



NETBIT WHITE PAPER

A Comparative Analysis of Crimped and Soldered Wires vs. Spring Contacts and Metal Rails in Power Supply Units for CPE Set-Top Boxes

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EXECUTIVE SUMMARY

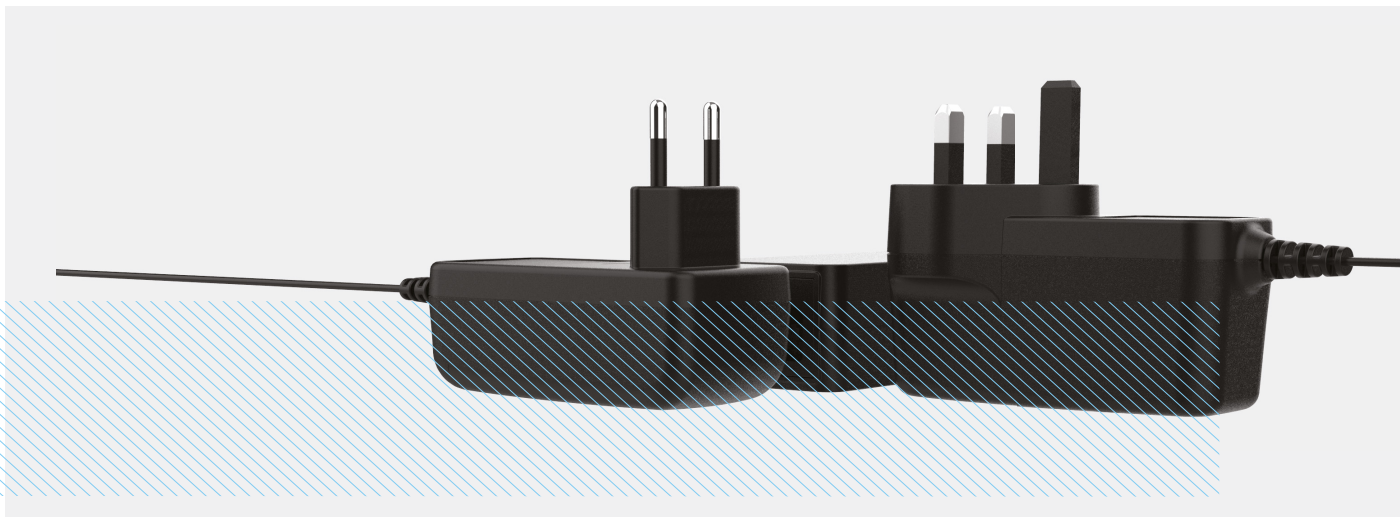
In the power supply unit (PSU) industry, particularly for Customer Premises Equipment (CPE) such as set-top boxes (STBs), the choice of connection method directly impacts performance, assembly efficiency, durability, compliance, cost, and overall reliability. This paper compares two prominent connection techniques: crimped and soldered wires versus spring contacts and metal rails.

These methods are critical in the design of PSUs, ensuring that STBs — whether IPTV receivers, DOCSIS cable boxes, DVB-S2 satellite units, or hybrid OTT platforms — operate effectively in diverse environments. This analysis incorporates real-world deployment examples, industry-standard references, environmental and recyclability considerations, and forward-looking trends in PSU design.

INTRODUCTION

The reliability and performance of PSUs in set-top boxes are heavily influenced by the quality of electrical connections. In residential, commercial, and industrial deployments, the choice between crimped and soldered connections and spring contacts can determine product lifespan, ease of assembly, compliance with safety standards, cost-efficiency, and adaptability to evolving broadcast and streaming technologies.

This paper presents a direct technical comparison of these two connection methods, supported by real-world case studies drawn from the STB sector.

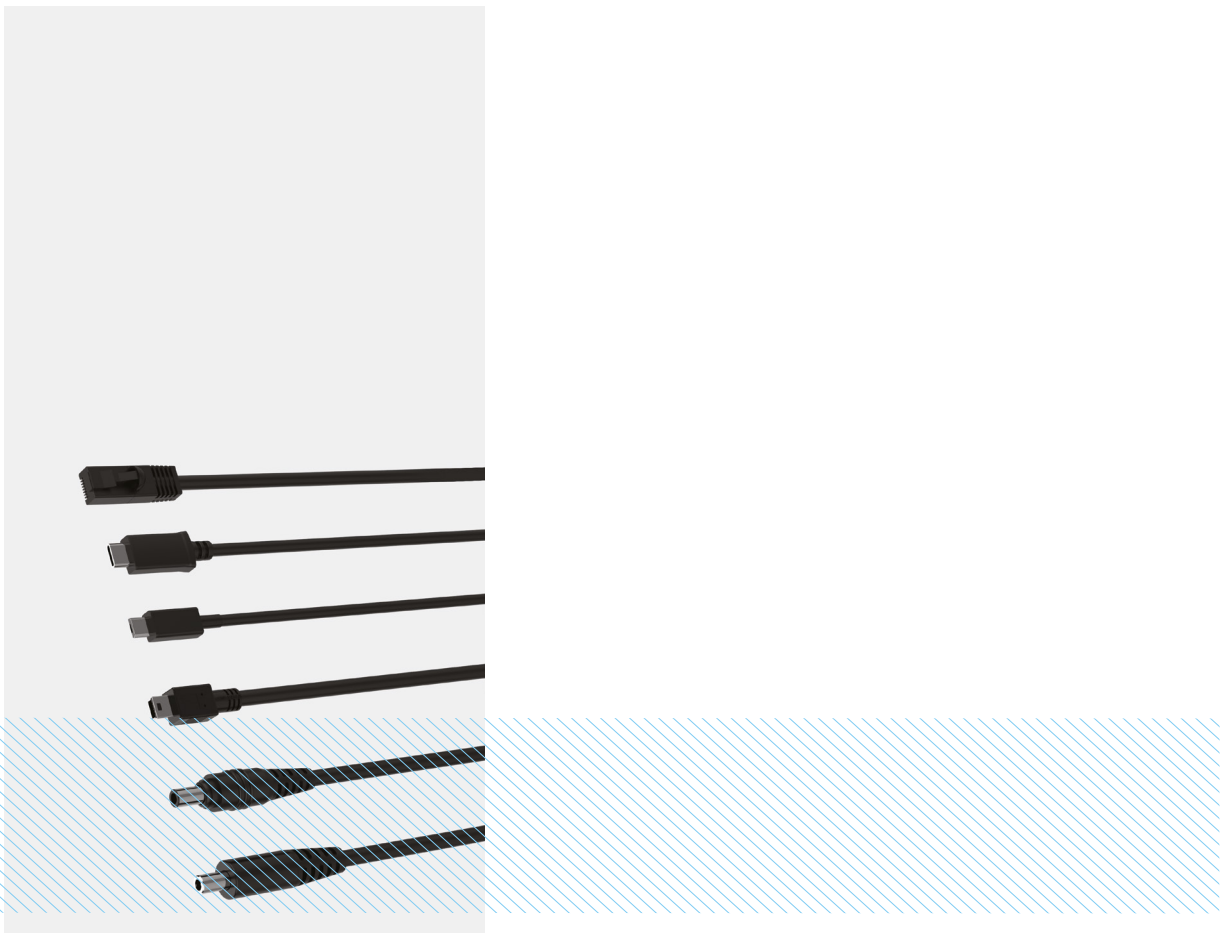


METHODOLOGY

We evaluate crimped and soldered wires against spring contacts and metal rails using six critical factors relevant to STB PSU design:

- Connection Security
- Ease of Assembly
- Durability
- Flexibility
- Cost
- Current Handling

In addition, this paper considers compliance requirements, environmental impact, recyclability, and future design trends.



COMPARISONS

1. Connection security



Spring contacts and metal rails

- Enable rapid connections but may lose tension over time in high-vibration or high-heat environments.
- Risk of loosening can result in arcing, necessitating **secondary protection mechanisms** to maintain compliance with IEC and UL safety requirements.



Crimped and Soldered Wires

- Offer maximum connection security.
- Mechanical pressure from crimping combined with low-resistance solder joints ensures a stable electrical path resistant to temperature changes, humidity, and vibration - essential for STBs operating continuously.

Industry Standard References

- **IPC/WHMA-A-620** - Crimp quality and pull-force requirements.
- **J-STD-001** - Solder joint acceptability for high-reliability electronics.
- **IEC 62368-1 / UL 60950 / UL 94** - connection safety and flammability compliance.

2. Ease of Assembly



Spring contacts and metal rails

- Enable fast, tool-free assembly, reducing labour costs.
- Highly suitable for automated production lines and cost-sensitive high-volume STB rollouts.



Crimped and Soldered Wires

- Labour-intensive and requiring specialized tools.
- Higher upfront effort but rewarded with greater reliability in premium deployments.

Conclusion

Spring contacts are assembly speed champions; crimped and soldered deliver reliability for high-value deployments.

3. Durability



Spring contacts and metal rails

- Adequate in stable, controlled environments.
- Potential degradation under long-term stress makes them less suitable for premium, high-reliability applications.



Crimped and Soldered Wires

- Resistant to corrosion, mechanical stress, and environmental extremes.
- Ideal for long-life and high-value deployments such as hospitality-grade IPTV or DOCSIS 3.1 gateways.

Conclusion

Crimped and soldered dominate in long-life, harsh conditions; spring contacts are fit for standard residential use.

COMPARISONS

4. Flexibility



Spring contacts and metal rails

- Highly adaptable to repeated assembly/disassembly cycles.
- Ideal for modular or pluggable PSU designs.



Crimped and Soldered Wires

- Rigid by nature but configurable into semi-flexible solutions.

Conclusion

Spring contacts are assembly speed champions; crimped and soldered deliver reliability for high-value deployments.

5. Cost



Spring contacts and metal rails

- Lowest production cost for mass-market devices.
- Automation-ready, reducing total manufacturing effort.



Crimped and Soldered Wires

- Higher unit cost due to labour and tooling.
- Offset by reduced field failures and lower return rates.

Conclusion

Spring contacts dominate in cost-sensitive mass production; crimped and soldered win in premium product economics.

6. Current Handling



Spring contacts and metal rails

- Sufficient for low-to-moderate load devices, where compactness and cost are prioritized.



Crimped and Soldered Wires

- Excellent for high-current, high-frequency power supplies, including GaN and SiC designs with elevated power density.

Conclusion

Crimped and soldered for high-power designs; spring contacts for low-to-moderate consumption models.

OTHER CONSIDERATIONS

Environmental and Recyclability Considerations

- **Soldering:** Uses tin-based solder, which is **RoHS and REACH compliant** but involves consumable material.
- **Spring Clips:** Typically made from stainless steel, a **fully recyclable material**.
- **Future Trend:** Strong market shift toward **lead-free, green manufacturing** with reduced environmental footprint.

Future Directions

Several emerging trends are shaping PSU connection design for STBs:

- **Modular design:** Adoption of pluggable PSU modules, where **spring clip assemblies** may offer significant benefits.
- **GaN/SiC high-frequency power supplies:** As power density increases, **soldered wire connections** provide the robustness required for high-current applications.
- **Low-carbon manufacturing:** Reducing manual processes and maximizing automation efficiency — an area where **spring clips excel**.
- **Total cost of ownership (TCO):** Beyond unit cost, factors such as **repairability, recyclability, and return rates** are increasingly critical. For ISPs and operators, high return rates often outweigh initial savings.

CONCLUSION

Both crimped and soldered wires, and spring contacts with metal rails, serve distinct but complementary roles in STB PSU design.

- **Crimped and soldered connections** deliver **unmatched reliability, compliance, and current handling**, making them the best choice **for high-reliability and high-power STBs**.
- **Spring contacts and metal rails** offer **fast assembly, cost savings, recyclability, and automation advantages**, making them ideal **for mass-market deployments**.



FINAL RECOMMENDATION

- **Premium/high-reliability STBs (DOCSIS 3.1, DVR, hospitality IPTV, broadcast):** Crimped and soldered.
- **Mass-market STBs (DVB-T2, OTT streaming, seasonal ISP rollouts):** Spring contacts and metal rails.

By aligning connection technology with compliance standards, deployment environments, environmental sustainability, and long-term cost of ownership, STB manufacturers can optimize product reliability while advancing toward greener, more modular, and automation-driven production.

