



**PL DSK 2.3
Power Line Smart Transceiver
Development Support Kit
User's Guide**

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www.echelon.com

Welcome

The Power Line Development Support Kit (PL DSK) contains reference designs and documentation you may find useful when evaluating the PL Smart Transceiver technology. You do not need to install any software to use the PL DSK. See the *Reference Designs* section in this document for further information.

Evaluation boards (EVBs) and example applications that you can use to test Echelon's power line technology are available with Echelon's Model 10000R-40-27 Mini FX/PL Evaluation Kit. Schematics for these boards are included in the PL DSK **Examples** folder. The Mini FX kit includes a PL 3150 EVB and a PL 3170 EVB. The schematic for the PL 3120 EVB is the same as the PL 3170 EVB, except that the PL 3120 Smart Transceiver is replaced by a PL 3170 Smart Transceiver on the PL 3170 EVB.

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Reference Designs

The PL DSK **Reference Designs** directory contains a collection of reference designs for the external interface circuitry for PL Smart Transceivers. The reference designs address applications requiring different numbers of printed circuit board trace layers, single-sided or double-sided component assembly, various aspect ratios, and transmit current requirements. Each PL Smart Transceiver reference design package consists of a directory that contains all of the relevant files for that design.

Table 5 provides a brief introduction to the reference designs included with the PL DSK. The PL 3170 EVB Evaluation Board uses reference design 1201 and the PL 3150 EVB Evaluation Board uses reference design 1205. For further information on these reference designs, see Appendix A, *PL Smart Transceiver Reference Designs*, of the *PL 3120 / PL 3150/PL 3170 Power Line Smart Transceiver Data Book*. The data book is available in the documentation section of the Echelon Web site at <http://echelon.com/docs>.

Table 5 PL DSK Reference Designs

Reference Design Number	PL Smart Transceiver Model	Description	Directory Name
1200F	PL3170-E4T10	2 layer 23x63mm PCB layout with 1-sided component mounting and 1Ap-p transmit amplifier	Reference Designs\1200
1201F	PL3170-E4T10	4 layer 20x38mm PCB layout with 2-sided component mounting and 1Ap-p transmit amplifier	Reference Designs\1201
1204E	PL3170-E4T10	2 layer 33x38mm PCB layout with 1-sided component mounting and 1Ap-p transmit amplifier	Reference Designs\1204
1205E	PL3150-L10	4 layer 36x49mm PCB layout with 2-sided component mounting and 1Ap-p transmit amplifier	Reference Designs\1205
1209E	PL3170-E4T10	4 layer 31x53mm PCB layout with 2-sided component mounting and 2Ap-p transmit amplifier	Reference Designs\1205
1217D	PL3170-E4T10	4 layer 17x38mm PCB layout with 2-sided component mounting and 1Ap-p transmit amplifier (SIP Design)	Reference Designs\1217
1218E	PL3150-L10	4 layer 48x66mm PCB layout with 2-sided component mounting and 2Ap-p transmit amplifier	Reference Designs\1218

Reference Design Number	PL Smart Transceiver Model	Description	Directory Name
1255C	PL3170-E4T10	4 layer 17x28mm PCB layout with 2-sided component mounting and 1Ap-p transmit amplified (SIP Design)	Reference Designs\1255

PL EVB Peripheral Circuitry

As mentioned in the Welcome section of this guide, the PL DSK documentation includes schematics for the peripheral circuitry for the PL 3120 and PL 3150 EVB Evaluation Boards in the **Examples** directory. The schematics are the **PL_3120_Eval_Board_Schem.PDF** and **PL_3150_Eval_Board_Schem.PDF** files. The PL 3120 schematic is the same as the PL 3170 schematic and can be used for the 3170. The peripheral circuitry is the section of the evaluation board external to the core circuit. The core circuit is outlined in a box labeled **CORE** on the EVB. The core circuit includes the PL Smart Transceiver, and uses one of the reference designs as described in the previous section. The PL DSK also includes a schematic for the MiniGizmo board in the **Mini_Gizmo_Board_Schem.PDF** file.

Coupling Circuit Designs

Chapter 4 of the *PL 3120 / PL 3150/PL 3170 Power Line Smart Transceiver Data Book* provides schematics and components for coupling the PL Smart Transceivers to power mains. These coupling circuits have been optimized to provide low cost solutions. The examples referenced in Table 6, a summary to determine appropriate coupling circuits, are described in detail in the *PL 3120 / PL 3150/PL 3170 Power Line Smart Transceiver Data Book*.

For each schematic, the required component specification and example supplier/part numbers are provided. Vendor part number information is provided as a way to reduce component selection times, because the suggested parts have already been verified to meet all required specification. While surge testing must be performed for each new product design, using the recommended vendor part numbers has the additional advantage that they were the parts used for circuit verification by Echelon.

The correct Q2 through Q5 transistors for circuit design purposes are listed below.

Q2	Dual NPN/PNP	Dual NPN/PNP	OnSemi BC847BPDW1T1 ⁽¹⁾ or Panjit BC847BNP ⁽¹⁾
Q3	Dual NPN	Dual NPN	OnSemi BC847BDW1T1 ⁽¹⁾ or Diodes Inc. BC847BS ⁽¹⁾
Q4	NPN	NPN	Zetex FCX690B ⁽¹⁾ , or STM 2STF1360 ⁽¹⁾
Q5	PNP	PNP	Zetex FCX790A ⁽¹⁾ , or STM 2STF2360 ⁽¹⁾

(1) Only use a listed part for these locations. Do NOT substitute any other part.

Table 6 Coupling Circuit Selection Guide

Example	Connection Type	Line Voltage	Isolated/ Non-Isolated	Freq. Band	Typical Application(s)
1	1-Phase L-N	50-240VAC/ DC	Non-Isolated	A	Electric utility meters world-wide.
				C	Consumer, residential devices world-wide, commercial devices in CENELEC countries.
2	1-Phase L-N	50-240VAC/ DC	Isolated	A	Utility in-home devices world-wide.
				C	Consumer residential devices world-wide, commercial devices in CENELEC countries.
3	1-Phase L-E	100-277VAC	Non-Isolated	C	Commercial devices in North America.
4	1-Phase L-E	100-277VAC	Isolated	C	Commercial devices in North America.
5	3-Phase	100-277VAC	Non-Isolated	A	3-Phase utility devices world-wide.
				C	Commercial panel devices world-wide.
6	3-Phase	100-277VAC	Isolated	A	3-Phase utility devices world-wide.
				C	Commercial panel devices world-wide.
7	2-Phase	200-240VAC	Non-Isolated	A	2-Phase electric utility devices in North America and Japan.
				C	2-Phase consumer devices in North America and Japan.
8	2-Phase	200-240VAC	Isolated	A	2-Phase utility devices in North America and Japan.
				C	2-Phase consumer devices in North America and Japan.
9	Low-Volt AC	≤48Vpk	Non-Isolated	C	HVAC and irrigation devices world-wide.
10	Low-Volt AC	≤48Vpk	Isolated	C	HVAC and irrigation devices world-wide
11	Low-Volt DC	≤48Vpk	Non-Isolated	C	Automotive wiring world-wide.
12	1-Phase L-N Wall Plug	120VAC or 230VAC	Isolated	C	Consumer residential devices, North America (120VAC) or European (230VAC).
13	Long-Haul	≤240VAC/DC	Isolated	C	300m-20km dedicated lines world-wide.
14	Current-loop	N/A	Isolated	C	Airport lighting devices world-wide.

Power Supply Design Considerations

Chapter 5 of the *PL 3120/PL 3150/PL 3170 Power Line Smart Transceiver Data Book* provides power supply schematics and components for devices containing PL Smart Transceivers. In order to realize the full communications capability of the PL Smart Transceivers, it is important to ensure that the power supply does not limit overall communication performance. Because the power supply input is directly connected to the communications channel, it has the potential to attenuate the transmit signal and to couple noise into the input of the receiver. Likewise, the power supply outputs, VDDS and VA, have the potential to degrade performance by coupling noise into the PL Smart Transceiver. The design and selection of an appropriate power supply is critical in ensuring that neither power supply loading nor power supply noise degrades communications performance. Table 7 summarizes the power supply options. For more details, see the *PL 3120/PL 3150/PL 3170 Power Line Smart Transceiver Data Book*.

Table 7 Power Supply Options

Power Supply Types	Application Current	Chip Support	Safety-Isolated	Universal Input (see Note 1)	Relative Cost (see Note 2)	Relative Size (see Note 2)	Relative Design Effort (see Note 2)
Energy Storage Capacitor Input	≤25mA	PL 3120 Smart Transceiver	No	No	1	1	2
Energy Storage Linear	≤10mA	PL 3120 Smart Transceiver	Yes	No	2	2	2
Traditional Linear	Any	PL 3120 and PL3150 Smart Transceivers	Yes	No	3	3	1
Wall-plug Supply and Coupler	≤150mA	PL 3120 and PL3150 Smart Transceivers	Yes	No	4	4	2
Pre-designed Energy Storage Switcher	≤10mA	PL 3120 Smart Transceivers	Yes	Yes	5	1	1
Pre-designed Switcher	≤100mA	PL 3120 and PL3150 Smart Transceivers	Yes	Yes	3	2	4
Off-the-shelf Switcher	Any	PL 3120 and PL3150 Smart Transceivers	Yes	Yes	10	5	4
Full Custom Switcher	Any	PL 3120 and PL3150 Smart Transceivers	Optional	Optional	4	3	10

Notes:

1. Multi-country line voltage support without switches.
2. Relative here is 1 = low and 10 = high.

Design and Test for Electromagnetic Compatibility

You can use Echelon's power line technology to develop products that meet a wide variety of regulatory requirements. Chapter 6 of the *PL 3120 / PL 3150/PL 3170 Power Line Smart Transceiver Data Book* describes how to create products using Echelon's power line technology that meet various electromagnetic compatibility regulations.

The Evaluation Boards in the Mini FX/PL Evaluation Kit are designed to facilitate testing of Echelon's power line technology. As such, they have no enclosure, providing open access to the I/O connectors, buttons, LEDs, and other I/O devices. They have been developed to allow consumer and commercial device OEM suppliers to evaluate the technology quickly, and have not been designed to be permanently installed in homes or commercial buildings. If you work with the PL EVB Evaluation Boards in a home environment, operation of other electronic equipment that is sensitive to RF radiated emissions, such as televisions or radios, might be temporarily impaired during the evaluation period.

The standards for RF emissions vary by geographic region. To determine which standards apply in your market, consult the appropriate regulatory agencies. In the European Union, CISPR 22 (or equivalently, EN 55022) applies. In the North American market, the FCC regulates emissions from unintentional radiators under 47CFR15.109, Subpart B, which allows for substitution of CISPR 22. The PL EVB Evaluation Boards comply with CISPR 22 Level A, but not Level B (which is required for deployment in home and commercial environments).

