VERTIV™

APPLYING PROPER CABLE
MANAGEMENT IN IT RACKS

A Guide For Planning, Deployment
And Growth

Why Proper Cable Management Is So Important

Your rack cabling systems are the lifelines of your IT operations. These cables handle critical circuits that must stay up and running. Any mishandling or excessive stress on these critical connection paths can have catastrophic results.

Today's high-density rack-based IT server and switching installations provide higher and higher levels of performance and capacity. But with this growth of capability come a parallel growth of discrete data communications and power cabling that must be managed within the confine of these tightly spaced rack environments.

Improper cable management can result in cable damage and failure. This can lead to data transmission errors and performance issues as well as system downtime.

Data centers contain two basic types of equipment enclosures: server cabinets and network cabinets. Each of these has similarities and differences with specific cable management needs that must be addressed. It is important to follow recognized industry practices for cable management within these IT equipment enclosures.

The problems created by poor cable management include:

1. **Signal interference and crosstalk due to improper placement of data and power cables.**
   Data and power cables running close to each other in parallel groups or in loops may create electromagnetic interference (EMI) due to induction. EMI can cause errors in data transmission over these cables. Whenever possible, power cables should be isolated from data cables on opposite sides of the rack to reduce the chances of EMI.

2. **Excess power and data cabling that is improperly arranged and secured.**
   Most IT racks will have varying lengths of cable resulting in the need to deal with excess cable. You should avoid simply bundling excess cable as this can often lead to EMI or even damage to the cable due to excess bends. There are preferred methods and cable management components for handling excess cable runs.

3. **The chance of cable damage due to improper bends, movement or sharp edges.**
   Installing cables within a tightly packed IT enclosure is going to require the bending of cables around components in the rack. The bend radius of these cables should be within the ranges specified for the type of cable being used. Any data cables and connectors exhibiting excessive movement should be secured and equipped with strain relief. Power cables and connectors should be securely installed to avoid any disconnection or arc flash hazard.

   Cables also need to be protected wherever there is a chance of contacting sharp edges or high heat. This is especially true with power cables where damaged or exposed conductors can result in downtime or safety concerns.

4. **Rack-mounted components blocked by improperly routed cables.**
Access to servers and other network components housed within an enclosure is critical. Because of the high density of cabling in many of these applications, it is important that cabling does not block these components, racks or rails.

Fiber optic cable presents additional challenges because of its more fragile nature. Care should be taken to avoid having other cables or components exerting tension on it to avoid damage. Velcro ties should be used to secure fiber optic cables. Try not to route fiber optic cable around corners within the enclosure.

5. **Cooling and airflow restriction resulting from poor cable placement.**
It is important to make sure that cables are not placed in such a way that they restrict airflow from components inside the enclosure. Obstructed air movement due to blocked vents and fans can result in component overheating and possible thermal shutdown or even equipment damage.

6. **Increased time and chance of error for maintenance, troubleshooting and cabling changes.**
Servicing network devices, as well as replacing and rerouting cables is unavoidable. To make this process easier, cables should be installed to enable quick access to discrete circuits.

7. **Inability to make changes to equipment blocked by cabling without creating an outage.**
Cabling should not be placed in such a way that it must be disconnected to reach a piece of equipment for adjustments or other changes.

8. **Problems with documentation for compliance as cabling becomes impossible to trace.**
Cables must be organized so that specific connections can be traced and validated for code compliance and other regulatory requirements.
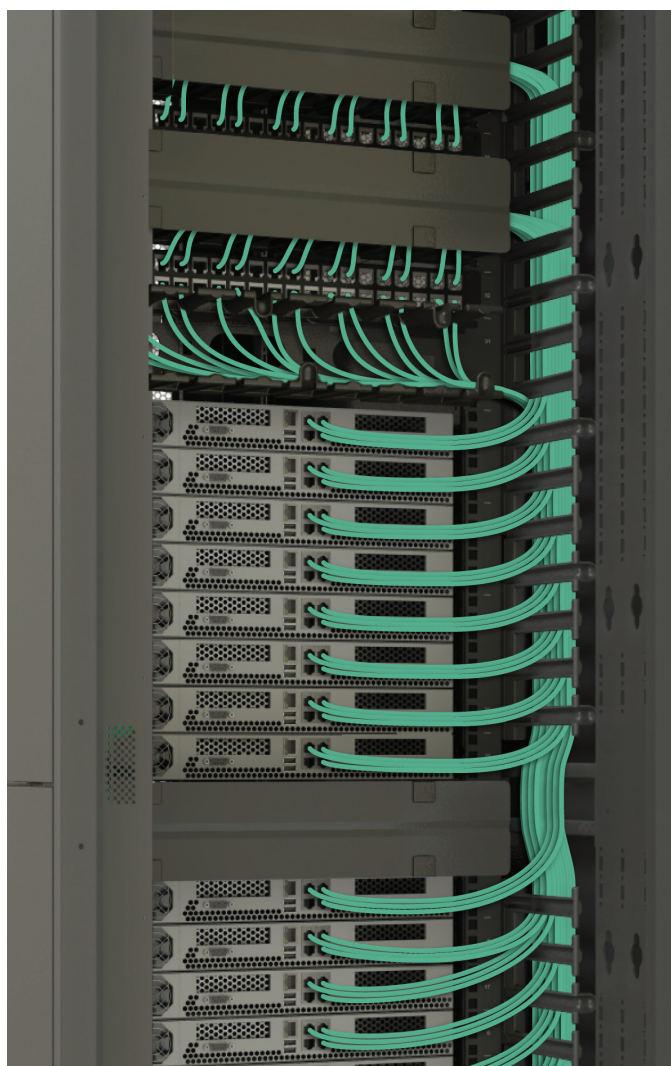
Benefits Of Cable Management

Proper management of data and power cabling within an IT enclosure will deliver a number of benefits that will enhance your system availability and improve your bottom line.

Reduced signal interference — the elimination of crosstalk and interference between cables will enhance system performance.

Improved maintenance and serviceability — easier access to internal rack components reduces maintenance time and improves safety.
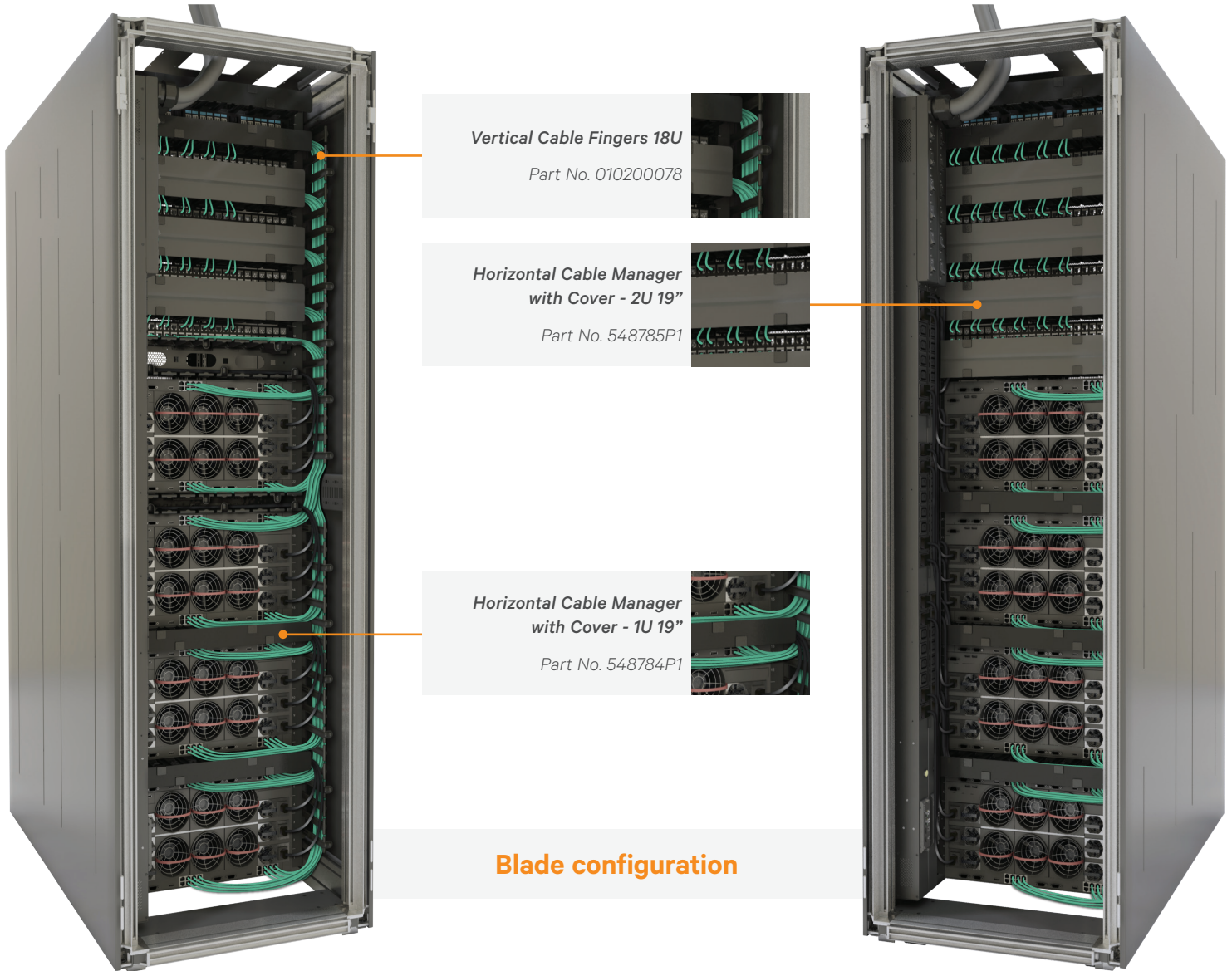
Cooler performance — cooling efficiency within the rack is enhanced thanks to proper positioning of cables to avoid air flow blockage.

A roadmap for growth — effective cable management solutions provide the ability to scale and adapt to changes in the IT infrastructure while minimizing service time.

Cable Management In Server Cabinets

Vertical Cable Fingers 18U

Part No. 010200078

Horizontal Cable Manager with Cover - 2U 19"

Part No. 548785P1

Horizontal Cable Manager with Cover - 1U 19"

Part No. 548784P1

Blade configuration

Server cabinets house mostly active equipment in the form of blade chassis or stackable (aka pizza box) servers. Blade servers require both front and the rear accessibility. This makes it necessary to keep data and power cables to the sides of the cabinet. With blade servers, for example, up to 120 data cables could be used and up to 80 power cords. It is important to understand the number and type of connections per server and the total number of servers expected to be housed in a cabinet.

The first step of preparing cable management for the enclosure is to determine the capacity needed for cabling. Calculate the number and type of connections per server and the total number of servers expected to be housed in the cabinet and determine where the cable needs to be routed.

Servers will generally have a primary and secondary network connection (typically copper), primary and secondary SAN (storage area network) connections which are typically fiber optic cables, and one or two management ports for in band and

out of band management. There may also be another copper connection for KVMs (Keyboard, Video and Mouse connections).

The ability to house these connections in the vertical patching space assures that cables are dressed in such a manner that they do not block exhaust fans on the rear of the servers. Swing arms are not necessary to dress cabling in the rear. In lower density situations, one vertical patching channel may serve two adjacent server cabinets.

Cabling requirements unique to server cabinets:

- Server cabinets typically have the patching for the devices occupying the rear-facing portion of the cabinet, along with power connections. This requires management of both network and power cords. The copper connections and fiber connections are served from one vertical bay, while power connections are addressed from another bay.

- A mounting area is provided where vertical mounted power strips are used. In instances where power and network cords have to cross from one side of the cabinet to the other, the use of horizontal cable managers can be deployed to provide distinct paths. Note that power and network cords should each be housed in separate cable managers.

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Horizontal Cable Manager with Cover - 2U 19"
Part No. 548785P1

Vertical Cable Fingers 18U
Part No. 010200078

Tool-Less Cable Management - Lobster Claw
Part No. 002185050
Part No. 002185070

Tool-Less Cable Management – Velcro Strap
Part No. 002185060
Part No. 002185080

Full Height PDU/Vertical Cable Manager
Part No. 546076G1L

1U Server Configuration

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Cable Management In Network Cabinets

Network cabinets house network switches and patch panels. These cabinets have the highest concentration of cabling in the data center, making patch cord management even more critical and requiring both horizontal and vertical cable management.

Determine the capacity needed for cabling by calculating the number and type of connections per component expected to be housed in the cabinet and establish where the cables need to be routed.
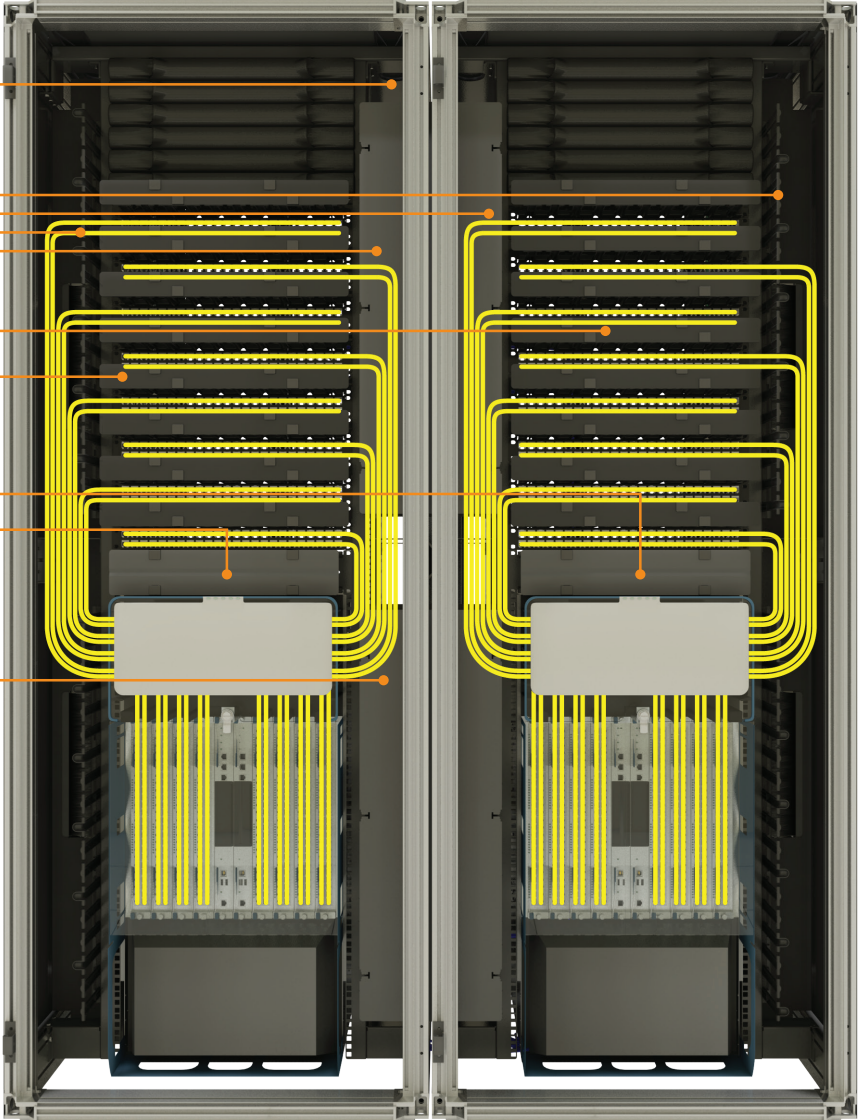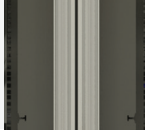
Network cabinets contain edge and/or core switches and patch panels. Due to the high concentration of cabling in these cabinets, a typical installation would use 19" patch panels and standard fiber enclosures mounted either at the top of the switch cabinet or in some cases in an adjacent cabinet when the cabinet houses multiple switches.

The network cabinet would be populated with cable management, for both copper and fiber connections. The majority of the patching connections typically occur at

the front of the cabinet. For in row switching or top of rack switching, the set back-side rails populated with horizontal cable managers allow patching within the cabinet and down the row.

Typically these cabinets would be configured in a manner using rack mount patch panels and cable managers along with vertically mounted cable managers to provide pathways for patch cords transcending from top of rack patch panels to bottom of rack switches.
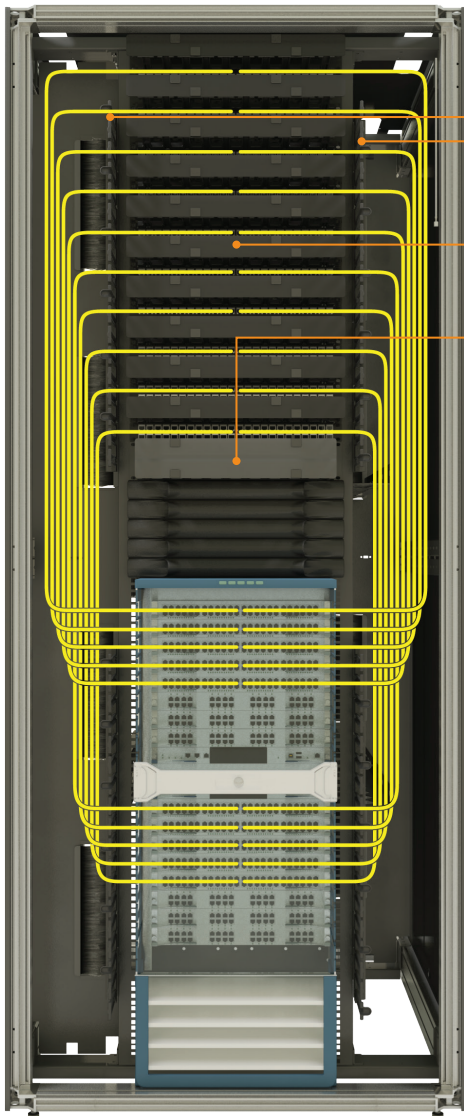
Cisco Nexus 7010 application

Vertical Cable Backplane
Part No. 546550P1
Part No. 546553P1

Vertical Cable Fingers 18U
Part No. 010200078

Horizontal Cable Manager with Cover - 1U 19"
Part No. 548784P1

Horizontal Cable Manager with Cover - 2U 19"
Part No. 548785P1

Vertical Cable Cover
Part No. 546545P1
Part No. 546547P1

Additional Accessories to use:

Lobster Claw

Velcro Strap

Metal Blanking Panel with Brush

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Cisco 7018 Network application

Vertical Cable Fingers 18U

Part No. 010200078

Horizontal Cable Manager with Cover - 1U 19"

Part No. 548784P1

Horizontal Cable Manager with Cover - 2U 19"

Part No. 548785P1

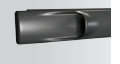### Additional Accessories to use:

Lobster Claw

Velcro Strap

Metal Blanking Panel with Brush

Plastic Blanking Panels

Cable management situations to address in network cabinets:

Power and network cables must be separate — to avoid crosstalk and electro-magnetic interference.

Proper routing of cables within cabinet — to avoid blockage of network components that require adjustments or maintenance.

Cable bends need to be within recommended specifications — to avoid cable damage.

Cables need to be protected — cables must be kept away from sharp items as well as high heat areas within the cabinet.

Proper handling of excess lengths of cable — ensure that excess lengths of cable are properly run to avoid excess bends or interference issues.

Cables and connectors should be secured — this will help to avoid excess movement, accidental disconnection or potential shorts.

Identification of cables — this is critical during cable installation as well as when making future changes and upgrades.

Cabling requirements unique to network cabinets:

- The majority of the patching connections typically occur at the front of the cabinet.

- For in row switching or top of rack switching, the set back side rails populated with a horizontal cable managers allow patching within the cabinet and down the row.

- Typically these cabinets would be configured in a manner using rack mount patch panels and cable managers along with vertically mounted cable managers to provide pathways for patch cords transcending from top of rack patch panels to bottom of rack switches.

Vertiv™ offers a wide variety of cable management components for use in both our DCM™ and DCF™ rack systems:

19" 1U Metal Blanking Panel with Brush

Provides cutouts for cable pass through or mounting.

PART NUMBER	USE WITH
542190G1L	DCM, DCF

19" 1U Cable Routing Panel with D rings

Facilitates cable routing within the enclosure.

PART NUMBER	USE WITH
011171448	DCM, DCF

Vertical Cable Fingers 18U - Kit of Two

With 1U center spacing, mount tool-lessly on 19" rails.

PART NUMBER	USE WITH
010200078	DCM, DCF

Tool-Less Cable Management - Lobster Claw

Provides versatile cable management within the cabinet.

PART NUMBER	DESCRIPTION	USE WITH
002185050	Package of 10	DCM, DCF
002185070	Package of 100	DCM, DCF

Tool-Less Cable Management – Velcro Strap

Provides versatile cable management within the cabinet.

PART NUMBER	DESCRIPTION	USE WITH
002185060	Package of 10	DCM, DCF
002185080	Package of 100	DCM, DCF

### 19" Tool-Less Blanking Panel

PART NUMBER	DESCRIPTION
010200087	1U Plastic Tool-Less Blanking Panel; Box of 10
010200088	2U Plastic Tool-Less Blanking Panel box of 5

Vertical Cable Cover - Two Pieces
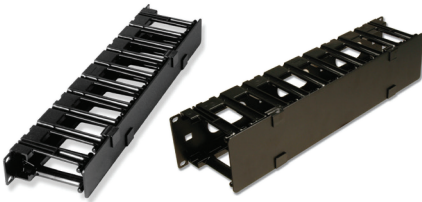
Protects cables inside cabinets.

PART NUMBER	DESCRIPTION	USE WITH
542970P1	18U 600-700mm	DCM
542971P1	18U 600-800 & 700-700mm	DCM
542972P1	18U 700 to 800mm	DCM
542973P1	18U 800-800mm	DCM
546545P1	18U 600-800mm	DCF
546547P1	18U 800-800mm	DCF
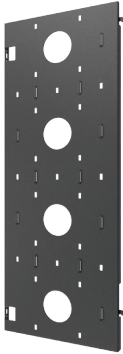
Vertical Cable Backplane - Two Pieces

Routes cables inside cabinets.

PART NUMBER	DESCRIPTION	USE WITH
542974P1	18U 600-700mm	DCM
542975P1	18U 600-800 & 700-700mm	DCM
542976P1	18U 700 - 800mm	DCM
542977P1	18U 800-800mm	DCM
546550P1	18U 600 - 800mm	DCF
546553P1	18U 800 - 800mm	DCF

Horizontal Cable Manager with Cover

Routes and protects cables inside cabinets.

PART NUMBER	DESCRIPTION	USE WITH
548784P1	1U 19"	DCM, DCF
548785P1	2U 19"	DCM, DCF

Full Height PDU/Vertical Cable Manager

Full height PDU mounting bracket, 4" wide. Holds two 2" wide max PDU's with Quick Mount button system (all Knurr® DI-STRIP™ and Liebert® MPH™ listed in catalog).

PART NUMBER	DESCRIPTION	USE WITH
539486G1L	42U 4" Wide	DCM
539487G1L	45U 4" Wide	DCM
546076G1L	42U 4" Wide	DCF
546077G1L	48U 4" Wide	DCF

Power And Cooling Solutions For Your Row-Based IT Infrastructure

Vertiv™ offers a complete range of row-based power protection, power distribution and cooling systems for your IT infrastructure. We lead the industry in infrastructure support, with a comprehensive offering that provides efficient operation without compromising availability. These solutions are backed by the industry's largest service organization, ensuring continued support by factory-trained experts.

IT Racks and Accessories

Rack PDUs

- Basic, controlled or adaptive designs.

- Local and remote monitoring.

- Additional in-rack sensors available.

- Available in low and high density.

- 2-year no-hassle replacement warranty.

Aisle Containment from Vertiv

- Flexible design independent from rack width.

- Sliding or vertical doors.

- Modular, vertical or retractable overhead containment.

- Integrated adaptive control reduces fan energy cost.

Liebert MB™ Modular Busway

- Tool-less mounting to Knurr racks.

- Plug-n-play bus plug/rack PDU connections.

- Replaces multiple power cables.

- Available in dual bus design.

Power and UPS

Liebert APM™ UPS

- Scalable capacity growth without increasing footprint: 15-90kW.

- Operates with up to 94% energy efficiency.

- Row-based installation.

Liebert NX™ UPS

- Scalable capacity growth without increasing footprint: 40-200kVA.

- Parallel configurations for capacity or redundancy.

- Operates with up to 97% energy efficiency.

- Row-based installation.

Liebert FDC™/ Liebert FPC™

- Rack-size power conditioning and distribution.

- Requires only front and back service access.

- Offers top or bottom cable entry.

Precision Cooling

Liebert CRV™ Row-Based Cooling

- 20kW to 40kW precision cooling with horizontal airflow design for both non-raised and raised floors.

- Digital scroll compressor and variable speed fans for highly efficient operation.

- Air, water, glycol and chilled water designs.

- Liebert iCOM® for intelligent control, communications and monitoring.

Tips For Specifying And Applying Cable Management Products

1. **Start with proper planning**
Once you have determined the amount of cabling and connections required, you can decide where the cables need to be routed within the cabinet. This will then allow you to select the proper cable management components needed to properly secure the all of the wiring and connections.

It is important to make sure that there will be adequate space within your rack for the amount of cabling to be used. Accurately establishing the amount of cabling and connections needed ahead of deployment will greatly improve the chance of a successful installation.

2. **Keep growth in mind**
Growth in the data center environment is a certainty. Planning ahead for installing additional cabinets, servers and network components should be taken into consideration even as you are installing the first phase of your racks. This will make it easier to integrate additional racks and

components in the future. Poor planning in terms of future changes can often result in the spaghetti of wiring present in many data centers.

Data center standards recommend not only installing cable for present needs, but also anticipated future growth that has been identified. Accommodating growth and building in flexibility is a key challenge to data center operators. Proper planning for the future will help avoid cabling issues down the line.

3. **Change is inevitable**
Your rack installations may change configurations a number of times during their life cycles. Properly installed cables will help facilitate change-outs and other component additions and movement within the rack environment. This can also minimize the risk of technicians accidently unplugging components that must not be taken off-line such as switches or critical servers.

Identifying cables that need to be moved can also pose a challenge. Verifying proper connectivity, troubleshooting, and managing device changes can become more complex and time-consuming without accurate cable identification and can lead to unplanned downtime of critical business applications.

4. **Follow industry standards**
Industry guidelines, such as ANSI/TIA and ISO/IEC, as well as any federal, state or local regulations regarding cabling should always be followed. This not only assures code compliance but promises a safe, failure-free installation that will minimize system downtime and data errors.

A standards-based cabling system will provide the best combination of reliability today and the ability to change and reconfigure in the future. Standards provide a written foundation for establishing a sound infrastructure and guidelines for maintaining a high level of cable performance.

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