Total installed cost comparison study of motorized shading systems

line voltage AC system
vs. low voltage
Sivoia® QS system

Technical white paper
October, 2009

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1 Installed cost study

1.1 Introduction

[1] **Motorized shading system:** electrical circuits, processors, motors and/or drives that work together as a system to control window treatments such as shades or drapery tracks.

The intent of this study is to illustrate an objective comparison method for the total installed cost of motorized shading systems[1] by comparing line voltage AC[2] and low voltage Sivoia® QS[3] shading systems. This comparison method will allow decision makers to maximize total cost savings and to better assess the value created by tangible and intangible features of these systems.

Decision makers often compare and select systems based only on the cost of components. Wiring and labor costs are typically not considered until the motorized shading system has already been chosen. This is due to several reasons:

- Due to radically different designs, the shading system must be specified and designed before any wiring and labor quotes can be obtained
- For each type of system, goods and services may be sold by different contractor types (see Table 1)

[2] **Line voltage AC shading system:** analog motorized shading system that uses 120V AC electrical motors to operate window treatments. Motors are powered and controlled by devices called group controllers. The grouping and operation of the shades is determined by hard-wired connections between the motors and specific inputs/outputs on the group controllers. Line voltage cable is required to connect the motors to the group controllers and to power the system.

Wiring and labor are critical factors to consider in cost comparisons for two reasons. First, they represent a substantial portion of the total installed cost; and second, these costs vary significantly between motorized shading system types due to design differences.

Before proceeding, it is important to clarify a couple of key terms that will be used throughout this study:

- The word "**cost**" is used to refer to the monetary amount paid by the end user for any particular item
- The total installed cost of a motorized shading system is subdivided into component, wiring, and labor costs (see Appendix for allocation details)

[3] **Low voltage Sivoia QS system:** digitally addressable motorized shading system that uses 24V DC electronic drive units (EDUs) to precisely control window treatments. EDUs receive power from either low-voltage power panels or power supplies. All system devices are put into a common communication link, making the grouping and control of the EDUs programmable. As a result, the system does not require rewiring for changes in grouping or control assignment. Low voltage cable is used for communication and powering of the drives. Line voltage cable is only required to provide power to the power panels or power supplies from the main power of the building.

Goods and services sold by contractor type

Contractor type	Goods and services offered for the line voltage AC shading system[2]	Goods and services offered for the low voltage Sivoia® QS shading system[3]
Window treatment contractor	• Shading components • Installation labor	• Shading components • Installation labor • Low voltage cable • Wiring labor
Electrical contractor	• Line voltage cable • Wiring labor	• Line voltage cable • Low voltage cable • Wiring labor

Table 1 – Comparison of goods and services that each provider can offer for line voltage AC and low voltage Sivoia QS shading systems

1.2 Execution details

This study compares the total installed cost of a line voltage AC system against a low voltage Sivoia® QS system.

Data gathering

- A commercial office floor plan was selected (see pages 4-5)
- Line voltage AC and low voltage Sivoia QS shading systems were designed to meet site and client requirements (see pages 4-5)
- Fabric, lineals, mounting hardware, and control requirements were kept consistent between systems whenever possible
- Component, wiring, and labor quotes were obtained from both window treatment† and electrical contractors in different regions of the United States

† All window treatment contractors in this study sell both line voltage AC and low voltage Sivoia QS shading systems.

Assumptions

- Cost savings were preferable and therefore, whenever a quote was offered by two or more contractors, the lowest priced quote was always selected
- All window treatment contractors applied an equal markup above their net component purchasing price for both systems

Scenarios

At the expense of control flexibility, coupling[4] shades reduces the cost of the system by using fewer operators[5] and less wiring. To account for this cost savings vs. control flexibility tradeoff, three different implementation scenarios were analyzed (see Table 2).

4 **Coupling:** method of controlling two or more roller shades together using only one operator. When shades are coupled, the user can no longer control each shade independently or change the way the coupled shades are grouped together.

5 **Operators**: electric motor (line voltage AC) or electronic drive unit (low voltage Sivoia QS) used to move shades.

Description of scenarios

Less ↑ Control Flexibility/ Cost ↓ More

Scenario	Coupling Method	Total # of Operators	Operator Type	Tube Diameter
Maximized coupling *(MAX)*[A]	As much as possible	15	AC 120v LT	2.5 in
			Sivoia QS roller 200CW or roller 100™	2.5 in
Coupled pairs *(COUPLE)*[B]	Each pair	23	AC 120v LT	2.5 in
			Sivoia QS roller 100	2.5 in
Independent shades *(INDIE)*[C]	N/A	46	AC 120v LT	2.5 in
			Sivoia QS roller 64™	1.625 in

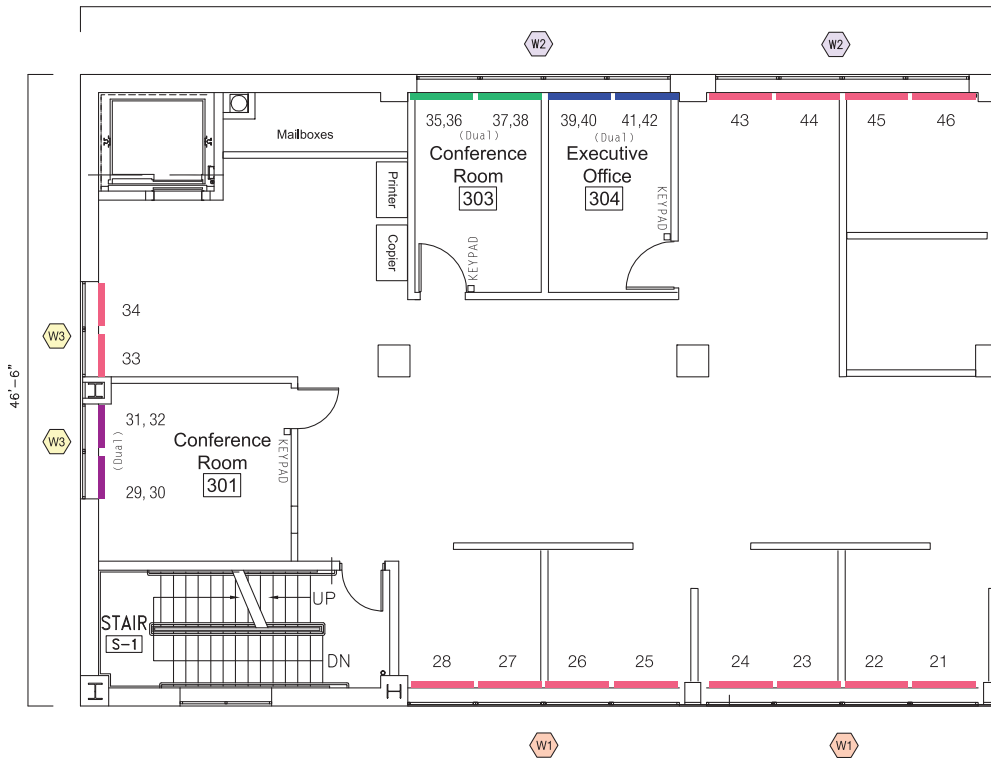
Table 2 – Implementation scenarios representing the typical tradeoff between total installed cost savings and control flexibility

A **MAX** – For the open office area, shades were coupled in groups of 4 (1 operator per every 4 shades). In the conference rooms and the executive office, shades were coupled in groups of 2 (1 operator per every 2 shades). This set-up represents the maximum coupling possible based on the project's constraints.

B **COUPLE** – All shades were coupled in groups of 2 (1 operator per every 2 shades).

C **INDIE** – Each individual shade had its own operator. The operators for this case were selected to best fit the individual parameters of each window.

Project Floor Plan
3rd Level



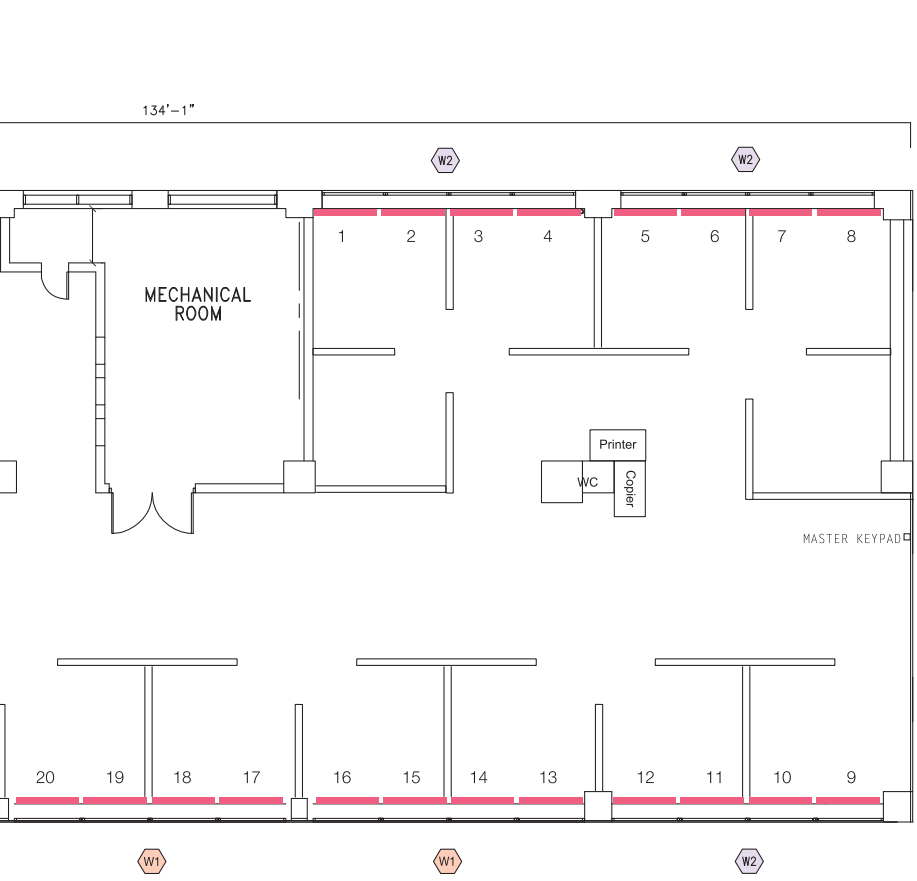
Area shading and control specifications

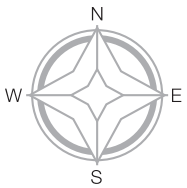
Color key	Area name	Shading requirements	Shade groups	Number of keypads	Total number of shades
	Open Office	Sheer shades	North+West South Master	1	34
	Conference Room - 301	Dual (sheer + blackout)	Sheers Blackouts Both	1	4
	Conference Room - 303	Dual (sheer + blackout)	Sheers Blackouts Both	1	4
	Executive Office - 304	Dual (sheer + blackout)	Sheers Blackouts Both	1	4

Table 3 – Client requirements for shading and control grouping

General specifications

Hembar Appearance: Exposed
Lineals: Fascia with top/back cover where possible, pocket otherwise
Metal Finish: Anodized aluminum
Fabric Drop: Regular (fabric closest to window)





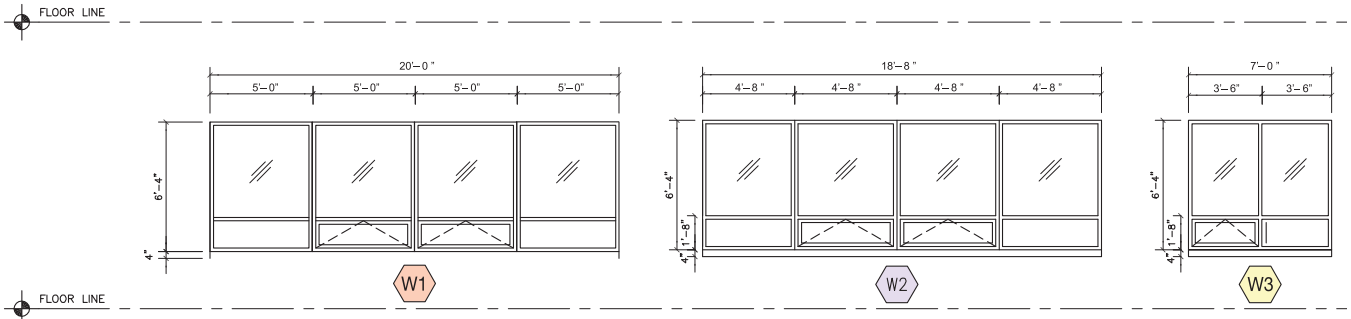
Fabric specifications

Shading System	Sheers (3%*)	Blackouts (0%*)
Line voltage AC	Solar Fabric 6000 Series	Blackout Fabric 100 Series
Low voltage Sivoia® QS	Basketweave 27	Standard NLFG Blackout

*Openness factor (percent of light coming through fabric)

Window types and dimensions

Window type	Number of panels per window	Shade dimensions (bracket to bracket)
W1	4	76 in. h x 60 in. w
W2	4	76 in. h x 56 in. w
W3	2	76 in. h x 42 in. w



1.3 Summary of results

A total installed cost comparison was executed for each of the three scenarios mentioned in Table 2 of this report. The results of the total installed cost comparisons are shown in Figure A. Detailed costs for components, labor, and wiring can be found on Table 4.

In the coupled pairs (COUPLE) and independent shades (INDIE) scenarios, the low voltage Sivoia® QS shading system's total installed cost was lower by 4% and 32% respectively. On the maximized coupling (MAX) scenario, despite the fact that component costs were 44% higher, the total installed cost was only 6% higher for the low voltage Sivoia QS shading system.

Key Observations

1. On average wiring and labor costs were lower by 80% and 34%, respectively, for the low voltage Sivoia QS shading system (see Table 4). This was the direct result of two factors related to switching from line voltage to low voltage wiring:
   - 71.6% ($1.21) decrease in the cost per foot of the cable used to wire the shades
   - 28.9% ($0.46) decrease in the cost per foot of wiring labor

2. It was discovered that wiring and labor costs represented a significant portion of the total installed cost. On average, wiring and labor were 50.4% and 32.7% of the total installed cost for the line voltage AC and low voltage Sivoia QS systems, respectively (see Figure B).

3. The dramatic difference in total installed cost for the INDIE scenario was found to be mainly caused by the Sivoia QS system's ability to "daisy chain" each pair of drives, therefore cutting in half the amount of cable and labor needed to wire the shades (see pages 8-12).

System costs

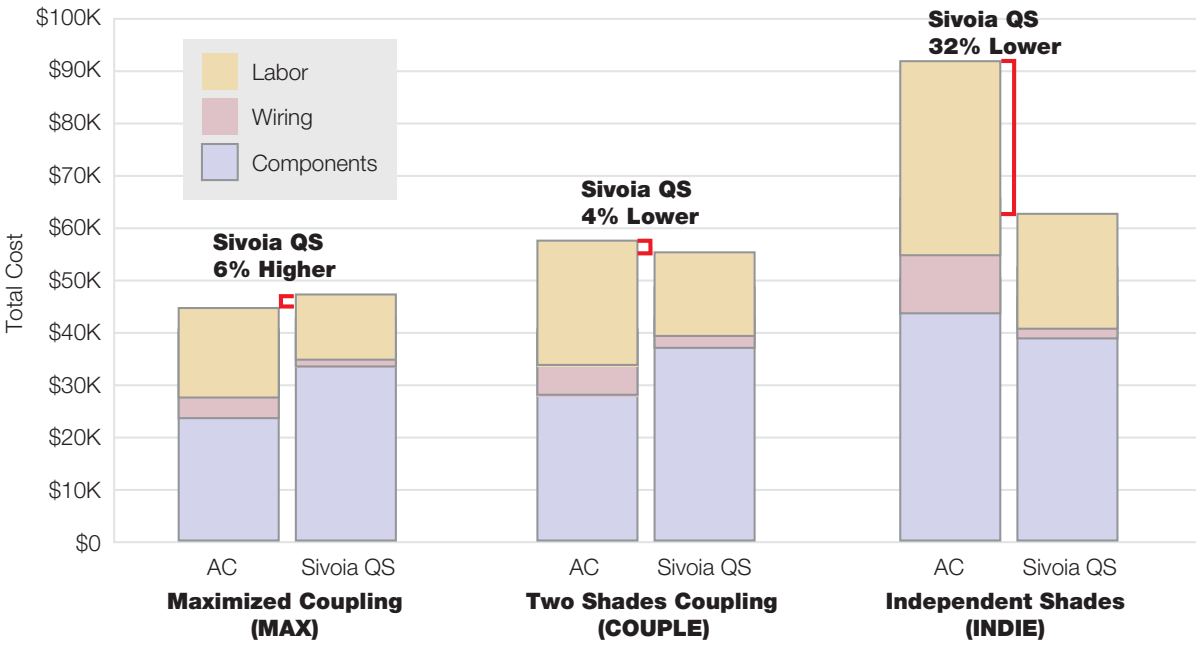


Figure A – Comparison of cost aspects for the line voltage AC and low voltage Sivoia QS shading systems

Summarized total installed cost

Less ↑ Control Flexibility ↓ More

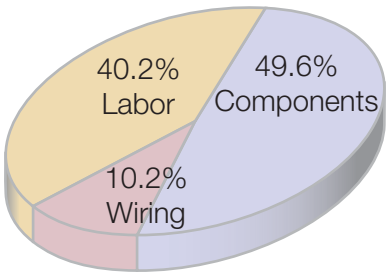
Maximized Coupling (MAX) Scenario				
Aspect	Aspect Cost ($)		Cost Differential ($) (Sivoia QS- AC)	Cost Differential (%) (Sivoia QS-AC)/AC*100%
	AC	Sivoia® QS		
Labor	$17,061.55	$12,173.79	$(4,887.75)	-29%
Wiring	$3,956.22	$1,082.23	$(2,873.98)	-76%
Components	$23,473.58	$33,803.26	$10,329.68	44%
Total Installed System	**$44,491.35**	**$47,059.29**	**$2,567.94**	6%

Coupled Pairs (COUPLE) Scenario				
Aspect	Aspect Cost ($)		Cost Differential ($) (Sivoia QS- AC)	Cost Differential (%) (Sivoia QS-AC)/AC*100%
	AC	Sivoia QS		
Labor	$24,040.19	$16,239.78	$(7,800.41)	-32%
Wiring	$5,729.64	$1,557.84	$(4,171.81)	-73%
Components	$27,992.45	$37,921.98	$9,929.53	35%
Total Installed System	**$57,762.28**	**$55,719.60**	**$(2,042.68)**	-4%

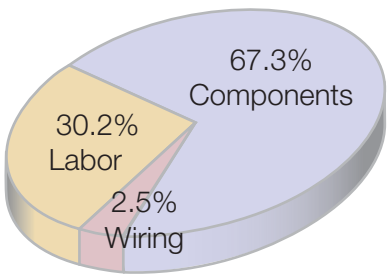
Independent Shades (INDIE) Scenario				
Aspect	Aspect Cost ($)		Cost Differential ($) (Sivoia QS- AC)	Cost Differential (%) (Sivoia QS-AC)/AC*100%
	AC	Sivoia QS		
Labor	$37,645.62	$22,341.22	$(15,304.40)	-41%
Wiring	$10,847.17	$1,577.86	$(9,269.31)	-85%
Components	$44,090.57	$39,124.49	$(4,966.08)	-11%
Total Installed System	**$92,583.35**	**$63,043.56**	**$(29,539.79)**	-32%

Table 4 - Comparison between component cost differentials and total installed cost differentials

Average total cost distribution



B-1) AC



B-2) Sivoia QS

Figure B – Average cost distribution of all three scenarios

1.4 Daisy chain wiring

Daisy chaining refers to the practice of wiring one or more electrical components in series from one power source. The Sivoia® QS shading system uses 24 V DC input power provided from a power panel with 10 outputs. This allows drives to be wired in a daisy chain configuration from each output (see Figure C), provided the shade sizes and wire run lengths fall within the parameters of the system (see Table 5). Diagrams A and B display the wiring configurations for each system in the INDIE scenario (see pages 9-12).

Two shade daisy chain example

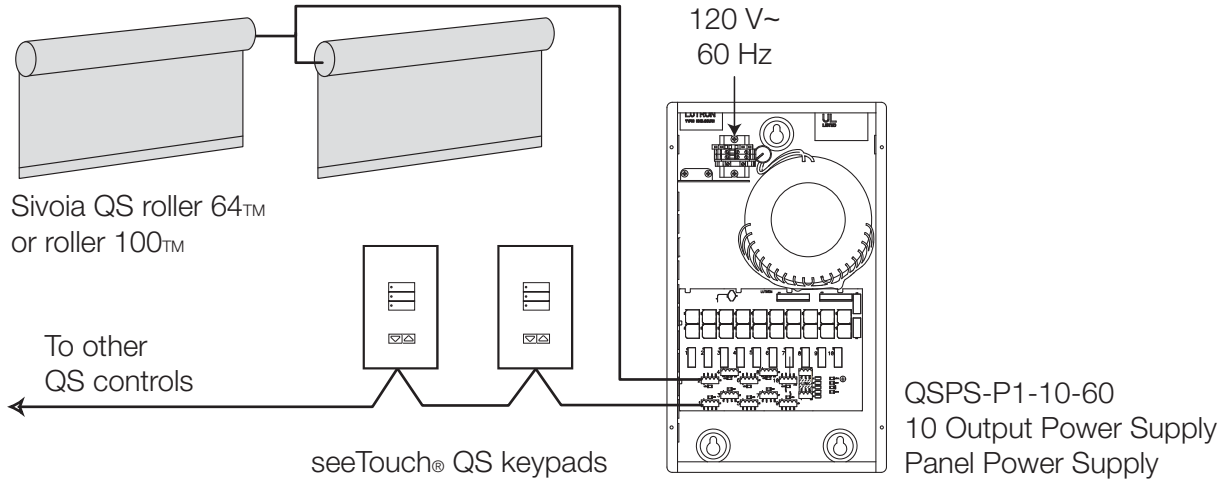


Figure C – Wiring diagram showing two drives daisy chained from one power output

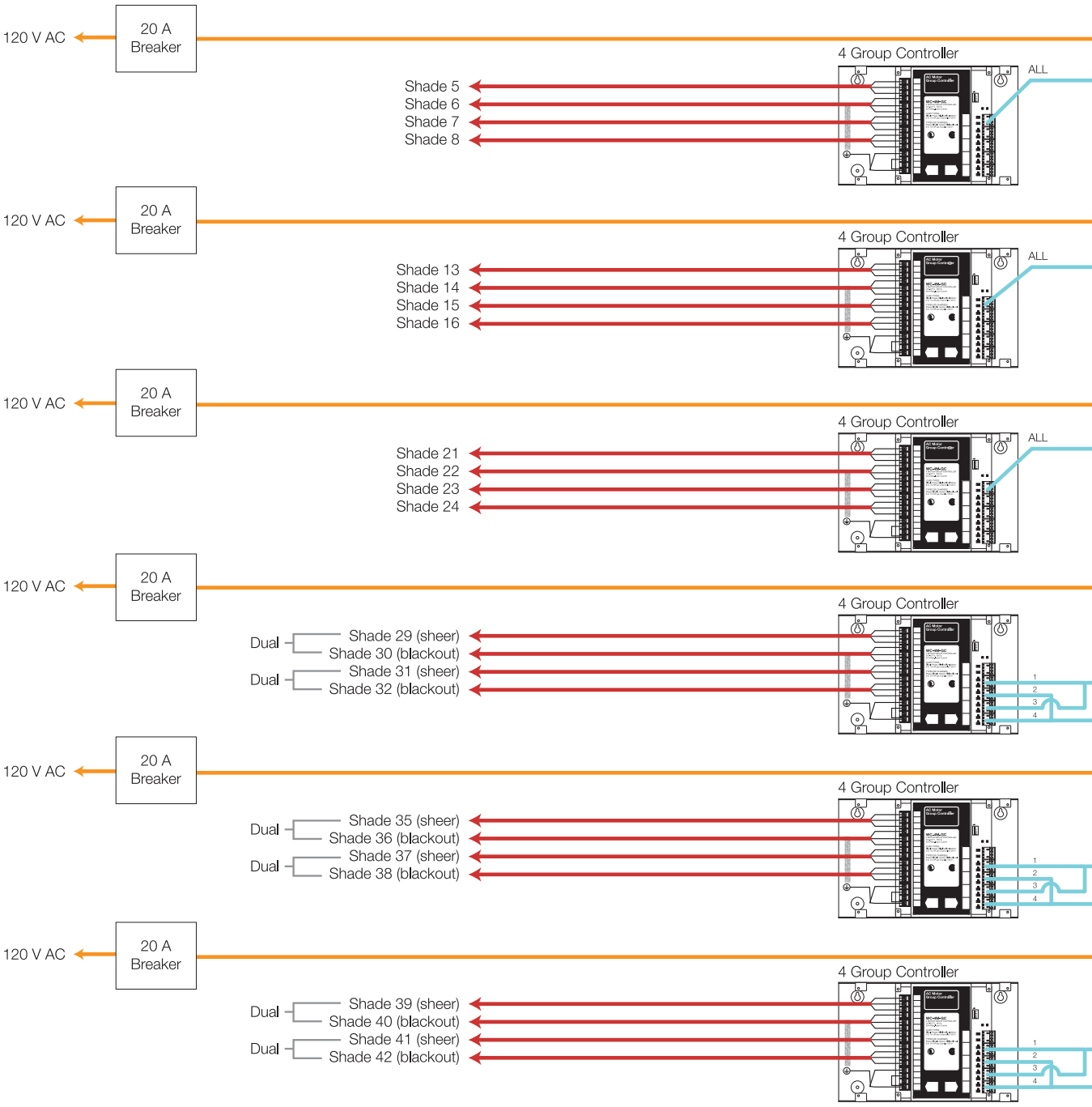
Sivoia QS smart panel power supply wiring guide

Maximum devices per output		Maximum distance per output based on wire gauge		
Shades + Controls		12 AWG	16 AWG	18 AWG
None	Up to 8 seeTouch QS keypads	1200 ft	500 ft	300 ft
1 Sivoia QS shade* / drapery drive unit	Up to 1 seeTouch QS keypad	500 ft	200 ft	125 ft
2 Sivoia QS roller 64™, ≤ 30 sq ft each	None	200 ft	75 ft	50 ft
3 Sivoia QS roller 64, ≤ 20 sq ft each	None			
2 Sivoia QS roller 100, ≤ 50 sq ft each	None			

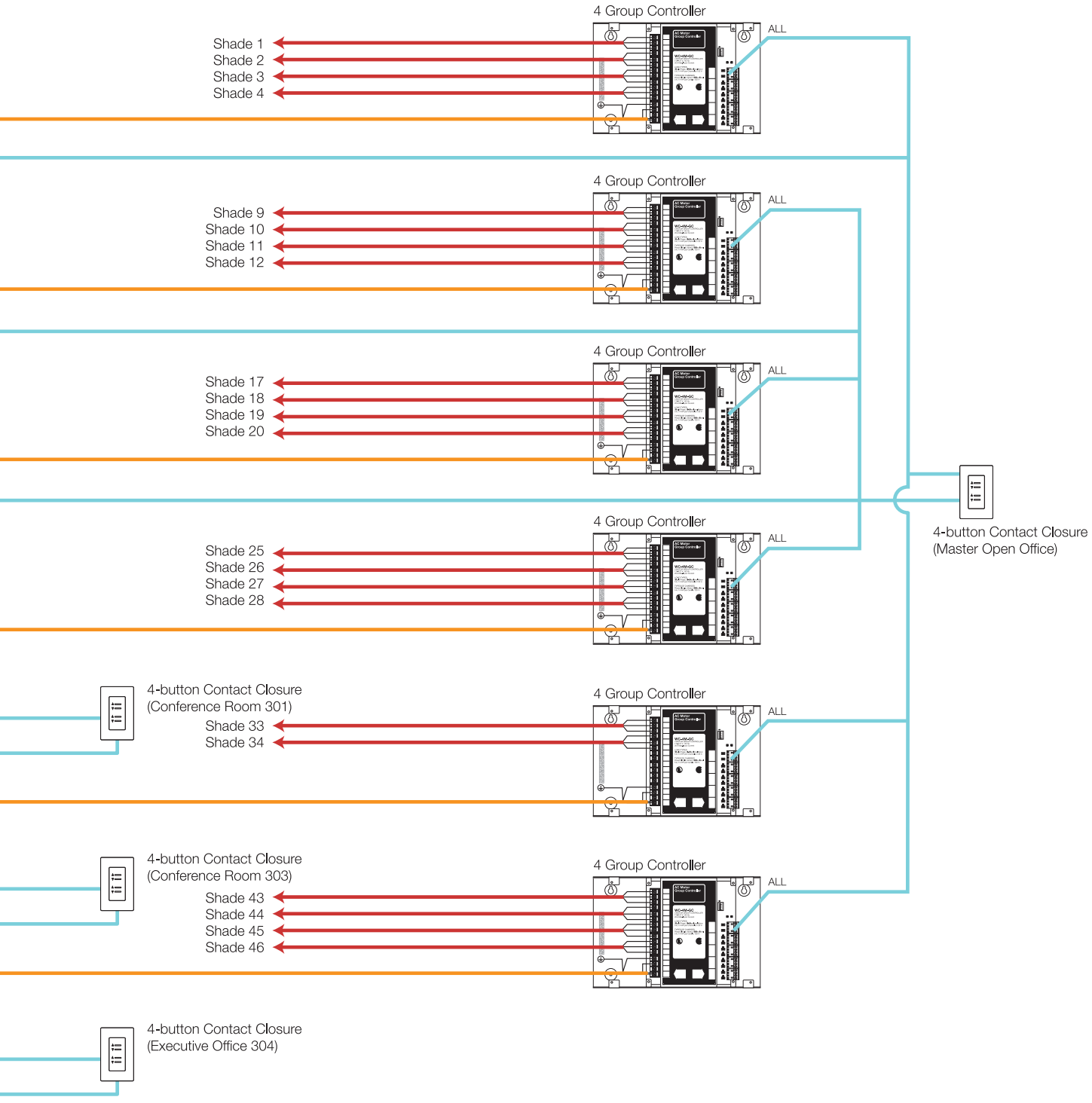
* roller 64, roller 100, roller 200CW, roller 225™, skylight

Table 5 – Providing power to drives from each output on a smart power panel

Diagram A: Line voltage AC wiring
Independent shades (INDIE) scenario

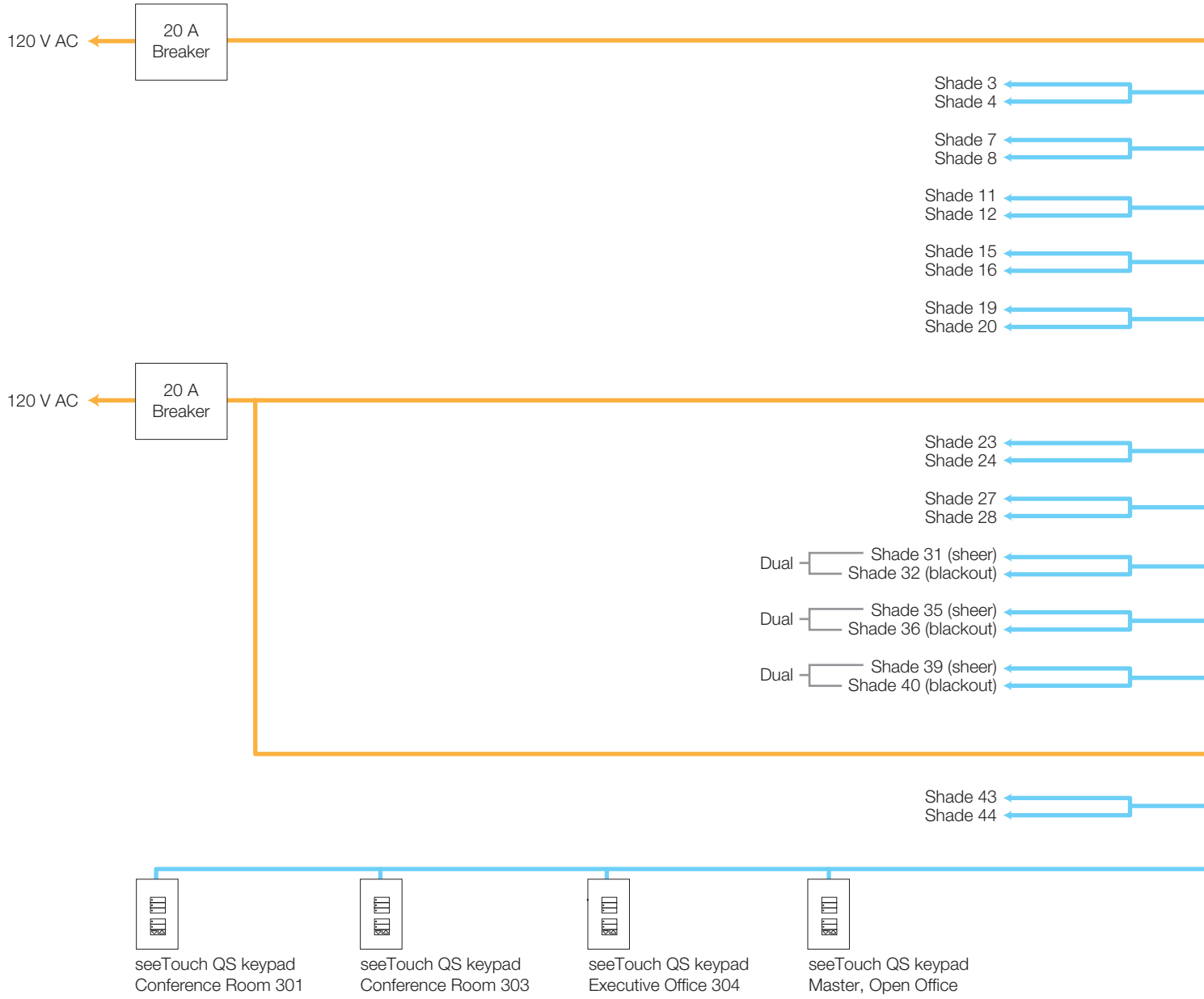


12/3 Line Voltage MC Cable
4 Conductor Low Voltage Cable (communication link-shielded)
12/2 Line Voltage MC Cable (input power)

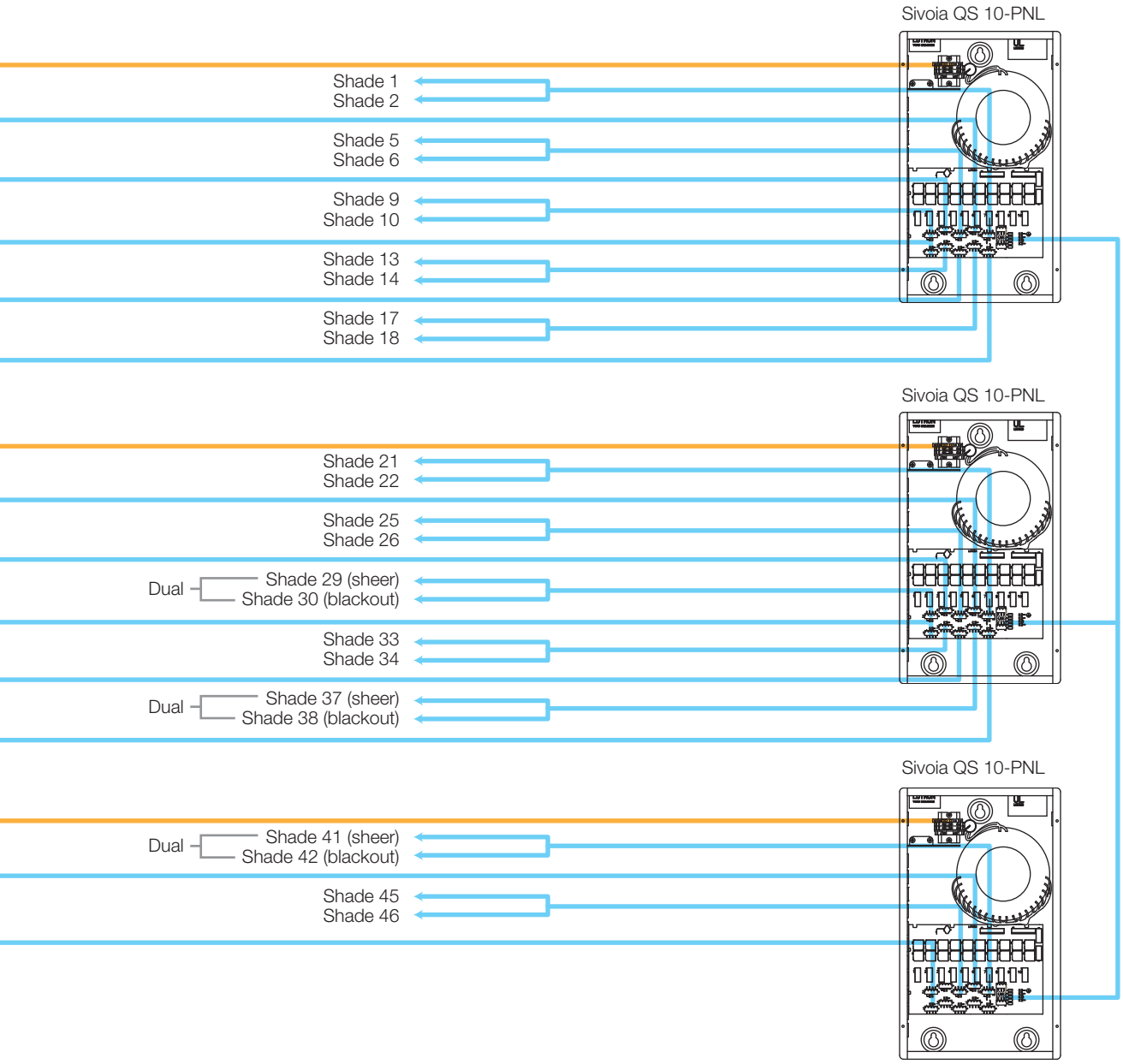


Note: Lutron® 4-group controller shown for display purposes only. Actual group controllers quoted in this study were manufactured by third party companies.

Diagram B: Low voltage Sivoia® QS wiring
Independent shades (INDIE) scenario



4 Conductor Low Voltage Plenum Cable* (communication link-shielded)
12/2 Line Voltage MC Cable (input power)
*Low voltage plenum cable does not require conduit


Sivoia QS 10-PNL
Shade 1
Shade 2
Shade 5
Shade 6
Shade 9
Shade 10
Shade 13
Shade 14
Shade 17
Shade 18
Sivoia QS 10-PNL
Shade 21
Shade 22
Shade 25
Shade 26
Dual
Shade 29 (sheer)
Shade 30 (blackout)
Shade 33
Shade 34
Dual
Shade 37 (sheer)
Shade 38 (blackout)
Sivoia QS 10-PNL
Dual
Shade 41 (sheer)
Shade 42 (blackout)
Shade 45
Shade 46

1.5 Conclusion

Based on the results of this study, it can be concluded that the relative component cost difference is not a proper representation of the total installed cost difference between the two systems (see Table 6).

Making cost-motivated decisions based on component cost comparisons alone can mislead a decision maker to pick a more expensive total system.

Therefore, it is critical to always compare shading systems on the basis of total installed cost, even if the cost of all goods and services is provided by different contractors at the various stages of the commissioning process.

Summary of relationship between component and total installed cost differentials

Scenario	Component cost differential of low voltage Sivoia® QS over line voltage AC	Total installed cost differential of low voltage Sivoia QS over line voltage AC
Maximized coupling (MAX)	**44% Premium** →	**6% Premium**
Coupled pairs (COUPLE)	**35% Premium** →	**4% Savings**
Independent shades (INDIE)	**11% Savings** →	**32% Savings**

Table 6 – Relative cost comparison at the component and total installed cost levels

2 Going beyond the shading system costs

Above and beyond the potential total cost savings that can be achieved by utilizing low voltage Sivoia® QS shading systems, there are clearly differentiated tangible and intangible benefits tied to low voltage Sivoia QS shading systems that provide significant value to the customer.

2.1 Integration to lighting controls

In today's commercial environment, maximizing the productivity of employees has become a major area of interest for many organizations. Facility managers are responsible for creating environments that help employees remain productive for long periods of time.

Research indicates that people are more productive working in their preferred light level *(Determinants of Lighting Quality II by Newsham, G. and Veitch, J., 1996.).* In order to provide the right light level for a job, a system must control the amount of daylight coming in through windows and adjust electric lights to maintain uniform illumination throughout the day. As technology progresses, the market's expectation is for this to be achieved through the integration of lighting and shading systems.

Lutron® is the only manufacturer in the world to provide both integrated lighting and shading controls. Lutron shading and lighting systems are designed to communicate directly and without interfaces. This is achieved through the use of a proprietary communication and wiring protocol shared by all system components. **As a result, the Sivoia QS system provides added functionality, one-touch control of lights and shades, and cost savings in system integration (see Figure D).**

For a line voltage AC shading system, integration to lighting controls is typically achieved through the use of contact closure interfaces. These interfaces are wired directly to the group controllers powering the shades to be controlled. The number of contact closure interfaces required for integration increases with the number of shade groups in the system. Furthermore, communication is unidirectional towards the shades. In other words, line voltage AC shades are not able to provide valuable feedback information that lighting control systems may need to deliver uniform light levels. **Consequently, line voltage AC systems provide limited flexibility and functionality and can be more expensive to integrate with lighting controls.**

Lutron total light control system

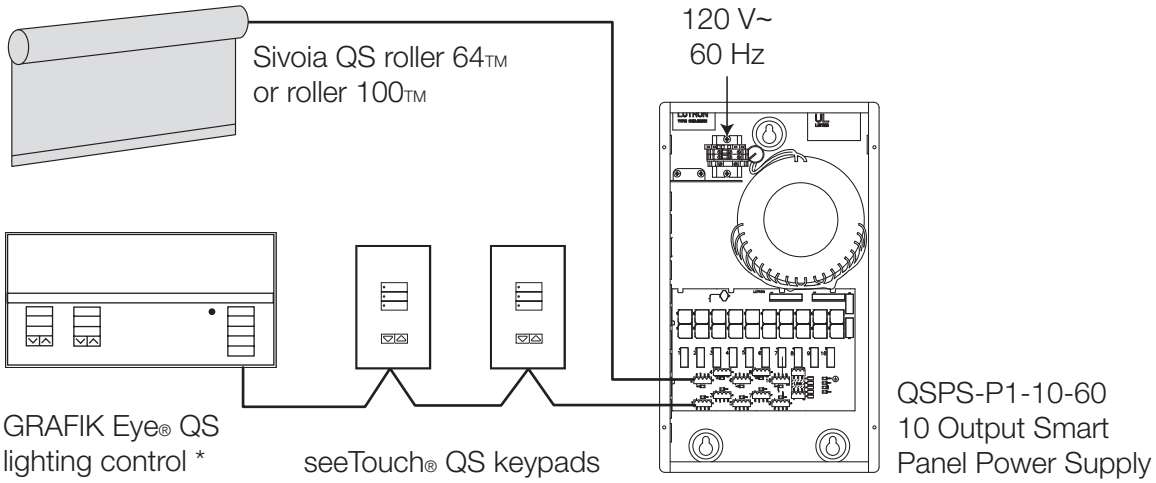


Figure D – One line diagram showing integration between a simple Sivoia QS shading system and Lutron lighting controls.

*GRAFIK Eye QS shown as example. All other Lutron QS systems, including Quantum™ total light management, can also connect directly to the Sivoia QS shading system.

2.2 Dealing with space churn[6]

As organizations evolve, the needs of the people and the way office spaces are used change. In order to accommodate for these changes, facility managers often move people, cubicle walls and furniture within a building or from one building to another. If the business requires it, moveable walls are also used to create new conference rooms, temporary project rooms, or offices.

According to the International Facility Management Association (IFMA), the main causes for churn include: reorganization, expansion, consolidation, downsizing, mergers, and collocation of groups to improve collaboration and maximize efficiencies within and between departments *("Space and Project Management Benchmarks," Research Report #28, IFMA, 2007, p. 40).*

When any of the situations mentioned occur and the purpose of a space changes, shades are often required to be grouped and controlled differently in accordance to a new layout. With a digitally addressable Sivoia QS shading system, changing the way the shades are grouped together and controlled is simple. **Properly trained facility managers can easily reprogram shade groups and re-assign controls in a Lutron® Sivoia QS system from a keypad, remote, or lighting control.**

Accomplishing the same task with most analog line voltage AC shading systems is not as straightforward. Since shade and control grouping is dictated by physical wire connections in the system, modifications to the system may require re-wiring, additional conduit (not applicable for MC cable), and possibly extra group controllers. **In most states in the United States, changes to line voltage AC wiring and devices require the services of a licensed electrician, increasing the cost of space churn for companies.**

[6] **Space churn**: To better understand and manage people and furniture moves, companies track these in the form of "churn," or the number of office moves during a given year, expressed as a percentage of the total number of offices occupied. *(International Facility Management Association [IFMA], "Space and Project Management Benchmarks," Research Report #28, 2007, p. 44.)*

2.3 Sivoia® QS specification benefits

Lutron® has been the world's leading manufacturer of lighting control and shading systems for over 45 years. We focus on continuous innovation, while offering world-class service and support.

Control

- *Ultra-quiet electronic drive*
  The Sivoia QS system is low-voltage and operates at a near-silent level (rated at less than 44 dBA at three feet). Shades move smoothly and stop at preset positions with no audible clicks.

- *Total light control*
  Lutron lighting control systems integrate with Sivoia QS shades and drapery tracks, offering intuitive control of both electric light and daylight. Quantum™, GRAFIK Eye® QS and Sivoia QS use the same wiring configuration and do not require any interfaces, ensuring seamless integration for total light control.

Installation

- *Simple reconfiguration*
  The Sivoia QS system can be easily reconfigured, limits can be changed, and presets can be reprogrammed without rewiring through the remote, keypad, or electronic drive unit (EDU).

- *Simplified wiring*
  Sivoia QS shading systems do not require any group controllers, relays, or line-voltage wiring between electronic drive units.

- *QS Smart Panel Diagnostics*
  The QS Smart Panel power supply features advanced diagnostics to quickly verify system communication and wiring.

Flexibility and performance

- *Limits and presets never lost*
  Precise limits and preset shade positions are electronically set and have a power-failure memory for the life of the system. These limits and presets will never drift regardless of age, electrostatic discharge, or power failure.

- *Sustainable solutions and LEED™*
  Lutron shading and lighting controls may contribute to obtaining up to 20 points in 5 of 6 LEED credit categories.

- *System warranty and support*
  Sivoia QS systems come with an 8-year limited warranty, plus optional extended service. Lutron has factory-employed field service engineers throughout the world and is the only lighting control or shade systems manufacturer in the world with a 24-hour, 7 days a week technical support center.

Aesthetics

- *Minimal, symmetrical light gaps*
  Sivoia QS roller shades offer symmetrical light gaps of .75 inch per side.

- *Elegant control options*
  Lutron controls are designed to match the high-end look and feel of today's premiere working and living spaces. They are available in a wide variety of colors and finishes, including metals.

- *Wide array of fabrics*
  Lutron shading systems are available in fabric styles to suit any function or aesthetic need, including many sustainable and NFPA fire rated materials.

3 Appendix

Line voltage AC

Breakdown of project costs for INDIE scenario

			Qty	Total Price (U.S.D.)
Labor	Window Treatment Contractor	Administrative Charges	-	$2,501.00
		Keypad Cable Labor	-	$400.00
		Shades Installation and Programming	-	$16,800.00
	Electrical Contractor	Line Voltage Wiring and Circuit Installation	-	$17,944.62
	Total Labor			$37,645.62
Wiring	Breakers & Electrical Materials	20 A Breakers	12	$314.29
		Miscellaneous Materials*	-	$1,979.21
	Cable (Qty. in feet)	#12/3 MC Cable (Shades Wiring)	4600	$7,757.38
		#12/2 MC Cable (Breaker Wiring)	600	$602.69
		Lutron 4 Conductor Keypad Cable	400	$193.60
	Total Wiring			$10,847.17
Components	Shades, Brackets and Lineals	Open Office Sheer Shades	34	$28,833.96
		Conference Rooms & Executive Office Shades in Dual Configuration	12	$10,471.70
	Keypads	Group A, B, A+B Keypads	4	$369.81
	Power and Control	Group Controllers	12	$4,415.09
	Total Components			$44,090.57
Total Installed Cost				**$92,583.35**

Table 6 - AC project costs

*Miscellaneous wiring materials include male and female wago plug kits, wire markers, ty-raps, and other materials.

Low voltage Sivoia® QS
Breakdown of project costs for INDIE scenario

			Qty	Total Price (U.S.D.)
Labor	Window Treatment Contractor	Administrative Charges	-	$2,786.00
		Low Voltage Shade and Keypad Wiring	-	$3,000.00
		Shades Installation and Programming	-	$15,736.00
	Electrical Contractor	Line Voltage Wiring and Circuit Installation	-	$819.22
	Total Labor			$22,341.22
Wiring	Breakers & Electrical Materials	20 A Breakers	2	$52.38
		Miscellaneous Materials**	-	$118.23
	Cable (Qty. in feet)	#12/2 MC Cable (Breaker Wiring)	100	$100.45
		Lutron 4 Conductor Keypad Cable	2700	$1,306.80
	Total Wiring			$1,577.86
Components	Shades, Brackets and Lineals	Open Office Sheer Shades	34	$26,418.91
		Conference Rooms & Executive Office Shades in Dual Configuration	12	$9,039.98
	Keypads	Group A, B, A+B Keypads	4	$603.20
	Power and Control	10-PNL Power Panels	3	$3,062.40
	Total Components			$39,124.49
Total Installed Cost				**$63,043.56**

Table 7 - Sivoia QS project costs

**Miscellaneous wiring materials wire markers, ty-raps, and other materials.

Lutron Electronics Co., Inc.
7200 Suter Road
Coopersburg, PA 18036-1299 USA

Customer Service/Quotes: 1.888.LUTRON1
Technical Support Center: 1.800.523.9466

For more information about Sivoia® QS shading systems, contact your local Lutron representative, or visit us on the web at www.lutron.com/shadingsolutions

LUTRON®

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