RUPLAN

# DESCRIPTION OF FUNCTIONS

**RUPLAN – Functionality, flexibility and integration in setting up electrical engineering documents**

AUCOTEC

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# 1. Introduction

RUPLAN is a CAD/CAE system for economical computer-assisted production and processing of drawings and circuit diagrams. RUPLAN has been developed for use in industry and offers ideal assistance in the production and processing of drawings in the areas of electrical engineering, I/E design and engineering, electronics, process engineering, hydraulics, and many other fields.

RUPLAN has been developed with the following targets in mind:

- high functionality to assist the user in an ideal way in the production of drawings, and to relieve him of time-consuming routine work.
- improvement of the user's productivity because derived documents, such as parts lists, terminal diagrams, cable lists, et cetera, are generated automatically through the evaluation of the schematic drawings.
- achievement of high flexibility, so that the CAD/CAE system can be used for various fields of application and can be adapted to user-specific requirements.
- safeguarding the integration capability of the system into available data processing structures in order to prevent „insular solutions" being produced. For this purpose interfaces were defined and implemented.
- independence of hardware in order to protect the investment of the user into drawings and plant documentations with a long life compared to the hardware.

More than 300 companies in Germany and the EC especially those active in the fields of plant construction, motor-car production, chemistry, electrical engineering, energy supply, mechanical engineering and engineering offices, are using RUPLAN to gain competitive advantages within their markets.

RUPLAN has been designed in such a way that the user is comprehensively assisted from graphical processing to the production of the entire plant documentation. The complete work flow involved in plant project tasks is taken into consideration by the system.

RUPLAN can be adapted to the requirements of the customer. The user need not adapt to the RUPLAN work environment, but he can create his own environment within RUPLAN.

RUPLAN already ensures savings in the mere production of drawings. High productivity is achieved where the drawings are evaluated automatically after drawing. For this purpose, RUPLAN enters cross-references into the drawings already during the production of drawings that are used to generate lists together with other pieces of information obtained during evaluation. Thus, the system takes on those functions that are time-consuming and error prone in conventional construction. The user has more time for creative work.

RUPLAN reduces the through-put time of projects, increases the productivity of staff members, and improves the quality of the documentation. On account of the user-friendly and thus easily comprehensible functions, the acceptance by users is very high. For this reason, the investment in RUPLAN pays for itself within a very short period of time.

# 2. Working method

RUPLAN may be used with dialogue masks or optionally with Windows menus, for all non-graphical inputs. Alternatively, Windows techniques or action codes can be used for graphical inputs.

### 2.1.1 Mask system

The dialogue masks have a uniform structure:

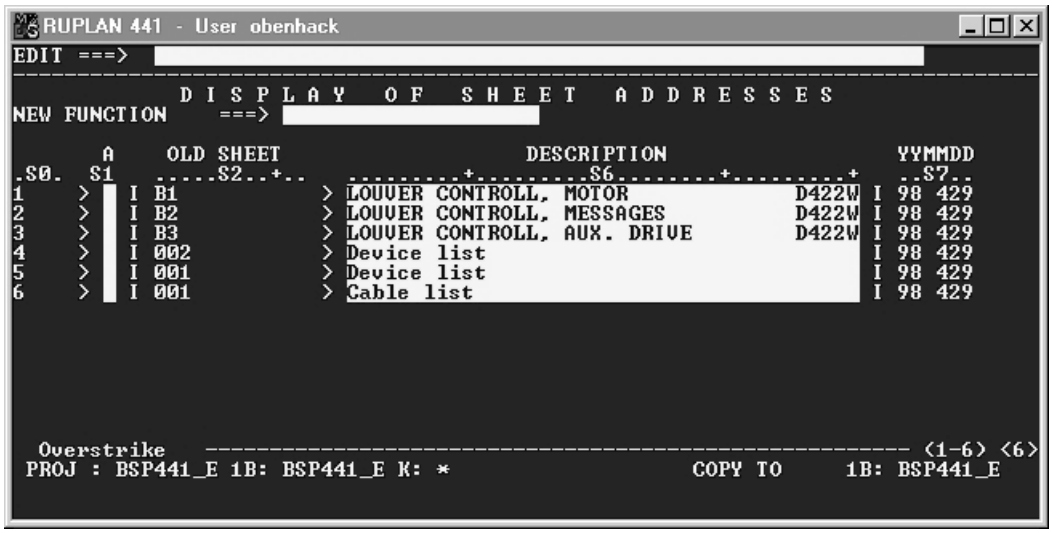
1. EDIT lines are used to re-organise masks.

2. The mask contents are organised in headlines and an almost extensive tabular area that is divided into columns.

3. Status and error message lines have been included.

The masks are used for various actions. Among other activities, they are used for the selection of sheets or symbols, which are to be edited graphically or are to be copied, the display of results, the default settings or designation of symbols. By means of the mask editor, the user may jump to any random position in the mask, if this is sensible, to make an entry, to re-organise masks or to browse through the masks. Actions, such as sorting, find, default value, replace column contents, and add, are available.

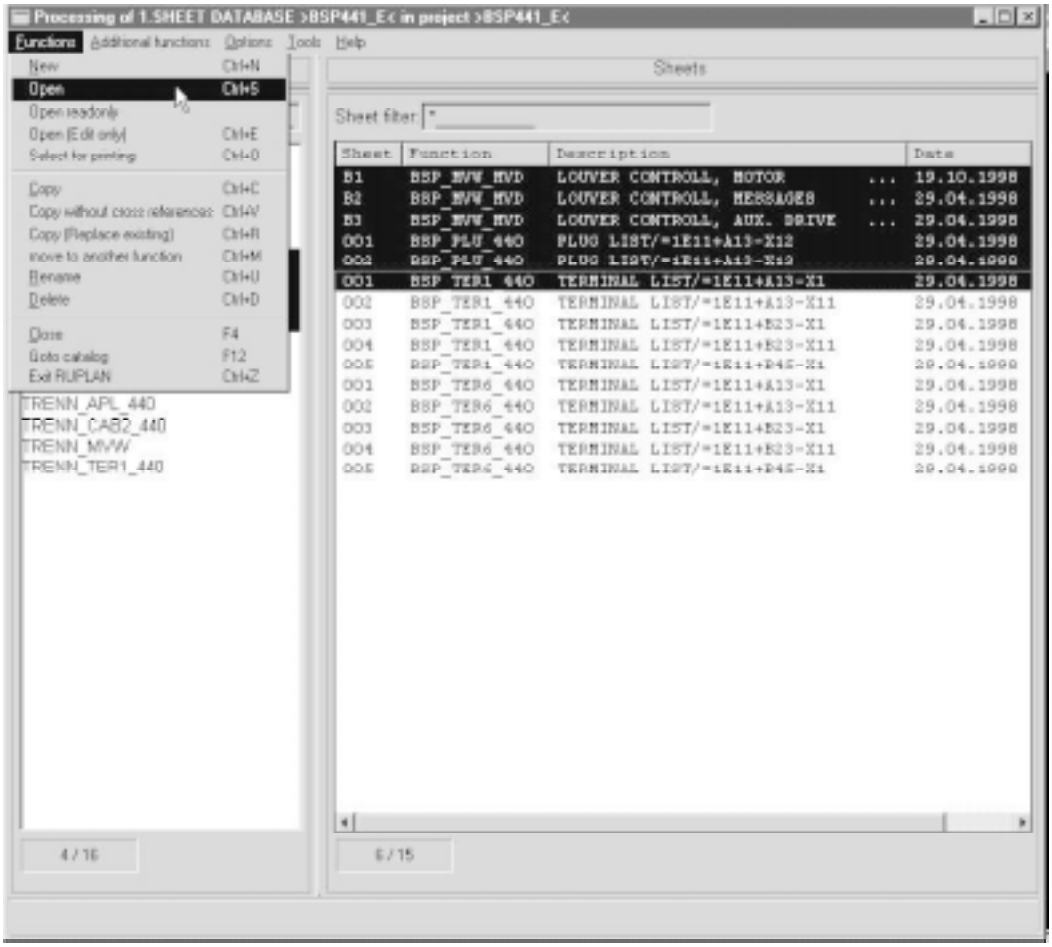
As a rule, the first column of a mask is the „action column“. The action code is entered in the lines, in which the elements to be processed, are located. After confirming the mask the requested actions are carried out. In the sheet selection mask, for example, one or several sheets are selected for graphical or alphanumeric processing and/or other actions, such as deleting or copying.




*Sheet selection mask*

### 2.1.2 Windows menus

As an alternative to the mask-oriented interface, a Windows-oriented interface is available which is especially suitable for first-time users and those users who predominantly work with PC software. Apart from text inputs, the control is carried out by means of the mouse.
During the use of RUPLAN the user can switch between the mask interface and the Windows interface.




*Standard functions*

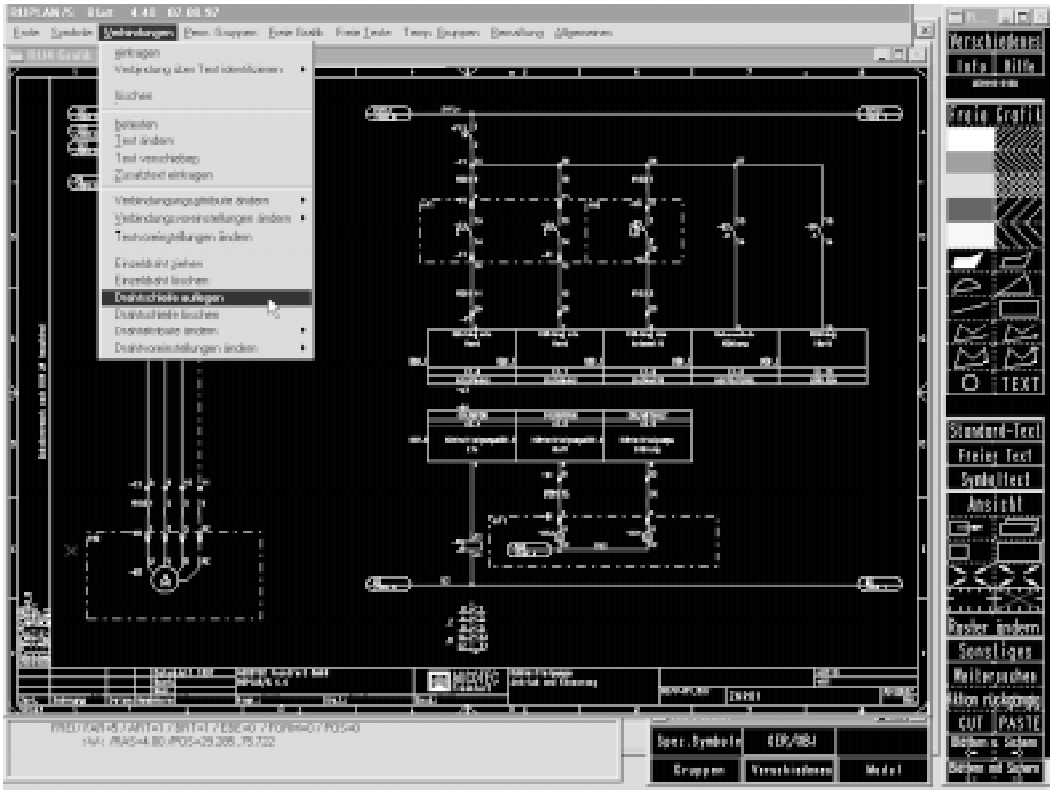
### 2.2 Graphics processing

During the graphical processing of drawings, symbols, and devices, menus are offered which the user can employ to activate all processing actions.

The upper margin of the screen contains a bar with groups of actions that in turn list individual actions in pull-down menus.

The following action groups are available:

- End
- Symbols
- Connections
- Permanent groups
- Free graphics
- Free texts
- Temporary groups
- Dimensioning
- General



*Screen structure*

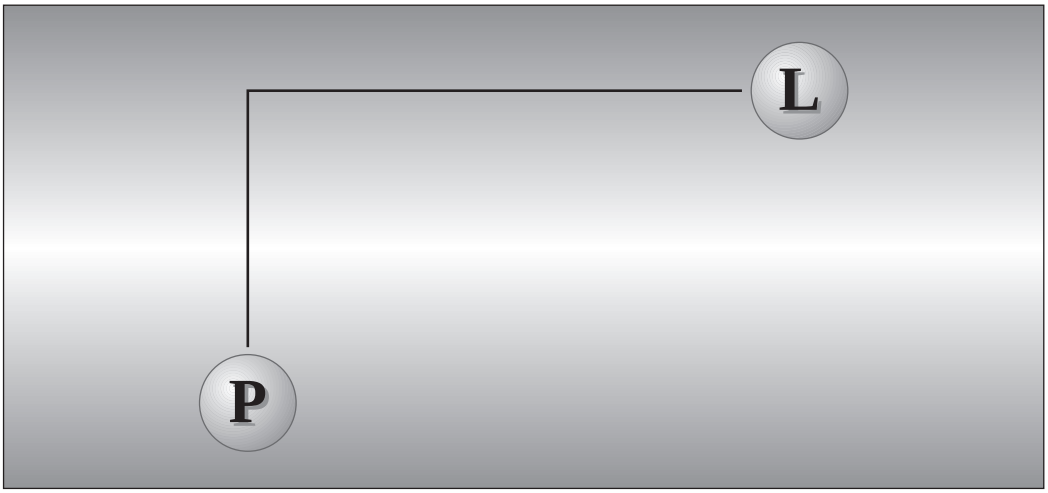
An information window is displayed at the lower screen margin, in which the most important active parameter values and the crosshairs position are displayed. In addition, a message is displayed, relative to the current action selected, reporting whether it has been carried out successfully or which input the system is next expecting the user to execute.

Additional windows can be activated on the right margin of the screen, in which the user may store his own actions, such as frequently used symbols or certain command sequences which are harmonised to his application. These menus can be set up graphically and administered by the user by means of RUPLAN resources. A mouse click is sufficient to activate these menus.

### 2.3 Action codes

In order to activate the actions in graphics mode the user has available for input alternative action codes, with the help of which he can quickly create his drawing. A time-consuming „seek-and-yea-shall-find action“ of the menu hierarchies is avoided.

The action codes are self-explanatory: a line, for example, is drawn by point and line.




*Graphic point and line*

In order to work even more effectively, the user has the possibility of allocating action sequences to those keys, which are not required for graphics input. Symbols, for example, can be identified, placed again, and subsequently provided with text by the push of a button.

### 2.4 Help action

The user can activate the help action to have all possible actions at this point listed with explanatory texts.

### 2.5 Information buffer

During the RUPLAN session, information and error messages in the event of possible faults are continuously written to the information buffer. The contents of the information buffer can be called at any time, and can be displayed on the screen or can be printed.

# 3. Database organisation

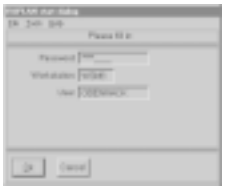
## 3.1 Administration

During the development of RUPLAN, great importance is attached to the fact that the user does not require any EDP knowledge to operate the system. For this reason, RUPLAN comprises a powerful data administration.
The created drawings, symbols, devices, online records, and evaluation command sequences are stored in databases. RUPLAN uses the following databases:

- Sheet database
- Symbol database
- Device database
- Online database
- AWT database
- Standard text file

RUPLAN offers the possibility of listing all databases generated as a catalogue, permitting the user to obtain an overview of the projects and databases in use and to select.

## 3.2 Protective system



The access to RUPLAN is protected by password. Various access authorisations may be allocated to each password. In addition, the user can protect each element in the databases (drawings, symbols, devices, and evaluation command sequences) by a separate password. The user can decide himself, whether several people shall have access to the same elements in the database or not. If this is not requested, a multiple write protection can be activated.

## 3.3 Project organisation

In plant engineering it is usual to combine data relative to projects. This method of working is possible with RUPLAN as well.

### 3.3.1 Project

In order to create a suitable data environment, RUPLAN permits databases, in which drawings, symbols, devices, online records, and evaluation command sequences are stored, to be combined in a project. Consequently, the user will find a suitable data environment when he starts up his project. If information is required from other projects for a short period of time, a „temporary project combination“ can be run which is not saved.

One project may contain a maximum of 17 databases, each type of database comprising a maximum of nine databases. An exception to this rule is the standard text files, of which a maximum of three may be accessed.
During the set-up of a database, the user defines the name and the start size. As soon as the fill level of the database reaches a critical value, a message is already released. If no further space is available in the database, it is extended automatically.

The RUPLAN project generator can be used very easily to create a complete project with all databases required. Below please find a more detailed description of the databases administered in the project and their contents.

### 3.3.2 Sheet database

The drawings generated are saved in the sheet database. The compilation of individual sheets to an overall set of drawings is carried out by means of a common drawing number (function). The size of the sheet databases within the RUPLAN environment is limited only by the capacity of the mass storages.

Evaluations can be run either across the entire sheet database, across one or several drawings or across individual sheets.

Various database actions are available for the manipulation of the drawings. Among other things it is possible to copy or to delete complete drawings or parts thereof, to rename drawings as well as to extend the sheet database.

### 3.3.3 Symbol database

The symbol databases are used to store symbols and complete drawing sections. The symbol databases can be administered and created independently of a project. The total number of symbol databases is not limited.

The Basic Symbol Library, which is based on the master file of the German Commission for Electrical Engineering and contains more than 2,000 symbols in compliance with German standards DIN 40 900 and DIN V 40 900, part 1000, is available for RUPLAN. The Basic Symbol Library is subject to licence by the German Commission for Electrical Engineering. Moreover, there is also a freely available RUPLAN inherent symbol database.

The symbol databases allocated during the planning work determine which symbol sets are used for the drawings. By allocation of a database with symbols according to foreign-country standards it is possible to plot drawings, which have been set up according to German standards, in another form without interactive change of the drawings, such as for export purposes. However, the pre-requisite is that the symbols have the same name in both standards, are equal in size, and have the same connection logic.

The user can simultaneously process several symbol databases (e.g. standard symbols, project-related symbols, partial circuits of the user). The priorities of these symbol databases are determined by the default settings.

Synonyms (alias names) can be allocated for symbols so that a symbol can be addressed under various names.

Corresponding administration functions are available for the symbol databases, similar to those for the sheet databases.

### 3.3.4 Device database

The device database is used to store all device descriptions which are required for the online check and the device-related evaluation of the drawings. A DIN device database, the Basic Object Library, which comprises the standardised devices belonging to the Basic Symbol Library (cf. 3.3.3), is available for the logical links of the devices in RUPLAN. The Basic Object Library is subject to a licence.

If the user already has a commercial material master file, it has to be checked whether data extracts can be made and transferred to the RUPLAN device database. The RUPLAN-specific data have to be supplemented. Commercial data can be accessed directly for evaluations.

The device database can be created independently of a project. Several device databases can be created. If a project is set up with several device databases, all devices (objects) used in the drawing for online reference, are copied into the first device database, thus creating a project-related device database automatically with all devices used in the project.

The actions for creating, deleting, copying, and expanding are available here as well, together with other facilities.

### 3.3.5 Online database

If online checks are requested for processing a project, a project-related online database has to be available. As the online database supports multiple users, several users may work on the same drawings at the same time. For applications in compliance with the requirements of the Power Supply Designation System, the item names may have a length of up to 128 characters.

The structure of the item names is defined in the administration records. If the online checks are activated, a record is generated for each item comprising the relevant data. Transfer records are used to temporarily store the information to be transferred to other sheets.

The above database actions are available here as well. However, there are some limitations with respect to use.

### 3.3.6 AWT databases

The AWT databases (AWT = abbreviation for the German word for evaluation) are used to store the command sequences for the evaluations. These command sequences are used to generate standard lists as well as project-related or user-related evaluations, such as for the compilation of lists, the transfer of data in drawings, et cetera. Moreover, the AWT databases contain the so-called user menus, the user commands, and the automatic texts.

As in the other databases, there are actions for creating, deleting, copying, and expanding, together with other facilities.

### 3.3.7 Standard text file

Frequently used texts are entered into the standard text files by means of an editor. A file for each requisite foreign language is set up. Cyrillic characters are available for Russian.

The allocation of the text files for the representation of the drawing determines in which language the drawing is labelled. As three files can be accessed at the same time, a multi-lingual labelling is possible.

# 4. Graphics

Symbols and drawings can be created interactively on a graphics screen. The actions of the free graphics are available for both element types. The symbol design is possible in the symbol database or during the processing of the drawing. In drawing processing, additional actions are available which have been adapted to the drawing logic.

## 4.1 Free graphics

The following elements of free graphics are used:

**Line / circle / arc**
Line attributes:
- Line thickness
- Type of line
  – continuous
  – dashed
  – dotted
  – dot-dashed
  – long-short dashed
- Colour

**Free text**
Font attributes:
- Character set
  – software font: Latin, Cyrillic, Greek
  – hardware font: Latin
  – pen allocation to font size
  – user-specific fonts (cf. chapter 4.6)
- Height / width ratio of the characters
- Placement angle of the text
- Position angle of the text
- Justification in compliance with German standard DIN
  – left (top, centre, bottom)
  – right (top, centre, bottom)
  – centre (top, centre, bottom)
- Colour

**Polygon**
Surface attributes:
- Empty
- Filled
- Hatched
  – narrow / medium / wide spacing
  – crossed
- Colour

Lines entered can be lengthened and shortened. The radius for circles and arcs already positioned can be corrected. The points of polygons can be moved, and additional points can be entered. When texts are placed, a displacement with respect to the basic grid may be set, thus permitting the display of a text in a table above the lines, for example, without having to change the basic

grid. The input mask permits text blocks with up to 15 lines to be edited. The user may choose whether the text lines are to be placed above or below the crosshairs.

Texts rendered in the drawing may be marked for modification. The text is displayed in the mask, and can be modified by editor actions, such as overwriting, deleting, and inserting. In addition, already available symbols disassembled into their graphical elements can be placed at any time.

### 4.2 Grid

In graphical processing it is advisable to set a grid. On account of this action, not every pixel on the screen is accessible; the point entered through the crosshairs is drawn into the next possible grid point. The grid set can be displayed at the screen margin or as a dot grid.

The basic grid can be set freely in RUPLAN at any time, and can be switched off as requested as well.

The dimensions of the symbols have to match the drawing grid. By means of a check run in drawing processing, it is possible to ensure that connection points of symbols are located on grid points only.

### 4.3 Image manipulation

The image can be zoomed at random.

By means of action keys, sections of an image can be zoomed in or out by a factor of 2 each time. The requested section can be defined by means of the crosshairs as well. A defined section can be pushed across a drawing, and the zoom area is retained.

### 4.4 Image layers

Graphical image elements can be placed in various image layers. A maximum of 100 layers are available. During graphical processing, the layers active on the screen for input and display can be selected.

The visible image layers can also be set for plotting.

### 4.5 Colour

RUPLAN supports colour graphics screens.

The setting of the colour is stored in the file structure so that the colour information is retained when the drawing or the symbol is accessed.

Basically, a different colour can be set for each element. During the entry of new elements in the drawing this setting will be taken into consideration and will be entered in the data structure as well. During the graphical processing the default setting can be changed to document the various revision states, for example. The previously entered elements will be retained in their old colour.

Symbols whose graphics have been allocated different colours can be placed in one colour in the drawing with a common symbol colour.

### 4.6 Fonts

Several fonts are available in RUPLAN, such as a Cyrillic and a Greek font, among others. Moreover, the user can create his own fonts by changing the requested characters of a given font or by drawing them like a symbol.

# 5. Graphical processing of drawings and symbols

## 5.1 Symbol design

A symbol is created and stored under a freely definable symbol name. During the design, reference graphics can be used to assist the design.

If created symbols are to be executed in compliance with German standard DIN, the rules laid down in German standard DIN 40 900 have to be observed. The rules of the Basic Symbol Library are part of the Basic Symbol Library.

### 5.1.1 Symbol structure

A symbol consists of graphical elements, such as lines, circles, arcs, texts belonging to the symbol, and the „connection point“ and „text field“ logic elements. Each symbol is allocated a reference point that corresponds to the crosshairs during the placement action.

Symbols can be mirrored.

### 5.1.2 Types of symbols

RUPLAN differentiates between various types of symbol. There are, for example:

S Standard symbol
„Normal“ symbol to display random elements in the drawings
Z Additional graphics
A purely graphical symbol as an addition to other symbols
L Logic symbol
Symbol with logic information which is linked to another symbol
G Group (partial circuit)
Partial circuit, in which individual elements can be accessed
K Terminal
Terminal symbols are logically passable for potentials contrary to other symbols
R Frames
Symbol for forms, et cetera. This differentiation permits an ideal access for evaluation routines.

### 5.1.3 Alias names

Retaining the graphics and the logic, symbols can be allocated to additional names, so-called alias names. Subsequently, the symbol can be accessed via each of the names allocated.

### 5.1.4 Connection points

In a symbol the points are defined, at which a logic link to other elements is possible. A maximum of 200 connection points can be defined. When the connection points are generated, the system will count the points automatically.

### 5.1.5 Text fields

Each symbol may contain up to 999 text fields. A text field is accessed through its text field name and defines the placeholder for the text in the drawing.

By means of the text field name, the requested text is entered in the drawing. The placeholder contains the text attributes, such as position, text height and width, justification, visibility, layer, colour and angle. A default setting of the text is possible, which is displayed in the mask during the text allocation in the symbol and can be transferred to the drawing.

In addition, the text field name permits the access to texts from the drawings (cf. chapter 9). If many text fields are defined in a symbol which are only partially filled with text in the drawing, the automatic text sequencer can be activated, which causes a text field which has been filled-in in the drawing to be moved to the position of an empty text field automatically.

### 5.1.6 Logic symbol

Connection points and text fields can be combined in a logic symbol and can be allocated to all similar symbols. For 0, 90, 180 and 270 degree placement angles of the symbols, corresponding logic symbols can be created with different text orientations so that a position of the texts ideally adapted to the placement angle is achieved.

## 5.2 Drawing production

The processing of a drawing is done sheet by sheet. The unique identification mark of the individual sheets is carried out by the function (e.g. drawing number) and the sheet designation (e.g. sheet number). By means of the sheet selection menu a sheet or several sheets available can be called for processing or a new sheet can be created. Forward and backward browsing is possible.

### 5.2.1 Sheet information

When a sheet is created, graphical information is set which is important for evaluation, for example, and for plotting,

which is:

- format
- current path distribution
- scale.

The requested drawing frame, which can be defined by the user as required, is placed into the format freely definable in height and width. The drawing frame contains a text field with the placeholders for the requested labellings.

The default setting of a reference form, which shows the surface available for the drawing, for example, is possible.

The format as well as the form can be modified.

### 5.2.2 Connections

Contrary to the lines of the free graphics, connections are entered into the data structure as logically linkable elements.

Connections can be entered in one unit as a line. If a connection finishes on another connection or on a symbol connection point, the elements are logically linked with one another.

If the connections of symbols are located on a connection that has already been entered, this connection will be divided. Connections can be laid across a whole row of symbols. If the final point of a connection already existing is located on the connection to be established, a potential point is set.

If a connection is extended in X or Y direction, the system will combine the partial sections automatically.

Potential designations and connectors as well as cable and wiring information can be allocated to the links. Potentials which continue on other sheets are defined as a joined network by means of potential cross-reference symbols. Direct short circuits between potentials are recognised and reported.

The types of lines available for connections have been described in chapter 4.1.

By using the „wire“ element, wiring information can be entered in the circuit diagrams. By this means the real wiring sequence can be clearly recorded.

### 5.2.3 Symbols

Symbols stored to one of the registered symbol databases are selected by means of graphical selection menus, entry of a name or by identification of a symbol already contained in the drawing.

Up to a maximum of three additional graphics can be allocated to a standard symbol.

The crosshairs are used for placement on the screen. Optionally the symbol can be attached to the crosshairs so that the user sees immediately where and how he places the symbol. The position of the crosshairs is identical with the reference point of the symbol.

During the placement process in the drawing the symbols can be rotated by a random angle (0, 90, 180, 270 degrees are the preferential positions). Multiple-placement is possible. Symbols already placed can be deleted, moved or rotated. All symbol attributes can be changed.

If, during the placing of symbols, connection points meet a connection or the connection point of another symbol, logical links are established immediately. If a connection point is located on an existing connection, this connection is divided and logically linked to the symbol. If two or more connection points of a symbol are located on the same connection, the section of the connection between the points will be deleted.

If a symbol is deleted or moved away from a connection, the resultant gap is closed. All defined text fields will be offered in a mask for the entry of a text to a symbol. Texts which are entered as default texts during the symbol design will be displayed as default text.

The text qualities defined for the text fields, such as font size, type, justification, visibility, layer, colour, will be used. The texts of the symbol last provided with text can be transferred to the mask as a default setting and the numeric section can be incremented on request.

This function is especially suitable for terminal numbers, device designations, et cetera. Subsequently, texts entered can be modified or moved, respectively by changing the text attributes (such as font size, visibility, placement angle).

In addition to the texts defined during the symbol design, each symbol can be allocated with additional text fields, which can be placed at any random position in the drawing. Additional connection points can be entered as well.

Symbols can be entered in three different ways:

- according to the type of storing
- without logic elements, i.e. reduced to the pure graphics
- as a free graphic disassembled into its elements

### 5.2.4 Temporary groups

Groups are defined by including the requested elements in a group frame. This frame can be defined by a maximum of 25 corner points or alternatively by two points diagonally opposite each other. All symbols, links and free graphical elements which are within an area thus defined are recognised as a temporary group and can be manipulated together. After the group frame has been closed, a selection from the elements contained can be made. The following manipulations are possible:

- Copy
- Move
- Delete
- Rotate
- Joint text entry for all symbols in the group
- Joint modification of graphical attributes (layer, colour, type of line, et cetera) or texts
- Storing and loading as partial circuit

These manipulations take the logical links of the elements into consideration. If a group is moved, for example, the existing connections at the old place are removed and the group elements are logically linked to the elements found in the new position.

During the text entry for a group, the texts entered are allocated to all symbols concerned by their text field names. By sorting the group elements the user can set in which sequence the elements are to be provided with text. A numeric section in the text can be incremented.

### 5.2.5 Fixed groups

As described in chapter 5.2.4, elements are combined in a group which are enclosed by a polygon. These elements are defined as a fixed group.

The user can choose whether texts that are allocated to the polygon are to apply for all symbols in the group or are to be accepted only by those symbols which have the same name in a text field. Symbols placed in the polygon at a later point in time are logically linked to these texts.

### 5.2.6 Partial circuits

Parts of a drawing can be stored in a sheet or symbol database under a name to be entered by the user. These parts can be used in other drawings. Partial circuits are defined as a group as described in chapter 5.2.4.

Partial circuits can be placed in drawings as:

- evaluable partial circuit
- non-evaluable partial circuit

If an evaluable partial circuit is used, the group is disassembled into its original elements when called in the drawing and is placed in the drawing as if the elements had been entered individually.

If a non-evaluable partial circuit is used, the group is „frozen“ and is used like a symbol. The constituent elements cannot be addressed separately in the drawing. Connection points and text fields can be allocated to a non-evaluable partial circuit.

### 5.2.7 Dimensioning

By means of spacing, distance, angle and radius dimensions, graphics can be provided with dimensional lines and dimensional figures. A scale set for the drawing will be taken into consideration.

The colour, type of line, layer, et cetera can be entered as a default setting for the dimensional elements. Settings can be made whether the dimensional lines are finished with an arrowhead or a slash.

### 5.2.8 Standard texts

Standard texts are used for foreign-language labelling in drawings or for easy entry of frequently used German-language texts.

Standard texts are addressed by the identification on the first eight digits in the text file. This identification is stored to the data structure. The appertaining text from the allocated text file is shown in the drawing. As three files can be accessed in a project at the same time, a multiple-lingual labelling of the drawing is easily achieved.

Standard text files are not limited as to size.

### 5.2.9 Checks

In the course of the graphical processing, the user can manipulate several construction requirements, so-called checks. These construction requirements can be switched on or off as requested.

Below please find a list of some possibilities:

- Connection to connection permitted
- Symbol without connection permitted
- Connections in a grid
- Overlapping symbol position permitted (graphics or logic)
- Horizontal and vertical connections only
- Capital letters only
- Net text unambiguity (short circuit)

### 5.2.10 Plotting

Plotting hardcopies
During the graphical processing of the drawing, the active screen content can be plotted.

# 6. Alphanumeric editing of drawings

Apart from the inter-active graphical processing of the drawings, drawings can be processed alphanumerically without a graphical image. Apart from savings in time, this method of working has the advantage that no graphics terminal is required - an alpha-numerical viewing unit is sufficient. In this type of processing the symbols of the drawing are shown to the user in a screen mask. He can make a selection to permit text entry, change or deletion of attributes, for example. Symbols and groups can be placed by means of a selection mask. If correspondingly processed groups are available, the set-up of complete drawing sets is possible in alphanumeric processing.

Alphanumeric editing is recommended also, if changes are to be carried out systematically in standard drawings.

# 7. Device organisation

## 7.1 Device classes

In plant engineering, other identifying terms are used for the different types of item (e.g. devices, terminals, cables).

In order to be able to define these differentiations, the user can specify different device classes, such as:

- GER (devices)
- KLE (terminal strips)
- KAB (cables)
- POT (potentials)
- TEC (technical and commercial data)

## 7.2 Device data

The data for the devices used are compiled in the device databases. Technical and commercial as well as RUPLAN-specific data can be defined for each device. All device data are defined by symbol text entries. Devices can be edited alphanumerically or graphically.

By means of the technical data symbol, the user determines how many and which technical and commercial data are to be included in his device database. Thus, the characteristics can be defined as required.

The logical structure of the devices is defined by the RUPLAN-specific data. A determination is made as to how many partial functions a device has and which symbol may be used in the drawing to indicate this purpose. In this way the base device parts and the dependent device parts as well as the appertaining handling can be defined for the partially displayed devices.

Moreover it is possible to define variants for devices. For the device of an „indicator light“, for example, several collar colours, sockets and voltages can be defined, whereby the device will only be accessed by one term (type of device) in all cases. The final applicable variant is defined by the text entry in the drawing. In addition, devices can be used which consist of several components.

### 7.3 Online databases

The rules for the structure of the items are defined in the online databases. For this purpose an administrative record is stored for each class of device, which contains, for example, which texts are used in the drawing for the item names of the elements. A maximum of five terms are permissible (e.g. in compliance with German standard DIN 40 719 = ,=. , + , +. , -). The administrative record also defines what the cross-reference text should look like on the various device parts (e.g. „(„,sheet number,“/“, current path,“)“). If the online check is used whilst processing the drawing or if the J action is released for the drawings, item records are stored in the online database which contain all device references to the items (allocation of symbols to a device).

The association of distributed devices is determined and their cross-references are set. By checking the device data in the device database against the elements rendered in the current diagram, the error messages and text transfers described in chapter 9 are generated.

If the item data are to be changed for the entire drawing set, this can be achieved by editing the item records. Changes carried out at this point are transferred to the drawings without the necessity for any additional graphical editing.

## 8. Tests and automatisms during drawing set-up

### 8.1 Device selection

If a device from the device database is to be allocated to an item in the drawing during the edition of a drawing, the user is supported by the system. Defined search terms can be used to search and select the suitable devices in the allocated device databases.

### 8.2 Interactive device test

During the edition of a drawing already, the devices used for the items can be checked on all sheets at any time.

After a device designation has been allocated, the following tests are carried out, among others:

- Symbol is permissible for the type of device
- Connection designation exists already
- Type of device is not available
- Number of permissible elements is exceeded
- Connection designation is compatible with the device definition
- An item has various types of devices

The user can obtain information on all parts of an item on all sheets at any time.

### 8.3 Device cross-references

If the online check is active, the connection designations of the symbols are taken from the device definition and entered in the circuit diagram during the edition of the drawing already.
If you work with partially displayed devices (relays or contactors) the following is valid, in addition:
The contact layout, which is defined for the corresponding device type within the device file will be represented at the basic device at a position predefined by a place holder.

The reference back to the appertaining basic device is entered in each contact. Cross-references may also be entered for devices which have not been allocated with contact handling. The cross-reference is subsequently entered to the elements of the device.

The structure of the cross-reference texts can be defined by the user. Different default settings are permissible for each class of device (as described in chapter 7.3).
On account of the immediate (online) automatic entry of the cross-references in the drawings, a time-consuming evaluation run is eliminated.

## 8.4 Short-circuit test

During the entry of connections or the deletion of symbols, impermissible links of different potentials or wiring properties may occur. By means of setting the corresponding checks, the user can prevent the entry of such connections. RUPLAN will release an error message in this case.

## 8.5 Automatic texts

Automatic texts are an important aid to increase the efficiency during the processing of drawings. With this tool RUPLAN offers the possibility of automatically including clearly defined dependencies in providing symbols with texts. Apart from the saving of time, unnecessary mistakes are prevented.

Examples for automatic texts are:

- Composition of the item name from the sheet, the letter „K“, and the current path (e.g. 17K4).
- Transfer of the connected PLC output to the item name of devices.

The settings for the automatic texts may be stored as default settings in the text fields of the symbols already. They will be activated during the marking of the symbol in the drawing. However, they can also be entered whilst providing the symbol with texts during the current editing of the drawing.

Automatic texts can also be used to transfer texts, which were entered for a partial function of a partially displayed device during the device definition, to all partial functions or to transfer the device texts from the device file automatically as soon as the type of device is determined.

Automatic texts can be permanently active, i.e. they are executed again in case of modifications, e.g. when a symbol is moved.

## 8.6 Jump function

**(Drawing navigation)**
The user may select a sheet to be processed by selecting a certain item or a component of an item, respectively. In this case RUPLAN will automatically jump to the sheet, on which the requested element is shown. Both in case of partially displayed devices and in case of potentials, the cross-references can be used to jump directly from a sheet to a consecutive sheet.

# 9. Evaluations

## 9.1 Standard evaluations

Standard evaluations are supplied along with the RUPLAN software, which were developed as a response to customer requests and cover the performances that are not specific to a user.

The user may define the evaluations by means of the functions of the AWT language described in chapter 9.2. For this purpose the standard evaluations may be used as a lead.

### 9.1.1 Device cross-references

Please refer to chapter 8.3.

### 9.1.2 Potential cross-references

By entering a connector symbol for potentials, which pass along several sheets, a graphical and logic reference to the next use may be generated automatically.

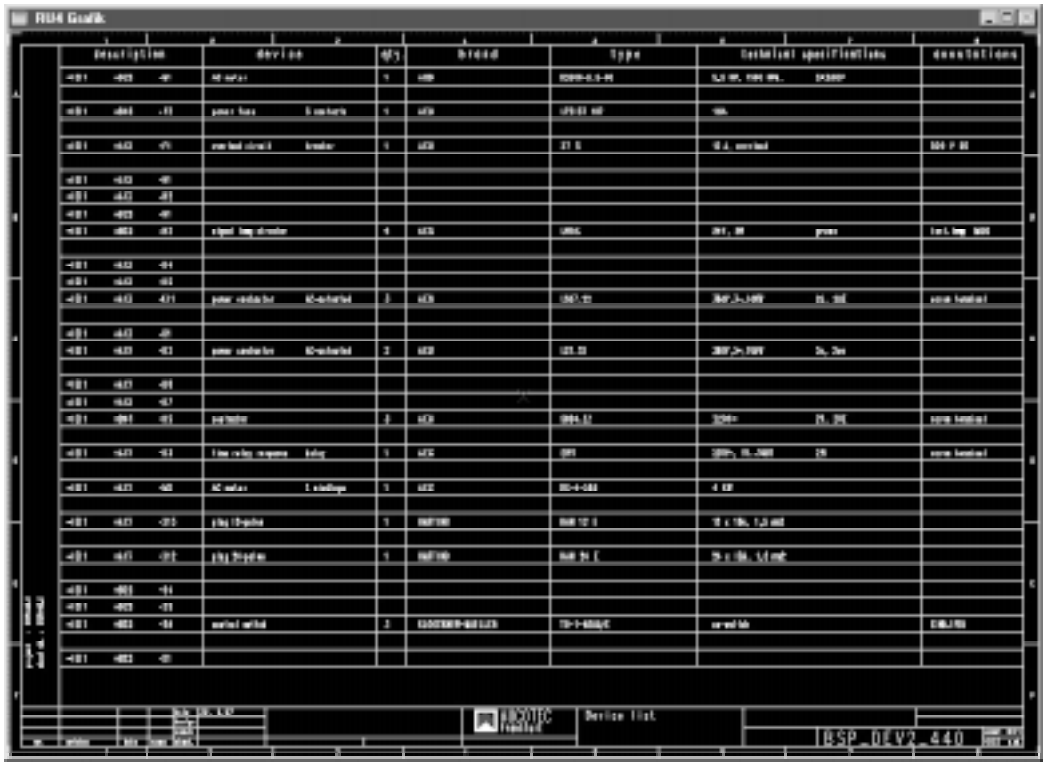
The structure of the cross-reference is defined in a separate device class, such as the device cross-references. The cross-reference may defined online during the processing of the drawing.

### 9.1.3 Parts list, device list

Several parts list formats are supplied in the standard version. The following data will be displayed for the devices used in the drawing:

- Item name
- Quantity
- Device name
- Type of device
- Type-related data, such as technical data, order data, et cetera (if available)

Depending on the list format, combined devices, which are addressed in the circuit diagram by a single device type, are split up into their component parts. The output of a type list (device list without item name) is possible. The evaluation may be run on one drawing with a single sheet or all sheets, several drawings or for individual plant parts. User-specific forms may be used. The result of the evaluation may either be printed or stored as a drawing in the sheet database.



*Device list*

### 9.1.4 Plant resource schedule

The plant resource schedule is another form of device list. By means of a handling symbol the overall device representation is placed on separate sheets and is supplemented by the technical and commercial data from the device database.

The device cross-references are entered on these separate sheets. Especially in the event of large devices in the field of power supply, this type of representation is usual.

### 9.1.5 Wiring list, net list

The evaluation interprets the connection logic of the drawings and determines the following contents:

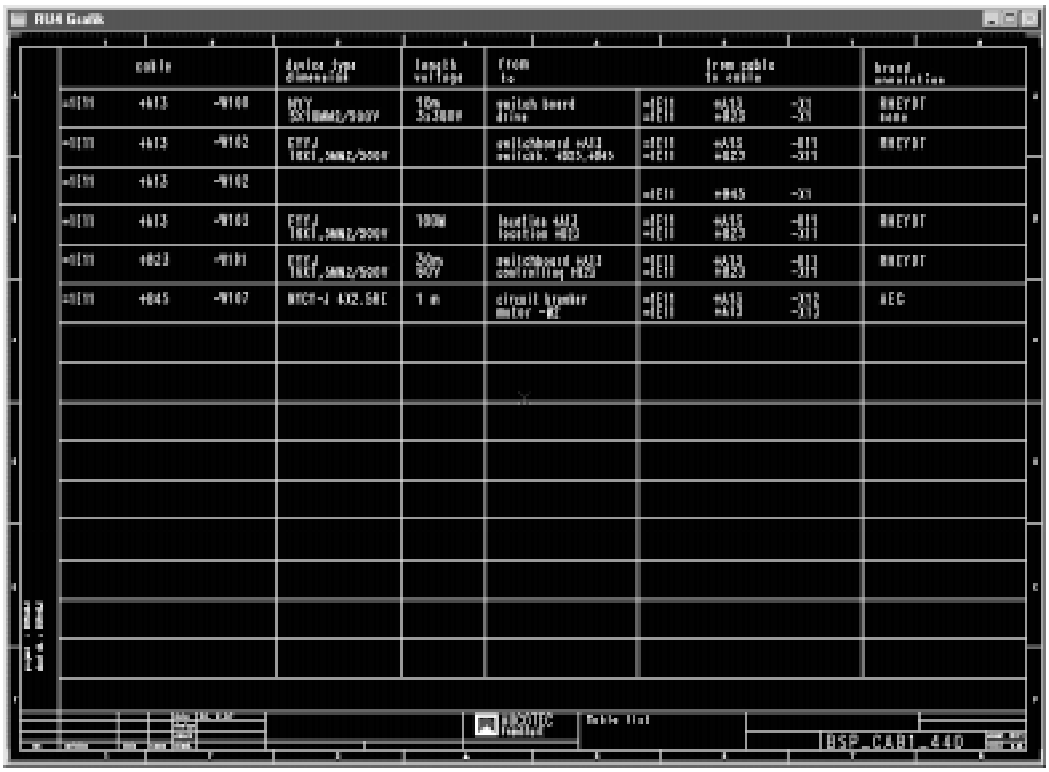
- Internal network number
- Potential designation
- Device designation of the devices connected
- Connection designation
- Cross-reference
- Colour / cross-section

### 9.1.6 Cable list

All cables allocated in the drawing are selected and the following information is rendered:

- Cable number
- Type of cable
- From - to
- Devices connected
- Length
- Voltage

The result of the evaluation can either be printed or stored as a drawing in the sheet database.



*Cable list*

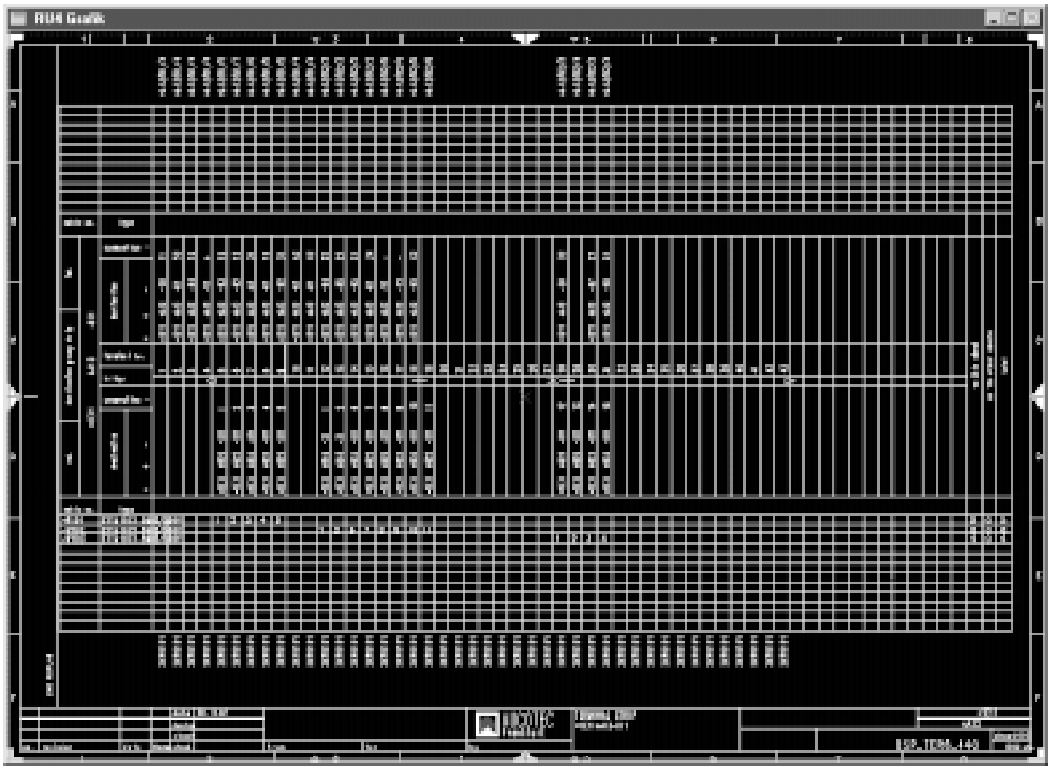
### 9.1.7 Terminal diagram

All terminals entered in the drawing are listed in a terminal diagram form automatically. Several forms are available in the standard version. User-defined forms can be created. The following data are produced:

- Terminal strip designation
- Terminal number
- Target (s) internal / target (s) external
- Cable number and core

Bridges, shifting bridges and isolating plates are added to the terminal diagram and are displayed graphically in addition. The empty terminals defined in the drawing are taken into consideration. Multiple terminals which may be spread across the drawing are displayed as well.

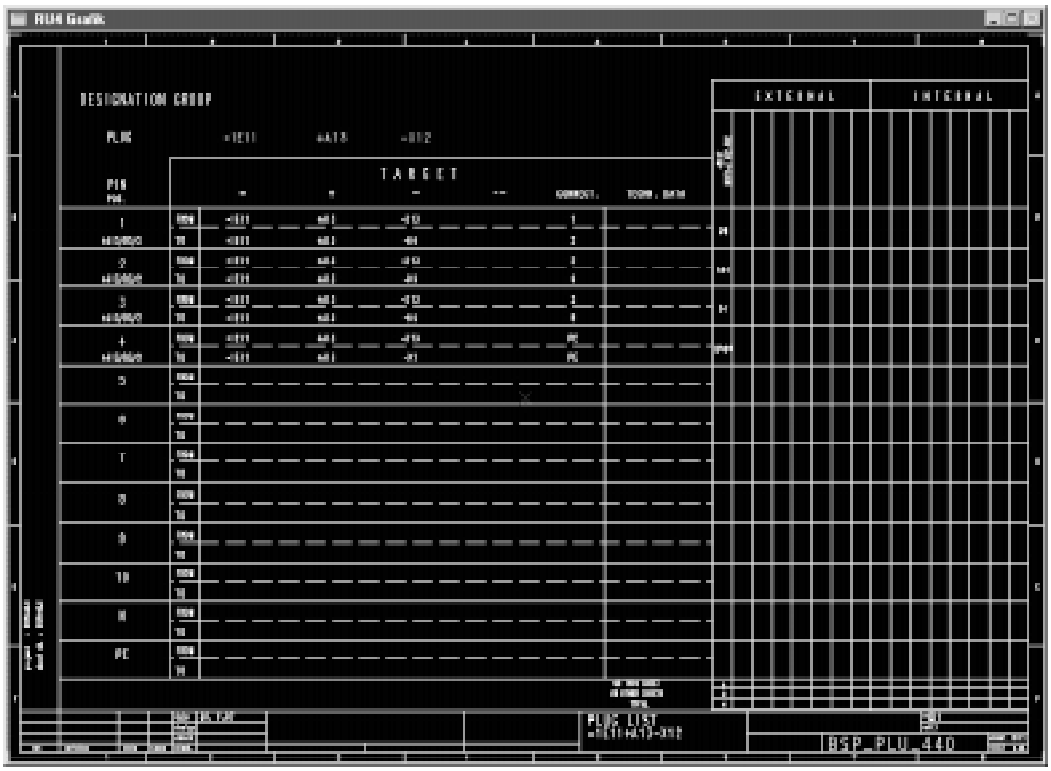
As requested the result of the evaluation may be printed or stored as a drawing in the sheet database.



*Terminal diagram*

### 9.1.8 Connector diagram

Similar to the actions in the terminal diagram, all connector symbols placed in the drawing are searched, the net logic is evaluated, and the information is rendered in a connector diagram. User-defined forms can be created. The outputs in the standard version correspond to the terminal diagram.




*Connector diagram*

### 9.1.9 Table of contents

In order to set up a table of contents, all requested drawings are selected in a sheet database, and the designations and the revision status information from the drawing frame are displayed. As requested the result of the evaluation may be printed or stored as a drawing in the sheet database.

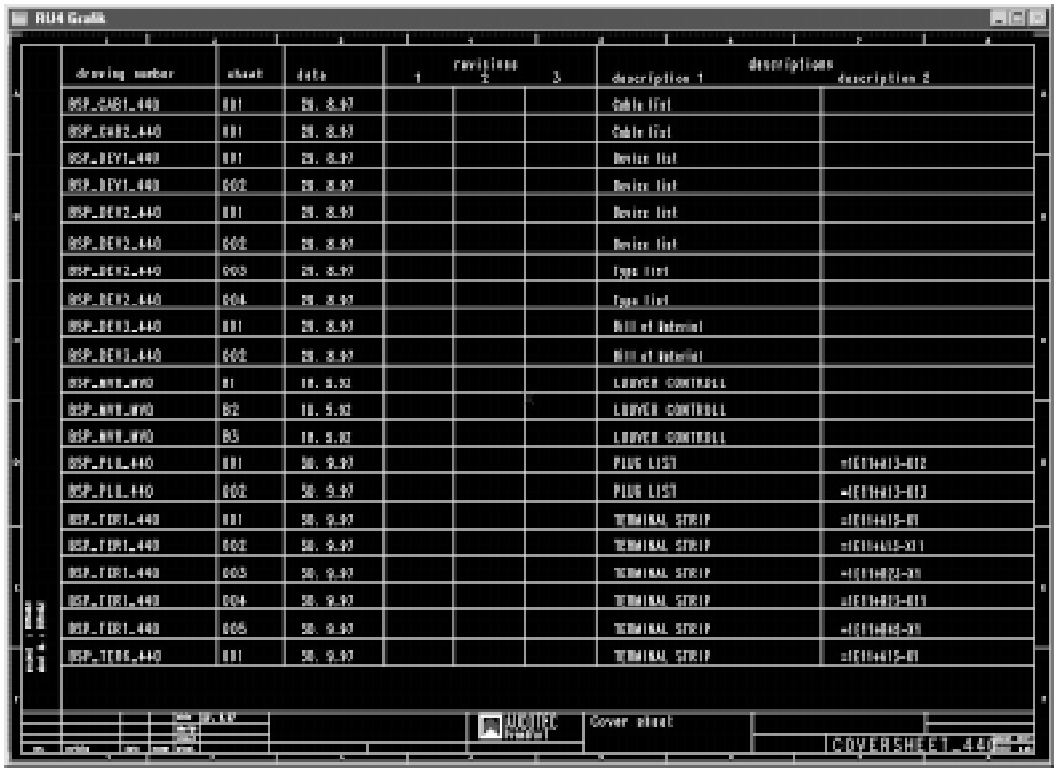



*Table of contents*

### 9.1.10 Test runs

In order to avoid potentially time-consuming evaluation runs in faulty data records, test runs are provided in the standard version.

Device test run:

- Is the designation of the item complete ?
- Is the device listed in the device database ?
- Are the symbols permissible ?
- Have too many partial functions been allocated ?
- Has the handling symbol been treated correctly ?

Terminal test run:

- Is the designation of the terminal correct ?
- Is the terminal listed in the device database ?
- Are the terminal symbols permissible ?
- Have too many partial functions been allocated ?

In addition, the following messages are rendered:

- Defined shifting bridges and isolating plates
- Number of reserved terminals

Cable test run:

- Are the default settings in the cable symbol correct ?
- Is the type of cable listed in the device database ?
- Have cable symbols been placed several times ?
- Have core symbols been used without a cable symbol ?
- Have too many core symbols been used ?

Potential test run:

- Have the potential cross-reference symbols been marked correctly ?
- Have the potentials been marked correctly ?
- Has the potential been branched correctly ?

## 9.2 User-defined evaluations (AWT)

The AWT is the RUPLAN inherent procedural „query language“, with which RUPLAN internal and external data can be read and written. The entire text and connection logic stored is recorded with AWT command sequences. In this way the data available can be evaluated and new data (such as sheets) can be created.

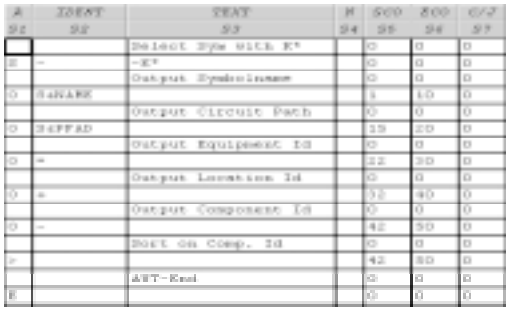
The standard evaluations mentioned above are contained in the AWT database provided in the form of AWT command sequences. By means of AWT commands, a definition is made as to which contents are to be evaluated and how it is going to be processed. The type of display is defined by symbols. The user has the possibility of copying these command sequences and of modifying them in such a way that they meet the requested form and function. Thus, it is possible to create completely different forms of plottable lists or to change the print formats.

In addition, the AWT commands can be used to enter information. The information to be entered can be read from a random external file. As all elements permissible in the drawings can be placed by means of AWT commands, drawing sets can be generated automatically in this way, if the corresponding data have been entered.

The data stored are accessed by their text field names or by the system terms. All information logically linked with an identified data element can be selected, output in random form, written into a file or a buffer for evaluation programs, modified or supplemented.

Below please find a small example:

The AWT generates a list of all symbols that belong to a contactor, which could look as follows:



| | | | | |
|---|---|---|---|---|
| GK001 | 3 | =A01 | +B1 | -K1 |
| GS001 | 4 | =A01 | +B1 | -K1 |
| AJ001 | 3 | =A01 | +B1 | -K2 |
| GK001 | 5 | =A01 | +B1 | -K2 |

## 10. User-defined command macros

Company-specific work processes can be defined by means of the user menus. Bypassing intermediate steps, the user is directed to the activity within RUPLAN immediately. This action should be employed most sensibly whenever the clearly delimited tasks and activities of the user are defined, which should be accessible for this user only.

The standard evaluations as well as the company-specific evaluations are addressed through a user menu as well.

The user menu can be extended or modified at any time. Thus, the inclusion of new evaluations is possible without having to change the actual RUPLAN program.

# 11. Batch processes

### 11.1 Plotting

RUPLAN supports a large number of commercially available plotters and many different graphics laser printers. Detailed information is available on request.

For other plotters, we will have to check in individual cases whether the use of the standard plot software is possible.

Several plotters can be used in parallel operation.

The plot processes run in the background. Directly after the start of the plotting operation the user can continue working at his workplace.

### 11.2 Batch run

Evaluation routines and the plotting of drawings can be carried out in batch routines.

For this purpose the requested address table and a potentially required parameter file is generated and stored online in RUPLAN. By means of the operating system a batch job is generated, which is provided with a starting time (e.g. at night) depending on the functions of the computer. At the time requested the batch job is activated and runs automatically. The system messages are stored to an information file so that the user can view the messages displayed on the screen during the online evaluation run after completion of the batch job.

### 11.3 Commands

Without having to quit the RUPLAN system, files can be edited, command procedures can be started or operating system commands can be run.

# 12. Interfaces

### 12.1 AWT interface

By means of the AWT language described in chapter 9.2, random drawing contents, symbol or device data can be saved to files which can be used by processing programs. Conversely data read in from files can be included in the drawings, symbols or devices.

### 12.2 RIS

**(RIS = abbreviation for the German equivalent of RUPLAN Internal Interface)**
By means of this interface drawings, symbols, devices, and AWT command sequences can be saved to a file and can be read from a file. The RIS format has a fixed definition within RUPLAN. The RUPLAN Internal Interface is used to exchange data between RUPLAN users of different hardware and operating systems.

### 12.3 External database interface

RUPLAN offers the possibility of the online access to an external database. Thus, access to a material database, an archive system or any other foreign data stock is possible.

For this purpose the name of a collective AWT can be entered in any random text field in the drawing. This collective AWT contains a sub-program which performs the actual database access. This sub-program has to be written to suit the specific requirements of the user.

By means of the AWT programs, the necessary drawing data are rendered available in a buffer. After the database has been accessed, the transmitted data are entered at the requested positions in the drawing by means of the AWT program.

### 12.4 VNS

**(VNS = abbreviation for the German equivalent of Process Neutral Interface, DIN V 40950)**
The Process Neutral Interface, by means of which drawing sets can be exchanged between different CAD/CAE systems used in electrical engineering, is available as an additional feature in stage 2.

### 12.5 DXF

Interface to exchange graphical data in AutoCAD format.

### 12.6 IGES

The internationally standardised IGES interface, by means of which graphical data can be exchanged between different CAD/CAE systems, has been partially realised for level 4.0 and can be obtained as an additional feature.

### 12.7 RBS

**(RBS = abbreviation for the German equivalent of RUPLAN Instruction Interface)**
The RBS interface creates the possibility of calling off RUPLAN performances from other DP systems. For example, the RBS interface can be used to display or process RUPLAN drawings stored in a database application. Another application is the performance of RUPLAN routines without the activation of the RUPLAN interface, such as text entry to text fields with information from an external database.

# 13. Additional modules

### 13.1 RUPLAN/View

The RUPLAN viewer accesses the original RUPLAN data, but permits a mere informative action. The user can have a look at all drawings, but he cannot carry out any logical modifications. A red-lining function is available, however. This function can be used to mark elements of free graphics (lines, circles, texts) in a certain colour in the drawings in order to be able to carry out the modifications later.

The red-lining entries are evaluated by RUPLAN /S, which offers to the authorised RUPLAN user the marked sheets for processing.

### 13.2 RUPLAN/SSL

**(Switch cabinet layout)**
Supplementing the set-up of a circuit diagram with online device references, a module is available for switch cabinet layout.

In the device definition a symbol is used to determine how the device is to be shown in the switch cabinet. If no symbols are available, a square will be generated automatically corresponding to the dimensions.

When the switch cabinet module is run, the items that belong to the location to be processed are retrieved from the online database, and are then offered in a mask. If items have been selected, the symbols defined in the device are placed next to each other automatically in the switch cabinet symbol, whereby the user may select whether the placing is carried out in X or in Y direction. System checks prevent symbols being placed on top of each other. When placed symbols are deleted, the resultant gaps are filled automatically. By means of the online administration, a multiple placing of installation symbols is prevented.

The switch cabinet symbol as well as the installation symbols adjust to the dimensions, i.e. the scale entered on a sheet is taken into consideration during the placing operation.

### 13.3 RUPLAN/EVU

**(EVU = abbreviation for the German equivalent of power supply company)**
By means of the EVU module, which is an extension of the RUPLAN standard by several components, a standardised branch-related solution was created for the field of power supply.

In co-operation with some large power supply companies and AEG T & D the module has been consistently further developed.

The following features are rendered:

- a standardised operation in document generation
- the joint use of data stock
- the non-paper data exchange between manufacturer and operator
- the automatic production of drawings

The following component are contained in the EVU module:

- A symbol database with approx. 1,000 symbols which are based on the standard graphical symbols and meet the requirements of German standard DIN 40 900, part 1,

which comprises:
- graphical symbols
- forms
- symbols for card rack engineering
- symbols for item design
- construction symbols for cabinets and views
- special symbols
- a device database with
- device descriptions (independent of the manufacturer)
- connectors
- electrical engineering features
- special RUPLAN AWTs for the evaluations
- table of contents
- terminal diagram
- automatic system to transfer terminal information from the terminal diagram to the circuit diagrams
- cross-reference diagram
- cable list
- connection diagram
- plant resource schedule
- guidelines to set-up wiring manuals in power supply companies

## 13.4 RUPLAN/PLC

**(programmable logic controller)**
The data created within the framework of plant projecting in RUPLAN and in PLC system (e.g. I/O allocation or symbols) can be transferred by the PLC module of RUPLAN to the programming unit and vice versa. The data can also be checked or updated. The allocation lists are used to generate circuit diagram automatically. Checks are run to safeguard that the I/O texts in the circuit diagram correspond to the data of the allocation list.

By selecting a neutral interface, the module is largely independent of the choice of PLC system.

## 13.5 RUPLAN/Hybrid

Scanned drawings can be displayed and modified to a certain extent in RUPLAN. All images stored in TIFF can be processed. The normal RUPLAN processing means can be employed parallel to the grid representation.

## 13.6 RUPLAN/DBS

**(Database server)**
The database server permits the operation of different computer systems with RUPLAN in one joint computer network. The database service ensures the conversion of the various computer data formats.

At the same time, RUPLAN/DBS permits the RUPLAN communication across several „RUPLAN worlds“ enabling an improved project structure.

### 13.7 RUPLAN/DBC (Database converter)

The database converter permits a simple conversion of complete RUPLAN projects between different computer system for the exchange of data between supplier and operator, for example, or the shift to another computer platform.

### 13.8 RUPLAN/CD

The easy data access to electronic documents of a plant is very useful for various corporate sectors of a company or for the final plant user in times of CD-ROMs as mass data carriers.

Without having any RUPLAN know-how, certain drawing attributes or item names can be searched. The selected drawings can then be displayed with a grid viewer, and can be printed, of course. TIFF was selected as an easy and widely used grid format.

To meet these requirements, the RUPLAN/TIFF-CD, i.e. the module for the generation of RUPLAN information CD-ROMs, was developed. It is an extremely user-friendly, easy means to produce data CD-ROMs and to make the drawings available on the target system. The programs, such as a selection program, a grid viewer, and a set-up program, required at the information workplace are provided on the CD-ROM.

By means of the software components supplied, sheets can be selected from RUPLAN projects, which are converted into TIFF, and which are copied on to the CD-ROM along with a set-up program, a selection program, and a viewer. The set-up program is used to install the components required for searching on the target system. Certain drawings can be searched by the help of frame texts or item names on the target system under Windows 3.1, 95 or NT. These drawings can be displayed by the TIFF viewer or can be plotted.

All necessary activities can be activated by icon in the Windows system, thus requiring no specific knowledge.

## 14. Extensions

In addition to the standard evaluations described, user-specific requirements can be implemented.

Information from the drawings on down-stream user programs can be stored to a file in the requested format by means of the AWT interface. In addition, AUCOTEC in co-operation with the user is most willing to put into practice such requirements that cannot be solved with the means provided by the RUPLAN standard software.

By signing a software maintenance contract, the customer obtains the right to the delivery of the latest RUPLAN version and he can use our hotline.

# 15. Hardware

RUPLAN has been designed and developed consistently as a multi-user system independent of hardware and operating system, thus ensuring that the data created by RUPLAN yesterday and today can still be used on future computer platforms.

## 15.1 Multi-user systems

RUPLAN runs under Windows NT as well as on various workstations. Depending on the performance of the networks RUPLAN also supports distributed workstations as multi-user systems.

A list of computers and workstations supported by RUPLAN can be obtained on request.

## 15.2 RUPLAN PC or workstation

The minimum equipment of a RUPLAN workstation comprises:

- 32 MB RAM
- 1 GB hard-disc unit
- DAT drive (tape streamer)
- 19" colour graphics screen
- alpha screen (optional)
- CD-ROM drive
- Graphics mouse
- Laser printer
- Operating system and RUPLAN software

However, we recommend as follows:

- 64 MB RAM
- 4 GB hard-disc unit
- 21" colour graphics screen
- Graphics board with 4MB memory

# 16. Services

### 16.1 Consultations

Hardware, software, network, operating systems, integration and interfaces.

### 16.2 Training

Training held in Frankfurt am Main, Germany, or on site: all RUPLAN functions and modules. Please refer to the respective RUPLAN training programme for seminars, times, and prices.

### 16.3 Installation

- RUPLAN in a network
- Connection of peripheral equipment
- Distributed data management


AUCOTEC