



SOLUTIONS FOR AN EVOLVING WORLD

RFL 9508D UCC

DIGITAL POWERLINE CARRIER
MULTIPLEXING SYSTEM



9508D Digital Powerline Carrier Multiplexing System



Product Description

The RFL 9508D UCC comprises two integrated subsystems that consist of a highly integrated fully digital PLC terminals that incorporates the latest Digital Signal Processing technology (DSP) along with a unique digital packetizing multiplexer that integrates voice, data, multiple T1 or E1 data ports, and IP traffic over the digital power line carrier link.

The RFL 9508D UCC offers a choice of two power output levels, and a wide range of options that also include plug-in teleprotection modules to complete an integrated communication system design.

The system is capable of Drop and Insert operation at the T1/E1 level. These features make for a unique product that integrates power line carrier sub-networks into large corporate WANs.

The equipment is designed to operate in the harsh environment of electric utility substations and is based on the successful and proven RFL IMUX 2000 T1/E1 multiplexer where thousands are in use around the world.

Key Features & Benefits

Integrate high quality voice and multiple channels of variable rate data traffic across a reliable narrow band power line carrier link

Use as a digital link between a power line and any existing or new digital network of any protocol

50 or 100 Watt PEP output power

Programmable from 20kHz - 500 kHz frequency range with no components to change in the field

Use to extend a WAN to a remote location over the power line

General Specifications

Digital Link Characteristics

The RFL 9508D UCC provides a digital data stream that when combined with the UCC packetizing multiplexer with voice, data and IP interfaces provides the user with flexibility not yet seen with power line carrier systems.

The transmission channel occupies a total bandwidth of 8 kHz making it suitable to replace analog systems using their existing frequency assignments. The system can also operate in a bandwidth of 4 kHz at a reduced rate with better performance and interface options than any available analog system. The system is programmable via the user interfaces to allow frequency ranges from 20 - 500 kHz

The RFL 9508D UCC uses algorithms for error detection and correction in order to achieve better performance in the presence of channel noise.

The RFL 9508 uses QAM modulation which has been proven to be the most robust and reliable method for digital power line carrier systems.

A versatile Windows® GUI (Graphical User Interface), allows the user to configure the system requirements. SNMP alarm reporting traps are also supported if required. The RFL 9508D UCC can be accessed via RS-232 interface or remotely with an optional Ethernet access port.

System Architecture

The modularity of the RFL 9508D UCC allows high flexibility to comply with different requirements; the main modules are:

Transceiver: Communications Unit, digital processing and converting the frequency signals either to SSB or T1/E1.

One Transceiver is required to establish the QAM data link, and another is required for the F6 Teleprotection if required

*Power Amplifier, 50 or 100 Watts
Peak Envelope Power (PEP)*

Coupling: RF Filters, Hybrid, Dummy Load

Detailed Functionality

Transceiver:

The Power Line Carrier Transmitter and Receiver module, includes the Modulator and Demodulator, Digital Filtering, Numerical Control Oscillator (NCO), Analog and Digital Channel Mapping and RS232 interface for configuration. This module has many functions as follows:

Provides QAM modulation for the digital link

Translate and convert the digital baseband source from the digital frame into the frequency range from 20 to 500 kHz

Translate and convert the Line Frequencies into digital baseband or the digital frame

Perform line frequency programming, configuration, RS232 Network Management System (NMS) Interface, diagnostics, impedance matching and level adjustment for Transmission and Reception.

Automatic Gain Control (AGC) to compensate for variations in signal level caused by line attenuation changes. If the teleprotection received signal level varies more than 40 dB from normal in the regulation range of -20 to +20 dB or -26 to +14 dB, a relay and LED will indicate an alarm. Additionally the AGC functions to perform the signal-to-noise squelch which disables the system and initiates an alarm under excessive noise conditions.

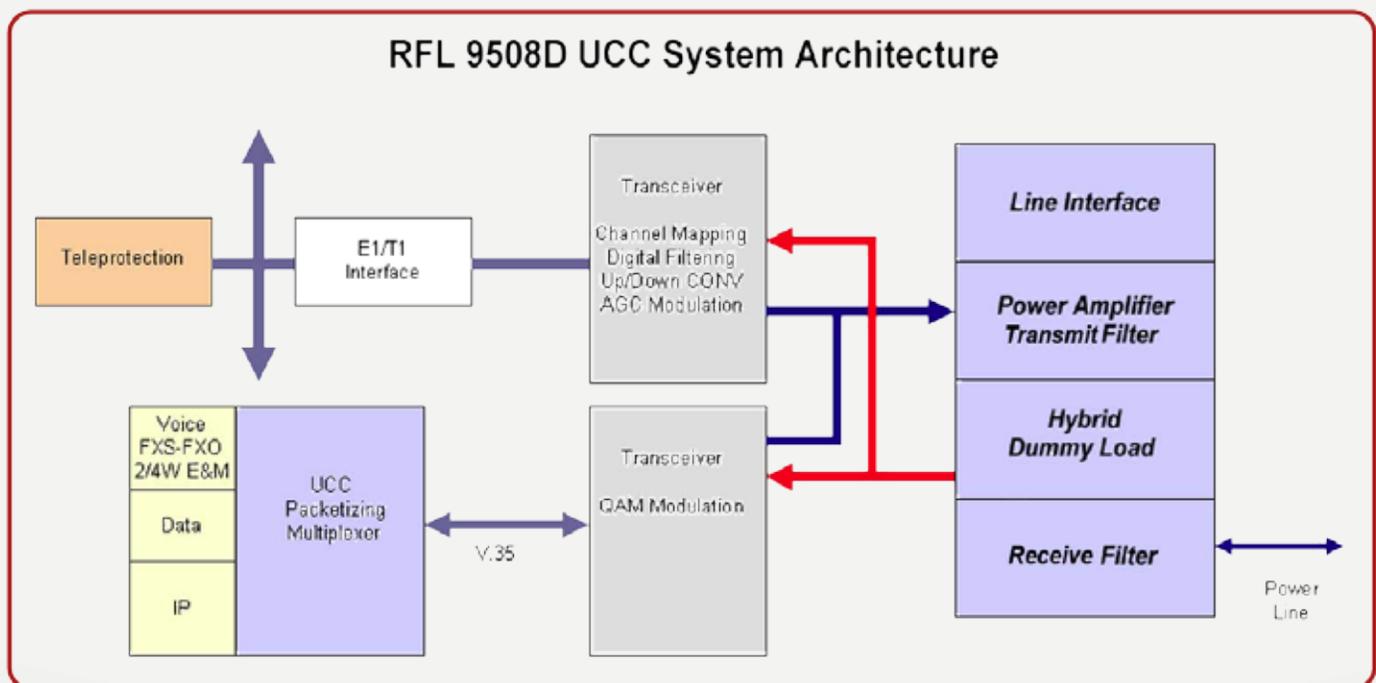


Figure 1. RFL 9508 System Architecture

General Specifications (continued)

Architecture of Digital Chassis

The Transceiver and the IMUX Common Module are mounted in a 19" wide chassis. The connection between the two is an E1 or T1 link with shared RS232 port and power. The CM4 common card, MTS, and digital link card are in the IMUX side of the chassis while the transceiver is on the PLC side of the chassis..

Programmable RF Test Generator

The Transceiver can generate an RF test tone between 20 and 500 kHz to be transmitted over the SSB path.

RF Chassis

The RF chassis comprises the RF skewed Hybrid, RF Impedance Adapter, Loop Back Test Module, RX Filter, Dummy Load, Power Monitor, and 50W power amp.

The RF Interface is located at the top in the RF chassis. Test points are found inside the front panel: Line TX (after transmit filter), Line RX (before front-end filter) and Line (after the Hybrid). These signals facilitate equipment testing and commissioning.

The Skewed Hybrid efficiently separates the send and receive frequencies. Use of a skewed hybrid keeps losses in the send direction very low (0.5 to 1 dB).

DIGITAL Interface Modules

MA-470 is interfaced to the transceiver and provides the digital interface for the UCC Packetizing Multiplexer.

The RFL optional MA-490, is an RS232/Telnet I/O adapter module used in RFL 9508D UCC for Telnet link capability. This module contains one Ethernet port and two RS-232 ports. The basic function of this module is to provide connectivity to the RFL 9508D UCC via an Ethernet network.

Man Machine Interface

A Windows® (W95, W98, ME, W2000, NT and XP) program allows the user to configure all RFL 9508D UCC parameters; the channel mapping for the SSB/E1/T1, load the carrier frequency to the NCO, adjust output power level, as well as to measure the SNR, alarms, etc. See figure 2 for typical setup screen.



Figure 2. Typical Setup Screen

Packetizing Multiplexer - Utility Communications Center

The RFL 9508D UCC can be used as a Utility Communications Center (UCC) because of its unique ability to integrate voice and data traffic across a single, converged network utilizing a multi-service access gateway that uses data packets switched for distributed substation utility applications.

The versatility of the RFL 9508D UCC helps to take advantage of the narrow bandwidth available over the Power Lines without sacrificing quality of service for voice and data applications.

Analog and digital telephony channels as well as data interfaces and serial data ports are supported by the RFL 9508D UCC. These are optimized specifically for distributed enterprise networks that have needs for multiple WAN connectivity requirements and differing needs for functionality, density, performance and connectivity.

The product is extremely flexible and easy to configure and manage. As a modular voice and data solution, the RFL 9508D UCC platform delivers ease of use and scalability in a fully integrated, stand-alone form factor.

Delivers High Quality Over Narrow Bandwidth

The RFL 9508D UCC offers state of the art prioritization and voice/data compression technology that provides superior quality of service with minimal bandwidth utilization, providing high compression voice and data transport over the Power Lines.

General Specifications (continued)

Any-to-any Voice Switching

The RFL 9508D UCC integrates the disparate phone systems of individual sites, eliminating the need for consistency increasing flexibility. With support for both analog and digital voice, and legacy and packet data, the RFL 9508D UCC supports all the networking needs of the Distributed Power Networks.

Simplified Network Management

Utilizing versatile software the RFL 9508D UCC is easy to configure and manage, integrating with multi-vendor network management systems via SNMP-compliant MIBs and user-friendly Windows graphical management.

Supports Industry Standards

Seamless interconnectivity is not limited to voice, however, the RFL 9508D UCC also offers flexible data protocol support and interfaces with a wide range of network services and user requirements.

UCC System Details

Standalone base unit with 19" rack mount

- One V.35 universal serial port (link)
- Two 10/100BaseT Ethernet (RJ45 connectors)
- 3 expansion slots for interface cards

Available Interface Modules

Analog telephony interface cards:

- 2 and 4-port FXS modules with on-board DSP, (RJ11 connector)
- 2 and 4-port FXO modules with on-board DSP (RJ11 connector)
- 4-port E&M module with on-board DSP (2 or 4 wire, types I, II, or V, 600 ohms, RJ48 connectors)

Data interface cards:

- 2-port universal serial WAN interface, DTE or DCE, compatible with RS-232/V.24, V.35, X.21/V.11, RS-449/V.36, RS-530, internal/external clocking

Network Connections

- Network Topology: mesh, hierarchical, star, point-to point, Automatic node discovery and rerouting with least cost metric routing

Link Port Protocols

Power Lines:

- Serial synchronous full duplex, Frame Relay, HDLC and PPP, PowerCell
- IP WAN

Channel Density

Maximum telephony channels:

Up to 8FXS, FXO, or E&M

Maximum data channels:

Up to 4 serial data ports with optional serial port extender chassis

Telephony Features

Voice compression algorithms (5 channels per DSP):

ACELP-CN (8K/6K with fallback), G.711 (PCM 64K), G.723.1 (Low 5.3K/High 6.3K), G.726, (ADP-CM 16K/24K/32K/40K), G.729 and G.729a (8K)

FAX Relay: Group III FAX 4.8, 7.2, 9.6, 12.0, 14.4 Kbps

Modem Relay:

V.32bis demodulation up to 14.4Kbps, modem pass through (G.711)

Any-to-any switching, using PowerCell over PVC or Frame Relay SVC, or SIP (Session Initiated Protocol) VoIP, including end-to-end QSIG/ISDN support for supplementary services

Analog telephony channels:

FXS: loop and ground start, forward disconnect, caller ID and billing tone generation

FXO: loop start, forward disconnect and caller ID detection

E&M: immediate and wink start, custom

Digital telephony channels:

Digital CAS Signaling types: Immediate, Wink, FXO, FXS, FXO ground, FXS ground, E1/R2, PLAR, custom

Pulse and tone dialing

Voice traffic routing with alternate destinations and digits manipulation using local mapping tables, locally switched TDM calls (hairpin)

VoIP peer-to-peer calling with ingress and egress dialing plan, centralized dialing plan using SIP Redirect, and registration to optional SIP proxy

LAN Support

Two independent fully routed 10/100BaseT ports, two IP address per port

Ethernet interfaces: Ethernet II and IEEE 802.2, 802.3, SNAP

Network Management

SNMP management via Network Management System (NMS).

Menu driven async console port (VT-100) via DB9 male connector, auto-sensing DTE/DCE

Remote Telnet access to command port

FTP upload and download of software and configuration

Username/password security control, Radius Authentication for console and Telnet access

Administrative filtering

General Specifications (continued)

UCC Physical Characteristics

Dimensions: 3.5" H x 16.8" W x 12.2" D
(8.9 cm H x 42.7 cm W x 31 cm D)
Typical weight: 10 lbs. (4.5 kg)

Environment Tolerances

Operating Temperature: 0° to 45° Celsius
Relative Humidity: 10% to 90%, non - condensing

Tested Under the Following Standards

IEC 60834-1, IEC 60068-1-1, IEC 60068-2-2, IEC 60068-2-3, IEC 60255-1, IEC 60255-21-2, IEC 60255-21-3

Integrated or External Teleprotection

The RFL 9508D UCC is available with either integrated teleprotection or with an external distant teleprotection system known as RFL 9508 RT. Both systems use a four function plug-in Modular Transfer Trip System (MTS) based on the proven F6 protection scheme.

The system is suitable for Direct Transfer Trip (DTT), Permissive Transfer Trip (PTT), Blocking and Unblocking applications. The RFL 9508D UCC and RFL 9508 RT comply to the IEC-60834 teleprotection standard.

The MTS system is comprised of two parts, the MTS module and the I/O modules. Together these modules work with the balance of the RFL 9508D UCC system to provide four-function teleprotection. Up to two MTS modules can be used in each system to provide up to eight functions of teleprotection.

The MTS module senses the inputs, de-bounces them, applies a small amount of logic, and passes them in a timeslot on the E1/T1 link to the transceiver. The MTS limits commands to 2 seconds, returning to the guard states after that time, even if the inputs remain keyed. The MTS user interface is in the IMUX NMS. Two and four function relay and solid-state I/O's are available. Additional I/O for providing parallel contacts is also supported.

The PLC transceiver DSP decodes the message from the MTS and creates the necessary tones to transfer the command to the other end. The other end receives the tones, performs the necessary actions to generate the needed security and dependability, and sends the information to the MTS via the E1/T1 link.

RFL 9508 RT Distant

Teleprotection via Optic Link

Many times the protective relays are not located in the same building as the communications systems that are used to transmit the relaying signals.

A unique feature of the RFL 9508D UCC is that the teleprotection modules can be housed in a separate chassis and communicate with the RFL 9508D UCC via fiber optic cable. The teleprotection chassis can be located up to 113km (70 miles) from the RFL 9508D UCC depending on the type of fiber optic transceiver selected. This chassis is known as the RFL 9508 RT.

General Specification

F6 teleprotection is a single tone system that sends only one tone at a time, making it ideal for PLC. Different combinations of inputs use a priority scheme to generate the correct tone and the correct output on the receiving side. This system can have two, four or eight inputs and outputs, which are programmable. Each input can be optionally inverted or not and if 8 inputs are employed, paired inputs can be AND'ed or OR'ed to form each of the 4 command inputs.

Once the input commands have been determined, the transmitted command is determined according to the priority chart. Two charts are available, based on the mode setting, "2+2" or "3+1" each provides up to four prioritized commands. The 2+2 mode is typically used for parallel line applications, while the 3+1 mode is typically used for single pole trip applications. The transmitted command is sent to the PLC transceiver after an appropriate de-bounce period.

Integrated Test Switch

The MTS module supports the connection of an internal test panel. The test panel can be mounted inside the door of the chassis and connect to the MTS via an 8 wire cable.

The test panel has a 10 position rotary switch, a push-button, and two-toggle switches. The rotary switch has Normal, Input #1, Input #2, Input #3, and Input #4 positions. The test switch can accommodate 2 MTS cards.

Selecting input 1 through 4 positions will not do anything until the push-button is pressed. Pressing the push-button will send the command corresponding to the selected position.

The toggle switch disables the local outputs.

Depending on the mode and the command, the transceiver sends one frequency for the entire time or switches back and forth between two frequencies. The single frequency is considered un-coded operation. Un-coded is less secure and is used for permissive or blocking applications. Coded transmission consists of two frequencies sent one after the other for a specified time. The receiver must receive each tone for a specified time period before declaring a valid trip reception.

Once the receiving DSP has determined that a valid trip has been received, the RX trip command is sent to the MTS where it is decoded into output contacts according to a user setup similar to that for the inputs.

Features and Specifications

Additional Features

Selectable Unblock Logic

In the event that the receiver enters an alarm state, the outputs programmed for unblocking will go active after 20 ms and will remain active for 150 ms.

Integrated SOE

The MTS stores up to 100 events including; Time/Date, and Input/Output contact status.

Trip Counters

Trip counters record how many times each command is sent or received. The counters roll over after 255 counts.

Teleprotection Electrical Specifications

Optically Isolated Inputs:

Operating Voltage Range:

48 Vdc	38-60 Vdc
125 Vdc	88-150 Vdc
250 Vdc	200-280 Vdc

Input threshold 1/2 normal station battery.

Solid-State Outputs:

Maximum continuous output current	1 A
Minimum output current	20 mA
Maximum open circuit voltage	280 Vdc
Maximum turn on delay	100 ms

Optional Relay Outputs:

Maximum continuous output current	2 A (inductive)
Maximum surge current (100ms)	30 A

Maximum breaking current	1 A (resistive)
Maximum open circuit voltage	280Vdc
Maximum operate time	5 ms
ESD Withstand	IEC-610004-2, ANSI C37.90.3
RFI Withstand	IEC-60834, ANSI C37.90.2
SWC Withstand	IEC-801-4, ANSI C37.90.1
Dielectric Withstand	2500 Vdc per IEC-60255-22-1 and IEC-60834-1

Alarm Relay

Output Form	"C" (spdt)
Open Circuit Voltage	300 Vdc
Current (continuous)	1 A
Breaking Current	1 A, Non-inductive

Technical Specifications

RF Band

Frequency range	20 to 500 kHz
Full duplex Channels	1 RF Channel
Channel Bandwidth	2.5, 4, 8 or 16 kHz
Selectivity	
Overall (4 kHz from Bandedge)	<= -75 dBmO
Channel (0.3 kHz from Bandedge)	<= -65 dBmO
Impedance	50, 75, 100 or 150 Ohms unbalanced or balanced

Harmonic Distortion	<= -40 dBmO F=400 Hz (IEC 495 recomm)
Group Delay	(IEC 495 recomm)
Frequency Stability	3 0.5 Hz at 250 kHz (32 ppm)
Tx Line Filters	Adjustable from 20 to 500 kHz
Rx Line Filters	Adjustable from 20 to 500 kHz
Minimum sensitivity	-30 dBm

AF Band

AGC dynamic range	+14 to -26 dB, or + 20dB
Background Noise	<= -55 dBmOp (IEC 495 recomm)

Guard

Frequency	3825, 3600, 2385 or 7825 Hz
Type of modulation	FSK
Frequency shift	3 30 Hz from channel center frequency

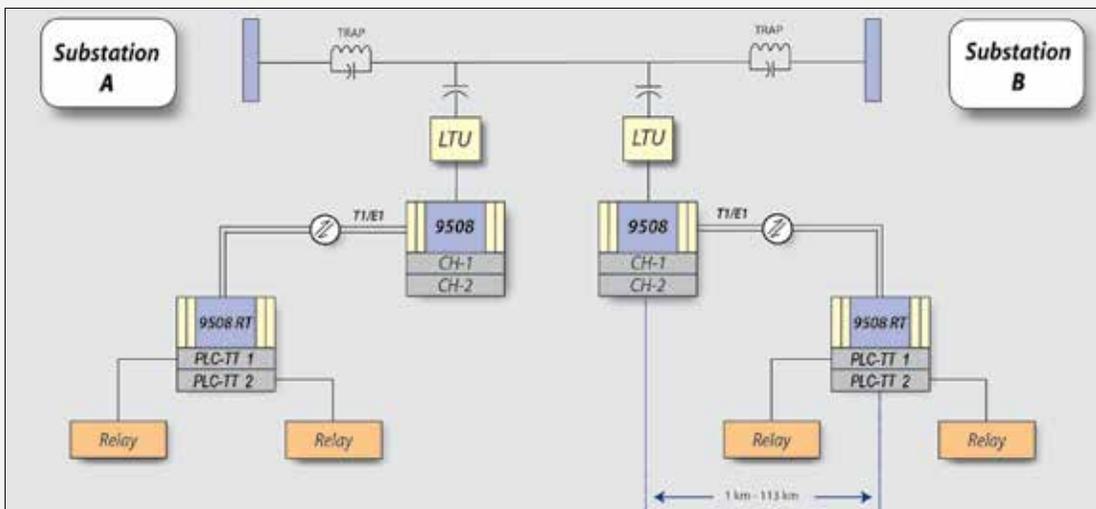


Figure 3. Distant Teleprotection via Optic Link

Data Transmission

Environmental Conditions

Ambient Temperature Range -20 to + 65°C
 Relative Humidity 0 to 95% non condensing

Weight

50W RFL 9508 38 lbs / 17.3 kg
 100W RFL 9508 54 lbs / 24.6 kg

Data Transmission Characteristics

This transceiver is intended for use on connections on Power Line Carrier Systems on point-to-point, mesh, hierarchical or star topology. The principal characteristics of the Transceiver are as follows:

- A. Duplex mode of operation.
- B. Channel separation by echo cancellation techniques;
- C. Quadrature Amplitude Modulation (QAM) for each channel with synchronous line transmission at selectable symbol rates of 2400, 3000, 3200, 3429 symbols/s.
- D. Depending on the Power Line Conditions, the following standard Synchronous channel data signaling rates can be achieved:

- 62.400 bit/s;	- 38.400 bit/s;	- 24 000 bit/s;	- 12 000 bit/s;
- 57.6 00 bit/s;	- 33 600 bit/s;	- 21 600 bit/s;	- 9600 bit/s;
- 52.800 bit/s;	- 31 200 bit/s;	- 19 200 bit/s;	- 7200 bit/s;
- 48.000 bit/s;	- 28 800 bit/s;	- 16 800 bit/s;	- 4800 bit/s;
- 43.2 00 bit/s;	- 26 400 bit/s;	- 14 400 bit/s;	- 2400 bit/s;

- E. Trellis coding for all data signaling rates;
- F. Adaptive techniques that enable the modem to achieve close to the maximum data signaling rate the channel can support on each connection;
- G. Exchange of rate sequences during start-up to establish the data signaling rate.
- H. Modulation : It is an Adaptive Trellis Code Modulation with Multidimensional Error Correction resulting in fractional bits per symbol, from 4 QAM to 1024 QAM, depending on the Power Line Conditions and Bandwidth available.

Input Command	TX Command (actual TX)	Frequency (2 / coded)	Receiver outputs
No input	None	Guard	None
A	A	F3	A
B	B	F5	B
A&B	A&B	F7	A&B
C	C	F2,F4	C
D	D	F2,F6	D
C&D	C&D	F4,F6	C&D
A&D	A&D	F6,F8	A&D
B&C	B&C	F4,F8	B&C
A&C	C	F2,F4	C
B&D	D	F2,F6	D
A&B&C	B&C	F4,F8	B&C
A&B&D	A&D	F6,F8	A&D
A&C&D	C&D	F4,F6	C&D
B&C&D	C&D	F4,F6	C&D
A&B&C&D	C&D	F4,F6	C&D

Figure 4. Command Priority Table for “2+2” Mode

Input Command	TX Command (actual TX)	Frequency (2 / coded)	Receiver outputs
No input	None	Pilot	None
A	A	F3	A
B	B	F5	B
A&B	D	F2,F6	D
C	C	F7	C
D	D	F2,F6	D
C&D	D	F2,F6	D
A&D	D	F2,F6	D
B&C	D	F2,F6	D
A&C	D	F2,F6	D
B&D	D	F2,F6	D
A&B&C	D	F2,F6	D
A&B&D	D	F2,F6	D
A&C&D	D	F2,F6	D
B&C&D	D	F2,F6	D
A&B&C&D	D	F2,F6	D

Figure 5. Command Priority Table for “3+1” Mode

Ordering Information

RFL 9508D UCC - Digital PLC Ordering Information			
RFL Part Number (fill in blanks):		9508D	
Base System			
Chassis with Digital Interface			
Power Supply			
38-150 Vdc	A		
200-300 Vdc	B		
RF Power Options			
50W		0	
100W		1	
Integral Teleprotection Modules			
None		0	
One		1	
Two		2	
Teleprotection I/O (Select 2)			
None or External (if External choose Drop and Insert Mode)		0	
MTS w/2 function Solid State 48/125 Vdc		1	
MTS w/2 function Solid State 250 Vdc		2	
MTS w/4 function Solid State 48/125 Vdc		3	
MTS w/4 function Solid State 250 Vdc		4	
MTS w/2 function Relay 48/125 Vdc		5	
MTS w/2 function Relay 250 Vdc		6	
MTS w/4 function Relay 48/125 Vdc		7	
MTS w/4 function Relay 250 Vdc		8	
Drop and Insert Mode			
None		0	
Electrical T1 (MA-278)		A	
Electrical E1 75 ohm (MA-271)		B	
Fiber 820 nm Multimode		C	
Fiber 1300 nm LED singlemode		D	
Fiber 1300 nm Laser singlemode		E	
Fiber 1550 nm Laser singlemode		F	
Special Options			
None		0	
Special Configuration		X	
Ethernet remote access (MA-490)		1	

UCC - Packetizing Multiplexer Ordering Information			
RFL Part Number (fill in blanks):		UCC	
Base System			
Base Chassis (See Note 1 Below)			
Expansion Slot 1,2, and 3			
None	A	A	A
2 Serial Data Ports	B	B	B
2 2-Wire FXO Ports	C	C	C
4 2-Wire FXO Ports	D	D	D
2 2-Wire FXS Ports	E	E	E
4 2-Wire FXS Ports	F	F	F
4 4W E&M Ports	G	G	G
IP WAN			
Yes			0
No			1

Notes:

1. Base UCC system includes -48VDC power supply, 2 LAN ports, 1 serial port which is used to connect to the above 9508D chassis, and 3 expansion slots

Ordering information (continued)

RFL 9508 Remote Trip Chassis PLC Ordering Information		
RFL Part Number (fill in blanks):		9508RT
Base System		
Chassis		
Power Supply		
38-150 Vdc	A	
200-300 Vdc	B	
Remote Teleprotection Modules		
One	1	
Two	2	
Teleprotection I/O (Select 2)		
None	0	
PLC-TT w/2 function Solid State 48/125 Vdc	1	
PLC-TT w/2 function Solid State 250 Vdc	2	
PLC-TT w/4 function Solid State 48/125 Vdc	3	
PLC-TT w/4 function Solid State 250 Vdc	4	
PLC-TT w/2 function Relay 48/125 Vdc	5	
PLC-TT w/2 function Relay 250 Vdc	6	
PLC-TT w/4 function Relay 48/125 Vdc	7	
PLC-TT w/4 function Relay 250 Vdc	8	
Remote Interface		
Electrical T1/E1 (MA-278)	A	
Electrical E1 75 ohm (MA-271)	B	
Fiber 820 nm Multimode	C	
Fiber 1300 nm LED singlemode	D	
Fiber 1300 nm Laser singlemode	E	
Fiber 1550 nm Laser singlemode	F	
PLC Audio Options (Select 2) Note: If orderwire is required a VF-5XP must be selected.		
None	0	
Speech Plus with comp. blocks(VF-5XP, MA-301B)	A	
Speech Plus with screw terminals (VF-5XP, MA-301A)	B	
Speech with comp. blocks (VF-5C, MA-301B)	C	
Speech with 50 Pin telco (VF-5C, MA-301)	D	
Speech with screw terminals (VF-5C, MA-301A)	E	
FXO with Modular Jacks (VF-15C-1, MA-303)	F	
FXS with Modular Jacks (VF-16B-1, MA-303)	G	
Orderwire with comp. blocks (VF-6I, MA-301B)	H	
Orderwire with screw terminals (VF-6I, MA-301A-1)	J	
Selective Calling Module (VF-8A, MA-306)	K	
Special Options		
None	0	
Special Configuration	X	
Ethernet remote access (MA-490)	1	



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