# IEC Appliance Couplers Safe, Simple and Flexible

## Power Supply System Selection made easy

**Pluggable power supply systems (Appliance Couplers) according to IEC 60320 provide a great deal of flexibility and efficiency while complying with the strictest safety requirements and responding to the increasing need for user-friendliness and maximum safety. In SCHURTER's portfolio, this product line plays a central role [1]. Our Website's new "Mating Connectors" [2] service provides support in selecting the right power supply system and simplifies product selection.**

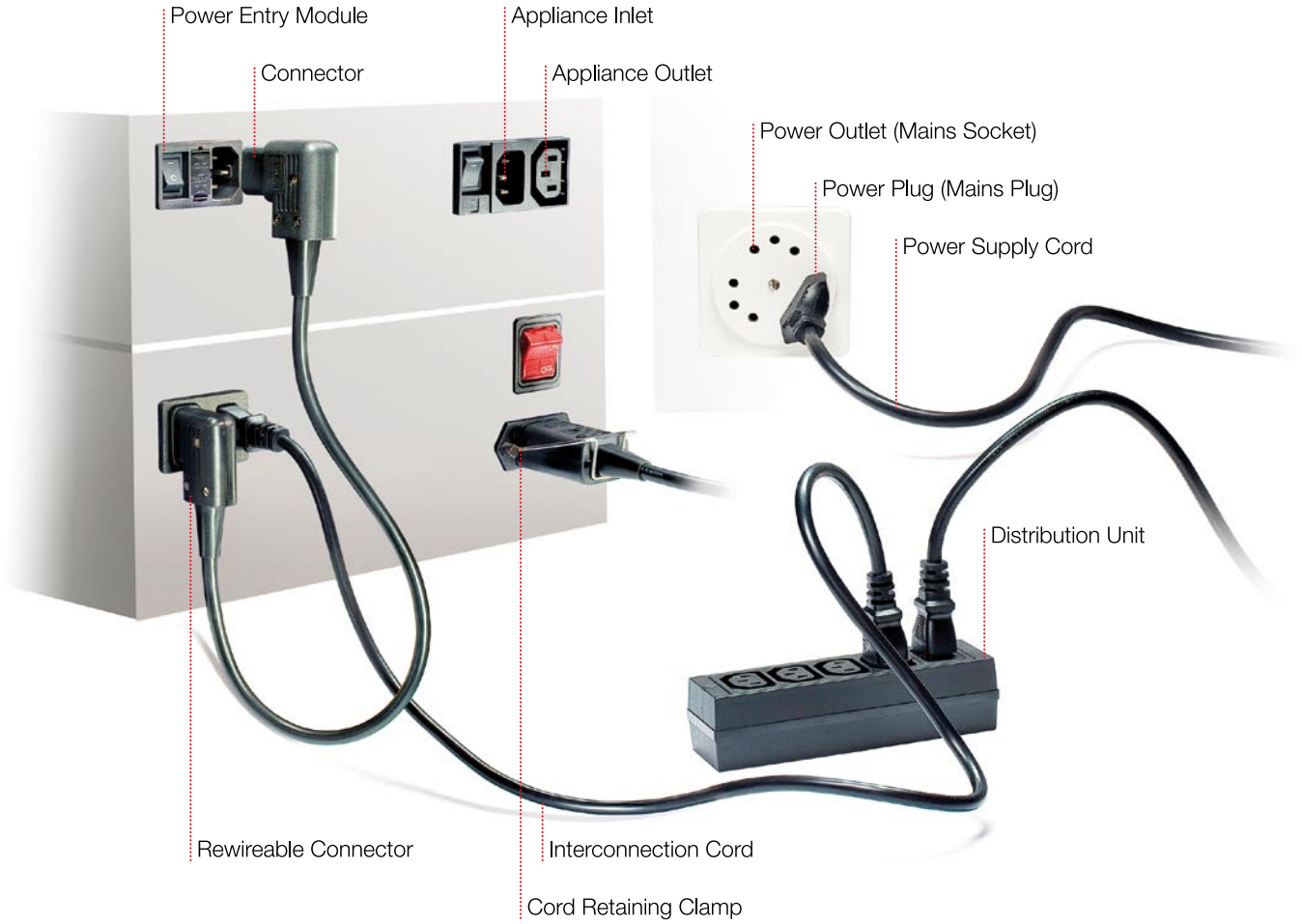


Figure 1: Application example including correct terms

Pluggable power supply systems are used in office appliances, in measurement technology, in IT and in medical technology, among many other areas. Most of these appliances are distributed and used worldwide. Therefore, each appliance's power supply must be adapted to country-specific conditions (e.g. different power plugs in Germany, the UK, the US, etc.). This, in turn, entails differences in the requirements placed on the appliances spanning their entire life cycle from assembly and testing to logistics and maintenance. In contrast to hard-wired power supply components, pluggable power supply systems according to IEC 60320 make it easier to comply with the most diverse of requirements, minimizing cost and expenditure in each phase of a product's life cycle. And so the trend towards appliance couplers continues.

Figure 1 illustrates the great variety of pluggable power supply systems (appliance couplers) and shows its different components.

**The individual terms shown in figure 1 are explained following**

**Appliance coupler** means a device for connecting a flexible power cord to an appliance or another type of installation. An appliance coupler consists of an appliance inlet and a connector.

The figures below show the fundamental differences between the various plug and socket components as defined by the standards on appliance couplers (IEC 60320-1) and interconnection couplers (IEC 60320-2-2), using components rated for 10 A, Protection Class I, pin temperature.


Appliance Inlet


Connector


Plug


Appliance outlet

Figure 2: Component differences between the two standards IEC 60320-1 and IEC 60320-2-2

**Power supply cord** means a flexible cord fitted with a power (mains) plug and a connector, used for con-necting an electrical appliance to the power supply (mains).

**Interconnection cord** means a structural unit consisting of a flexible cord fitted with a plug and a connec-tor built for interconnecting or disconnecting any appliance or installation with/ from any other appliance or installation using a power supply cord.

**PEM** (short for 'Power Entry Module') means a component fitted, in addition to the actual appliance coupler, with other technical components such as:

- a switch including bowden cable actuation
- a circuit breaker for equipment including overload and overcurrent protection, undercurrent protection and remote triggering
- an appliance fuseholder
- a voltage selector
- an EMC filter for standard and medical applications

SCHURTER distiguishes between Power Entry Modules with and without filters.

**Advantages of PEM over Individual Components:**

- Compact dimensions
- Only one product with pre-wired individual components
- Efficient mounting
- Alternative designs with similar dimensions
- Protected, pre-wired and tested power supply components

**Ditribution unit** means a housing fitted with several appliance outlets to form a component designed to distribute power. A typical application area could be a mobile measurement station, where several devices can be supplied with power from a single distribution unit.

**Cord retaining clamp** means a mechanical device preventing an appliance coupler from inadvertently being pulled or shaking loose. Typical application areas with stricter safety requirements in this regard include medical technology, stage and lighting technology as well as IT.

## Advantages of Appliance Couplers over the entire Life Cycle

It is only at the end of the manufacturing process or during distribution, i.e. when the pluggable power supply cord is inserted into the box, that an appliance is adapted to country-specific requirements. Each appliance housing is configured identically in terms of power supply. The number of variants is minimal.
Mounting and wiring a hard-wired power supply cord is labor-intensive and conducive to errors. On the other hand, all that needs to be mounted when appliance couplers are used, is an appliance inlet. In many cases, there is not even any need for internal wiring, as the appliance's PCB already comes fitted with an appliance inlet. There is only one type of appliance in terms of power supply. There are no connection wires dangling from the housing exterior. Assembly and handling become easier. Power supply solutions using IEC application couplers help eliminate causes of error while increasing process security and hence enhancing the quality of the finished product.
Further rationalizations or automatizations are possible during systems testing. No country-specific test setups are required. The appliances can be connected to slot-in test ports which test appliance functionality and safety in one go using the predefined testing procedures.
Warehousing costs are minimal, as appliance manufacturers need only keep a small number of appliances in their inventory. After temporary storage, the non-wired appliance is packaged according to its destination country including a country-specific power supply cord and operating instructions in the respective language.
Evidence of the consistent and steadfast implementation of this optimized production principle can be seen in the fact that in many instances the software's country-specific basic settings, too, are determined by the end users themselves instead of being set at the factory.
After initial use, appliances can be easily transferred to and used in another country, as country-specific adaptation no longer requires that the device be opened. All that is required is a standard power supply cord fitted with an IEC 60320 connector and a country-specific power plug. Even when the power supply cord is damaged, it can be replaced easily, because it is a standardized part that can simply be unplugged and replugged.
Safety hazards, maintenance expenditure and repairs are thus minimized.
Below you see a summary of the advantages of power supply systems fitted with IEC appliance couplers in each phase of an appliance's life cycle (Figure 3):

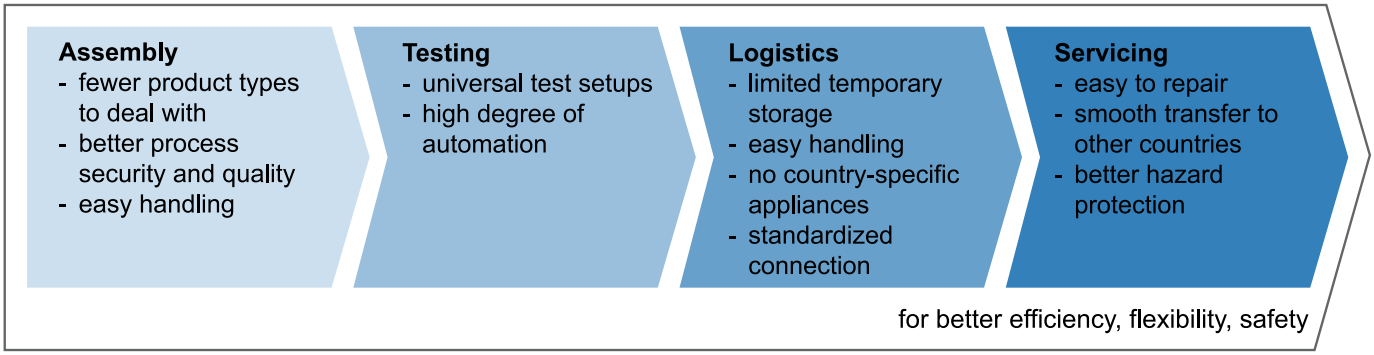


Figure 3: Advantages of appliance couplers

**Standards Overview:**
Power supply safety is crucial from the user's perspective. The IEC 60320 standards as well as its substandards create a binding agreement, defining the mechanical, electrical and thermal requirements and safety goals of pluggable power supply systems (appliance couplers) and establishing a common base for combining components with different origins, thus eliminating the potential safety hazards involved when adding an additional, separate component (pluggable power supply cord). The standard's scope is limited to appliance couplers rated at 250 VAC, up to 16 A.
Figure 5 shows an overview of the standardized appliance couplers with their relevant names within the meaning of IEC 60320.

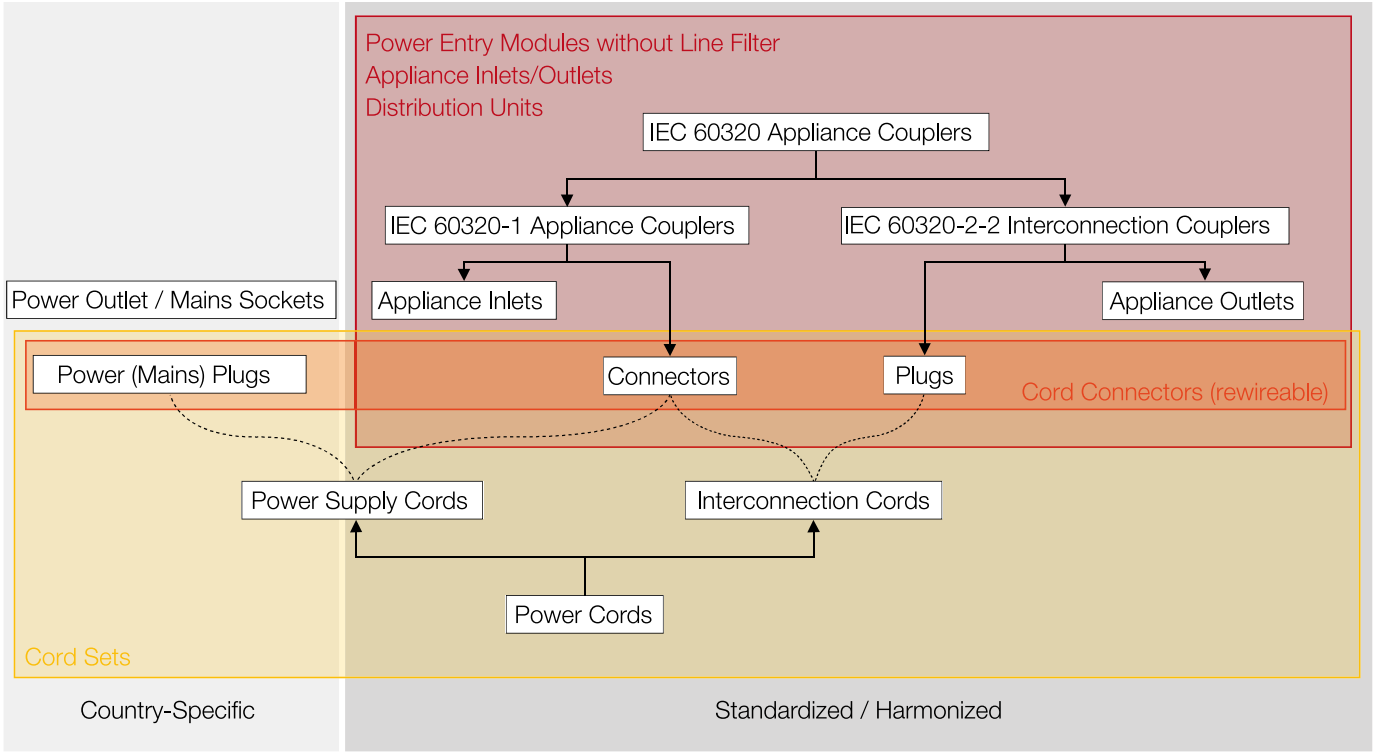


Figure 4: Overview of the coupplings and their designation

IEC 60320-1 deals with appliance couplers including appliance inlets and appliance outlets. IEC 60320-2-2 describes interconnection couplers including connectors and plugs. Power supply cords are fitted with these appliance couplers (dotted lines). In addition to these two central standards, there are further substandards of IEC 60320 focusing on special topics such as IP protection and appliancespecific requirements.

**Safety through Coding:**
The standards establish the fundamental criteria governing protection class, nominal current and pin temperature and define various plug outlines. The purpose of plug outlines is to code the appropriate connections in a manner that the part of an appliance coupler or interconnection coupler to be supplied with power defines the safety-relevant limits, i.e. that an appliance inlet can be fed only by a connector of identical or higher valency. It is impossible, for instance, to connect a protection class II connector to a Protection Class I appliance inlet, while the opposite, i.e. connecting a protection class I connector to a Protection Class II appliance inlet, is very well possible. The same applies to the nominal current and the pin temperature. This coding is a significant contribution towards the safe operation of appliances and towards the protection against improper use.

| Parameter | Example | Distinguishing Features |
|---|---|---|
| Protection Class | C14 Protection Class I; C18 Protection Class II | with / without earth conductor contact |
| Rated Current | C8 A 2.5A; C9 6A; C14 10A; C20 16A | varying plug outlines |
| Pin Temperature | C14 70°C for cold applications; C16 120°C for hot applications; C16 A 155°C for very hot applications | plug outlines feature additional notches |

Table 1: Standard's definition

**Table 1** shows the various main criteria and their specific values according to the standard's definition.

**Nominal current:** The standard, instead of 'nominal current', uses the term 'rated current'. It defines the current for which the manufacturer has designed the appliance coupler.

Pin temperature TP is measured where the pin projects from the engagement surface (Figure 5). The maximum permitted pin temperatures are, according to the standard, 70°C, 120°C and 155°C, respectively. The appliance's normal ambient temperature $T_{A1}$ during operation, according to IEC 60320, is 25°C and may occasionally reach 35°C. In other words, the pin temperature is determined essentially by the design of the respective appliance, i.e. its interior temperature $T_{A2}$, rather than by its ambient temperature. Typical applications with increased pin temperatures include appliances with heating coils such as ovens or electric grills.

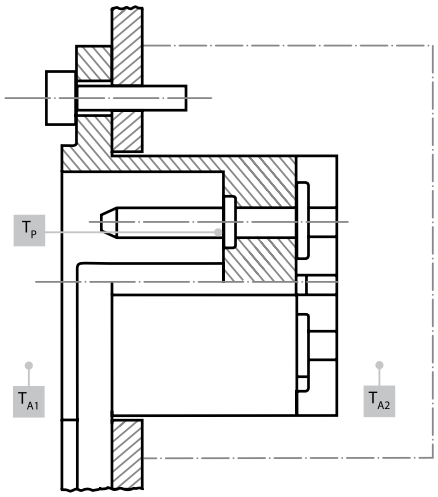


Figure 5: Lateral section view of an appliance inlet and its relevant temperatures

Protection classes are defined in IEC 61140. The IEC 60320 standard defines, for appliance couplers, protection class 1 and 2 types, i.e. types for appliances equipped with a protective conductor and special insulation.
In addition to the limiting values described, the standards define further general criteria such as withdrawal forces, testing procedures, the minimum number of plugging cycles and the number of flections in flexible cords. IEC 60320-1 codes the various plug outlines using a combination of letters and numbers (e.g. 'C14'), while IEC 60320-2-2 uses a single letter (e.g. 'F').

**Tables 2, 3 and 4** describe the individual plug outlines in detail (Symbol, Type), i.e. their relevant nominal/rated current, pin temperature and protection class parameters. They also show which combination the standard defines. Each possible combination in the matrix is denoted with a dot. The columns list the components with the pins, while the lines show the sockets.

Normaly the parameter of inlet and outlet are similar (e.g. protection class 1 -> 1). It is generally possible to match a connector with a higher rated temerature with a lowe rated inlet.

| Mating Appliance Coupler IEC 60320-1 | | | | | | Appliance Inlets | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Gender Male | | | | | | | | | | |
| | | | | | Symbol | | | | | | | | | | | |
| | | | | | Type | C6 | C8 | C8p | C10 | C14 | C16 | C16A | C18 | C20 | C22 | C24 |
| | | | | | Current [A] | 2.5 | 2.5 | 2.5 | 6 | 10 | 10 | 10 | 10 | 16 | 16 | 16 |
| | | | | | Temperature [°C] | 70 | 70 | 70 | 70 | 70 | 120 | 155 | 70 | 70 | 155 | 70 |
| | | Symbol | Type | Current [A] | Temperature [°C] | Protection class | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |
| IEC 60320 Connectors | Gender Female | | C5 | 2.5 | 70 | 1 | • | | | | | | | | | |
| | | | C7 | 2.5 | 70 | 2 | | • | | | | | | | | |
| | | | C7p | 2.5 | 70 | 2 | | | • | | | | | | | |
| | | | C9 | 6 | 70 | 2 | | | | • | | | | | | |
| | | | C13 | 10 | 70 | 1 | | | | | • | | | □ | | | |
| | | | C15 | 10 | 120 | 1 | | | | | □ | • | | □ | | | |
| | | | C15A | 10 | 155 | 1 | | | | | □ | □ | • | □ | | | |
| | | | C17 | 10 | 70 | 2 | | | | | | | | • | | | |
| | | | C19 | 16 | 70 | 1 | | | | | | | | | • | | □ |
| | | | C23 | 16 | 70 | 2 | | | | | | | | | | | • |

Table 2: Combinations according to IEC 60320-1; • Intended, □ Possible

| Mating Intercorrection Coupler IEC 6032-2-2 | | | | | | lugs | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Gender Male | | | | | | |
| | | | | | Symbol | | | | | | | |
| | | | | | Type | A | C | E | G | I | K | |
| | | | | | Current [A] | 2.5 | 2.5 | 10 | 10 | 16 | 16 | |
| | | | | | Temperature [°C] | 70 | 70 | 70 | 70 | 70 | 70 | |
| | | Symbol | Type | Current [A] | Temperature [°C] | Protection class | 1 | 2 | 1 | 2 | 1 | 2 |
| IEC 60320 Appliance Outlets | Gender Female | | B | 2.5 | 70 | 1 | • | | | | | |
| | | | D | 2.5 | 70 | 2 | | • | | | | |
| | | | F | 10 | 70 | 1 | | | • | □ | | |
| | | | H | 10 | 70 | 2 | | | | • | | |
| | | | J | 16 | 70 | 1 | | | | | • | □ |
| | | | L | 16 | 70 | 2 | | | | | | • |

Table 3: Combinations according to IEC 60320-2-2 • Intended, □ Possible

| Mating Appliance Coupler IEC 60320-1 | | | | | | Plug | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Gender Male | | | | | | |
| | | | | | | Symbol | | | | | | |
| | | | | | | Type | A | C | E | G | I | K |
| | | | | | | Current [A] | 2.5 | 2.5 | 10 | 10 | 16 | 16 |
| | | | | | | Temperature [°C] | 70 | 70 | 70 | 70 | 70 | 70 |
| | | Symbol | Type | Current [A] | Temperature [°C] | Protection class | 1 | 2 | 1 | 2 | 1 | 2 |
| IEC 60320 Connectors | Gender Female | | C5 | 2.5 | 70 | 1 | • | | | | | |
| | | | C7 | 2.5 | 70 | 2 | | • | | | | |
| | | | C13 | 10 | 70 | 1 | | | • | □ | | |
| | | | C15 | 10 | 120 | 1 | | | □ | □ | | |
| | | | C15A | 10 | 155 | 1 | | | □ | □ | | |
| | | | C17 | 10 | 70 | 2 | | | | • | | |
| | | | C19 | 16 | 70 | 1 | | | | | • | |
| | | | C23 | 16 | 70 | 2 | | | | | | • |

Table 4: Combinations according to IEC 60320-1 • Intended, □ Possible

In addition to the connections within the standards, as mentioned, there are possible combinations between IEC 60320-1 and IEC 60320-2-2. Fitted with a flexible cord, the components become interconnection cords to be used for connecting appliances or for extending other interconnection cords or power supply cords.

## Finding the mating Connection

Knowing which counterpart to choose for a given component is one thing; finding it is another. Out of this need, SCHURTER has created on its Web site the new 'Mating Connectors' [2] service reflecting the relationships shown in tables 2, 3 and 4 above.
This instrument makes it easy for the user to find the right power supply system fast instead of having to assemble it from individual components. There are two approaches to finding a solution.

- The user already knows a product from the SCHURTER catalog and is looking for the matching counterpart. One click shows all suitable counterparts.
- The user knows the desired parameters according to IEC 60320 (current, pin temperature, protection class). All combinations of matching appliance couplers with the corresponding characteristics are shown.

In both cases, the selection range is narrowed down step by step and iteratively by additional parameters and thus gradually adapted to the user's needs. Figure 6 shows the access via a specific SCHURTER product leading to a mating coupler or below the entry of a specific IEC-connector parameter to gain an overview of the specific SCHURTER inlets and their mating couplers.

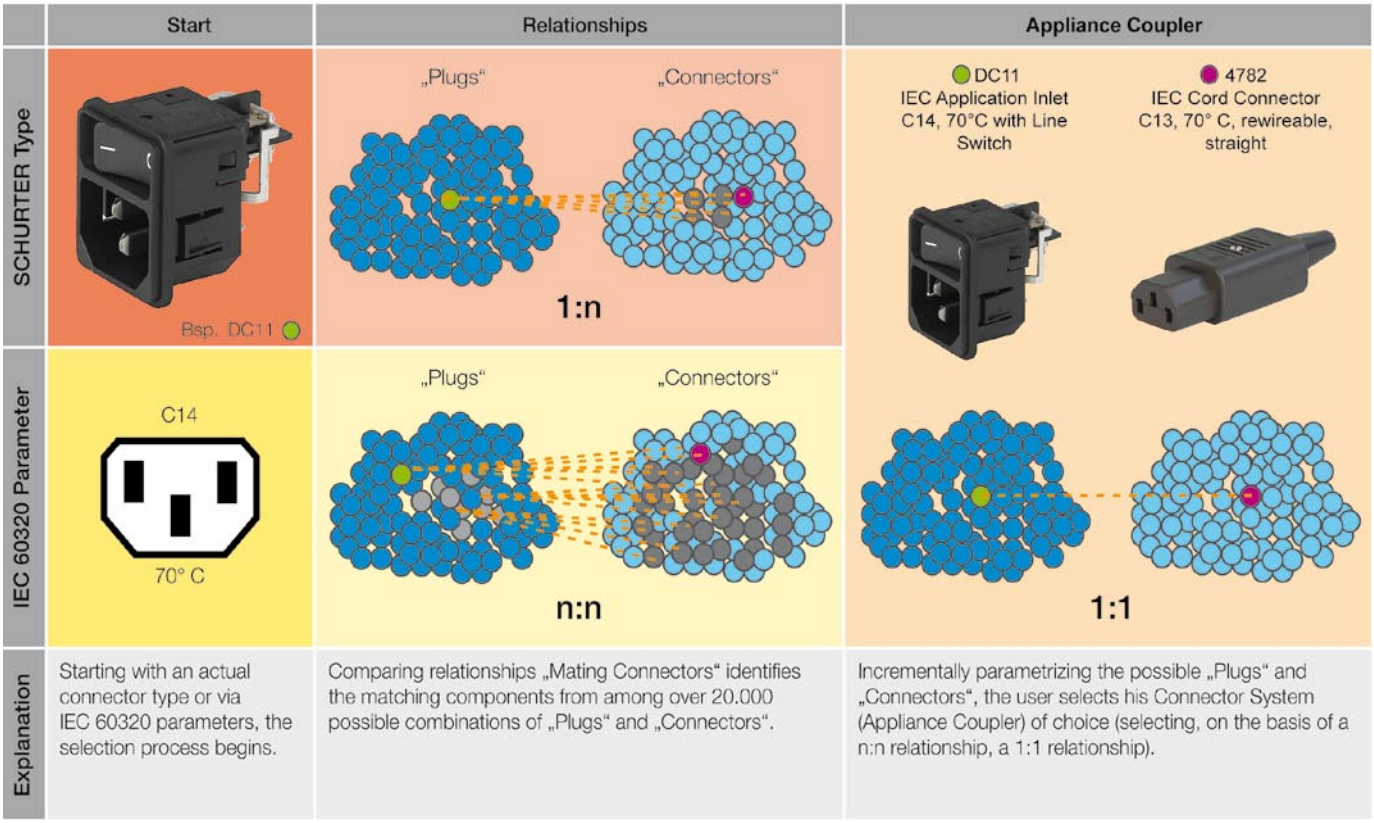


Figure 6: Selection of a power supply system

The advantage of SCHURTER's 'Mating Connectors' [2] tool (Figure 9) is that the user is shown every possible combination, ensuring that he finds the optimal solution from among the vast variety of over 20'000 possible connections available from SCHURTER.

**Selection Criteria for Appliance Inlets and Appliance Outlets:**
A detailed product description can either be looked up in the related data sheet or be compared with other products within the reffered selector chart.
The selector charts [3] offers also the entry to the mating products as well as the necessary accessories [4].

- Nominal/rated current / nominal/rated voltage / pin temperature / protection class
- Mounting side (front / rear)
- Mounting method (screw-on / rivet or snap-in mounting)
- Terminals (push-on, rivet, solder tabs, PCB mounting, pre-fitted with stranded wires)
- Additional features such as line switch / fuseholder / voltage selector / ciruit breaker for equipment / cord retaining clamp

**Selection Criteria for Connectors / Plugs and Cords:**

- Nominal/rated current / nominal/rated voltage / pin temperature / protection class
- Non-rewireable / rewireable components
- Color / cross-sectional area/gauge / cord length and material
- Accessory

SCHURTER's 'Mating Connectors' [2] tool increases the efficiency of pluggable power supply systems by simplifying the selection process and making it possible to find the best combination possible. It helps users keep track of the vast variety of power supply systems.
Introducing this tool, SCHURTER sets a new standard in IEC appliance coupler product selection. Providing an extremely broad range of individual components backed by proven consulting services and a high quality standard, SCHURTER is your expert partner for complete IEC-compliant appliance couplers - worldwide.

Further explanations and description of terms can be looked up under general information for connectors [3].

Please do not hesistate to contact [5] us in case of raising questions or if you have any comment to improve our information service.

Links:
[1] www.schurter.com/connectors
[2] www.schurter.com/iec_connectors
[3] www.schurter.com/connector_info
[4] www.schurter.com/accessories
[5] www.schurter.com/contact

## Robust Appliance Inlet for PCB Mounting

**The appliance inlet GSP1 offers a proven and robust mechanical design for a power supply directly onto the circuit board.**

The mechanical mounting styles include self tapping screws, metrical screws with included counter sinks or additional nuts. This assures a vast variaty of design possibilities.

## General Product Information about Connectors

- Product Standards
- National Approvals
- Electric Protection
- Fuseholder
- Technical Data for Line Switches
- Line Filters
- Product Codes

**Please find details:**
**www.schurter.com/product_information**

## Rewireable Cord Connector 20 A Angled

**The rewireable cord plug 4790 with its angled cord entry facilitates a minimal installation depth and enables a marginal distance of the attached system to the wall.**

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