TECHNICAL NOTE

TEMPEST Line Impedance Stabilization Networks (LISNs)

Comprehensive Guide for Conducted Emissions Testing in Secure and Classified Environments

Understanding TEMPEST vs. Commercial LISNs
Industries, Applications, and Real-World Use Cases

Featuring Com-Power Corporation LIP-120 and LIP-1000

January 2026

1. Introduction to TEMPEST LISNs

A Line Impedance Stabilization Network (LISN) is a critical test device used in electromagnetic compatibility (EMC) testing to measure conducted emissions from electronic equipment. TEMPEST LISNs are specialized versions designed specifically for security-related emissions testing in classified and government environments.

1.1 What is TEMPEST?

TEMPEST is a U.S. National Security Agency (NSA) specification and NATO certification referring to spying on information systems through leaking emanations, including unintentional radio or electrical signals, sounds, and vibrations. TEMPEST testing ensures that electronic equipment does not emit compromising electromagnetic emanations that could be intercepted by adversaries.

1.2 Primary Functions of a LISN

During conducted emissions measurements, a LISN performs four essential functions:

1. **Stable Impedance:** Provides a defined, stable impedance (typically 50Ω) across the measurement frequency range.
2. **Power Source Isolation:** Isolates the Equipment Under Test (EUT) and measurement circuit from the power source, minimizing its influence on measurements.
3. **Line-to-Line Isolation:** Provides isolation between power lines to minimize cross-coupling between conductors.
4. **RF Coupling:** Couples disturbance voltages to the coaxial measurement port for connection to the measuring instrument.

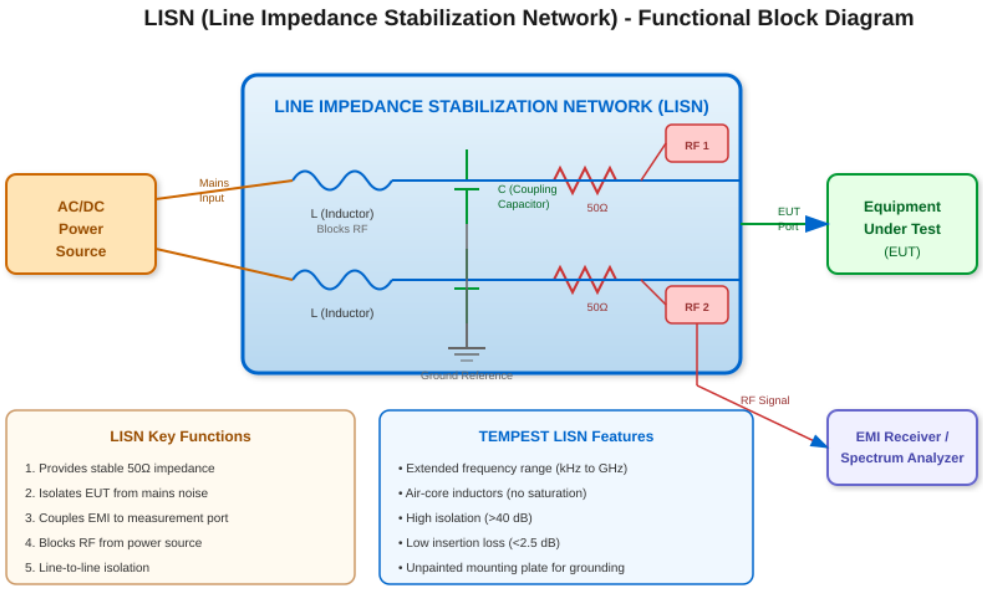

Figure 1: LISN Functional Block Diagram and Key Features

2. TEMPEST LISNs vs. Commercial LISNs

While commercial LISNs are designed for standard EMC compliance testing (CISPR 16, MIL-STD-461), TEMPEST LISNs are purpose-built for security emanations testing with distinct characteristics. Understanding these differences is essential for selecting the appropriate equipment for your testing requirements.

2.1 Key Differences

Extended High-Frequency Range

Standard commercial LISNs typically measure up to 30 MHz per CISPR 16 standards. TEMPEST LISNs, such as the **Com-Power LIP-1000** or the **Schwarzbeck TEMP 8400**, are specifically designed to operate at much higher frequencies—typically from 1 MHz up to 1 GHz (or 9 kHz to 1 GHz for some models). This extended range is critical to capture a broader spectrum of potential compromising signals that modern high-speed digital equipment may emit.

Dual-Conductor Design with Reduced Cross-Coupling

TEMPEST LISNs feature a **dual-conductor network** designed to minimize cross-coupling between the lines. This enhanced isolation is critical in sensitive testing environments where even minor interference could mask a critical compromising signal. The LIP-120 and LIP-1000 both provide >40 dB line-to-line isolation, significantly higher than typical commercial units.

Air-Core Inductors

Many high-quality LISNs, including Com-Power's single-phase commercial LISNs (www.com-power.com/products/line-impedance-stabilization-networks/single-phase-lisn), utilize **air-core inductors** rather than ferrite-core designs. In TEMPEST LISNs, this design choice is particularly crucial for the following reasons:

- **Prevention of Magnetic Saturation:** Air-core inductors cannot saturate regardless of current level, ensuring stable performance across all operating conditions.
- **Consistent Impedance:** Reliable impedance is maintained across the entire broad frequency band—a vital requirement for consistent and repeatable TEMPEST evaluations.
- **No Permeability Variation:** Unlike ferrite cores, air-core inductors are immune to temperature and frequency-dependent permeability changes that could introduce measurement uncertainty.
- **Linear Behavior:** Air-core inductors maintain linear behavior across all operating conditions, essential for accurate security assessments.

Targeted Compliance Standards

While general LISNs typically comply with commercial EMC standards like **CISPR 16, FCC Part 15,** or military standards like **MIL-STD-461** for general EMI testing, TEMPEST LISNs are built specifically for **classified, government-mandated TEMPEST evaluations**. These evaluations have their own set of rigorous and sensitive requirements that go beyond standard EMC compliance, focusing on preventing information leakage through electromagnetic emanations.

2.2 Comparison Summary

Table 1: TEMPEST vs. Commercial LISN Comparison

Parameter	Commercial LISN	TEMPEST LISN
Frequency Range	9 kHz – 30 MHz (typical)	5 kHz – 1 GHz (extended)
Standards	CISPR 16, FCC Part 15, MIL-STD-461	TEMPEST (classified specifications)
Primary Application	EMC compliance testing	Security emanations testing
Inductor Type	Air-core or ferrite (varies)	Air-core (mandatory)
Line-to-Line Isolation	>20 dB typical	>40 dB (enhanced security)
Cross-Coupling	Standard design	Minimized dual-conductor design
Grounding	Standard chassis ground	Unpainted plate for direct earth
High-Frequency Focus	Up to 30 MHz	Up to 1 GHz for digital equipment

2.3 Frequency Coverage Comparison

Com-Power offers two complementary TEMPEST LISNs that together provide comprehensive frequency coverage from 5 kHz to 1 GHz:

- **LIP-120 (5 kHz to 1 MHz):** Lower frequency range for power line conducted emissions and low-frequency emanations analysis. Uses 1.37 mH inductance for optimal low-frequency performance.
- **LIP-1000 (1 MHz to 1 GHz):** Extended high-frequency range essential for modern digital equipment, computing systems, and RF communications. Uses 23 µH inductance optimized for high-frequency measurements.

3. LIP-120: Low-Frequency TEMPEST LISN

Frequency Range: 5 kHz to 1 MHz | **Type:** 50Ω / 1.37 mH

Figure 2: Com-Power LIP-120 TEMPEST LISN

3.1 Specifications

Parameter	Specification
Frequency Range	5 kHz to 1 MHz
Type	50Ω / 1.37 mH
Impedance	50Ω (see graph)
Insertion Loss	< 2 dB
Mains-to-EUT Isolation	>20 dB @ 5 kHz to >40 dB @ 1 MHz
Line-to-Line Isolation	>30 dB @ 5 kHz to >55 dB @ 1 MHz
Max Voltage	270 VAC (50-60 Hz), 380 VDC
Max Current	10 Amperes (continuous)
Mains Input	IEC C13 Receptacle
EUT Output	Universal Multi-Configuration Receptacle
RF Ports	N-Type (female)
Dimensions	5.1" × 8" × 11.8" (130 × 204 × 300 mm)
Weight	8.5 lbs (3.9 kg)

3.2 Performance Graphs

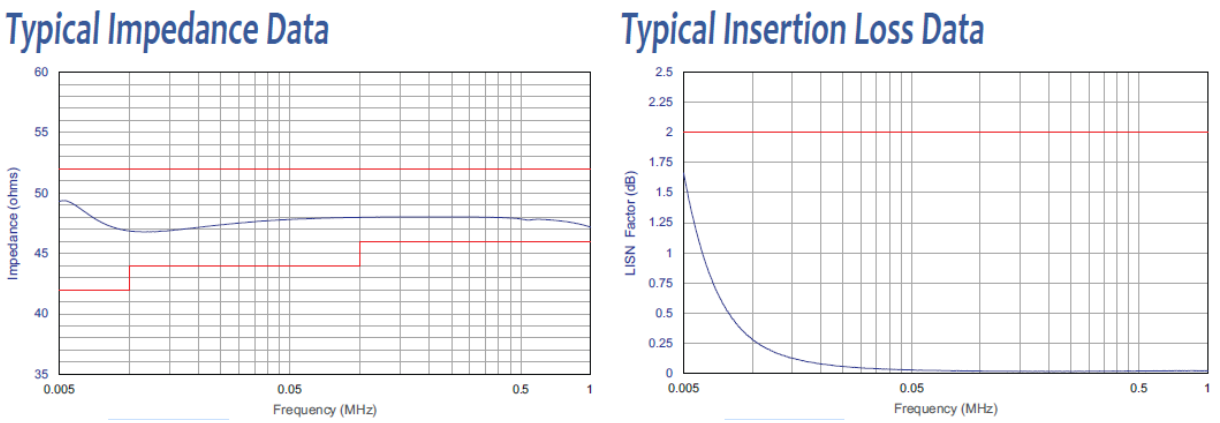

Figure 3: LIP-120 Impedance (left) and Insertion Loss (right)

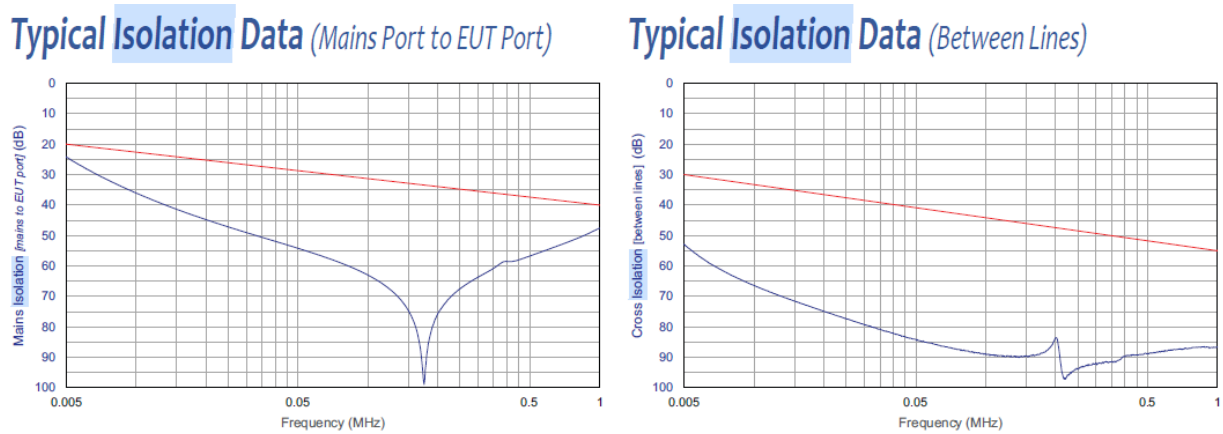

Figure 4: LIP-120 Mains Isolation (left) and Cross Isolation (right)

4. LIP-1000: High-Frequency TEMPEST LISN

Frequency Range: 1 MHz to 1 GHz | **Type:** 50Ω / 23 µH

Figure 5: Com-Power LIP-1000 TEMPEST LISN

4.1 Specifications

Parameter	Specification
Frequency Range	1 MHz to 1 GHz
Type	50Ω / 23 µH
Impedance	50Ω (+30Ω/-20Ω)
Insertion Loss	< 2.5 dB
Mains-to-EUT Isolation	>40 dB
Line-to-Line Isolation	>40 dB
Max Voltage	270 VAC (50-60 Hz), 380 VDC
Max Current	10 Amperes (continuous)
Mains Input	IEC C13 Receptacle
EUT Output	Coaxial N-Type Connectors
RF Ports	BNC (female)
Dimensions	4.1" × 8.1" × 14.4" (104.5 × 206.9 × 365 mm)
Weight	5.5 lbs (2.5 kg)

4.2 Performance Graphs

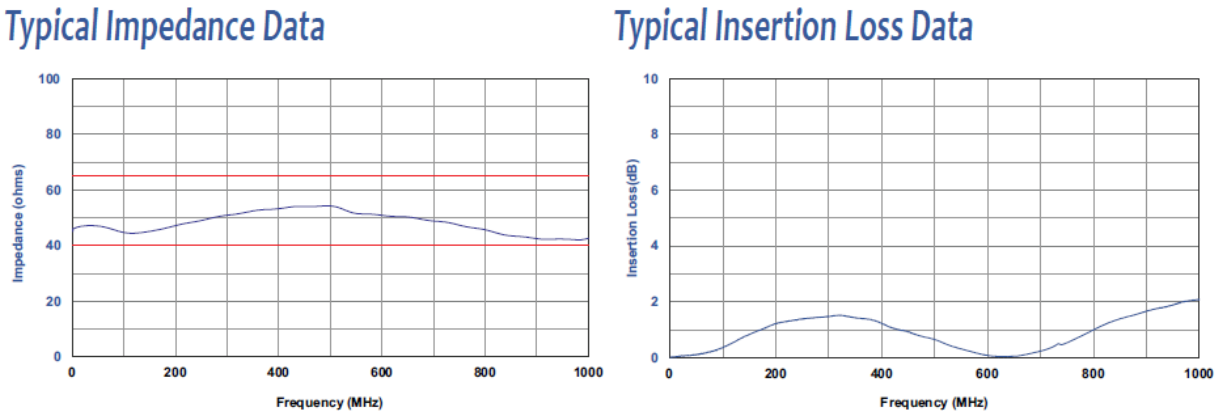

Figure 6: LIP-1000 Impedance (left) and Insertion Loss (right)

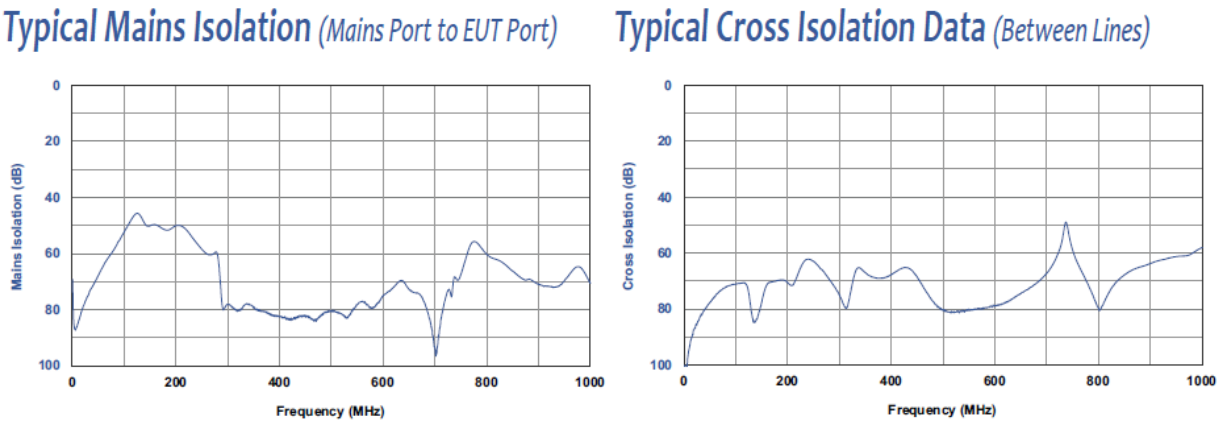

Figure 7: LIP-1000 Mains Isolation (left) and Cross Isolation (right)

4.3 Universal Power Adapter

The LIP-1000 features coaxial N-type connectors at the EUT port for optimal high-frequency performance. A **coaxial N-type to universal power receptacle adapter** is included, which accommodates almost any EUT plug without additional adapters.

5. Typical Connection Diagrams

TEMPEST LISNs can be configured for various power system types. The following diagrams show typical connections for different applications.

5.1 LIP-120 Connection Configurations

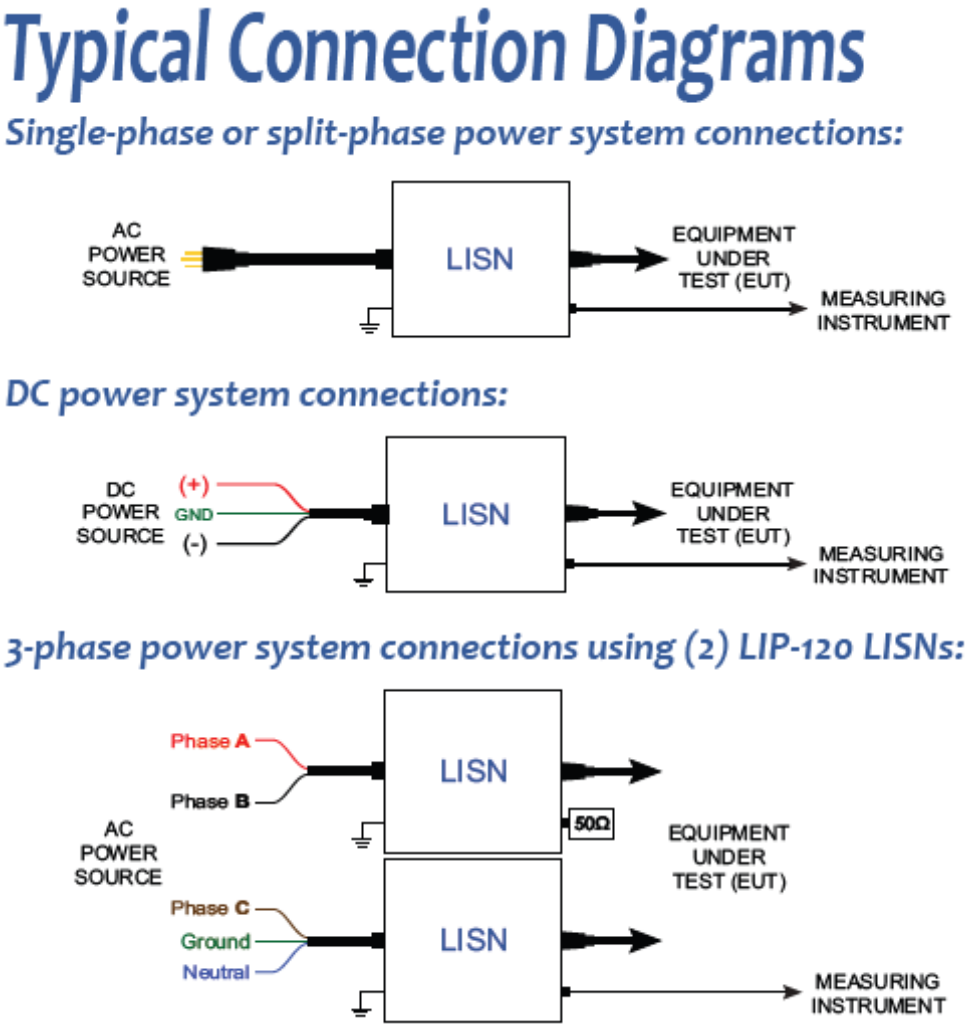

Figure 8: LIP-120 Connection Diagrams for Various Power Systems

Supported configurations include:

- **Single-phase AC:** Line and Neutral through single LISN
- **Split-phase AC:** Two hot legs through single LISN
- **DC Power:** Positive and negative through single LISN
- **Three-phase AC:** Requires two LIP-120 units for complete coverage

5.2 LIP-1000 Connection Configurations

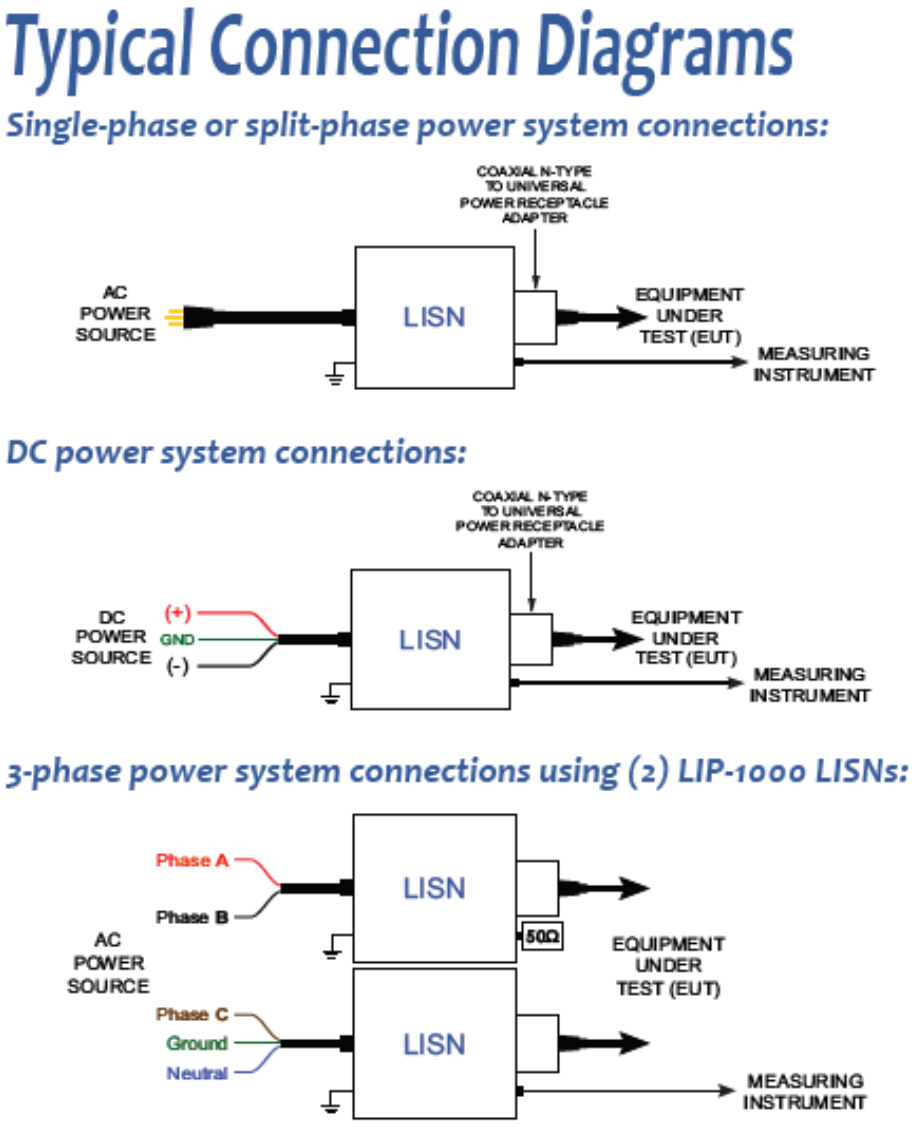

Figure 9: LIP-1000 Connection Diagrams with N-Type to Power Adapter

6. Industries and Real-World Applications

TEMPEST LISNs are essential in industries where information security through electromagnetic emanations control is critical.

6.1 Government and Defense

Use Case: Classified Computer Systems

Application: Testing workstations and servers that process classified information to ensure no data can be captured through power line emanations.
LISN Selection: LIP-120 + LIP-1000 combination for full 5 kHz to 1 GHz coverage
Test Criteria: Verify emanations are below TEMPEST zone limits, particularly during cryptographic operations and data processing.

Use Case: Military Communications Equipment

Application: Testing radios, encryption devices, and tactical communication systems for conducted emissions that could reveal operational information.
LISN Selection: LIP-1000 for RF equipment (1 MHz – 1 GHz coverage essential for modern digital comms)
Test Criteria: Monitor for modulated emanations correlated with transmitted data, keyboard activity, or display content.

6.2 Intelligence Agencies

Use Case: Secure Communications Facilities (SCIFs)

Application: Certification testing of equipment installed in Sensitive Compartmented Information Facilities to meet ICD 705 requirements.
LISN Selection: Both LIP-120 and LIP-1000 for comprehensive emanations assessment
Test Criteria: Full TEMPEST certification per NSTISSAM TEMPEST/1-92 or successor documents.

6.3 Automotive and Vehicle Security

Use Case: Government/Diplomatic Vehicles

Application: Armored or high-security vehicles designed for heads of state, diplomats, or intelligence agencies undergo TEMPEST testing to ensure secure communications cannot be compromised through power line or vehicle electrical system emanations.
LISN Selection: Both LIP-120 and LIP-1000 for comprehensive vehicle electrical system assessment
Test Criteria: Verify that onboard communications, encryption devices, and computing equipment do not leak sensitive information through the vehicle's power distribution system.

Use Case: Military Vehicle Development

Application: Tactical vehicles that handle classified data must meet TEMPEST standards in addition to standard military EMC requirements (MIL-STD-461). This includes command vehicles, mobile intelligence units, and communications platforms.
LISN Selection: LIP-1000 for high-frequency digital equipment; LIP-120 for power system analysis

Test Criteria: Dual compliance with MIL-STD-461 (general EMC) and TEMPEST (security emanations) requirements.

Use Case: Advanced Automotive R&D

Application: Some automotive manufacturers use TEMPEST LISNs in ultra-high-frequency research (up to 1 GHz) that exceeds the requirements of standard automotive EMC tests. This is particularly relevant for connected and autonomous vehicle development where data security is paramount.
LISN Selection: LIP-1000 for extended frequency coverage beyond standard automotive EMC testing
Test Criteria: Assess emanations from V2X communications, telematics, and autonomous driving systems across the full 1 GHz spectrum.

6.4 Financial Institutions

Use Case: High-Security Trading Systems

Application: Testing trading floor workstations and servers that handle market-sensitive information to prevent economic espionage through emanations capture.
LISN Selection: LIP-1000 for high-speed digital equipment testing
Test Criteria: Verify that keystroke, screen content, and network data cannot be reconstructed from power line emissions.

Use Case: ATM and Payment Processing

Application: Testing PIN entry devices and payment terminals for emanations that could reveal customer PINs or card data.
LISN Selection: LIP-120 for lower-frequency keypad emanations analysis
Test Criteria: Correlation analysis between PIN entry events and power line conducted emissions.

6.5 Healthcare (HIPAA Security)

Use Case: Medical Records Systems

Application: Testing electronic health record (EHR) systems in high-security medical facilities to protect patient data from emanations-based attacks.
LISN Selection: LIP-1000 for modern networked medical equipment
Test Criteria: Ensure PHI (Protected Health Information) cannot be intercepted through power line monitoring.

6.6 Critical Infrastructure

Use Case: Power Grid Control Systems

Application: Testing SCADA and control systems in electrical utilities to prevent reconnaissance through emanations analysis of grid operations.
LISN Selection: LIP-120 for industrial control equipment operating at power frequencies
Test Criteria: Verify that control signals and operational states cannot be determined from conducted emissions.

Use Case: Nuclear Facility Control Rooms

Application: NRC-regulated testing of digital I&C systems in nuclear facilities for emanations security.
LISN Selection: Both LIP-120 and LIP-1000 for full spectrum analysis
Test Criteria: Meet NRC Regulatory Guide 5.71 (cyber security) with emanations assessment component.

6.7 Diplomatic and Embassy Security

Use Case: Embassy Communications Equipment

Application: Testing all electronic equipment in diplomatic missions for emanations that could be captured by hostile intelligence services in nearby locations.
LISN Selection: Complete TEMPEST test setup with both LIP-120 and LIP-1000
Test Criteria: Full TEMPEST zone compliance per State Department requirements.

7. Product Selection Guide

Table 2: TEMPEST LISN Selection Matrix

Application	LIP-120	LIP-1000	Both
Full TEMPEST Certification			✓
Modern Digital Equipment (>1 MHz)		✓	
Industrial/Power Equipment (<1 MHz)	✓		
Computing Equipment		✓	Recommended
Communications/RF Equipment		✓	
Legacy/Analog Equipment	✓		
SCIF/Secure Facility Certification			✓
Government/Diplomatic Vehicles			✓
Military Vehicle Development		✓	Recommended
Advanced Automotive R&D (>30 MHz)		✓	

8. Calibration and Traceability

All Com-Power TEMPEST LISNs are individually calibrated in compliance with their relevant requirements. Each unit ships with:

- Impedance calibration data
- Insertion Loss measurements
- Mains-to-EUT port isolation data
- Line-to-line isolation data
- Certificate of calibration
- **ISO 17025 accredited calibration** available upon request

9. Ordering Information

Model	Description	Frequency Range
LIP-120	TEMPEST LISN, 50Ω/1.37mH, N-Type RF	5 kHz – 1 MHz
LIP-1000	TEMPEST LISN, 50Ω/23µH, BNC RF	1 MHz – 1 GHz

For complete TEMPEST testing capability from 5 kHz to 1 GHz, **both LIP-120 and LIP-1000 are recommended.**

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Three-Year Warranty on All Products

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