

Modicon Quantum automation platform

I/O architectures

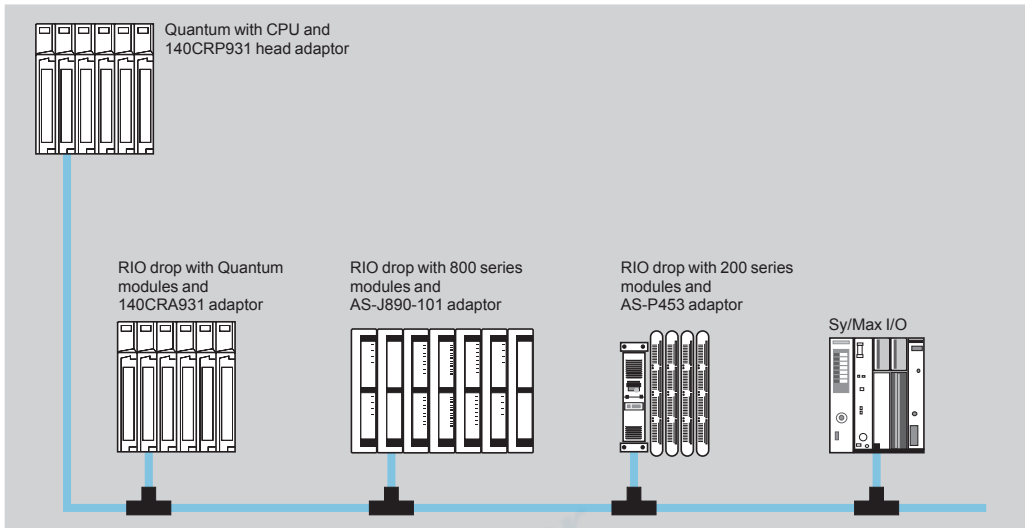
Remote I/O (RIO)

S908 bus

Presentation

For applications that require remotely mounted I/O drops, a higher I/O capacity and/or connectivity to existing Modicon I/O installations, Quantum provides a remote I/O (RIO) architecture solution.

Based on the S908 RIO network technology, this network is compatible with existing Modicon I/O installations, including those with 800 and 200 series I/O modules and Sy/Max I/O. Retrofit installations can therefore incorporate an installed I/O base to reduce installation costs.



The RIO architecture uses coaxial cabling and provides long distance capability up to 4572 m with a CATV cable, or longer with an optional optical fibre cable. It is a high-performance network, operating at 1.544 Mbps, providing a high I/O data throughput.

The RIO cabling system consists of a linear trunk cable, with line taps and drop cables for connection to each remote drop.

Up to 31 remote drops can be configured. Each drop can support up to 128 I/O words (64 input words/64 output words).

Segment scheduler mechanism

The segment scheduler mechanism increases the performance of the RIO network by interleaving I/O scanning and program execution.

The segment scheduler breaks the application program into logical segments, then co-ordinates the scanning of the inputs and the updating of the outputs in conjunction with the execution of the program associated with the segment. The inputs are read before the program is processed and the outputs are written after the program is processed. This avoids having to wait for an entire scan before the outputs are set, thus giving a faster system response time. This means that an RIO architecture does not reduce system performance.

For most systems, throughput of local or remote I/O can be estimated at no less than two times scan (with 24 V $\pm$ I/O modules). Analog values and words are updated automatically, as fast as discrete I/O, with no user programming.

Compatibility with 800 and 200 series I/O products

Quantum is compatible with 800 and 200 series I/O, which are earlier generation products (1). Using the same RIO head adaptor, 800 series I/O are connected via J890, J892, P890 or P892 RIO adaptors and 200 series I/O are connected via P453/J290 and P451/J291 RIO adaptors.

Other standard components are also compatible with this system, including **MA0185100** network T-connectors and **MA0186100** splitter boxes. The Quantum remote I/O system also takes Sy/Max I/O drops.

Configuration rules

To ensure a valid configuration, add together the consumptions (in mA) of the modules in the rack, for each drop, and check that the total is less than the power available with the selected power supply.

(1) For the entry-level HSBY CPU model, 140CPU67060 is not compatible with the S908 RIO bus.

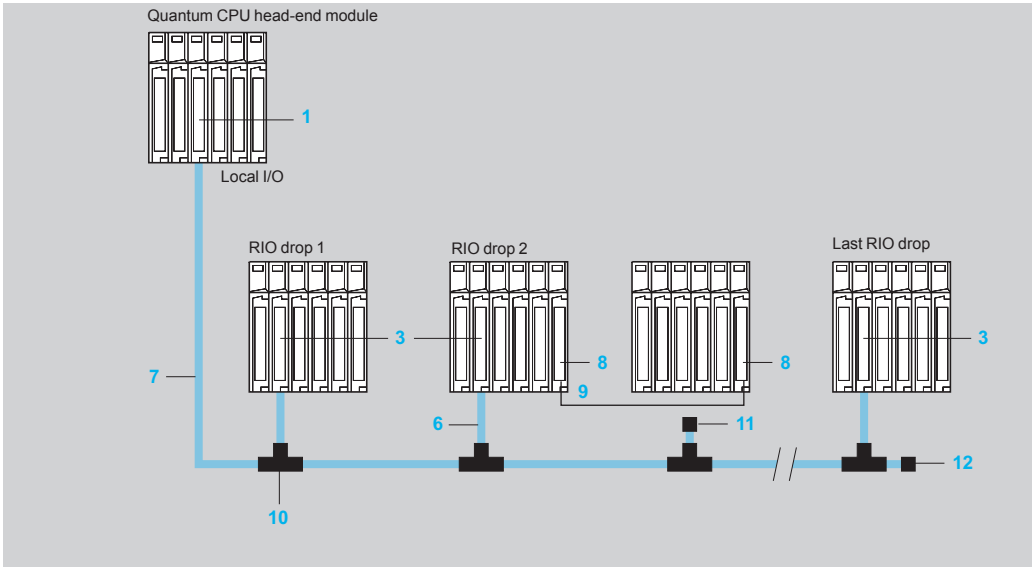
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Topologies

Single-cable topology

Line length 4.572 km max.



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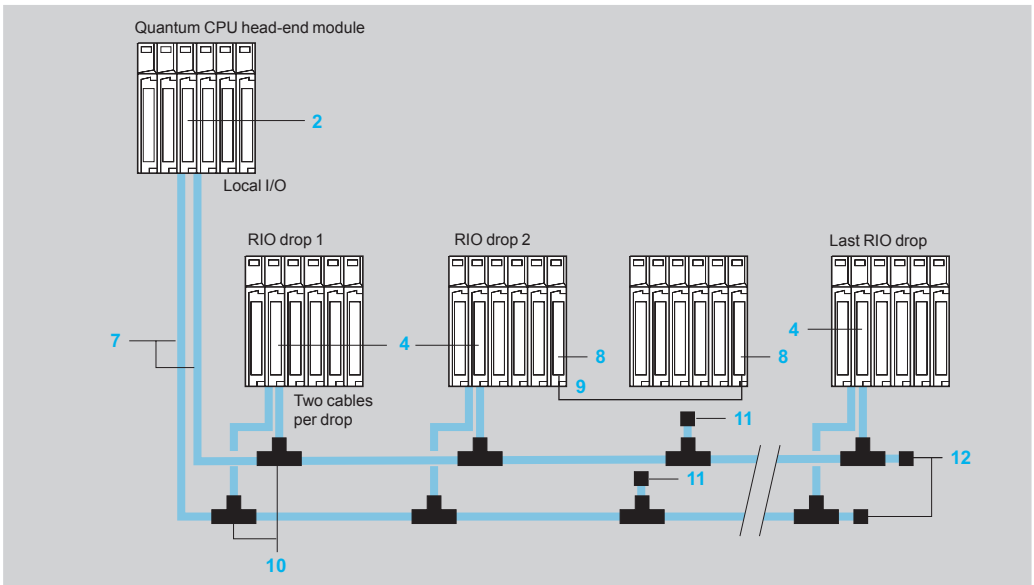
- 1 140CRP93100 RIO head adaptor
- 2 140CRP93200 RIO head adaptor (redundant)
- 3 140CRA93100 RIO drop adaptor
- 4 140CRA93200 RIO drop adaptor (redundant)
- 5 140NRP95400 or 140NRP95401C RIO drop optical fibre repeater
- 6 RG-6 coaxial cable (drop)
- 7 RG-11 coaxial cable (trunk)
- 8 140XBE10000 rack expansion module
- 9 140XCA7170 cable for expansion module
- 10 MA0185100 T-connector 2 x RG-11/1 x RG-6
- 11 520402000 RG-6 terminator for T-connector
- 12 520422000 RG-11 trunk cable terminator for T-connector

A MA0185100 T-connector 10 is required for each I/O drop on the system to electrically isolate the drop from the trunk cable and to protect the system from impedance mismatches and cable disconnections. A minimum signal strength of 14 dB is required between the trunk cable and each I/O drop to ensure correct operation. The signal loss on the trunk cable is less than 1 dB as it crosses a T-connector. A total of 35 dB is available from the head-end RIO CPU. The whole cabling architecture must not exceed this system limit.

For systems that require high availability, a solution with redundant cable is available, to provide protection against cable breaks and damaged connectors. With two cables connected between the host and each drop, the first cable break does not disrupt communication. If a cable break occurs, a status bit is set to 1 to indicate the problem drop or the faulty cable. For preventive maintenance, the system also provides counter values for all communication transactions to all drops. High counter values on a cable in a specific drop could indicate connection problems. This will enable corrective work to be scheduled before there is unwanted downtime.

RIO topology with redundant cable

Line length 4.572 km max.



Topologies(continued)

Point-to-point RIO communication with optical fibre repeaters

140NRP95400 optical fibre repeaters **5** or **140NRP95401C** enhance network noise immunity and allow significantly increased cable lengths.

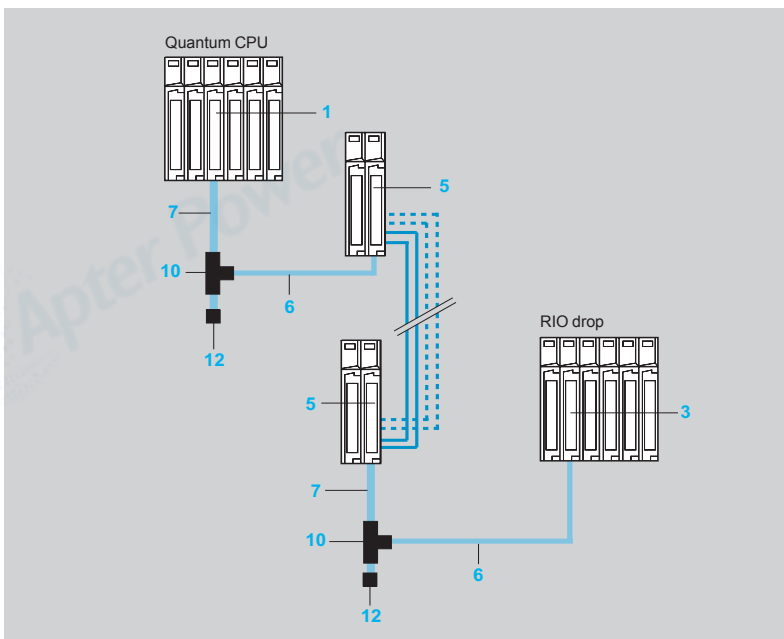
These repeaters enable a standard 62.5/125 µm or 9/125 µm single mode optical fibre cable to be used instead of an RG-6/RG-11 coaxial cable, while maintaining the dynamic range of the network.

Up to 12 repeaters can be daisy-chained, creating bus architectures over fifteen or so kilometres or redundant ring architectures over a perimeter of fifteen or so kilometres.

As these optical fibre repeaters are in Quantum module format, they can be used as *standalone* devices with a single power supply in a 3-slot rack (for example replacing **140NRP95400** or **140NRP95401C** repeaters, with which they are fully compatible) or directly incorporated in the Quantum racks, which provides a more compact configuration and enables the redundant power supplies of the Quantum PLC to be used.

Optical fibre repeaters used as standalone devices

Line length 16 km max.

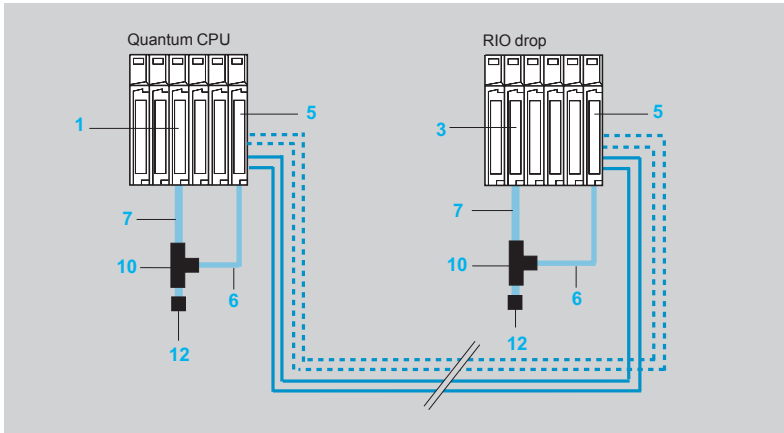


- 1 **140CRP93100** RIO head adaptor
- 2 **140CRP93200** RIO head adaptor (redundant)
- 3 **140CRA93100** RIO drop adaptor
- 4 **140CRA93200** RIO drop adaptor (redundant)
- 5 **140NRP95400** or **140NRP95401C** RIO drop optical fibre repeater
- 6 RG-6 coaxial cable (drop) (1)
- 7 RG-11 coaxial cable (trunk) (1)
- 8 **140XBE10000** rack expansion module
- 9 **140XCA7170** cable for expansion module
- 10 **MA0185100** T-connector 2 x RG-11/1 x RG-6 (1)
- 11 **520402000** RG-6 terminator for T-connector
- 12 **520422000** RG-11 trunk cable terminator for T-connector (1)

(1) The connection between the CRP/CRA and NRP modules in the same rack, with 2 coaxial cables **7** and **6**, the T-connector **10** and the T-connector terminator **12**, can be replaced by a connection with a single RG-6 coaxial cable **6**, if the distance between the modules is less than 30 cm.

Optical fibre repeaters incorporated in the Quantum racks

Line length 16 km max.



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Topologies (continued)

"Self-healing" ring topology with optical fibre repeaters

Several **140NRP95400** or **140NRP95401C** optical fibre repeaters can be interconnected to form a ring, so that if a break occurs anywhere on the ring, the network can reconfigure itself.

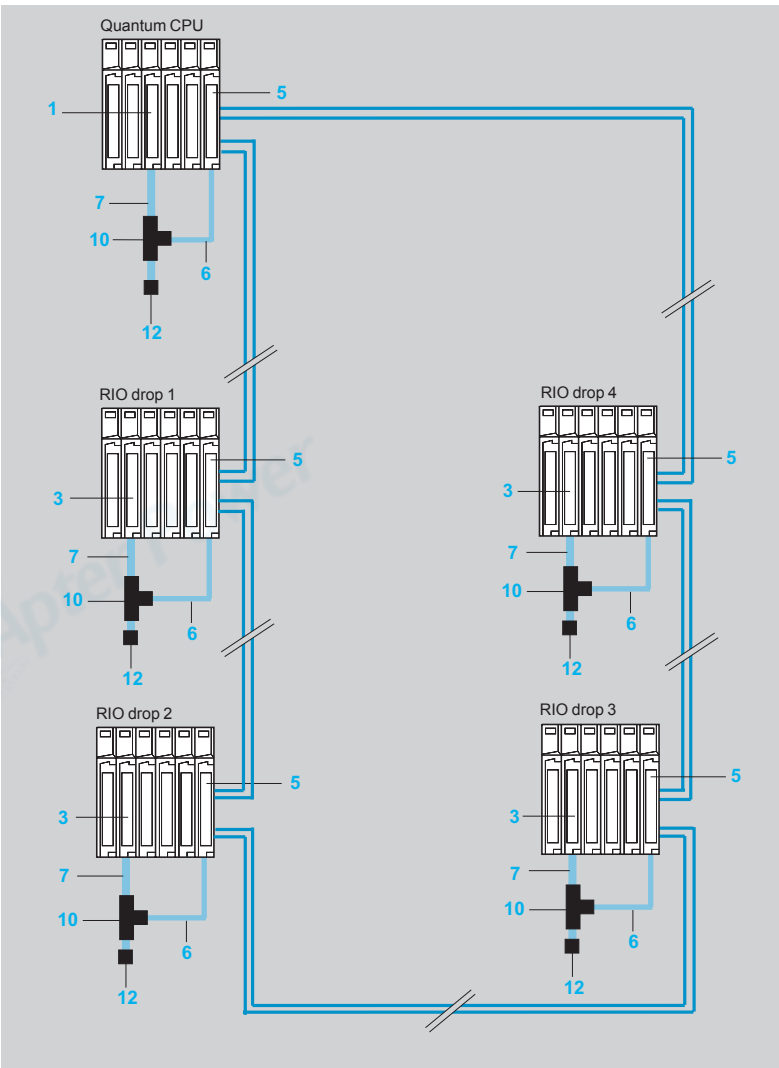
The RIO signal is sent by the drop repeater to the head repeaters, in both legs of the ring. When a signal is received on one Rx line, the other Rx channel is blanked, which prevents the same signal being transmitted twice on the ring.

Line length 16 km max.

2

- 1 **140CRP93100** RIO head adaptor
- 2 **140CRP93200** RIO head adaptor (redundant)
- 3 **140CRA93100** RIO drop adaptor
- 4 **140CRA93200** RIO drop adaptor (redundant)
- 5 **140NRP95400**
or **140NRP95401C** RIO drop optical fibre repeater
- 6 RG-6 coaxial cable (drop) (1)
- 7 RG-11 coaxial cable (trunk) (1)
- 8 **140XBE10000** rack expansion module
- 9 **140XCA7170** cable for expansion module
- 10 **MA0185100** T-connector 2 x RG-11/1 x RG-6 (1)
- 11 **520402000** RG-6 terminator for T-connector
- 12 **520422000** RG-11 trunk cable terminator for T-connector (1)

(1) The connection between the CRP/CRA and NRP modules in the same rack, with 2 coaxial cables 7 and 6, the T-connector 10 and the T-connector terminator 12, can be replaced by a connection with a single RG-6 coaxial cable 6, if the distance between the modules is less than 30 cm.



Note on optical fibre cables

To use an optical fibre link on a RIO network, the following points must be taken into consideration when selecting the optical fibre cable from a supplier:

- For most applications, 62.5/125 µm fibre is recommended because of its relatively low loss and signal distortion. However, for high optical power applications, such as those using splitter boxes or star couplers, 100/140 µm fibre should be used.
- Whenever possible, select a multiconductor cable. For a small additional cost this provides a backup solution in case a fibre breaks during installation.

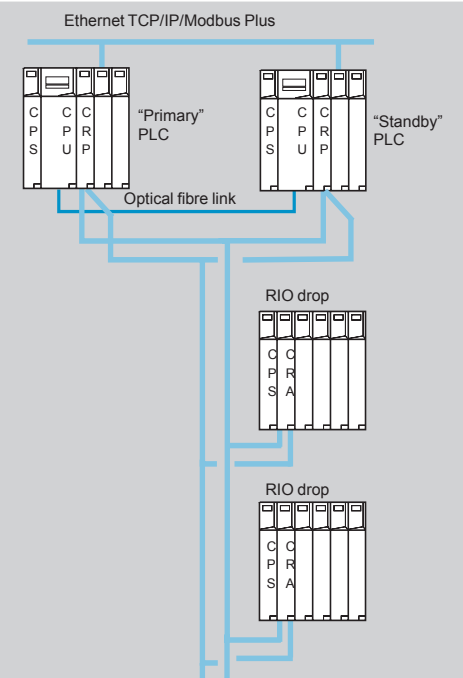
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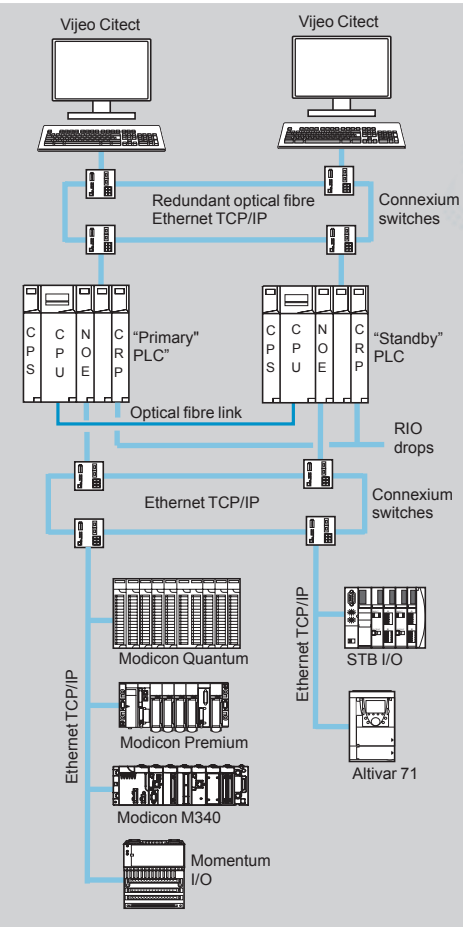
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Hot Standby system and RIO drops



Mixed Hot Standby system, Ethernet network and RIO drops

Hot Standby system with Unity Pro software

The Unity Hot Standby system is used for the the most demanding applications, in terms of the availability of their control/command system, as no interruption of the process can be tolerated.

This system consists of two PLC racks (Primary and Standby) with identical hardware configurations, based on **140CPU67•6•** Unity Hot Standby CPUs, linked via a high-speed optical fibre cable (100 Mbps).

The "Primary" PLC executes the application program and controls the I/O, while the "Standby" PLC remains in the background.

If a fault occurs on the "Primary" PLC, the Standby system automatically switches execution of the application program and control of the I/O to the "Standby" PLC. The changeover is performed smoothly at the outputs and is transparent for the process.

The Hot Standby system with Unity Pro software increases productivity by minimizing process downtime.

Hot Standby system based on remote I/O (RIO) architecture

The Hot Standby system based on the remote I/O (RIO) architecture is used for sensitive processes which require an I/O control takeover time within the region of the PLC scan time.

As the RIO drops are synchronized with the PLC's CPU scan time, the CPU changeover is carried out smoothly at the outputs, *i.e.* *bumpless*. See page 2/39.

Ethernet Hot Standby system

The Ethernet Hot Standby system is used for processes for which the I/O control time is compatible with Ethernet technology.

It is possible to adopt a mixed architecture, combining both RIO distribution on at least one drop and distribution of devices on an Ethernet TCP/IP network.

From an operational point of view, client type devices (PLC modules, Human-Machine interfaces, etc.) and Modbus TCP server type devices (Modicon OTB or Momentum distributed I/O, Modicon STB I/O islands, Altivar variable speed drives, etc.) can in fact coexist on a single Ethernet TCP/IP network.

As far as Ethernet network topology elements for connection between PLC modules and distributed devices are concerned, it is better to use switches rather than hubs. The topology adopted can be bus or ring type (copper wire or optical fibre), as appropriate

With 140CPU6•2• CPUs, it is also possible to implement the S908 bus and Quantum Ethernet I/O architectures.

Hot Standby system based on Profibus DP fieldbus modules

This Hot Standby system is based on the use of two **PTQ-PDPMV1** communication modules from ProSoft Technology which are used to control the I/O on the Profibus DP fieldbus. See page 2/42.

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Adaptor modules							
Description	Cable	Safety	Bus current required	Power dissipation	Item (4)	Reference	Weight kg/lb
Quantum RIO head adaptor (max. 1) (1)	Single coaxial	–	600 mA	3 W	1	140CRP93100	–
	Redundant coaxial	Non-interfering	750 mA	3.8 W	2	140CRP93200	–
Quantum RIO drop adaptor (max. 31) (1)	Single coaxial	–	600 mA	3 W	3	140CRA93100	–
	Redundant coaxial	Non-interfering	750 mA	3.8 W	4	140CRA93200	–
RIO drop optical fibre repeater (2)	Multimode optical fibre	Non-interfering	500 mA	2.5 W	5	140NRP95400	–
	Single mode optical fibre	Non-interfering	750 mA	5 W	5	140NRP95401C	–

Connection cables				
Description	Use/length	Item (4)	Reference	Weight kg/lb
RG 6 quad shield coaxial cable	Drop cable, 320 m/1047.87 ft per reel	6	975750000	–
RG 11 quad shield coaxial cable	Trunk cable 320 m/1049.87 ft per reel	7	975951000	–
Pre-assembled drop cable (supplied with F connectors, line termination impedance and quad shield RG 6 cable)	15 m/ 49.21 ft	–	ASMBII003	–
	42 m/ 137.79 ft	–	ASMBII004	–

Rack accessories (3)				
Description	Length	Item (4)	Reference	Weight kg/lb
Rack expansion module	–	8	140XBE10000	–
Cables for rack expansion module	1 m/ 3.28 ft	9	140XCA71703	–
	2 m/ 6.56 ft	9	140XCA71706	–
	3 m/ 9.84 ft	9	140XCA71709	–

(1) Approvals: UL 508, CSA 22.2-142, cUL, FM Class 1 Div. 2, Cc.
 (2) Module can be declared and configured in Unity Pro Small/Medium/Large/Extra Large version ≥ 6.0.
 (3) For racks with 3 to 16 slots, see page 1/17.
 (4) For item numbers, see pages 2/27 to 2/29.