Structured Cabling System
Product & Installation Specifications
For
LS Category 6 Solution

LSGS-10-LN0009-08

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INTRODUCTION

1.1 Scope

This documentation is the specification for the LS serviced structured cabling system for category 6 (up to 250MHz) range from each product to total system. This solution is suitable for the provision of high speed Ethernet communications for individual buildings and basically for the construction of new building, major renovations and so on.

The structured cabling system by LS aims to supply with flexible and predictable infrastructure with more convenient maintenance functions.

This basically follows the relevant EIA, TIA and IEC standards and architectures for commercial buildings. The construction & electric work details not indicated in this specification shall follow related standards specification.

Though all details in a bid are not described in this specification, it shall be reflected in real system configuration. A builder shall work with all materials indicated in a drawing as well as this specification and submit all documents required in a drawing. This includes all communication outlets, terminating hardware and selected connectivity devices as outlined in this specification.

The cabling contractor shall supply and install a complete telecommunications cabling system based on a physical star wiring topology that is designed in accordance with practices recommended by the Building Industry Consulting Services International (BiCSi) organization.

All products that are consisted in channel should be provided from same company to keep impedance matching.

All products should be verified with technical qualifications of Structured Cabling Systems 'RCDD' (Registered Communications Distribution Designer) from BICSI (Building Consulting Service International) for facilitate technical supports and optimal design of systems.

STANDARDS

2.1 General

The equipment, material and installation shall confirm to the latest version of the applicable codes, standards and regulations of authorities having jurisdiction.

All components supplied and installed will support current applications and future application introduced by recognized standards or user forums that use EIA/TIA 568 component and link/channel specifications for cabling.

The specifications detailed in this document are accompanied by EIA/TIA and IEC requirements for both product and installation practices. The following are communications standards documents that must be adhere to:

ISO/IEC 11801	Information technology – Generic cabling for customer premises
ANSI/EIA/TIA-568-B.1	Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
ANSI/TIA-568-C.2	Commercial Building Telecommunications Cabling Standard
IEC 61156-5	Multicore and symmetrical pair/quad cables for digital communications Part 5: Symmetrical pair/quad cables with transmission characteristics up to 1000MHz – Horizontal floor wiring – Sectional specification
ANSI/EIA-310-D	Standard for cabinets, racks, panels and associated equipment
ANSI/EIA/TIA-569-A	Commercial Building Standard for Telecommunications Pathway and spaces
ANSI/EIA/TIA-606(A)	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
ANSI/EIA/TIA-607(A)	Commercial Building Grounding and Bonding Requirements for Telecommunications
ANSI/NECA/BICSI-568	Standard For Installing Commercial Building Telecommunications Cabling
UL 969	Marking and Labeling systems
TIA/EIA TSB-67	Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
UL 1863	Communications circuit accessories
UL 94	Test for flammability of plastic materials for parts in devices an appliances

47 CFR 68	Connection of terminal equipment to the telephone network
IEC 60068-2-6	Environmental Testing - Part 2: Test Fc: Vibration (sinusoidal)
IEC 60068-2-14	Environmental Testing - Part 2: Test N: Change of temperature
IEC 60068-2-38	Environmental Testing - Part 2: Test Z/AD: Composite temperature / humidity cyclic test
IEC 60603-7	Detail specification for connectors, 8-way, including fixed and free connectors with common mating features, with assessed quality
IEC 60603-7-1	Detail specification for 8-way, shielded free and fixed connectors with common mating features, with assessed quality
IEC 60512-2-1	Electrical continuity and contact resistance tests - Test 2a: Contact resistance – minim-volt level method
IEC 60512-3-1	Insulation tests - Test 3a: Insulation resistance
IEC 60512-4-1	Voltage stress tests - Test 4a: Voltage proof
IEC 60512-6-3	Dynamic stress tests - Test 6c: Shock
IEC 60512-9-1	Endurance tests - Mechanical operation
IEC 60512-9-3	Endurance tests - Mechanical operation (engaging/separating) with electrical load
IEC 60512-9-4	Durability of contact retention system and seals
IEC 60512-11-1	Climatic tests - Section 1: Tests 11a - Climatic sequence
IEC 60512-11-3	Climatic tests - Test 11c: Damp heat, steady state
IEC 60512-11-4	Climatic tests - Test 11d: Rapid change of temperature
IEC 60512-13-2	Mechanical operation tests - Test 13b: Insertion and withdrawal forces

PRODUCT SPECIFICATIONS

3.1 General

Acceptable products throughout this document are LS Category 6 solution.
See the appendices for product list and part Number.

The LS Category 6 Solution shall meet or exceed up to 250MHz in the channel.
Third party test results shall be required, such as ETL test results.

Products installed must meet or exceed all local, provincial and federal building, fire, health, safety and electrical codes.

The cabling contractor is responsible for complete storage, handling, delivery, and installation of all materials used in the performance of the work.

The cabling contractor is responsible for keeping the workplace clean, safe and free from debris at all times.

3.2 Communications Cabling

Data & Voice Cable

The approved data cabling shall be solid copper, unshielded(foiled) twisted pair, 4-pair, 23~24AWG, CMX rated**(or CM, CMR, CMP), PVC or LSZH jacket, Category 6 cable** as applicable.

The applicable cable shall be as follows,

- UTP-G-C6G-E1VN-X(M)(R) 0.5X004P/xx: LS U/UTP Category 6 PVC CMX/CM/CMR rated cable
- UTP-G-C6G-F1VN-P 0.5X004P/xx: LS U/UTP Category 6 PVC CMP rated cable
- UTP-G-C6G-E1ZN-X 0.5X004P/xx: LS U/UTP Category 6 LSZH CMX rated cable
- FTP-G-C6G-E1VN-X(M)(R) 0.5X004P/xx: LS F/UTP Category 6 PVC CMX/CM/CMR rated cable
- FTP-G-C6G-E1ZN-X 0.5X004P/xx: LS F/UTP Category 6 LSZH CMX rated cable
- SFP-G-C6G-E1VN-X(M)(R) 0.5X004P/xx: LS SF/UTP Category 6 PVC CMX/CM/CMR rated cable
- SFP-G-C6G-E1ZN-X 0.5X004P/xx: LS SF/UTP Category 6 LSZH CMX rated cable
- UTP-E-C6G-E1VN-X(M)(R) 0.5X004P/xx: LS U/UTP Category 6+ PVC CMX/CM/CMR rated cable
- UTP-E-C6G-E1ZN-X 0.5X004P/xx: LS U/UTP Category 6+ LSZH CMX rated cable

Requirements of cable are as below,

A. **The cable shall be tested and characterized up to 250MHz. It should also be UL Listed**.
B. All cables shall be certified with CM/CMR/CMP as high flame retardant grade.
C. All cables should be provided with diverse colors by customer requests.
D. Cross-filler & Non-filler type cables should be provided with customer requests in case of Cat.6 4pair cable.
E. Performance of all cables should be proved with UL or ETL certification.
F. RIB (Reel-in-a box) type packing should be supported for stable installation and best performance.
G. All cables shall meet RoHS regulations.

The jacket shall be printed with cable length by feet or meter unit.
Jacket color shall be separated according the purpose. (Data & Voice)

3.3 Work Area Outlet

Category 6 Modular Jacks

The approved Category 6 data & voice cabling to be terminated at the workstation shall be terminated with modular 8 positions, 8 wires RJ45 connector. Modules are to be wired as per T568A or T568B.

Requirements of modular jack are as below.

A. Modular Jacks must meet 47 CFR part 68 Subpart F:
Contacts of RJ45 8Pin are to be plated with 50 micro inches of gold.
B. Performance of Modular Jacks shall be proved with KC Certification
C. Modular Jack shall be proved UL Listed certification in order to maintain stable reliability of mechanical performance continually.
D. Modular Jacks shall be supported with diverse colors, types.
E. Modular Jacks shall be supported to prevent dust with IDC cover and
IDC cover could be replaced freely in terminated status.
F. Excess wires(4pair) of IDC connection shall be cut at the same time with squeezed by special tool.
G. Jack's lock should be available in snap-in type.
H. Modular Jacks should meet UL V2 grade over of flame retardant.
I. Modular Jacks shall meet RoHS regulations.
J. Diverse type of faceplates for modular jacks should be provided as reclaiming or exposure installation.
K. Modular Jacks shall be supported with both unshielded and shielded solution.

L. Modular jacks shall be supported by dedicated exclusive tool (Easy Termination Tool).

M. Pre-termination modular jack in factory should be provided for fast installation and reliability of performance.

N. Depending on installation condition, RJ45, 180degree or diagonal type or bezel type of modular jack should be provided. Also unshielded door type modular jack should be provided

O. Modular Jack contacts shall have a minimum of 750 plug insertions without degradation of electrical or mechanical performance as per the IEC60603-7 specification.

P. Shield Jack shall be covered by die-casting material fully or Steel material

The modular Jack shall be as follows,

- LS-MJ-UC6-xx-ERI: LS slim-body Category 6 Modular Jack 180degree IDC (Enhanced Performance)
- LS-MJ-UC6-xx-SB: LS slim-body Category 6 Modular Jack 90degree IDC
- LS-MJ-SC6- RIDC: LS Category 6 Shielded Modular Jack 180degree IDC

The dedicated tool for Modular jack's IDC termination shall be as follows,

- LS-EZT-TOOL-SB: LS Easy Termination Tool for LS-MJ-UC6-xx-SB
-LS-EZT-TOOL-FR: LS Easy Termination Tool for LS-MJ-SC6- RIDC
-LS-EZT-TOOL-ER: LS Easy Termination Tool for LS-MJ-UC6A-xx-ERI

Jack termination shall utilize a paired termination sequence.
It shall be untwisted to a maximum of 13mm(1/2 inch) during termination.

Work Area Patch Cords

Requirements of Patch Cord are as below,

A. Patch Cords shall be stranded or solid Category 6 and meet or exceed CFR 47 part 68 and IEC 60603-7 specifications.

B. The plug shall have contacts plated with 50 micro inches of gold for improved durability and have a minimum of 750 plug insertions without degradation of electrical or mechanical performance.

C. Patch Cords shall be verified with ETL channel or EC and listed with UL
for stable performance in channel and stable mechanical performance continually.

D. The security function should be supplied according to customer requirement.

E. Boot cover to protect hinge on modular plug shall be consisted of.

F. The Plug should be fully covered by Boot, and It should be manufactured by over-molding

mechanism to continue long term reliability

G. Patch Cords shall meet UL V2 grade over of flame retardant.
H. Patch Cords shall meet RoHS regulation.
I. Patch Cords shall be supported with both unshielded and shielded solution.
J. Pre-termination Patch Cords in factory (equipment cord) should be provided for fast installation and reliability of performance.
K. Patch Cords shall be supported with diverse colors and lengths.
L. Patch cord shall be marked with cable length on cable sheath and packing.

The patch cord shall be as follows,
- LS-PC-UC6-xx-yyy (Category 6 Unshielded Patch Cord with T568B or T568A wiring)
- LS-PC-SC6-xx-yyy (Category 6 Shielded Patch Cord with T568B or T568A wiring)
- LS-SPC-UC6-xx-yyy (Category 6 Unshielded Security Patch cord with T568B wiring)
- LS-SPC-SC6-xx-yyy (Category 6 Shielded Security Patch cord with T568B wiring)
- LS-TOOL-SPC (Security Key of Patch cord)
- LS-PC6-UC6-www-JPxx-yyy (Fast-Net™ 6 Equipment Cord, Jack to Modular Plug)
- LS-PC6-UC6-www-JJxx-yyy(Fast-Net™ 6 Equipment Cord, Jack to Jack)

Faceplates

The horizontal cabling shall be terminated at the workstation on a mounted wall plate. Each faceplate should be 1, 2, 3, 4 or 6 ports on a single gang to allow for future growth. All unused ports will have blank modules installed.

Requirements of faceplates are as below,

A. Faceplates shall meet UL V2 grade over of flame retardant.
B. Faceplates shall meet RoHS regulations.
C. Depending on installation condition, faceplates should be supported with diverse depth of back box.

The faceplates shall be LS-FP-US-1PORT(or 2,4,6PORT), LS-FP-SA-1(2), LS-FP-SF-1(2)(4), LS-BB-8686-27(37), LS-BB-11572-38, LS-SMB-1PORT(2,4,6 PORT).

3.4 Telecommunications Room Termination

All data & voice Category 6 horizontal cabling shall be terminated on 110 Block or RJ45 modular jacks connected to modular rack mount empty patch panels, or on general IDC patch panels that should be mounted in a standard 19" rack.

All data Category 6 patch panel should be terminated with general cord or special cords with additional security functionality.

Requirements of general Patch Panel are as below,

A. Patch Panels must meet 47 CFR part 68 Subpart F:
   Contacts are to be plated with 50 micro inches of gold.
B. Patch Panels shall be certified with KC.
C. Patch Panels shall be verified with ETL channel or EC and listed with UL certification
   for stable performance in channel and stable mechanical performance continually.
D. Patch Panels shall meet UL V2 grade over of flame retardant.
E. Pre-termination module with panel in factory should be provided for fast installation and reliability of performance. (6port in a module)
F. Patch Panels(six in one module) should be attached and detached on the panel(Pre-terminated)
G. Each Modular Jack's ports should be separated on the panel
H. Modula Jack should be joined by snap-in type
I. Wire Management should be detachable for easy installation.
J. Wire Management should have the double hooks on the left and right position to hang the WM on the panel
K. Patch Panel(Six in one module type) should be mixed with fiber solution(LC, SC, FC and MPO solution)
L. Depending on the circumstances, the patch panel shall be supported with blank bezel to improve security function

Requirements of intelligent patch panel are as below,

A. Intelligent Patch Panels shall be supported with flat or angled 24Ports.
B. Intelligent Patch Panel shall be supported with dedicated software & hardware.
C. The modular jack of each port in Intelligent Patch Panel shall be separated individually to facilitate maintenance.
D. All Intelligent Patch Panel & Controller shall be certified with KC to protect peripheral equipment from EMI/EMC.
E. Intelligent Patch Panels shall be verified with ETL channel or EC.
   for stable performance in channel and stable mechanical performance continually.
F. Intelligent Patch Panels shall meet UL V2 grade over of flame retardant.
G. Intelligent Patch Panels shall meet RoHS regulations.
H. Intelligent Patch Panels shall be supported with both unshielded and shielded solution.
I. Wire Management should be detachable for easy installation.

The patch panel shall be as follows,

- LS-PP-UC6-24P-WM : 24-Port Category 6 Unshielded Patch Panel with wire management
- LS-PP-SC6-24P : 24-Port Category 6 Shielded Patch Panel with wire management

The empty patch panel shall be as follows,

- LS-PP-24P-E-LWM : 24-Port 1U Empty Panel with hinged management
- LS-PP-24P-E-WM : LS 24-Port 1U Empty Panel with wire management
- LS-PP-48P-E-WM : LS 48-Port 2U Empty Panel with wire management
- LS-PP-MD-12P-E : LS 12-Port Mini Empty Panel
- LS-PP-MD-24P-E : LS 24-Port Empty Panel (6 insert in 1 module)
- LS-PP-MD-24P-E-WM : LS 24-Port Empty Panel with wire management (6 insert in 1 module)
- LS-PP-MD-WM-EX : LS 24-Port Empty Panel's Management
- LS-APP-24P-E-WM : LS 24-Port Angled Patch Panel with wire management
- LS-APP-48P-E-WM : LS 48-Port Angled Patch Panel with wire management
- LS-PPP-UC-24P-E4-WM-C : Unshielded 4 Module, 6 in 1, empty panel
- LS-APP-UC-24P-E4-WM-C : Unshielded Angled 4 Module, 6 in 1, empty panel
- LS-PPP-SC-24P-E4-WM-C : Shielded 4 Module, 6 in 1, empty panel
- LS-APP-SC-24P-E4-WM-C : Shielded Angled 4 Module, 6 in 1, empty panel

The intelligent patch panel & controller shall be as follows,

- LS-IPPC-UC-24P: 24-Port intelligent unshielded patch panel cross-connection, 1U, Modular Jack separately
- LS-IPPI-UC-24P: 24-Port intelligent unshielded patch panel inter-connection, 1U, Modular Jack separately
- LS-IAPC-UC-24P: 24-Port intelligent angled unshielded patch panel cross-connection, 1U, Modular Jack separately
- LS-IAPI-UC-24P: 24-Port intelligent angled unshielded patch panel inter-connection, 1U, Modular Jack separately

-LS-IPPC-SC-24P: 24-Port intelligent shielded patch panel cross-connection, 1U, Modular Jack separately

-LS-IAPC-SC-24P: 24-Port intelligent angled shielded patch panel cross-connection, 1U, Modular Jack separately

- LS-IC960-PS1(2)A: intelligent controller 960ports, a power supply
- LS-ICPC960-xxx-A: RS-485 cable for connecting the panels to controller

110 Block patching on Telecommunication Room

In case of using 110 Block patching, all 110 Patch Blocks should be available 20, 40 and 80-pair per one base block's body to mount on the standard rack brackets variously and should be worked by Category 5e 110 5pair tool in order to work easily by installer on field.

Requirements of 110 Block are as below,

A. 110 Blocks shall be verified with ETL channel or EC and listed with UL for stable performance in channel link and stable mechanical performance continually.
B. 110 Blocks shall meet UL V2 grade over of flame retardant.
C. 110 Blocks shall meet RoHS regulations.

The 110 Block shall be LS-110WB-UC6-20P(40P)(80P)-W/O (Without leg) or LS-110WB-UC6-40P(80P)-W (With leg). These 110 Blocks shall be patched by using LS-110PCC-UC6-4-xx-yyy (LS GXC™ Cat.6 110 4pair Patch Cord).

Category 6 Backbone Riser Cable

Between each telecommunications room and the BEF(Building Entrance Facility), 4, 12, 24 of Category 6 cables are to be installed and terminated on a modular rack depending on site environment..

Telecommunication Room Patch Cords

Patch cords shall be stranded Category 6 and meet and exceed CFR 47 Part 68 and IEC 60603-7 specifications. The plug shall have contacts plated with 50 micro inches of gold for improved durability and have a minimum of 750 plug insertions without degradation of electrical and mechanical performance.
The patch cord of telecommunication room shall be same as Work Area Patch cord's performance.
The patch cord shall be marked with cable length.

Requirements of Intelligent Patch Cord are as below,

A. Intelligent Patch Cords shall be verified with ETL channel or EC and listed with UL certification for stable performance in channel and stable mechanical performance continually.
B. The security function of inter-connection system should be supplied according to customer requirement.
C. Intelligent Patch Cords shall meet UL V2 grade over of flame retardant.
D. Intelligent Patch Cords shall meet RoHS regulation.
E. Intelligent Patch Cords shall be supported with both unshielded and shielded solution.
F. Intelligent Patch Cords shall be supported with diverse colors and lengths.
G. Intelligent patch Cords shall have separated mark on packing.

The Intelligent Patch cord shall be as follows,
- LS-IPCC-UC6(L)-xx-yyy: Category 6 unshielded patch cord with T568B for cross-connection panel-panel patching
- LS-IPCC-SC6(L)-xx-yyy: Category 6 shielded patch cord with T568B for cross-connection

panel-panel patching

- LS-IPCI-UC6(L)-xx-yyy: Category 6 unshielded patch cord with T568B for inter-connection panel-switch patching
- LS-IPCS-UC6(L)-xx-yyy: Category 6 unshielded security patch cord with T568B for inter-connection panel-switch patching

3.5 Racks and Cable Management System

Telecommunication Racks

Telecommunication racks should be 19", accommodate a max. of 45 rack unit space and shall be floor mounted and have anchor holes in the base. Also each rack shall be equipped with isolated ground circuit.
All telecommunications racks are to be fitted with outlet horizontal, rack mount, power strip.

The Rack shall be as follows,

Cabinet Rack
-LS-CR-24(28)(32)(36)(40)-2430-EX: Cabinet Rack 24U, 28U, 32U, 36U, (40)

Open Rack
-LS-OR-PAT36A-EX: Open Rack 36U
-LS-OR-PAT40A-EX: Open Rack 40U
-LS-OR-PAT44A-EX: Open Rack 44U

Vertical Cable Management

The vertical cable manager is to be provided on each side of the rack, except where racks are ganged together.
The vertical cable manager shall have bend radius control built into the manager so as patch cables transition into the manager they are not resting on a sharp edge.

Horizontal Cable Management

One horizontal cable manager per copper patch panel is to be provided. Managers are to be 1U for 24 port patch panel or 2U for 48 port patch panel.

3.6 Raceway

All raceway shall be installed to the recommended practices of the manufacturer and all-applicable electrical codes. All accessories shall have bend radius control built in for communications cabling as per the ANSI/EIA/TIA 569-A standard.

3.7 Grounding and Bonding

The grounding and bonding of the telecommunications system shall meet all local, provincial and national codes and bylaws.

All grounding and bonding shall be installed as per ANSI/EIA/TIA 607(A).

A separate ground should be established for the telecommunications system. Where this is not possible the telecommunications system ground shall be tied into the building/electrical ground.
A communications ground that is continuous and permanent through all telecommunication rooms must be established.

3.8 Test Equipment

The cabling contractor is to use the Level III tester or equivalent with the latest version of firmware to test the cabling system.

3.9 Fire stopping

The cabling contractor must supply and install all required fire stopping materials to reestablish the integrity of any and all fire-rated architectural structures and assemblies they have worked on mechanical systems consisting of standard conduit, sleeves, cored holes and all horizontal and backbone pathways that penetrate fire-rated barriers shall be fire stopped. The cabling contractor must install an approved fire-stop material recommended by UL in accordance with all applicable codes.

INSTALLATION

4.1 General

The installer shall have a minimum of five years related experience and have been trained in the proper installation practices as per ANSI/EIA/TIA-568-B.

The approved cables and components must be installed and terminated in accordance with the ANSI/EIA/TIA-568-B standard. Particular attention must be given to maintaining the integrity of the pair twists, bend radius and ensuring proper distance is kept from electrical cables or any other source of EMI. The pair untwists shall not exceed 13mm(1/2inch) and the maximum bend radius for 4-pair cable shall exceed four times the outside diameter of the cable. The requirements for minimum separation distance from EMI source are as follow table.

Condition	Minimum separation distance from possible sources of EMI exceeding 5.0kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.	610mm (24in)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway.	300mm (12in)
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway.	150mm (6in)
Electrical Motors and transformers.	1,194mm (47in)

The slack of 3m shall be required in the telecommunications room to allow for future rack relocation if required. The slack shall be stored in an extended loop or figure eight not bundled loop.
The slack of 0.3m shall be required in the ceiling above each work area outlet location.

The maximum horizontal cable length is not to exceed 90m. The maximum sum of the patch cord length is not to exceed 10m.

All plywood backboards are to be supplied and installed by the contractor unless otherwise noted.
All plywood backboards shall be fire retardant.

All cables and pathways such as conduits, cable tray or other system used for communication cable distribution shall be run parallel or perpendicular to building lines.

Any deviation from the cable routing, outlet and equipment locations shown on drawing must be approved by the consultant and documented on as-built drawings.

Any sharp projections on all conduits prior to installation of communications cables shall be bushed, reamed and removed.

4.2 Horizontal Cable Distribution

All cables pulling shall be in a continuous run. No cable splices will be permitted.

The cable slack of 0.3m shall be required in the ceiling above each work area outlet location.
If the cable is installed in conduit, it shall be required in the closest pull box and cable tray.

4.3 Horizontal Cabling

Horizontal cabling shall be supplied and installed as detailed on communications cabling layout drawings.

A typical station cable drop consists of a combination of one horizontal voice and one horizontal data unless otherwise noted on the drawings and or otherwise specified.

All horizontal data and voice cabling will originate from the telecommunication room out to the designated workstation in a star topology.

4.4 Rack & Cable management system

All 19'' racks and brackets are to be located as shown on communications cabling layout drawings.

All racks are to be anchored securely to the floor.

All racks, patch panels, cabinets, metal raceways and data equipment are to be grounded to building ground bus bars.

4.5 Fire stopping

Fire stopping requirements must include prevention of fire passing through a barrier. These seals are required to maintain safety and security within the CUSTOMER's premises.
The cabling contractor must re-establish the integrity of any and all fire-rated architectural structures and assembles they have worked on.

4.6 Labeling

Cable labels shall be of self-laminating vinyl construction with a white printing and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times and be installed within 2'' of the termination point of the cable, patch cord or pigtail.
All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

All cable labels shall be compliant with the TIA/EIA-606(A) Section 6.2.2 Cable Labeling, Section 6.2.4 Termination Hardware Labeling, and Section 6.2.6 Termination Position Labeling.

One label should be attached to the front of the workstation faceplate, one to the front of the patch panel, and one at each end of the cable.

All labels must be mechanically printed. Hand written labels are not permitted.

All intra-building and inter-building backbone cables for voice and data shall be labeled.
Labeling shall include destination (building) to and from at each end.

TEST

5.1 General

The test for structured cabling system materials and subsidiary equipment shall be done with supervisor after writing test schedule of each item during test working period.

The cabling contractor is to use the Level III tester or equivalent with the latest version of firmware to test the cabling system. The cabling contractor must ensure that all cabling is tested in accordance to the specification of the Category 6.

5.2 On-site test of Cable

Testing of all copper wiring shall be performed prior to system cutover. The 100m cabling site test shall be terminated before connection between telecommunication equipment and cabling. The test for horizontal and backbone cable shall be done necessarily on site. The horizontal cable test for Data & Voice from workplace outlet to TC(Telecommunication Closet) shall be done by checking if the cable meets requirements of ANSI/TIA 568 or ISO/IEC 11801. In this case, the test equipment shall meets accuracy more than UL Level III and TIA/EIA TSB-67 standard in case of UTP.
The items tested on site including a short circuit test are as follows:

- Wire Map
- Cable Length
- Attenuation
- Pair to pair NEXT
- PSNEXT
- FEXT(Far end crosstalk)
- Pair to pair ELFEXT(Equal level far end crosstalk)
- PSELFEXT
- Return Loss
- PSACR
- Propagation Delay
- Delay Skew

In case of UTP, a tester with most recent version of its software and firmware must perform all tests in accordance to ANSI/EIA/TIA TSB-67. The nominal velocity of propagation (NVP) must be set specific to 69% before testing. Portable testers to be calibrated on a minimum annual basis.
Level III tester or equivalent shall be used.

Test patch cords for the tester must be designed and approved for testing by the manufacturer.
Field assembled patch cords are not acceptable.
All cable faults must be corrected. Splicing of any cables will not be permitted, for any reason, unless prior authorization.
A contractor necessarily shall submit the test results to CUSTOMER after terminating on-site test.

5.3 Supervision

The supervisor who CUSTOMER or contractor designated shall have knowledge for cabling system total process and a method of installation. The supervisor shall check if the below items meet the adequate condition:

A. The document related with design shall be prepared perfectly.
   Both termination of all cables shall be labeled adequately.
B. The test items(open circuit, short, RL, NEXT and so on) for all cables connected in outlet and patch panel shall be done without omission.
C. The cables shall be installed through adequate pathway.
D. The installer shall adhere to allowed bend radius.
E. EMI & RFI sources shall be considered in total installation.
F. The pathway installed in the ceiling shall keep up 1.5m interval.
G. No cable droop installed in the ceiling shall be allowed.
H. The cable installed in ER, TR, TE shall be configured adequately for application.
I. The below items related with system configuration installation shall be considered.
   - The stripped point of the cable sheath.
   - The termination point of the cable.
   - The cabling shall be done tightly without twist.
   - The cable pitch shall be kept up to termination point.
J. T568A or T568B wiring scheme shall be configured rightly to outlet.
K. The labeling shall be recognizable and have unique format.

DOCUMENTATION

6.1 Drawings

The installer shall investigate the construction/electricity/machinery drawing received before for 1 week minimum. After installation design(ER, TR, TE detail drawing and so on), Two of the drawing shall be submitted to CUSTOMER.

The drawings to be considered are as follows:

- ER, TR, TE detail drawing:
  a. cabling pathway
  b. equipment position
  c. the details for wallfield/frames
  d. labeling schedule
- Work Area:
  a. detail cabling pathway
  b. approved labeling schedule
- Cross Connect:
  a. cross connect configuration table for voice & data & building automatic control
- Riser Diagram
- A ground plan for cable tray, conduit and trunking.
- A ground plan for campus distribution (if necessary)
- A ground plan for building automatic control (if necessary)
- The drawing for the completion of construction work.

The cabling contractor is also required to provide as-built drawings of the cable installation. This shall include the pathway of the cables from the telecommunications rooms to the workstation. The as-built drawings shall also include all additional cabling installed during the project.

6.2 Cable & System Test Results

The cabling contractor shall provide all test results in soft copy to LS & CUSTOMER. Test results shall include all voice and data horizontal cables and all voice and data backbone cables. The report should indicate for each cable, when it was tested successfully and the signature of the technician that performed the test. The entire report must be signed by an authorized person for the cabling contractor at the end of the project.

SUPPORT

7.1 Authentication

LS have ETL certificate for channel environment and UL & Delta etc. certificate for each component such as cable, patch cord, modular jack, panel.

Intertek ETL SEMKO

CERTIFICATE OF CONFORMANCE

This authorizes the application of the ETL Verified Mark shown below to the models described in the Product Description section when made in accordance with the conditions set forth in the Verification Agreement and Qualification Testing Report.

Certificate Number: 3097817CRT-005

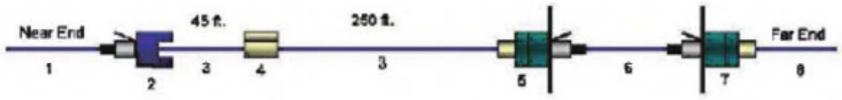
Applicant:
LS Cable
19-20F ASEM Tower
159 Samsung-dong Gangnam-gu
Seoul 135-798, Korea

Manufacturer:
LS Cable Ltd.
190 Gongdan-dong, Gumi,
Gyongsangbukdo, Korea

Contact: Mr. Tae-Seong Yoo

Mfg. Contact: Mr. Sang-Cheol Yeo

Report No.: 3097817



Product Description:

4 Connector Channel

Component ID	Manufacturer	Description	Part Number
1, 8	LS Cable	Equipment Cord, 3m	LS-PC-UC6-XX-03
2	LS Cable	Wall Outlet	LS-MJ-UC6-XX
3	LS Cable	Horizontal Cable	UTP-G-C6G-E1VN-R 0.5X004P/XX
4	LS Cable	110 Block	LS-110WB-25P-W/O
5, 7	LS Cable	Patch Panel	LS-PP-UC6-24P-WM
6	LS Cable	Cross Connect	LS-PC-UC6-XX-03

The components identified above have been tested and found to comply with the applicable electrical transmission characteristics specified in ANSI/TIA-568-B.2-1 Category 6.

This certificate, supported by your participation in the ETL Channel Verification Program, is authorization to apply the ETL Verification Mark to the Channel consisting of the components specified above. The marking shall include: ETL Verified Channel to ANSI/TIA-568-B.2-1 Category 6.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

Date ETL Verified: 6/27/2006

Certificate Issued By: Kathy Heath
Kathy Heath, Program Administrator

This document is the property of Intertek ETL SEMKO and is not transferable. Only the Applicant may reproduce this document. The ETL Verified Mark may be applied only at the above noted location of the Party Authorized to Apply the Mark.

This document supersedes all previous ETL Verified Certificates of Conformance for the noted Certificate Number.

Intertek ETL SEMKO
3933 U.S. Route 11, Cortland, NY 13405
Telephone (607) 758-6641 or (800) 345-3851 Fax (607) 758-6637

7.2 Training & Warranty Program

The installed Category 6 solution will be covered by a warranty program provided by LS Cable & system Ltd.

Telecommunications spaces and pathways in new building or in those buildings having undergone major retrofit in the preceding three years should conform to the requirements per TIA/EIA-569-B.
In cases of installations in restrictive spaces and pathways, where it is impossible to implement the aforementioned requirements, the cabling runs shall not exceed the maximum distances specified in ANSI/TIA/EIA-568-B and shall not in any manner diminish the performance of the Category 6 solution.

Network should be fully supported by a comprehensive warranty giving complete peace on mind for 25 years. To obtain 25-year warranty for category 6 solution, Total system shall be designed, engineered, installed and tested by LS certified Installer. Also, it shall fully comply with all relevant integrated building distribution network design and applications guidelines. For this purpose, LS Cable & System Ltd operates training program about LS-specialized structured cabling system, which includes cabling, test, maintenance over all.

The application for 25-year warranty will be counted from completion time of the total system test.

Only LS-approved products shall be used to ensure end-to-end system performance. The full product warranty and lifetime performance assurance can be provided only to systems built using products supplied by LS Cable & System Ltd. (It will not cover for other manufacturer's products)

Certification shall provide 25-year product warranty for all passive components used in the installed Category 6. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the purchaser.

APPENDIX

8.1 LS Product Part No.

8.1.1 General products

Item	Part No.	Description	Details
Cable	UTP-G-C6G-E1VN-X 0.5X004P/xx	Category 6 U/UTP Cable, 4-Pair PVC (CMX/CM/CMR/CMP) LSZH (CMX)	LSSS-LN0090-01
	UTP-G-C6G-E1VN-M 0.5X004P/xx		
	UTP-G-C6G-E1VN-R 0.5X004P/xx		
	UTP-G-C6G-F1VN-P 0.5X004P/xx		
	UTP-G-C6G-E1ZN-X 0.5X004P/xx		
	UTP-E-C6G-E1VN-X 0.5X004P/xx	Category 6+ (up to 350MHz) U/UTP Cable, 4-Pair PVC (CMX/CM/CMR) LSZH (CMX)	LSSS-LN0079-02
	UTP-E-C6G-E1VN-M 0.5X004P/xx		
	UTP-E-C6G-E1VN-R 0.5X004P/xx		
	UTP-E-C6G-E1ZN-X 0.5X004P/xx		
	FTP-G-C6G-E1VN-X 0.5X004P/xx	Category 6 F/UTP Cable, 4-Pair PVC (CMX/CM/CMR) LSZH (CMX)	LSSS-LN0100-02
	FTP-G-C6G-E1VN-M 0.5X004P/xx		
	FTP-G-C6G-E1VN-R 0.5X004P/xx		
	FTP-G-C6G-E1ZN-X 0.5X004P/xx		
	SFP-G-C6G-E1VN-X 0.5X004P/xx	Category 6 SF/UTP Cable, 4-Pair PVC (CMX/CM/CMR) LSZH (CMX)	LSSS-LN0064-05
	SFP-G-C6G-E1VN-M 0.5X004P/xx		
	SFP-G-C6G-E1VN-R 0.5X004P/xx		
	SFP-G-C6G-E1ZN-X 0.5X004P/xx		
Patch Panel	LS-PP-UC6-24P-WM	24-Port Category 6 Unshielded Patch Panel with wire management	DS300203
	LS-PP-SC6-24P	24Port Category 6 Shielded Patch Panel with wire management	DS300212
Empty Panel	LS-PP-24P-E-LWM	24-Port 1U Empty Panel with hinged management	-
	LS-PP-24P-E-WM	LS 24-Port Empty Patch Panel with wire management	DS300502
	LS-PP-48P-E-WM	LS 48-Port 2U Empty Patch Panel with wire management	-
	LS-PP-MD-12P-E	LS 12-Port Mini Empty Patch Panel	DS300504
	LS-PP-MD-24P-E	LS 24-Port Empty Patch Panel without wire management (6 insert in 1 module)	DS300505
	LS-PP-MD-24P-E-WM	LS 24-Port Empty Patch Panel with wire management (6 insert in 1 module)	DS300506
	LS-PP-MD-WM-EX	LS 24-Port Empty Patch Panel's Management	DS300507
	LS-APP-24P-E-WM	LS 24-Port Angled Patch Panel with wire management	DS300601
	LS-APP-48P-E-WM	LS 48-Port Angled Patch Panel with wire management	DS300603
	LS-PPP-UC-24P-E4-WM-C	Unshielded 4 Module 6 in 1, Empty panel	-
	LS-APP-UC-24P-E4-WM-C	Unshielded Angled 4 Module 6 in 1, Empty panel	-

	LS-PPP-SC-24P-E4-WM-C	Shielded 4 Module 6 in 1, Empty panel	-
	LS-APP-SC-24P-E4-WM-C	Shielded Angled 4 Module 6 in 1, Empty panel	-
Modular Jack	LS-MJ-UC6-xx-ERI	LS slim-body Category 6 Modular Jack 180degree IDC (Enhanced Performance)	DS200209
	LS-MJ-UC6-xx-ERD	LS Slim-body Category 6 Modular Jack 180degree IDC Door type	DS200209
	LS-MJ-UC6-xx-SB	LS slim-body Category 6 Modular Jack 90degree IDC	DS200207
	LS-MJ-SC6-RIDC	LS Category 6 Shielded Modular Jack 180degree IDC	DS200213
Patch Cord	LS-PC-UC6-xx-yyy(-AW)	Category 6 Unshielded Patch Cord with T568A/B wiring (PVC/LSZH)	DS400201
	LS-PC-SC6-xx-yyy(-AW)	Category 6 Shielded Patch Cord with T568A/B wiring (PVC)	DS400202
	LS-110PCC-UC6-4-xx-yyy	110 Patch Cord, 4-Pair (110 4-pair to 110 4-pair)	DS400403
	LS-110PCR-UC6-4-xx-yyy	110 Patch Cord, 4-Pair (110 4-pair to Modular Plug)	DS400403
	LS-SPC-UC6-xx-yyy LS-TOOL-SPC	Category 6 Security Patch Cord with T568B wiring stranded cable & Security key for Patch Cord	DS410101
Pre-terminated Solution	LS-PPP-UC-24P-EP4-C	Fast-Net ™ Patch Panel For Unshielded	-
	LS-APP-UC-24P-EP4-C	Fast-Net ™ Angled Patch Panel For Unshielded	-
	LS-PPP-SC-24P-EP4-C	Fast-Net ™ Patch Panel For Shielded	-
	LS-APP-SC-24P-EP4-C	Fast-Net ™ Angled Patch Panel For Shielded	-
	LS-PC6-UC6-www-JPxx-yyy-ERI	LS Fast-Net™ 6 Equipment Cord (Jack to Modular Plug)	DS3008 series
	LS-PC6-UC6-www-JJxx-yyy-ERI	LS Fast-Net™ 6 Equipment Cord (Jack to Jack)	DS3008 series
110 Block	LS-110WB-UC6-20P-W/O	Unshielded Category 6 110 Wiring Block 20P	DS100301
	LS-110WB-UC6-40P-W/O	Unshielded Category 6 110Wiring Block 40P	DS100302
	LS-110WB-UC6-80P-W/O	Unshielded Category 6 110Wiring Block 40P	DS100303
	LS-110WB-UC6-40P-W	Unshielded Category 6 110Wiring Block 40P with Leg	DS100304
	LS-110WB-UC6-80P-W	Unshielded Category 6 110Wiring Block 80P with Leg	DS100305
	LS-JT-T1-W/O	Jumper Trough, 5 Wire Hangers without Leg	DS100402
	LS-JT-T2-W	Jumper Trough,	DS100401

		5 Wire Hangers with Legs	
10 Voice Block System	LS-10-VB-AR-230-FS	10-Pair Arrestor Magazine, Loaded w/fail safe 3-pole 230V	DS100501
	LS-10PMF-10R-A	Mounting Frame	DS100501
Rack Mounting Patching	LS-HWMR-PR12-8726-WC6240-WM	Unshielded Category 6 110 Wiring Block 240-Port Wall Mount Rack	DS100602
Faceplate	LS-FP-SA-1 LS-FP-SA-2	Euro Mode Faceplate with Angled Shutter Bezel	DS5001 series
	LS-FP-SF-1 LS-FP-SF-2 LS-FP-SF-4	British Faceplate with shutter & Icon	DS5001 series
	LS-FP-US-1PORT LS-FP-US-2PORT LS-FP-US-4PORT LS-FP-US-6PORT	US type single gang Faceplate	DS5001 series
	LS-FP-US-9PORT LS-FP-US-12PORT	US type double gang Faceplate	DS5001 series
Back Box	LS-BB-8686-27 LS-BB-8686-37	Euro Mode single gang Back Box	DS5001 series
	LS-BB-11572-38	US type single gang Back Box	DS5001 series
Adaptor Insert	LS-AI-US-BI-1	Blank Adaptor Insert	DS5001 series
Surface Mount Box	LS-SMB-1PORT LS-SMB-2PORT LS-SMB-4PORT LS-SMB-6PORT	Surface mount box with Station ID & Shutter	DS5001 series
Rack	LS Simple ™ Closet (High-Density Rack)		DS9001 series
Raceway	LS Simple Path ™ Raceway System Product List & Installation Guide		LSGS-10-LN0036-03
Crimping Tool	LS-CT-C6-SI1	LS Crimping Tool for Category 6 Modular Plug	DS210201
Easy Termination Tool	LS-EZT-TOOL-ER	Easy Termination Tool for ERI type Modular Jack	DS210105
	LS-EZT-TOOL-SB	Easy Termination Tool for SB type Modular Jack	DS210105
	LS-EZT-TOOL-FR	Easy Termination Tool for RIDC type Modular Jack	DS210105

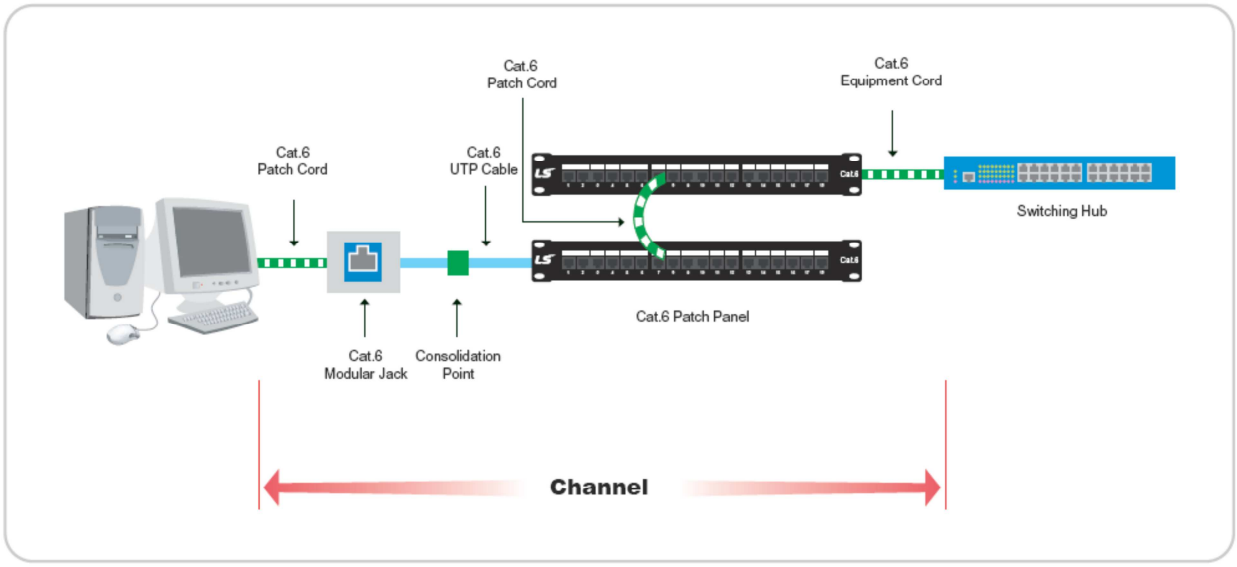
※ xx denotes color,yyy denotes lengths.

8.1.2 Intelligent products

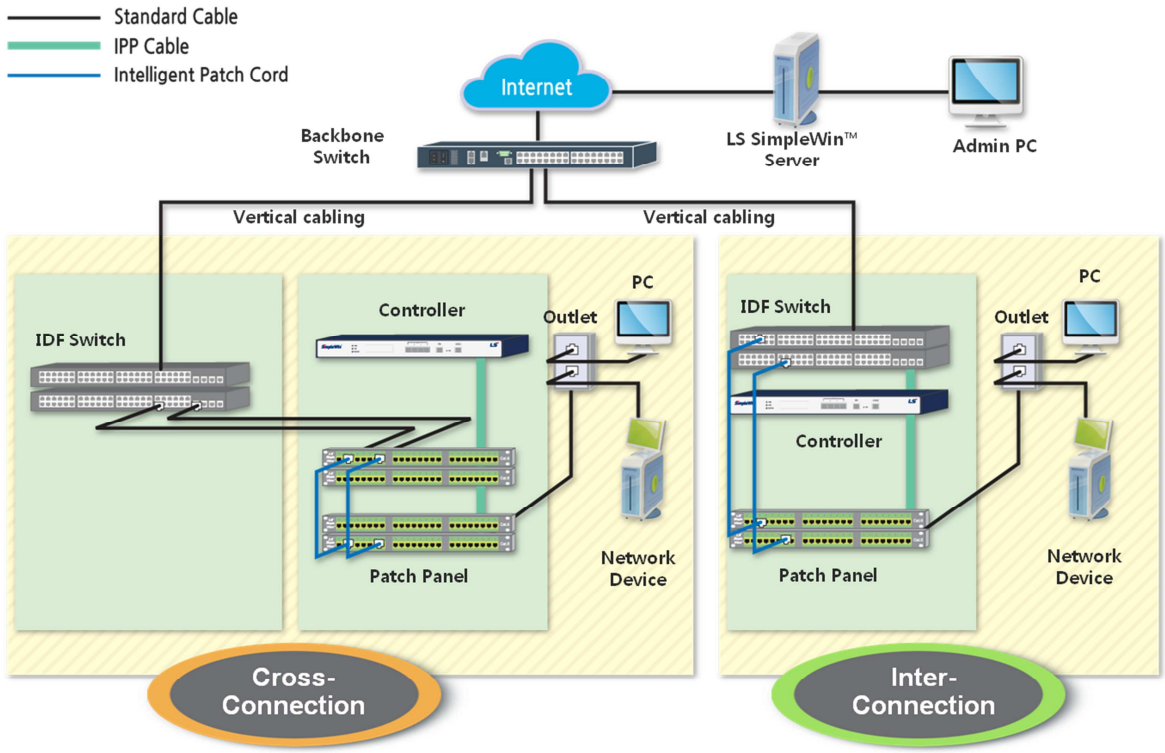
Items	Part Number	Description	Details
Intelligent Controller	IC960-PS1A	Intelligent Controller 960ports, Power Supply 1ea	DS1300
	IC960-PS2A	Intelligent Controller 960ports, Power Supply 2ea	DS1300
485 Cable	ICPC960-001-A	PP cable Cable, 1m	DS1300
	ICPC960-002-A	PP cable Cable, 2m	DS1300
	ICPC960-005-A	PP cable Cable, 5m	DS1300
Intelligent Copper Patch Panel	IPPC-UC-24P	Intelligent Unshielded Patch Panel, Cross-connection, 19" Rack mount(1U), 24ports, Modular Jack separately	DS1300
	IPPI-UC-24P	Intelligent Unshielded Patch Panel, Inter-connection, 19" Rack mount(1U), 24ports, Modular Jack separately	DS1300
	IAPC-UC-24P	Intelligent Unshielded Angled Patch Panel, Cross-connection,19" Rack mount(1U), 24ports, Modular Jack separately	DS1300
	IAPI-UC-24P	Intelligent Unshielded Angled Patch Panel, Inter-connection, 19" Rack mount(1U), 24ports, Modular Jack separately	DS1300
	IPPC-SC-24P	Intelligent Shielded Patch Panel, Cross-connection, 19" Rack mount(1U), 24ports, Modular Jack separately	DS1300
	IAPC-SC-24P	Intelligent Shielded Angled Patch Panel, Cross-connection, 19" Rack mount(1U), 24ports, Modular Jack separately	DS1300
Intelligent Copper Patch Cord	IPCC-UC6(L)-xx-yyy	Intelligent Patch Cord (Cross-connection, Panel-Panel patching) UTP Cat.6 PVC(or LSZH)	DS1300
	IPCC-SC6(L)-xx-yyy	Intelligent Patch Cord (Cross-connection, Panel-Panel patching) STP Cat.6 PVC(or LSZH)	DS1300
	IPCI-UC6(L)-xx-yyy	Intelligent Patch Cord (Inter-connection, Panel-Switch patching) UTP Cat.6A PVC(or LSZH)	DS1300
	IPCS-UC6(L)-xx-yyy	Intelligent Security Patch Cord (Inter-connection, Panel-Switch patching) UTP Cat.6 PVC(or LSZH)	DS1300
Management SW.	IMSW-W-xxxxx	Intelligent Management Software Port License	DS1300
Management App.	IMSW-M-xxxxx	Intelligent Management Software Mobile Application	DS1300

8.2 System Block Diagram

8.2.1 General Channel Configuration



8.2.2 Intelligent System configuration



8.2.3 Guaranteed Channel Performances

Frequency (MHz)	Attenuation (dB/100m)	NEXT (dB)	PSNEXT (dB)	ACR (dB)	PSACR (dB)	ELFEXT (dB)	PSELFEXT (dB)	Return Loss (dB)
1.00	2.1	65.0	62.0	62.9	59.9	63.3	60.3	19.0
4.00	4.0	63.0	60.5	59.0	56.5	51.2	48.2	19.0
8.00	5.7	58.2	55.6	52.5	49.9	45.2	42.2	19.0
10.00	6.3	56.6	54.0	50.2	47.7	43.3	40.3	19.0
16.00	8.0	53.2	50.6	45.2	42.6	39.2	36.2	18.0
20.00	9.0	51.6	49.0	42.6	39.9	37.2	34.2	17.5
25.00	10.1	50.0	47.3	39.9	37.2	35.3	32.3	17.0
31.25	11.4	48.4	45.7	37.0	34.3	33.4	30.4	16.5
62.50	16.5	43.4	40.6	26.9	24.1	27.3	24.3	14.0
100.00	21.3	39.9	37.1	18.6	15.8	23.3	20.3	12.0
200.00	31.5	34.8	31.9	3.3	0.3	17.2	14.2	9.0
250.00	35.9	33.1	30.2	-	-	15.3	12.3	8.0