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INFRASTRUCTURE ISSUES FOR LOW VOLTAGE SYSTEMS COORDINATION IN VIDEOCONFERENCING AND AV PRESENTATION ENVIRONMENTS

Note 1: Figure 1 (following) and the intermediate excerpted notes & illustrations following are intended to be generic and reflect overall relationships of work by various design team members and construction trades. Not all rooms will have all systems, and some rooms may have additional and/or supplemental systems. The notes address general conditions and typical applications as well as generally observed variations.

Additionally, these notes try to indicate guidelines for incorporating variations and/or supplemental systems. However, it will be the responsibility of all design team members to coordinate their work with not only the architect, but with all other specialty consultants.

Finally, because all of the systems noted below are tied to high voltage (≥ 120VAC) power, virtually all of the raceway and devices noted below are required to be indicated on the project electrical engineer's sheets, though the electrical engineer may not have originated the need or criteria for these systems. This makes the role of the electrical engineer *critical* in coordination of these systems, with key information required from the numerous other design team members.

> *author's 2¢: While the notes below may seem repetitive and dogmatic, it is only to assist in the creation of a final document specific to a particular project (with all of the cutting & pasting that can occur during a document's evolution, important issues can stray or become lost), and to emphasize (not-so-subliminally) that one **cannot be too rigorous** in the application of review and coordination by the team members under the informed leadership of the architect.*

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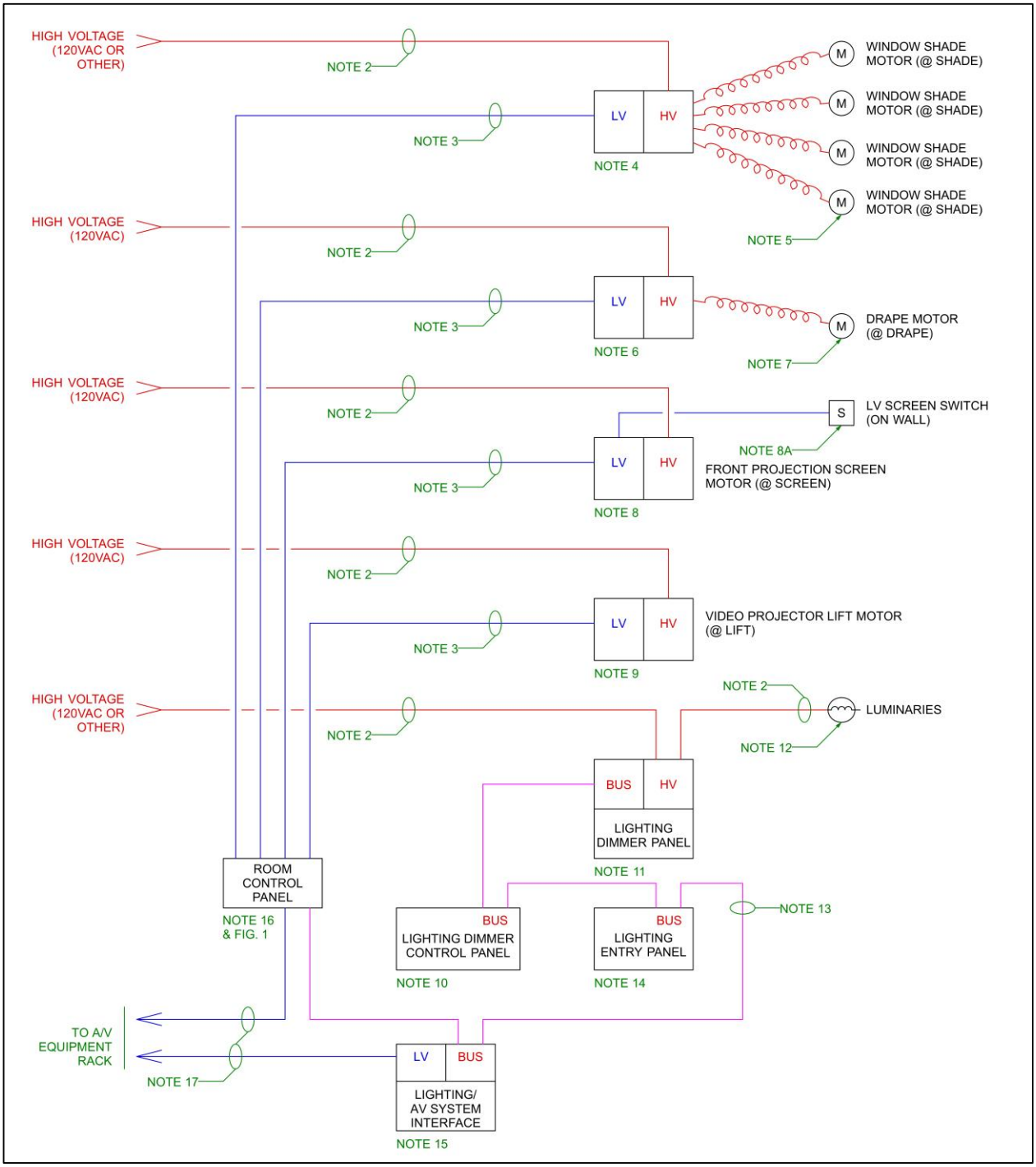

Figure 1: Typical Low-Voltage Systems Cable & Raceway Diagram

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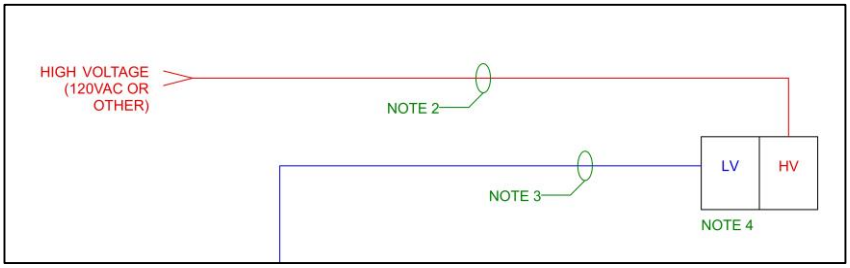
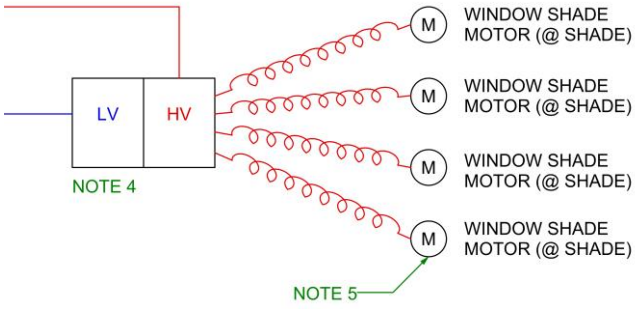


Note 2: This **raceway and all high voltage conductors** provided, installed and terminated under Division 16. *This note will be repeated in many of the following diagrams*.

Note 3: This **raceway and all low voltage conductors** provided, installed and terminated under Division 16. *This note will be repeated in many of the following diagrams*.

Note 4: This device, **the window shade motor controller**, is provided by a specialty sub-contractor (usually the window shade vendor) but installed under Division 16. All high voltage connections are made under Division 16.



In basic installations, many widow shade manufacturers (MechoShade, Vimco, Draper, others) use a Somfy® motor controller, though other similar controllers are available. The device is usually indicated on the electrical sheets as a "GCS" or "MLC" depending on the window shade manufacturer. This device is a NEMA-type enclosure approximately 10" x 10" x 6" deep, has a high voltage section, a low voltage section, and is usually mounted above the accessible ceiling near the window shades. The high voltage section accepts a single 20A branch circuit and usually has four (4) switched high voltage outputs for up to four (4) shade motors. A home run of high voltage conductors to the controller from each shade motor should be provided. The shade motors (see Note 5 for more details) typically require approx. 2A to 3.5A each.

The low voltage section typically has screw terminals for connection to external contact closures: one set of terminals is for "Up", another for "Down". Additionally, some manufacturers also provide terminals for a "Stop" function. The external contact closures may be push-button, rocker, toggle or any other type but must be momentary as there are usually several switches in parallel (see Note 16 for more details). The low-voltage side may also have connections for optional devices such as photocells or timers, but these optional devices are not installed in most rooms. The particulars of the low voltage cabling (AWG, # of conductors,

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etc.) should reviewed at the shop drawing stage by the design team (particularly the architect, electrical engineer and A/V consultant) and should be verified by Division 16 before installation.

Should there be a need for more than four (4) shade motors, the low voltage circuits may be "daisy chained" to the low voltage section of additional window shade motor controllers. Depending upon the total current requirements of the window shade motors, additional high voltage circuits may be required, usually one high voltage branch circuit per window shade motor controller. This requirement should be verified for each particular project and reviewed at the shop drawing stage by the design team (particularly the architect, electrical engineer and A/V consultant).

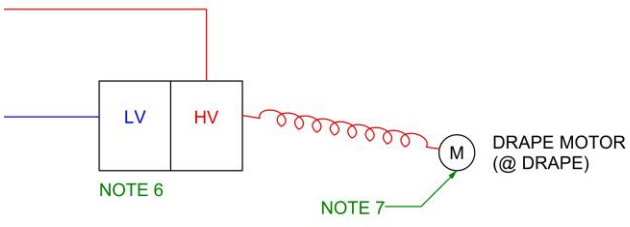
Finally, segregation of the high voltage and low voltage circuits should be maintained per all codes and regulations applicable to the project.

Note 5: This device, the window shade motor, is provided by a specialty sub-contractor (usually the window shade vendor) but may be installed by any of several trades (the GC, Division 16, the window shade vendor, others). All high voltage connections are made under Division 16.

The window shade motor is usually mounted inside or immediately adjacent to the shade roller and will usually have a short pigtail of multi-conductor cable for connection to the high voltage circuits from the window shade motor controller. Division 16 will usually provide a J-box at/near each window shade motor for final connection. The particulars as to the location(s) of the J-boxes, the types of raceway (flex, EMT, portable cordage) and the final connections should be reviewed at the shop drawing stage by the design team and verified by Division 16 before installation.

Note that basic shade motors are asynchronous, in that they may operate at slightly different speeds, and that they do not return positional information to the motor controller. There are numerous high-end shade systems that use microprocessor-based systems that provide these features, and should these be required for specific projects, additional design information will need to be reviewed.

Note 6: This device, **the drape motor controller**, is provided under a specialty sub-contractor (usually the drapery vendor) but installed under Division 16. All high voltage connections are made under Division 16.



This device is similar to the shade motor controller noted above, but there are many more variables in drapery motor controllers and drapery motors, mainly depending on the size of the drapery and the bulk of the material. Small lightweight drapes/shears may use a small combination motor/controller with high voltage inputs and low voltage control contacts. Medium size drapes may use a small outboard motor controller with high voltage input, high (or low) voltage outputs to the drapery motor and a low voltage terminal for external contact closures for control. Large wall or window curtains as well as

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theatrical type drapes will probably use a high voltage (and possible poly-phase) motor with outboard motor controller.

In all of these applications however, the low voltage control section will typically have screw terminals for contact closures from external switches: one for "Up", one for "Down". Additionally, some manufacturers also provide a third contact for a "Stop" position. As with the window shade motor controllers, external switches may be push-button, rocker, toggle or any other type but must be momentary as there are usually several switches in parallel (see Note 16 for more details). The particulars of the low voltage cabling (AWG, # of conductors, etc.) should be reviewed at the shop drawing stage by the design team (particularly the architect, electrical engineer and A/V consultant) and should be verified by Division 16 before installation.

Finally, segregation of the high voltage and low voltage circuits should be maintained per all codes and regulations applicable to the project.

Note 7: This device, **the drapery motor**, is provided under a specialty sub-contractor (usually the drapery vendor) but may be installed under any of several trades (the GC, Division 16, the drapery vendor, or others). Depending on the voltage requirements of the motor, high voltage connections will be made under Division 16; low voltage connections may be made under the drapery vendor or under Division 16.

The drapery motor is usually mounted inside, or attached to, the drapery track. As noted above, small drapes may have a single integrated motor/controller unit that may require .5A to 2A.

Medium and larger motors may have a short length of multi-conductor pigtail for connection to the high (or low) voltage circuits from the separate drapery motor controller. Medium and large motors require 3A to 8A. Unlike window shades where one controller serves several window shades, drapery motors and motor controllers usually have a one-to-one relationship, with the motor controller being located within very close proximity of the motor.

The particulars as to the location(s) of drapery, drapery motor and drapery motor controller, and the final connections should be reviewed at the shop drawing stage by the design team (particularly the architect, electrical engineer and A/V consultant) and should be verified by Division 16 before installation.

Note 8: This device, **the front projection screen motor and low voltage interface**, is provided under a specialty sub-contractor (usually the projection screen vendor) but is generally installed by the GC. All high voltage connections are made under Division 16.

In all but the largest theatrical screens, the motor is mounted inside the projection screen case. High voltage connections to the motor are usually brought out to a J-box on the outside of the case, usually on one end.

Some screens, however, locate this J-box inside the screen case at one end. Adjacent to, or part of, this J-box is a low voltage interface where low voltage control connections can be made.

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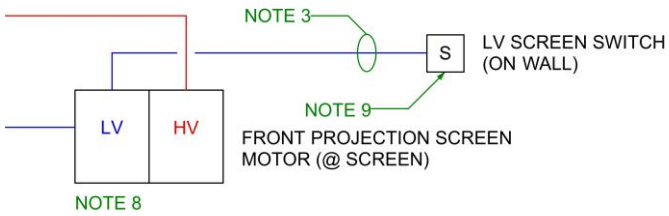


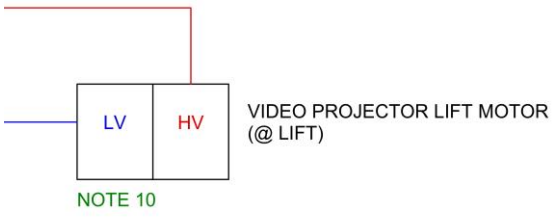
The low voltage control section will typically have screw terminals for contact closures from external switches: one for "Up", one for "Down". Additionally, some manufacturers also provide a third contact for a "Stop" position. As with the window shade or drapery motor controllers, external switches may be push-button, rocker, toggle or any other type but must be momentary as there are usually several switches in parallel (see Note 16 for more details).

Note 9: Many newer screens have dedicated low-voltage controls with microprocessors mounted on a wall switch for control of the screen as well as upper / lower limit sets. Typically, these screens must have this dedicated wall switch connected via a CAT5-type cable in order for the screen to operate at all. The dedicated switch may be located at the "Room Control Panel" (*see Note 17*) or in any convenient location.

The particulars of the low voltage cabling (AWG, # of conductors, etc.) should be reviewed at the shop drawing stage by the design team (particularly the architect, electrical engineer and A/V consultant) and should be verified by Division 16 before installation.

Finally, segregation of the high voltage and low voltage circuits should be maintained per all codes and regulations applicable to the project.

Note 10: This device, **the video projector lift motor and low voltage interface**, is provided under a specialty sub-contractor (usually the Audiovisual Systems vendor), but is generally installed by the GC. All high voltage connections are made under Division 16.



The motor is usually mounted inside the lift case. High voltage connections to the motor are usually brought out to a J-box on the outside of the case, usually on the top. Adjacent to, or part of, this J-box, is a low voltage interface where low voltage control connections can be made.

The low voltage control section will typically have screw terminals for contact closures from external switches: one for "Show", one for "Up". Additionally, some manufacturers also provide a third contact for a "Service" position which is an extended drop to lower the projector all the way to the floor for service. As with the window shade motor controllers, external switches may be push-button, rocker, toggle or any other type but must be momentary as there are usually several switches in parallel (see Note 16 for more details).

The particulars of the low voltage cabling (AWG, # of conductors, etc.) should be reviewed at the shop drawing stage by the design team (particularly the architect, electrical engineer and A/V consultant) and should be verified by Division 16 before installation.

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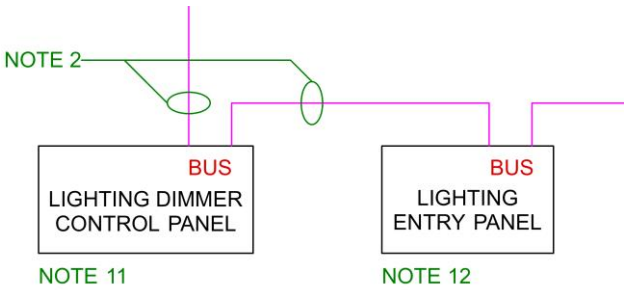
Finally, segregation of the high voltage and low voltage circuits should be maintained per all codes and regulations applicable to the project.

Note 11: This device, **the lighting dimmer control panel**, is provided and installed under Division 16. All low voltage connections are made under Division 16. It is very important to understand the difference between the **lighting dimmer control panel** (a low voltage *control* device, and the **lighting dimmer panel** (a high voltage *dimming* device).



The *dimmer control panel* is a wall-mounted device, usually 3, 4 or 5-gangs that contains the low-voltage control circuitry that adjusts the intensity of each lighting zone. This is accomplished through push buttons (or slide controls) and LED displays to indicate the relative intensity of each zone. There will usually be one control/display for each zone, with a typical panel having up to 8 controls/displays on a 4-gang panel. For control/display of additional zones (as many as 24, or more), a 4-gang dimmer control panel will have some method of easily assigning the controls/displays to the additional zones (1-8, 9-16, 17-24, etc.).

The dimmer control panel also stores the lighting presets (or scenes) for programmed conditions such as "High", Low", "A/V", etc., and there is usually a display to save, indicate and recall the presets.

The *dimmer control panel* will generally have a finished-appearance faceplate and bezel for mounting in a visible location. However, in most applications it is recommended that this device be mounted in a controlled access location such as a nearby storage closet or projection room, as once the lighting presets are adjusted for "High", Low", "A/V", etc., they should not be adjusted or accessed by unauthorized personnel. The A/V consultant or lighting designer will usually set the presets at the time of final commissioning.

Note that there are no high voltage circuits at this device; this is a low-voltage-only control device in most applications. In very small room applications, the dimmer control panel *may* also control the high voltage circuits to the luminaries, but in vast majority of classrooms, conference rooms and boardrooms of any size, the high voltage dimmers (Note 11) will be located separately. Low cost, manual wall dimmers are not acceptable in any room designed for presentations as they cannot be remotely controlled, and typically produce unacceptable levels of electronic noise that can interfere with audio, video and data circuits.

Finally, dimmer control systems can be as simple as those described above or a complex as a facility wide, computer programmed & controlled system with over 1,000 zones. The electrical engineer will generally be responsible for specifying the dimming system with design criteria input from the A/V and lighting consultants. The final testing, commissioning and set-up of even basic systems will usually require on-site work from the

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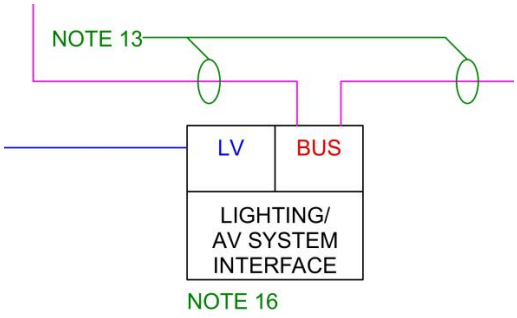
Manufacturers' or their local field reps. Fortunately, all of the major dimming system manufacturers are very responsive to the testing and commissioning process as long as the design & construction team has fully implemented the design & installation guidelines.

Note 12: This device, **the lighting entry panel**, is provided and installed under Division 16. All low voltage connections are made under Division 16.

This panel is usually a 1-gang, two button wall panel at project standard switch height, located adjacent to each entry/exit door in the room. The two buttons are programmed to select "All On" or "All Off" lighting presets for first person entry or last person exit. The entry panel will generally have a finished-appearance faceplate and bezel for blending with adjacent surfaces or devices, and should be mounted in a visible and convenient location.

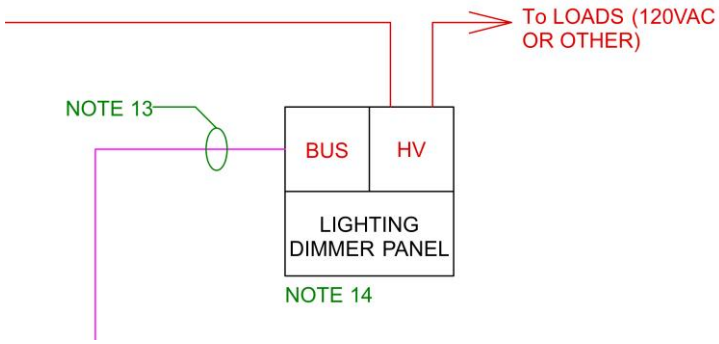
Note 13: This **raceway and the low voltage dimmer control cable** is provided and installed under Division 16. All low voltage connections are made under Division 16.



Each dimming system manufacturer employs a proprietary control bus with a unique topology: some use a "star" topology while some use a "series" method; some use shielded twisted pairs, some use individual conductors, some use both. The sequence and topology of devices indicated in the sketch is generic only.

The important issue is coordination and design team review during the DD & CD phases of the project, with additional review at the shop drawing stage by the design team (particularly the architect, electrical engineer, lighting designer and A/V consultant), and should be verified by Division 16 before installation.

Note 14: This device, **the lighting dimmer panel**, is provided and installed under Division 16. All low voltage and all high voltage connections are made under Division 16.



The dimmer panel is usually a large and heavy wall mounted device, the size depending on the quantity of circuits and total dimming capacity. The dimmer panel is usually mounted in a nearby electrical closet or back-of-house utility area.

Dimmer panels can generate considerable heat, and heat loads should be provided to the mechanical engineer early in the design

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process. Dimmer panels should not be installed in storage closets where required ventilation can be compromised, or in high traffic areas where non-qualified personnel can accidentally (or purposely) interfere with normal operation.

Dimmer panels should not be installed near (8-12 feet, min.) A/V equipment racks or data/telco equipment racks due to the possibility of unacceptable levels of electronic noise that can interfere with audio, video and data circuits.

There are also numerous code and safety issues related to the dimmer panel location that must be addressed by the design team early in the project.

High voltage from a lighting branch panel is usually brought to a set of main lugs inside the dimmer panel, distributed to internal circuit breakers (one for each lighting zone), then to the dimmers, then out to the individual zones of luminaries. Input voltage can be 120V, 208V, 240V, 227V, single or poly-phase. Low voltage control circuits are brought to a segregated area within the dimmer panel.

The individual dimmers within the dimmer panels are generally rated for 15A to 20A, though this may vary depending on the manufacturer. However, the relationship of one dimmer to each zone must be maintained, and if one area exceeds the capacity of an individual dimmer (say a large lobby or auditorium), it must be sub-divided into two or more small zones, with each zone served by a separate individual dimmer. Individual dimmers must be properly selected (or programmed via software in some manufacturer's units) to match the type of load: incandescent, magnetic low voltage, cold cathode, fluorescent, electronic ballast, etc.

Also, switched circuits, while not technically "dimming" inboard/outboard fluorescents or other specialized fixture, also fall under the umbrella of "dimmers" as they will be housed and/or controlled by the dimming system.

In multi-room facilities, one large dimmer panel can serve several adjacent rooms (8 dimmers for 8 zones in room A, 4 dimmers for 4 zones in Room B, etc.). However, the specifics of the low voltage control cabling is unique to each manufacturer, and should be reviewed at the shop drawing stage by the design team (particularly the architect, electrical engineer and A/V consultant) and should be verified by Division 16 before installation (see Note 13).

Finally, segregation of the high voltage and low voltage circuits should be maintained per all codes and regulations applicable to the project.

Note 15: These devices, the **individual luminaries and fixtures**, are provided and installed under Division 16. All low voltage and all high voltage connections are made under Division 16.

The selection, placement and zoning of the room devices are critical to the final ability of the room to function as a successful presentation environment. This is particularly important in videoconference and distance learning rooms such that instructors and participants can properly see and be seen.

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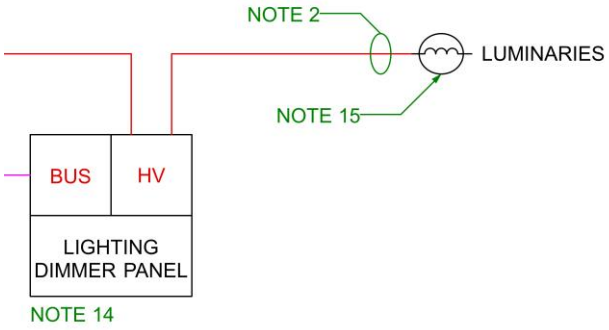
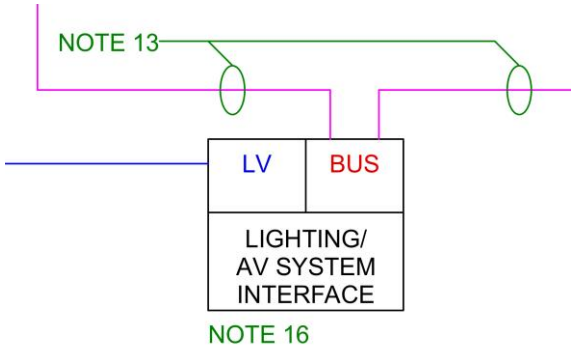


It is also especially important in any room employing front projection, as any misdirected light or excessive ambient light that washes the screen will significantly reduce the image quality through reduced contrast. The electrical engineer will generally be responsible for specifying the individual luminaries, with significant design criteria input from the A/V and lighting consultants.

As noted above, luminaries may be incandescent, magnetic low voltage, cold cathode, fluorescent, electronic ballast, etc. Additionally, the different types of fixtures may vary as widely as the designer's imagination can conceive. However, the final goal will be the selection of fixtures, luminaries and light levels that best serve the room's functions.

Note 16: This device, **the lighting / AV system interface**, is provided and installed under Division 16. All low voltage connections to the lighting system control bus are made under Division 16. All low voltage cable and connections to the A/V system (Note 17) are made under the A/V Systems contractor.



This device allows control of the lighting system by the A/V remote control system. Each dimming system manufacturer employs a proprietary device for this function, but they can be generally characterized as a small J-box with low voltage terminals for the proprietary dimming control bus, and separate low-voltage terminals for connections to the A/V control system.

This device may be either wall or ceiling mounted in the general vicinity of the A/V equipment rack. Depending on the dimmer manufacturer and size/ type of dimming system, this device may be optional or offered as standard equipment; it will be the responsibility of the project's electrical engineer to properly specify this item with input from the AV systems consultant.

The low voltage circuits to the A/V control system are generally one of two types: dry contact closures, or an industry-standard connectivity such as RS-232, 422, 485, TCP/IP or others. As a general guideline, contact closures are simple to implement in that the A/V system directs the dimming system to select a preset via a closure at the A/V control system mounted in the A/V equipment rack. The use of an RS-232 (or other) protocol offers the advantage of two-way communications between the dimming & A/V systems and allows more control and flexibility in selecting and implementing presets.

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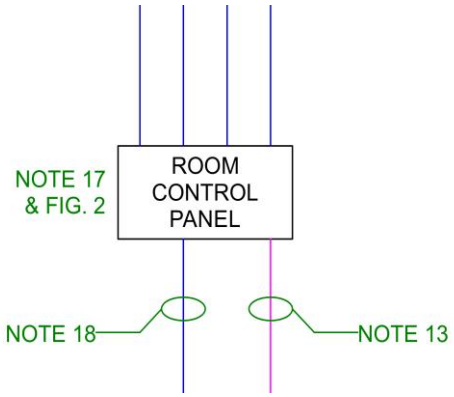
The proper selection of the specific type of interface and resultant communications between the lighting & A/V systems is a critical coordination issue that should happen early in the design phase between the electrical engineer and the A/V consultant.

Note 17: This device, **the room control panel**, is provided and installed under Division 16. All low voltage connections to all of the systems noted above are made under Division 16. All low voltage cable and connections to the A/V system (Note 17) are made under the A/V Systems contractor.



This is a multi-gang box, at least 3" deep, located at project standard switch height on the front or side wall *reasonably* adjacent (with-in 3-4 steps) to the presenters' location. Its function is to locate hard-wired momentary push-button switches to control all of the systems noted above.

The control offered by these switches are in addition to the control by the A/V control system, and these switches will also serve as a "back-up" should there be a problem or failure in the A/V remote control system.

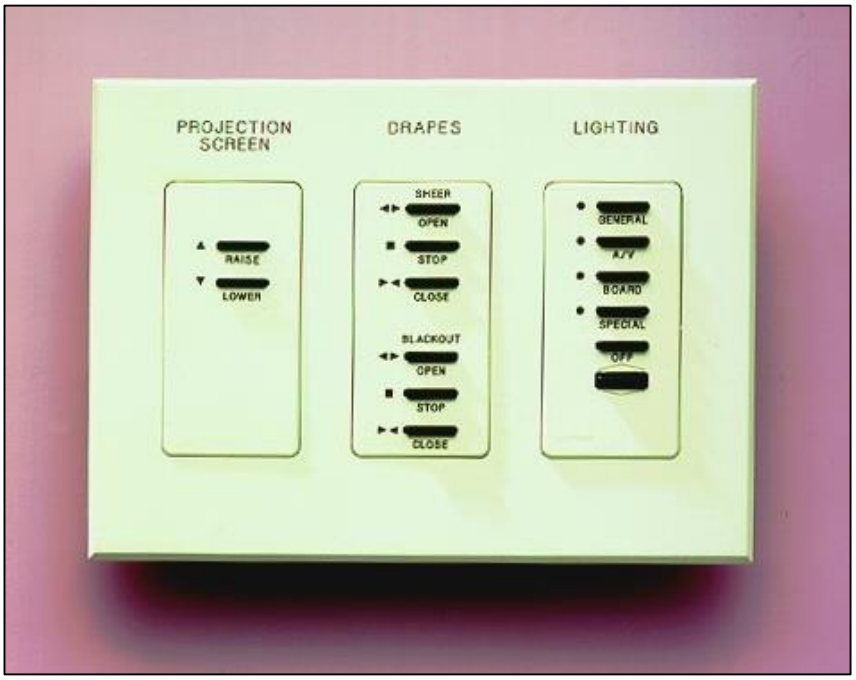


Figure 2: Generic Room Control Panel Example (note that these are all low voltage controls)*

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Typically, Decora® type modules with up to 7 momentary push buttons can be provided with custom engraved nomenclature. The exception is usually the lighting module, which is typically a 4-preset plus "Off" Decora® type module specifically intended for the proprietary lighting control bus. While the term "custom" may set off alarms of miss-coordination and appear to be a dubious proposition with near impossible chances of success, there are actually numerous companies that can provide custom engraved modular switch plates based on a standard Decora® template. Also, fortunately, virtually all the manufacturers of all the afore-mentioned systems (window shades, drapes, projection screens, video projector lifts) make Decora® switch modules that will readily fit this location.

3 switch modules plus the lighting module (4 modules total) will typically offer more than sufficient switches and labels for all systems (lighting, shade/drape control, screen control, auxiliary device control).

The architect will typically provide the design for this panel (comprised of the switch modules and multi-gang Decora® faceplate) based on input primarily from the A/V consultant but also including the electrical engineer, lighting designer and interior designer.

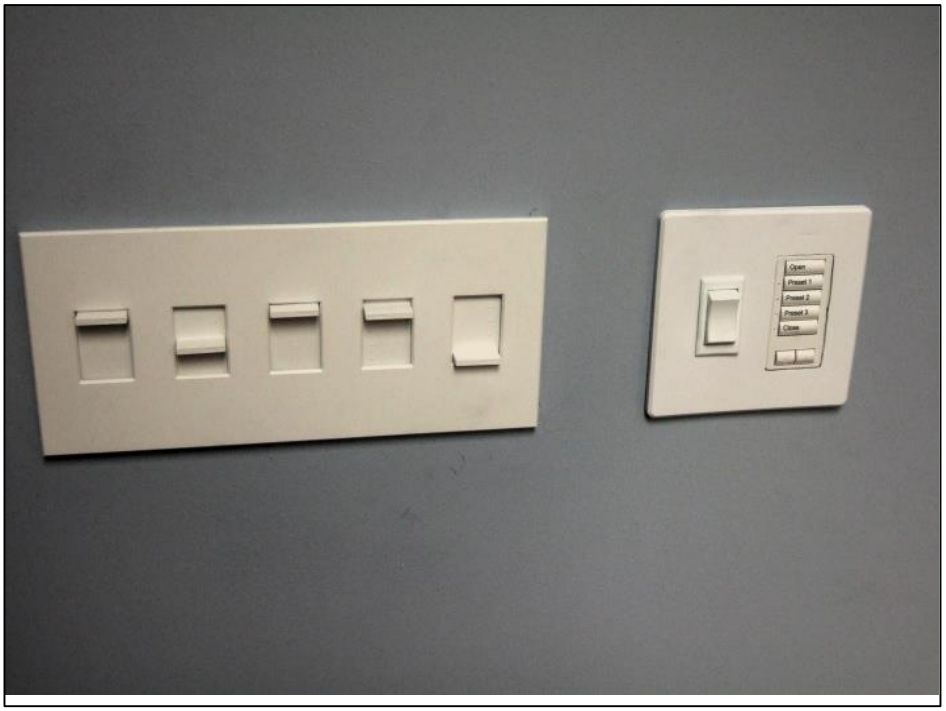

Figure 3: Typical Room Control Panel Example (note that the low-voltage projection screen switch module and window shade control module are segregated from the high-voltage lighting controls)*

Division 16 will supply the modules, the Decora® wall plate and make all the connections to the low voltage components and test the systems for proper operation. It is recommended that after Division 16 has

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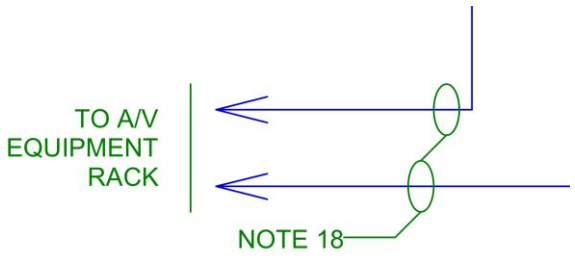
completed installation and testing that proper operation of the systems be independently verified. The A/V contractor will then extend the low voltage circuits to the A/V control system (*see Note 18*).

* The exact plate size, finish, text and device details are specific to each project and are to be coordinated on a per job/ per room basis by the design team. These images are for general illustrative purposes only.

Note 18: These **raceways are provided and installed under Division 16**. All low voltage cable and connections to the A/V system are made under the A/V Systems contractor.



These raceways will typically be terminated at a J-box or wire-trough at the A/V equipment rack location. The A/V J-box and/or A/V wire trough is not indicated on SK-1 (or the DD/CD electrical sheets) as it is typically indicated on the A/V system raceway sheets created by the A/V consultant. The electrical engineer only needs to provide an appropriate note on the E-* sheets that indicate the raceways are routed to the A/V J-box and/or A/V wire trough. An example of such a note would be - "*Route 3/4" C to A/V wire-trough WT24U in A/V Closet 315, see Sheet EAV-4*."

The cable(s) will be terminated at the A/V remote control system at the appropriate contact closures or communication ports. The A/V contractor will program the A/V control system to operate the various systems described above.