White Paper: Engineering Reliability Through High-Performance Cable & Interconnect Systems

Critical Considerations for Cables, Connectors, and Integrated Interconnect Solutions

Date: June 2026

Table of Contents

1. Executive Summary

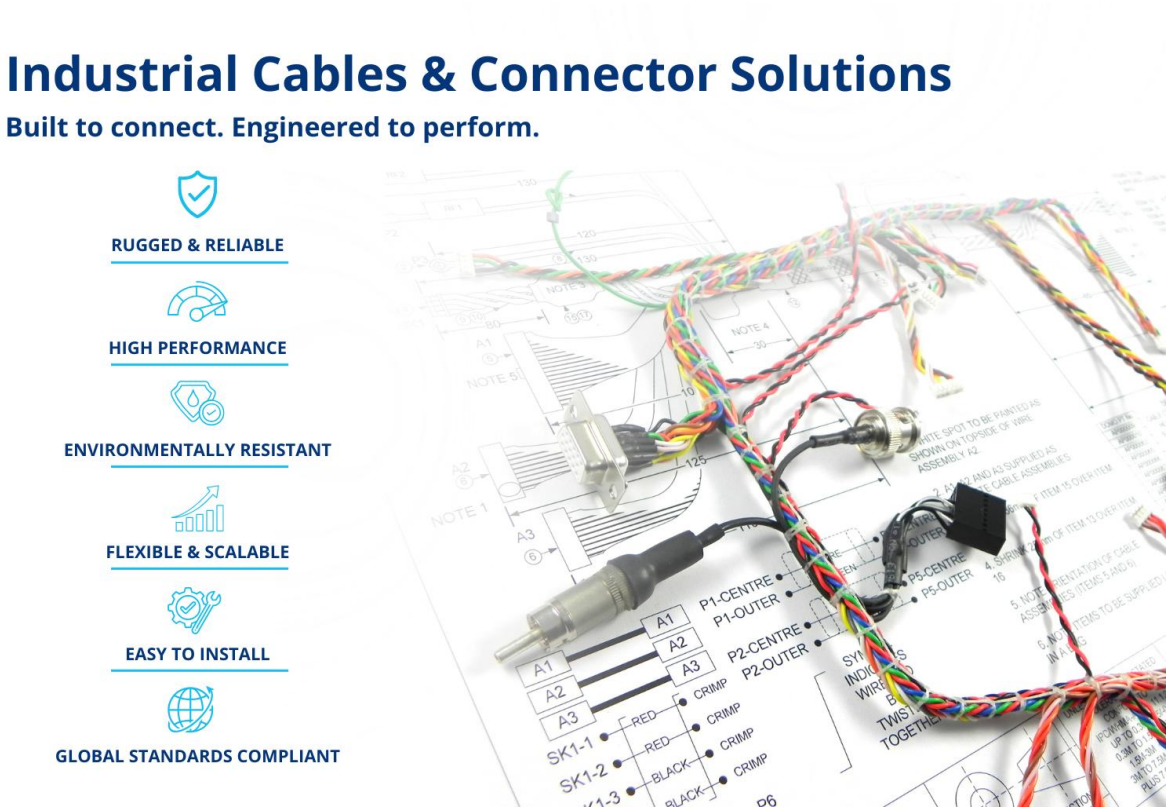
As electronic systems become increasingly interconnected, compact, and performance-driven, the importance of cable and interconnect infrastructure continues to grow. Across industrial automation, medical technology, transportation, clean energy, defence, and retail systems, reliable connectivity is fundamental to operational performance.

While processors, displays, and software often receive the greatest attention, the physical interconnect layer remains one of the most critical elements within any electronic system. Failures in cabling or connectivity can result in signal degradation, downtime, operational disruption, or complete system failure.

Modern applications increasingly demand:

- Higher data transmission speeds
- Greater power delivery capability
- Increased miniaturisation
- Enhanced electromagnetic compatibility (EMC)
- Long-term mechanical reliability
- Resistance to harsh environmental conditions

This paper explores the engineering considerations required to design and manufacture high-reliability cable assemblies and interconnect systems, focusing on signal integrity, environmental resilience, compliance, and scalable manufacturing.



2. The Operational Environment: Defining Interconnect Reliability

Cable assemblies and connectors are frequently deployed in demanding operational environments where reliability is critical to system stability.

Key environmental challenges include:

- **Mechanical Stress:** Repeated flexing, vibration, torsion, and shock loading can cause conductor fatigue and connector failure.
- **Temperature Extremes:** Systems may operate across wide thermal ranges requiring stable electrical performance.
- **Electromagnetic Interference (EMI):** High-noise environments can compromise data integrity and signal quality.
- **Moisture & Contaminants:** Exposure to water, oils, dust, chemicals, and salt spray can degrade performance.
- **Continuous Operation:** Many systems operate 24/7, placing long-term demands on connector durability and contact reliability.

Engineering robust interconnect systems requires a holistic approach that considers not only electrical performance, but also mechanical, thermal, and environmental resilience.

3. Cable & Connector Design Considerations

Modern interconnect systems must support increasingly complex electrical and mechanical requirements while maintaining long-term reliability.

Signal Integrity & High-Speed Transmission

As data rates continue to increase, signal integrity becomes increasingly important.

Critical design factors include:

- Controlled impedance design
- Shielding and grounding strategies
- Crosstalk reduction

- Low insertion loss
- High-speed differential pair routing

Applications such as industrial automation, embedded computing, digital signage, medical imaging, and AI-enabled edge systems require high-performance interconnects capable of supporting reliable high-bandwidth communications.

Power Delivery & Hybrid Connectivity

Many modern systems combine power and data transmission within a single cable assembly.

This requires careful consideration of:

- Current carrying capability
- Thermal dissipation
- Connector contact resistance
- Voltage isolation
- Power-over-Ethernet (PoE) integration

Hybrid cable assemblies increasingly enable simplified installation, reduced system complexity, and improved reliability across connected infrastructure.

Miniaturisation & Mechanical Design

As devices become more compact, connector density and cable routing become critical engineering considerations.

Modern interconnect solutions increasingly require:

- Low-profile connector systems
- Fine-pitch assemblies
- Compact overmoulded designs
- Flex-life optimisation
- Space-constrained routing capability

This is particularly important across medical, transportation, defence, and embedded computing applications where space and weight constraints are significant design factors.

---

4. The Intelligent Infrastructure: Integrated Interconnect Architecture

Modern electronic systems increasingly rely on fully integrated connectivity architectures rather than standalone cable assemblies.

Feature	Technical Specification
Cable Types	LVDS, USB, HDMI, Ethernet, RF, power, hybrid, fibre optic
Connector Technologies	Board-to-board, wire-to-board, circular, ruggedised, waterproof
Manufacturing Capability	Custom cable assemblies, harnessing, overmoulding, box build integration
Environmental Protection	IP-rated sealing, EMI shielding, strain relief, ruggedisation
Scalability	Prototype through high-volume manufacturing support

Key engineering priorities include:

- Signal Integrity Optimisation
- Mechanical Reliability
- Environmental Protection
- Assembly Repeatability
- Long-Term Supply Stability

Modern cable assemblies are increasingly designed as integrated system components rather than passive accessories.

This includes:

- Custom overmoulded harnesses
- Integrated PCB and connector assemblies
- Hybrid power/data systems
- Application-specific shielding strategies
- Pre-tested plug-and-play interconnect modules

Through vertically integrated engineering and manufacturing capabilities, companies such as GTK and Review Display Systems support customers with fully customised interconnect solutions spanning prototyping through to full production deployment.

Built for Real-World Industries

MANUFACTURING
Robotics, automation, and assembly lines

AUTOMOTIVE & TRANSPORTATION
In-vehicle systems and infrastructure

ENERGY & UTILITIES
Power generation, distribution, and renewable energy

OIL & GAS
Exploration, drilling, and refining operations

BUILDINGS & FACILITIES
HVAC, lighting, security, and building automation

AGRICULTURE & ENVIRONMENT
Precision farming, irrigation, and environmental monitoring

5. Connectivity & Data Integrity

Reliable connectivity is essential across modern electronic infrastructure.

As systems become increasingly distributed and data-driven, cable assemblies must support:

- High-speed data communications
- Real-time control systems
- AI-enabled edge computing
- Sensor integration
- Industrial IoT connectivity
- Power distribution

High-Reliability Communications

Interconnect systems increasingly support protocols including:

- USB 3.x / USB-C
- HDMI / DisplayPort
- Ethernet & Industrial Ethernet
- CAN Bus
- RS232 / RS485

- Fibre optic communications

Maintaining signal integrity across these interfaces requires precise engineering of shielding, grounding, impedance control, and connector design.

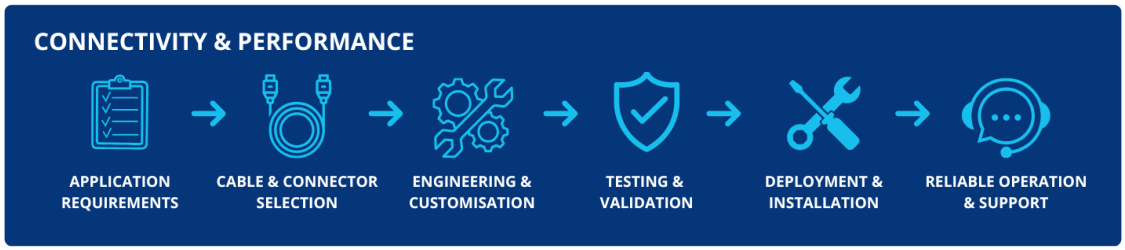
Predictive Maintenance & Monitoring

Connected systems increasingly incorporate monitoring capabilities that enable proactive maintenance strategies.

This includes:

- Cable health monitoring
- Connector wear analysis
- Thermal monitoring
- Power consumption analysis
- Network diagnostics

By identifying degradation before failure occurs, organisations can reduce downtime, improve SLA performance, and lower operational costs.



6. Ruggedisation and Environmental Protection

In many applications, cable assemblies must operate reliably within harsh operational environments.

Critical protection strategies include:

- Overmoulded assemblies for ingress protection
- IP-rated connectors and sealing systems
- EMI shielding for electrically noisy environments
- High-flex cable designs for dynamic movement applications
- Chemical-resistant jacket materials
- UV-resistant outdoor cabling

Thes requirements are particularly important across:

- Industrial automation

- Transportation systems
- Medical equipment
- Defence infrastructure
- Clean energy installations
- Outdoor digital signage

Engineering for environmental resilience ensures long-term operational stability and reduced field failure rates.

---

7. Lifecycle Management: From Prototype to Production

Successful interconnect development requires support throughout the entire product lifecycle.

Typical stages include:

1. Concept & Requirements Definition
2. Rapid Prototyping & Validation
3. Signal Integrity & Mechanical Testing
4. Environmental Qualification
5. Production Scaling
6. Long-Term Supply & Obsolescence Management

Modern manufacturing partners increasingly provide end-to-end engineering support including:

- Custom cable design
- Connector selection
- Harness manufacturing
- Box build integration
- Logistics and supply chain management
- Regulatory documentation

This vertically integrated approach simplifies deployment while improving quality control and supply continuity.

---

8. Compliance, Quality Assurance, and Manufacturing Standards

High-reliability interconnect systems must comply with strict industry standards and manufacturing controls.

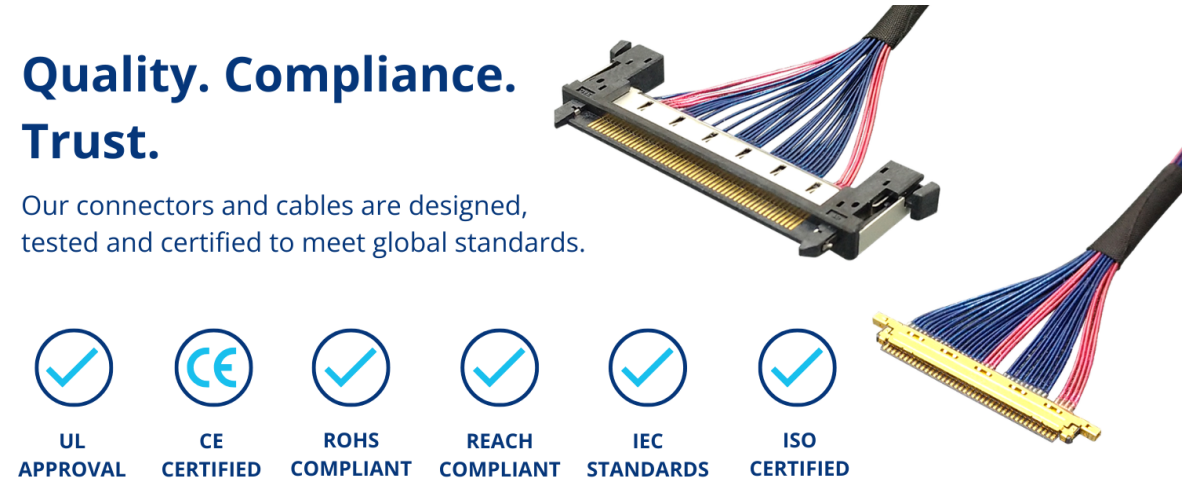
Key considerations include:

- ISO 9001 Quality Management
- IPC/WHMA-A-60 cable assembly standards
- UL certification requirements
- RoHS & REACH compliance
- AS9100D aerospace and defence quality standards, through our sister company GTK UK Ltd
- Medical and transportation-specific compliance requirements

Modern manufacturing increasingly relies on:

- Automated testing
- Traceability systems
- Controlled assembly processes
- Electrical verification
- Environmental stress screening

Quality assurance is not limited to final inspection – it must be embedded throughout the entire engineering and manufacturing process.



9. Conclusion: The Future of High-Reliability Interconnect Systems

As electronic systems become increasingly intelligent, connected, and distributed, the role of interconnect engineering continues to expand.

Future systems will increasingly require:

- Higher bandwidth connectivity
- Greater power density
- Enhanced environmental resilience
- Increased miniaturisation
- Smarter monitoring and diagnostics
- Long-term supply continuity

By combining:

- Advanced cable engineering
- High-performance connector systems
- Integrated manufacturing capabilities
- Robust quality assurance
- Application-specific design expertise

Manufacturers can deliver reliable interconnect infrastructure capable of supporting next-generation industrial, medical, transportation, defence, retail, and energy systems.

Achieving this requires engineering approaches that treat cable assemblies and interconnects not as commodity components, but as mission-critical infrastructure fundamental to overall system reliability.

Review Display Systems & GTK: Integrated Interconnect Engineering

Through its partnership with GTK, Review Display Systems provides customers with access to vertically integrated cable assembly and interconnect engineering capabilities.

This includes:

- Custom cable assemblies
- Overmoulded harnesses
- Connector integration
- Embedded system interconnects
- Box build and full system integration
- High-reliability manufacturing for industrial, medical, transportation, and defence applications.

By combining embedded computing, display technologies, and interconnect expertise within a unified engineering ecosystem, RDS and GTK support customers throughout the full product lifecycle – from rapid prototyping to scalable global production.