



AUCOTEC
Create Synergy – Connect Processes

Engineering Base

Cabinet-Routing

Requirements

March 2018

AUCOTEC AG

Oldenburger Allee 24
D-30659 Hannover
Phone: +49 (0)511 61 03-0
Fax: +49 (0)511 61 40 74

www.aucotec.com

AUCOTEC, INC.

17177 North Laurel Park Drive,
Suite 437
Livonia, MI 48152
Phone: +1 630 485 5600
Fax: +1 248 655 7800

Copyright: All rights, especially the right of reproduction and distribution as well as translation, are reserved. No part of this book may be reproduced, stored in retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording, or otherwise, without prior permission from **AUCOTEC AG**.

Exclusion of liability: Texts and software have been prepared with the greatest of care. The publishers as well as the authors cannot assume any legal or other liability of any nature for potential faulty statements and their consequences, which shall apply also for the software potentially included.

Trademarks Engineering Base® is a registered trade mark of the AUCOTEC AG, Germany. Microsoft Office Visio®, Microsoft SQL Server and Windows® are registered trademarks of Microsoft Corporation, USA.

Content

1	Introduction	1
1.1	Features	1
2	Requirements	3
2.1	Circuit Diagram	3
2.2	Project Structure	3
2.3	Layout diagram	4
2.3.1	Mounting Plate	5
2.3.2	Cable Duct	5
2.3.3	Channel Structure	6
2.3.4	Mounting Rail	6
2.4	Device Structure	7
2.5	Connection Structure	8
2.5.1	Definition of the Values for the Wiring Direction (AID 10222) in the Assistant Select Value	10
2.5.2	Definition of the Values for the Reference Point (AID 27868) in the Assistant Select Value	10
2.6	Transition between Mounting Plates	11
3	Messages	13
4	Cabinet Routing Attributes	14

1 Introduction

This document contains additional information about the assistant **Cabinet Routing**.

Certain preconditions in the Engineering Base project must be fulfilled to get an errorless routing when using the assistant **Cabinet Routing**.

After the successful execution of the Cabinet Routing the worksheet "Routing Information" is displayed which contains information about the routed wires, warnings and information.

If errors occurred, the length and paths are not calculated and the displayed worksheet only contains a list of errors, warnings and information.

If errors are reported they have to be corrected!

1.1 Features

The assistant **Cabinet Routing** enables the automatic wire routing and the calculation of wire lengths using a specified cable duct system of a switching cabinet layout diagram.

The information needed for routing the wires in the cabinet is taken from the layout diagram (position of devices and cable ducts in the layout), the part information (pin position at the device) and the wiring list (source/target, wire type).

The assistant **Cabinet Routing** calculates the route through specified cable ducts and the coordinates of the placed device pins based on a minimum distance approach for each individual wire the length. During this operation, the framework of cable ducts is checked and problems in creating the layout are reported when indicated. In calculating the wire length, there is an option to add a length supplement on a percentage base (values between 0% and 100% are supported). If no wiring specification has been defined, the program uses a default wiring direction. The default wiring direction can be defined globally.

Routing can be carried out across multiple units (mounting plates). The layouts of each unit can be displayed on one or multiple sheets.

By assigning attributes to cable ducts and wires, restrictions to the signal routing can be specified (signal type). Wires and devices can also be excluded from routing (e.g. wire jumpers).

For a cable duct, you may also specify a maximum filling level at its attribute **Maximum Filling Level in % (Cable Duct)** which will then be taken into account by the assistant **Cabinet Routing**. If the preset value is exceeded during routing, the assistant provides the following indications:

- The tab **Cable Ducts** is marked in red.
- On the tab **Cable Ducts**, all cable ducts exceeding the maximum filling level with the current routing process are marked in red.

You may then abort the routing process and carry out changes to the wiring or the filling level of the cable duct.



In the project properties, you may activate the check box **Find alternative routes if cable duct is full** in the category **Routing**. If the filling level is exceeded during routing, the assistant will use another cable duct which has not yet reached its maximum filling level.

The calculated data (route, length of the wire, etc.) is inserted into the wire's properties and is entered in the layout diagram as line graphs.

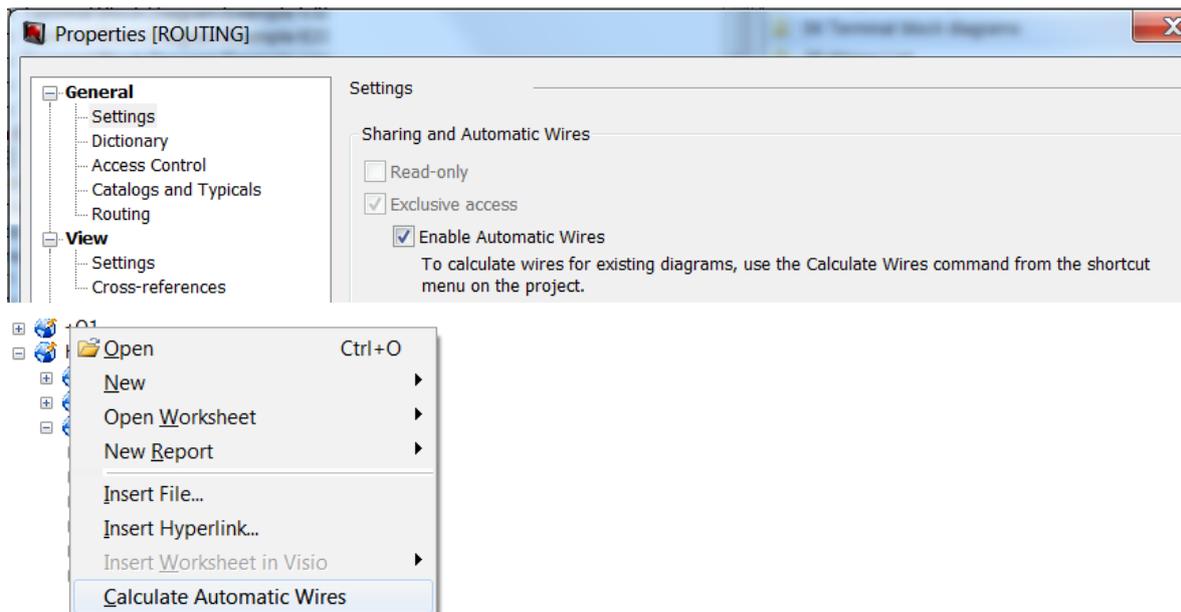
The transfer of information to manufacturing support systems (wire manufacturing, etc.) is guaranteed by using other modules.

2 Requirements

2.1 Circuit Diagram

For routing, a complete circuit diagram with all equipment, terminals and connections between the pins are required.

In the model the connections have to be defined as wires. Before starting the routing, **Enable Automatic Wires** has to be activated in the project's properties or **Calculate Automatic Wires** has to be started at the unit.



Both ends of the wires have to be connected with device pins. You can check this for each wire. In the wire's master data, values have to be assigned to the attributes **Destination 1** and **Destination 2**.

System Attributes	Purchase Order Data	Specifications	Operating Data
Part of			
Designation			
Comment			
Type			Unspecified Wire
Destination 1			HV1 .2 -X222 126
Destination 2			HV1 .2 -X222 127
Associated Function			

2.2 Project Structure

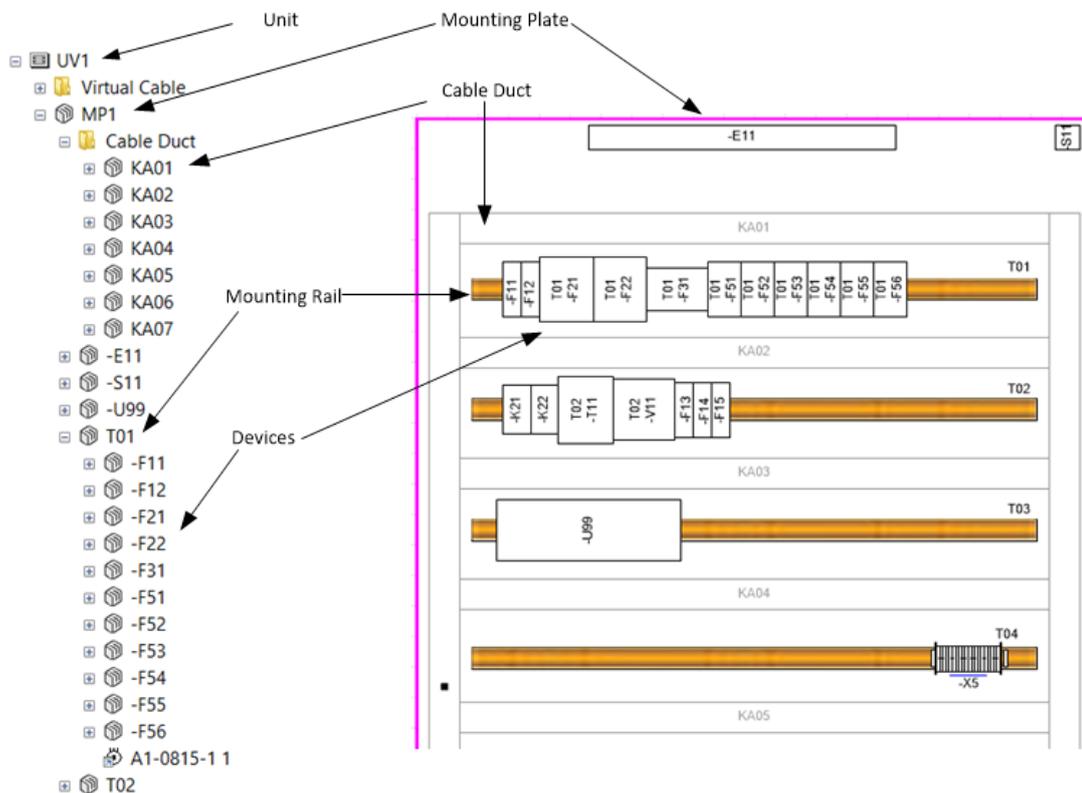
Within the project, all devices and terminals represented in the circuit diagram need to have a specific structure in the tree.

- In the equipment structure the top level has to be an object of the type **Common Unit**. A consistent routing is only feasible within a unit's structure.
- Objects of the type **Mounting Plate** have to be subordinated to the unit. In the model (tree) all devices, terminals and cable ducts that are physically located on the mounting plate, need to be subordinated to the mounting plate. An immediate routing is executed only within a mounting plate. Special transitions have to be defined to enable routing between several mounting plates (see chapter 2.6, [Transition between Mounting Plates](#)).

- In the tree devices and terminals clamped to a mounting rail have to be subordinated to an object of the type **Mounting Rail**.



For an automatic placement of devices and terminals on the mounting rail the module **Mounting rail assignment** can be used.



2.3 Layout diagram

To start routing, a layout diagram is required. The routing is two-dimensional.

The following conditions have to be complied:

- In the layout diagram the shapes have to be placed in frontal view.
- Objects in the layout diagram have to be placed with an angle of 0° or 90° .
- The pin position of all layout symbols must be center-left. This applies to devices, terminals, cable ducts, mounting rails and mounting plates. To control this, the Size & Position window in Visio can be checked.
- The reference point of the layout form has to be bottom left.
- The sheets of the layout diagram have to be associated with the same unit as the devices and terminals displayed in the layout diagram.
- When placing devices and cable ducts, it must be ensured that there are no overlaps.

In the layout diagram a scale can be defined that is taken into account for the layout representation and the length calculation.

2.3.1 Mounting Plate

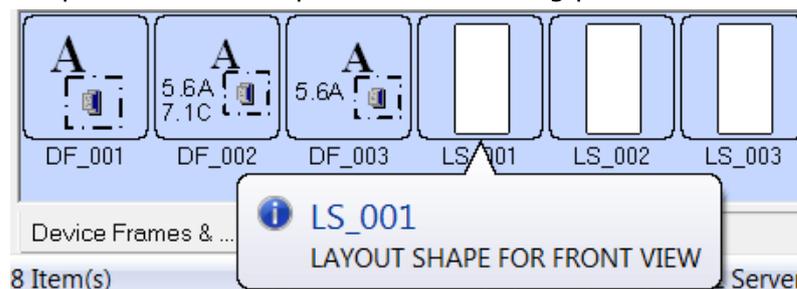
- Mounting plates have to be specified by the type **Mounting Plate**.
- For the graphical representation of mounting plates the standard shape "LS_001" (front view) should be used preferably. It is displayed as a rectangle and automatically resized depending on the default values of **Width**, **Height** and **Depth**.

The attributes of mounting plates have the following meaning:

Width - the width of the mounting plate

Height - the height of the mounting plate

Depth - the depth of the mounting plate.



- In the tab **Specifications** of the object's properties the attributes **Width**, **Height** and **Depth** should always be assigned with correct values.

System Attributes	Purchase Order Data	Specifications	Operating Data	Classification
Width		960,00 mm		
Height		50,00 mm		
Depth		50,00 mm		
Remarks				



The graphical representation of the mounting plate is mandatory. All devices have to be placed within the frame, otherwise the routing is not executed!

2.3.2 Cable Duct

- Cable ducts have to be specified with type **Cable Duct**.
- The shape "LS_001" should be used for the graphical representation of cable ducts (like mounting plates).
- For the calculation of the filling rate, the attributes **Width**, **Height** and **Depth** have to be defined in the tab **Specifications**.
- The attributes of cable ducts have the following meaning:

Width - the length of the cable duct

Height - the width of the cable duct

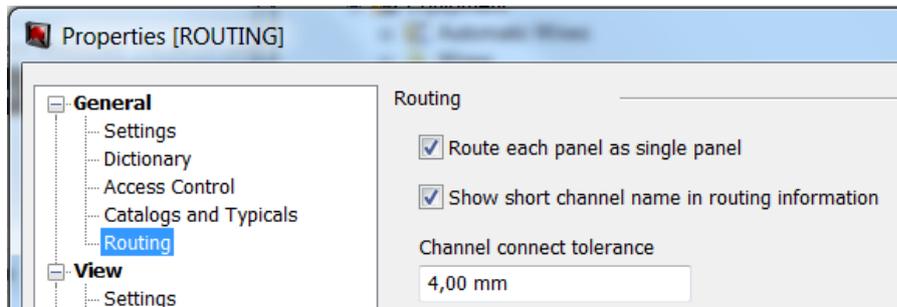
Depth - the depth of the cable duct.

The attributes **Height** and **Depth** are used for the calculation of cable duct's cross-section which is used to calculate the filling rate.

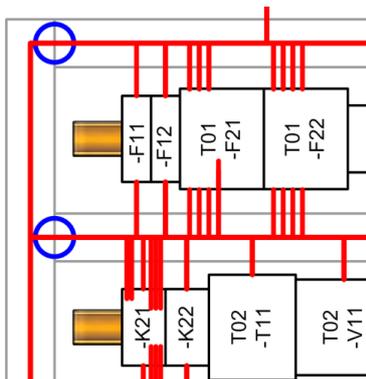
System Attributes	Purchase Order Data	Specifications	Operating Data
Filling rate in %		3,29032%	
Not permitted Signal Types (EMC)			
Position Z (Dimension)			

2.3.3 Channel Structure

To create a closed channel system the cable ducts will be arranged graphically in the way that the transition points abut. A tolerance is permitted. The maximum permitted value (default 4.00 mm) can be defined in the project settings. The drawing scale is used for calculating the maximum distance, i.e. at a scale of 1:10 and 4.00 mm tolerance, the maximum distance is 40 mm.



For monitoring all detected transfer/connection points of the cable ducts are marked with blue circles in the layout diagram.



It is impossible to route single cable ducts, a channel framework is required.

2.3.4 Mounting Rail

- Mounting rails have to be defined with type **Mounting Rail**.
- The shape "LS_001" should be used for the graphical representation of mounting rails (like mounting plates).
- The attributes of mounting rails have the following meaning:
 - Width - the width of the mounting rail
 - Height - the length of the mounting rail
 - Depth - the height of the mounting rail.
 These values are not relevant for routing.

2.4 Device Structure

- The devices have to be specified according to the device type.
- The shape "LS_001" should be used for the graphical representation of devices (like mounting plates). A specially designed shape for the device type can be used alternatively.
- In the device properties the dimensions must be filled with meaningful values so that the devices are shown to scale in the layout diagram. These values are normally stored in the device master data. In case of deviations the values can be entered manually. Each device has the attributes **Width/Height/Depth**.
- The attributes of devices have the following meaning:

Width - the width of device

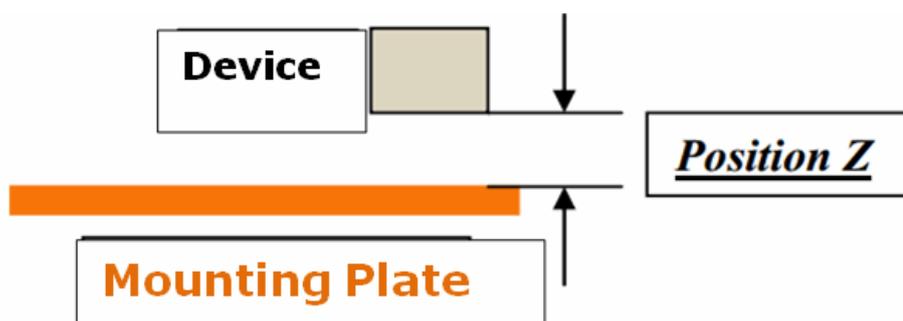
Height - the height of the device

Depth - the depth of the device.

System Attributes	Purchase Order Data	Specifications	Operating Data	Classification
Rated Voltage				
Rated Current				
Power				
Protection Classification (IP)				
Mounting Form				
Width		30,00 mm		
Height		90,00 mm		
Depth		50,00 mm		
Weight				

- The attribute **Position Z (Dimension)** contains the distance of the base of the device to the base of the mounting plate.

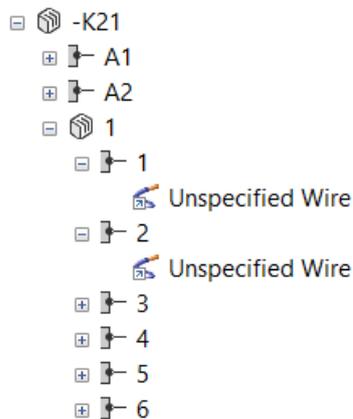
System Attributes	Purchase Order Data	Specifications	Operating Data	Classification	Pins
Position					
Position Z (Dimension)		20,00 mm			
Interface Relevant		<input type="checkbox"/>			
Voltage Level					



- If a specially designed shape is used, it has to be drawn and stored in the scale of 1:1. When the shape is inserted, it is scaled accordingly. When storing the shape, make sure that the symbol is stored with Shape Type **Layout Diagram**.

System Attributes	
Master Name	3RT10 15-1BB41
Comment	
Version	
Shape Type	Layout Diagram

- It is possible to use complex devices in the layout. For example a contactor with auxiliary equipment. If these additional components are not displayed graphically in the layout, nevertheless the connections of this additional component are taken into account when routing.



The coordinates of the pins refer to the position and orientation of the graphical representation of the main device.

2.5 Connection Structure

To define the position of the pin relative to the device, you have to specify the following properties:

System Attributes	Specifications	Operating Data
Number of Wires (max.)		
Coordinates		
Wiring Direction	South	
Reference Point	Bottom/Left	
Position X (Dimension)	30,00 mm	
Position Y (Dimension)	20,00 mm	
Position Z (Dimension)	0,00 mm	
Rated Current		
Required connector terminal finish		
Potential class		
Permitted Lug		

-- System Dialog --

- Position X (Dimension)**
is the distance in direction X from the pin to the reference axis Center-Left.
- Position Y (Dimension)**
If you enter data here, then the way the Y position is determined depends on the existence and filling of the attribute Reference Point.
 - Reference Point** exists and has been filled: the Y position will be determined starting from the Top/Left or Bottom/Left edge of the shape.
 - Reference Point** not existing or not filled: the Y position will be determined as follows:
 - With wiring direction north: starting from the upper edge of the shape.
 - With wiring direction south: starting from the lower edge of the shape.

- **Position Z (Dimension)**

is the distance in direction Z from the pin to the base of the device.

- **Wiring Direction**

The wiring direction determines from what direction a wire has to be connected with a pin.

Wiring Direction	
North	Wire feed from above, with default representation of the device. If the device is rotated by 90°, the wire is supplied from the left (West).
South	Wire feed from below, with default representation of the device. If the device is rotated by 90°, the wire is supplied from the right (East).
West	Wire feed from left, with default representation of the device. The attribute Reference Point has to be filled to allow for a correct determination of the wire length.
East	Wire feed from right, with default representation of the device. The attribute Reference Point has to be filled to allow for a correct determination of the wire length.

If the wire direction is changed, then the attribute **Reference Point** should be filled under all circumstances, to guarantee a correct determination of the length.



Input is expected in the form of system dictionary texts. If the texts have been entered by hand, then the routing assistant will not recognize them. Use the assistant **Select Value**, to predefine the values.

- **Reference Point**

Defines the reference point for the wiring.

Possible input is **Top/Left** and **Bottom/Left**.

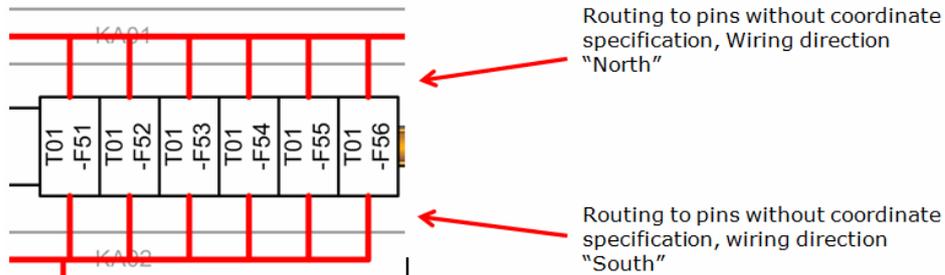
If the attribute **Reference Point** is used, then the wiring direction may be changed without altering the geographical position of the pin in the model



Input is expected in the form of system dictionary texts. If the texts have been entered by hand, then the routing assistant will not recognize them. Use the assistant **Select Value**, to predefine the values.

The attribute **Reference Point** of the pins may be altered in the catalog using a worksheet of all pins. For that purpose, select all pins with wiring direction **North** and assign to all pins in column **Reference Point** the value **Top/Left** (Drag-Down). Proceed alike with the pins with wiring direction **South** by assigning to the column **Reference Point** the value **Bottom/Left**.

- If no values are added to the coordinates of the pin, the middle of the device symbol, at the outer contour, is used as default pin position. The specified wire direction is considered.



If no wire direction is specified at the pin, the predefined rules in the project properties are used.

2.5.1 Definition of the Values for the Wiring Direction (AID 10222) in the Assistant Select Value

- Start the assistant **Select Value**.
- Create with **Add** a new line, if the attribute **Wiring Direction** is not listed in the table. With **Edit** you display the dialog **Attribute Selection**. Enter **10222** into the field **AID**.
- Assign the four values listed below (North, South, East, West).

Select Values Configuration

Select Values Configuration

Attributes			Values	
Attribute	Category	Type	Text	Comment
All	All	All	<10:10433>	North
Processing Locatio	*	*	<10:10434>	South
Processing Mode	*	*	<10:10435>	West
Protection Classific	*	*	<10:10436>	East
Wiring Direction	*	*		
Accessory directio	*	*		
Reference Point	*	*		

2.5.2 Definition of the Values for the Reference Point (AID 27868) in the Assistant Select Value

- Start the assistant **Select Value**.
- Create with **Add** a new line, if the attribute **Reference Point** is not listed in the table. With **Edit** you display the dialog **Attribute Selection**. Enter **27868** into the field **AID**.

Assign the two values listed below (Top/Left, Bottom/Left).

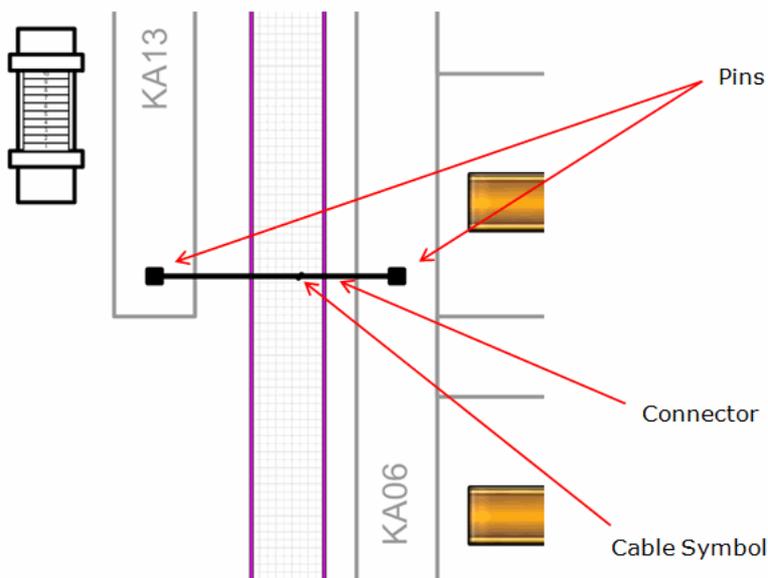
Select Values Configuration

Select Values Configuration

Attributes			Values	
Attribute	Category	Type	Text	Comment
All	All	All	<10:10503>	Top/Left
Processing Locatio	*	*	<10:10504>	Bottom/Left
Processing Mode	*	*		
Protection Classific	*	*		
Wiring Direction	*	*		
Accessory directio	*	*		
Reference Point	*	*		

2.6 Transition between Mounting Plates

To perform a routing between multiple mounting plates, a transition must be generated. The transition can only be made between cable duct segments of the mounting plates to be connected. The transition consists of one pin at each cable duct segment and a "virtual cable".



Follow these steps:

1. In the tree select the cable duct to get a connection on the first mounting plate. Add a pin to the cable duct.

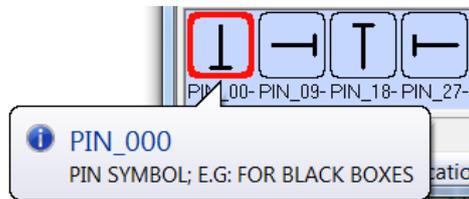
KA06

Device

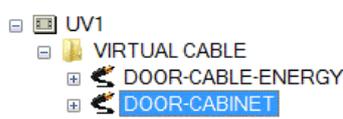
System Attributes	
Part of	UV1 MP1 KA06
Pin Designation	Device
Comment	
Type	Single Line:Block Diagram
Pin Position	1
Associated Potential/Substance	
Pluggable	<input type="checkbox"/>

The type has to be "Single-Line: Block Diagram".

2. Insert the pin at the position in the layout, where the connection should be created. It is possible to use the standard symbols or to create your own symbols.



3. Using the same principle, add a pin to the cable duct on the second mounting plate where the connection should end.
4. Insert this pin graphically in the layout diagram.
5. Add a virtual cable below the unit which includes the two mounting plates to be connected (e.g. DOOR-CABINET).

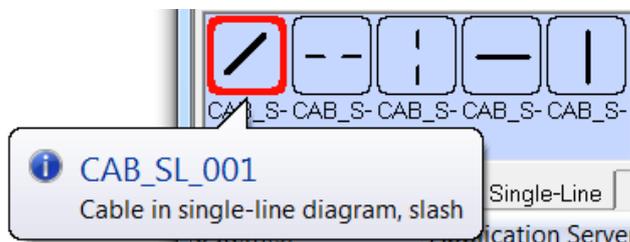


6. In the layout connect the two pins with a connector.



If the two mounting plates are displayed on different sheets, then one connector has to be placed on each sheet at the pin attached with a cable symbol (double graphical representation).

7. Add the single-line cable symbol to the connector.



If the connector is properly connected to the pins and the cable symbol is placed correctly on the connector, the connection is automatically detected. This may be controlled by editing the cable symbol. The destinations have to be entered correctly.

System Attributes	Purchase Order Data	Specifications	Operating Data	Classification
Part of	UV1			
Designation				
Comment	DOOR-CABINET			
Additional Comment				
Device Char				
Type	Multi-core Cable			
Associated Function				
Destination 1	UV1 MP2 KA13 Door			
Destination 2	UV1 MP1 KA06 Device			
Lock Structure	<input type="checkbox"/>			

A value for the length can be defined for the "virtual cable". If a wire is routed through this connection, this value is added to the total length of the wire.

3 Messages

Message	Meaning
Error	Cable duct dimension invalid. Cannot calculate the filling rate!
Error	Errors were detected while calculating data. Check all errors and start the routing again.
Error	Failed to read the attribute with id =
Error	Invalid cable duct information. Is the cable duct `...` already represented?
Error	Missing a connection point to connect the cable ducts!
Error	No cable ducts for export found.
Error	No devices for export found.
Error	The mounting angle for the device is not permitted. Use only 0° and 90°!
Error	The object `...` has multiple representations on different layout sheets!
Error	The object `!..` is not aggregated to a mounting rail!
Information	Routing of wire failed from ,object `1` to `object 2`.
Information	The wire `...` was routed over the mounting place boundary!
Information	Wire was ruled out from routing! Wire not routed from `object 1` to `object 2`.
Warnings	Empty pin `x` position found. Default pin position was used!
Warnings	Empty pin `y` position found. Default pin position was used!
Warnings	Empty pin `z` position found. Default pin position was used!
Warnings	Empty pin wire direction found. Default wire direction was used!
Warnings	He cable duct exceeds the valid filling rate!
Warnings	Invalid EMC Class.
Warnings	Item was excluded from routing!
Warnings	Missing object height to calculate routing.
Warnings	Missing object width to calculate routing.
Warnings	The attribute 'FastWireType' is obsolete. Please remove it from `...`.
Warnings	The default cable length to connect cable ducts was used!
Warnings	The layout diagram contains a not 'none electrical symbol'!
Warnings	Unknown pin wire direction found. Default wire direction was used
Warnings	Wire color not specified. The default wire color was used.
Warnings	Wire size / gauge not specified. The default wire size / gauge was used.



- If errors are reported they have to be corrected!
- If errors occurred, the length and paths are not calculated!
- If warnings or information messages are reported, the lengths are calculated!

4 Cabinet Routing Attributes

The assistant **Cabinet Routing** uses attributes for wiring, which contain information about devices, wires and cable channels.

The following attributes are accessed.

Object	Attribute and AID	Description and admissible values
Pin	Position X AID = 490	Optional: The positions X, Y, Z will be calculated, if there are no entries for the attributes. In the project properties/wiring the following values are predefined. Alphanumerical Pins will be connected at top center direction 'North'. Numerical pins with even numbers will be connected at top center direction 'North'. Numerical pins with uneven numbers will be connected at bottom center direction 'South'.
Pin	Position Y AID = 491	Optional: See Position X. If you make an input here, then the way the Y position will be determined depends if the attribute Reference Point exists and has been filled. Reference Point existing and filled: the Y position will be determined starting from the edge of the shape Top/Left or Bottom/Left Reference Point does not exist or has not been filled: the Y position will be determined in the following way: <ul style="list-style-type: none"> • With wiring direction North: starting from the upper edge of the shape. • With wiring direction South: starting from the lower edge of the shape
Pin	Position Z AID = 492	Optional: See Position X
Pin	Wiring Direction AID = 10222	Optional: The pin's wiring direction, North = at top, South = at the bottom. If no entry exists, then the values from Project properties/Routing will be used. Please use the system dictionary for entries, otherwise the entries are not accepted from the Routing assistant.
Pin	Reference Point AID = 27868	Optional: Enter the reference point for wiring. Possible input is Top/Left and Bottom/Left. If the attribute is being used, then the wiring direction may be changed without altering the geographical position of the pin in the model. The input is expected in the form of system dictionary texts, otherwise the Routing assistant will not recognize them.
Wire	Routing Information AID = 394	Contains the calculated cable duct designations, separated by commas.

Wire	Coordinates AID = 394	Contains the routed wire coordinates, separated by commas.
Wire	Length AID = 10193	The calculated length of the wire.
Wire	Signal Type (EMC) AID = 10129	Optional: Signal Type of the wire. Wires can be excluded for specified cable ducts. See also attribute 'Not permitted Signal Types (EMC)' at a cable duct.
Wire	Wiringdirection 1 AID = 10901	Possible range: Upward, Downward, Left, Right and combinations: Upward, right; Upward, left; Downward, right; Downward, left.
Wire	Wiringdirection 2 AID = 10902	Possible range: Upward, Downward, Left, Right and combinations: Upward, right; Upward, left; Downward, right; Downward, left
Wire / Object	Exclude from routing AID = 10652	Using this check-box wires or items can be excluded from routing.
Device	Position Z AID = 492	Distance of the device to the mounting plate.
Device	Width AID = 245	Width of the device.
Device	Height AID = 246	Height of the device.
Device	Depth AID = 247	Depth of the device.
Cable Duct	Filling rate in % AID = 10653	Contains the filling rate in % of the cable duct calculated with the diameter of the routed wires.
Cable Duct	Not permitted Signal Types (EMC) AID = 262	Optional: Wires of specific signal types can be excluded from the routing through cable ducts.