Power Line Phase Coupler™ Data Sheet

The Power Line Phase Coupler™ network module is an in-box circuit that couples CEBus signal over different phases of residential, commercial or industrial power line networks. It can support most common voltage and network configurations and can be easily installed in most common electrical distribution panels.

The phase coupler is mounted in an in-line enclosure and is intended for indoor use only. The device is optimized to achieve a simple and low-cost solution.

Features
The device includes versatile power line configurations:

- All circuitry with 2 phases or 3 phases
- Range of voltage between 120-600VAC
- Line-to-line neutral and/or line-to-neutral coupling
Electrical Specifications

**Absolute Maximum AC Ratings**

Table 1: Phase Coupler Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{AC}$ line to line</td>
<td>$V_{L-L}$</td>
<td>X</td>
<td>952</td>
<td>$V_{RMS}$</td>
</tr>
<tr>
<td>$V_{AC}$ line to neutral</td>
<td>$V_{L-N}$</td>
<td>X</td>
<td>550</td>
<td>$V_{RMS}$</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_{STG}$</td>
<td>-55</td>
<td>+100</td>
<td>°C</td>
</tr>
</tbody>
</table>

1 Exceeding these values may cause permanent damage. Functional operation under these conditions is not implied.
2 For network without neutral, we assume a virtual neutral.

**AC Recommended Operating Conditions**

Table 2: Phase Coupler Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{AC}$ line to line</td>
<td>$V_{L-L}$</td>
<td>X</td>
<td>600</td>
<td>$V_{RMS}$</td>
</tr>
<tr>
<td>$V_{AC}$ line to neutral</td>
<td>$V_{L-N}$</td>
<td>X</td>
<td>347</td>
<td>$V_{RMS}$</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$T_{O}$</td>
<td>-40</td>
<td>+85</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Absolute Maximum DC Ratings**

Table 3: Absolute Maximum DC Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DC}$ line to neutral</td>
<td>$V_{L-N}$</td>
<td>X</td>
<td>4400</td>
<td>$V_{DC}$ / 1sec</td>
</tr>
<tr>
<td>$V_{DC}$ line to line</td>
<td>$V_{L-L}$</td>
<td>X</td>
<td>8800</td>
<td>$V_{DC}$ / 1sec</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$T_{O}$</td>
<td>-40</td>
<td>+85</td>
<td>°C</td>
</tr>
</tbody>
</table>
Phase Coupler Models
There are two different phase coupler models, the PLPC-000-10 and the PLPC-000-20.

The **PLPC-000-10** is intended for all residential power line networks, light commercial power line networks, light industrial power line networks as well as all two-phase-only power line networks.

The PLPC-000-10 is used for all two-phase power line networks, providing phase-to-neutral coupling as well as phase-to-phase coupling if needed. It is also used for three-phase power line networks when only phase-to-neutral coupling is required and no phase-to-phase coupling.

The **PLPC-000-20** is intended for heavy commercial and industrial power line networks. Those networks can be defined as hosting three-phase devices such as industrial motors, which do not use the neutral and therefore need to be coupled to other products via a phase instead of the neutral.

The PLPC-000-20 is not intended for two-phase power line networks but rather any three-phase power line network that requires phase-to-phase coupling. Note that this model also couples devices via the neutral. However, if used to couple phase-to-neutral devices only, it will have lesser performance than the PLPC-000-10.

**Choosing the right phase coupler model**

<table>
<thead>
<tr>
<th></th>
<th>2-phase Networks</th>
<th>3-phase Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-N coupling</td>
<td>PLPC-000-10</td>
<td>PLPC-000-10</td>
</tr>
<tr>
<td>L-L coupling</td>
<td>PLPC-000-10</td>
<td>PLPC-000-20</td>
</tr>
<tr>
<td>L-N and L-L coupling</td>
<td>PLPC-000-10</td>
<td>PLPC-000-20</td>
</tr>
</tbody>
</table>
## PLPC-000-10 - Coupling Factors

### Table 1  Coupling factors for the PLPC-000-10 Phase Coupler

<table>
<thead>
<tr>
<th>Amplitude读</th>
<th>N-L1</th>
<th>N-L2</th>
<th>N-L3</th>
<th>L1-L2</th>
<th>L2-L3</th>
<th>L3-L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Phi V_{p,p} ) between L1-L2</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>0</td>
</tr>
<tr>
<td>( \Phi V_{p,p} ) between L2-L3</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>0</td>
</tr>
<tr>
<td>( \Phi V_{p,p} ) between L3-L1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( \Phi V_{p,p} ) between N-L1</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( 2\Phi V_{p,p} )</td>
<td>( 2\Phi V_{p,p} )</td>
<td>0</td>
</tr>
<tr>
<td>( \Phi V_{p,p} ) between N-L2</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( 2\Phi V_{p,p} )</td>
<td>( 2\Phi V_{p,p} )</td>
<td>0</td>
</tr>
<tr>
<td>( \Phi V_{p,p} ) between N-L3</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( \Phi V_{p,p} )</td>
<td>( 2\Phi V_{p,p} )</td>
<td>( 2\Phi V_{p,p} )</td>
<td>0</td>
</tr>
</tbody>
</table>

For this example, amplitude of \( \Phi V_{p,p} \) on network was used.
PLPC-000-20 - Coupling Factors

Table 2  Coupling factors for the PLPC-000-20 Phase Coupler

<table>
<thead>
<tr>
<th>Amplitude Read →</th>
<th>N-L1</th>
<th>N-L2</th>
<th>N-L3</th>
<th>L1-L2</th>
<th>L2-L3</th>
<th>L3-L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Phi V_{p,p}$ between L1-L2</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$3\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>$\Phi V_{p,p}$ between L2-L3</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>$\Phi V_{p,p}$ between L3-L1</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$3\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
</tr>
<tr>
<td>$\Phi V_{p,p}$ between N-L1</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$3\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
</tr>
<tr>
<td>$\Phi V_{p,p}$ between N-L2</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$2\Phi V_{p,p}$</td>
<td>$3\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
</tr>
<tr>
<td>$\Phi V_{p,p}$ between N-L3</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$3\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
<td>$\Phi V_{p,p}$</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

For this example, amplitude of $\Phi V_{p,p}$ on network was used.
Installation Guide
CEBus® Power Line Phase Coupler

Connection Procedure for Residential, Commercial and Industrial Operations

This installation guide applies to the prototype version of the Power Line Phase Coupler. This coupler is specifically designed for the CEBus® Power Line communication technology that transmits signals in the 100 to 400 kHz frequency range, but it can very well be used in environments that work within these frequencies.

1. Physical Description of the Phase Coupler

The Power Line Phase Coupler is housed in a plastic flame-retardant material casing. The approximate dimensions of this case are 2.0" x 3.0" x 1.5". Two screw tabs are available at each side of the casing to enable mounting the coupler beside the house electrical distribution panel.

From the phase coupler, four wires (about 12" long) are available to connect the phase coupler to the electrical distribution panel. These wires are color-coded: the WHITE one is the neutral; the BLACK and RED ones are to be connected to L1 and L2 respectively; the BLUE wire is used for three-phase power line networks and is connected to L3.

2. Phase Coupler Installation

The phase coupler must be installed on the side of the electrical distribution panel of the house to meet UL and CSA certification. See drawing for installation.

Warning: the metal ring must be properly grounded to avoid any damage or electrical shock.
Wires are connected in the following order:

- The WHITE wire is connected to the NEUTRAL terminal block of the electrical distribution panel;
- The BLACK wire is connected to L1 directly on a breaker terminal;
- The RED wire is connected directly to L2 on a breaker terminal.
- The BLUE\(^*\) wire is connected directly to L3 on a breaker terminal (use only on 3\(\Phi\) network).

**Note:**

- The BLACK, RED and BLUE\(^*\) wires may be inverted.

\(^*\) Never use the BLUE wire on two-phase or residential network.

**Warning:**
Successfully using the phase coupler requires proper installation, operation and maintenance. Failing to meet fundamental installation and maintenance requirements may cause personal injury as well as damage to electrical equipment or other property. Only qualified and experimented personnel should install, operate and maintain the phase coupler. The installation must follow all local and national electrical codes to ensure safe installation.

See next page for network schematics.
3. Schematic of Typical Two-Phase Network

High Voltage Three-Phase Lines

Electrical distribution panel

Phase Coupler

L1

L2

L3

Workstation

Television

L1

Microwave

Refrigerator

Coffee Maker

Laser printer

L2

L2

L1

N

Red

Black

white

Halogen lamp

Television

L1

L2

Halogen lamp

Workstation
4. Schematic of Typical Three-Phase Network

[Diagram of a three-phase network showing electrical appliances and connections, including L1, L2, L3, High Voltage Three-Phase Lines, Electrical distribution panel, Workstation, Television, Laser printer, Refrigerator, Oven, Coffee Maker, Microwave, Halogen lamp, Motor, and Phase Coupler.]
Warranty

LIMITATION OF LIABILITY
To the maximum extent permitted by applicable law, in no event will Domosys be liable to the Customer or any third party for any indirect, special, consequential, incidental or exemplary damages whatsoever, including but not limited to loss of revenue or profit, lost or damaged data, business interruption or any other pecuniary loss whether based in contract, tort, or other cause of action, even if Domosys has been advised of the possibility of such damages, except in relation to gross negligence or willful breach of this agreement by Domosys. No Domosys agent, representative or dealer is authorized to extend, modify or add to this warranty on behalf of Domosys. Nothing in this agreement shall imply Domosys’ responsibility for death or personal injury caused by Domosys or its employees or agents. The total liability of Domosys for damages, whether in contract or tort, under or related in any way to this agreement shall be limited to the price actually paid by the Customer to Domosys or, if no fees were paid, according to Domosys’ list price for the Phase Coupler covered under this agreement. The exclusion of implied warranties and/or the limitation of liability may not be permitted in some jurisdictions and some or all of these exclusions may not apply.

DISCLAIMER
Except for the foregoing warranty, the Phase Coupler is provided “as is” without warranty or condition of any kind. Domosys disclaims all warranties or conditions, written or oral, statutory, express or implied, including but not limited to the implied warranty or merchantable quality or fitness for a particular purpose, title and non-infringement of rights of any other person. Domosys does not warrant that the Phase Coupler will meet the Customer’s requirements or that operation of one of these products will be uninterrupted or error-free.

The Phase Coupler is not fault tolerant and is not designed, manufactured or intended for use or resale as on-line control equipment in hazardous environment requiring fail-safe performance, and in which the failure of the Phase Coupler could lead directly to death, personal injury or severe physical or environmental damage, including where the proposed use by the Customer is regarded as against the rules of the art or as a Critical application (hereafter generally referred to as “high-risk activities”). Accordingly, Domosys specifically disclaims any express or implied warranty of fitness for high-risk activities.

THIRTY-DAY MONEY BACK GUARANTEE
If the Customer wants to return the Phase Coupler for any reasons, he may do so, together with his Return Merchandise Authorization form (RMA), to Domosys, postage prepaid, for a full refund at any time during the thirty (30) day period following the delivery of the product to the Customer.

ONE YEAR LIMITED WARRANTY
Domosys warrants that its products will be free from defects in materials and workmanship for a period of one (1) year from the date of delivery of the product to the Customer. The Customer’s sole remedy in the event of a breach of this warranty will be that Domosys will, at its option, replace any defective product returned to Domosys within the warranty period or refund the money the Customer paid for the product. Domosys does not warrant that the product will meet the Customer’s requirements.

This warranty does not cover damage due to:
   i. Usage not in accordance with Domosys’ instructions
   ii. Servicing not authorized by Domosys Corporation or
   iii. A force majeure or external cause, including, but not limited to, accidents, abuse, misuse, and problems with electrical power

For warranty service, the Customer must notify the Domosys customer service within the warranty period. If warranty service is required, Domosys will issue a Return Merchandise Authorization Number. The product must be returned to Domosys in its original packaging or equivalent with prepaid shipping charges. The Customer must insure the shipment or accept the risk of loss or damage during the shipment. Domosys will repair or replace products returned to Domosys’ facility. Domosys owns all parts removed from a repaired product. If Domosys repairs a product, its warranty is not extended. If Domosys replaces a product, the replacement product is warranted for the remainder of the original term or 60 days, whichever is longer. Domosys will ship freight collect the repaired or replacement product to the Customer. The above warranty is exclusive and in lieu of all other warranties, whether express or implied, including the implied warranties of merchantability, fitness for a particular purpose and non-infringement. Domosys’ responsibility for malfunctions and defects in hardware is limited by the terms of this document.

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