitting at a steep angle (such as in a lecture hall), you may have to adjust the installation height or angle.

Assessing the wall

Be sure the wall you're installing the SMART product on can support the weight of the SMART product and mounting equipment. If the wall can't support the weight of the SMART product and mounting equipment, consider using a SMART wall stand to transfer some of the weight from the wall to the floor (see [smarttech.com/accessories](https://www.smarttech.com/accessories)).

 NOTE

Refer to the SMART product's specifications for its weight.

In some situations, you may need to request an engineering analysis to determine if the wall can support the SMART product.

Wall flatness

Although a wall might appear to be completely flat, it might have a degree of variation, depending on how it is constructed. Installing the SMART product on a wall with a large variance can lead to issues with the SMART product's touch system, and in extreme cases can damage the SMART product. The area of the wall where you will mount the SMART product should be no more than 3/16" (5 mm) off plumb horizontally and vertically.

 To evaluate the wall's flatness

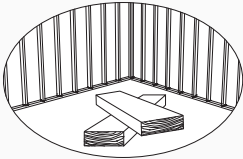
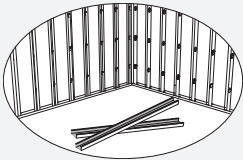
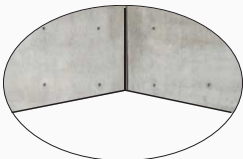
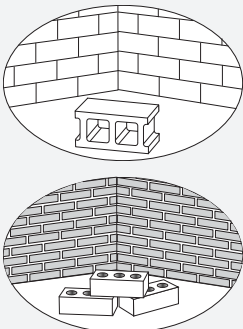
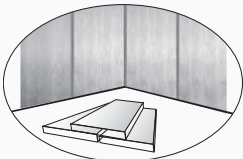
1. Place an object that has a long flat edge of at least 3' (1 m), such as a meter stick or level, across the wall where the SMART product will be mounted.
2. Look along the object to find places where there is a gap between the object's edge and the wall's surface.
3. Measure any gaps to see if they exceed 3/16" (5 mm). If a gap is wider than 3/16" (5 mm), this indicates the wall is not flat enough for mounting a SMART product.
4. Repeat steps 1–3, this time placing the object's flat edge diagonally across the wall in the other direction (if you previously placed the object diagonally from the top-left to the bottom-right, place the object from the top-right to the bottom-left).

 TIP

Gaps located at the center of the object indicate a concave wall, while gaps located on both ends of the object indicate a convex wall (consequently, the object may make a "rocking" motion). Walls with a significant degree of concavity or convexity may require the use of shims with the mounting hardware.

Wall type

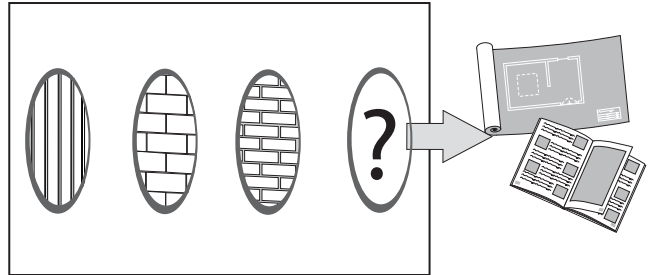
The type of wall affects how you can mount the SMART product. The following table identifies wall types and provides guidance for mounting.

Wall type	Details
Drywall over wood studs 	• Can be load or non-load bearing • Can carry weight when constructed as a load-bearing wall • Mounting must attach to three wood studs • Pilot holes should be drilled into the wood studs. These holes should be no larger than the diameter of the screw's body to ensure the screw's thread gains as much traction in the wood studs as possible
Drywall over steel studs 	• Commonly non-load bearing • Can not support the wall-mounted SMART product without additional support (for example, a wall stand that helps support the SMART product's weight) • Mounting must attach to the steel studs
Solid concrete 	• Can be load or non-load bearing • Can carry weight when constructed as a load-bearing wall • Must have at least 3" (7.6 cm) between adjacent fasteners
Concrete masonry unit or brick 	• Can be load or non-load bearing • Can carry weight when constructed as a load-bearing wall • Use only one masonry or brick fastener per block • Do not anchor mounting hardware in mortar or grout
Modular panels 	• Can be load or non-load bearing • Can carry weight when constructed as a load-bearing wall • If non-load-bearing, might not support the wall-mounted SMART product without additional support (for example, a wall stand that helps support the SMART product's weight)

Engineering analysis

An engineering (structural) analysis may be necessary for determining if a wall can support the SMART product. Get an engineering analysis if:

- You can not find the wall's studs using appropriate tools, such as a stud finder
- You are unsure of the wall's construction and the person in charge of the building can not answer your questions
- The wall is not connected at both the floor and ceiling
- The wall is a modular panel system
- The wall is also bearing the weight of additional hardware or furniture (such as cabinets or bookshelves)
- There are special zoning requirements (for example, earthquakes)
- The wall exceeds typical construction practices (for example, taller than 8' or 2.4 m)



Selecting mounting hardware and tools

The mounting hardware and tools required for installation vary according to the type of wall onto which the SMART product is being mounted.

Screws, bolts and anchors

This table describes different types of hardware and the types of wall on which it's appropriate for use.

Wall type	Mounting hardware	Details
Drywall over wood studs	Wood and lag screws	Threads on these screws are widely spaced. These screws have wider threads.
Drywall over steel studs	Toggle bolts and butterfly anchors	These bolts/anchors have “wings” that open inside a hollow wall, bracing against the wall to secure the fastener.
 IMPORTANT SMART does not recommend using metal screws.		
Solid concrete, concrete masonry unit or brick	Concrete screws and anchors	These screws typically have alternating high and low threads and can be designed for use with a sleeved insert.

Other hardware

Additional hardware may be required for the installation of the SMART product. This hardware can include:

- Fasteners
- Washers
- Wall anchors

If possible, use the hardware that comes with the SMART product. Consult the installation instructions or the manufacturer of third-party mounting hardware for guidance on the type of hardware to use with the wall type.



Some SMART products do not include mounting hardware. Consult the SMART product's installation instructions for a complete list of included hardware.

Tools

Tools commonly used in the installation of a SMART product include:

- Drill and drill bits
- Level
- Stud finder
- Screw drivers
- Tape measure
- Hole saw

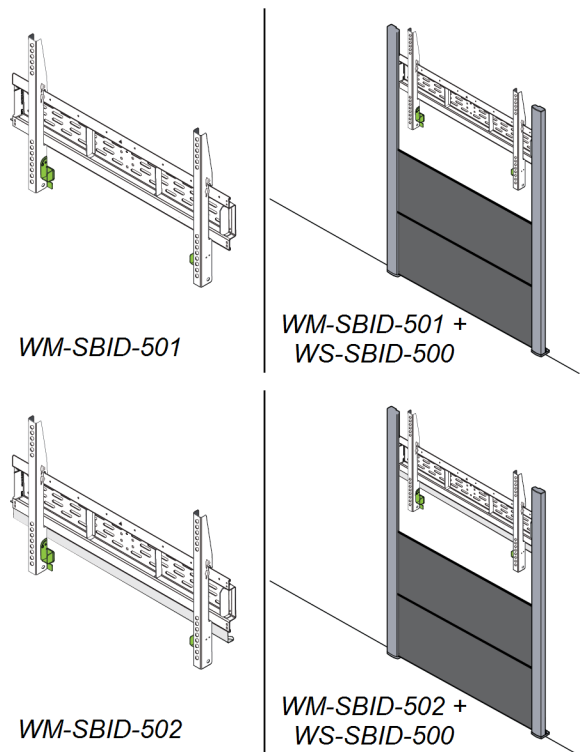
Although SMART products typically don't include the tools used for installation, the installation instructions list the tools you'll need.

Selecting a wall mount

It is always best to mount the SMART product on a wall. If the wall can't support the SMART product's weight, you can use additional hardware to transfer some of the weight to the floor.

SMART offers two wall mounts for SMART Board interactive flat panels: [WM-SBID-501](#) and [WM-SBID-502](#). Most interactive flat panels can use the WM-SBID-501, while the WM-SBID-502 is for larger and heavier interactive flat panels, such as the SMART Board 8084i-G4 interactive flat panel. These mounts can be purchased separately or as part of a SMART Wall Stand Kit ([WSK-Single](#) or [WSK-Dual](#)).

These wall-stand kits are not free-standing mounts; they still require a wall that can support the SMART product's weight.



SMART offers other mounting options for SMART Board interactive whiteboards, including:

- [SMART Height Adjustable Wall Mount UX/UF](#)
- [SMART Height Adjustable Wall Mount 600i3](#)
- [Fixed Unit Wall Mount](#)

If you choose a third-party option rather than one of SMART's mounting options, be sure the wall mount can support the SMART product's weight as well as the weight of any attached accessories and can accommodate the SMART product's dimensions.

 IMPORTANT

It is crucial to correctly assess the load (weight) requirements of a system. SMART is not responsible for incorrect load assessments.

Although mounts for consumer-grade, non-interactive displays are often rated based on the display's size, the mounts might not be sufficient for interactive displays of equal dimensions. Interactive displays include additional internal components and may also have accessories (for example, speakers and cameras) that add to the total size and weight.

Look for wall mounts that meet the following requirements:

Requirement	Details
Support the wall type	Determine the types of fasteners and mounting materials that are needed based on the wall's structure and the total weight (the SMART product and its accessories and additional components). SMART makes the following recommendations to help you properly assess the wall: • Have a qualified technician assess the installation wall. • Talk to the building facilities group about the wall's construction. • If you're still not sure of the wall's suitability, consult a construction contractor or the wall's manufacturer. If you still can't get suitable answers, have an engineering analysis performed for the wall.
Approved by a regulatory body	Use only mounts that have an Underwriter Laboratories (UL) or similar approval marking. This approval indicates that an independent body has tested the mount for proper adherence to safety considerations. If the mount is not approved by a regulatory body, it may fail to support the SMART product.
Allow for adequate ventilation	Consider air flow and ventilation when choosing mounting hardware. The SMART product should have at least 2" (5 cm) of clearance on all sides or 4" (10 cm) if the SMART product is installed in a recessed area.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Mounting the SMART product

The electrical and mechanical components of a SMART product are designed to work properly when the SMART product is mounted in the orientation described in its installation instructions. Mounting the SMART product in a different orientation can cause malfunctions and will void the SMART product's warranty.

SMART products are designed for vertical mounting only: 90° relative to the floor, plus or minus 5°–15° for tolerance, depending on the SMART product (consult the SMART product's documentation). SMART doesn't support mounting SMART products at other angles or in a horizontal orientation.

There are a number of potential hazards of mounting a SMART product in a non-standard orientation or angle:

- Mounting a SMART product horizontally (like a table top) can cause the glass to sag, damaging the SMART product or interfering with the SMART product's touch system.
- Non-standard orientation can affect ventilation, creating hotpots in equipment, premature failures and, in SMART products that use projectors, exploding projector bulbs.



TIP

The only SMART product that supports a horizontal orientation is the SMART Table interactive learning center.

Mounting multiple SMART products

A multiple-SMART product configuration can include two or more SMART products in a variety of arrangements. SMART recommends that you mount no more than three SMART products side by side.



NOTE

Different SMART products support multiple-SMART product configurations to varying degrees. Consult a SMART product's documentation before including it in a multiple-SMART product configuration.

Although a computer can support up to 16 touch-sensitive SMART products, the demands on the computer and graphics card increase as you add more SMART products. If you want to use more than three SMART products, SMART recommends that you work closely with an experienced installer.

Installing the SMART product on a stand

If you want to move the SMART product from place to place or if it's not possible to install the SMART product on a wall, you can install it on a stand.

 NOTE

SMART does not recommend using mobile stands with SMART products that include multiple components and cables, such as the SMART Room System. Cables and table equipment (including microphones and speakerphones) can be damaged easily and are difficult to manage. Contact SMART Support for advice if you choose to use a mobile stand with components in addition to the SMART product. Any damage to components that results from being mounted on a mobile stand will likely not be covered by the warranty.

Using SMART mobile stands

SMART mobile stands are designed for SMART interactive displays. They are height-adjustable. Some models include integrated speakers, a locking cabinet to secure equipment and casters that swivel and lock for easy movement.

For more information about SMART mobile stands, see smarttech.com/accessories.

Using a third-party stand

You can install the SMART product on a third-party stand as long as the stand meets the following requirements:

Requirement	Details
Supports the SMART product's weight and size	The stand must support the combined weight of the SMART product and all its accessories and components. Make sure the dimensions of the stand are also properly accommodated.
Provides adequate ventilation	If the stand has an equipment enclosure, the enclosure must provide adequate ventilation for the SMART product and any accessories. Damage that results from overheating caused by improper installation is not covered by warranty and may also void the warranty.
Is approved by a regulatory body	Stands must be approved by Underwriters Laboratories or a similar independent body. This approval indicates that the mounts have been tested for proper adherence to safety regulations. These regulatory tests go beyond the equipment's loading restrictions, helping to guarantee that the stand will be safe when used properly. If the stand is not approved by a regulatory body, it may fail to support the weight of the SMART product.

Requirement	Details
Has a lower center of gravity or adjustable height	A low center of gravity helps make the system more stable. The ability to reduce the height is useful during transport.  NOTE Take care that equipment beneath the mounted SMART product is not damaged when it is lowered. Movement of the SMART product can also damage cables if the cables are pinched or bent.
Supports mounting speakers	Mount speakers directly on the stand itself rather than on the SMART product.
Has large wheels	Large wheels make it easier to cross door thresholds and move the stand over a variety of surfaces.
Has handles	Using a stand with handles helps prevent the application of pressure directly to the SMART product during transport. Applying pressure to the SMART product's frame directly can twist the frame during transport.
Has a safety locking mechanism	Using a stand with locking wheels ensures the SMART product stays in place while it's in use.
Has built-in equipment and cable management	Built-in equipment and cable management helps prevent damage to components and connections during transport. Shelving and mounting points are also useful for cable management.

If you use a third-party stand, consider the following guidelines when installing the SMART product on the stand and moving the system:

Guideline	Details
Do not overload the stand	Putting too much weight on a stand, possibly by including speakers or other equipment, can make the stand unstable. Consider the system's total weight and not just the weight of the SMART product.
Be aware of the system's center of gravity	When moving a SMART product mounted on a mobile stand, tipping can be a concern. The addition of other components can increase this risk by affecting the system's center of gravity.

Guideline	Details
Use the stand's handles	SMART recommends using mobile stands that have handles. A SMART product can become misaligned if it's moved using the SMART product rather than the stand's handles. To avoid this, always use one hand to hold the SMART product and the other hand to hold the mobile stand when moving the system. This prevents putting too much pressure on the SMART product during transport.
 IMPORTANT SMART products damaged during transport on a mobile stand are outside of SMART's warranty terms and conditions.	
Do not attach speaker brackets directly to the SMART product	Attaching brackets directly to the SMART product can twist the SMART product's frame, causing issues with touch and potentially voiding the warranty. You can make custom brackets that attach to the stand or use an industrial adhesive (for example, industrial strength tape or heavy-duty hook-and-loop fasteners) to attach speakers to the stand. Work closely with the stand's manufacturer when mounting speakers in a non-standard way, as it can potentially change the stand's safety features or affect the system's center of gravity and create a tipping hazard.
Be careful of the placement of speakers and microphones	When mounting speakers on a mobile stand, consider their location relative to microphones to avoid issues with echo-cancellation. Make sure speakers are not too close to the microphone, and test the setup with a few outside callers.
Watch out for equipment and cable placement when using mobile stands that have motorized lifts	Equipment and cables beneath the SMART product can be damaged if a stand that includes a motorized lift lowers the SMART product onto the equipment. Movement of the SMART product can also damage cables if the cables are pinched or bent.
Use best practices for cable management	Power and extension cables must be manageable during transport to prevent damage. Cables should be easy to wrap and store before moving the stand and SMART product. Letting cables dangle or drag as you move the SMART product can increase the risk of injury, product damage and damage to the cables.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Considering power management and room control systems

When installing the SMART product, keep in mind its power management capabilities and features. In some situations, you might also need to integrate the SMART product with a room control system.

About the SMART product's power management capabilities

SMART products feature advanced power-management capabilities. For more information about the power management capabilities of a particular SMART product, refer to its documentation.

About presence detection sensors

Some SMART products include a presence detection sensor (also called a proximity sensor) that detects movement in the room and turns on the SMART product. If the sensors detect no movement for a time, the SMART product goes into Standby. The SMART product's use of the proximity sensor can be adjusted or disabled in the SMART product's settings. For more information about power states and power-management settings, refer to the SMART product's documentation.

 NOTE

When you install a SMART product, remember that the SMART product's proximity sensors might be able to detect movement through large windows or glass walls. Also, make sure that no obstructions prevent the proximity sensor from functioning correctly.

Integrating the SMART product with a room control system

A room control system enables users to control a room's lighting, audio system and, possibly, the SMART product. Some installations may require you to integrate the SMART product with a room control system. Refer to the SMART product's documentation to see if it works with an external room control system.

You can use the SMART product's RS-232 connector to connect a third-party external control system to the SMART product (see *Appendix A: Third-party referrals* on page 69).

 NOTE

SMART products are not compatible with centralized remote control systems, such as a universal remote control.

Chapter 3

Configuring the product

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After the SMART product is mounted and connected to power and source devices, it needs to be configured. Configuration includes:

- Calibration and orientation
- Display resolution and refresh rate
- Audio set up
- System settings (language, date, time, and so on)
- Power management setup

Calibrating and orienting the SMART product

Calibration and orientation are important to the proper functioning of a SMART product's touch features. Calibration and orientation ensure the touch interactions with the SMART product's surface are interpreted and communicated correctly with the SMART software installed on the connected computer. Without calibration and orientation, digital ink could appear at a distance from the pen's contact with the screen, or areas might not respond to touch properly.

Calibration and orientation are required:

- When the SMART product is installed
- After the SMART product is moved

Calibration and orientation are recommended:

- After an upgrade to the SMART product's firmware or the SMART software on the connected computer
- If the room's lighting changes (for example, brighter or dimmer bulbs are installed)
- Touch features aren't working correctly

Refer to the SMART product's documentation for information about calibration and orientation.

Setting connected devices' resolutions and refresh rates

Set any connected computers and other devices to the resolutions and refresh rates recommended in the SMART product's documentation to ensure the best possible image quality. See the connected computers or other devices' documentation for instructions.

Resolutions

Many SMART products support full high definition (FHD) 1080p and 4K ultra high definition (4K UHD) resolutions, provided the source device meets the minimum requirements for such resolutions.

Resolution	Pixels	Details
FHD (1080p)	1920 × 1080 (2.1 megapixels)	Most modern video devices (computers, laptops, DVD players and Blu-ray™ disc players) support FHD resolutions. Check a device's specifications to see which resolutions it supports. SMART recommends a digital HDMI, DVI or DisplayPort connection for best results with FHD. Although an analog VGA connection might support FHD, the video quality may be degraded, particularly if the VGA cable is longer than 16' (5 m).

Resolution	Pixels	Details
4K UHD	3840 × 2160 (8.3 megapixels)	A 4K UHD display has greater pixel density than an FHD display. A 4K UHD display can show up to four times as much visual information as FHD displays.
 NOTES - Some video hardware described as “4K” or “UHD” may be capable of displaying a 3840 × 2160 image but will not perform well with video at the same resolution. See the knowledge base article, Minimum requirements for Ultra High Definition or 4K on your interactive flat panel. - SMART software may have additional requirements. See smarttech.com/downloads for more information.		

SMART advises against the use of an analog video connection for displaying FHD or 4K UHD because analog video connections can not display high-resolution images with adequate picture quality. If you want to use FHD or 4K UHD resolutions and the source device supports only an analog video connection, you will likely need to upgrade the source device.

Refresh rates (30 Hz versus 60 Hz)

Displays can support different refresh rates, typically 30 Hz or 60 Hz. Higher refresh rates can result in smoother, flicker-free video. This is most evident when using 4K UHD.

Most computers support a refresh rate of 60 Hz. Using the highest frame refresh rate possible will provide a better experience when using the SMART product, provided the connected device supports the refresh rate. If it doesn't, you may need to set the device's display settings to a lower refresh rate.

 NOTE

To display 4K UHD at 60 Hz on the SMART product, use the DisplayPort (if available) or HDMI 2.0 input. The standard HDMI 1.4 input supports only 30 Hz at 4K UHD.

Supporting other resolutions

If the connected device doesn't support FHD or 4K UHD, refer to the SMART product's documentation for other supported resolutions. Using a resolution other than the SMART product's native resolution can cause the pixels to be scaled, resulting in slightly blurry text and images. If the connected computer is using a different aspect ratio than the SMART product's, the image can also appear stretched or compressed.

Configuring the SMART product for the best audio performance

Consider these factors as you configure a SMART product for the best audio performance:

- Room acoustics
- System gain
- Gain staging
- Ground loops
- Acoustic Echo Cancellation (AEC)
- Equipment placement

Room acoustics

The importance of room acoustics varies depending on the room's size and intended use. If you plan to enable voice conferencing in a large room, such as a board room or a lecture space, room acoustics are more important than they would be in a small classroom or meeting space where voice conferencing is not likely to be used often. Sound absorption can be required in large, open areas in which sound can echo freely.

Use this simple test to check the room's acoustics: Stand in different parts of the room and count to ten loudly. If you hear anything other than your own voice (such as a rattle, buzzing from elsewhere in the room or echoes), the room may require some modifications to improve the acoustics.

A number of features in a room can affect its acoustics:

Feature	Details
Hard surfaces	Hard surfaces in a room (such as brick, cement or glass) can cause sound to echo and distort, which can cause muffled or echoing audio during a voice conference.
Flooring	Tile, hardwood and laminate flooring are hard surfaces that can cause echoes and distortion. Carpeted floors offer more absorption of unwanted sounds.
Ceiling	A dropped ceiling with regular ceiling tiles can greatly change the acoustics of a room. Alternatively, a high, open or cavernous ceiling can also affect audio quality.

NOTE

Consult a sound reinforcement specialist before making changes to a room's acoustics.

There are a number of things you can do to improve a room's acoustics:

Improvement	Details
Install acoustic tiles or foam	Acoustic tiles or foam absorb and diffract sound waves, helping to minimize sound distortion (especially in rooms that have long parallel walls and hard surfaces).
Install ceiling tiles with better acoustic absorption	Although all types of ceiling tile offer a degree of sound absorption, some provide more sound absorption than others. Look for ceiling tiles that have a higher sound attenuation rating. This sound absorption ability is rated on a scale of 0 to 1 or as a Noise Reduction Class on the same type of scale. Higher numbers are better.

System gain

In electronic systems, gain is a measurement of the input signal's strength in relation to the strength of an output signal. Absorption, scattering and other electrical impedance can reduce signal strength as the distance the signal has to travel increases. To account for this reduction and to help prevent the introduction of noise or other signal distortion, include controls for adjusting the gain, typically by increasing or decreasing the signal's strength.

Volume control in audio systems

In audio systems, the input signal passes from the source device, such as a computer, through cables to (potentially) multiple devices. Each point within an audio system can introduce distortion or weakening of the audio signal, which in turn affects the system's audio quality. However, any audio system device that has a volume control can be used to adjust the system's gain. Each device with audio controls is considered a "gain stage" and can be used in a process called "gain staging" to provide the best possible audio.

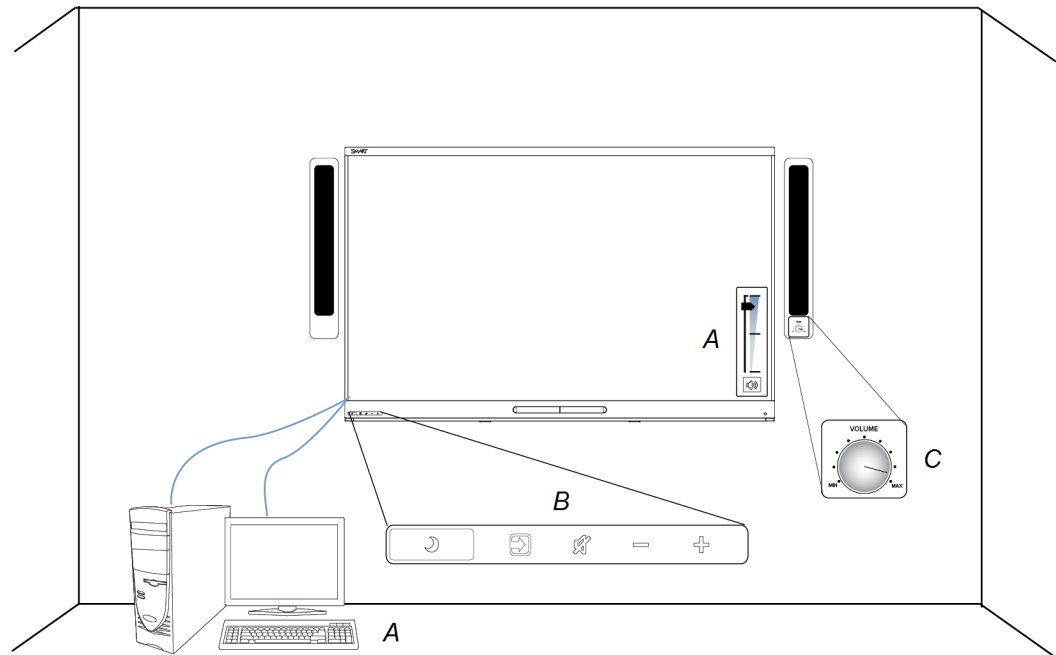
Gain staging

Gain staging involves adjusting the signal levels, such as audio, of a series of gain stages to prevent introduction of noise and distortion. Most in-room audio systems will require some sort of adjustment at each gain stage to provide the best audio.

Begin gain staging adjustments at the system's first adjustable volume control (likely at the audio signal's source, such as a computer), and end at the system's final volume control (such as a set of speakers).

► To gain stage an audio system with a SMART product

Set the volume on all but the last gain stage to 75%–95%. The following example demonstrates this procedure:



- | | |
|---|---|
| A | Audio signal source (a media player on the computer connected to the SMART product) |
| B | SMART product |
| C | External speakers |



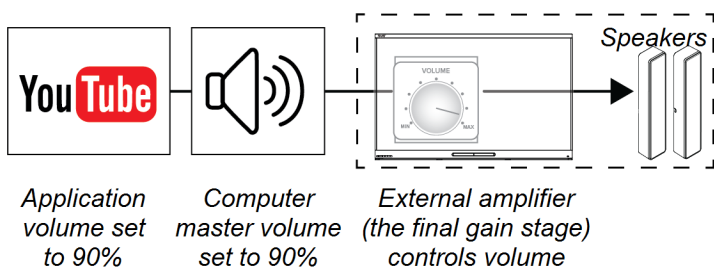
NOTE

Some speakers do not include a volume control.

This example includes four gain stages at which volume can be adjusted:

1. Volume control in the media player software
2. Volume control on the computer
3. Volume control on the SMART product
4. Volume control on the speakers

Starting with the beginning of the audio signal (in this case, the media player), set the first three gain stages' volume controls to 75%–95% to push the clearest audio signal from the first gain stage to the last gain stage without overloading the system. Then, at the final gain stage, use the volume controls on the speakers to adjust the sound for the room.



NOTE

Starting with a lower volume in the first gain stages and increasing the volume elsewhere will amplify any bad qualities (such as noise) of the audio signal.

Reducing gain stages

If a system includes multiple gain stages or a long path for the audio signal, audio latency and additional signal processing can result in issues with Acoustic Echo Cancellation (AEC). Reducing the number of gain stages in the system to shorten the audio signal's path may be helpful.

A setup that includes a SMART product and a connected computer may include additional options for connecting audio devices. Speakers are commonly connected to the SMART product and act as the final gain stage. If the computer offers an audio connection, the speakers can be connected to the computer, reducing the gain stage count and shortening the audio signal's path.

Ground loops

A ground loop is a low buzzing or hum from the speakers. Ground loops can result when two pieces of equipment are plugged into two different outlets that are on different electrical breaker circuits.

The best way to avoid ground loops is to have all devices powered by the same outlet. If this isn't an option, use an AC mains isolation transformer on the audio signal's source device (such as the computer). This will match the source's grounding to the SMART product to which the audio source is connected.

WARNING

Never remove the earth ground pin from an AC cable, as this can create the potential for electrical shock.

Acoustic echo cancellation (AEC)

Issues with AEC are among the most common that can arise in installations that employ both

microphones and speakers, especially with installations using components not provided by SMART.

When AEC issues occur, both remote participants and participants in the meeting room will likely hear an echoing when others are speaking.

 NOTE

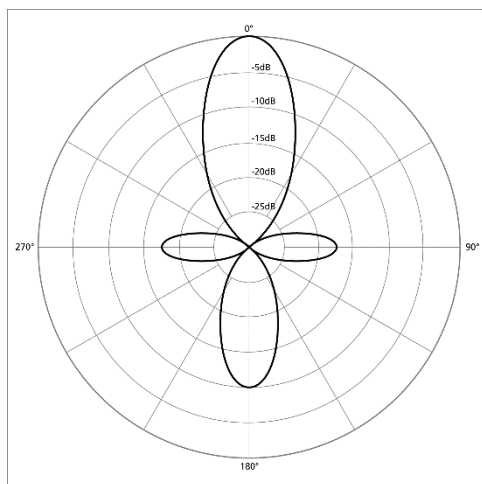
If you hear an echo of your voice during a conference call with remote participants, the issue is likely with one of the remote participants' devices. Have individual participants mute their microphones one at a time.

Equipment placement can help alleviate AEC issues.

Equipment placement

After you've determined that a room is acoustically acceptable, consider the relative placement of sound-recording devices (speakerphones, microphones, webcams, and so on) and playback devices. This helps to avoid AEC issues.

- If the speakers are above or below the SMART product, maintain a line of sight between the speakers and the microphones.
- Test the setup by making a few calls.
- Never place a microphone immediately in front of speakers. Such microphone placement can cause audio issues or loud, unpleasant feedback.
- Look at how the polar pattern for the microphone captures the sounds around it:



- Although speakers are typically located to either side of the SMART product, the room shape, size and acoustics might make it necessary to place them elsewhere.

Completing other configuration tasks

For more information about configuring a SMART product, refer to the SMART product's documentation.

Chapter 4

Product accessories

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Use accessories that meet the SMART products' requirements to ensure that the SMART products work as expected. This chapter describes the accessories' requirements and provides guidelines for selecting accessories for use with a SMART product.

It is best practice to use accessories manufactured by established, reputable companies.

OPS computers

SMART currently offers three types of Open Pluggable Specification (OPS) computers:

- AM30 (-ENT or -EDU)
- AM40 (-ENT or -EDU)
- AM70-L

The AM30/40 and the AM70-L are self-contained systems and include the software that makes them work with SMART hardware. The AM30/40 are also referred to as the iQ appliance. An iQ appliance is included with select SMART Board 6000 and 7000 series interactive displays and SMART kapp iQ boards. The AM70-L (also known as the room system appliance) is included only as part of the SMART Room System for Skype for Business.

Several issues can accompany the use of a non-standard OPS computer:

- Touch, video or audio might not work correctly.
- Additional drivers might not be supported.
- The OPS computer can over heat, or other thermal issues can result.
- The OPS computer might not receive full power.

 IMPORTANT

SMART products do not support “hot plugging” of OPS computers. Hot plugging is when the OPS computer is removed from the accessory slot while power is applied.

Minimum requirements and guidelines

Use only OPS computers that meet the following requirements:

Requirement	Details
Do not require active cooling	However, SMART Board 8000i-G4 series interactive flat panels can support OPS computers that require active cooling from fans within the interactive flat panel.
Can be adequately powered by the SMART product's power supply	If an OPS computer requires more power than the SMART product was designed to dedicate to an OPS computer, it may restrain your ability to power specific units. Make sure the power supply requirements of the OPS computer are met by the supply capabilities of the SMART product. Otherwise the OPS computer will not function fully, and may not even turn on.
Meet the SMART product's requirements for video output and connections types	Make sure the OPS computer is compatible with the SMART product's video resolution and connection types.
Comply with regulatory requirements	OPS computers must comply with your area's regulatory requirements and must also meet IEC 60950-1 certifications for Fire Enclosures.

See the knowledge base article, [Open Pluggable Specification \(OPS\) computer disclaimer](#), for more information.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Room cameras

SMART products support USB cameras, both with and without an integrated microphone to enable video and sound recording with the same component.

NOTE

Cameras with integrated microphones are not recommended for recording audio in large rooms. Separate microphones are better suited to such settings. See *Microphones* on page 36 for more information.

Both the SMART Room System for Skype for Business and the SMART Room System with SMART Meeting Pro software come with a USB camera (CAM301). Third-party USB cameras can also be used with room systems. SMART does not offer separate cameras other than those used in its room systems. You can use a third-party camera if you want to use a SMART product for videoconferencing.

NOTE

A computer typically supports only one USB camera connection, even with the use of a USB hub.

Minimum requirements and guidelines

Use only room cameras that meet the following requirement:

Requirement	Details
Comply with the USB Video Class (UVC) specification	Cameras that do not comply with the UVC specification may introduce reduced image quality or incompatibility with other devices or might not work at all.

In addition, look for room cameras that meet the following guidelines:

Guideline	Details
Compensate for the room's lighting	Image quality depends largely on optics and image compression. SMART has worked to achieve a balance between these with the CAM301. When choosing a different room camera, consider the room lighting. If the room has only dim fluorescent lighting, consider a camera with higher-quality optics to allow better light sensitivity. Optics can not compensate for everything. Remember that bright, natural light can make a significant difference in image quality.
Are certified for use in a Skype for Business room system	If you're installing a SMART Room System for Skype for Business, use a camera that has been certified for that use.
Use high compression encoding (if network bandwidth is a concern)	A high compression encoding scheme helps maintain higher network speeds by sending less data. Different degrees and types of compression will affect the image quality. SMART recommends a camera with built-in H.264 SVC compression.
Are large enough to allow adequate range of focus or zoom	Smaller cameras can impose limitations on focus and zoom.
Have good optics	A camera with fine-polished glass lenses and a large aperture can provide better image quality than one with plastic lenses and a smaller aperture.
Have a high-resolution image sensor	Cameras with high-resolution image sensors can produce better images, particularly if digital-zoom features are used.
Have optical zoom	If you want to zoom the camera to narrow the field of view, optical (mechanical) zoom is recommended over a camera with only a digital zoom function. Digital zoom can reduce image quality, especially on cameras with lower resolution image sensors.
Have an appropriate focal range for the room's size	Use a camera with a defined focal range that is appropriate for the size of the room in which it will be used. Generally, the larger the room, the longer the focal range of the camera needs to be. For example, a camera with a focal range of 1'–5' (0.3–1.5 m) will not provide a good image of the room beyond 10' (3 m), and a camera with a focal range of 10'–40' (3–12 m) will not provide a good image of objects close to the camera.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Speakers

Some SMART products, such as SMART Board interactive flat panels, include internal speakers, but you might want to use external speakers in particular applications.

The speakers included with SMART products are designed to provide sound at the front of the room, not for projecting sound in larger spaces. If you want to use the SMART product in a larger space, you'll need external speakers.

In most cases, external speakers should be connected to the audio output on the SMART product, but there are other setups that can provide additional options for connecting external speakers. For example, a room computer connected to the SMART product might also provide an audio connection. See *Configuring the SMART product for the best audio performance* on page 24 for more information about connecting external speakers and producing the best possible audio experience.

SMART offers speakers for use in the classroom (such as the [SBA series](#)) and the meeting room (such as [CSR500](#)). These speakers are self-powered: they require only a Line Level input signal and have an internal amplifier.

Both series of speaker include mounting brackets for mounting to the wall on either side of the wall-mounted SMART product. For mounting speakers on mobile stands, refer to *Installing the SMART product on a stand* on page 16.

Minimum requirements and guidelines

Look for speakers that meet the following guideline:

Guideline	Details
Meet the suggested specifications as close as possible	In small to medium sized rooms (rooms up to 20' × 30' or 6 m × 9 m), using speakers that meet the following suggested specifications as closely as possible should help to ensure good quality audio: • Frequency response: 80 Hz to 10 kHz ± 3 dB • Total Harmonic Distortion (THD) at Peak Power: 100Hz – 10kHz 1% Avg. 3% Max. • Signal to Noise Ratio: Better than 60 dB • Sensitivity (1W@1m): 86 dBA Sound Pressure Level (SPL) This information should be available in the speakers' specifications. For rooms larger than 20' × 30' (6 m × 9 m), such as auditoriums, SMART recommends that you consult an audio specialist to help determine the best option for the space.

 IMPORTANT

If the speakers are used in conjunction with microphones (for example, as part of a meeting room conferencing system or complete audio system), place the speakers correctly in relation to the microphones, especially if you're using wireless microphones. For more information about speaker and microphone placement, see *Configuring the SMART product for the best audio performance* on page 24.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

 NOTES

- If you're substituting audio components with third-party components, substitute the speakers, microphones and mixer. Substituting only part of the audio system can lead to echos and noise.
 - For a SMART Room System for Skype for Business, SMART does not recommend using speakers other than those sold by SMART. The speakers that are part of the SMART Room System are acoustically tuned to work with the included microphones and audio processor. SMART can not assist with any audio issues that arise from the use of non-SMART speakers.
-

Microphones

Microphones can provide audio recording for a classroom or lecture hall or function as part of a voice conferencing solution in a meeting room. SMART offers microphones as part of a complete audio system and does not offer them separately. SMART offers a classroom audio system and a conferencing audio system. Classroom audio systems are available separately, but the conferencing audio system is available only as part of the SMART Room System for Skype for Business or SMART Room System with SMART Meeting Pro software.

Minimum requirements and guidelines

Look for microphones that meet the following guidelines:

Guideline	Details
Are appropriate for the room's intended use	The type of microphone (wireless or wired) that will best suit the system depends on how the room will be used. A wireless microphone might be better suited for a room used primarily for lectures or presentations, with one person speaking at a time and moving around the space. Wired table-top microphones might be better suited for a room used for video conferencing, in which a number of stationary people speak throughout a meeting.
Have a suitable polar (pickup) pattern	Select a microphone that has a suitable polar (pickup) pattern. An omnidirectional pattern is good for rooms set up for a single speaker, such as a lecture hall or presentation space. A unidirectional microphone is good for rooms set up for voice conferencing.
Are designed for normal speech	Microphones can be designed for different uses (musical recordings, lectures, speeches, and so on). Make sure you choose a microphone that has a frequency response and polar pattern suited for a speaking application.
Provide channel diversity (wireless)	If you use wireless microphones, be sure to choose a wireless microphone that provides enough channel diversity to support multiple wireless devices in one location, particularly if you plan to use wireless audio equipment in more than one location within a building.
Have a USB microphone (if used with a SMART Room System)	If you decide to use a third-party audio system to replace the SMART conferencing audio system included with a SMART Room System for Skype for Business or a SMART Room System with SMART Meeting Pro software, the audio system must be a USB audio system. For more details on this, see the knowledge base article, Using hardware not provided by SMART with your SMART Room System for Skype for Business .

IMPORTANT

If the microphones are used in conjunction with speakers (for example, as part of a meeting room conferencing system or complete audio system), place the speakers correctly in relation to the microphones. For guidance on speaker and microphone placement, see *Configuring the SMART product for the best audio performance* on page 24.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

 NOTE

If you're substituting audio components with third-party components, substitute the speakers, microphones and mixer. Substituting only part of the audio system can lead to echos and noise.

Room controls

Although SMART does not offer room control equipment, you can use the SMART product's RS-232 connector to connect a third-party external control system to the SMART product. The RS-232 connector is featured on nearly all SMART products and allows for easy communication between an external control system and the SMART product. To learn about a specific SMART product's capabilities, command hierarchy and setup, refer to the documentation for that SMART product.

Minimum requirements and guidelines

SMART does not have minimum requirements or additional guidelines for selecting a third-party room control system.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Chapter 5

Cables and connectors

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To ensure the proper functioning of a SMART product, use cables that meet the SMART product's requirements as closely as possible and are tested for compliance with connection standards. The requirements vary according to the signal type and the distance the signal needs to be transmitted.

Cable best practices

General best practices

Cables can vary widely in terms of quality and cost, and higher cost doesn't always indicate better quality. The cable's quality can greatly affect the quality of signals it carries. This becomes increasingly important as cable runs get longer.

Always use the cables provided with the SMART product. SMART tests these cables against industry standards and for regulatory compliance. Refer to *Appendix B: SMART reliability testing* on page 71 for more information. If you need a cable that is not included, or you need to replace a cable, follow these general guidelines to help ensure the third-party cables function correctly:

- Use cables tested for compliance to connection standards. For example, use HDMI cables that provide proof of being tested against the HDMI standard.
- Test cables for continuity. Connect the cable and confirm that the signal is sent and received correctly.
- Choose good quality cables from reputable manufacturers.
- If possible, use cables from a single manufacturer. This is especially important if you're performing multiple installations. It provides greater consistency across the entire installation, and if you encounter any issues, you deal with only one manufacturer.

- Keep cables as short as possible. Shorter cables are less prone to signal degradation. If cables are too long, noise, rolling lines, video drop-out or other adverse effects can result, especially with analog video signals at higher display resolutions.

 NOTE

For guidance on adapting and extending connections, see *Chapter 6: Cable accessories* on page 61.

- Use cables that feature end-to-end shielding. Shielding reduces the risk of external electromagnetic interference (EMI).
- Use cables that are designed for flexibility and durability. Such cables are:
 - Coated with rubber, silicone or similar flexible materials rather than plastic or similar, less-flexible materials
 - Made with stranded wire and a high per-wire strand count rather than a solid-core wire
- When possible, use connection cables with larger internal wires (a larger diameter) to reduce signal reduction or loss over longer distances. This diameter for video and audio cables is typically 22–24 AWG, and 12–16 AWG for speaker cables. Network and USB cables are typically in the range of 22–26 AWG.

 TIP

Use the American Wire Gauge (AWG) reference numbers to determine the size of the cable's internal wires.

- Avoid cables with very large ferrite beads. A ferrite bead that seems conspicuously large in proportion to the diameter of the cable can indicate the ferrite bead is compensating for excessive interference that results from poor cable construction or excessive length.
- If you install terminators on a cable yourself, test the cable for correct connections and continuity. Such installations are more common for analog audio, RS-232 and Ethernet cables.
- Avoid using poor-quality passive (unpowered) digital cables. These types of cables can also result in noise, video drop-out and other adverse effects, especially with higher display resolutions.

Maintenance and management best practices

Use the following guidance to help manage cables and maintain them in good working order:

- Keep the cables in good condition. Secure them out of the way of high-traffic areas, don't bend them beyond their critical bend radius, and avoid excessively disconnecting and reconnecting the cable. If frequent connections and disconnections of the cable are

unavoidable, make sure the cable's connector is rated to withstand them.

- Use cable ties to secure cables or groups of cables that don't need to be frequently connected and disconnected. This provides the cables with some strain relief and reduces the risk of damage. If cables need to be connected and disconnected frequently, leave additional length on the cable to allow for easy connecting and disconnecting of the cable.

 CAUTION

Securing the cable ties too tightly can damage the cables.

- Reduce the risk of ground loops by using the same power source (such as a power bar) for all devices. Ground loops can cause noise, humming and interference with audio or video systems.
- If possible, run extra, known-working cables through a conduit during installation. It's less expensive to include spare cables than to install a replacement later. Otherwise, make sure you have an extra set of cables that have been tested and are known to work properly. These will be helpful if you need to troubleshoot the installation.

Power cables

Power cables can be grounded (three-pronged) or ungrounded (two-pronged). Grounded power cables limit the buildup of static electricity, reducing the chances of electric shock and damage to audio systems and other sensitive equipment.

SMART products feature a standard International Electrical Commission (IEC) interface and provide certified, country-specific power cables. SMART recommends that you always use the power cable provided with the SMART product because the cable has been appropriately sized for the SMART product. However, if you ever need to replace a power cable, use the following minimum requirements and guidelines.

Minimum requirements and guidelines

Use only power cables that meet the following requirements:

Requirement	Details
Meet country-specific power requirements	Power standards vary among regions, and you'll need to use a power cable that supports your region's voltages and frequencies. Although you can use adapters to make power cables compatible with local power sources, first verify that the adapter can handle the necessary voltage conversion.

Requirement	Details
Are appropriate for the load current	Device power cables can be rated for use with different load currents. Make sure the power cable is rated to safely handle more current than a connected device will draw. See the specifications for the SMART product for power consumption information. If only a power rating is provided, the current can be calculated using the following formula: $\frac{\text{Power (watts)}}{\text{Voltage}} = \text{Current (amps)}$

 NOTE

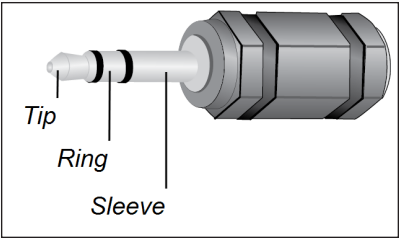
See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Analog audio cables and connectors

Analog audio cables fall into a few categories:

Category	Details
Unbalanced	An unbalanced cable features two or more conductors, one for ground and at least one for signal. The stereo 3.5 mm cable is a commonly used unbalanced connection. It has a ground connection (sleeve), a connection for the right stereo channel (ring), and another for the left (tip).  Unbalanced connections are affordable and ideal for shorter connections. An unbalanced cable of good quality can provide a connection of up to 20' (6 m). The main disadvantage of an unbalanced cable is its susceptibility to electrical interference when using line levels.

Category	Details
Balanced	Balanced cables use two conductors for the signal, one positive and one negative, in addition to the ground. This means a stereo application requires two cables. Balanced connections are far more resistant to electrical interference and support runs of 98' (30 m). Longer runs have special considerations and an engineer should be consulted. Although SMART products do not feature balanced audio connections, you can use a Balun device to convert unbalanced connections to balanced ones if you need to use a balanced cable. SMART does not sell or support Balun devices, but they can be used if implemented properly. Consult your reseller if you think the use of a balanced cable with a Balun device is required for your installation.
Powered	Powered connections can be balanced or unbalanced, and are only used to connect an amplifier to a speaker. Powered connections use a much heavier gauge of wire than standard connections, and the connectors will be larger than a standard connector as well. In addition, powered connections typically have a thicker, more durable jacket, enabling easier runs across floors, under stages, and so on.

SMART products with analog audio connectors

The following SMART products have analog audio connectors:

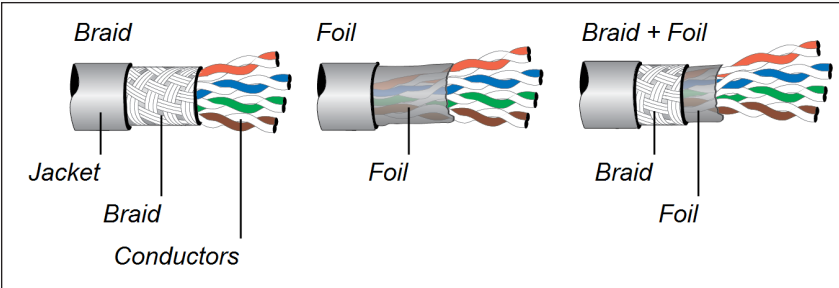
Product type	Products
Displays	• SMART Board 8000i-G4 series interactive flat panels • SMART Board 8000i-G3 series interactive flat panels • SMART Board 4000 series interactive flat panels
Projectors	• SMART projectors • LightRaise interactive projectors
Interactive learning centers	SMART Table 442i interactive learning center

NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

Use only analog audio cables that meet the following requirements:

Requirement	Details
Have proper shielding	An audio cable's shielding is critical for ensuring the cable's proper functioning. Make sure the cable has at least a 95% overall braided or foil shield. A hybrid shield of braid and foil is even better, and a double braided and foiled shield (not illustrated) is better still. 
Have a gauge size appropriate for the cable's required length	The thinner a cable's gauge, the shorter its reach can be before signal quality is at risk. For example, if you need to run a 16' (5 m) stereo 3.5 mm cable, you should use a cable with a heavier gauge. The American Wire Gauge (AWG) standard indicates heavier gauges with a lower number and lighter/thinner gauges with a higher number.
Are no longer than 20' (6 m)	If a connection is longer than 20' (6 m), you may need to use a balanced connection.

When selecting analog audio cables, look for cables that have the right gauge of wire. If possible, use analog audio cables with a larger wire gauge for powered connections, such as connecting to speakers. The gauge should be at least 16 AWG, or 12–14 AWG for longer distances.

For unpowered balanced or unbalanced cables, the gauge should be at least 20 AWG.

NOTE

See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Digital audio cables and connectors

There are two common types of digital audio cable:

Type	Details
Digital coaxial cable	A digital coaxial audio cable has RCA connectors at both ends. The RCA connectors are plugged into the orange digital coaxial receptacles on both the source and receiving device. A digital coaxial audio cable's signal is subject to weakening when it passes over long distances.
Optical digital cable	Optical digital cables use plastic filaments, similar to fiber optics, that use light to transmit the signal. Although audio signals delivered by light don't weaken as they do with copper-wired cables, optical digital cables can be damaged by excessive twisting or curling. This risk increases when these cables run over longer distances. If possible, use a different type of connection if the cable run must be longer than 4'–6' (1.2–1.8 m). The connector on an optical digital cable looks like a small square plug. This connector can come in a standard or mini size.

SMART products with digital audio connectors

The following SMART products have digital audio connectors:

Product type	Products
Displays	• SMART Board 8000i-G4 series interactive flat panels • SMART Board 8000i-G3 series interactive flat panels • SMART Board 4000 series interactive flat panels
Projectors	• SMART projectors • LightRaise interactive projectors

NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

There are no minimum requirements or additional guidelines for selecting digital audio cables.

However, because digital optical cables are less durable, a best practice is to use shorter cables to reduce the risk of damage.

 NOTE

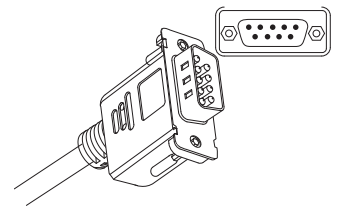
See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

RS-232 cables and connectors

RS-232 is a standard for the serial communication of data between data terminal equipment (DTE), such as a computer, and data communication equipment (DCE), such as a computer modem, a room control system or a control port on electronic equipment. When using an RS-232 connection, be sure to test it with a terminal program on a computer first.



The RS-232 standard defines the electrical characteristics, timing and meaning of signals. The standard also defines the physical size and pinout of connectors. Although RS-232 connectors were once common on computers and peripheral devices, such as printers and modems, they have been phased out in most modern devices in favor of USB connectors.

RS-232 serial cables are used to connect an RS-232 connector on the DTE device to an RS-232 connector on the DCE device.

Most modern computers don't include an RS-232 connector, so if you need to connect a computer and a SMART product using an RS-232 serial cable, you'll need an external USB to RS-232 converter.

SMART products with RS-232 connectors

The following SMART products have RS-232 connectors:

Product type	Products
Displays	• SMART Board 8000i-G4 series interactive flat panels • SMART Board 8000i-G3 series interactive flat panels • SMART Board 4000 series interactive flat panels
Projectors	• SMART projectors • LightRaise interactive projectors

 NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

When selecting RS-232 cables, make sure the cable is not a “null” modem cable. Unless they are specifically required, null modem cables should not be used except when troubleshooting connections.

Null modem cables can be identified by the word “null” stamped on them. Null modem cables are also characterized with a crossover of the transmitter and receiver pins.

 NOTE

See *Cable best practices* on page 40 for general guidelines.

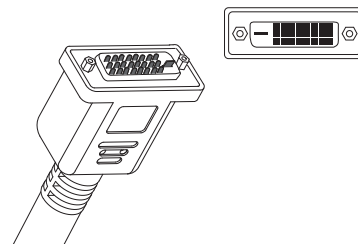
Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

DVI cables and connectors

Digital Visual Interface (DVI) is a video display interface used to connect a video source (such as a computer) and a display device (such as a monitor). DVI was designed as a digital replacement for the analog VGA connection.

If only one end of a connection uses DVI, you can use an adapter or converter to make the connections compatible. See *Cable adapters and converters* on page 61 for more information.



The two most common versions of DVI connections are shown below.



DVI-D (dual link)



DVI-I (dual link)

 IMPORTANT

Although DVI is typically a video-only connection, some audio source devices can use DVI to send audio. In this case, you must convert the DVI cable to an HDMI connection to connect it to the SMART product. Refer to the source device's documentation to see if it supports DVI audio. Otherwise, if you need to include audio and other data, such as touch, you will need to use a connection other than DVI.

SMART products with DVI connectors

The following SMART products have DVI connectors:

Product type	Products
Displays	SMART Board 8000i-G4 series interactive flat panels

 NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

Look for DVI cables that meet the following guidelines:

Guideline	Details
Match the device's connector type (digital versus analog)	Some connectors, such as DVI-D, work with digital equipment only. Other types of connector, such as DVI-I, can work with both analog and digital connections. Make sure you choose the correct type for the device.
Are no longer than 23' (7 m)	To maintain signal quality, DVI cables must not be longer than 23' (7 m). If you need to extend a DVI connection, see <i>Video cable extenders</i> on page 65.

 NOTE

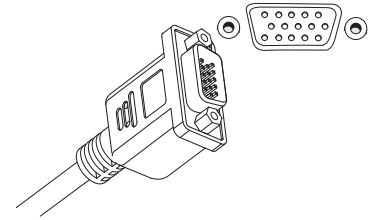
See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

VGA cables and connectors

Video Graphics Array (VGA) is an analog interface designed for use with high-resolution monitors and computers. VGA connectors are commonly found on older computers, though the connection is still widely used.



NOTE

- Although a VGA connection can support up to 1080p with the right source device, this is not recommended. This use pushes the VGA standard to its upper limit. Unless both the cable and source device are of the highest quality, degradation in video quality is likely.
- VGA is a video-only connection. If you need a setup to include audio and other data (such as touch), you'll need to use other connection types that support those types of data.

Using low-quality, passive (non-powered) VGA cables can result in an unfocused image, ghosting, noise, rolling lines and other adverse effects.

SMART products with VGA connectors

The following recent SMART products have VGA connectors:

Product type	Products
Displays	• SMART Board 8000i-G4 series interactive flat panels • SMART Board 8000i-G3 series interactive flat panels • SMART Board 4000 series interactive flat panels
Projectors	• SMART projectors • LightRaise interactive projectors

NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

Use only VGA cables that meet the following requirements:

Requirement	Details
Have all pins in the connectors fully populated and wired	The VGA cable connectors have multiple pins. Lower-cost cables might not include them all, and this can cause operational issues.
Are no longer than 23' (7 m)	Running a VGA cable longer than 23' (7 m) is not recommended because it may degrade the video signal quality. To extend the video signal properly, use a powered solution. See <i>Video cable extenders</i> on page 65 for more information.

In addition, look for VGA cables that meet the following guidelines:

Guideline	Details
Have a gauge size appropriate for the cable's required length	When running a VGA cable less than 10' (3 m), a thinner cable (about 12–15 mm) will work. However, use a thicker cable if you need to run the cable 10'–26' (3–8 m). Consider using a cable that also has smaller ferrite beads on the ends.
Have a minimum of 95% overall braid shielding	The cable's shielding should be, at minimum, a 95% overall braid or even better, use a double braid with good bonding on the shell. The braid should be either soldered or mechanically attached to maintain constant contact. In the absence of a specification from the manufacturer, you can only determine the degree of shielding through a destructive test of a cable sample.

NOTE

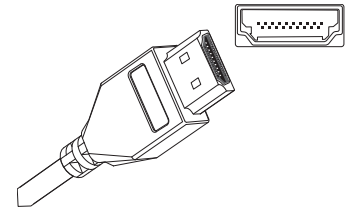
See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

HDMI cables and connectors

The High Definition Multimedia Interface (HDMI) is a type of cable and connection used for transferring digital data from an HDMI source device, such as a computer, to a display device, such as a monitor, projector or television. HDMI combines video, Consumer Electronics Control (CEC) and multi-channel audio in a single cable, which reduces the cost and complexity of setup.



Characteristics of HDMI cables include:

- Two-way communication supported
- High-definition ready
- Three sizes available:
 - Standard (Type A)
 - Mini (Type C)
 - Micro (Type D)

 NOTE

Most SMART products use the Standard (Type A) size.

-
- Different types of HDMI cable, each designed to meet a specific version of the HDMI standard

 NOTE

HDMI types you're likely to use with a SMART product include:

- Standard
 - High speed
 - Premium high speed
-
- Backwards compatible with DVI and VGA connections when used with converters

The following table provides more detailed information about the types of HDMI cables and the HDMI versions, resolutions and refresh rates they support. Use this to determine the type of HDMI cable that will provide the best experience.

Cable type	Max. supported HDMI version	Maximum supported resolution	Designed and certified for
Standard	HDMI 1.4	1920 × 1080 @ 60 Hz (Interlaced)	HD resolutions (720p and 1080i) used by most consumer electronics

Cable type	Max. supported HDMI version	Maximum supported resolution	Designed and certified for
High speed	HDMI 1.4	3840 × 2160 @ 30 Hz	Ultra-high definition/advanced displays, such as: • 4K UHD • 3D displays • Deep Color
Premium high speed	HDMI 2.0b	3840 × 2160 @ 60 Hz	Ultra-high definition displays (for example, 4K UHD) with advanced features such as higher refresh rates

Refer to the SMART product's specifications to see which HDMI standards and resolutions it supports.

SMART products with HDMI connectors

The following SMART products have HDMI connectors:

Product type	Products
Displays	• SMART Board 8000i-G4 series interactive flat panels • SMART Board 8000i-G3 series interactive flat panels • SMART Board 4000 series interactive flat panels
Projectors	• SMART projectors • LightRaise interactive projectors

NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

Make sure an HDMI cable is no longer than 23' (7 m). Using a longer HDMI cable could degrade signal quality. See *Video cable extenders* on page 65 for information about extending an HDMI connection beyond this length.

NOTE

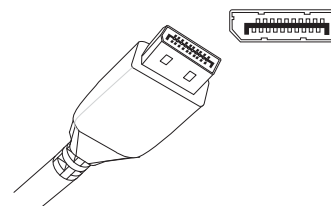
See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

DisplayPort cables and connectors

DisplayPort is a high-bandwidth digital display interface mainly used for connecting a video source to a display device. Found mostly on computers and monitors, DisplayPort, like HDMI, also supports audio. DisplayPort was designed for modern displays, whereas HDMI was designed for consumer electronic connections, such as HDTVs, game consoles, and so on.



The following are characteristics of DisplayPort:

- Supports up to 3840 × 2160 @ 60 Hz

IMPORTANT

SMART Board 8084i-G4 interactive flat panels only support 30 Hz.

- Standard and mini formats available
- Different versions available (current version is 1.4)
- Features a captive/locking connector, which is useful for permanent installations

SMART products with DisplayPort connectors

The following SMART products have DisplayPort connectors:

Product type	Products
Displays	• SMART Board 8000i-G4 series interactive flat panels • SMART Board 8000i-G3 series interactive flat panels

NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

Make sure a DisplayPort cable is no longer than 23' (7 m). If you need a longer DisplayPort cable, use a powered extension. See *Video cable extenders* on page 65 for more information.

NOTE

See *Cable best practices* on page 40 for general guidelines.

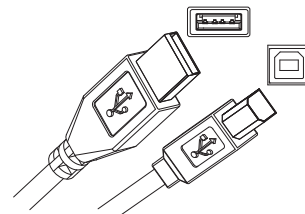
Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

USB cables and connectors

A Universal Serial Bus (USB) cable is used for data communication and supplying a small amount of power between devices. USB cables come in three sizes:

- Standard
- Mini
- Micro



Each of those sizes can connect to two types of USB connectors: Type-A and Type-B. Standard Type-A connectors are the most common for computers, while mini and micro Type-A connectors are mostly used for mobile devices. Type-B connectors are commonly found on endpoint devices, such as SMART products.

A third type of connector, Type-C, is newer and comes in only one size. Type-C connectors are commonly found on small personal electronics, such as mobile devices and newer Apple laptops.

SMART products have standard Type-A and Type-B connectors. The source device's USB connection type determines the type of USB cable you will need.

In addition to different connector types and sizes, there are also different varieties of USB cables:

- USB 1.x
- USB 2.0
- USB 3.0
- USB 3.1

The main differences among varieties of USB cable are the power delivery and data transfer speeds. Newer varieties (USB 3.0 and 3.1) carry more power and have faster data-transfer speeds. USB 3.0 and 3.1 are backwards compatible with USB 2.0, but not with USB 1.1. Although SMART products support all varieties, USB 2.0 or newer is recommended.

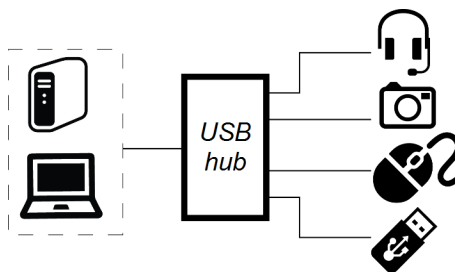
 NOTE

Although USB 3.0 and 3.1 are designed to be backwards compatible, the compatibility can be less than 100%, and you might experience issues when using USB 3.0/3.1 with USB 2.0. If you experience issues while using a USB 3.0/3.1 connection, try connecting a USB 2.0 hub between the SMART product and the computer. If the issues persist, use USB 2.0 instead of USB 3.0/3.1 or contact the computer's manufacturer. To guarantee the best USB performance, make sure the latest USB 3.0/3.1 and chipset drivers are installed on the computer.

SMART products use the USB connection to enable touch features. Poor quality USB cables that do not meet industry standards can cause issues with a SMART product's touch functions. Poor quality cables can also cause unexpected behavior with SMART's software products (such as SMART Notebook® collaborative learning software) when the software is used with a SMART product or other touch-enabled display.

About USB hubs

USB cables connect to the USB receptacles on devices. For SMART products, use the USB cable to connect from the SMART product's connector panel to a room computer. If you need more than one USB connection, use a USB hub as shown below:



A common scenario in which you might need a USB hub is when you have only one USB receptacle available on the computer but need to connect a mouse, keyboard and microphone. Hubs also let you consolidate USB-connected devices into one receptacle, making it possible to disable all the devices by unplugging a single cable.

There are three types of USB hubs:

Type	Description
Bus-powered	A bus-powered hub draws its power from the USB source device, such as a computer. A bus-powered hub doesn't need a separate power connection. It's limited to four downstream ports and can't provide more power to the downstream devices than that provided by the USB source device. If you use a bus-powered hub with an extension cable, you can quickly run out of power. You should purchase a USB cable hub with a separate power adapter.
Self-powered	A self-powered hub draws power from external power supply and provides up to 500 mA for USB 2.0 and 900 mA for USB 3.0/3.1 to power each of the connected USB devices. The amount of power depends on the specifications of the hub and the version of USB ports available on the hub.
Dynamic-powered	A dynamic powered hub is a combination of bus- and self-powered hub. It automatically switches between modes if a separate power supply is available.

SMART products with USB connectors

Most SMART products feature at least one USB connector.

Minimum requirements and guidelines

Use only USB cables that meet the following requirements:

USB version	Requirement
1.x and 2.0	Can not be longer than 16' 5" (5 m) without using special extension methods
3.0 and 3.1	Can not be longer than 9' 10" (3 m) without using special extension methods

For more information on special extension methods, see *USB cable extenders* on page 63.

When selecting third-party USB cables, look for cables that have the USB certification logo. The logo indicates the cable has passed the USB Implementations Forum (USB-IF) regulatory body's compliance testing for product quality.

NOTE

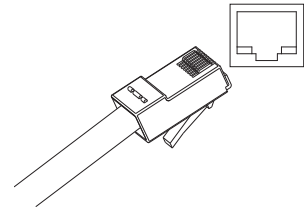
See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Ethernet (network) cables and connectors

Ethernet is a type of Local Area Network (LAN) technology. Ethernet differs from a Wireless Local Area Network (WLAN) in that it requires physical twisted-pair network cables to connect devices, such as a computer and a network router. Different varieties of network cable exist, the most common of which are currently Cat 5e (Category 5 enhanced) and Cat 6 (Category 6). Network cables can be shielded to protect against electromagnetic interference (EMI) which can interfere with communication through the network cable.



SMART products with network connectors

The following SMART products have network connectors:

Product type	Products
Projectors	• SMART projectors • LightRaise interactive projectors
Interactive learning centers	SMART Table 442i interactive learning center

NOTE

Refer to other SMART products' specifications to see if they support this type of connection.

Minimum requirements and guidelines

Use only network cables that are shorter than 300' (100 m). A network cable can not be longer than 300' (100 m) without the use of special extension methods. The total length includes the “visible” length (from the SMART product to the wall) and the “non-visible” length (the cable behind the wall to the network switch).

NOTE

See *Cable best practices* on page 40 for general guidelines.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Chapter 6

Cable accessories

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Cable adapters and converters

A variety of cable adapters and converters are available for connecting disparate types of devices. An adapter or converter is usually required when connecting a source device (such as a computer) to a display device (such as a SMART product) that doesn't have a matching connection. For example, a computer that has only a DisplayPort connection would need an adapter to connect to a SMART product that has only an HDMI connection.

Some connection types have multiple versions, such as USB 2.0 and 3.0, HDMI 1.4 and 2.0, Single and Dual mode DisplayPort, and so on. Any adapters you use must take these versions into account. Some connections support only adapters of the same version.

Adapters versus converters

Because adapters do not convert signal types, they work only for connections that have the same signal type. An adapter can't convert a digital signal to an analog signal, for example. If you require

such a conversion, use a cable converter instead.

A convertor can adapt the physical connection type and the signal type (analog to digital and vice versa). To determine if you need a converter, you must first understand the signal type of the connection you're trying to use. Some connections are analog-only and others are digital-only. See the descriptions for each cable type in *Chapter 5: Cables and connectors* on page 39.

Use this list to help select the right option for adapting and converting connections:

Type	Option
Analog to analog	Passive, non-powered adapter OR Active amplifier
Analog to digital	Powered adapter that converts analog signals to digital signals
Digital to analog	Digital-to-analog converter
Digital to digital	Passive, non-powered adapter if the digital signals are the same OR Active signal converter if the digital input signal is different than the digital output signal

SMART does not offer adapters or converters other than those for USB to Cat 5. You can purchase replacements for these from the [store for SMART parts](#).

Using the wrong cable adapter or converter can lead to a variety of issues, including:

- Signal degradation or drop-out
- Noisy video or audio
- Damaged equipment resulting from improper adapter construction

Minimum requirements and guidelines

In general, look for products from established, reputable companies. Using inexpensive, low-end adapters or converters results in lower-quality performance.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Couplers and extenders

Couplers

A coupler is a connector with two receptacles (also called a female-to-female connection) used to join two cables of the same type. Couplers can provide an easy way to connect two cables and extend a cable run. However, couplers cause signal degradation and can become easily disconnected. Use of a coupler will usually cause a cable to break industry signal standards due to improper extension. SMART strongly advises against use of couplers because they increase the risk of issues and poor performance of SMART products.

 NOTE

Some locations may use wall plates for network and cable connections, and these wall plates may have built-in couplers. If this is the case, test the connection to make sure it functions as expected.

Extenders

Use only active, externally-powered extenders and not bus-powered extenders (that is, an extender that's powered by the device it's connected to).

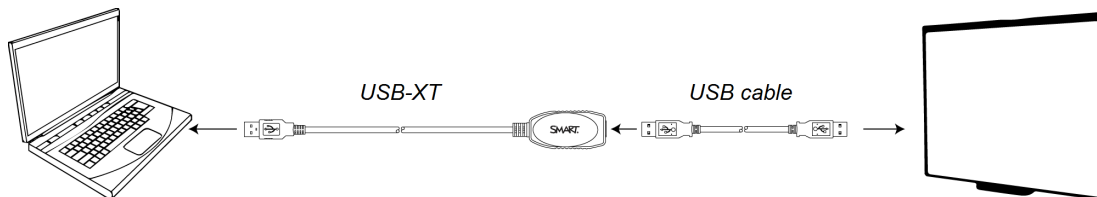
 IMPORTANT

SMART can not provide support for installations that use bus-powered extenders (with the exception of extenders manufactured by SMART, such as the USB-XT or CAT5-XT-1100). Before contacting SMART for assistance, replace any bus-powered extenders with a shorter, passive (non-powered) cable and test the system again.

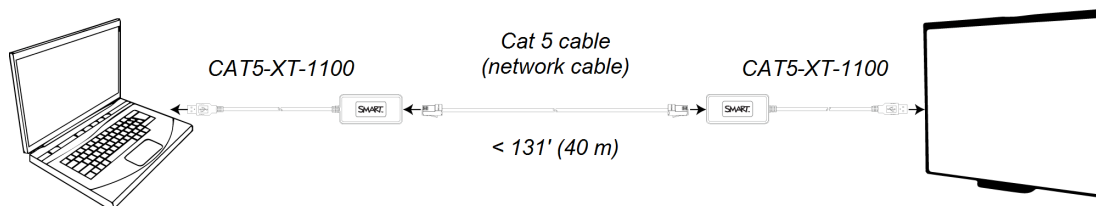
USB cable extenders

Improperly extended USB connections can cause a SMART product's touch features to behave unexpectedly.

An active USB extension cable (USB-XT) can be used to extend the USB connection beyond the length of the USB cable that was included with the SMART product, as shown below:

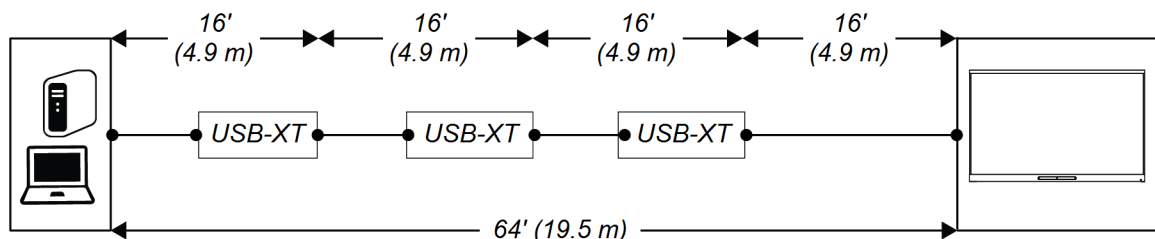


In addition to the active USB extension cable, SMART offers a CAT 5 USB extender (CAT5-XT-1100) that enables even greater extension. The CAT5 USB extender uses a Cat 5 or Cat 5e cable in addition to the USB cables:



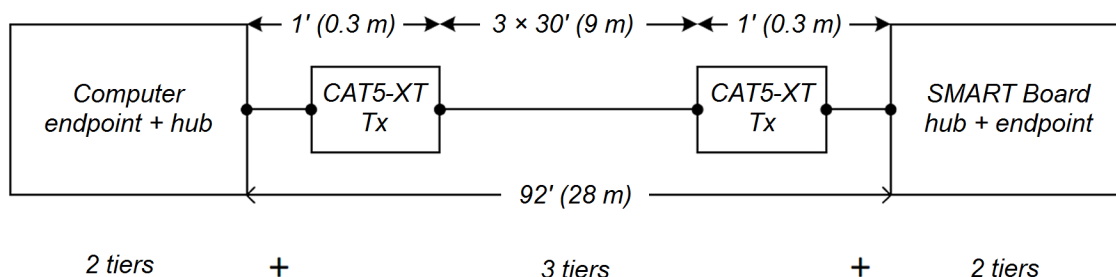
USB tier structure

USB devices can be extended based on the system's number of USB tiers, up to a maximum of seven. A tier can be a 16' 4" (5 m) cable with a built-in hub, a discrete hub, or an endpoint device, such as a computer or SMART product. An endpoint device can contain additional tiers that you won't necessarily see, such as internal hubs. Some SMART products contain one hub and the endpoint, while others do not. See the example below:



As this example shows, the computer counts for two tiers, the three active USB extension cables count as three, and the SMART product counts as two tiers for a total of seven tiers, or about 48' (15 m) of cable extension, plus the additional 16' (4.9 m) from the previous cable.

The next example uses the CAT 5 USB extender instead. With the Cat 5 cable, each tier is approximately 30' (9 m) with a total extension of 92' (28 m) and seven USB tiers.



 NOTE

These are hypothetical examples based on standard calculations. Differences among cables, computers and other hardware can cause actual performance to exceed or fail to achieve these numbers.

An improperly extended USB connection is likely to work only intermittently or not at all. SMART products have built-in diagnostics to help you understand when this is the case. For most SMART products, check if the indicator light is not solid green to tell if an issue is USB related or SMART Product Drivers software isn't running correctly.

Minimum requirements and guidelines

SMART provides support only for its own USB extenders and recommends using the active USB extension cable or CAT 5 USB extender, as they have been designed and tested to work with SMART products. However, if this isn't possible, use products from well-established, reputable companies.

Use only active USB extenders. Active extenders help maintain the signal strength as the data is transmitted across longer distances.

SMART can not provide support for USB extension beyond the supplied USB cable, or the use of non-SMART USB extenders.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Video cable extenders

Use an active video extender if you need to extend the length of a digital or analog video connection further than the cables provided with the SMART product, or if you need to extend the connection beyond 23' (7 m). An active extender will help maintain the signal integrity as the audio and video data is transmitted across longer distances.

Although high-quality passive cables can work at longer lengths, an active extender ensures satisfactory signal strength. The extender's supplier should be able to recommend the length of cable that the extender can support.

Minimum requirements and guidelines

Use only active, externally-powered video extenders and not bus-powered extenders (that is, an

extender that's powered by the device it's connected to).

 IMPORTANT

SMART doesn't support installations that use bus-powered video extenders. Before contacting SMART for assistance, replace any bus-powered extenders with a shorter, passive (non-powered) cable and test the system again.

Look for video extenders that meet the following guidelines:

Guideline	Details
Are produced by established, reputable companies	SMART recommends you use products from well-established, reputable companies. SMART can not provide support for video extending beyond the supplied video cable.
Support EDID and HDCP signals	If you use a Video Distribution Amplifier (VDA) to extend an analog connection, make sure the VDA extender has an output connector that supports Extended Display Identification Data (EDID) and High-Bandwidth Digital Content Protection (HDCP) data to pass through to the input. For more information about HDCP and SMART products, see the knowledge base article, SMART Board interactive flat panels and High-bandwidth Digital Content Protection (HDCP).

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Source switching

Source switching is the use of a device to switch between multiple inputs while using only one output. The single output is sent to a SMART product.

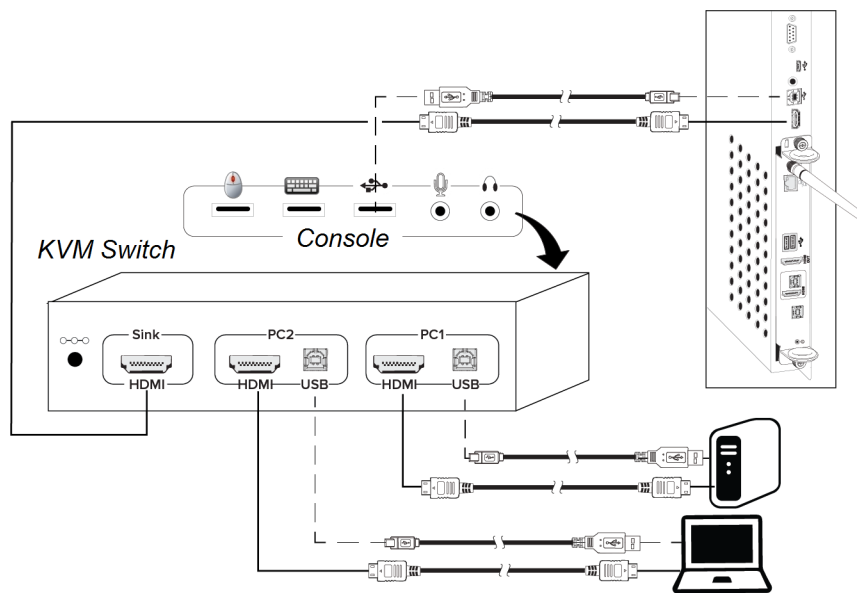
SMART does not currently provide external source switching equipment. SMART products typically supply at least two video and two USB inputs, enabling a SMART touch interface for two source devices. To increase the number of available video and USB inputs:

- **Use SMART's I/O extension module (XTM):** This module connects to a SMART product's Open Pluggable Specification (OPS) slot and provides additional HDMI and USB inputs. This module is available through the [store for SMART parts](#).

 NOTE

You can connect only one of SMART's modules to a SMART product at a time. If an iQ appliance occupies the SMART product's OPS slot, you can not connect the XTM module without first removing the iQ appliance. If this is the case, use a KVM switch to increase the available video and USB outputs.

- **Use a Keyboard/Video/Mouse (KVM) switch (if connecting a computer):** The switch must support simultaneous video and USB signal switching. Refer to the knowledge base article, [Connecting your laptop to SMART kapp iQ Pro board](#), for information about using KVM switches with SMART products.



 IMPORTANT

To help prevent issues with interactive features, such as gestures or the video display in general, make sure the KVM switch does not buffer or modify the USB or video signal in any way, such as by scaling the image.

- **Use an HDMI A/B switch, if connecting a video-only source:** Use an HDMI A/B switch, if connecting a video-only source. If the source device is video only (such as a DVD or Blu-ray player), a simple HDMI A/B switch is sufficient. If the source device does not have an HDMI connection, use a cable adapter.

Potential Issues

The following issues may result when using a source switching device with SMART products:

- Problems displaying the correct display resolution
- Sync polarity inversion (analog connections only)
- Signal degradation
- Issues with touch control or writing and drawing
- Errors with High-Bandwidth Digital Content Protection (HDCP) protected content



NOTE

SMART does not recommend using a source switching device with a SMART Room System for Skype for Business.

Minimum requirements and guidelines

Use only switching devices that meet the following requirements:

Requirement	Details
Are produced by established, reputable companies	When using a switching device with a computer, the switch must switch both video and USB to enable both video and touch (USB) on the SMART product.
Support EDID and HDCP	Make sure any devices connected in line with a SMART product pass the video handshake signals, such as Extended Display Identification Data (EDID) and HDCP. The use of products that do not pass those signals can result in unwanted behavior or no output.

When selecting a switching device, look for a device produced by an established, reputable company. Using inexpensive, low-end switching devices can result in lower-quality performance.

Third-party options

Refer to *Appendix A: Third-party referrals* on page 69 for a list of companies that sell this type of equipment.

Appendix A

Third-party referrals

SMART has identified the companies listed below as potential suppliers of products that may be compatible with SMART products if properly designed, manufactured and correctly incorporated into a system.

IMPORTANT

SMART does not assess, inspect or test products manufactured by others for compatibility with SMART products, and thus provides no guarantee, representation or warranty that the listed products will be compatible with SMART products, or that they will perform as represented by the supplier.

If you experience any issues, SMART will not troubleshoot third-party equipment added to the system. If troubleshooting is needed, you will very likely be asked to remove the third-party equipment as part of that process. Therefore, SMART highly recommends you set up and test the SMART product as it was shipped before you add third-party equipment.

The following list is provided as examples of available peripheral products only. Additional information regarding these products must be obtained directly from the other companies.

IMPORTANT

SMART strongly recommends that you test any third-party components, accessories, cables or adapters before installation. Consult your certified reseller for assistance.

Company	Website
Microphones	
Yamaha	yamaha.com
Shure®	shure.com
Speakers	
Yamaha	yamaha.com
JBL®	jblpro.com

APPENDIX A
THIRD-PARTY REFERRALS

Company	Website
Speakerphones	
Jabra	jblpro.com
Polycom™	polycom.com
Cables	
Cables 2 Go® (C2G)	c2g.com
Extron®	extron.com
Gefen	gefen.com/cables
Adapters	
C2G	c2g.com
StarTech	startech.com
Video extenders	
C2G	c2g.com
Extron	extron.com
Source switching	
StarTech	startech.com
Belkin®	belkin.com
OPS computers	
NEXCOM	nexcom.com
Advantech	advantech.com
Axiomtek	axiomtek.com
Room control systems	
Crestron®	crestron.com
Extron	extron.com
Cameras	
Logitech®	logitech.com
Polycom	polycom.com
Mounts and stands	
Chief	milestone.com
Peerless-AV®	premiermounts.com

Appendix B

SMART reliability testing

Cable standards testing

Cables can be tested for compliance to a variety of standards. A quick quality check for a cable is to see what standard it has been tested against.

SMART tests its cables against a variety of standards to ensure the quality of the cables it provides with its products.

SMART tests and certifies its hardware up to the following interface standards:

- HDMI 1.4/2.0
- DisplayPort 1.2/1.3
- HDCP 1.4/2.2
- USB 1.1/2.0/3.0
- VESA Video and Mounting
- Bluetooth 4.0
- IEEE 802.3

Mechanical, electrical and safety standards testing

The following table identifies the standards SMART uses to validate product reliability:

Type	Standard	Details
Thermal cycling	JESD94 JESD22A-104D IPC9592B	Non-operating test Temperature range = from minimum rated storage temperature to maximum rated storage temperature Temperature rate of change = minimum 15°C/minute Dwell time duration= minimum 5 minutes Number of cycles per hour = minimum 2 Number of cycles = TBD by SMART (dependent on temperature range) Sample size = TBD by SMART
Random vibration	JESD22B-103B IPC9592B	Non-operating Test Acceleration Level = TBD by SMART Frequency Range = TBD by SMART Axes Stimulated = TBD by SMART Sample size = TBD by SMART
High temperature and humidity with bias	JESD94 JESD22A-101C IPC9592B	Operational Test (non-condensing) Temperature = maximum operating design limit Humidity = maximum operating design limit Input voltage = maximum rated input voltage Output loading = TBD by SMART (dependent on the subsystem) Test time = TBD by SMART (dependent on temperature and humidity) Sample size = TBD by SMART
Voltage variation, power and temperature cycling	JESD94 JESD22A-108C IPC9592B	Operational Test (non-condensing) Temperature = stepped from minimum operating design limit to maximum operating design limit Temperature rate of change = 1°C/minute Input voltage = varying from minimum rated input voltage to maximum rated Input power = turned on and off Output loading = maximum rated loading Number of cycles = 15 minimum Sample size = TBD by SMART

Glossary

active cables

Cables with powered components

AEC

Acoustic echo cancellation

American Wire Gauge (AWG)

American Wire Gauge (AWG) is a standardized system that measures wire diameter. In this system, smaller diameters have higher gauge numbers. AWG is used primarily in North America.

aspect ratio

Aspect ratio refers to the proportional relationship between an image's height and width. For example, an aspect ratio of 16:9 means that the width of the image is 1.77 times greater than its height ($16 \div 9 = 1.77$).

balun

A transformer that converts an unbalanced signal to a balanced one or vice versa

compression encoding scheme

The type of compression used to reduce file sizes, making them easier to send and store electronically. Some examples of common formats are JPEG, GIF and MPEG.

critical bend radius

A measurement of the degree to which a cable can be bent to before it is damaged. A cable's bend radius should not be less than ten times the diameter of the cable. The cable's manufacturer should be able to provide you with the cable's critical bend information.

DHCP

Dynamic Host Configuration Protocol

DVI

Digital Video Interface

EDID

Extended Display Identification Data

GLOSSARY

ferrite bead

A ferrite bead (also known as a ferrite choke, block, core, ring or EMI filler), is a passive electronic component that is used to help suppress electromagnetic interference (noise) in electronic circuits. Larger ferrite beads on a cable can indicate the need to compensate for a higher amount of interference in the cable due to poor cable construction or excessive length.

frame or refresh rate (Hz)

Video is a series of still images shown at very high speed. The speed at which this happens is stated in images shown per second. This number is typically referred to as the frame or refresh rate, and can be stated as frames per second (FPS) or as frame frequency in hertz (Hz). Both units refer to the same thing.

handshake signal

Refers to the automated exchange of specific signals between a computer and a peripheral device (or another computer) to ensure proper synchronization between the two. This exchange takes place when a connection is first established to set the parameters of communication, and it repeats at intervals during data transmission to ensure continued synchronization.

HDCP

High-Bandwidth Digital Content Protection

HDMI

High-Definition Multimedia Interface

hot plugging

The addition or removal of components to or from a supporting device while power is still on

KVM

Keyboard/Video/Mouse (switching device)

line level

The strength of an audio signal output by a typical consumer electronic device. It often has a nominal level of -10 dBu and a maximum output of +4 to +8 dBu. A line level signal requires additional amplification before it can work with an unpowered speaker system.

native resolution

Every display device has a native resolution (also known as “pixel perfect”) which matches the number of pixels built into the display’s hardware. This means that when using the device’s native resolution, the pixels are displayed at the correct scale, providing the best image quality possible for that device.

OPS

Open Pluggable Specification computer

GLOSSARY

passive cables

Cables with no powered components

polar pattern (pickup pattern)

The pattern of a microphone's sensitivity to sound from various directions. A polar pattern is either unidirectional (pick up sound from one direction) or omnidirectional (pick up sound from multiple directions). All microphones have a polar pattern.

source switching

Using a device to switch between multiple inputs that go to a single output.

UL

Underwriter Laboratories

USB

Universal Serial Bus

VDA

Video Distribution Amplifier

VESA

Video Electronics Standards Association

VGA

Video Graphics Array

SMART TECHNOLOGIES

smarttech.com/support

smarttech.com/contactsupport

smarttech.com/kb/171035