ECHELON®

Description

The LonBuilder Developer's Kit includes all the tools and components needed to develop LONWORKS® devices and systems. The LonBuilder Developer's Kit includes the following components:

▼ *The LonBuilder Developer's Workbench, the heart of the LonBuilder Developer's Kit.* The LonBuilder Developer's Workbench integrates three development tools—a multi-device development system, a network manager, and a protocol analyzer—into a single, easy-to-use development environment. The multi-device development system provides the tools to create software applications and to prototype hardware on a development network of two to hundreds of devices.

▼ *Four Free Topology transceivers (FTM-10).* The FTM-10 transceivers provide a high-speed twisted pair transceiver to integrate the devices in the LonBuilder Developer's Workbench with external devices into a prototype network.

▼ *The DDE Server.* The DDE Server lets you quickly create graphical user interfaces for your LONWORKS networks using any Windows application that has Dynamic Data Exchange (DDE) capability.

▼ *A PCNSI PC Network Services Interface Card.* The PCNSI provides a high-performance network interface for use with the DDE Server, LonMaker™ Integration Tool, LNS™ for Windows, or your own custom host applications.

▼ One LonSupport™ Site-Pack.

The DDE Server and the PCNSI may be installed in a separate PC from the LonBuilder tools to allow network services application development and application device development to proceed in parallel.

▼ Integrated compiler for the Neuron® C programming language simplifies development of applications for control networks with networking and real-time language extensions

▼ Compiles, links, and loads Neuron C applications on multiple LONWORKS devices in a development network using a single command

▼ Includes two emulators for hardware-assisted debugging

▼ Integrated Neuron C debugger provides a source-level view of multiple Neuron C applications running on multiple emulators

▼ Integrated network variable browser provides a network view of any LONWORKS application while it is running

▼ Includes a protocol analyzer for monitoring and analyzing network communications

▼ Tests prototype I/O and transceiver hardware using the LonBuilder hardware

▼ Integrates devices into networks using the LonBuilder Network Manager

▼ Tests custom I/O devices using the LonBuilder Application Interface Kit

▼ Communicates with custom devices on an external network

▼ Includes a DDE Server and PCNSI PC Interface Card

LonBuilder Software

The LonBuilder software integrates into a single, seamless environment, the software tools required to create LONWORKS devices and networks. These tools include the following:

▼ An editor, compiler, and source-level debugger, used to create and debug application programs for the Neuron Chip

▼ A network manager used to install and configure devices on a development network, making the network as easy to build as it is to program an individual device.

▼ A protocol analyzer used to monitor the development network and interpret its activity—allowing network debugging without requiring LONWORKS protocol expertise.

The integrated environment minimizes learning time and maximizes productivity for developers creating applications for control networks. Developers have found that they can create complex control network applications within weeks of receiving their first LonBuilder Developer's Kit.

Development Station Hardware

The development station is an expandable hardware platform that includes two LONWORKS devices, one for network management and one for protocol analysis. A free topology network is included for network communications among LonBuilder processor boards installed in the development station, and external free topology or link power devices.

The development station hardware simplifies control network debugging by combining network management and analysis tools with a platform that can hold up to six emulators. Up to four development stations can be daisy-chained together to debug applications on up to 24 emulators simultaneously.

Two Neuron Emulators

This pair of LONWORKS devices is used with the Neuron C Debugger for running and debugging Neuron C programs and for testing prototype I/O and transceiver hardware.

The two Neuron emulators allow application programs to be debugged on two devices simultaneously as they interact over the network. The emulators and Neuron C Debugger are used to single-step, set breakpoints, and modify application and network variables in two application programs running in parallel.

The emulators can communicate with each other, the network manager, and the protocol analyzer over the free topology network included with the development station.

LonBuilder Interface Adapter and Cable

The interface adapter is a half-length, 8-bit ISA compatible card that can be installed in any ISA compatible slot in an IBM PC compatible computer. The interface adapter provides a high-speed, 10Mbps connection between the host PC and the development station hardware. A single interface adapter can be used with up to four daisy-chained development stations.

The interface adapter reduces total investment by allowing developers to use their existing PCs with the LonBuilder tools.

A 3m (10') cable is used to connect the interface adapter to the development station. The 3m length of the interface cable allows development station hardware to be placed near prototype hardware.

LONWORKS Transceivers

The LonBuilder Developer's Kit base system includes four LonBuilder SMX™ Adapters and four FTM-10 Free Topology Modular Transceivers. The LonBuilder SMX Adapters and FTM-10 SMX-compatible transceivers are installed in the two Neuron emulators, and in the development station network management and protocol analysis devices.

The LonBuilder Developer's Kit is available in seven channel type configurations. Specify one of the following media kits when ordering:

▼ *TP/FT-10* — includes one additional FTM-10 Free Topology Modular Transceiver, which is installed in the PCNSI PC Interface Card.

▼ *TP/XF-1250* — includes five TPM//XF-1250 Twisted Pair Modular Transceivers. Four of these are installed in the two Neuron emulators, and in the development station network management and protocol analysis devices. One TPM/XF-1250 transceiver is installed in the PCNSI PC Interface Card.

▼ *TP/XF-78* — includes five TPM//XF-78 Twisted Pair Modular Transceivers. Four of these are installed in the two Neuron emulators, and in the development station network management and protocol analysis devices. One TPM/XF-78 transceiver is installed in the PCNSI PC Interface Card.

▼ *PL-20 C-Band Line-to-Earth* — includes two PLM-22 C-Band Power Line Modular Transceivers, two PL-20 0-120VAC or DC Line-to-Earth Couplers; compatible with PLT-22 transceivers (5kbps, FCC and CENELEC EN50065-1 125-140kHz BPSK), one LonBuilder Router, two LonBuilder SMX Adapters and one FTM-10 Free Topology Modular Transceiver. One PLM-22 transceiver is installed in the PCNSI PC Interface Card.

▼ *PL-20 C-Band Line-to-Neutral* — includes two PLM-22 C-Band Power Line Modular Transceivers, two PL-20 0-240VAC or DC Line-to-Neutral Couplers; compatible with PLT-22 transceivers (5kbps, FCC and CENELEC EN50065-1 125-140kHz BPSK), one LonBuilder Router, two LonBuilder SMX Adapters and one FTM-10 Free Topology Modular Transceiver. One PLM-22 transceiver is installed in the PCNSI PC Interface Card.

Application Interface Kit

This kit includes an application interface board and cable used to connect custom I/O and transceiver hardware to a Neuron emulator. To allow in-circuit testing of custom device hardware, the kit includes a LonBuilder Module Application Interface (for devices based on LONWORKS control modules) and a LonBuilder Application Interface Adapter for use with either a Neuron 3150® or 3120® adapter from Emulation Technologies (for devices that do not use LONWORKS control modules).

The application interface kit minimizes hardware development time and expense by allowing I/O and transceiver prototypes to be tested with emulator hardware prior to building complete custom devices.

DDE Server

The Dynamic Data Exchange (DDE) Server gives any DDE-compatible Microsoft Windows application the ability to monitor and control LONWORKS networks—without programming.

DDE defines a standard way for Microsoft Windows applications to share information with one another. The DDE Server makes it easy to add a graphical user interface to a LONWORKS network. Using the DDE Server, any DDE-compatible Windows application can observe the values of network variables and application messages, and can change the value of network variables or send application messages to effect the operation of the network.

PCNSI PC Interface Card

The PCNSI PC Interface Card provides ISA-bus PCs with a high-performance interface (up to 228 packets per second) to LON-WORKS networks. When equipped with a PCNSI, PCs can be used for centralized monitoring, control, and network management of LONWORKS networks. The PCNSI can be used as an LNS network interface for the LonMaker Integration Tool and other LNS tools. The PCNSI can also be used to develop high performance gateways to other networks and systems.

The PCNSI uses LONWORKS SMX transceivers to provide a flexible solution for interfacing to any LONWORKS communications media.

LonBuilder Router

The LonBuilder Router included with the LonBuilder power line media kits supports development of networks with multiple communication channels and media. When installed in the development station and used with two transceivers, the LonBuilder Router can be used to connect the free topology network in the development station to an external network.

The LonBuilder Router is included as part of the PL-10, PL-20, and PL-30 LonBuilder media kits. Two SMX Adapters, one of the SMX-compatible power line transceivers, and one FTM-10 free topology transceiver are installed on the router in order to connect the development station twisted pair network to an external power line network.

The router makes it easy to connect the development station to any type of external network. The transceivers installed in the router can be changed at any time to connect the development station to different communication channels. Multiple routers can be installed in a development station to connect to multiple communication channels simultaneously.

The LonBuilder Router may also be used outside of a development station with two transceivers to connect between any pair of communication channels.

Usage

The LonBuilder Developer's Workbench is used to create custom LONWORKS devices. Custom LONWORKS devices combine a Neuron Chip, I/O, communications transceiver, and a custom application to both interact with a local I/O device and to communicate with other devices on a LONWORKS network.

The following figure illustrates the components of a typical custom device.
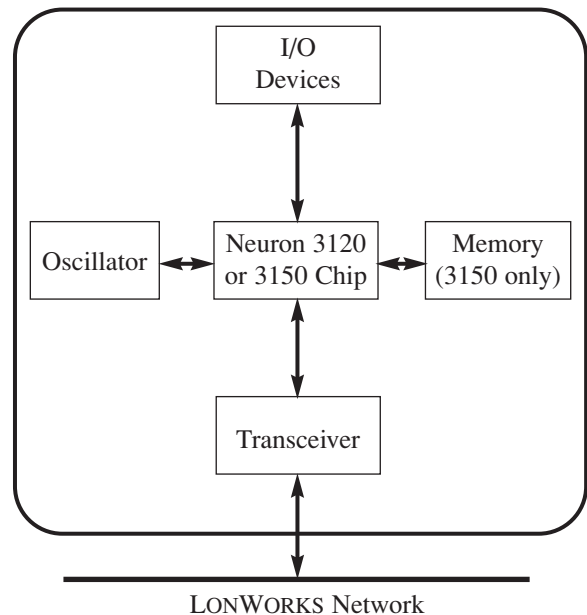
LONWORKS Network

Using the LonBuilder tools, developers can create custom LONWORKS devices with minimal training and without inventing new tools or learning complex networking protocols. The LonBuilder tools are used with LONWORKS OEM components as described below to:

▼ *Write and compile application code for Neuron Chips using Neuron C*. Neuron C is a high-level language based on ANSI C with extensions for network communications and high-level hardware device interfaces. Writing code to communicate with other devices across a LONWORKS network requires only two lines of code: one to declare a network variable and one to assign a value to the network variable. Network variables look like standard variables to the application programmer, but the LONWORKS protocol allows network variables to be shared among any group of devices on a LONWORKS network.

Interfacing to complex hardware devices is just as easy. For example, controlling a triac again only requires two lines of code—one to declare a triac I/O object and one to set the triac delay to a new value.

The LonBuilder software includes an integrated editor that simplifies entry of code. The Neuron C Compiler compiles application code and the compiler is integrated with the editor so that any syntax errors are highlighted in the editor along with the compiler error message.

▼ *Build and load applications in multiple devices on a LONWORKS network*. During development, the developer creates a development network consisting of devices running on the LonBuilder hardware and devices running on developer-created hardware. The LonBuilder software includes a project

manager that automatically builds the memory images for all the devices on the development network, loads the devices, and starts the applications—all with one command. This one-touch operation makes networks easy to build and manage—freeing the developer to concentrate on the application rather than the tools. The LonBuilder software can load application programs using a high-speed interface to the LonBuilder hardware, over the network to custom devices, or through PROMs using an export file for standard PROM programmers.

▼ *Debug Neuron C applications using the Neuron C Debugger and LonBuilder Neuron Emulator.* The Neuron C Debugger provides a source-level view of the developer 's application program. It enables the developer to stop the program at any point, run the program one Neuron C instruction at a time, and symbolically view, modify, and watch any variables in the program. The debugger includes built-in support for the Neuron C networking extensions, so debugging network code is as easy as reading and modifying a local variable.

The debugger also includes built-in support for multiple emulators, so that application programs can be debugged on 1 to 24 emulators simultaneously. This simplifies debugging of network applications since the developer may not know which device is at fault when an error occurs. Using the debugger and multiple emulators, the flow of execution of an application can easily be traced from a hardware sensor's input on one emulator, to transmission of the new sensor state over the network to a second emulator, to calculation of the required response on the second emulator, to a hardware actuator's output on the second emulator.

▼ *Test prototype I/O and communications transceiver hardware using the LonBuilder hardware.* Devices on a LONWORKS network typically have two types of interfaces—a local interface to an I//O device and a communications interface to the LONWORKS network. Off-the-shelf OEM transceivers from Echelon are usually used for the communications interface, but the I/O interface is typically unique for each application. To simplify testing with any I/O device or communications transceiver, the Neuron emulators incorporate two expansion slots—one for an external I/O device interface and one for a communications transceiver. These expansion slots are used to test prototype I/O and transceiver hardware using an application program running on the emulator. This allows new hardware to be prototyped incrementally reducing development risk and minimizing costly hardware revisions.

The LonBuilder SMX Adapter allows the use of any SMX-compatible transceiver with the LonBuilder hardware. These transceivers are available for twisted pair, free topology, and power line communications so that networks can be prototyped without developing control or transceiver hardware. These transceivers are compatible with OEM transceiver and control modules available from Echelon so that production hardware can be built with OEM modules that are completely interoperable with prototype hardware built with the LonBuilder hardware.

▼ *Integrate and test LONWORKS devices on a development network using the LonBuilder Network Manager.* The network manager installs LonBuilder devices, custom devices, and routers on the development network by assigning network addresses to each device, binding network variable addresses to each network variable, configuring each device and router based on transceiver types and network topology, and maintaining a database of the network configuration. The network manager frees the developer from learning the addressing, binding, and configuration details of the LONWORKS protocol, as these details are managed transparently and automatically by the network manager. The network manager does its work without modifying applications—the LONWORKS protocol allows application programs to be completely independent of network configuration.

The network manager supports network testing by allowing the developer to view, modify, and watch any network variable on any device on the development network. Network variables are viewed and modified symbolically, using device names and network variable names assigned by the developer. The network manager also gives the developer control over each device on the development network by providing commands to take any device offline, put any device online, or reset any device. This further simplifies network testing by giving the developer control over which devices on the development network are operational at any time.

OEM products are also available from Echelon® to simplify field installation of LONWORKS networks. The LonMaker Integration Tool provides a turnkey network integration tool.

The LONWORKS Module Application Interface (MAI) is an interface board that is plug compatible with the LONWORKS TP/FT-10, TP/FT-10F, TP/XF-78, TP/XF-78F, TP/XF-1250, and LTM-10 Control Modules. The MAI replaces the control module in a custom device so that the LonBuilder emulator can be used to debug the custom hardware. This simplifies testing since the application can be easily downloaded to the LonBuilder emulator during development and testing. Once the application has been debugged, the MAI can be replaced by the control module with the application programmed into the control module 's PROM.

▼ *Create multi-channel networks during development using routers.* Multiple communications channels may be used during development to simplify development and to simulate a multi-channel production network. Multiple channels are used in production networks to increase system capacity, reduce installation cost, and increase system reliability. Multiple channels are linked using routers, which are installation devices that selectively pass packets between two communications channels.

The LonBuilder Router is used during development with any pair of LonBuilder transceivers to create a router between any pair of channels. OEM routers are used in production networks to install multi-channel systems. Application programs are independent of network topology, so applications do not

have to be modified when routers are added, removed, or changed in a network. LONWORKS installation tools such as the LonMaker tool, tools based on LNS for Windows, or the LonBuilder Network Manager automatically reconfigure devices and routers when the network topology changes—making router installation a simple process.

▼ *Analyze network behavior using the LonBuilder Protocol Analyzer.* The protocol analyzer simplifies testing of network applications by collecting, time stamping, and saving all network communications into log files that can be later viewed and analyzed by the developer. The protocol analyzer decodes and displays log files so that the developer does not have to interpret the ones and zeros of the LONWORKS protocol. Instead, each packet is displayed using the device and network variable names assigned by the developer, along with a description of the LONWORKS protocol services used to transmit the packet. The developer can also create filters that limit the packets collected to packets to or from specific devices or network variables and to packets using selected LONWORKS protocol services. This further simplifies network application debugging by limiting the packet log files to relevant packets only.

The protocol analyzer also provides snapshots of network behavior using a detailed network statistics display. The statistics display includes total packet counts, error packet counts, and average network loading. The statistics display provides the developer with an easy-to-read summary of network activity.

Echelon also offers an OEM protocol analyzer, the LonManager Protocol Analyzer that provides an enhanced set of protocol analysis services for field diagnostics and maintenance.

▼ *Create application programs for any host processor using a LONWORKS network interface.* While the Neuron Chip is ideally suited as the sole processor in most LONWORKS devices, some devices require additional processing or need to interface with a different processor. For these devices, a LONWORKS network interface is used to provide a communications interface between the host processor and a LONWORKS network. A network interface may also be used for existing applications that are migrating to LONWORKS.

The network interface processes layers 1 through 5 of the LONWORKS protocol, reducing network processing overhead on the host and simplifying implementation of the host application. The host application implements layers 6 and 7 of the LONWORKS protocol, giving the host the ability to send and receive network variables. The LonBuilder Network Manager and Protocol Analyzer can both be used with these host applications, allowing host applications to be integrated and tested on the development network.

The LonManager PCNSI Interface Card included in the LonBuilder Developer's Kit is a high performance network interface for ISA-bus compatible PCs which supports LNS tools including the LonMaker Integration tool, and uses SMX Modular Transceiver.

The PCC-10 PC Card Network Adapter is a type 2 PC Card (formerly PCMCIA) network interface with integral FT-10 free topology transceiver for laptop PCs. The PCLTA-20/FT-10 is a single channel plug-and-play network interface with integral TP/FT-10 free topology transceiver for PCI-bus desktop PCs. The PCLTA-10/FT-10 is a single channel plug-and-play network interface with integral TP/FT-10 free topology transceiver for ISA-bus desktop PCs. These three devices provide a high-performance network interface, which also supports LNS tools.

For non-PC hosts, or PCs without an available half-size slot, the SLTA-10 Serial LonTalk Adapter provides an integrated network interface with a high-speed (115,200bps) EIA-232 serial interface to the host and a twisted pair communications transceiver. The SLTA-10 also supports LNS tools.

Custom network interfaces can be built with the LTM-10 LonTalk Module, LTS-20 SLTA Core Module, or with the LONWORKS Microprocessor Interface Program (MIP).

The DDE Server included with the LonBuilder Developer's Kit can be used to develop host applications running under Microsoft Windows using the Windows standard DDE protocol. Additional copies of the DDE Server can be purchased as needed. The LNS DDE Server is a 32-bit DDE Server that is based on LNS and is compatible with the LonMaker Integration Tool. For 32-bit Windows applications not based on DDE, the LNS Developer's Kit for Windows can be used to develop custom host applications.

▼ *Transition to manufacturing by exporting the required manufacturing support files.* Once an application has been fully debugged and tested, the LonBuilder software is used to export memory image files for use by any PROM programmer to create PROMs for application devices based on the Neuron 3150 Chip. PROMs can be made self-booting so that the on-chip EEPROM of the Neuron 3150 Chip does not have to be programmed prior to field installation. The LonBuilder software is also used to create application image files for use by a Neuron 3120 programmer. Memory images can also be created for use by a network tool to download new application programs in the field. The LonMaker Integration Tool, or a custom network tool created with an LNS Developer's Kit, can be used to download these images. This capability reduces maintenance costs by allowing application programs to be replaced over the network, even after devices have been installed in a production network.

Specifications

PC Requirements (PC not included)	
Processor	Pentium 150 or faster
Bus	8 or 16-bit ISA compatible (2 adjacent slots are required for the PLM-10, 20, and 30 transceivers)
Memory	32Mbytes min.
Floppy Drive	1.44Mbyte 3.5"
Hard Disk (available)	10Mbyte min.
Graphics Adapter	Windows compatible
Mouse	Windows compatible
OS	Windows 98 or Windows 95
PC I/O Addresses	
Interface Adapter	8 contiguous I/O locations starting at 200 hex to 3F0 hex (selected by DIP switch); default 310 hex
PCNSI	8 contiguous I/O ports starting at 200 hex to 3F0 hex (selected by DIP switch); default 340 hex
PC Bus Interrupts	
PCNSI	5, 9, 10, 11, 12, or 15 (software configurable)
Neuron C I/O Objects	Bit, byte, nibble input/output
	Bitshift input/output
	Dallas Touch input/output
	Dualslope input (for low-cost A/D)
	Edgedivide input/output
	Edgelog input
	Frequency output
	Infrared input
	I^2C input/output (requires license)
	Level detect input
	Magcard track 1 and 2 input (for ISO 7811 input)
	Muxbus input/output (multiplexed address/data)
	Neurowire input/output (National Semiconductor Microwire and Motorola SPI compatible)
	Oneshot output
	Ontime input
	Period input
	Pulsewidth output
	Parallel input/output
	Pulsecount input/output
	Quadrature input
	Serial input/output
	Totalcount input
	Triac output
	Triggeredcount output
	Wiegand input
Neuron C Network Communications Extensions	Network Variables
	Application and Foreign Frame Messages
	Network, I/O, and Timer Events
Neuron C Debugger Commands	Set or clear breakpoint
	Start, stop, continue, reset, single step, and trace application
	Select emulator
	View current source statement
	View file
	Display or clear error log
	Display call stack
	Evaluate, modify, and watch a variable
Project Manager Commands	Build (compile and link) and load all devices
	Install all network hardware

Integrated Editor Commands	Move cursor
	Select, cut, copy, paste, delete, and undelete text
	Open, save, save as, print, insert, and write file
	Find, translate, repeat find string
	Compile file
	Set options
	Load, save, playback, record, edit macro
	Close, go to, resize, zoom, next, previous window
	Execute DOS command
	Display help
Network Manager Commands	Create, copy, delete, modify network object
	Query network variable types
	View and modify network variables
	Set device online or offline
	Install, load, reset, test, wink, and export device
	View and modify device memory
Protocol Analyzer Commands	Create, enable, disable, clear, view, and delete packet log
	Display, clear, and update network statistics
	Define, enable, disable packet filter
Processor	
Network Manager	Neuron 3150 Chip
Protocol Analyzer	Neuron 3150 Chip
Neuron Emulator	Neuron 3150 Chip
PCNSI	Neuron 3150 Chip
Processor Input Clock	
Network Manager	5 or 10MHz
Protocol Analyzer	5 or 10MHz
Neuron Emulator	0.625, 1.25, 2.5, 5, or 10MHz
PCNSI	10MHz
Processor Memory	
Network Manager	32Kbytes
Protocol Analyzer	32Kbytes
Neuron Emulator	64Kbytes code/data dual-ported RAM, 64Kbytes control RAM
Operating Input Voltage	
Interface Adapter	5VDC ±5%
Development Station	100 to 120VAC and 200 to 240 VAC, 50 and 60 Hz
Operating Input Current	
Interface Adapter	500mA max.
AC Power Input	
Connector	IEC
North America/	North American NEMA 5-15R
Japan/ROW Cord	Continental Europe CEE 7
Europe Cord	British Standard BS 1363
U.K. Cord	
Power Supply Output	
Development Station	+5VDC @100W max.
	±12VDC @12W max.
Expansion Power	+5VDC @1A max. per expansion board, 2.8A max per development station
	±12VDC @35mA max. per expansion board
ESD Tolerance	15kV max.
Temperature	
Operating	0 to +40 °C
Non-operating	-20 to +65 °C

Dimensions	
Interface Adapter	99mm x 133mm x 11mm (3.9" x 5.25" x 0.44")
PCNSI	178mm x 114mm x 18mm (7.0" x 4.5" x 0.7")
Development Station	279mm x 445mm x 318mm (11" x 17.5" x 12.5")
Weight	
Development Station	12 kg (27 pounds)
EMI Compliance	FCC Level A, VDE Level A
Safety Compliance	UL, CSA, TÜV
System Capacity	
Emulators	24 max
Control Processors	4 max
Remote Devices	256 max
Routers	8 max

Documentation

The following documentation is included with the LonBuilder Developer's Kit. The documentation provides an overview of the development of LONWORKS applications for the Neuron Chip and provides a complete description of how to use the LonBuilder tools and create applications using the LonManager DDE Server.

Document	Echelon Part Number
LonBuilder Hardware Guide	078-0003-01
LonBuilder User's Guide	078-0001-01
Neuron C Programmer's Guide	078-0002-01
Neuron C Reference Guide	078-0140-01
PCNSI &PCNSS User's Guide	078-0144-01B

Ordering Information

The LonBuilder Developer's Kit is available in five configurations, depending on the selected transceiver.

Product	Echelon Model Number
LonBuilder Developer's Kit	
TP/FT-10 Free Topology Twisted Pair	20311-14P
PL-20 Power Line 0-120V, Line-to-Earth Coupling	20311-10-17P
PL-20 Power Line 0-240V, Line-to-Neutral Coupling	20311-21-17P
TP/XF-1250 Transformer Isolated Twisted Pair	20311-13P
TP/XF-78 Transformer Isolated Twisted Pair	20311-11P

Select P from the following power supply options:

        1. U.S. power supply

        2. European power supply

        3. U.K power supply

        4. Japanese power supply