Test Review

Industrial-grade Rackmount Ethernet Switches

Proven Industrial Reliability for Mission-critical Communications

Professional Ethernet networks often deploy rackmount Ethernet switches in a variety of applications. However, a major issue we face is how to achieve high reliability and availability in mission-critical or environment-specific applications, such as intelligent transportation system (ITS) networks. When constructing a communication network, engineers are always seeking more stable network solutions with reasonable construction costs. In the past, solutions were limited to commercial rackmount Ethernet switches or expensive high-end substation-level network products. We are pleased to find a new industrial-grade rackmount Ethernet solution with long-term durability, high performance, and an optimal price ratio for a wide range of demanding industrial applications.

Industrial Ethernet switches must adhere to high standards when it comes to design and certification. All of Moxa's IKS series rackmount Ethernet switches are tested to ensure hardened reliability in addition to maintaining high quality control through the entire production process. Their testing process is described as follows.

Hardened Design Verification

ESD Test

The ESD test helps to ensure uninterrupted operations in case of electrical static discharges. Even under +/- 8KV enclosure port contact or +/- 15KV enclosure port air, the switch is able to maintain normal communication without any packet loss.

• *Test Environment*

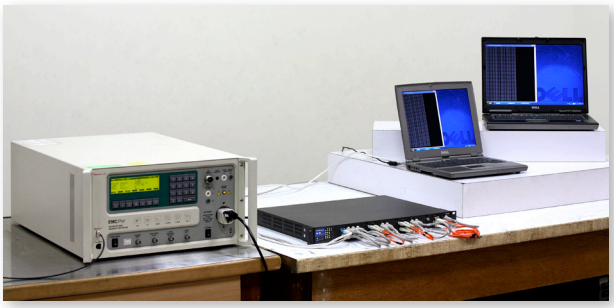
Temperature:	24°C (25+/-10°C)
Humidity:	55%RH (30-60%RH)
Barometric pressure:	950-1000 mbar (860-1060mbar)

• *Test Conditions*

Criteria:	±15 kV Air Discharge ±8 kV Contact Discharge

Surge/EFT Test

Surge and EFT immunity tests are used to certify the Ethernet switches' continuous operation when subjected to power surges. Testing is done under 4KV CM/2KV DM with terms for signal ports, DC power, and AC power. The IKS series performed without interruption under the test.



• *Surge Test Environment*

Temperature:	24°C (25+/-10°C)
Humidity:	54%RH (25-75%RH)
Barometric pressure:	950-1000 mbar (860-1060 mbar)

• *Surge Test Conditions*

Signal Ports and Telecommunication Ports

Surges:	1.2/50 Tr/Th ns (8/20)
Line to Ground:	+/-1 kV

AC and DC Input Power Ports

Surges:	1.2/50 Tr/Th ns (8/20)
Line to Line:	+/-1 kV
Line to Ground:	+/-2 kV

• *EFT Test Environment*

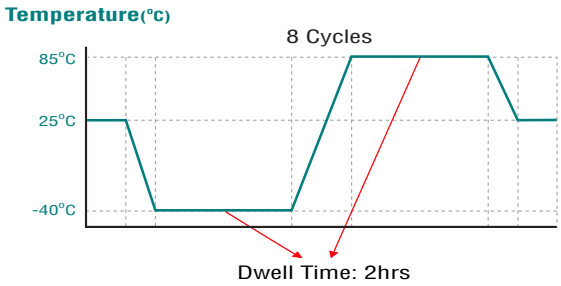
Temperature:	18°C (25+/-10°C)
Humidity:	48%RH (15-75%RH)
Barometric pressure:	950-1000 mbar (860-1060 mbar)

• *EFT Test Conditions*

I/O and communication ports:	+/-1 kV 5/50 Tr/Th ns 5 Rep. Frequency kHz
Input AC/DC Power Ports:	+/-2 kV 5/50 Tr/Th ns 5 Rep. Frequency kHz

Extended Operating Temperature

Extended operating temperature tests were conducted to verify the IKS series' ability to survive extreme temperature conditions. The product specifications shown that IKS series is capable of operating under temperature range of -40 to 75°C. According to the datasheet, we tested the products at high temperature of 80°C and low temperature of 40°C with 24 hours test and 48 hours cycling test. Conclusion showed IKS running non-stop throughout the test.



• *Test Conditions*

High Temperature:	80°C
High Humidity:	0% RH
Low Temperature:	-40°C
Low Humidity:	0% RH
Room Temperature:	25 +/-5°C
Room Humidity:	60+/-20% RH
Retention period:	2 hrs
Test cycle:	8 cycles

Vibration/Shock Test

Vibration and shock tests were conducted to verify the IKS series' ability to survive its intended environment. Testing criteria included 5~150Hz Random Vibration. The half-sine duration was 30 ms and peak acceleration was X Axis - 50 m/s^2 , Y/Z Axis - 30 m/s^2 for shock test.

• *Test Environment*

Temperature:	26.4°C (25+/-10°C)
Relative Humidity:	67%RH (60+/-20% RH)

• *Random Vibration Test Conditions (Operation)*

Frequency:	5 to 150 Hz
Acceleration:	0.70 m/s^2 rms (Longitudinal) 0.45 m/s^2 rms (Transverse) 1.0 m/s^2 rms (Vertical) 0.0144 m/s^2/Hz (5 to 20Hz) (Longitudinal) 0.006 m/s^2/Hz (5 to 20Hz) (Transverse) 0.298 m/s^2/Hz (5 to 20Hz) (Vertical) -6dB/oct (20Hz to 150Hz)
Test Time:	10 mins (each Axis)
Total Test Time:	30 mins

• *Random Vibration Test Conditions (Non-operation)*

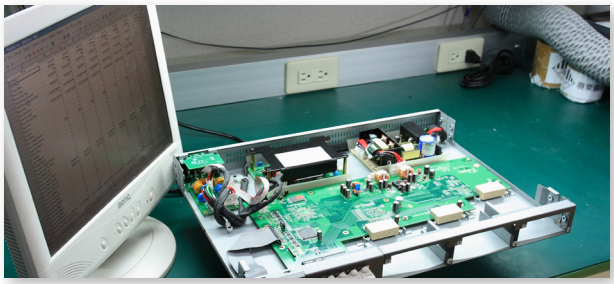
Frequency:	5 to 150 Hz
Acceleration:	5.5 m/s^2 rms (Longitudinal) 3.5 m/s^2 rms (Transverse) 7.9 m/s^2 rms (Vertical)
	0.901 m/s^2/Hz (5 to 20Hz) (Longitudinal) 0.366 m/s^2/Hz (5 to 20Hz) (Transverse) 1.857 m/s^2/Hz (5 to 20Hz) (Vertical) -6dB/oct (20Hz to 150Hz)
Test Time:	5 hrs (each Axis)
Total Test Time:	15 hrs

Strict Manufacturing Verification

The IKS rackmount Ethernet switches are subject to quality control testing during the manufacturing verification process. The following describes the tests used during this stage of production.

Board-level Test

The board-level test is conducted after the board is completely assembled. This is a functionality test for every single PCB board to ensure they work well. Test programs and tools are applied to simulate real operation conditions with normal packet communications. Only boards that pass the test can go on to the next assembly stage. Any board that fails to pass the test must be re-worked.

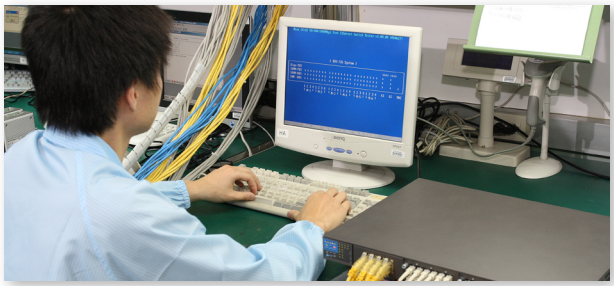


Burn-in Test

In this test phase, IKS rackmount Ethernet switches were turned on with normal operation conditions, and placed in sealed 75°C chamber. All IKS Ethernet switches are required to pass a 40-hour burn-in test in this phase.

System-level Test

The system test is another verification process to test the complete functionality of the Ethernet switches after the entire assembly process is completed. This test double checks product quality before they go to market.



Hipot Test

The hipot test checks the product's insulation for any defects that may cause the insulation break down and leak current flow. High voltage was applied to the IKS switch's conductors and metallic chassis. The value of electrical resistance and leakage current must be below a preset limit or the product fails the test.

- *Test Conditions and limits*

Electric Current:	30 A for 3 seconds with limit of max. 100 mini-ohms grounding resistance
High Voltage:	2.12 KV for 1 second with limit of max. 6 mA leakage current

Drop Test

For the drop test, the IKS switch packaged in a cardboard box and dropped from a given height to examine how well the product fares when it is dropped from different angles.

- *Test Conditions*

Test Phase:	One corner, three edges, and six faces
Test Height:	90 cm
Package weight:	15.5 Kg
Package Dimensions:	518x418x405 (mm)

Summary

Through strict testing, manufacturing verifications, and high-level certifications, we were able to conclude that the IKS series performs well under harsh environmental conditions and noises. In summary, the IKS series rackmount switches meet the following criteria for industrial-grade reliability:

Hardened Hardware Design

IKS industrial rackmount Ethernet switches are designed with redundant power inputs and completely fan-less ventilation. Quality industrial components also help increase the MTBF. The IKS even features modular flexibility for future expansions and upgrades.

Reliable Software Design

Ring topologies and RSTP/STP are oftentimes applied to enhance network availability. The recovery time for industrial-grade ring redundancy must be faster than commodity Ethernet switches. The IKS series is equipped with a fast fault recovery ring capability with network recovery time of less than 20 ms and a 250-Ethernet switch load. Commodity Ethernet switches often require several seconds to recover.

Industrial-grade Certifications

In order to operate reliably under harsh environmental conditions, IKS industrial rackmount Ethernet switches are required to pass high-level regulatory approvals. Certifications are also obtained for specific environmental parameters, such as NEMA TS2 for road traffic control, EN50121-4, EN50155 for railway traffic, DNV/GL for maritime and offshore use, and EN60950-1 for safety.

Strict Manufacturing Verification

Each IKS industrial rackmount Ethernet switch is subjected to strict manufacturing verification to examine its reliability. Complete test cycles from board-level to system-level and wide temperature screenings are strong indicators of industrial-grade reliability.

Industrial vs. Commercial Rackmount Ethernet Switches

Evaluation Factors		Moxa industrial rackmount Ethernet Switch	Commercial rackmount Ethernet Switch
A. Electrical - Surge Levels & EMI/RFI			
ESD	Enclosure port	+/- 8 KV	+/- 4 KV
	Contact		
	Enclosure port air	+/- 15 KV	+/- 8 KV
Radiated RFI Standard(RS)	Signal ports	10 V/m @ 80~1 GHz	3 V/m @ 80~1 GHz
Surge	Signal ports	+/- 1 KV CM	n/a
	D.C power	+/- 2 KV CM / +/- 1 KV DM	0.5 KV
	A.C power	+/- 2 KV CM / +/- 1 KV DM	2 KV
EFT	Signal ports	+/- 1 KV	+/- 0.5 KV
	D.C power	+/- 2 KV	+/- 0.5 KV
	A.C power	+/- 2 KV	+/- 1 KV
PF Magnetic Field	Enclosure Ports	100 A/m continuous 1000 A/m 1 s to 3s	1 A/m
B. Physical Environment			
Low air temperature operation		-40°C, 24 hours test & 48 hours cycling test	0°C from datasheet
High air temperature operation		+85°C, 24 hours, 95% humidity test & 48 hours cycling test	40°C from datasheet
Low air temperature for storage and transportation		-40°C, 16 hours test	-40°C from datasheet
High air temperature for storage and transportation		+85°C, 20 hours test	70°C from datasheet
Stationary vibration		5~150Hz Random Vibration	n/a
Shock		half-sine duration: 30ms peak acceleration: X Axis - 50 m/s^2 , Y/Z Axis - 30 m/s^2	n/a
Free fall		mass less than 20Kg: 0.9m	n/a
C. Longevity			
Design life		20-25 years	5-7 years in IT application
Warranty		5 years	1-2 years
D. Performance Testing			
100% Burn-in		All models undergo a 100% burn-in test	Not usually required
Certification		Certified test data per EN60950-1, NEMA TS2, DNV/GL, FCC Part15, CISPR(EN55022) class A	Type test data submission accepted

IKS Series Specifications

Items	IKS-6726 24+2G-port Industrial Rackmount Managed Ethernet Switch	IKS-6324 22+2G-port Industrial Rackmount Unmanaged Ethernet Switch
Product Picture		
Standards	IEEE 802.3, IEEE 802.3u, IEEE 802.3ab, IEEE 802.3z, IEEE 802.3x, IEEE 802.1D, IEEE 802.1w, IEEE 802.1Q, IEEE 802.1p, IEEE 802.1X, and IEEE 802.3ad	IEEE 802.3, IEEE 802.3u, IEEE 802.3ab, IEEE 802.3z, and IEEE 802.3x
Interface	Fast Ethernet: Slot 1 and 2 for any combination of 8-, 7-, or 6-port fast Ethernet modules with 10/100BaseT(X) or 100BaseFX (SC/ST connector) Gigabit Ethernet: Slot 3 for 2-port Gigabit Ethernet combo module with 10/100/1000BaseT(X) or 1000BaseSFP slots Console: RS-232 (RJ45)	RJ45 Ports: 10/100BaseT(X) or 10/100/1000BaseT(X) auto negotiation speed, F/H duplex mode and auto MDI/MDI-X connection Fiber Ports: 100BaseFX (SC/ST connector) or 1000BaseSFP slots
Power	24 VDC (18 to 36 V), or 48 VDC (36 to 72 V), or 110/220 VDC/VAC (88 to 300 VDC and 85 to 264 VAC)	24/48 VDC (9 to 60 V), or 110/220 VDC/VAC (88 to 300 VDC and 85 to 264 VAC)
Casing	IP30 protection	IP30 protection
Installation	19'' rack mounting	19'' rack mounting
Operating Temperature	-40 to 75°C (-40 to 167°F)	-40 to 75°C (-40 to 167°F)
Dimensions	440 x 44 x 325 mm (17.32 x 1.73 x 12.80 in.)	440 x 44 x 254 mm (17.32 x 1.73 x 10.00 in.)
Weight	5700 g	4300 g
Certifications	FCC Part 15, CISPR (EN55022) class A, EN60950-1, DNV (Pending), GL (Pending), NEMA TS2	FCC Part 15, CISPR (EN55022) class A, EN60950-1, DNV (Pending), GL (Pending), NEMA TS2
Manufacturer	Moxa	Moxa