YRKESHÖGSKOLAN NOVIA

EPLAN Electric P8 – parts database and pilot project

Development of component database for E-CAE tool and its implementation in project documentation

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Bachelor's thesis

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BACHELOR'S THESIS

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Abstract

This work has been done in cooperation with the department Sales & Solution Support, at the company Vacon Plc in Vaasa. An older E-CAE technology based design tool is currently being used, when designing electrifications for cabinet drive systems. The idea is to replace EPLAN 21 in the near future with its sequel EPLAN Electric P8.

The main goal of the project has been to develop and create a component database in the program EPLAN Electric P8. The initial work was to prepare a covering range of components, based on fresh project templates utilized when designing. The importance of the database was studied and taken into account in the project documentation and from an electrical designer's point of view when using the tool. Based on the study a comprehensive structure was presented for the database and a model for every component type. This was realized by updating the database following the component list and the presented standard. A trial was finally carried out to investigate the functionality of the database in the design process and its visualization in the final documentation. For the purpose, a common DC bus project was transferred to EPLAN Electric P8.

The result was an established and a useable component database, which will enable the commissioning of the program at the department. The aim was also to benefit from the pilot project in future tasks.

Language: English Key words: EPLAN, component database, Vacon Oyj

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EXAMENSARBETE

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Abstrakt

Det här arbetet har gjorts i samarbete med företaget Vacon Oyj, vid avdelningen Sales & Solution Support i Vasa. Vid avdelningen används för tillfället ett äldre E-CAE teknologi baserat designverktyg, som utnyttjas vid planering av elektrifiering för skåpkapslade frekvensomriktarsystem. Tanken är att inom en snar framtid ersätta EPLAN 21 med dess uppföljare EPLAN Electric P8.

Huvudmomentet i projektet har varit att utveckla och skapa en komponentdatabas i programmet EPLAN Electric P8. Arbetet gick inledningsvis ut på att bereda ett täckande urval komponenter, utgående från färska projektunderlag som utnyttjas vid planering. För uppgiften studerades och beaktades innebörden av databasen i projektdokumentation och ur elplanerarens synvinkel vid användningen av verktyget. Utgående från undersökningen togs en genomgående struktur fram gällande databasen och en modell för varje komponenttyp. Detta förverkligades genom att uppdatera databasen enligt sammanställd komponentlista och presenterad standard. Ett försök genomfördes slutligen för att undersöka funktionaliteten av databasens vid planering och dess visualisering i slutdokumentation. För ändamålet överfördes ett common DC bus typprojekt till EPLAN Electric P8.

Resultatet blev en upprättad och användbar komponentdatabas som ska möjliggöra ibruktagningen av programmet vid avdelningen. Ett delmål var att kunna utnyttja pilotprojektet i framtida arbetsuppgifter.

Språk: engelska Nyckelord: EPLAN, komponentdatabas, Vacon Oyj

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Nimike: *EPLAN Electric P8 – osatietokanta ja pilottiprojekti*

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Tiivistelmä

Tämä työ on tehty yhteistyönä yrityksessä Vacon Oyj, Sales & Solution Support -osastolla Vaasassa. Tällä hetkellä osastolla on käytössä vanhempi E-CAE -teknologiaan perustuva suunnittelutyökalu, jota hyödynnetään kaappi-taajuusmuuttajien sähköistyksen suunnittelussa. Ajatus on lähitulevaisuudessa korvata EPLAN 21 -järjestelmää EPLAN Electric P8:lla.

Projektin päävaihe oli kehittää ja luoda osatietokanta EPLAN Electric P8 -järjestelmään. Alustavan työn tarkoitus oli valmistella kattava komponenttivalikoima, käyttäen tuoreita projektipohjia, joita hyödynnetään suunnittelussa. Tehtävää varten tutkittiin ja otettiin huomioon tietokannan merkitys sekä projektidokumentaatiossa että sähkösuunnittelijan näkökulmasta hänen käyttäessään työkalua. Tutkimuksen perusteella kehitettiin kattava rakenne tietokantaa varten ja malli jokaiselle komponenttityypille. Tämä toteutettiin päivittämällä tietokanta kootun komponenttilistan avulla sekä noudattamalla esitettyä standardia. Lopuksi suoritettiin käyttökoe, jotta selvitettäisiin tietokannan toiminnallisuus suunnittelussa ja sen visualisointi loppudokumentaatiossa. Tarkoitusta varten siirrettiin common DC bus tyyppiprojekti EPLAN Electric P8 -järjestelmään.

Tulos oli laadittu ja käyttökelpoinen osatietokanta, joka mahdollistaa järjestelmän käyttöönoton osastolla. Tavoitteena oli myös pystyä hyödyntämään pilottiprojektia tulevissa tehtävissä.

Kieli: englanti Avainsanat: EPLAN, osatietokanta, Vacon Oyj

Contents

Wordlist

ACB – Air circuit breaker

API – Application programming interface

CAD – Computer aided design

E-CAE – Electrical computer aided engineering

ERP – Enterprise resource management

MCB – Miniature circuit breaker

MCCB – Module cased circuit breaker

NC – Normally closed

NO – Normally open

PDM – Product data management

PLM – Product lifecycle management

PPM – Project page macro

R&D – Research & development

VDW – Vacon documentation wizard

Foreword

This thesis has been done in cooperation with the Sales & Solution Support department, at the company Vacon Plc in Vasa. First of all, I would like to thank my supervisors Kyösti Rajala at Vacon and Ronnie Sundsten at Novia University of Applied Sciences, Vasa for your huge help and support throughout the project. I also wish to thank Juha-Pekka Suomela for making this work possible. Last but not least, the whole Sales & Solution Support department and all others involved who helped me to succeed in this project.

Christoffer Avela, Vaasa

19.3.2012

EPLAN Electric P8 – parts database and pilot project

1 Introduction

This thesis is based on the software EPLAN Electric P8. The project is an electrical design tool development done in cooperation with Vacon Oyj. The project represents a part of the software commissioning at the company.

1.1 Background

For the moment a database-driven software, named EPLAN 21, is used at Vacon Oyj, Sales & Solution Support department for producing electrical documents for cabinet drives. The E-CAE technology based tool is used for creating complete schematics and reports for the entire project documentation. From now on I will refer to EPLAN 21 as "Eplan 21".

Eplan 21 will be replaced by an updated version from the same software developer. The crucial reason for the software renewal is that the support for Eplan 21 has been discontinued and no further updates are available. The new electrical design tool is named EPLAN Electric P8 and is based on the same technology. The software is a module of the new EPLAN platform. From now on I will refer to EPLAN Electric P8 as "Eplan P8".

In the early introduction stage of Eplan P8, the engineering team concluded that the transition phase for the program will become a major one. The Eplan 21 drawing archive at the department is extensive and the ability to transfer its contents to Eplan P8 is not sufficient. Tests had been made by transferring old projects, but without the required results. The main difficulties emerged in the missing of database and graphical contents of the transferred electrical drawings.

A decision was made not to export data directly from Eplan 21, as the project designing and documentation quality and reliability would suffer in the end. This meant that the previously used Eplan 21 drawing library, customized for the department's own project designing, would have to be reconstructed. This would include new designing of standard drawings and a development of a parts database for Eplan P8. During the summer 2011 I

worked at Vacon as an electrical design engineer and my main task was to update and transfer standard drawings of Eplan 21 to Eplan P8.

1.2 Target

The initial phase of the project was to develop the throughout *parts database* structure for Eplan P8. This included standardization of contents, depending on component type or tool management tasks. This was later utilized when updating the database with a sufficient amount of cabinet drive components, following the presented structure. The following step of the project was to test its functionality in the Vacon environment by creating *project page macros* using the parts database and predesigned schematics. The idea was later to compile a complete Eplan P8 project of a typical cabinet drive system. The project progressed according to the following phases:

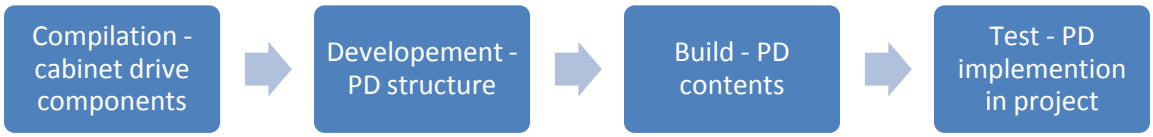

Figure 1. The parts database's development process.

As no one in the team had a deeper knowledge of the Eplan P8 parts database features, the first task was to get acquainted with this part of the program to manage to gain as much as possible from it. As the tool was already in operation at the Vacon Solar department, it was possible to obtain support from there. Through a component training arranged by ABB I could get more information for the project, regarding their new low-voltage products on the market. Simultaneously I cooperated with my own department's engineers and managers to find out requirements and possibilities concerning various decisions throughout the project.

1.3 The purpose

The main requirement regarding the parts database was sufficient information accessibility, in order to benefit from the Eplan P8 features as much as possible. Heavy emphasis was placed on the database remaining reliable, since documentation reports of various kinds are generated on the basis of the information. The aim was also to clarify the "model to

follow" and how to handle the *parts management* when further component updates are made in the database. The idea was to integrate the database with the Vacon Solar department and thereby get the opportunity to strive to utilize common components. The parts database was still missing in order to enable the preparing of *project page macros* for Eplan P8. A complete engineering library would then enable the use of the program as a standard electrical tool for cabinet drives designing.

The purpose of the pilot project was to test the functionality of the database in real conditions. This was to be done in the order to clarify and review different tasks and approaches to be considered during component selection. The idea with a real cabinet drive system was to be able to benefit from the project in real future situations.

1.4 Research methods

It has been challenging to obtain access to theoretical sources in my thesis. For this reason I have chosen to base the theory partially on personal experience, in other words, I have looked at this from an empirical point of view. I have also used information sources such as interviews, meetings and internal course material from the company.

2 Vacon Plc

Vacon began its operations in 1993 when the company was founded. Thirteen key members from ABB Vaasa decided to go their own way under the name Vaasa Control Oy. The company is specialized in variable speed AC drives, whose function is to regulate the speed of the squirrel cage motor. Vaasa Control Oy changed its name to Vacon in 2000 and was listed at the Helsinki Stock Exchange later the same year. /21/

The company's revenues are 338 million EUR (2010) and the number of employees are 1301 (2010). Vacon has R&D and production units in Finland, the USA, China, India and Italy and the headquarters is located in Vaasa, Finland. The company has 27 sales offices around the world. Currently the target for the company is to increase its revenues to 500 million EUR by 2014. Vacon is also a member of the Cleantech Finland network, a national sector that proves its energy efficiency in its technology. /20/ /16/

The Sales & Solution Support department is located in the headquarter in Vaasa, Finland. The unit is responsible for cabinet drive projects for the whole world market. The main responsibilities can be defined as *solution definition*, *quotation support* and *project management*. The department's solution team is responsible for both electrical and mechanical engineering. Their task is to define and dimension drive systems. The cabinet drive product can be divided into *standard drive* and *engineered drive*. The Vacon NXC represents the standard drive, which can be obtained with a fixed set of options. The engineered drive is available in multiple different systems, whose performance is always dimensioned based upon the customer's process. Typical applications are cranes, elevators and line equipment. The cabinets are mostly assembled in Vaasa, at Vacon and at Vaasa Switchgear, which is a division of Vaasa Engineering. /17/ /19/

3 E-CAE

Electrical Computer-Aided Engineering (E-CAE) software is an advanced form of the traditional Computer-Aided Design (CAD) tool. What sets E-CAE apart from traditional CAD programs is the software structure – the central database. When a database is integrated to a CAE system, it allows ability to support more than one discipline. Such a system incorporates all kinds of design and reporting tools needed for several disciplines, like electrical, fluid and process engineering. The direct results are increased engineering efficiency, accuracy and cost savings. The main advantages with E-CAE tools are:

- Improved workflow among engineering disciplines
- Closer collaboration between project partners
- Storage and reuse of data
- Reduction of errors and less time for error-checking
- Shortened design timelines and more reliable schedules
- Increased data consistency and tracking for part sourcing and inventory management
- Automated wire processing and enclosure designing
- Digitized work environment for automation, controls, and mechatronic design
- 3D modeling.

However, the E-CAE systems do more. They ensure that if a specific piece of data is changed, that same piece of data will be updated wherever it appears in the project. For example, if a process engineer adds a solenoid valve, the fluid engineer needs to add it to the project design, and then the electrical engineer has to control it. With a traditional system, each engineer works separately, possibly using different software tools. With a multi-disciplinary CAE system, each engineer would be able to work collaboratively, at the same time ensuring that the final product is completed with greater speed and accuracy.

Database-driven E-CAE softwares allow sharing of standardized data between departments, which makes it possible for disciplines to do cooperation, to create an integrated project package. Enterprise systems such as Product Lifecycle Management (PLM), Product Data Management (PDM) and Enterprise Resource Planning (ERP) can be connected to the database. This enables the database to be connected to multiple departments in a company like sales, purchasing, accounting, manufacturing and services. Since the same database operates in several places, the information is always up to date,

which makes all disciplines aware of the project status. Collaborators located in other parts of the world can share the same data in real time. /7/

4 EPLAN

EPLAN Software & Service was founded in 1984 in Germany. The company launched EPLAN, as the world's first PC-based design automation solution software. EPLAN's headquarter is located in Monheim am Rhein, in Germany, and the subsidiaries are located in more than 54 countries. The company has approximately 25.000 customers and 80.000 software installations worldwide.

EPLAN is a developer of electrical and automation CAD/CAE solutions. The most recent product is the EPLAN Platform, which is a database-driven solution for hardware design. The new EPLAN Platform consists of several modules including:

- EPLAN Electric P8
- EPLAN Fluid
- EPLAN PPE
- EPLAN ProPanel
- M-CAD Data Management
- EPLAN Engineering Center.

The common platform means that the systems are fed from the same database, to make the engineering even more effective. The idea with a common core is to be able to standardize the data exchange and at the same time avoid duplicate data and inconsistency. The platform is based on an Application Programming Interface (API), which enables integration with other systems. /2/

4.1 Introduction to EPLAN Electric P8 2.0

EPLAN Electric P8 is a database-driven software, customized for planning of electrical power hardware installations. The idea behind EPLAN Electric P8 lies in the automated technology in planning, documentation and management of projects. The fundamental principle is to let the user decide how to operate the tool. The program offers unlimited possibilities and the idea is to let the user adapt the program for his own use. Different modules can be integrated into the software to expand the engineering possibilities, such as an online device library and a layout-designing pack for enclosures. From now on I will refer to EPLAN, as 'Eplan'. In this chapter I will concentrate on the most vital Eplan features and elements that are related to this project. /2/

4.1.1 Project basics

The Eplan term *project* refers to the place where all kinds of document pages are managed. Schematics are designed within a project, which may also include later generated reports such as lists and diagrams. The software *project structure* is a way to hierarchically organize objects within a project, such as pages, devices and functions. All objects have a *structure identifier* to be able to locate and reach them in the projects. The project structure is based on the IEC 81346-1 standard. /3/

[== EXAMPLE] [= TAD] [++ 01] [+ 02] [- QA1]

==	Functional assignment
=	Higher-level function
++	Installation site
+	Mounting location
-	Device

4.1.2 Parts data

All devices implemented in the schematics are presented as graphical symbols. Besides with symbols, devices can also be initiated with parts within the project. The *parts data* represents the real component of the schematic symbol. The part can represent limits of component-specific details, such as technical, size and price information. The user has to create his own parts data, as the Eplan default parts database offers no more than a few examples. Eplan allows the user to update parts data information according to his own requirements and needs. A sufficient access to parts-related information can facilitate component dimensioning and designing of the enclosure layout. The parts are stored in a specific database and they are reached through the Eplan *parts management* (see chapter 6.2). Since the information is stored in a separate database, it is possible to make it accessible from a server. The parts information can be further utilized in project reports, like parts lists, spare part lists and bills. At Vacon, the Eplan parts management possibility has enabled engineering to become a part of the electrical designing.

4.1.3 Graphical reports

The graphical reports can be automatically generated within the project. There is a wide selection of different report types that Eplan can produce, such as connection, wiring and parts based project pages. Eplan generates reports by reading the created schematics and the user decides which types of reports that is to be added to the project documentation. /6/

5 Electrical designing

Companies using E-CAE softwares usually choose to restructure their work process into a more streamlined engineering, in other words, to adapt the engineering and designing tool to their own process and product. This results in a more efficient way of working and projects are able to progress faster and with increased accuracy. /7/

At the Sales & Solution Support department, the projects usually start with a customer specification, based on the customer's requirements and process. The defining of the cabinet drive system is handled by the project manager before the project is sent over to the engineering team. As the concept enters the electrical designing desk, the project can be processed in different ways depending on the drive system.

Eplan is used for cabinet drive designing and has opened several possibilities for the electrical designing of the products. From another aspect, the tool has affected different elements regarding the cabinet drive engineering. One element affected is the *project sequence*, which presents the engineering process in projects. Another element is the *tool management*, which reflects the software's application in projects. These elements have been standardized by product type in order to facilitate and speed up the engineer's task as much as possible, while raising the quality of the work. (Personal communication with electrical engineer K. Rajala)

5.1 Project sequence

At the Sales & Solution Support department the project sequence is standardized for each cabinet drive product. The engineering is proceeds in different ways, depending on the drive system (see Figure 2.). (Personal communication with electrical engineer K. Rajala)

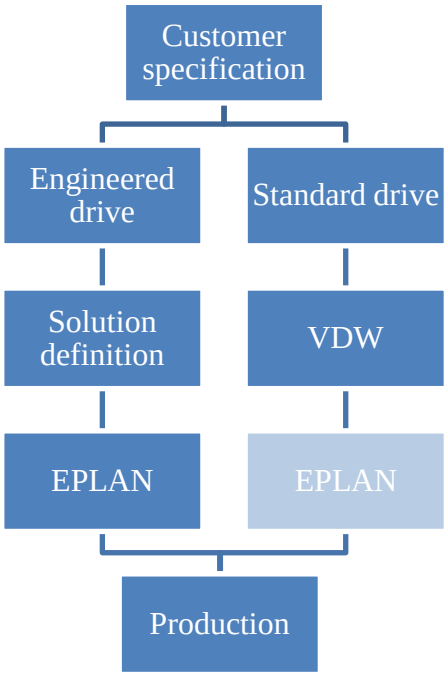

Figure 2. The electrical design sequence for cabinet drives.

5.1.1 Standard drives

The Vacon NXC drive is a standard product and its electrical designing is managed by the Vacon Documentation Wizard (VDW) tool. Vacon Documentation Wizard is a technical documentation tool intended for the NXC drive. The system generates the entire project documentation and operates beside the Eplan 21 system. The NXC drive enables the use of such a system, as the product offers only a limited amount of options. The tool can also be reached from the Internet. /18/

By entering the product and option codes of the wanted drive, VDW utilizes Eplan 21 macros to generate the schematics and relevant reports. All cabinet ratings are defined in the codes. In some cases the NXC drive documentation needs additional designing which is not supported by the VDW tool. This happens when customer-specific options have to be taken into account. The WDV output project is then forwarded to further designing with Eplan 21. After the project documentation has been checked by the project manager it can be forwarded to the production unit.

The Eplan P8 commissioning will not replace the use of Eplan 21, when it comes to the NXC designing, in the first instance. Updating and integrating the VDW system with Eplan P8 would result in a considerable development work. This was also considered

rather insignificant at this stage, as the system is still operating and an important engineering resource. (Personal communication with electrical engineer K. Rajala)

5.1.2 Engineered drives

When it comes to engineered drives, the process always starts by defining the system. The dimensioning starts from the customer's process, by considering the torque, load and speed cycle. There are different systems to be considered, when selecting a suitable system for the customer. Typical Vacon drive systems are *common DC bus*, *common AC bus* and *single drive*. /19/

After the system has been configured completely, the concept is forwarded to the engineering team. The electrical designer receives the project specifications needed to start off the cabinet designing. Usually the designing starts with a rough draft single line schematic, which is then processed in Eplan 21, utilizing the *Vacon engineering library* (see chapter 5.2). Different project-related requirements that the designer must take into account before the project designing starts are:

- Voltage classes
- Current ratings
- Enclosure class
- Environmental conditions
- Applied standards
- Applied segment.

The designer is also needs additional information, when it comes to the component selection. These customer specifications can be related to drive control options, protection levels and auxiliary equipment.

In the near future, Eplan P8 will replace the former engineered drive design tool, Eplan 21. The project sequence regarding engineered drives will continue to be applied, since the current approach was considered efficient. (Personal communication with electrical engineer K. Rajala)

5.2 Tool management

When preparing electrical documentation for an engineered drive, the project always starts with pre-prepared Eplan material. This includes all kinds of graphical and functional data needed when designing. The term *data* in this context refers to the main and necessary Eplan elements the electrical designer needs for creating projects such as:

- Page and symbol macros
- Parts data
- Graphical symbols
- Graphical data forms
- Graphical page frames.

The data source used in Eplan consists of two separate databases. See Figure 3. One is the Eplan master database, which contains basic and default data. The other source is Vacon's own database, which contains the department's own product related data and which forms the *Vacon engineering library*. These databases overlap and are used simultaneously, since they mutually deal with different, but necessary data. The master database provides designing with all necessary basic data and the separate Vacon database provides more customized data.

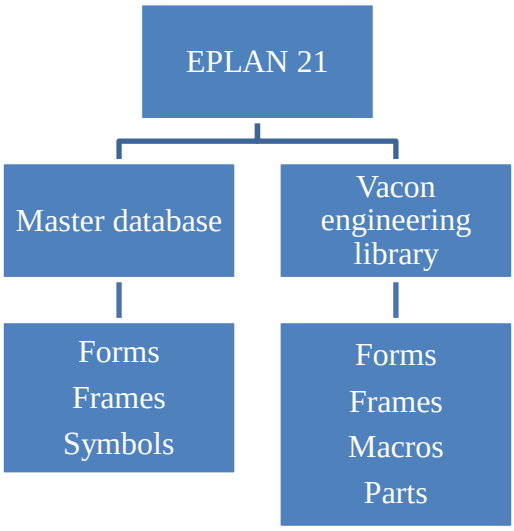

Figure 3. The Eplan 21 data source structure and contents.

The purpose of the Vacon engineering library is to let the electrical designer utilize pre-prepared data as much as possible during the designing process. The library is used as an output source in the initial electrical designing phase when a rough concept of the wanted drive system is being built up. At same time the aim is also to encourage the designer to progress in a structured way, by utilizing the source. Another important aspect is to allow other designers access to the same database, to further encourage its development. The reasons why the department has opted for this method, is to further streamline the work. This has benefited important factors such as:

- Accuracy
- Speed
- Quality.

The Vacon engineering library contains mainly data intended for engineered drives but also for standard drive designing. Its function is to archive data of integrated wholes, such as entire schematics and complex symbols. These kinds of data are stored as macros files, which can be utilized as entire pages or as single device symbols. The database also holds other graphical contents, such as graphical Vacon page frames and forms intended for documentation diagrams and lists. The *project page macros* represent almost the entire Vacon engineering library content. The PPMs are pre-prepared schematics and the most important building blocks for engineered drive designing. (Personal communication with electrical engineer K. Rajala)

5.2.1 Project documentation – Pre-design

The database allows necessary designed data to be easily imported from a specified source or archive of standardized material during the pre-design. The purpose of the archive is to let the user store frequently used parts and special macros of entire product assemblies or sub-assemblies. This data has already been tested to ensure that it is error-free when it is implemented in projects. /7/

The engineered drive's PPMs have been prepared for both main and auxiliary circuits, of single- and multi-line schematics. The Eplan macro allows storage of more than just graphical data, such as *parts data* and a *page frame* (see Figure 4.). This enables all devices in the schematics to be pre-assigned with the correct parts data. The PPMs are also pre-implemented in Vacon forms, which allow them to be directly implemented into

projects. A comprehensive range of PPMs has been ensured by having prepared multiples of schematic variants differing in either graphical or parts data contents. (Personal communication with electrical engineer K. Rajala)

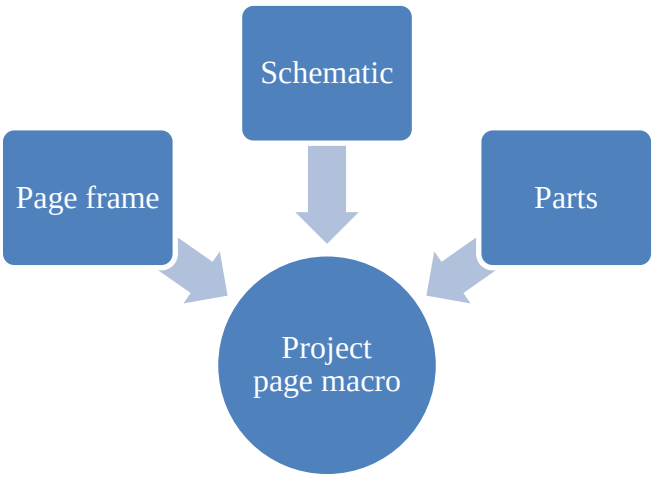

Figure 4. The project page macro.

5.2.2 Project documentation – Design

After the data has been incorporated, the E-CAE user implements graphical contents of the pre-designed material in the schematic page and then selects the required data from the predefined value table. The system then automatically re-sizes all variables and then actualizes all the changes through the project of schematics and lists. This result in no time being spent on cross-referencing, wire numbering, device-tagging and creating different kinds of project reports, such as bills of materials and parts lists. /7/

The designing part of engineered drives starts by selecting the correct PPMs from the Vacon engineering library, by considering the defined drive system and the customer's specifications. The PPMs are then selected on the basis of how well the schematics match the wanted concept in wiring and dimensioning. The rough PPMs are then compiled into an Eplan project, required connections are rewired and parts are replaced. Switchgear designations like field, cabinet and component designations are then simultaneously entered while applying proper project standards. The remaining manual designing is to update the mains supply and signals, in order to link correctly between project pages. (Personal communication with electrical engineer K. Rajala)

5.2.3 Project documentation – Build

When the designing is complete, the E-CAE user generates all necessary project documentation and forwards it to further processing. After manufacturing, the approved documentation is sent to the customers by exporting it in several common file formats. If the project is abroad, the documentation can be converted to different languages or accepted standards of a region or industry. /7/

After the electrical designing phase of the drive system has been completed, the reports representing the schematics are then generated by Eplan. When producing reports the program checks all connections, wirings and parts data of the compiled PPMs and through these generates the selected report types. The final project documentation is then forwarded to the production unit. The *parts list* is necessary as the components are ordered on the basis of it. The *connection list* is also important, as it is the preferred document type when doing electrical installations, as it is clearer are more certain when it comes to preventing miss wiring. This means that the initial project PPMs have to be correct otherwise they will be returned for maintenance. See chapter 5.2.4 Project documentation – Maintenance. Depending on the customer's requirements, the documents are either forwarded in a physical format or in a common file format. In accordance with the Vacon standard, the following document set is produced and sent to the customer:

- Title page
- Table of contents
- Single-line
- Layout
- Multi-line
- Terminal diagram
- Connection list
- Parts list
- Cable diagram.

(Personal communication with electrical engineer K. Rajala)

5.2.4 Project documentation – Maintenance

The maintenance with CAE systems is efficient. The information is usually available in multiple formats, which means it can be pulled out and updated directly. The troubleshooting is fast, which prevents processes and machinery from being down and wasting time. The technology also favors the documentation stored by the equipment, when it comes to keeping it up to date. /7/

The Vacon cabinet electrical installations can be updated during manufacturing. This will immediately make the project documentation obsolete. This leads to the entire documentation being sent back to the responsible electrical designer for updating. The same procedure occurs if errors in the documentation are discovered. The first task for the designer is to correct the open project and return it to production. Secondly, if the errors or the updates are not project specific the designer corrects the project related PPMs. Typical project design maintenance tasks for PPMs are:

- components are replaced
- standard product installation is updated
- new standards are launched.

(Personal communication with electrical engineer K. Rajala)

6 Parts database development

The Eplan 21 parts database used at moment contains almost 4000 components. This has affected the component management in a negative manner during designing. The current database holds a bad structure and some negative factors are:

- Non-standardized data structure
- Messed up languages
- Unused components
- Duplicate components
- Unavailable components

One reason is that the program has been in use for a long time and several designers have used the program and thereby updated the parts database using their own terms. Unnecessary data has not been taken into account, which has affected the growth of the source. Throughout the time that Eplan 21 has been in operation, there has not been a proper parts database standard to follow, which has now increasingly been taken into account. (Personal communication with electrical engineer K. Rajala)

The parts database's different contents are presented from their functional point of view, instead of being presented in a chronological way. The purpose is to let the reader gain a broader understanding of project designing from a functional aspect.

6.1 Compiling of components

The initial task of the development process of the parts database was to compile all necessary components. The lack of specific knowledge and experience regarding the electrification of these systems made this phase challenging. As the systems include a lot of different electrical parts, the first issue was how to get the *knowledge* and how to find out the proper *approach* regarding cabinet drive components?

In the early project phase two possible options were presented concerning the component know-how. One alternative was to do simultaneous cooperation with the responsible electrical designer at the department in order to partake of his knowledge. The other option was to benefit from Eplan 21 PPMs, from which all parts could be exported into lists. A decision was made to go for the latter method, as this would not require major supervision during that phase of the project. Following this method, access would be given to only

standard drive components. Since PPMs are standard solutions and constantly being updated, it was not necessary to take into account if a component is unavailable or project specific.

Eplan 21 has a function which allows for example exporting of component data from a project. Utilizing Eplan 21 PPMs of the Vacon engineering library would also permit export of parts data from the project pages. As the PPMs in the library amounted to a few hundred, it was necessary to do this in a structured way to ensure the compiling of all information. The following approach method was used:

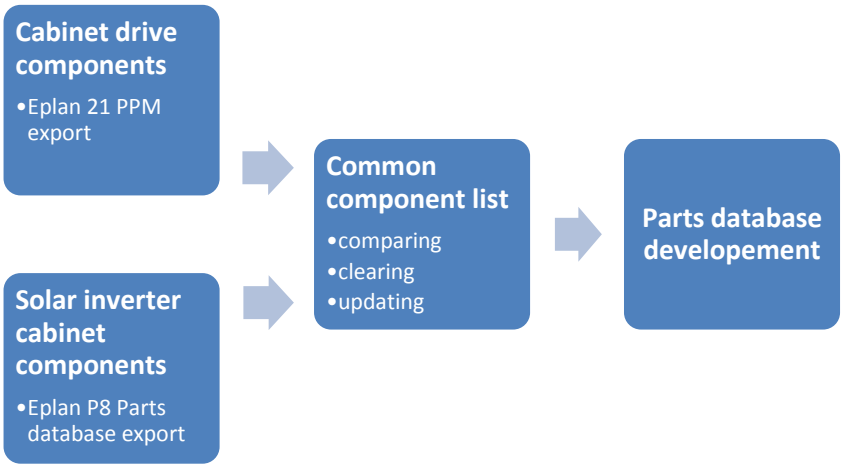

Figure 5. The approach used for component compiling.

As Eplan P8 was already introduced at the Solar department, the already existing database components had to be considered. The aim was to integrate the department's own database with the Solar team's already existing database. For this reason the Solar Eplan P8 parts database had to be exported, so that already existing components could be compared and cleared. For this task a decision was made to import all information into Excel. The program offers easy sorting and filtering possibilities of data, which in this task facilitated component data management. First of all duplicates in the common component list had to be removed, since the same parts emerged in many of the PPMs and in the Solar component selection as well. Secondly all missing technical parts information had to be updated. In this phase Internet and catalogues of various component manufacturers were used for this purpose.

6.1.1 ABB – AF-line

The idea with the new Eplan database was naturally to update components available on the market. The project was also an opportunity and resource to introduce components of new technology and at the same time to strive to utilize the same components in the departments responsible for electrical designing of enclosure products (Solution Support and Solar team).

At the end of November 2011 a product schooling was held at Vacon. The training was held by ABB and the aim was to present new low-voltage products on the market. A new contactor series, named AF (see Figure 6.) had been launched to replace the former A-line. A few components of the AF-line had already been introduced on the market at an earlier stage and these had also been tested in Vacon projects. From now on the series covers all current- and voltage classes of both AC and DC type. The AF-line contactors are equipped with a new electronic coil, which differs from the A-line coils which are based on traditional induction technology. The electronic type allows both AC and DC voltage and at the same time it has a reduced energy consumption. The AF-line has also built-in surge suppressors to suppress high-voltage spikes generated by the coil. /1/

Figure 6. ABB AF-line contactor.

In engineered drive projects, ABB A-series contactors have been used for motor control. After the product training, it was decided by the engineers of both Solution Support and Solar department that from now on strive to use only AF-contactors in their projects. This affected the parts updating in such a way that all used A-line contactors had to be converted to AF-contactors. For this task I used ABB contactor model transfer tables that had been made for this purpose.

6.2 Parts management

The Eplan parts management is a part of the software, where you can manage technical and commercial data specific to parts and people (see Figure 7.). This could be information such as technical characteristics, dimensions and price. It is also possible to manage the corresponding function definition for every device. The information is stored in a separate and Eplan-specific parts database. The parts management allows you to handle products from different fields, such as electrical engineering, mechanics, process engineering and fluid power components. /10/

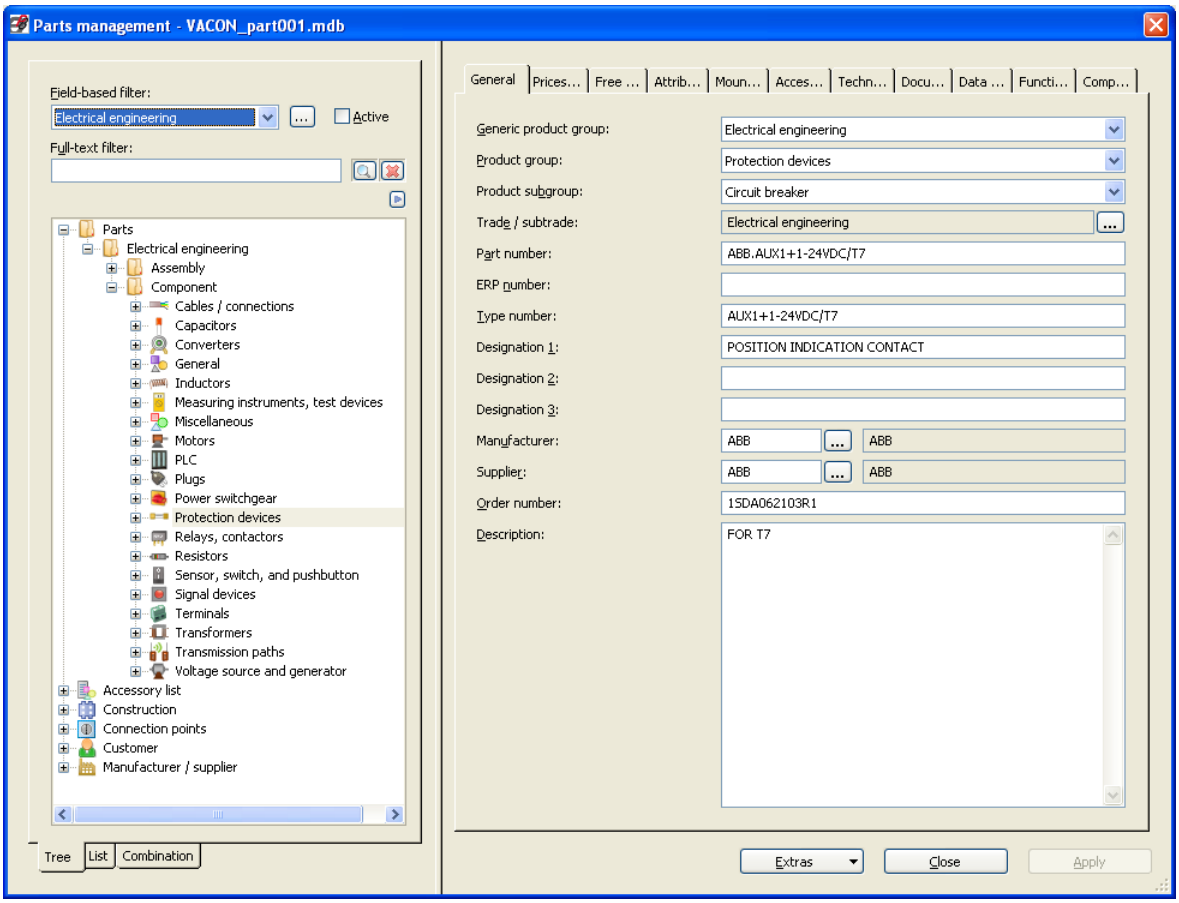

Figure 7. The parts management dialog.

6.2.1 Structure

The parts management needed a comprehensive standard regarding the structure. This would facilitate the device selection and permit an easy parts updating in the future. It was also important that the information in the database should be accessible in a common language. The reason is that it should be possible for other engineers with another mother tongue to use the information, as the software will, in the future be introduced at other

Vacon offices. Another factor is that the data linked to the database, which is presented as text in the final project documentation should be in English for the customer, since most projects are overseas. In Eplan 21 parts data can be found in both English and Finnish, which has resulted in the same components being updated in both languages. For this reason it was decided that all parts data was to be updated in English.

Another important aspect was to make the component category structure as simple as possible, but still functional. It was desirable that the structure have a consistent and clear pattern to facilitate and to avoid a wrong categorization when new components are updated. This means that the structure should not consist of too many, nor too general considered product categories in the parts management. The following hierarchical structure was chosen for the parts management in order to cover all used cabinet drive components in use.

- Cables, connections
- Capacitators
- Converters
- General
- Inductors
- Measuring instruments, test devices
- Miscellaneous
- Motors
- PLC
- Plugs
- Power switchgear
- Protection devices
- Relays, contactors
- Resistors
- Sensor, switch and pushbutton
- Signal devices
- Terminals
- Transformers
- Voltage source and generator.

General and Miscellaneous are typical undefined categories, which basically allow parts of any kind to be stored. The intention was, however, to establish a separate category for common accessories and one for non-electrical components. Different main components using the same accessories (see chapter 6.5.3) as the ABB switch fuse and switch-disconnectors use the same auxiliary contacts, which are then placed in a common folder.

Difficult situations occurred when it was hard to determine the proper category for a particular component. In such cases it was necessary to take the component's basic construction into account and also roughly determine it in order to categorize it correctly. One particular situation was a case when different protection and detection relays were categorized. The problem lay in the choice of placing such devices under *protection device* or *relay, contactors* category. The solution was to roughly categorize them as relays, since the modules often include several functions.

It will facilitate future component updating, when all kinds of parts already exist in the database, as the pattern is then predetermined. At the same time all the decisions made regarding categorizing were important, as the standard will be applied in the future.

6.2.2 Part number

For several categories, a large number of components will be listed. The requirement was that the components under the main categories should be sorted in some way to facilitate managing. As the visual parts part number in the Parts management dialog can’t be organized in subgroups, they are just alphabetically sorted under the main part category. Because of this a decision was made to organize them as in the following example:

SCH.C60N 3P C16

By using this method the components would be sorted by its manufacturer, in the form of a three letter code. According to the example, this miniature circuit breaker is manufactured by Schneider.

6.2.3 Parts data tabs

Specific parts-related information is stored and organized under several tabs, visible on the right side of the Parts management dialog (see Figure 7.). The tabs can be utilized on the basis of the user’s different designing tasks and requirements. The needs can be related either to software tasks or to project documentation.

The requirement was that the parts data should include no more information than necessary. The reason was that it will complicate the pattern that is to be followed during future updating, if the specific parts information is too extensive. This will result in the user not applying the set parts database standard. A rough overview of the data assets used and their related designing tasks applied in this project can be seen in the table below.

Table 1. The Parts management assets used for the project.

Data tab	Function area
General	Documentation/ Designing
Prices/ Other	-
Free properties	-
Attributes	-
Mounting data	Designing
Accessories	Designing
Technical data	Designing
Documents	-
Data for reports	-
Function templates	Designing
Component data (type specific)	Documentation/ Designing

6.3 Documentation requirements

A lot of parts data appears in the project documentation as graphical information. To get an idea of what kind of information is vital and important for different parts, it was necessary to go back to the project documents. For this purpose, old Eplan 21 projects and standard Vacon forms were used to clarify these kinds of requirements.

6.3.1 Schematics

Other documentation-related parts data occurs in schematics. Components always have terminal designations, which should be identified in the schematics. This kind of information is directly linked to the parts database. Usually terminals are designated by consecutive numbers, which, in this case, are always set as default for every Eplan symbol. This meant that only symbols with specific terminal designations had to be taken into account, such as transformers, power supplies and relays (see Figure 8.). It is also an advantage if the components used have some vital technical characteristics presented beside the symbol, in order to clarify different electrical ratings and dimensions. For this

purpose this was also considered during the database updating. This kind of information is updated in the Parts management's *Function templates* (see chapter 6.5.1).

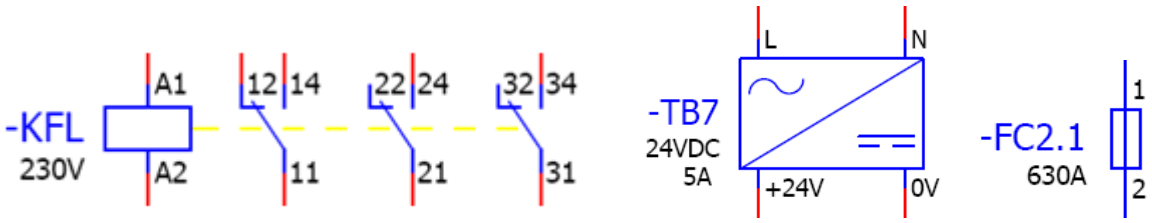

Figure 8. Symbols with parts data linked information (in black).

6.3.2 Parts list

The parts list is primarily intended for the production unit, to let them know what components are included in the drive enclosures. Based on this information, the electrical parts are ordered for the project. When the project is ready and in operation at the customer's site, the parts list is used for ordering spare parts. For these reasons, it is important that the information is accurate and reliable to avoid mistakes when ordering. (Personal communication with electrical engineer K. Rajala)

Parts list

Device tag	Type designation	Quantity	Designation	Order number	Technical characteristics	Manufacturer
-QA0	YU220-230V/E1-6	1	UNDERVOLTAGE RELEASE	1SDA038312R1		ABB
-QA0	YUE/E1-6(N-O)	1	UNDERVOLTAGE RELEASE	1SDA038340R1		ABB
-RA7	WDK 2.5 LD GR 1R 24VDC	1	TERMINAL WITH LED	8010040000		WEIDMÜLLER
-SF1	CG8 A425-600 FT2-V	1	START SWITCH			KRAUS & NAIMER
-SFG	704.910.4	2	EMERGENCY STOP CONTACT			EAO
-SFG	704.064.2	1	EMERGENCY STOP BUTTON			EAO
-SFG	704.963.6	1	EMERGENCY STOP LABEL			EAO
-TA4	066228-901	1	VOLTAGE TRANSFORMER		2500VA	NORATEL
-TB7	SPD241201	1	POWER SUPPLY		24VDC 5A	CARLO GAVAZZI
-XD0	SN016P	1	SOCKET	25 197 10		TYCO
-XD1	WDU 2,5	12	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER

Figure 9. Vacon parts list form.

According to the Vacon parts list form, the following information is vital for every single part:

- Type designation
- Designation
- Order number
- Technical characteristics
- Manufacturer.

From the Parts management point of view, this kind of basic information is updated in the General sheet.

6.4 Part selection

Part selection is a dialog used for assigning parts and their data from a source. The parts are stored and are available for parts selection through the Eplan *Parts management*. The dialog is visually exactly like the Parts management dialog with product hierarchy levels of electrical engineering, fluid power and mechanics. Part selection offers different filter schemes that can be activated for displaying only particular types of components. Compared to *Device selection* (see chapter 6.5) Parts selection is independent and does not check if the part matches the device in the project. Thence a PLC card part could be assigned to the motor overload switch device. However, the function detects the differences afterwards between the data stored for the part and the data in the device, by opening a conflict dialog. It is up to the user to decide if the part is allowed to be assigned. /4/ /5/ /9/ /13/

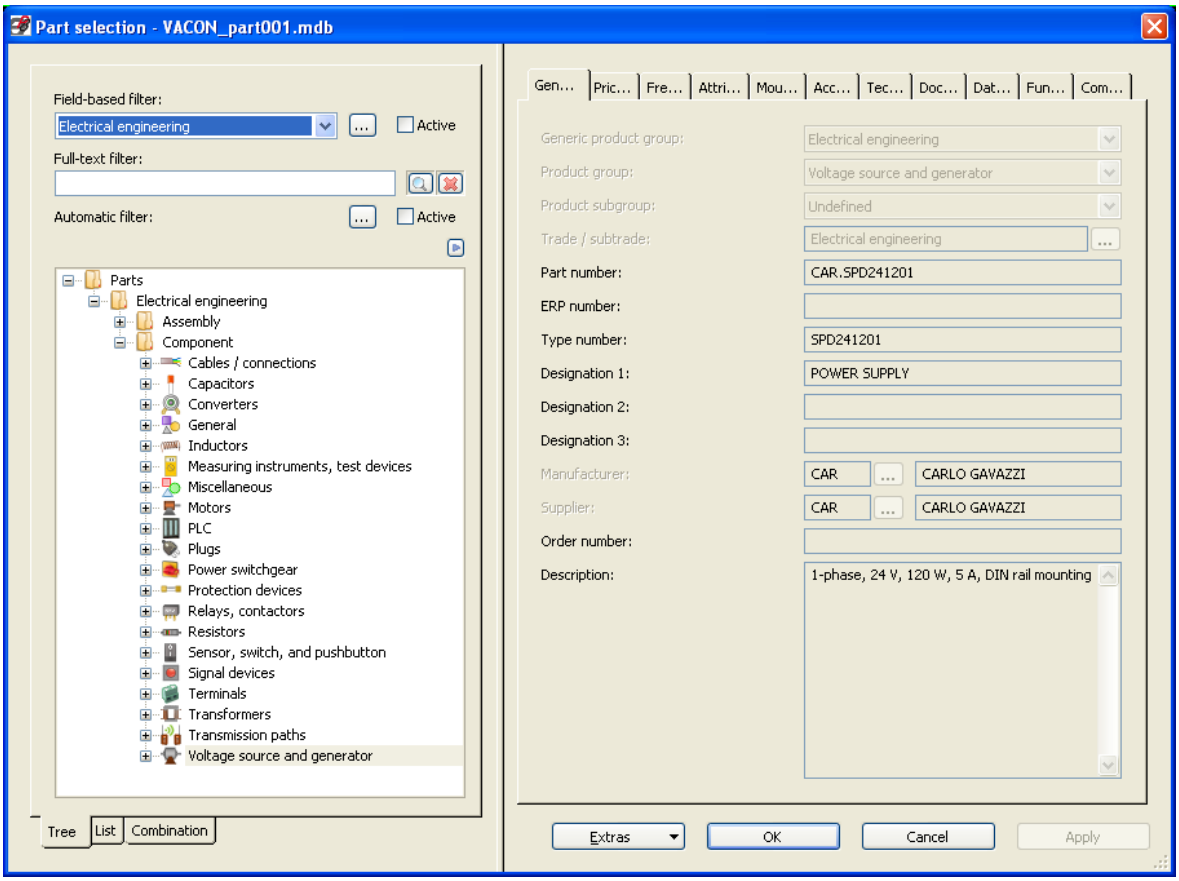

Figure 10. The Part selection dialog.

6.4.1 Identifier

In the Parts management's *Technical data* tab, an identifier can be assigned to the part. The character(s) typed allows filtering in *Parts selection* on the basis of such identifiers. The identifier, however, is not transferred as a designation to the schematic device. /15/

A decision was made to utilize this Identifier feature in order to benefit from the filter and at the same time make the Parts selection useful. The intention was therefore also to create different possibilities for other designers to choose between when approaching component selection tasks in Eplan. As the Part selection feature is not dependent on any other technical conditions it was easy to update device designations for every part. The filter facilitates a part's location in the database significantly, when searching for specific and uncommon components.

In the early project stage, it was decided that a new standard would be applied regarding device designations. At the same time this would be easy to carry out, since the entire library would be reconstructed anyway. The SFS-EN 81346-2 (2009) standard; *Classification of objects and codes for classes* had already been considered during the standard drawing transfer. The only thing remaining was to apply the standard in the parts database building.

> "The aim of this part of IEC 81346 is to establish classification schemes for objects with associated letter codes which can be applied throughout all technical areas, e.g. electrical, mechanical and civil engineering as well as all branches of industry, e.g. energy, chemical industry, building technology, shipbuilding and marine technology. The letter codes are intended for use with the rules for the construction of reference designations in accordance with IEC 81346-1" /8/

The part of the standard considered for this project is chapter *5.2 Subclasses of objects according to intended purpose or task*. This chapter includes a *Table 2. Definitions and letter codes of subclasses related to main classes*, which provides specific letter codes for electrical components. The classification system is based on a two-letter code, where the first character defines the main class (see Appendix 1) and the second (see Appendix 2) defines the subclass. An additional subclass can be defined according to "*Rule 6; Additional subclasses to those defined in Table 2, may be applied if: the subclasses are defined in accordance with the basic grouping of subclasses in Table 2"*. The following example shows the basic classification principle for a contactor:

Controlled switching or varying a flow
of energy, of signals or of material

Subclass

↓ ↓

Q A 1

↑

Switching and variation
of electrical energy circuits

6.5 Device selection

The Device selection is a part in the program where you assign parts data to the schematic device. Eplan P8 also offers *Device selection* as an addition to *Part selection*. Device selection is dependent on the schematic and the function definitions belonging to the device. There is an immediate check (compare Part selection) upon clicking the device selection button to determine which device functions already exist. Thereafter, only parts that match the function definitions are displayed. This means that it is not possible to assign a PLC card part to a motor overload switch device. /9/ /14/

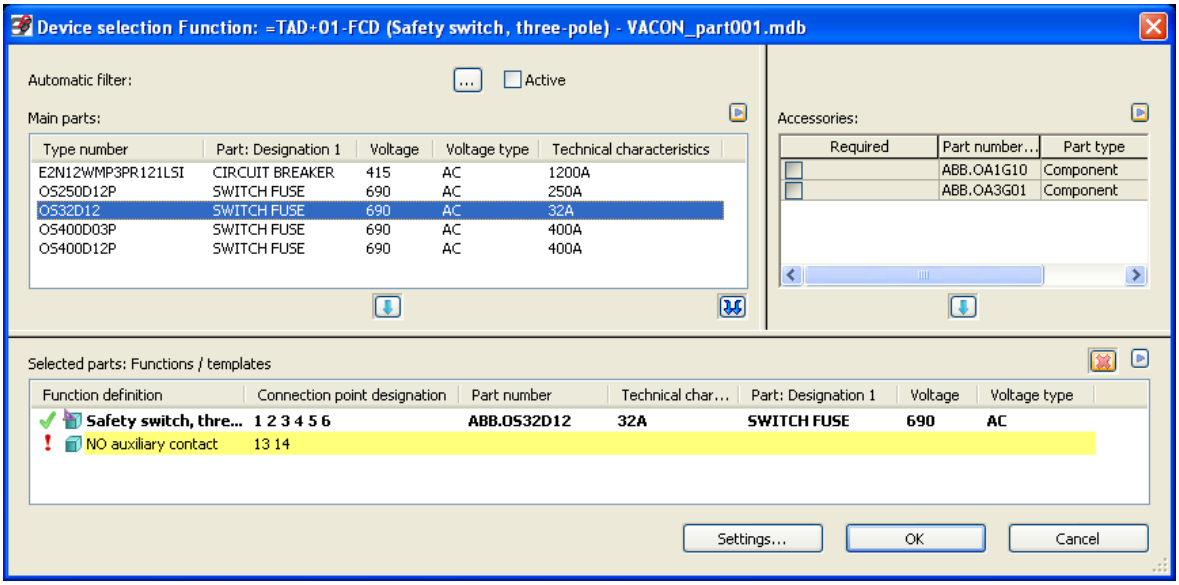

Figure 11. The Device selection dialog.

6.5.1 Function template

The *function templates* are defined to determine the key information for the actual part. When a part is updated in the database it is defined whether the part is a lamp or an auxiliary contact. The information is defined in the *Function templates* tab in the Parts management (see Figure 12.). The templates are utilized during the Device selection action

to determine matching parts for devices. This permits selection of exactly the parts matching the devices in the schematic. /12/

As the function template is the solution behind *Device selection*, it was an obvious decision to include it in this part's database. This would facilitate device dimensioning when suitable parts are preselected, instead of being forced to browse through the whole database in search for suitable or required parts. The feature would especially benefit components available in multiple variants, such as contactors, relays, MCBs and terminals.

By adding a function template, this in turn permits terminal designations for devices to be pre-entered. This would facilitate part assigning, as the designer would not be forced to browse through component data sheets in search for the correct terminal markings. Instead this would automatically assign the designations for a contactor or auxiliary relay. Therefore this feature was also considered in the database updating.

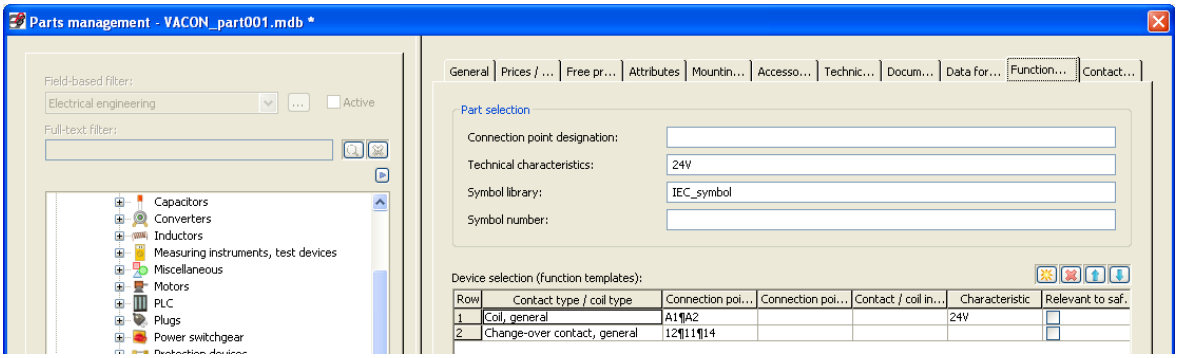

Figure 12. Function templates with pre-entered connection point designations.

6.5.2 Technical data

During the device selection the preselected parts are listed in a *Main parts* window. As the function template(s) already have determined suitable parts, the designer still needs to find out further details regarding the components' technical features. The function template does not consider anything else but the device itself. The device surroundings, such as voltage type, potentials, currents and powers are not taken into account. This means that the actual dimensioning is to be carried out by the designer. As the function template feature was already utilized, it was necessary to include the technical data as well in the project, as that they go hand in hand.

These features are entered in the Parts management's *Technical data* tab (see Figure 13.). The tab in question is component dependent, and its appearance is different according to

the component type. This means that the input fields vary depending on whether the component are a fuse or a terminal, for example. In the case of fuses, the IEC size and tripping current is crucial information. When assigning a terminal part, the cross-section for conductor and color is important.

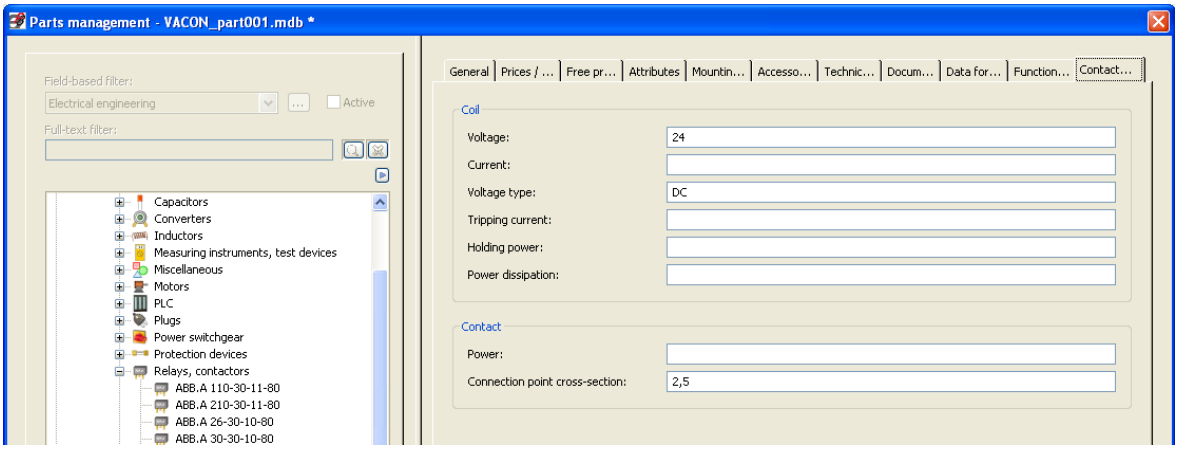

Figure 13. The component data tab for a contactor.

6.5.3 Accessories

The *accessories* function lets the user assign accessories to main parts. These accessories are stored as normal parts in the database. When a part is being created it can be defined as "accessory" or "main" in the Parts management *Accessories* tab. The defined main part is then assigned with an undetermined amount of accessory parts. The selected accessories can be marked as *required*, if the part is operationally necessary. This function can be utilized during the Device selection action. /11/

During the component compiling phase, a major amount of accessories appeared especially for particular main components. A typical example is the ABB ACB, which in Vacon projects usually contains approximately 5-10 accessories (see Figure 14.). It was decided to utilize the accessories feature, as the *component selection* could be in need of further automation when handling these kinds of components. It was decided to realize this only on particular main parts with several related accessories.

Figure 14. ABB Emax – air circuit breaker.

7 Pilot project

When the parts database was established, the following step was to test its functionality in the project environment. This was necessary action, since Eplan P8 had still not been used in real projects at the department. The aim was to apply the same project sequence and tool management as for Eplan 21, to ensure its operation in Vacon projects. This was realized by designing an entire cabinet drive project, starting from PPM designing to complete project documentation. In this way the parts database could be tested on a larger scale, but also on a function-specific level.

7.1 Selecting drive system

The designing of entire drive systems requires a lot of previous experience. To still be able to create a real project in a set time, it was decided to utilize an old Vacon project. With this approach, engineering would not be a part of the project, which again was not the intention. As Eplan P8 is initially only to be used for designing of engineered drives it was decided to design such a system. To ensure that the pilot project would be beneficial in the future at the department a typical *common DC bus* system was selected (see Figure 15.).

7.1.1 Common DC bus

The common DC bus drive system includes a front end unit, whose mission is to convert the mains AC voltage into DC voltage and current. The converted power is then fed to the common DC bus and then to the inverter units. The power can also be transferred back to the mains, depending on the front end. In other cases a break chopper is used to dissipate the braking energy. The breaking power can also be directly fed to the other drives via the common DC bus and thereby save energy. (Engineered drives manual)

The crucial reason for opting for this drive system was that a more complex cabinet drive was required, including a major range of different components. This would allow all kinds of designing tasks and components to be reviewed. Predesigned Eplan P8 schematics were used for the project, which had been designed during the previous summer. This also enabled testing of these schematics.

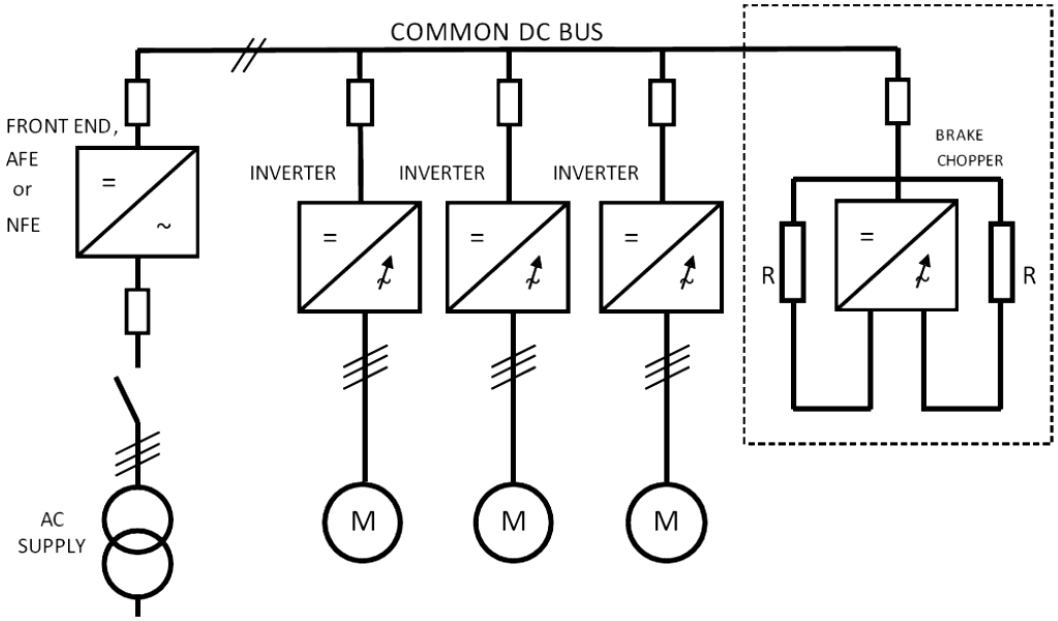

Figure 15. A common DC bus drive system. /19/

7.2 Project page macros

After having selected a suitable drive system the project continued with creating the needed PPMs. As most of the standard drawings were already predesigned, they were still not assigned with parts data. In this case parts lists of the needed PPMs were generated in Eplan 21 in order to obtain the corresponding components for the project. Finally, the correct components were implemented in each Eplan P8 PPM.

7.2.1 Device selection

In most cases *device selection* was utilized when assigning parts. When implementing contactor parts the function was especially useful. For the inverter unit a main contactor is needed to control the "charging ready" action of the charging circuit. The component must meet technical characteristics of 230 VAC and 15 kW for the coil and power contacts. The contactor also needs auxiliary contacts for ACB signaling (2 x NC), indication lamp controlling (NO) and its own holding circuit (NO). The coil and all contacts are separately initiated with a common designation, "-QA6", in order to be linked together.

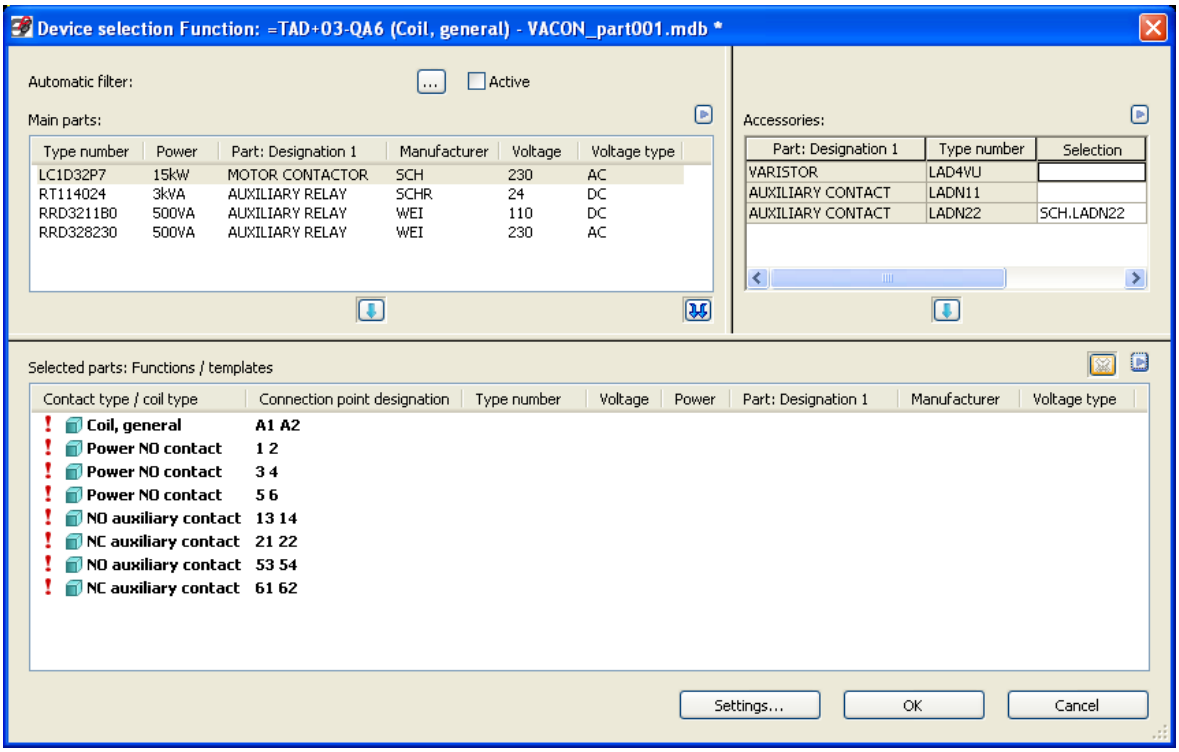

Figure 16. Unassigned device in the Device selection dialog.

When the device selection dialog is opened, the device to be assigned with part(s) are seen in the *Selected parts* field (see Figure 16.) as *function templates*. The preselected relays and contactors with technical information are listed in the *Main parts* field (see Figure 16.). Here the filter has taken into account the function templates together to find individual matching parts from the database. To be able to match each contact of the device, the filter also considers accessories associated with the main part, such as auxiliary contacts in this case. The accessories available for the main component are visible in the *Accessories* field (see Figure 16.).

The only option here is the Schneider LC1D32P7 motor contactor, which also meets our technical requirements. The device is then assigned with a part, but the main part does not assign every function template (see Figure 17.). An auxiliary contact is still needed to fulfill our requirements and the Schneider LADN22 auxiliary contact package is then assigned to the device (see Figure 18.). The device will be graphically assigned with the actual component *connection point designations* in the schematic.

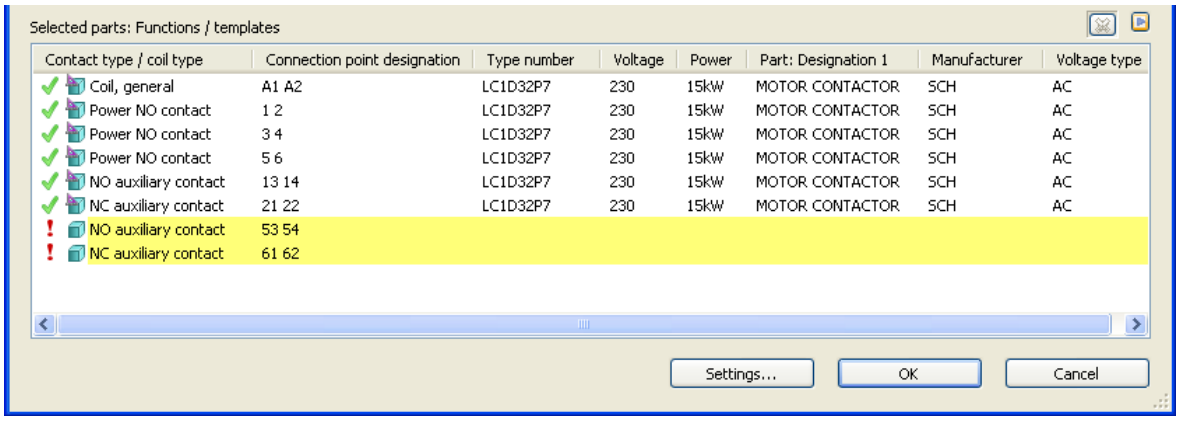

Figure 17. *Partially unassigned device in the Device selection dialog.*

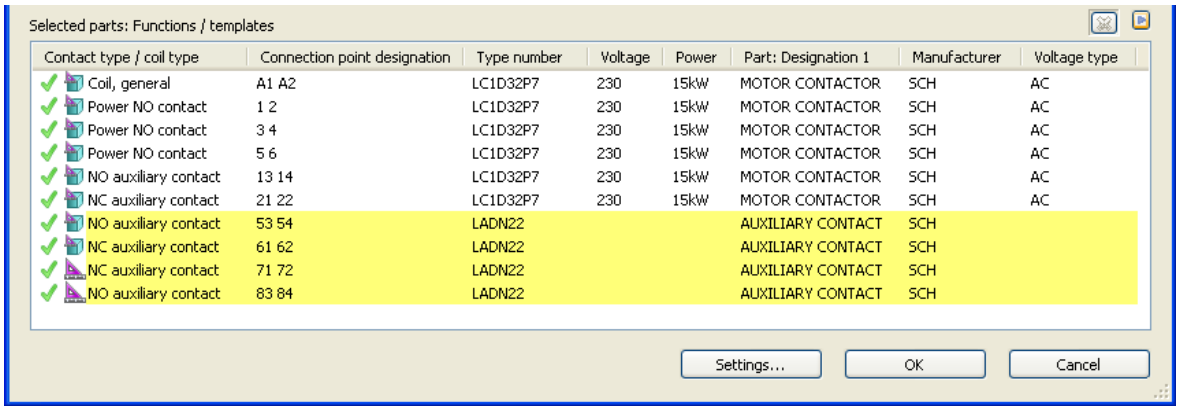

Figure 18. Completely assigned device in the Device selection dialog.

As only two additional contacts were needed, there still remains one NC and one NO contact. These contacts and their *connection point designations* 71:72 and 83:84 are retained as free. A contact image can be added to the device to clarify its status and location (see Figure 19.).

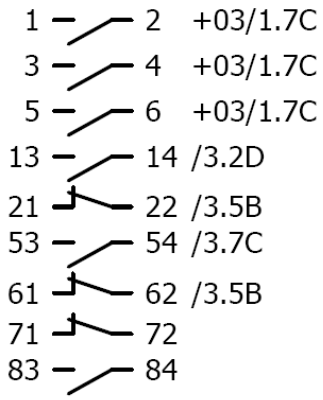

Figure 19. A contact image for contactor and auxiliary contact package.

7.2.2 Parts selection

When the Parts selection function is utilized, the part is located in the database on the basis of its corresponding device designation, the *Identifier*. The function was noticeably effective when parts of one option only were managed. In this case I wanted to assign parts for the two inverter units. For this drive system each inverter modules had been dimensioned to 300 A and 500 V for the common motor output.

The devices are designated in accordance with the related standard as "-TB2". When the parts selection dialog is opened, the entire component database is listed. By activating the *Identifier* in the *Automatic filter* (see Figure 20.) the designation related parts are only listed in the dialog (see Figure 21.).

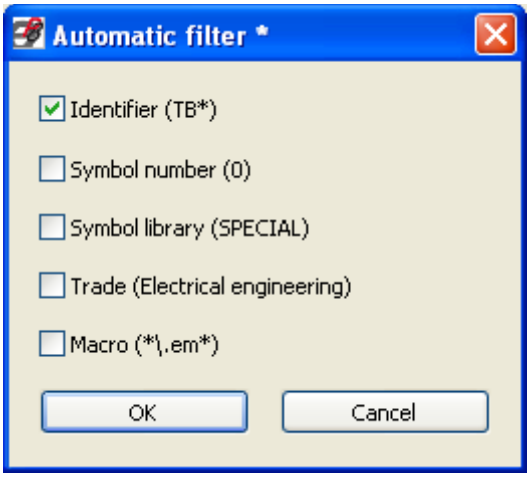

Figure 20. The Automatic filter.

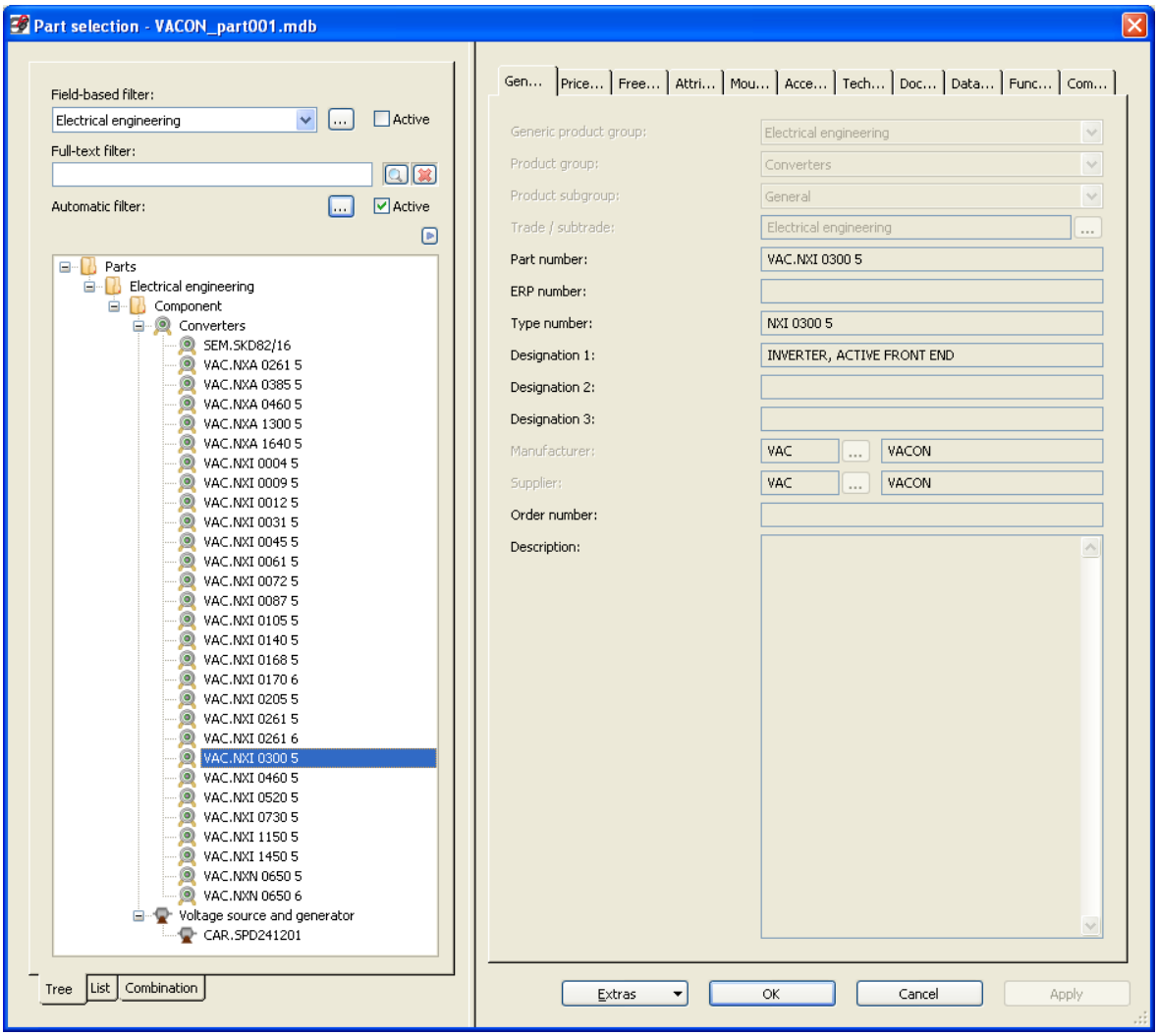

Figure 21. Automatic filter activated in the Part selection dialog.

7.3 Solutions

During the creating of the PPMs of the pilot project, a standard approach was presented regarding parts assigning. This approach was defined to separate the Device selection and the Parts selection depending on task. I already processed this approach during the database development, since it would affect the characteristics of the database. The standard was as follows:

- Eplan symbol → Device selection (or Parts selection)
- Symbol macro → Parts selection

In Eplan P8 it is possible to model customized symbols, which are graphically identical to default ones. When it comes to the linking between these devices and the part, the *function template* is not recognized correctly. This leads to conflicts and "no preselected parts"

when trying to use the device selection. For symbol macros, it was decided to use *Part selection*, which in most cases is equally efficient in time and functionality. When it comes to Eplan symbols the approach is in accordance with the user's own choice and tasks.

8 Result

The result of this work was an established parts database for the electrical design tool Eplan P8, ready to be used at the Sales & Solution Support department. The source now covers the most common electrical components needed in Vacon cabinet drive systems. The result was also a complete documentation of a project to be used in future work tasks (see Appendix 5).

The result also meets the desired targets in parts database structure and standard. The structure that the database now holds will facilitate component management during electrical designing while clarifying the pattern regarding further updating. The project, now covering the basic components needed in cabinet drive systems (see Appendix 4) also meets the presented targets. The consequence is that the parts database now enables the start of the next project phase, the preparation of final project page macros for Eplan P8. Subsequently the program can be taken into operation at the department.

Throughout the project it became obvious that such a component database will never achieve full functionality or extent. This, however, is not the most vital target, as the crucial matter is only when it is sufficient for the user. In this project there are still things to improve such as the reliability of the database. This became clear during the pilot project as minor features did not function and appear as they should. By adapting the database to the electrical designing and applying the presented standard of this project, reliability can be improved as time goes by and as different issues occur.

In the future the possibility of having separate databases in the departments using Eplan P8 will have to be assessed. This, however, contradicts with the initial concept, but could be more effective when it comes to database management. This would favor the organization of components if it is controlled within the department. Decision-making regarding database characteristics would also be easier as changes would not need to be agreed on outside the responsible team. A common database would then be available online and it can be copied and adapted to own department design. This pre-customized source would then be further developed to comply with own department's tasks if needed. This should especially be considered when commissioning the program in other units.

9 Discussion

The distribution of E-CAE programs is not high among companies today, although they have become more common. Therefore, it has been interesting to become more acquainted with the technology. The work itself has been a special performing, considering its depth in the software structure, but that still comes naturally in the electrical designer's everyday. The project was facilitated by the fact that I had during the previous summer worked every day with the program. The project itself also felt natural, as the software was already familiar and it was a continuation of the summer's project.

If I were to do a similar project again I would prioritize quality over quantity. I would spend more time on identifying the needs and possibilities of the parts database in electrical designing and make up a model for every component before creating the actual source. This would also include simultaneous testing to ensure every parts proper operation and appearance in the Eplan environment and project documentation.

It has been a useful experience to have experienced the impact and importance of such a program in an engineering environment, considering own future tasks. The work was challenging right from the start, as the approach to every phase in the project was not predefined. The project also required a previous technical competence with regard to the understanding of electrical components and project schematics in different situations. I am satisfied with the result and the work I have contributed with to succeed in this project. I have got a broader understanding of Vacon cabinet drive systems and their components. I have also gained a lot of technical and social experience by having done cooperation throughout the project with engineers and project managers at the company.

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Appendices

(Table 1. Classes of objects according to their intended purpose or task)

Code	**Intended purpose or task of object**
A	Two or more purposes or tasks. NOTE: This class is only for objects for which no main intended purpose or task can be identified.
B	Converting an input variable (physical property, condition or event) into a signal for further processing
C	Storing of energy, information or material
D	*Reserved for future standardization*
E	Providing radiant or thermal energy
F	Direct protection (selfacting) of a flow of energy, signals, personnel or equipment from dangerous or unwanted conditions. Including systems and equipment for protective purposes
G	Initiating a flow of energy or material. Generating signals used as information carriers or reference source
H	Producing a new kind of material or product
I	*Not to be applied*
J	*Reserved for future standardization*
K	Processing (receiving, treating and providing) signals or information (excluding objects for protective purposes, see Class F)
L	*Reserved for future standardization*
M	Providing mechanical energy (rotational or linear mechanical motion) for driving purposes
N	*Reserved for future standardization*
O	*Not to be applied*
P	Presenting information
Q	Controlled switching or varying a flow of energy, of signals (for signals in control circuits, see Classes K and S) or of material
R	Restricting or stabilizing motion or a flow of energy, information or material
S	Converting a manual operation into a signal for further processing
T	Conversion of energy maintaining the kind of energy. Conversion of an established signal maintaining the content of information. Conversion of the form or shape of a material
U	Keeping objects in a defined position
V	Processing (treating) of material or products (including preparatory and posttreatment)
W	Guiding or transporting energy, signals, material or products from one place to another
X	Connecting objects
Y	*Reserved for future standardization*
Z	*Reserved for future standardization*

(Table 2. Classes of objects according to their intended purpose or task)

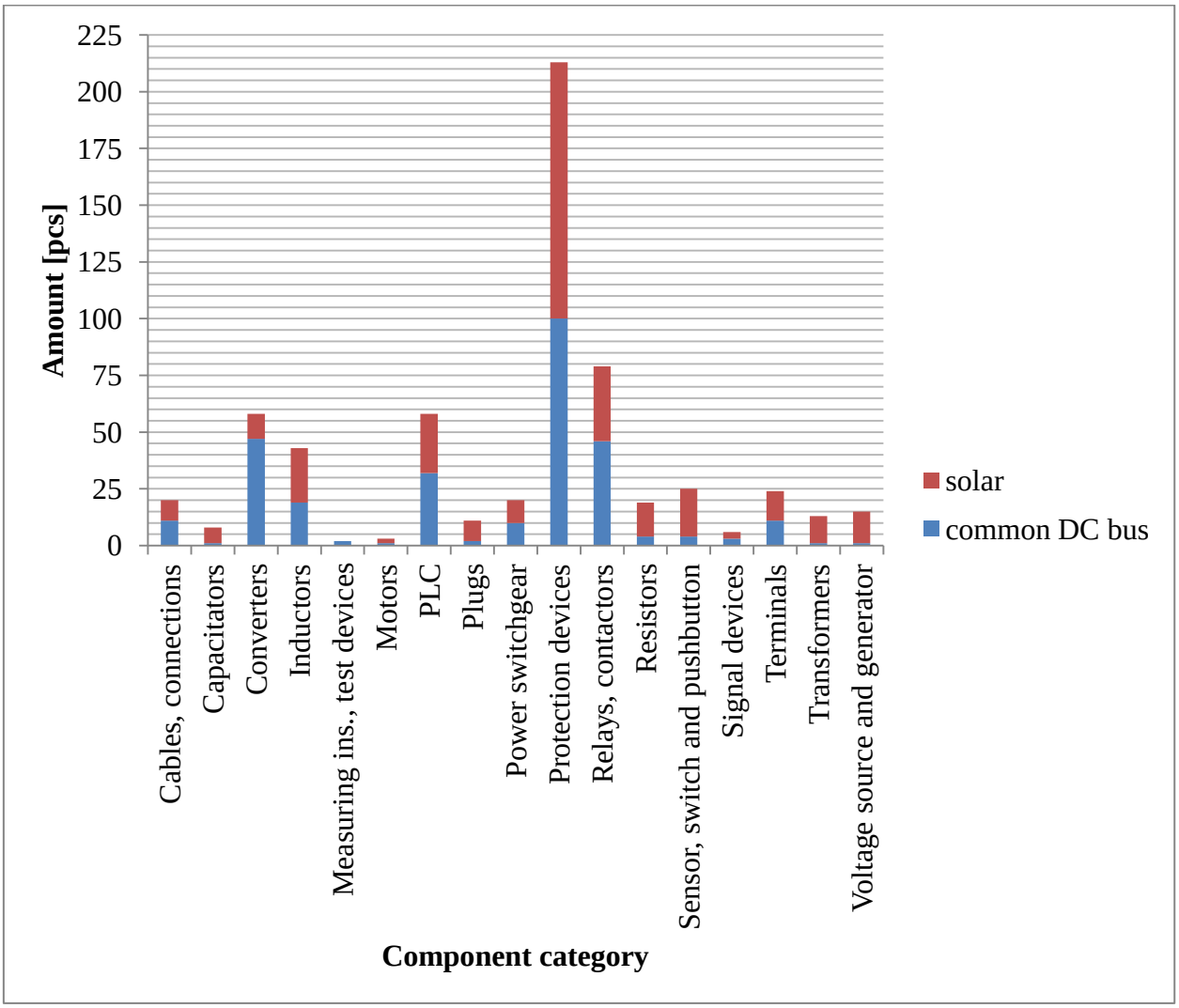
Main class Q Controlled switching or varying a flow of energy, of signals or of material		
Code	**Definition of subclass based on purpose of switching or variation**	**Examples of components**
QA	Switching and variation of electrical energy circuits	Circuit-breaker, contactor, motor starter, power transistor, thyristor
QB	Isolation of electrical energy circuits	Disconnector, fuse switch, fuse-switch disconnector, isolating switch, load-break switch
QC	Earthing of electrical energy circuits	Earthing switch
QD	*Not used*	
QE	*Not used*	
QF	*Not used*	
QG	*Not used*	
QH	*Not used*	
QJ	*Not used*	
QK	*Not used*	
QL	Braking	Brake
QM	Switching of flow of flowable substances in closed enclosures	Blank, blanking plate, damper, shutoff valve (including drain valve), solenoid valve
QN	Varying of flow of flowable substances in closed enclosure	Control damper, control valve, gas control path
QP	Switching or varying of flow of liquid substances in open enclosures	Dam plate, lock gate
QQ	Providing access to an area	Bar (lock), cover, door, gate, lock, turnstile, window
QR	Shut-off of flow of flowable substances (no valves)	Isolation device, rotary lock (open/close)
QS	*Not used*	
QT	*Not used*	
QU	*Not used*	
QV	*Not used*	
QW	*Not used*	
QX	*Not used*	
QY	*Not used*	
QZ	Combined tasks	

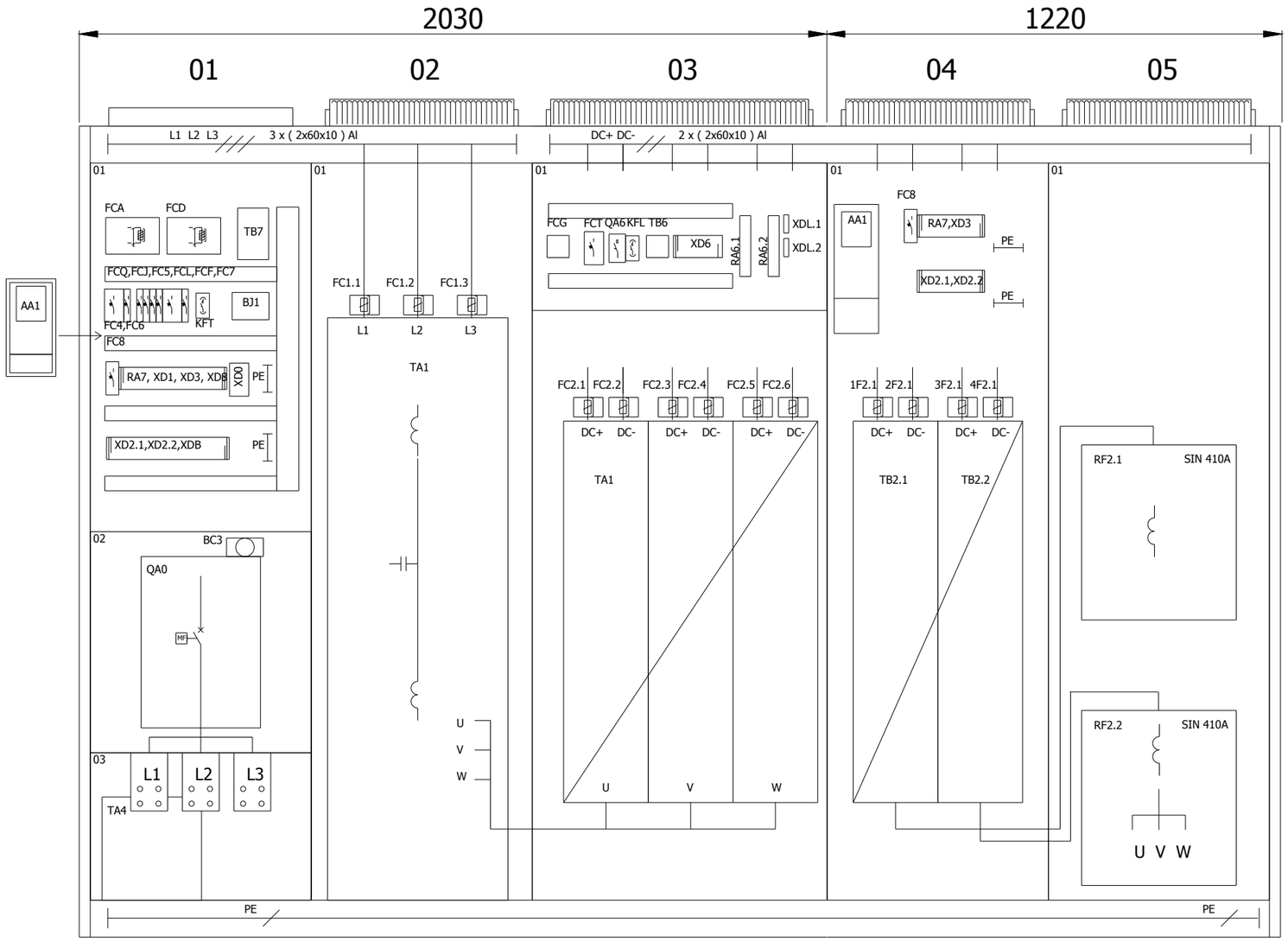
(Table 3. Parts database technical specifications for each component and category)

Component	Voltage	Voltage type	Current	Current (tripping)	Power	Cross-section	Color	Dimension	Description*	EPLAN category
Signal cable						X		X		*Cables, connections*
Power cable	X					X		X		
Capacitator	X	X							X	*Capacitators*
Rectifier	X	X	X							*Converters*
Inverter	X	X	X							
Frequency converter	X	X	X							
Du/dt filter	X	X	X							*Inductors*
Sine filter	X	X	X							
LCL-filter	X	X	X							
Current meter	X	X	X							*Measuring ins., test devices*
Voltage meter	X	X	X							
Fan	X	X	X							*Motors*
PLC card									X	*PLC*
Socket	X	X	X						X	*Plugs*
Plug	X	X	X					X		
Switch-disconnector	X	X	X			X			X	*Power switchgear*
ACB	X	X	X		X					*Protection devices*
Fuse	X			X					X	
Fuse switch	X		X						X	
MCB	X	X		X		X			X	
MCCB	X	X		X					X	
Relay	X	X	X			X			X	*Relays, contactors*
Contactor	X	X	X	X	X				X	
Break resistor	X								X	*Resistors*
Pushbutton contact	X	X	X						X	*Sensor, switch and pushbutton*
Indication lamp	X								X	*Signal devices*
Signal terminal						X	X		X	*Terminals*
Power terminal	X	X	X			X	X		X	
Voltage transformer	X	X	X		X					*Transformers*
Current transformer	X	X			X					
Power supply	X	X	X		X	X			X	*Voltage source and generator*

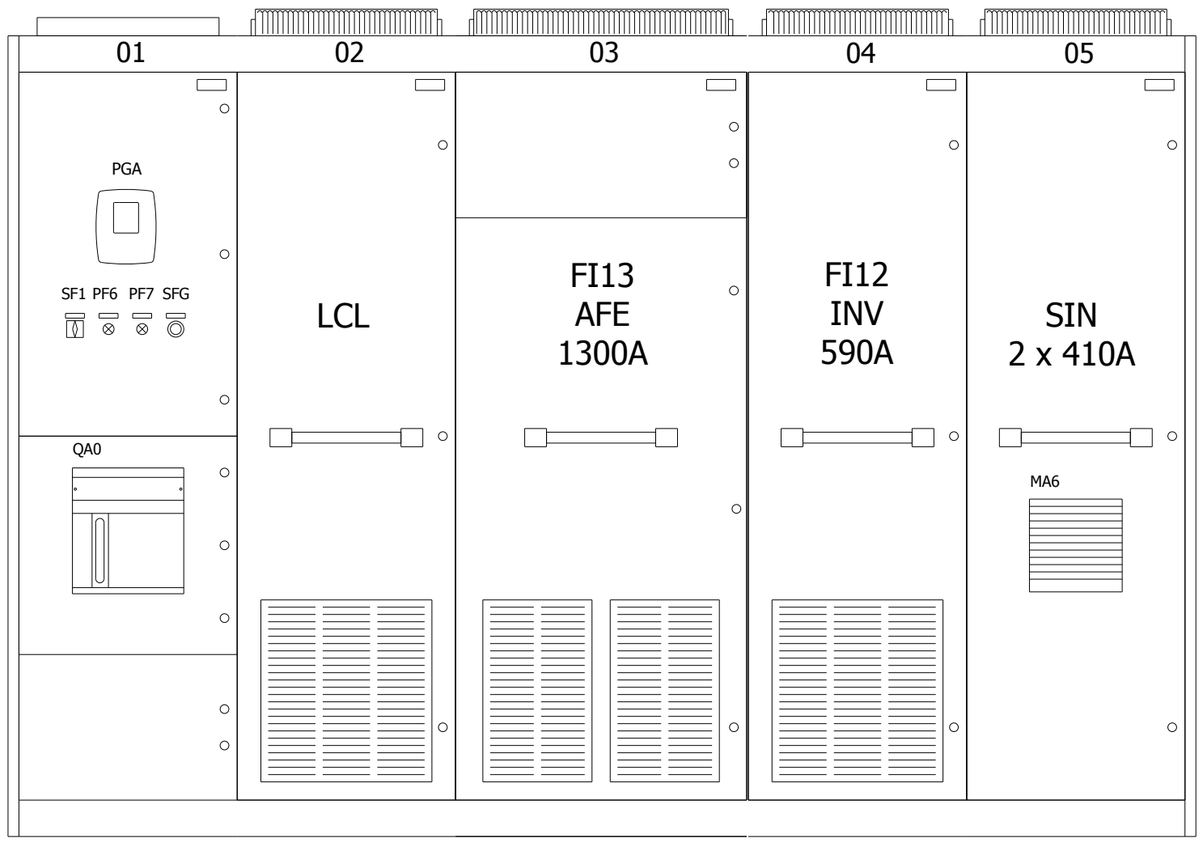
*Category for additional technical data, not supported as separate fields

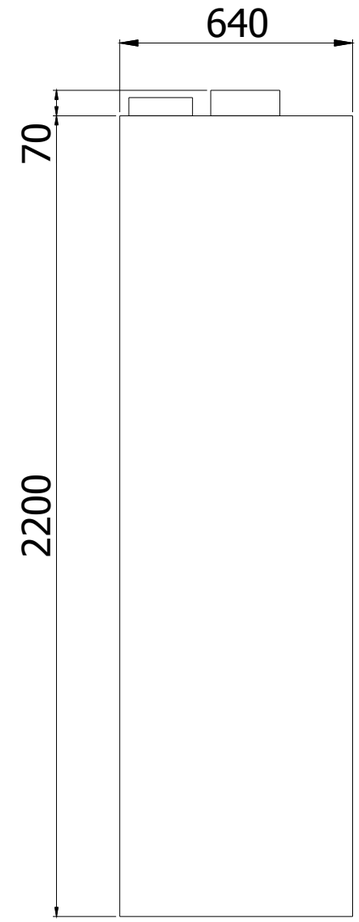
Table 4. Category specific content presentation of the Eplan P8 parts database.





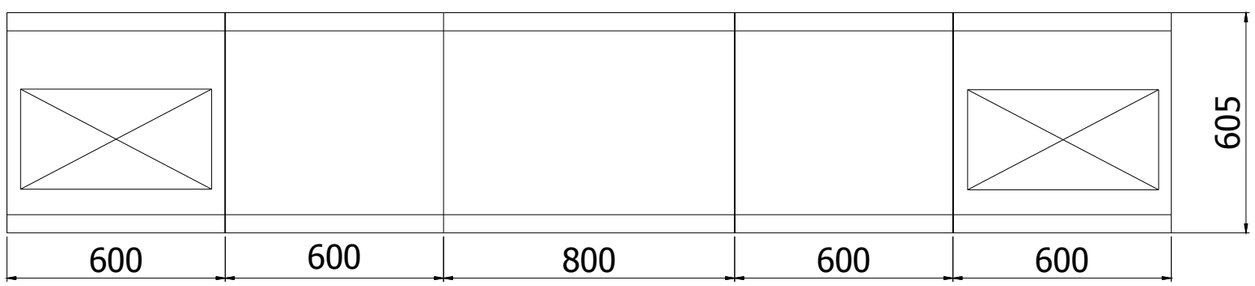
VACON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 Singleline	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind	Based on Scale	External doc. Id Ref. designation =TAD +00 Document Id =TAD+00/3	DCC Rev.	Continue 4 Lang. EN Page 3





Side view

Foot print



VACON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 Layout	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind	Based on Scale	External doc. Id Ref. designation =TAD +00 Document Id =TAD+00/4	DCC Rev.	Continue 5 Lang. EN Page 4

AFE SUPPLY

L1 / +03/1.2A

L2 / +03/1.2A

L3 / +03/1.2A

-FCA
32A

VOLTAGE AND
FREQUENCY MEASURING

-BJ1

-XD5

3 I1

1 I1

CURRENT MEASURING

IL

BC3
1250/5A
P1
P2
S2
S1

AO1 - 15 / + 16
AO2 - 17 / + 18
AO3 - 19 / + 20

230 VAC L1 14 — L-RELE / 2.3C
N 13 — N-RELE / 2.3C

PE

-QA0
/3.2D
/4.6B
/3.1D
+04/2.5A
1200A

I> I> I>
I>> I>> I>>

MAIN AIR CIRCUIT BREAKER

DOUBLE INSUL.

DOUBLE INSUL.

DOUBLE INSUL.

FCD
/3.7B
32A

T1_0 / 2.2D ...AC CONTROL COLTAGE
400/230VAC

T1_400 / 2.2D ACB CONTROL VOLTAGE

CH3L3 / +03/1.6A

CH2L2 / +03/1.6A MAIN CHARGING

CH1L1 / +03/1.6A

PE

L1 L2 L3

MAIN SUPPLY 440 VAC / 60 Hz

VACON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 AUXILIARY/FEEDING SECTION	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind CIRCUIT DIAGRAM	Based on Scale	External doc. Id Ref. designation =TAD +01 Document Id =TAD+01/1	DCC &EFS	Continue 2 Rev. A / Lang. EN / Page 1

400/230 VAC
CONTROL VOLTAGE

230 VAC

-XD1

-FC6
10A

PE

-TA4
2500VA

-FC4
6-10A

1.3E / T1_400

1.3E / T1_0

-FCQ
2A

1.6C / L-RELE

1.6D / N-RELE

-FCJ
6A

-XD1

-FC5
2A

3.1C / 2L

3.1F / 2N

-FCL
4A

-XDL.2

+05-MA6

-FCF
25A
30mA

PE

-XD0

-FC7
4A

-TB7
24VDC
5A
+24V
0V

PE

-KFT
24V OK

-XDB

-KFT
/2.7D
24V OK

4.1C/ TB7_24VDC_1

4.1C / TB7_GND_1

A1 A2
14 11 /2.6E
12

MONITORING RELAY

RESERVE

...AFE ACB AND CHARGING CONTROL VOLTAGE

CB FAN

SOCKET

PAGE MAIN SUPPLY AC

INU AND AFE CONTROL UNIT 24VDC POWER SUPPLY

VAGON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 AUXILIARY/FEEDING SECTION	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind CIRCUIT DIAGRAM	Based on Scale	External doc. Id Ref. designation =TAD +01 Document Id =TAD+01/2	DCC &EFS	Continue 3
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DC CHARGING

CHARGING IS READY

CHARGING

K+ /4.4E

AFE
-RO2
26
25

AFE CLOSING CMD TO ACB -QA0 CHARGING READY

AFE RUN

2R+/ 4.4E

-KFL
230V
A1
A2

12 14 22 24 32 34
11 21 31

K-/3.1F

-XD8 6

-XD8 7

3

-SF1
/3.2C
0-1-START
4
1

...AC CONTROL VOLTAGE
(230 VAC)

2.4C / 2L

-XD8
15

M+ /3.5C

-XD8
3

-SF1
/3.2B
/3.7C
4
5
2

PLC REMOTE "1" / "0"

-SFG
11 23 33
12 24 34

-QA0
/1.1D
23 24

+03-QA6
/3.8D
13 14

-PF7
POWER ON
1
2

-PF6
CHARGING
1
2

-XD8 2

2.4C / 2N

-XD8
16

1

3.2B / K-

-XDB 25

-XDB 26

-QA0
C1
C2
YC
D13
D14

13 11 23 21 96 98
14 12 24 22 95

Q/1
Q/2
Q/3
Q/4
S51

M+ /3.2C

S33M/1
F1
M
U1
U2

D1
D2
YU

R1
R2
YR

11 15 17 19 21 23
12 16 18 20 22 24

S75I/1
S75I/2
S75T/1
S75E/1
S75E/1

104 112 124 134 142
102 111 121 131

1 2 4

-XD8 10

+03-QA6
/3.8D
21 22

+03-QA6
/3.8D
61 62

-XD8 14

-QA6 MCCB AND -QB6 FUSE SWITCH
(MAINCHARGING CIRCUIT SUPPLY)

+03-FCT
+03/1.6B
43 44

-FCD
/1.2E
13 14

-XD8 8

PLC PRE-CHARGED CMD

-XD8
9

PULSE

+03-QA6
/3.8D
53 54

-SF1
/3.2C
START
5 6

-XD8
11

-XD8 12

AF_S / 4.4E

AFE FAULT

AFE
RO1
23
22

INHIBIT CHARGING

A1
A2
+03-QA6
230V

AF_E / 4.4E

-XD8 13

-SF1

	1 2	3 4	5 6	7 8
0				
1	X	X		
START	X	X	X	

-YC SHUNT CLOSING RELEASE
-YU DI3, DI4 INDICATING CONTACT OF UNDER VOLTAGE COIL
-S51 ACB TRIPPED, ALARM CONTACT
-Q/1, Q/3 MAIN CONTACT CLOSED (NO)
-Q/2, Q/4 MAIN CONTACT OPEN (NC)
-YU UNDER VOLTAGE COIL
-YR ACB PLC RESET 24VDC

-Q/1 ACB FEEDBACK to AFE control unit
Q/2 INHIBIT CHARGING
-Q/3 "POWER ON" LED SWITCH
-Q/4 ACB INDICATION
(ACB Closed -> contact = 0)

-S75I,T,E POSITION INDICATING CONTACT
DRIVE (I), TEST(T), DISCONNECTED POSITION (E)

1 — 2 +03/1.7C
3 — 4 +03/1.7C
5 — 6 +03/1.7C
13 — 14 /3.2D
21 — 22 /3.5B
53 — 54 /3.7C
61 — 62 /3.5B
71 — 72
83 — 84

VACON
DRIVEN BY DRIVES

Project Id	THESIS_PROJECT	Title	DRIVE 1	Prepared	C. AVELA 16.12.2011	Based on	External doc. Id
Project name	EPLAN P8 PILOT PROJECT		AUXILIARY/FEEDING SECTION	Approved	K. RAJALA 25.5.2012		Ref. designation =TAD +01
Customer				Document kind	CIRCUIT DIAGRAM	Scale	Document Id =TAD+01/3

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AFE CONTROL UNIT

+24VDC EXTERNAL IN

+03-XDL.1 2

-XD3 2

-XD3 1

-FC8 2A 1 2

-XD3 5

-RA7 A K

-XD3 3 4

-XD3 6

TB7_24VDC_1 / 2.7E

TB7_24VDC_1 / +04/1.1C

TB7_GND_1 / 2.7E

TB7_GND_1 / +04/1.2C

4.6B / TB7_24VDC_2

4.6B / TB7_GND_2

POWER UNIT
-U1:X10

+03/1.4E / AP1 2 X2

+03/1.4E / OF1 7

-AB6

-AA1

-AB1

-AB2

-XD2.1 -WF3

1 OG | 2 WH | 3 OG | 4 WH | 5 OG | 6 WH | 7 OG | 8 WH | 9 OG | 10 WH | 11 OG | 12 WH | 13 OG | 14 WH | 15 OG | 16 WH | 17 OG | 18 WH | 19 OG | 20 WH

+10Vref | AIA1+ | AIA1- | AIA2+ | AIA2- | +24V | GND | DIN1 | DIN2 | DIN3 | CMA | +24V | GND | DIN4 | DIN5 | DIN6 | CMB | AOA1+ | AOA1- | DOA1

TF+1 / +03/1.3B

TF11 / +03/1.3C

LCL COIL
OVERHEAD

TB7_24VDC_2 / 4.1E

TB7_GND_2 / 4.1E

-QA0 /1.1D 13 14

ACB FEEDBACK

-KFJ 24V AFE RUN A1 A2

-XD2.1 54 55 56

-KFJ /4.8B AFE RUN 12 14 11

AFE POWER UNIT
IS RUNNING

AFE FEEBACK
TO PLC

-XD2.1 57 58 59

/4.8B AFE RUN 22 24 21

X1 ABCD | X2 ABCD | X3 B A | X6 ABCD

NXOPTA1
BASIC I/O
SLOT A

RO1 NC RO1 C RO1 NO | RO2 NC RO2 C RO2 NO

21 22 23 | 24 25 26

-WF4 -XD2.2 BK BK BK BK BK BK

21 22 23 24 25 26

3.7E / AF_E

3.7D / AF_S

3.2A / 2R+

3.1A / K+

NXOPTA2
2xRO
SLOT B

-AC2

RO1 NO RO1 NO | RO2 C RO2 NO | RO3 C RO3 NO

22 23 | 25 26 | 28 29

NXOPTB5
3xRO
SLOT E

+04/2.5B / FL1

+04/2.5B / F1

AFE
WARNING

RUN ENABLE
FOR INU

PE 6

-PGA 9

AFE POWER UNIT
OVERCURRENT
(INHIBIT CHARGING)

AFE CHARGING OK
(AFE CLOSING CMD
TO ACB -QA0)

14 12 — 11 /4.7A

24 22 — 21 /4.8A

VACON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 DRIVE SECTION	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind CIRCUIT DIAGRAM	Based on Scale	External doc. Id Ref. designation =TAD +01 Document Id =TAD+01/4	DCC &EFS	Continue +03/1 Rev. A / Lang. EN / Page 4

MAIN CIRCUIT 380-500VAC, 50/60Hz

L1 / +01/1.8A
L2 / +01/1.8A
L3 / +01/1.8A

+02-FC1.1 2200A
+02-FC1.2 2200A
+02-FC1.3 2200A

PE 1

+02-RF4
LCL13005B0R011T
L1 L2 L3
U V W PE

X52
1 TF+1 / +01/4.4B
2
3
4 TF11 / +01/4.5B

AFE CONTROL UNIT -A1
+24V and DIN3

X53
+
-
M

DOUBLE INSUL.
DOUBLE INSUL.

Vacon LCL
wiring harness

X51
1
3
4

-FCG
8A
1 3
2 4

-TA1
NXA 1300 5
U PE V PE W PE
X2
X3
X10 AP1 / +01/4.2D
OF1 / +01/4.2D

AFE CONTROL UNIT -A1

B+ B- B+ B- B+ B-

-FC2.1 1100 A
-FC2.2 1100 A
-FC2.3 1100 A
-FC2.4 1100 A
-FC2.5 1100 A
-FC2.6 1100 A

DOUBLE INSUL.
DOUBLE INSUL.

DC+/ +04/2.1A
DC- / +04/2.1A

MAIN CHARGING CIRCUIT

+01/1.3F / CH1L1
+01/1.3F / CH2L2
+01/1.3F / CH3L3

-FCT
6-10A
1 3 5 43
I> I> I>
2 4 6 44

-QA6
1 3 5
2 4 6

-TB6
1600V
80A
L1 L2 L3
3 ~
+ -

-CA2
300nF

-RA6.1 11Ω
-RA6.2 11Ω

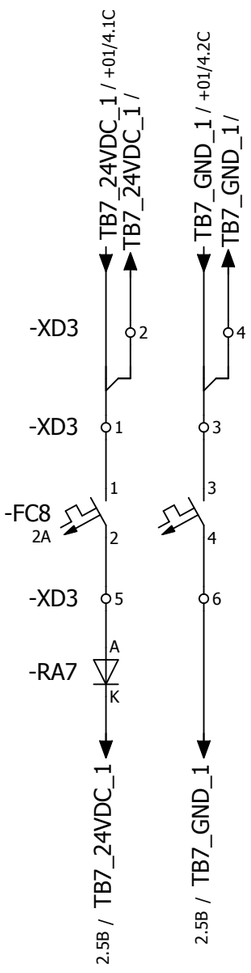
DOUBLE INSUL.
DOUBLE INSUL.

-XD6 1 2

DOUBLE INSUL.
DOUBLE INSUL.

VACON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 DRIVE SECTION	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind CIRCUIT DIAGRAM	Based on Scale	External doc. Id Ref. designation =TAD +03 Document Id =TAD+03/1	DCC &EFS	Continue +04/1 Rev. A / Lang. EN / Page 1

+24VDC EXTERNAL
IN



VACON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 DRIVE SECTION	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind CIRCUIT DIAGRAM	Based on Scale	External doc. Id Ref. designation =TAD +04 Document Id =TAD+04/1	DCC &EFS	Continue 2 Rev. A Lang. EN Page 1

MAIN CIRCUIT

INU CONTROL UNIT

SET DIN3
RUN ENABLE

+03/1.8F /DC+

+03/1.8F /DC-

PE

-FC2.1 630A

-FC2.2 630A

-FC2.3 630A

-FC2.4 630A

-TB2.1
NXI 300 5

-TB2.2
NXI 300 5

DC+ DC-

X10

-AB6

X10 11 X2

-TB2.1

PE U V W

+05-RF2.1
410A

+05-RF2.2
410A

U1 V1 W1 PE

U2 V2 W2

NOT INCLUDED IN DELIVERY

-MA1

M
3~

PE V1 U1 W1

1 2

TB7_24VDC_1 / 1.1E

TB7_GND_1 / 1.2E

+03-XDL.1

+01-QA0
+01/1.1D

43 44

FL1 / +01/4.5D

ACB FEEDB.

F1 / +01/4.6D

+03-XDL.1

SPEED SP

START STOP

RESET

SPEED FEEDBACK

-XD2.1
-WF3

1 OG 2 WH 3 OG 4 WH 5 OG 6 WH 7 OG 8 WH 9 OG 10 WH 11 OG 12 WH 13 OG 14 WH 15 OG 16 WH 17 OG 18 WH 19 OG 20 WH

+10Vref AIA1+ AIA1- AIA2+ AIA2- +24V GND DIN1 DIN2 DIN3 CMA +24V GND DIN4 DIN5 DIN6 CMB AOA1+ AOA1- DOA1

-AA1

-AB6

-AB1

-AB2

X1 X2 X3 X6 (ABCD / B A)

NXOPTA1
BASIC I/O
SLOT A

RO1 NC RO1 C RO1 NO RO2 C RO2 NO RO2 NO

NXOPTA2
2xRO
SLOT B

21 22 23 24 25 26 BK

-WF4
-XD2.2

RUNNING FAULT

PE 2

9

-PGA

VACON DRIVEN BY DRIVES	Project Id THESIS_PROJECT Project name EPLAN P8 PILOT PROJECT Customer	Title DRIVE 1 DRIVE SECTION	Prepared C. AVELA 16.12.2011 Approved K. RAJALA 25.5.2012 Document kind CIRCUIT DIAGRAM	Based on Scale	External doc. Id Ref. designation =TAD +04 Document Id =TAD+04/2	DCC &EFS Rev. A Lang. EN Page 2 / Continue +RE/1

Parts list

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Device tag	Type designation	Quantity	Designation	Order number	Technical characteristics	Manufacturer	Location	Page
-BC3	MAK86/60	1	CURRENT TRANSFORMER			GANZ	=TAD+01	+01/1.1C
-AA1	NXP	1	CONTROL UNIT			VACON	=TAD+01	+01/4.3C
-AB1	OPTA1	1	I/O CARD OPTA1		BASIC I/O	VACON	=TAD+01	+01/4.3C
-AB2	OPTA2	1	I/O CARD OPTA2		2 x RO	VACON	=TAD+01	+01/4.3D
-AB6	PC228 D	1	OPTICAL INTERFACE CARD			VACON	=TAD+01	+01/4.3C
-AC2	OPTB5	1	I/O CARD OPTB5		3 x RO	VACON	=TAD+01	+01/4.5D
-BJ1	SINEAX M563	1	PROGRAMMABLE MULTI-TRANSDUCER	146 440		CAMILLE BAUER	=TAD+01	+01/1.5B
-FC4	GV2RT14	1	THERMAL MAGNETIC CIRCUIT BREAKER		6-10A	SCHNEIDER ELECTRIC	=TAD+01	+01/2.2D
-FC5	C60N 1P C2	1	MINIATURE CIRCUIT BREAKER	24396	2A	SCHNEIDER ELECTRIC	=TAD+01	+01/2.4B
-FC6	C60N 1P C10	1	MINIATURE CIRCUIT BREAKER		10A	SCHNEIDER ELECTRIC	=TAD+01	+01/2.1B
-FC7	C60N 1P C4	1	MINIATURE CIRCUIT BREAKER		4A	SCHNEIDER ELECTRIC	=TAD+01	+01/2.7B
-FC8	C60N 2P C2	1	MINIATURE CIRCUIT BREAKER	24332	2A	SCHNEIDER ELECTRIC	=TAD+01	+01/4.1D
-FCA	OS32D12	1	SWITCH FUSE	1SCA022456R9710	32A	ABB	=TAD+01	+01/1.5B
-FCA	OFAF000H6	3	FUSE 6A GG 690V	1SCA022627R0400	6A	ABB	=TAD+01	+01/1.5B
-FCD	OS32D12	1	SWITCH FUSE	1SCA022456R9710	32A	ABB	=TAD+01	+01/1.2E
-FCD	OA1G10	1	AUXILIARY CONTACT	1SCA022353R4970		ABB	=TAD+01	+01/1.2E
-FCD	OA3G01	1	AUXILIARY CONTACT	1SCA022456R7410		ABB	=TAD+01	+01/1.2E
-FCD	OFAF000H32	3	FUSE 32A GG 690V	1SCA022627R0910	32A	ABB	=TAD+01	+01/1.2E
-FCF	ID 2P 25A 30mA	1	RESIDUAL CURRENT CIRCUIT BREAKER	12229A	25A 30mA	SCHNEIDER ELECTRIC	=TAD+01	+01/2.6B
-FCJ	C60N 1P C6	1	MINIATURE CIRCUIT BREAKER	24399	6A	SCHNEIDER ELECTRIC	=TAD+01	+01/2.3B
-FCL	C60N 1P C4	1	MINIATURE CIRCUIT BREAKER		4A	SCHNEIDER ELECTRIC	=TAD+01	+01/2.5B
-FCQ	C60N 1P C2	1	MINIATURE CIRCUIT BREAKER	24396	2A	SCHNEIDER ELECTRIC	=TAD+01	+01/2.3B
-KFJ	PLC-RSC- 24DC/21-21	1	AUXILIARY RELAY	2967060	24V	PHOENIX CONTACT	=TAD+01	+01/4.8B
-KFL	RRD328230	1	AUXILIARY RELAY	8690580000	230V	WEIDMÜLLER	=TAD+01	+01/3.2B
-KFL	SRD 3CO	1	RELAY BASE	8690920000		WEIDMÜLLER	=TAD+01	+01/3.2B
-KFT	RT114024	1	AUXILIARY RELAY		24V	SCHRACK	=TAD+01	+01/2.7D
-KFT	RT17017	1	RETAINER CLIP			SCHRACK	=TAD+01	+01/2.7D
-KFT	YRT78624	1	RELAY BASE			SCHRACK	=TAD+01	+01/2.7D
-PF6	XB5AVM1	1	INDICATOR LAMP WHITE			SCHNEIDER ELECTRIC	=TAD+01	+01/3.2E
-PF7	XB5AVM1	1	INDICATOR LAMP WHITE			SCHNEIDER ELECTRIC	=TAD+01	+01/3.1E
-PGA	NXP	1	CONTROL UNIT			VACON	=TAD+01	+01/4.8D
-QA0	E2N12WMP3PR121LSI	1	CIRCUIT BREAKER	1SDA055857R1	1200A	ABB	=TAD+01	+01/1.1D
-QA0	AUX10/E1-6	1	AUXILIARY CONTACTS	1SDA038327R1		ABB	=TAD+01	+01/1.1D
-QA0	E2WFPHR3N	1	CIRCUIT BREAKER TERMINALS	1SDA059667R1		ABB	=TAD+01	+01/1.1D
-QA0	M220-250V/E1-6	1	SPRING CHARGING MOTOR	1SDA038324R1		ABB	=TAD+01	+01/1.1D
-QA0	PC5/E1-6	1	AUXILIARY CONTACTS	1SDA038361R1		ABB	=TAD+01	+01/1.1D
-QA0	SR/E1-6	1	TRIPPING SIGNAL CONTACT	1SDA038300R1		ABB	=TAD+01	+01/1.1D
-QA0	YC220-230V/E1-6	1	CLOSING RELEASE	1SDA038302R1		ABB	=TAD+01	+01/1.1D

Parts list

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Device tag	Type designation	Quantity	Designation	Order number	Technical characteristics	Manufacturer	Location	Page
-QA0	YU220-230V/E1-6	1	UNDERVOLTAGE RELEASE	1SDA038312R1		ABB	=TAD+01	+01/1.1D
-QA0	YUE/E1-6(N-O)	1	UNDERVOLTAGE RELEASE	1SDA038340R1		ABB	=TAD+01	+01/1.1D
-RA7	WDK 2.5 LD GR 1R 24VDC	1	TERMINAL WITH LED	8010040000		WEIDMÜLLER	=TAD+01	+01/4.1D
-SF1	CG8 A425-600 FT2-V	1	START SWITCH			KRAUS & NAIMER	=TAD+01	+01/3.2C
-SFG	704.910.4	2	EMERGENCY STOP CONTACT			EAO	=TAD+01	+01/3.1C
-SFG	704.064.2	1	EMERGENCY STOP BUTTON			EAO	=TAD+01	+01/3.1C
-SFG	704.963.6	1	EMERGENCY STOP LABEL			EAO	=TAD+01	+01/3.1C
-TA4	066228-901	1	VOLTAGE TRANSFORMER		2500VA	NORATEL	=TAD+01	+01/2.1C
-TB7	SPD241201	1	POWER SUPPLY		24VDC 5A	CARLO GAVAZZI	=TAD+01	+01/2.7D
-XD0	SN016P	1	SOCKET	25 197 10		TYCO	=TAD+01	+01/2.6D
-XD1	WDU 2,5	12	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+01	+01/2.1A
-XD1	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+01	+01/2.1A
-XD2.1	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+01	+01/4.3C
-XD2.1	WDU 2,5	26	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+01	+01/4.3C
-XD2.2	WDU 2,5	10	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+01	+01/4.3D
-XD2.2	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+01	+01/4.3D
-XD3	WDU 2,5	6	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+01	+01/4.1C
-XD3	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+01	+01/4.1C
-XD5	WDU 2,5	6	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+01	+01/1.6C
-XD5	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+01	+01/1.6C
-XD8	WDU 2,5	32	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+01	+01/3.2F
-XD8	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+01	+01/3.2F
-XDB	WDU 2,5	28	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+01	+01/2.7E
-XDB	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+01	+01/2.7E
-FC1.1	7,5 URD 44 TTQPLAF 2200	1	FUSE 2200 A		2200A	MERSEN	=TAD+02	+03/1.2B
-FC1.2	7,5 URD 44 TTQPLAF 2200	1	FUSE 2200 A		2200A	MERSEN	=TAD+02	+03/1.2B
-FC1.3	7,5 URD 44 TTQPLAF 2200	1	FUSE 2200 A		2200A	MERSEN	=TAD+02	+03/1.2B
-RF4	LCL13005B0R011T	1	LCL FILTER		LCL13005B0R011T	TRAFOTEK	=TAD+02	+03/1.1B
-CA2	PHE448WF6300KR06	1	SNUBBER CAPACITOR		300nF	EVOX RIFA	=TAD+03	+03/1.7D
-FC2.1	9,5 URD 73 TTF 1100	1	FUSE 1100 A	PC73UD95V11CTF	1100 A	MERSEN	=TAD+03	+03/1.2F
-FC2.2	9,5 URD 73 TTF 1100	1	FUSE 1100 A	PC73UD95V11CTF	1100 A	MERSEN	=TAD+03	+03/1.2F
-FC2.3	9,5 URD 73 TTF 1100	1	FUSE 1100 A	PC73UD95V11CTF	1100 A	MERSEN	=TAD+03	+03/1.3F
-FC2.4	9,5 URD 73 TTF 1100	1	FUSE 1100 A	PC73UD95V11CTF	1100 A	MERSEN	=TAD+03	+03/1.3F
-FC2.5	9,5 URD 73 TTF 1100	1	FUSE 1100 A	PC73UD95V11CTF	1100 A	MERSEN	=TAD+03	+03/1.3F
-FC2.6	9,5 URD 73 TTF 1100	1	FUSE 1100 A	PC73UD95V11CTF	1100 A	MERSEN	=TAD+03	+03/1.4F
-FCG	USM2I	1	FUSEHOLDER 2-POLE			MERSEN	=TAD+03	+03/1.4C
-FCG	ATQ8	2	FUSE 8 A		8A	MERSEN	=TAD+03	+03/1.4C
-FCT	GV2RT14	1	THERMAL MAGNETIC CIRCUIT BREAKER		6-10A	SCHNEIDER ELECTRIC	=TAD+03	+03/1.6B

Parts list

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Device tag	Type designation	Quantity	Designation	Order number	Technical characteristics	Manufacturer	Location	Page
-FCT	GVAN11	1	THERMAL MAGNETIC CIRCUIT BREAKER			SCHNEIDER ELECTRIC	=TAD+03	+03/1.6B
-QA6	LC1D32P7	1	MOTOR CONTACTOR		230V	SCHNEIDER ELECTRIC	=TAD+03	+01/3.8D
-QA6	LADN22	1	AUXILIARY CONTACT			SCHNEIDER ELECTRIC	=TAD+03	+01/3.8D
-RA6.1	CBV 335 C 11R	1	BREAK RESISTOR		11Ω	DANOTHERM	=TAD+03	+03/1.7D
-RA6.2	CBV 335 C 11R	1	BREAK RESISTOR		11Ω	DANOTHERM	=TAD+03	+03/1.7D
-TA1	NXA 1300 5	1	ACTIVE FRONT END		NXA 1300 5	VACON	=TAD+03	+03/1.1E
-TB6	SKD82/16	1	AC/DC BRIDGE	07913140	1600V 80A	SEMIKRON	=TAD+03	+03/1.7C
-XD6	WDU 2,5	2	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+03	+03/1.7E
-AB1	OPTA1	1	I/O CARD OPTA1		BASIC I/O	VACON	=TAD+04	+04/2.3C
-AB2	OPTA2	1	I/O CARD OPTA2		2 x RO	VACON	=TAD+04	+04/2.3D
-AB6	PC228 D	1	OPTICAL INTERFACE CARD			VACON	=TAD+04	+04/2.3C
-FC2.1	12,5 URD 73 TTF 0630	1	FUSE 630 A	PC73UD13C630TF	630 A	MERSEN	=TAD+04	+04/2.1B
-FC2.2	12,5 URD 73 TTF 0630	1	FUSE 630 A	PC73UD13C630TF	630 A	MERSEN	=TAD+04	+04/2.1B
-FC2.3	12,5 URD 73 TTF 0630	1	FUSE 630 A	PC73UD13C630TF	630 A	MERSEN	=TAD+04	+04/2.2B
-FC2.4	12,5 URD 73 TTF 0630	1	FUSE 630 A	PC73UD13C630TF	630 A	MERSEN	=TAD+04	+04/2.2B
-FC8	C60N 2P C2	1	MINIATURE CIRCUIT BREAKER	24332	2A	SCHNEIDER ELECTRIC	=TAD+04	+04/1.1D
-PGA	254A	1	CONTROL PANEL	LCD DISPLAY		VACON	=TAD+04	+04/2.8D
-RA7	WDK 2.5 LD GR 1R 24VDC	1	TERMINAL WITH LED	8010040000		WEIDMÜLLER	=TAD+04	+04/1.1D
-TB2.1	NXI 0300 5	1	INVERTER, ACTIVE FRONT END		300A	VACON	=TAD+04	+04/2.1C
-TB2.2	NXI 0300 5	1	INVERTER, ACTIVE FRONT END		300A	VACON	=TAD+04	+04/2.2C
-XD2.1	WDU 2,5	22	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+04	+04/2.3C
-XD2.1	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+04	+04/2.3C
-XD2.2	WDU 2,5	10	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+04	+04/2.4D
-XD2.2	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+04	+04/2.4D
-XD3	WDU 2,5	6	FEED-THROUGH TERMINAL	1020000000		WEIDMÜLLER	=TAD+04	+04/1.1C
-XD3	WAP 2.5-10	1	END PLATE	1050000000		WEIDMÜLLER	=TAD+04	+04/1.1C
-MA6	SK3327.107	1	CABINET FAN AND FILTER UNIT	84145100		RITTAL	=TAD+05	+01/2.5C
-RF2.1	SIN-0410-5-0-P	1	SINE FILTER		410A	PLATTHAUS	=TAD+05	+04/2.1D
-RF2.2	SIN-0410-5-0-P	1	SINE FILTER		410A	PLATTHAUS	=TAD+05	+04/2.2D

VACON
DRIVEN BY DRIVES

Project Id	THESIS_PROJECT	Title	DRIVE 1 Parts list	Prepared	C. AVELA 16.12.2011	Based on	External doc. Id	DCC / Continue
Project name	EPLAN P8 PILOT PROJECT			Approved	K. RAJALA 25.5.2012		Ref. designation =TAD +RE	31
Customer				Document kind		Scale	Document Id =TAD+RE/23	Rev. / Lang. EN / Page 23