WHITE PAPER

SYSTEM COMPARISON AND SELECTION GUIDE: LINE VOLTAGE VS. LOW VOLTAGE ROLLER SHADE SYSTEMS

APPLICATIONS FOR A TYPICAL RECTANGULAR FLOOR PLATE WITH CURTAINWALL GLAZING

Executive Summary

The following white paper is intended to be a comparative analysis of Line Voltage (110-220VAC) and Low Voltage (24-48VDC) motorized roller shade systems being installed in commercial settings with perimeter curtainwall or continuous glazing layouts.

While **cost** is a key consideration, this document is intended to examine **all factors** that drive the decision making process, including project conditions, existing infrastructure, trade coordination requirements, and installation constraints, with cost serving as one of several critical factors.

Instead of declaring a single "winner", the intent of the paper is to offer owners, designers, and engineers the ability to **critically examine all factors to determine the appropriate design approach for a specific project** which best suits the use case to maximize performance and value while limiting project risk.

1. How to Use This White Paper

This document is intended to support early-stage decision-making during schematic design, budgeting, and retrofit planning.

Readers should:

- Identify whether the project is new construction or a retrofit / tenant improvement
- Evaluate existing electrical infrastructure and panel capacity
- Consider coordination complexity, ceiling access, and disruption tolerance
- Use cost comparisons as a contextual guide, not a standalone decision metric

The sections that follow are structured to walk designers through a series of categories; system architecture, installation requirements, impact on labor, and ideal use cases, allowing them to arrive at a final decision on the optimal final design for a specific project.

2. Project Scenario Description

Typical project design and layout includes:

- Perimeter glazing on all exterior elevations
- Roller shades installed at each glazed opening
- Standard building electrical and IT/controls infrastructure

Variables that are assumed constant across both system types include:

- Equivalent number of shades
- Identical shade hardware and fabric
- Same motor manufacturer (where possible) for apples-to-apples comparison

3. Line Voltage Roller Shade Systems

3.1 System Overview

Line voltage motors are typically powered by building power, typically 120VAC, and draw approximately 1.2A per motor. These motors require two separate connections: An AC power feed cable (normally provided and installed by an electrical contractor) and a low-voltage data bus, which is commonly wired using a Category (CAT5e) cable.

This requirement for two cables increases the amount of coordination between electrical contractors and controls teams.

3.2 Electrical Hardware Requirements

Given a typical motor load of 1.2A at 120VAC, a standard 20A branch circuit can typically power up to 13 motors per circuit (subject to local code and continuous-load rating as required by the electrical engineer).

Key hardware elements include:

- Dedicated branch circuits (assume 20A)
- Home-run wiring from electrical panel to each shade zone
- EMT or AC90 conduit subject to building code and spec
- Junction boxes adjacent to shade headboxes
- Optional control accessories including network interface modules

3.3 Installation Requirements

- Licensed electrician for all conduit prep and installation, long wire pulls, terminations and final connections
- Coordination with additional trades for box placement
- Possible ceiling access requirements for routing

3.4 Cost Drivers

- Conduit prep, and installation from electrical panel to shade locations
- Higher labor cost (electrician vs. low-voltage installer)
- Pulling and routing of low voltage cable to data runs

4. Low Voltage Roller Shade Systems

4.1 System Overview

Low voltage shades operate on 24 – 48VDC that is supplied by a power transformer, which generally provides power to multiple motors. Control is almost always integrated into the motor, and power and data/communication are supplied over a single cable.

4.2 Electrical Hardware Requirements

Low voltage motors in this comparison are powered from a power supply/transformer. Each supply:

- Accepts 120VAC input
- Outputs between 24 and 48VDC
- Typically can power between 6 and 12 motors
- Draws approximately 8A at 120VAC at full load

From an electrical power requirement perspective, a single 20A, 120VAC circuit can typically support two power supplies (subject to local code and rating), for a conservative total of 20 low-voltage motors per circuit.

Hardware elements include:

- Centralized or distributed DC power supplies (e.g., 200 – 900W)
- Class 2 low-voltage cabling
- No conduit required in many jurisdictions
- Power and data/communication are handled on a single cable

4.3 Installation Requirements

Low voltage motors in this configuration use a single low voltage cable that carries both power and data to each motor. While this greatly simplifies field terminations at the shade head, each motor still requires a home-run connection back to a power supply/transformer.

Practically, this results in a star topology:

- One Low-Voltage homerun from each motor location back to a power supply/transformer
- All terminations are low-voltage, which allow them to be completed by a control or low voltage contractor or in some cases even a shade contractor, rather than a licensed electrician

This approach:

- Removes the need for junction boxes at each shade motor location
- Allows for a single cable to handle power and data
- Eliminates conduit runs from electrical panels to junctions boxes
- Consolidates terminations to the power supply locations
- Allows wiring to be completed by Low-voltage technician (lower labor cost)
- Reduces cabling cost by using smaller gauge cable

4.4 Cost Drivers

- Power supply/transformer equipment cost
- Higher cost motors
- Cable length and topology
- Number of home runs vs. daisy chains
- Reduced labor cost compared with electrical

5. Cost Comparison: Line Voltage vs. Low Voltage

5.1 Electrical Material Cost

Line Voltage:

- Higher material costs due to requirement for conduit, EMT, and junction boxes

Low Voltage:

- Drastically reduced material cost due to elimination or reduced amount of conduit, EMT, and junction boxes

5.2 Rough-In Cost

Line Voltage:

- Requirement for Electrician increases labor rates
- More material and higher man hours required to complete the installation

Low Voltage:

- Lower-cost cabling and reduced hours for installation
- Reduced labor cost due to work being carried out by low voltage technician or control group

5.3 Motor & Control Cost

Line Voltage:

- Line voltage motors are generally less expensive than low voltage motors
- They are often positioned as the standard or baseline option for commercial projects
- However, they still require separate power and data wiring

Low Voltage:

- Low voltage motors are typically considered a premium product category
- They offer quieter operation, enhanced speed control, and graduated speed movement, all of which contribute to a higher-perceived quality

5.4 Panel & Distribution Cost

Line Voltage:

- Requires circuit allocation and panel real estate
- Additional circuit breaker allotment and wire management

Low Voltage:

- Requires power supplies (initial equipment investment)
- Lower breaker allotment

5.5 Long-Term Maintenance

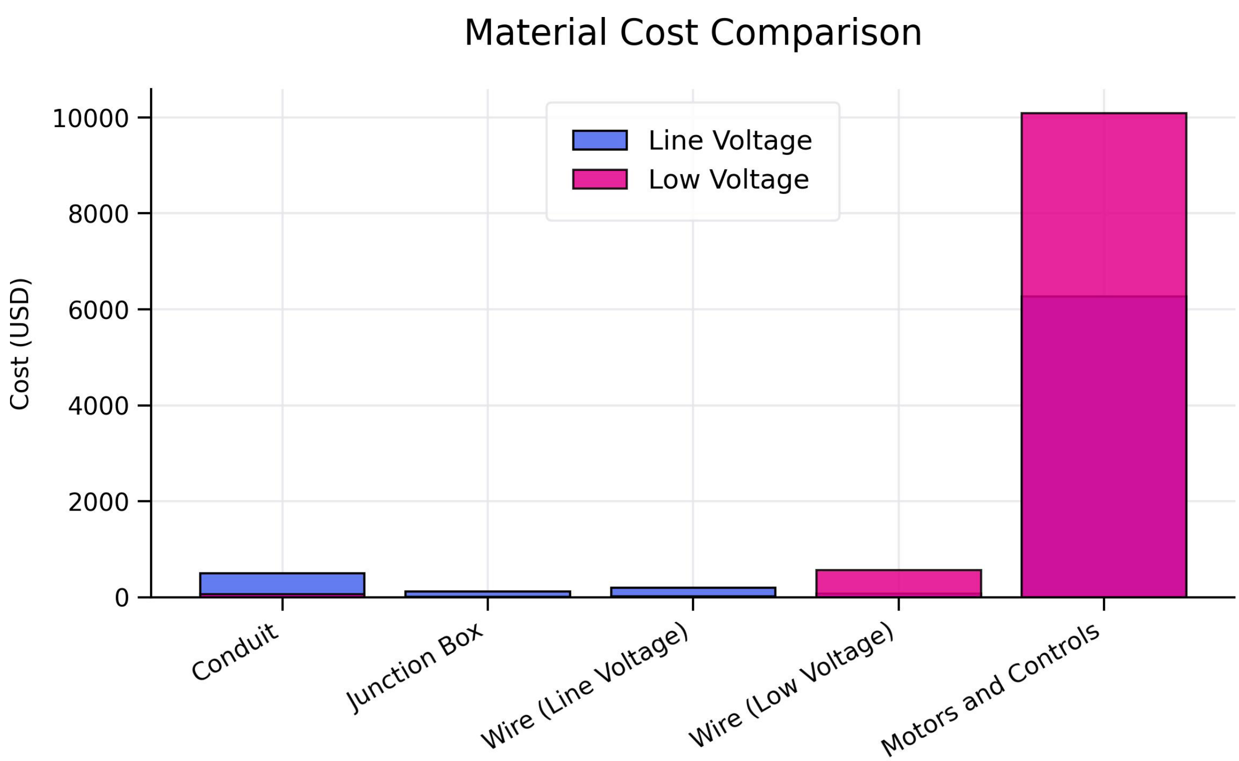
Line Voltage:

- Troubleshooting can require electrician
- Control relays or interfaces may fail before motor

Low Voltage:

- Technicians can maintain and replace components

- Modularity and consolidation of Power Panel locations simplifies service



6. Example Floor Plate Cost Illustration

The following outlines typical cost ranges: actual pricing varies by jurisdiction, contractor, and specification.

Assumptions

- Perimeter glazing of 300 ft total
- 30 shades
- Panel located 75 ft average distance from shades

6.1 Material Cost Comparison

The following table compares the material costs associated with line voltage and low voltage motorized shade systems. The intent is to break out key components of shade systems including conduit, junction boxes, wiring, and system hardware. This side-by-side comparison highlights how each system's architecture has an influence on the type and quantity of materials required to complete the electrical portion of the installation.

Material Cost	Line Voltage Qty	Line Voltage Cost	Low Voltage Qty	Low Voltage Cost	Delta
Conduit	500 (ft)	$500.00	60 (ft)	$60.00	88%
Junction Box	30	$120.00	3	$12.00	90%
Wire (Line Voltage)	500 (ft)	$200.00	60(ft)	$24.00	88%
Wire (Low Voltage)	300 (ft)	$75.00	2250	$562.50	-650%
Motors and Controls	30	$6,271.20	30	$10,089.00	-61%
		$7,166.20		$10,747.50	-50%

While low voltage systems typically carry a higher upfront cost for motors and controls, this cost is offset by significant reductions in infrastructure materials such as conduit, junction boxes, and line voltage wiring, which works to offset the cost of motors and controls and bring the overall material cost closer. The result, however, still favors the Line Voltage System in terms of material requirements to complete the project installation.

6.2 Labor Cost Comparison

Labor represents possibly the largest cost differentiator between Line Voltage and Low Voltage shade systems. The following sections use national average wage data to illustrate impact of labor cost on a project installation.

6.2.1 Line Voltage Installation Labor Cost

Line voltage wiring must be performed by a licensed or journeyman electrician. National averages (U.S.) for fully burdened labor cost typically fall in the range of $75 - $110 per hour (including overhead, licensing, insurance, and union considerations where applicable)

Key cost implications:

- Electricians perform all conduit installation, junction box placement, circuit wiring, and 120VAC terminations
- Line voltage shades require two separate field-installed components:
    - Line Voltage (120VAC) power feed
    - Low-voltage data bus (CAT5e) for motor control
- The combination of conduit, wiring, and dedicated branch circuits adds substantial labor time

6.2.2 Low Voltage Installation Labor Cost

Low voltage wiring is typically installed by low-voltage technicians, specialty Low Voltage Contractors, or shade installers. Fully burdened National average (U.S.) hourly wages for these groups fall in the range of: - $45 - $65 per hour.

Key cost implications:

- Low-voltage technicians route and terminate CAT5e homeruns from each motor back to the power supply
- No conduit or line-voltage junction boxes are required at shade locations
- All terminations at the motor and PSU are low voltage and significantly faster to complete
- Because each motor uses a single CAT5e cable carrying both power + data, field wiring is faster and simpler

6.3 Labor Cost Impact Summary

The following table compares the labor cost associated with installing, terminating, and testing a Line Voltage system vs. a Low Voltage motorized shade system. This side-by-side comparison highlights how time and labor rates highly impact the overall installation cost of each system.

Installation Cost (Labor)	Line Voltage System	Low Voltage System	Delta
Conduit Install	$5,625.00	$200.00	96%
Junction Box	$2,250.00	$100.00	96%
Wire Pull (line Voltage)	$3,000.00	$0.00	100%
Wire Pull (Low Voltage)	$1,200.00	$2,000.00	-67%
Low Voltage Connections	$2,400.00	$1,200.00	50%
Testing and Commissioning	$2,000.00	$100.00	95%
	$16,475.00	**$3,600.00**	**78%**

The significant reduction of man hours and reduced labor rates associated with a Low Voltage system offers impactful savings that far outweigh the increased material cost of a Low Voltage system. This is especially true on projects that have large motor counts or have large footprints (i.e. cable runs).

6.4 Total Cost Impact Summary

The following table combines both material and labor costs to provide a comprehensive comparison between line voltage and low voltage motorized shade systems. When evaluated together, it becomes clear that while low voltage systems may carry a high component cost, the significant reductions in labor and supporting infrastructure result in substantial savings when installing a low voltage motorized shade system.

Full Installed Cost	Line Voltage	Low Voltage	Delta
Material Cost	$7,166.20	$10,747.50	-50%
Labor Cost	$16,475.00	$3,600.00	78%
	$23,641.20	**$14,347.50**	**39%**

7. Retrofit Considerations: Why Low Voltage Is Typically More Cost-Effective in Non-Motorized Buildings

Most retrofit projects occur in buildings where the original shades were **manual or non-motorized.** This means that no infrastructure for power or data exists at the window. Under these conditions, the potential cost and installation requirements differ significantly from scenarios where motorized shade infrastructure already exists.

7.1 Existing Infrastructure Limitations

In typical retrofits:

- No conduit or junction boxes exist for shade power
- No low-voltage control wiring exists
- Electrical panels often lack spare breaker capacity

Because of this, any line-voltage shade installation requires a substantial amount of new electrical work.

7.2 Added Costs for Line Voltage Retrofits

Line-voltage systems require:

- Installation of conduit installed throughout ceiling spaces
- Junction boxes at each shade or shade group
- 14AWG/12AWG line-voltage wiring pulled through conduit
- Separate low-voltage data bus wiring (CAT5e)
- Electrical Panel upgrades to accommodate additional power requirements
- Licensed electrician to carry out all rough-in and terminations

7.3 Lower Retrofit Cost for Low Voltage Systems

Low Voltage systems avoid many of the retrofit costs listed above. Key advantages include:

- No conduit required (in most jurisdictions)
- No junction boxes required at shade locations
- Single CAT5e homerun per motor carrying both 36VDC power and data
- One 20A 120VAC circuit can support up to 24 motors via two 12-motor power supplies
- LV labor is significantly less expensive than electrician labor
- Minimal ceiling disruption—ideal for occupied or finished spaces

Because LV systems consolidate power distribution into centralized power supplies, only a few homeruns from the electrical panel are required.

7.4 Retrofit Conclusion

When buildings do not have existing motorized shade infrastructure (which is the case for most retrofit projects):

- Low Voltage shade systems provide a lower installed cost, require fewer electrical upgrades, reduce installation labor, and minimize disruption to finished spaces

Line Voltage only becomes cost-competitive in rare cases where suitable branch circuits, conduit, and junction boxes already exist.

8. Conclusion and Recommended Use Cases

This white paper compares Line Voltage and Low Voltage roller shade systems across electrical infrastructure, installation labor, coordination effort, retrofit implications, performance characteristics, and cost.

The analysis shows that system selection is fundamentally contextual. Neither approach is universally superior; each excels under specific conditions.

8.1 Summary of Advantages

Line Voltage

- Longer shade run capability
- No central power supplies required, eliminating the need to allocate wall or rack space for power distribution equipment
- Power is distributed directly from electrical panels, which may already be planned and coordinated as part of the base building electrical design
- Shade motors can be daisy-chained at line voltage, reducing the number of home runs back to panels and simplifying routing within ceiling spaces
- Fewer coordination points between electrical, IT, and controls trades

Low Voltage

- Lower installation cost
- Cleaner infrastructure with low-voltage cabling
- Integrated digital control and easier integration
- Safer installation and servicing
- Better for large new builds with high shade counts

8.2 Ideal Use Cases

Line Voltage is best suited for:

- Projects with existing motorized shade infrastructure
- Buildings with ample panel capacity
- Projects favoring decentralized power distribution

Low Voltage is best suited for:

- New construction projects seeking optimized infrastructure
- Retrofits and tenant improvements with no existing shade power
- Applications prioritizing premium performance and acoustic comfort

8.3 Decision Flow (High-Level)

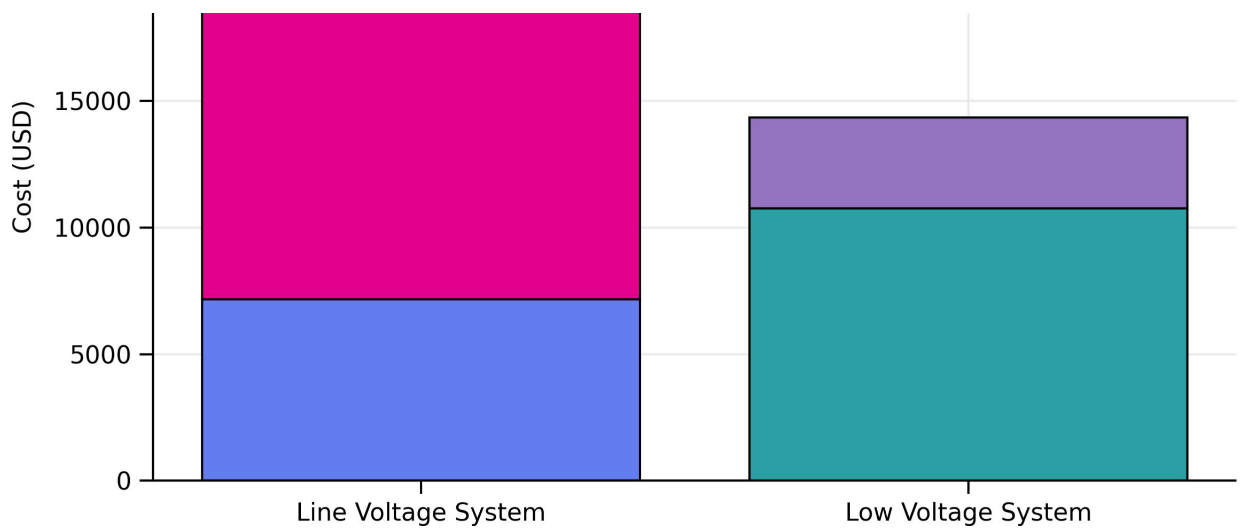
- Is shade power infrastructure already in place? –> Consider Line Voltage
- Is this a retrofit with limited panel capacity? –> Low Voltage
- Is minimizing coordination and equipment placement critical? –> Line Voltage
- Is minimizing installation cost and disruption critical? –> Low Voltage

8.4 Final Recommendation

When evaluated holistically, Low Voltage roller shade systems provide the greatest overall value for the majority of modern commercial projects, particularly new construction and retrofit applications.

Line Voltage systems remain a valid and effective solution where infrastructure reuse and coordination simplicity outweigh installation cost considerations.

It is important to emphasize that this document is intended to serve as a practical decision framework, supporting informed system selection rather than prescribing a one-size-fits-all solution.



A Note on Costs

Cost estimates included in this white paper are just that — estimates — and are meant to serve as a general guide. They are based on market conditions and typical cost ranges experienced on projects in which our products were specified and installed.

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