



**Capital<sup>®</sup>**

**Capital Harness XC<sup>™</sup>  
v2012.1**

Lab Workbook

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Part Number: 072634

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# Chapter 2 Library Creation

## Exercise Worksheet

**Exercise 2:** Users will now create component part numbers in the Library tool

Please replace all instances of XY with your initials

- **Wire Record**

**Part Number:** XY-SW-51003

**Group Name:** Wire

**Status:** Current

**Description:** Wire

**Unit Of Measure:** Length

**Type Code:** WIRE

**Material Code:** TWC

**Include on BOM?** Yes

**Wire Color:** Black

**Specification:** 16/.2

**Outer diameter:** defined: 2.3

**Weight:** 0.001

**Supplier Details:**

**Supplier Part Number:** XY-NC-1233

**Supplier:** Nortec Cable

**Cavity Components Records**

- **Terminal**

**Part Number:** XY-T-2006

**Group Name:** Terminal

**Status:** Current

**Description:** Terminal

**Unit Of Measure:** Each

**Type:** TERM

**Strip:** 5

**Color:** -

**Multi-Strip:** 8

**Material:** TP

**Include on BOM?** Yes

**Supplier Details:**

**Supplier Part Number:** XY-SUPP1

**Supplier:** Gerrard Brothers

**Single Wire Terminations:**

**Wire Material:** TWC

Select Range Specification

**Min. C.S.A:** 0.5

**Max C.S.A:** 2.5

**NOTE: Single Wire Terminations** can be set equally against the wires specification or against a range of C.S.A.

- **Cavity Plug**

**Part Number:** XY-CP-4875

**Group Name:** Cavity Plug

**Status:** Current

**Description:** Cavity Plug

**Unit Of Measure:** Each

**Type:** PLUG

**Color:** W

**Material:** PVC

**Include on BOM?**Yes

**Supplier Details:**

**Supplier Part Number:** XY-0980

**Supplier:** A.A.G Group

- **Cavity Seal**

**Part Number:** XY-CS-7564

**Group Name:** Cavity Seal

**Status:** Current

**Description:** Cavity Seal

**Unit Of Measure:** Each

**Type:** CVSL

**Color:** Y

**Material:** PVC

**Include on BOM?**Yes

**Supplier Details:**

**Supplier Part Number:** XY-3746

**Supplier:** Gerrard Brothers

**Single Wire Terminations:**

**Wire Material:** TWC

Select Range specification

**Min. C.S.A:** 0.35

**Max C.S.A:** 2.5

**NOTE: Single Wire Terminations** can be set equally against the wires specification or against a range of C.S.A.

- **Connector Record**

**Part Number:** XY-C-33847

**Group Name:** Connector

**Status:** Current

**Description:** Connector

**Unit Of Measure:** Each

**Type:** CONN

**Color:** B

**Material:** PVC

**Add On:** 4

**Knock Off:** 5

**Include on BOM?** Yes

**No of Cavities:** 5

**Customer Details:**

**Customer Part Number:** XY-EM279

**Customer:** European Motors

**Supplier Details:**

**Supplier Part Number:** XY-2120

**Supplier:** A.A.G Group

**Housing Definitions:**

**Cavity Components:** XY-T-2006  
XY-CP-4875  
XY-CS-7564

**Additional Component:** AB-4581

**NOTE:** Cavity components and Additional components are to be added in the **Housing Definition** of the connectors with the following attributes:

- ⇒ Cavity components: **Optional**
- ⇒ Additional components: **Mandatory** (quantity=1)

- **Splice Record**

**Part Number:** XY-SP-45220

**Group Name:** Splice

**Status:** Current

**Description:** Splice

**Unit Of Measure:** Each

**Type:** SPL

**Strip:** 15

**Color:** -

**Material:** BRSS

**Include on BOM?** Yes

**Weight:** 5

**Supplier Details:**

**Supplier Part Number:** XY-SG-4384

**Supplier:** Seddon Group

**Splice Attributes:**

**Min. Total C.S.A:** 1

**Max. Total C.S.A:** 3

**Min. single Wire C.S.A:** 0.25

**Max. single Wire C.S.A:** 1

**Min Number of Wires:** 2

**Max Number of Wires:** 10

**Max no. Wires per side:** 5

**Selectable:** Yes

- **Tape Record**

**Part Number:** XY-TA-57743

**Group Name:** Tape

**Status:** Current

**Description:** Tape

**Unit Of Measure:** Roll/Reel

**Type:** TAPE

**Color:** B

**Material:** PVC

**Include on BOM?** Yes

**Weight:** 100

**Supplier Details:**

**Supplier Part Number:** XY-GB-2483

**Supplier:** Gerrard Brothers

**Tape Attributes:**

**Wall Thickness:** 0.2

**Tape Width:** 25

- **Tube Record**

**Part Number:** XY-TU-45393

**Group Name:** Tube

**Status:** Current

**Description:** Tube

**Unit Of Measure:** Length

**Type:** TUBE

**Color:** B

**Material:** PVC

**Include on BOM?** Yes

**Weight:** 0.002

**Supplier Details:**

**Supplier Part Number:** XY-GB-2341

**Supplier:** Gerrard Brothers

**Tube Attributes:**

**Bore (tube width):** 25

**Wall Thickness:** 0.5

**Slit Tube?** Yes

**Conv. Tube?** Yes

- **Multicore Wire Record**

**Part Number:** XY-MW-74332

**Group Name:** Multicore Wire

**Status:** Current

**Description:** Multicore Wire

**Unit Of Measure:** Length

**Type:** MWIR

**Color:** -

**Material:** PVC

**Include on BOM?** Yes

**Weight:** 0.008

**Supplier Details:**

**Supplier Part Number:** XY-NC-1889

**Supplier:** Nortec Cable

**Multicore Wire Attributes:**

**Sheathed:** Yes

**O/S Color:** B/R

**O/S Spec:** Class-1

**Outside Diameter:** 4.05

**Inner Core Details:**

⇒ **Color:** B/O; **Material:** TWC; **Spec:** 32/.2

⇒ **Color:** O; **Material:** TWC; **Spec:** 16/.2

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## Chapter 3 Introduction to Capital Project

### Exercise Worksheet

**Exercise 1:** Capital Project-Users will create a project and define release levels

- Create the project 'XY-Capital-Harness, where 'XY' are your initials.
- Assign the following release levels for the newly created project as follows:

Name	Release Level
Draft	Draft
Outdated	Obsolete
Released	Released
Review	Pending

You may add them manually if they do not already exist or add them from the System values already assigned using the ellipse or drag and drop functionality.

- Assign the following Transition to the release level:

Release Level	Transitions
Draft	Outdated, Released, Review

**Exercise 2:** Users will define object properties and naming conventions

This is done in the Object Type Information section under the Properties Tab

- Define the object properties according to Table 1 – Object Properties.  
Each property must be entered separately.

Object Type	Object Properties
Connector	Function
Wire	Signal

**Table 1 – Object Properties**

Predefine object names:

This is done in the Object Type information menu – Replace XY with your initials

Object Type	Name
Wire	XY-test
Connector	XY-test

If time Allows:

### Exercise 2a:

- Your trainer will walk you through how to view the object names and properties you have just created

### Trainers:

- Create a new harness diagram
- Enter a wire onto the diagram and explain how the default name is created (view properties)
- Add a connector to the drawing
- Explain how the default names have been created
- Now explain how users can change the default names by selecting the ellipses button next to the name field (under properties) and select the xy-test created previously

## Chapter 4 Harness Creation

### Exercise Worksheet

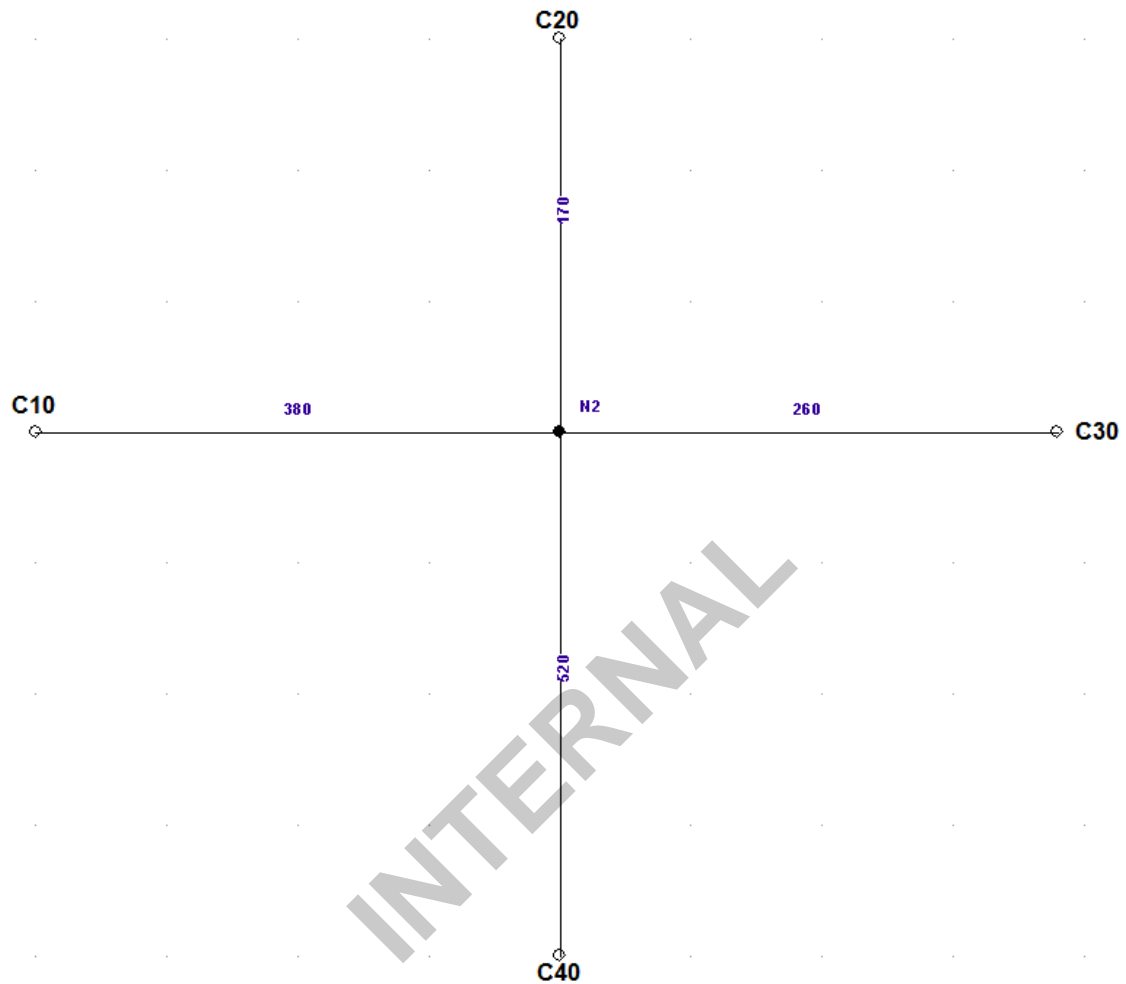
**Exercise 1:** Adding Harness designs to the project (XY-Capital-Harness)

- Open your project in Capital Project and Right mouse click on the Design folder at the bottom of the list and choose New Harness Design.
- **Name:** P016  
**Part Number:** XY-P016-J01 where XY are your initials  
**Revision:** A  
**Short Description:** Simple  
**Description:** Simple harness for trainees  
**Release Level:** Draft  
Seal Harness
- Open Harness XC and create a new diagram for the Design P016 – name the diagram XY-P016 where XY are your initials.

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### Exercise 2: Creating a branch layout

- Using a method of your choice, add the bundles to create the branch layout shown below, node names are not important.

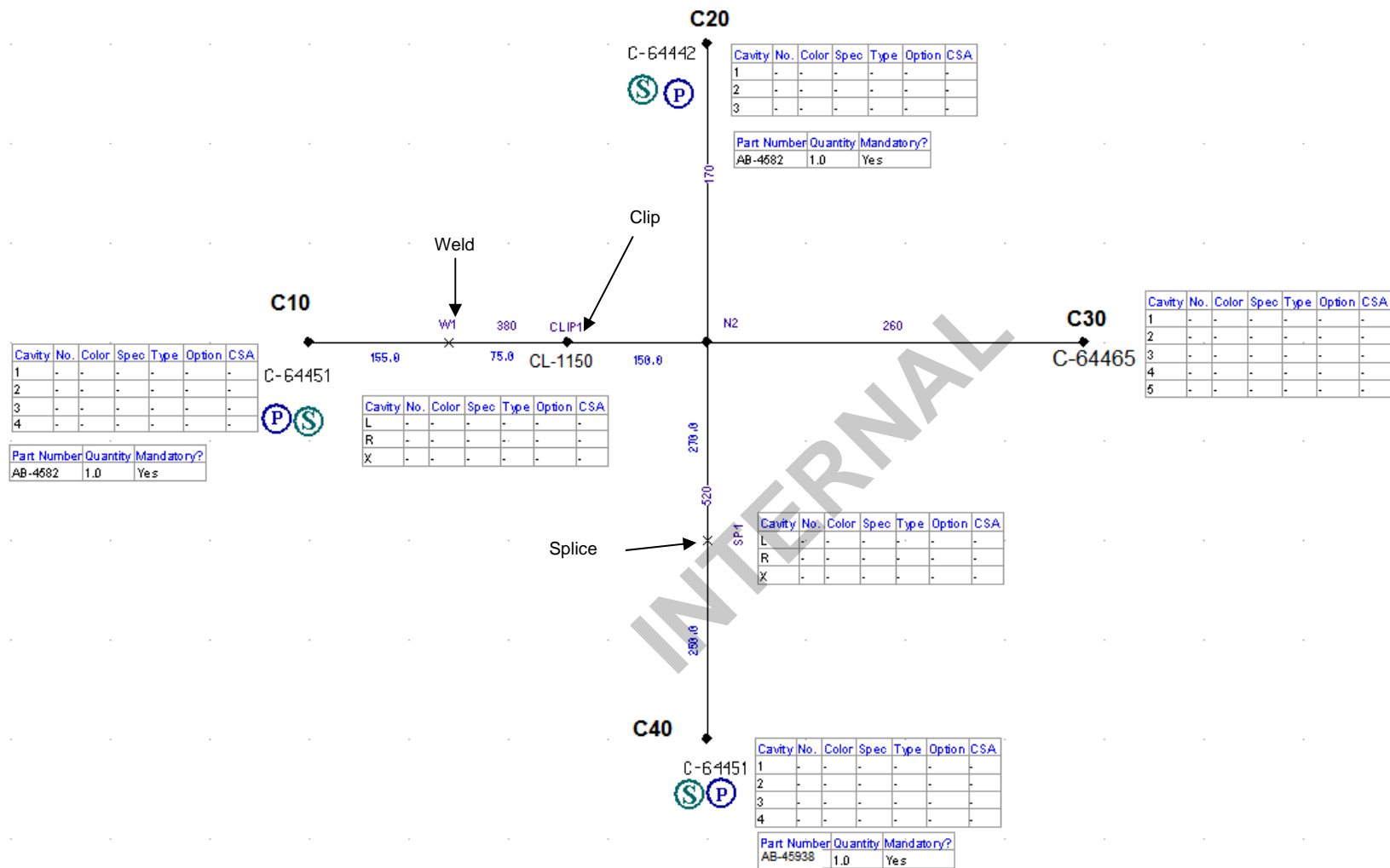


### Exercise 3: Adding components

- Add the components as shown overleaf
  - ⇒ All part numbers are internal
  - ⇒ Remember splice and welds do not require a part number – ensure you choose the correct splice type
  - ⇒ Name connectors and splices as shown
  - ⇒ Note: Connector C30 does **not** require seals and plugs
  - ⇒ Use the NPU function to add the mid branch components choosing the connectors as anchor nodes

**N.B.** You may need to manipulate the default style set to ensure that the connector cavity wire table has a nominal origin of '**owner**'. This can be done under the 'Related Entities' for the connector.

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#### Exercise 4: Adding wires to the diagram

- Ensure you have added the Splice and Ultrasonic weld;
  - ⇒ SP1 is the splice
  - ⇒ W1 is the weld
- Add the wires as shown, all wires have material TWC.

Wire Name	Color	Spec	CSA	From	Cavity	To	Cavity
Wire 1	B	16/.2	0.5	C10	3	SP1	X
Wire 2	G	16/.2	0.5	C10	1	W1	X
Wire 3	G	12/.2	0.35	SP1	X	C20	1
Wire 4	B	32/.2	1	SP1	X	C40	2
Wire 5	B	16/.2	0.5	C10	4	SP1	X
Wire 6	G	28/.3	2	W1	X	C40	3
Wire 7	R/K	16/.2	0.5	C10	2	C30	1
Wire 8	O/W	16/.2	0.5	C30	4	C40	1
Wire 9	B/O	32/.2	1	C30	3	C20	3
Wire 10	O	16/.2	0.5	C30	4	C20	2
Wire 11	R	16/.2	0.5	C30	5	C40	4

- Add the multicore using the library reference MW-74332.
- Assign wires WIRE9 and WIRE10 to the multicore.

### Exercise 5: Adding insulation to the diagram


- Create the following insulation codes:  
Create the following 4 insulation codes in your XY – Capital Harness project

The Number of turns is always 3.

**The insulation linestyles are only an example of what users could implement, we will not be using these linestyles in the example diagram**

1. No Taping: -----

2. 50% Overlap tape:   
(part number TA-57743)

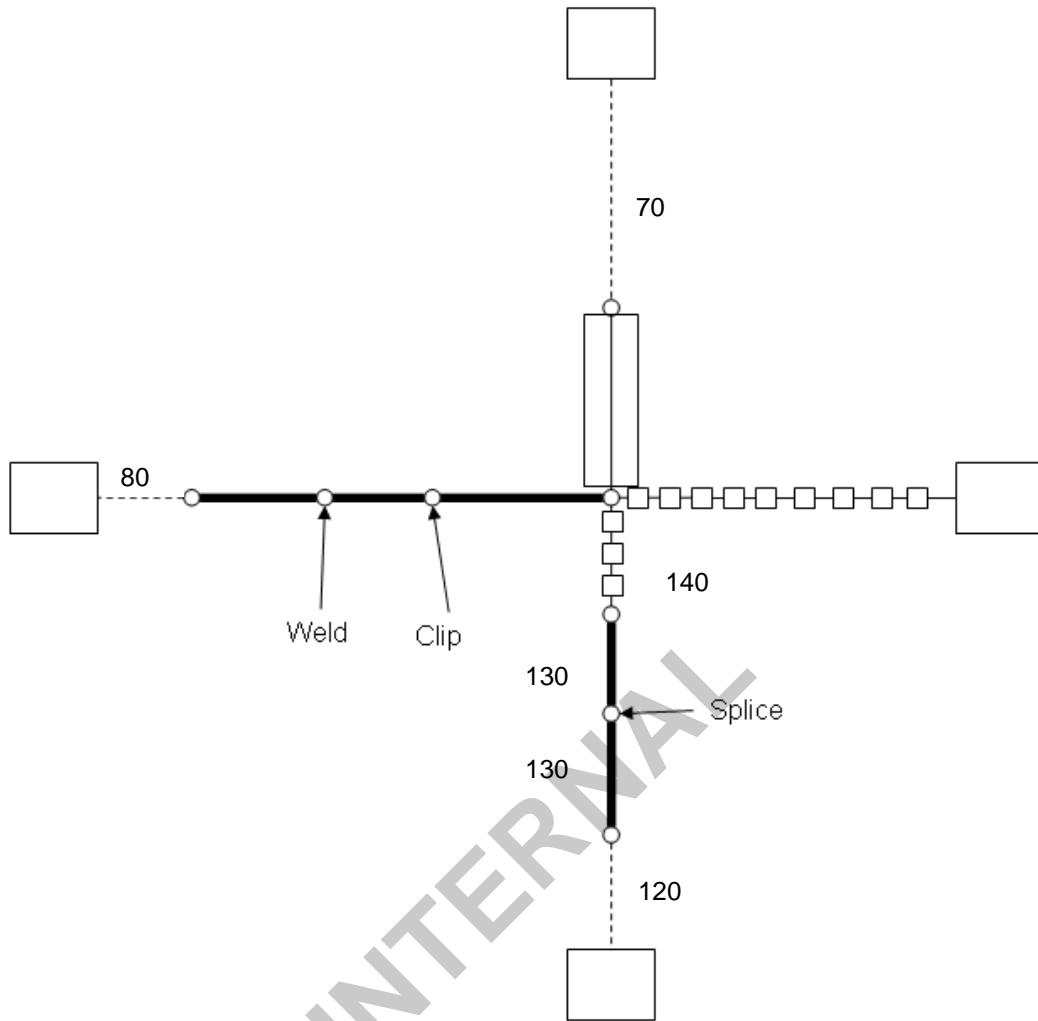
3. Space Tape:   
(part number TA-57743)  
Choose your own values for the following:  
Distance between items  
Distance from connector  
Longest distance allowed

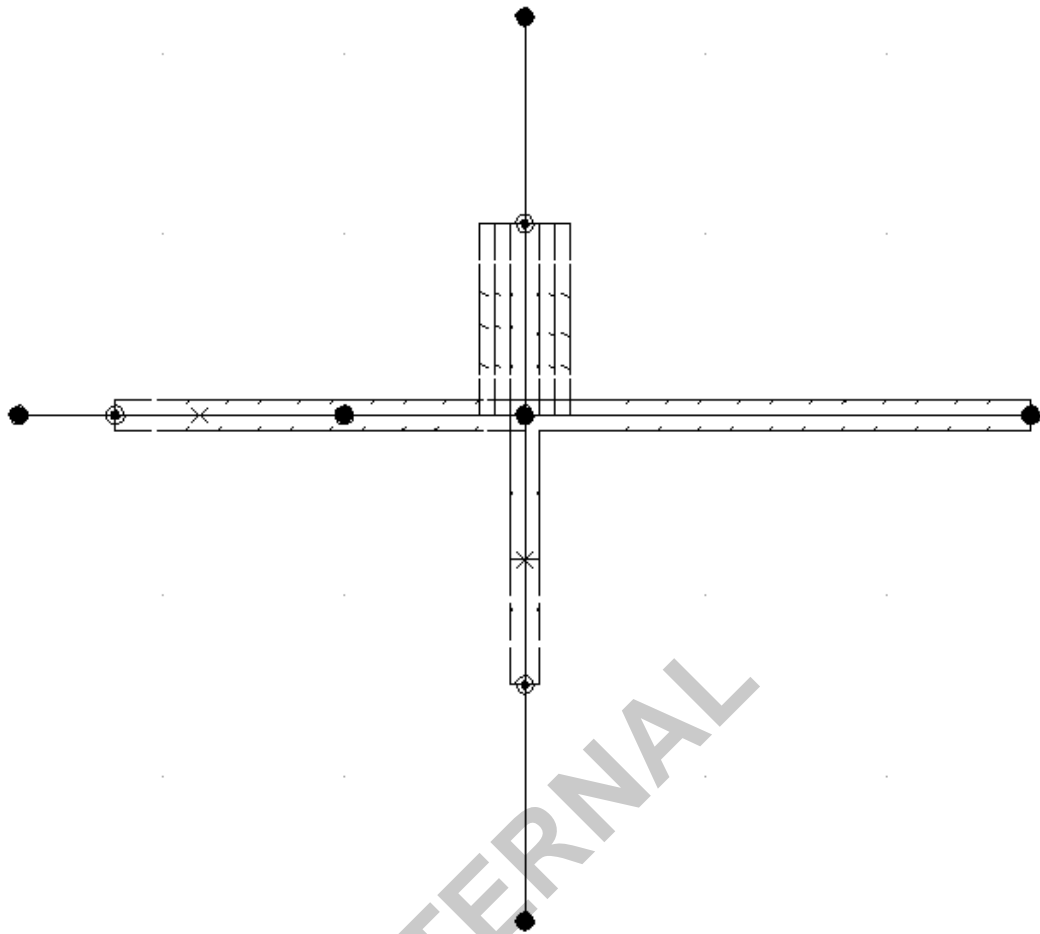
4. Layered Insulation: 

#### 3 layers:

1. Spiral Tape (part number TA-57743)
  2. PVC Convuluted Slit Tube – fixed tube (part number TU-45388)
  3. 50% Overlap tape (part number TA-57743)
- Apply the relevant codes to the harness as shown on the diagram – remember that the linestyle you have will not match that on the diagram
  - Choose to insert using start and end nodes, creating the reference node anchored to the connectors.







- Your diagram should look similar to this

## Chapter 6 Creating Symbols

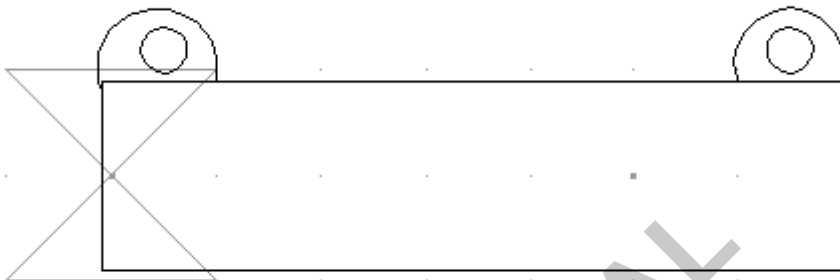
### Exercise Worksheet

#### Exercise 1: Creating symbols in the symbol Library

- Create a symbol library called XY-Training, where XY are your initials.
- Create a symbol for the following components in your library, making sure to save it as a comment symbol.

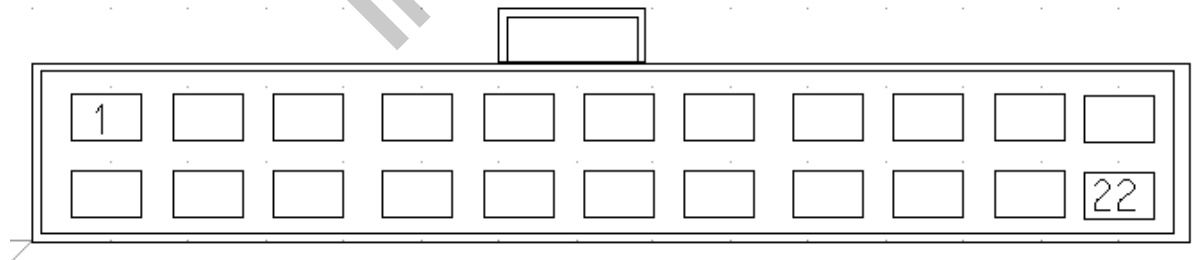
#### Part Number: COV-4211

This is a protector channel with a resizable symbol



#### Part Number: C-61851

This is a connector with 22 cavities with a resizable symbol



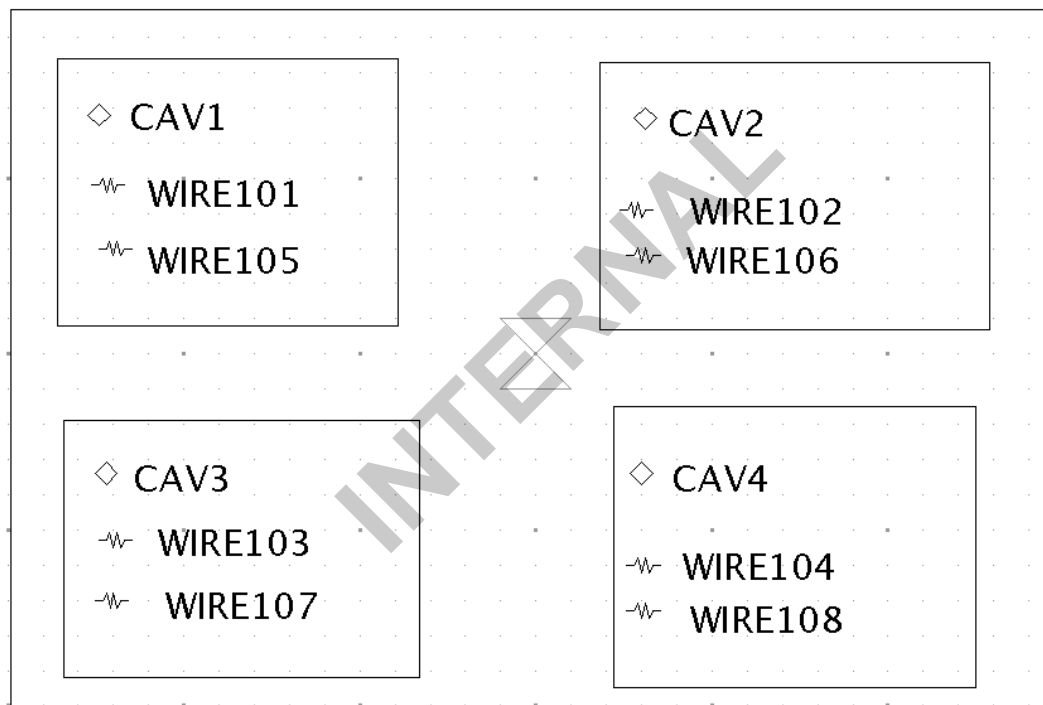
- Assign the symbol library to your style set library settings

## Exercise 2

- Create a 4 cavity connector symbol named conn-xy where xy are your initials

The outer border for the connector symbol should be 4 major grid points high by 6 major grid points wide.

- For each cavity add a connector cavity datum point:  
**Add / Add RED Datum / context: connector, Related Object: Connector Pin**
- For each connector cavity datum, add 2 wire datum points:  
Highlight the cavity datum in the browser **Right click / Add associated datum / Context: Connector cavity, Related Object: Wire** – repeat this step twice



- Save the symbol – this will be used in the styling chapter later on

### Exercise 3: You will now create a D Size diagram border

- **In Capital Symbol**

Create a new border library called XY-Borders (XY are your initials).

File / New Library

Library Name: XY-Borders

Type: Border

- Create a D size border with the following attributes:

Name: A1 s

Paper size: A1

Margins: 2 cm

- Modify the size of the editable area (gray boundary).

- Move the lower left corner and the upper right corner to see the gray area change. The coordinates are displayed at the bottom right hand side.

Hide the Boundary.

**Edit / Show Boundaries**

- Create a zone area with the following attributes:

Zone Area

Use Zone Area: Checked

Rows: 8

Columns: 8

Text height: 10 mm

Row Naming

Numbering: Bottom to Top

Naming: Alphabetical

Column Naming

Numbering: Left to Right

Naming: Numerical

Start With: 1

- Add an inner border just inside the displayed grid references. Change the thickness of the border lines to 2.

Select the lines / Properties / Thickness:Over-ride:2

- Create a title block area that occupies the lower right part of the border.

<b>Mentor Graphics®</b>	
Design: {design.name}	
Description: {design.description}	
Release: {design.releaselevel}	
Revision: {design.revision}	
Diagram: {diagram.index} of {design.diagramcount}	

- Add the following properties and placeholders as defined in the diagram above

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# Chapter 7 Design Revisions

## Exercise Worksheet

**Exercise 1:** You will now create a revision

In order to create a revision you will need to copy a harness design from another project:

- Open project XY-Capital –Harness
- Open the Design folder
- Highlight the design name XY-P017 where XY matches your student login i.e. T1 = train1
- Right Click on the harness and select copy/advanced and select your Capital project to copy the harness design into
- Complete the harness copy by following the wizard
- Open your harness project and Right Click on the harness XY-P017 and create a revision. Change the revision to B
- Create the following ECO in XC (Edit/ECO):

**New Category:** Initial changes to XY-P017

**ECO Name:** ECO-XX-YY (where XX is the month and YY the year)

**Description:** Addition of routed connector

Addition of id labels

Balancing of splice

Addition of busbar

**Impacted Design:** XY-P017 revision B (where XY are your initials)

- Edit the XY-P017 harness design revision B properties and change the ECO status to In Progress

### Exercise 2:

- Make the following changes to the harness revision B. All Part numbers are **Customer** part numbers.  
The diagram can be found at the back of the workbook.
- Add a Routed Connector
  - Add the branch and create node C4
  - Add the connector, remembering to assign route code 1, note the symbol you have previously created.
  - Add the wires remembering to assign route code 1
  - Add the insulation at node C4

Wire No:	Color	Material	Spec	Start Conn:	Start Cav:	End Conn:	End Cav:
7	K/S	TWC	12/.2	C4	6	C10	10
8	U/P	TWC	12/.2	C4	21	C10	7
9	U/N	TWC	12/.2	C4	22	C10	6
10	U/G	TWC	12/.2	C4	2	C10	8
26	W/G	TWC	12/.2	C4	15	C9	1
27	O/R	TWC	12/.2	C4	17	C9	11
28	S/N	TWC	12/.2	C4	3	C9	13
29	Y/O	TWC	12/.2	C4	10	C9	12
30	Y/N	TWC	12/.2	C4	9	C9	14
31	O/B	TWC	12/.2	C4	1	C9	2
35	G/Y	TWC	12/.2	C4	20	C9	6
43	B/P	TWC	12/.2	C4	7	C9	7
45	O/Y	TWC	12/.2	C4	12	C11	10
46	O/U	TWC	12/.2	C4	4	C11	11
48	LG/U	TWC	12/.2	C4	5	C11	5
61	B	TWC	28/.3	C1	1	C4	8

- Balance Splice SP1  
The splice at this node is not balanced. Change the direction for wire number 62. Increase the length of wire number 62 by 100mm to allow for looping back.
- Add an Identity label  
  
Place a label, Customer Part Number '**L-478G**' between nodes C1 and the grommet, 50mm away from the connector. If you have time you may create a symbol for the label.



- Place identity label customer part number: '**L-478U**' at the end of wire number 10 at the node C4
- Add the protector channel, Internal Part Number COV-4211, 50 units from node SP2, note the symbol you have previously created
- Add a multi-location component

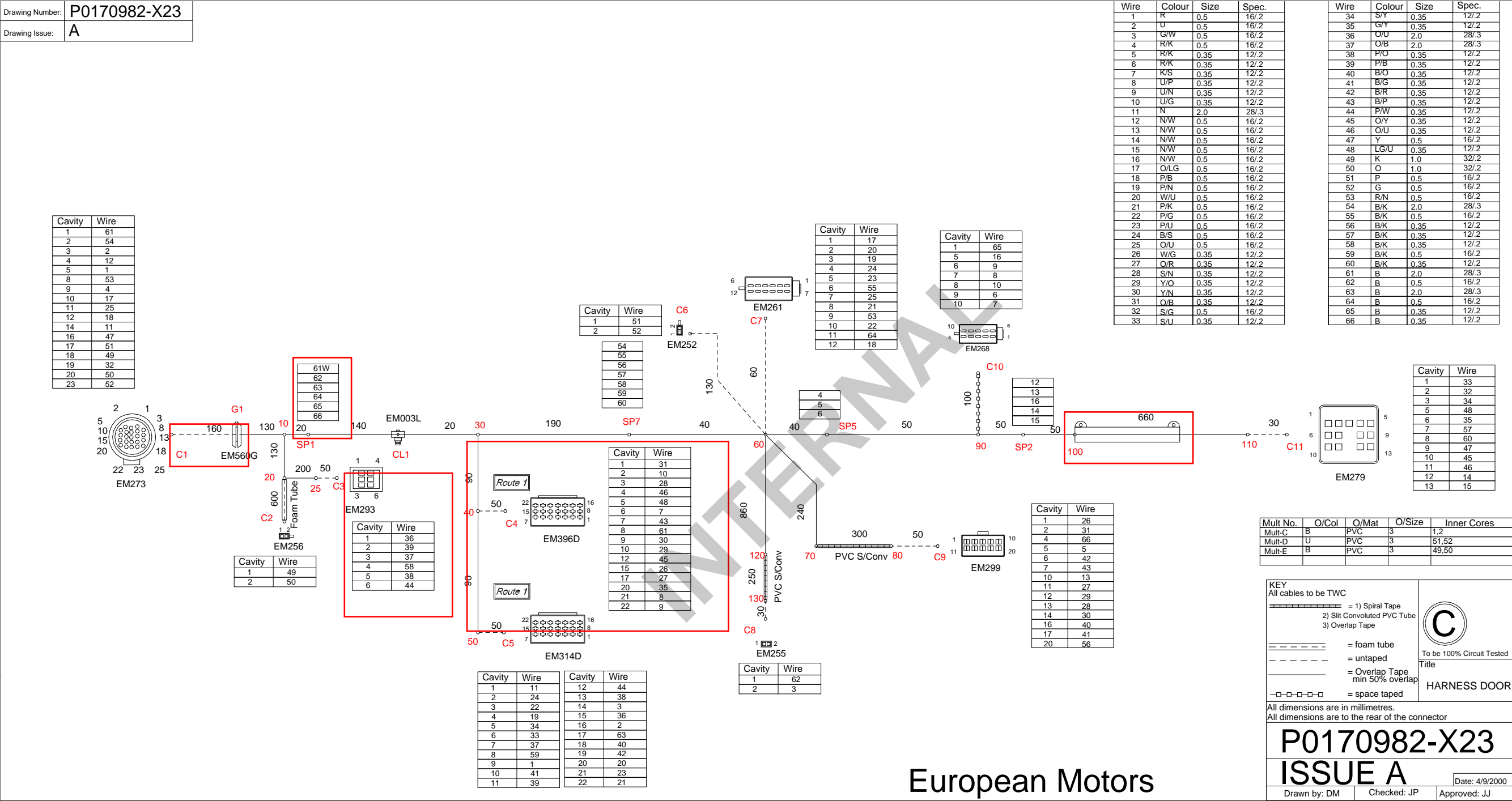
**Create the following busbar in Capital Library:**

- Internal part number: BUS-XY-123 where XY are your initials
- Group: In house assembly
- Type Code:IHA
- Color: -
- Material Code: TP
- In house Assembly sub component: T-54038
- Retain all other defaults

- Delete wires 37 and 39.
- Replace the terminals at cavities 1-3 of connector EM293 at node C3 with the busbar, part number Bus-XY-123
- Remember to add the centre strip wire for wire 61 at SP1

**Exercise 3:** Perform a design comparison between Revision A and revision B of your P017 harness

Drawing Number:	P0170982-X23
Drawing Issue:	A



## Chapter 8 Introducing Composites

### Exercise Worksheet

**Exercise 1:** You will now create derivatives for your harness XY-P016-J01 (where XY are your initials)

- Add the following options to the project in Capital Project using Option Maintenance.

Code	Description
O1	Interior light
O2	Boot Hazard
O3	Puddle Light

- Right click on the harness XY-P016-J01 and Edit to add the previously created options.
- Right click on the composite harness XY-P016-J01 and create the following **derivatives** – remember to replace XY with your initials.

**Name:** XY-P016-A  
**Part Number:** XY-P016-A  
**Revision:** A  
**Short Description:** Deriv1  
**Description:** Derivative 1  
**Release Level:** Draft  
Seal Harness  
Applicable options: O1 and O2

**Name:** XY-P016-B  
**Part Number:** XY-P016-B  
**Revision:** A  
**Short Description:** Deriv2  
**Description:** Derivative 2  
**Release Level:** Draft  
Seal Harness  
Applicable options: O2 and O3

- Add the options to the wires as follows:

Wire Number	Option
WIRE1	O1
WIRE2	O1
WIRE3	O1
WIRE4	O3
WIRE5	O1
WIRE6	O1
WIRE7	O1
WIRE8	O3
WIRE9	O3
WIRE10	O3
WIRE11	O2

- Discuss as a group which components will exist on which derivative.
- Run composite breakdown on the composite harness and harness engineering on the derivatives, selecting all options bar evaluate blank option expression as all
- View the results by opening up the derivative diagram

**Exercise 3:** You will now create a composite harness

- Create the composite harness: 'XY-P022-400-J44', where XY are your initials.
- Define the customer as European Motors and set the library part selection to scope to Customer or manufacturing site – this can be done under 'modify harness details'.
- Add the following options to the project in Capital Project using Option Maintenance.

Code	Description
1	Front Conn
2	Sunroof Electric
3	Sunroof Electric Multi Way
4	LAB1 Red
5	LAB2 Blue
6	LAB3 Green

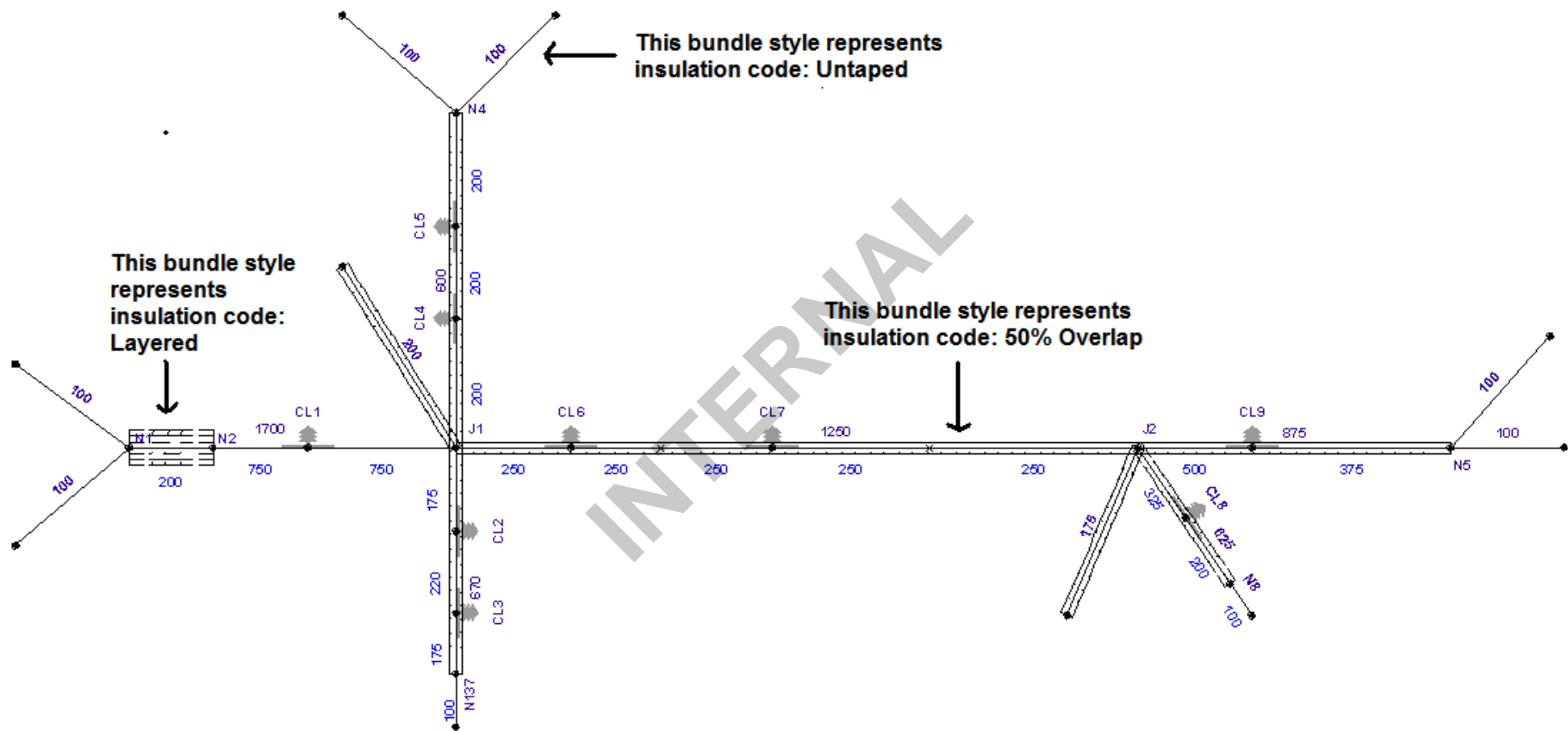
- Right click on the harness XY-P022-400-J44 and Edit to add the previously created options.
- Right click on the composite harness XY-P022-400-J44 and create the following derivatives. – Remember to replace XY with your initials.
- **Name:** XY-450D  
**Part Number:** XY-P022-450D  
**Revision:** A  
**Short Description:** Manual  
**Description:** Manual Sunroof  
**Release Level:** Draft  
Seal Harness  
Applicable options: 1 and 4
- **Name:** XY-451D  
**Part Number:** XY-P022-451D  
**Revision:** A  
**Short Description:** Elec SRF-multi  
**Description:** Electric Sunroof, multi opening  
**Release Level:** Draft  
Seal Harness  
Applicable options: 2, 3 and 5

- **Name:** XY-452D  
**Part Number:** XY-P022-452D  
**Revision:** A  
**Short Description:** Elec SRF  
**Description:** Electric Sunroof  
**Release Level:** Draft  
Seal Harness  
Applicable options: 2 and 6
- Create and process the harness XY-P022-400-J44 where XY are your initials.  
The harness diagram can be found in a separate workbook.
- **All parts are customer part numbers.**
- Add the wires as follows:

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Wire No.	Option	From	Cav.	To	Cav.	Spec	Size	Col.	M/C
WIRE1	1	C4	3	C8	6	16/.2	0.5	R	
WIRE2	1	C4	2	C8	4	16/.2	0.5	R/K	
WIRE3	1	C4	1	C8	1	16/.2	0.5	B	
WIRE4	2	SP1	X	C8	3	16/.2	0.5	R	
WIRE5	2	SP1	X	C1	1	16/.2	0.5	R	
WIRE6	2	SP1	X	C9	2	16/.2	0.5	R	
WIRE7		C8	4	C5	2	16/.2	0.5	R/K	
WIRE8	2	C2	2	C9	1	16/.2	0.5	R/K	
WIRE9	2	C10	2	C1	2	16/.2	0.5	R/K	
WIRE10	2	SP2	X	C8	1	16/.2	0.5	B	
WIRE11	2	C10	1	SP2	X	16/.2	0.5	B	
WIRE12	2	SP2	X	C2	1	16/.2	0.5	B	
WIRE13	3	SP2	X	C3	1	16/.2	0.5	B	
WIRE14	3	C3	2	C8	2	16/.2	0.5	G/W	
WIRE15	3	C3	3	C8	5	16/.2	0.5	R	
WIRE16	1	C5	1	C8	5	16/.2	0.5	G/W	
WIRE17	1	C6	1	C7	2	16/.2	0.5	B	
WIRE17	3	C6	2	C7	1	16/.2	0.5	R	

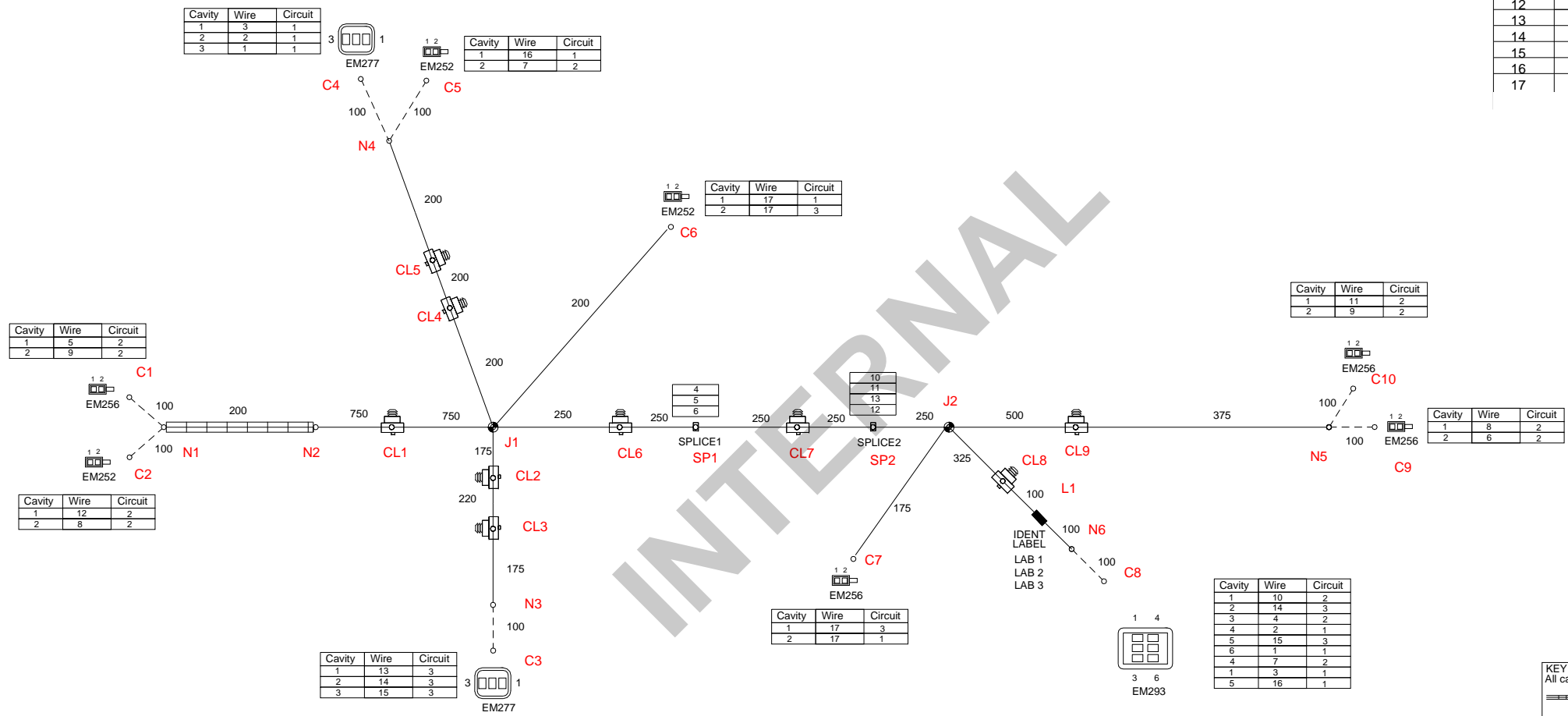
- Add the insulation as shown overleaf





Drawing Number:	P022-400-J44
Drawing Issue:	A

Wire	Colour	Size	Spec.	CIRCUIT
1	R	0.5	16/2	1
2	R/K	0.5	16/2	1
3	B	0.5	16/2	1
4	R	0.5	16/2	2
5	R	0.5	16/2	2
6	R	0.5	16/2	2
7	R/K	0.5	16/2	2
8	R/K	0.5	16/2	2
9	R/K	0.5	16/2	2
10	B	0.5	16/2	2
11	B	0.5	16/2	2
12	B	0.5	16/2	2
13	B	0.5	16/2	3
14	G/W	0.5	16/2	3
15	R	0.5	16/2	3
16	G/W	0.5	16/2	1
17	B	0.5	16/2	1



COMPOSITE DRAWING CIRCUIT						
CIRCUIT DESCRIPTION	front door	sunroof	sunroof electric	LAB 1 red	LAB 2 blue	LAB 3 green
P022-450D	A	X		X		
P022-451D	A		X		X	
P022-452D	A		X			X

**KEY**  
All cables to be TWC

- ===== 1) Spiral Tape
- ===== 2) Silt Convuluted PVC Tube
- ===== 3) Overlap Tape
- = untaped
- ===== = Overlap Tape min 50% overlap
- = breakout tape

All harness clips Part No. EM003L

All dimensions are in millimetres.  
All dimensions are to the rear of the connector

To be 100% Circuit Tested  
Title

**Sunroof Harness**

**P022-400-J44**  
**ISSUE A**

Date: 25/05/01

Drawn by: DM    Checked: JP    Approved: JJ

# Chapter 9 Through Nodes, Complex Routes & Modular Connectors Exercise Worksheet

## **Exercise 1:** Definition of Backshell terminations

- Copy harness P030 to your project from the XY-Harness project, inserting XY (your initials) as a prefix
- Open the P030 harness design and navigate to node C1
- Edit the connector and assign a backshell termination (without a library part)
- View the cavity component management

How can you resolve the empty terminal part number cavity for the backshell termination?

- Make the necessary edits to the backshell in order to view a selected terminal part for the backshell termination  
[HINT: you will need to create a backshell library part with termination references and housing information]

INTERNAL

## Exercise 2: Modular connectors and complex routes. XY-P030-MOD

### Modular Connectors

- Create the modular connector as follows.

**FB-9845** – *this is the main shell for the modular connector*

**Part Number:** XY-9845

**Group:** Connector – Modular shell

**Unit Of Measure:** Each

**Status:** Current

**Type:** CONN

**Color:** B

**Material:** PVC

**Add On:** 6

**Knock Off:** 5

**No of Cavities:** 30

**Include on BOM?** Yes

**Formboard Classic Symbol?** Yes

#### Customer Details:

**Customer Part Number:** XY-EM837

**Customer:** European Motors

#### Supplier Details:

**Supplier Part Number:** XY-348

**Supplier:** A.A.G Group

#### Housing Definitions:

**Cavity Components:** T-54038  
CS-6300

#### **Position Components:**

FB-5283      Position 1, blocking position 3

FB-4321      Position 2

C-60908      Position 3, blocking position 1 and 2

- Open harness P030
- Node C14 has a connector with no library part assigned. This will be the modular connector parent you have previously set up.
- Assign the parent modular part number XY-9845
- Assign the wires to the cavities of the main module as follows

Cavity	Wire
1	WIRE31
2	
3	WIRE46
4	WIRE10
5	WIRE48
6	WIRE7

- Associate the two sub connectors to the parent modular and reassign wires as shown below

Position 1: P1

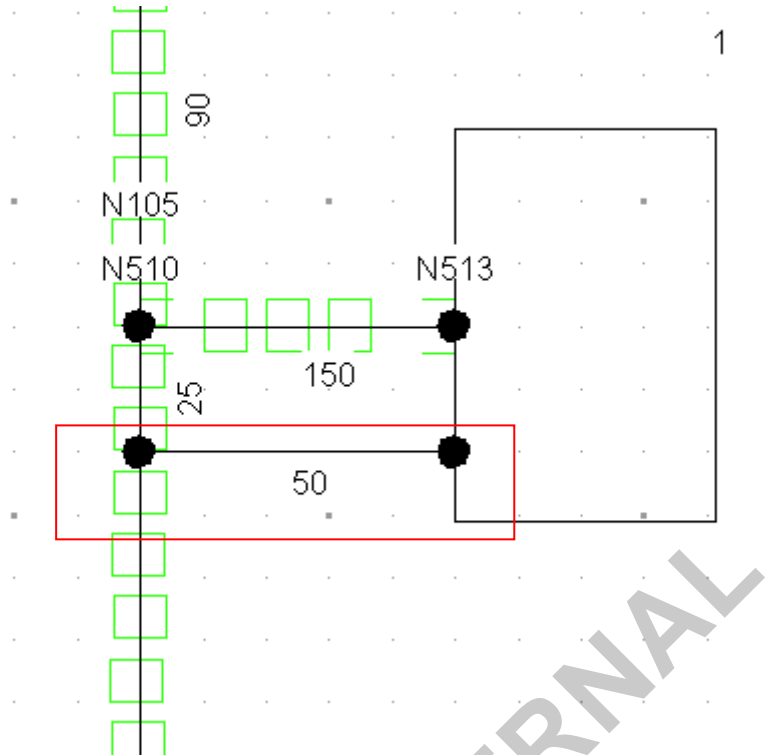
Cavity	Wire
A	WIRE 11
B	WIRE24
C	
D	WIRE22
E	
F	
G	WIRE19
H	
J	WIRE34
K	
L	WIRE33
M	
N	
P	
Q	
R	
S	WIRE37
T	WIRE25
U	WIRE1
V	
W	
X	WIRE41
Y	
Z	WIRE39

Position 2: P2

Cavity	Wire
1	WIRE44
2	
3	
4	WIRE38
5	
6	
7	
8	WIRE3
9	WIRE36
10	WIRE2
11	
12	
13	WIRE23
14	
15	
16	WIRE40
17	
18	
19	
20	
21	
22	
23	WIRE21

## Multiple Routes

- Assign route 1 to the connector at node C4
- Insert another branch to the connector as shown below and assign route 2



- The new branch should be un-taped
- Assign the routes to the wires as follows:

Wire Number	Route Number
WIRE28	1
WIRE48	2
WIRE43	1
WIRE30	1
WIRE29	1
WIRE45	1
WIRE35	1
WIRE8	1
WIRE9	1

# Chapter 11 Synchronize Logic Interactive

**Exercise 1:** Synchronizing with Capital Logic. You will now synchronize a Logic Wire design into Harness XC

- In Capital Harness XC open your Logic project

You will now make a Harness design:

- Right Click the project name and select New Harness Design

**Name:** Audio Harness – XY (replace XY with your initials)

**Part Number:** Audio Harness-XY (replace xy with your initials)

**Revision:** A

You will now create a change policy:

- Open Capital Project and open your Logic project
- Right Click the change policy folder and select New

**Name:** XY-Change Policy (replace XY with your initials)

Retain all other defaults

Click OK

You will now create a new harness build list:

- Open the build list folder and right click the harness build list  
Select New

**Name:** XC build list XY (replace XY with your initials)

Add the Audio Harness-XY design to this build list

You will now define a logic build list:

- Right click the logic build list folder, Select New

**Name:** XY logic build list (replace XY with your initials)

Add the Audio design to this build list

Before you can run the synchronisation, you will need to ensure that your logic design has a harness attribute assigned to it:

- Open Capital Logic and your Logic project
- Open the Audio Design and highlight the connector and wires between the Radio device and SPKR-LF, SPKR-LR, SPKR-SBWFR, SPKR-RF and SPKR-RR devices in the design and assign harness attribute H1 to them [HINT: select all objects/ right click/ edit harness attribute]
- Save and close the design and return to harness XC

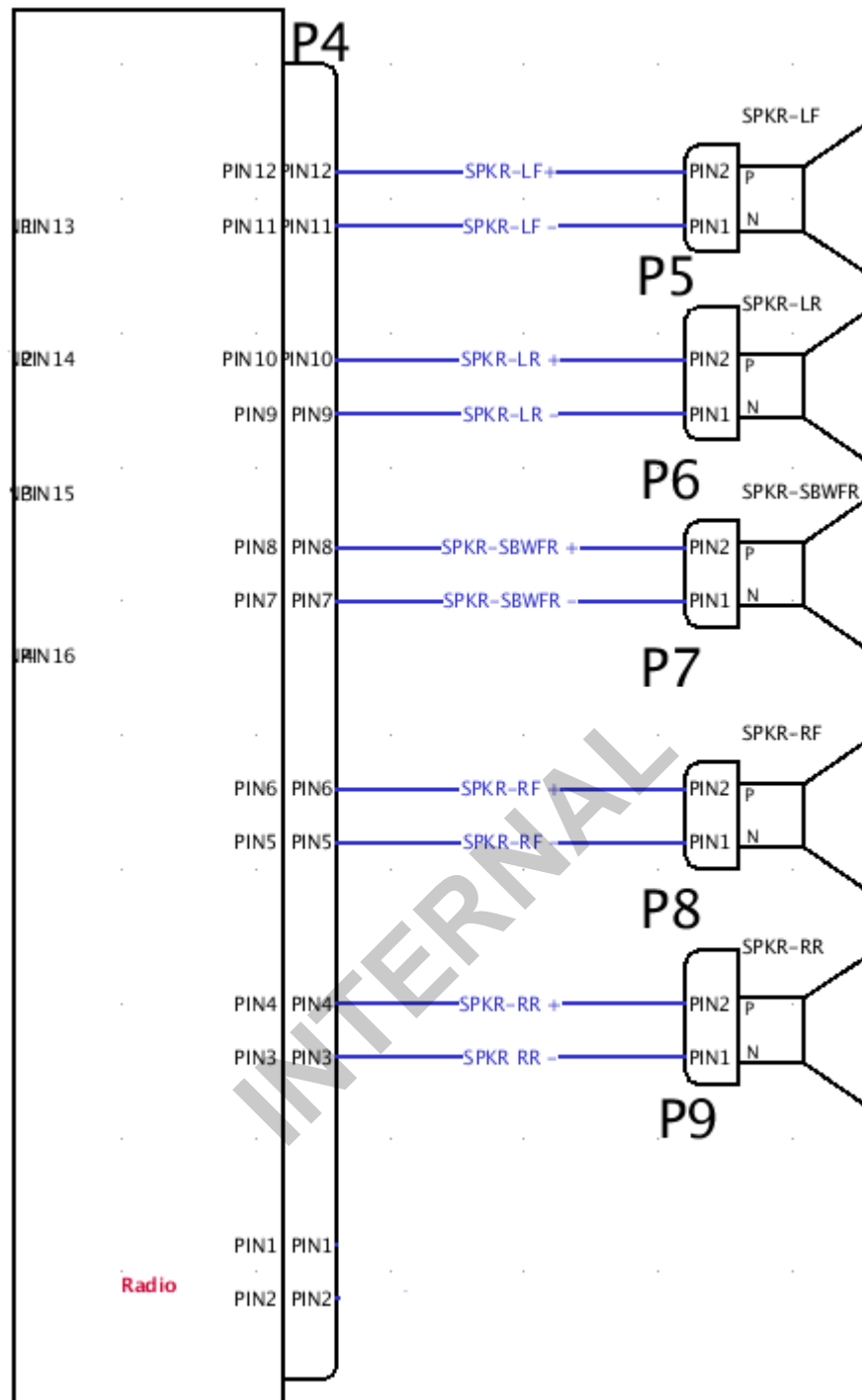
You will now synchronize the logic design with the Harness XC design:

- In Harness XC go to Actions/Harness/Synchronize
- Select your change policy, harness and logic build lists
- Insert a check in the logic and harness design boxes and define the harness mapping
- Click OK and view the results in the harness design

Notice there is no branch configuration, this is because the Logic diagram has no concept of the harness branch configuration, the user must create the branch configuration before synchronising data.

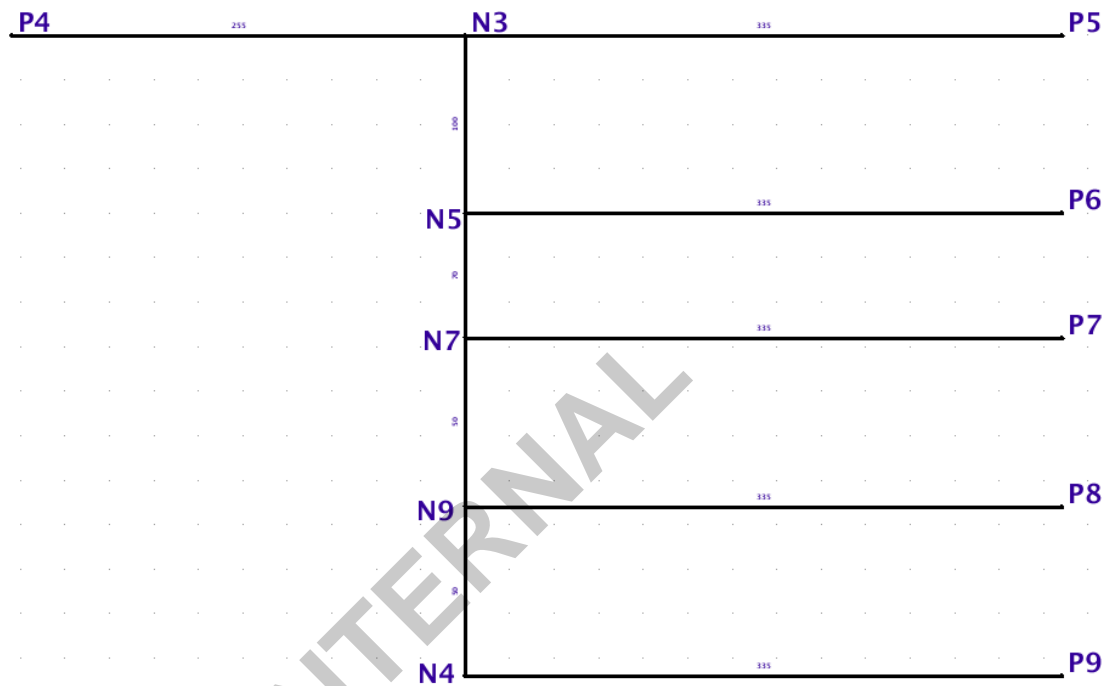
- Return to Capital Logic and open your Audio diagram
- Rename the connectors as displayed below:





- Save the design and return to XC

You will now create the following branch configuration in the Audio harness design to reflect the H1 connector references in the Logic Audio design, do not be concerned with the bundle lengths or reference node names (it is the bundle end node names are important):



Save the design and re-run the synchronize defining the harness mapping as H1 to the Audio harness design

- View the results

If you have time:

- Make a change in the Logic diagram to wire SPKR-LF+, add the Wire Color Attribute G
- re-run the synchronize and view the results
- Discuss what you would have to do to prevent that attribute coming through in the XC diagram

# Chapter 11 Synchronize (Aero)

**Exercise 1:** Synchronizing with Capital Logic. You will now synchronize a Logic design into Harness XC

- In Capital Project open your XC harness project and your student – New Aircraft project (the instructor will tell you which one to use)

You will now make a copy of the Autopilot design in the New Aircraft project and place it into your XC project

- Locate the Autopilot design in your New Aircraft project [HINT: 22-Autopilot]
- Right click the design and select copy/Advanced and select your xc harness project as the target project
- Click OK

You will now create a change policy in Capital Project:

- In your XC project open the change policy folder, right click and select New  
Name: XY-Change Policy (replace XY with your initials)  
Retain all other defaults

You will now create a new harness build list:

- Open the build list folder and right click the harness build list. Select New  
Name: XC build list XY (replace XY with your initials)

You will now define a logic build list:

- Repeat the above steps for the logic build list folder  
Name: XY logic build list (replace XY with your initials)  
Add the autopilot design to your build list

You will now define a new harness design in XC

- Create a new harness design:  
Name: Autopilot harness – XY (replace XY with your initials)  
Part Number: Autopilot harness-XY (replace xy with your initials)  
Revision: A

Before you can run the synchronisation, you will need to ensure that your logic design has a harness attribute assigned to it:

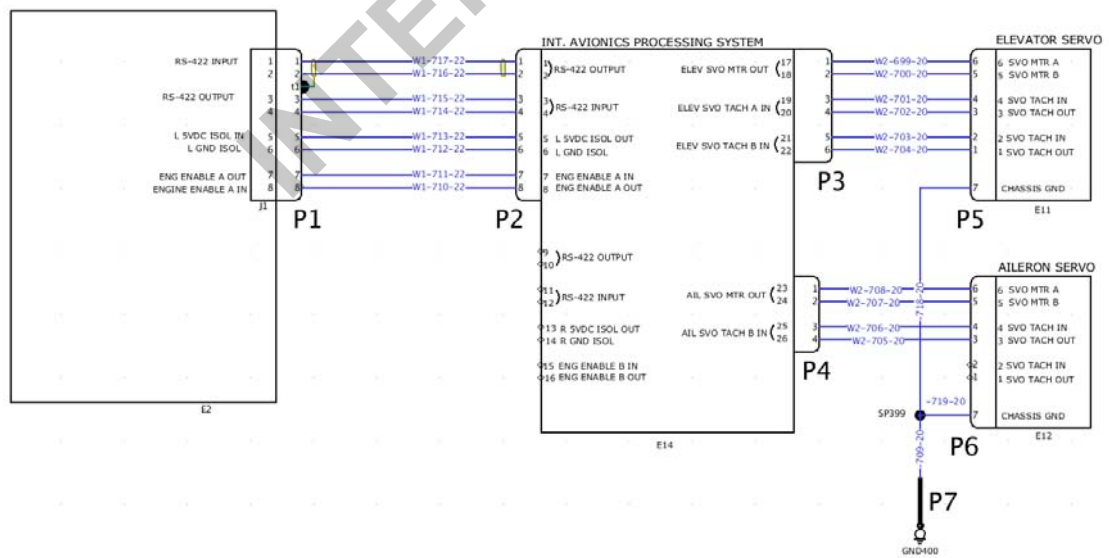
- In Capital Logic open the XC harness project and open the Autopilot design
- Highlight all objects in the design and assign harness attribute H1 to all objects [HINT: select all objects/ right click/ edit harness attribute]
- Save and close the design and return to harness XC

You will now synchronize the logic design with the Harness XC design:

- In Harness XC go to Actions/Synchronization/Synchronize
- Select your change policy, harness and logic build list
- Check the logic and harness design names and define the harness mapping
- Click OK and view the results in the harness design

Notice there is no branch configuration, this is because the Logic diagram has no concept of the harness branch configuration, the user must create the branch configuration before synchronising data.

- Return to Capital Logic and open your autopilot diagram
- Rename the connectors as displayed below:



- Change the harness attribute for connectors P3 to P7 (include their devices and conductors) to H2
- Save the design and return to XC

You will now create the following branch configuration to reflect the H1 connector references in the Logic Autopilot design:

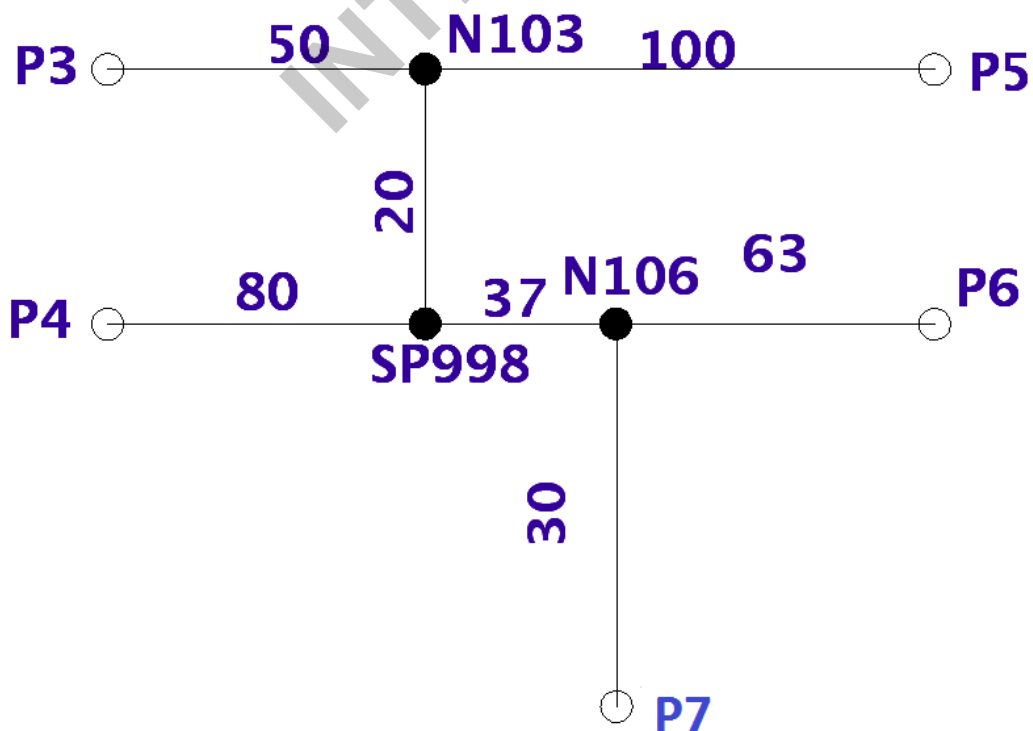


Save the design and re-run the synchronize defining the harness mapping as H1 to the Autopilot harness design

- View the results
- Make a change in the Logic diagram to connector P2 – change the name of cavity 8 to match your initials and re-run the synchronize

You will now create a second harness design and diagram in XC and create a branch configuration within the diagram that reflects the connector locations with the harness attribute H2:

- Name: Autopilot –XY 2 (replace XY with your initials)  
Revision: A
- Add the new design to the harness build list
- Re-run the synch using harness attribute H2 and the new XC design



NB :Be aware that any changes made in Logic will only be reflected in XC if the change policy allows this

INTERNAL

# Chapter 11 Synchronize

## Exercise Worksheet

**Exercise 1:** Synchronizing with Capital Integrator. You will now synchronize an Integrator design into Harness XC.

- Open Quickflow – XY where XY is your student login
- Create a harness design called XY-Quickflow-Main where XY are your initials, revision A
- Create a build list and add your new harness design, naming the build list as you wish
- Create a **Change Policy** in Capital Project using your initials for the name
- Retain the default settings
- Synchronize with the Capital Integrator design 'Quickflow vehicle diagram', making sure to map the **Main harness** design with the **Capital Integrator Main harness (Actions / Synchronization/Synchronize)**
- Open your XY-Quickflow-Main harness in XC and view the results – you should see the main harness layout as it was defined in Capital Integrator

**You will now make a change to a wire color in the XC diagram**

- Open the **Edit wires** form in XC and select the wire located in Cavity 1 of the 2 way connector that links to the WF SP device (you may need to refer to your integrator design to identify this)
- Add a wire color (G) to this wire and save your XC design
- Open Capital Project and amend your change policy as follows:

Select the component type **wire**

For the Attributes uncheck each box for the **Wire color** attribute

This change will ensure that the XC wire color is retained whenever a synch is done from Logic or Integrator

**You will now perform a change on the Main harness within Capital Integrator and synchronise the changes in XC**

- Open Integrator and open your Quickflow-XY vehicle design
- Open the Main harness and check the length of the bundle linking the WF SP slot to the main bundle . Currently the length should be 30 units.
- Change the length of the bundle to 100
- Save the Integrator design and close the diagram
- In harness XC select **Actions / Synchronization/Synchronize** and re-synch the Integrator Main diagram with the Harness Main diagram
- Re-open the XC main harness diagram and view the results – the bundle length leading to the WF SP device should now be 100 units and the wire color attribute in cavity 1 should remain as G

Note – If users have done the Logic Interactive course they may use the Logic audio Quickflow diagram and synch this with the Harness diagram instead, remembering to create a logic build list and assign the audio diagram to it.

INTERNAL

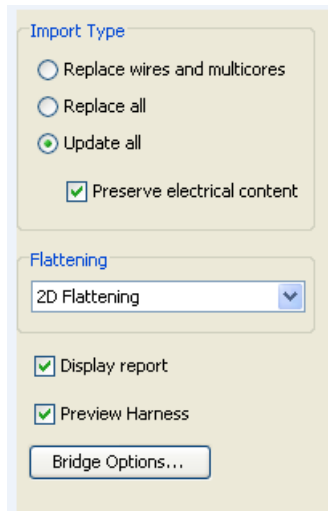


# Chapter 12 MCAD

## Exercise Worksheet

### Exercise 1: Using Bridge In

- Create a new harness design: Define your own name, part number and revision
- Select Bridge in and navigate to file MCAD-model.xml and select to bridge in with the following options:



- View the results

You will now import a 2<sup>nd</sup> file via change manager, this will be imported over the top of the harness you have imported

- Open Change Manager
- Navigate to file MCAD-model-2.xml via the incoming icon. Using Change Manager identify any changes (use the filter icon) and link or synchronise the incoming harness details to the harness you have created in step 1 above
- View the changes

#### If time allows:

- Open your P016 composite harness
- Bridge out a 3D harness file
- Edit the file and make a change to a bundle length
- Bridge the file back in to the P016 harness and view the bundle length change

# Chapter 13 Styling

## Exercise Worksheet

### Exercise – Creating a style set

- Open the style set editor and create your own style set:
- Edit/Style/Style sets/Add
- Define a name for your style set
- Click OK

### Exercise

#### Create a style set for nodes:

- Create an Attribute of Name for nodes
- In your style set select Node/Decorations/Attributes/Add
- Select Name/Ok
- Click on the Name attribute and define the following style:
- **Font:** Times New Roman, bold, **Color:** Red
- Apply the style to your harness drawing – you will need to edit the drawing and assign the correct style set then Edit/Select All/Edit/Style/Apply style

#### Now edit the name attribute offset values:

- Re-open your style set and select the Node Name attribute
- Change the offset values as follows:  
Horizontal: 2 , Vertical 2
- Apply the style set and view the result.

#### Now create a Leader Line for the Node Name attribute:

- Select the Node name attribute
- Open the Leader Line Tab
- Check the visible box
- Select a primary color and start line end style (arrow left filled)
- Apply the style

## Exercise :

Connector related entities

- Create the following library connector in Capital Library:

**Part Number :** Conn – XY where xy are your initials

**Group Name:** Connector

**Status:** Current

**Description:** 4 way connector

**Unit of measure:** Each

**Type:** Conn

**Color:** B

**Material:** PVC

**Add On:** 4

**Knock Off:** 5

**Include on BOM?:** Yes

**Formboard Symbol?:** No

**No.of cavities:** 4

- In Harness XC
- **Create the following harness Diagram:**
  - Define your own harness name and part number. – ensure that you apply your new style set
  - Use the connector part number you created above

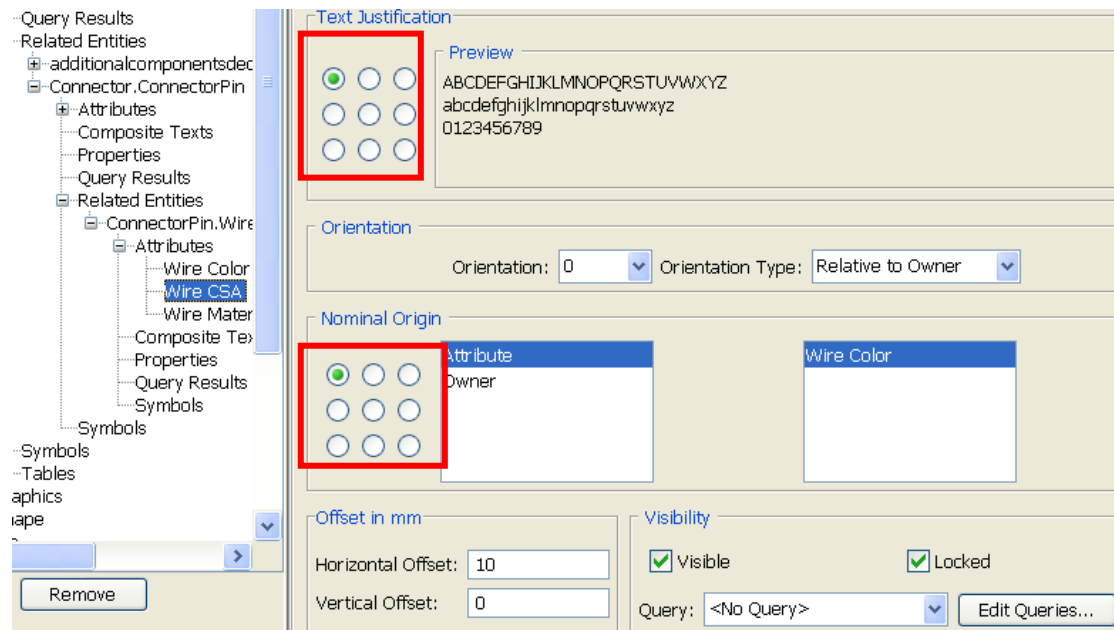
570

Cav	No.	CSA	Col.	Type
a	WIRE2	0.5	B	TWC
A	WIRE3	0.5	B	TWC
b	-	-	-	-
B	-	-	-	-

Cav	No.	CSA	Col.	Type
a	WIRE2	0.5	B	TWC
A	WIRE3	0.5	B	TWC
b	-	-	-	-
B	-	-	-	-

- **Update the diagram to show connector symbols** – the system will use the symbols you created earlier in the symbol exercise
  - ⇒ **Edit / Style / Style Set / (select style) / Connector / Decorations / Symbols / Connector symbol**
  - ⇒ Check the **Visible** box
  - ⇒ Re apply the style to the diagram

- **Update the diagram to show cavity names on the symbol:**
  - ⇒ Open your Style set as per the steps above
  - ⇒ Select **Connector / Related Entities / Add**
  - ⇒ Select **connector pin / Datum symbol**
  - ⇒ Open the **Attributes** for the connector pin
  - ⇒ **Add / Name/ OK**
  - ⇒ Apply the style to your diagram – the 2 connectors should now show cavity names in the place you added the cavity datum back in the symbol creation exercise
  
- **Update the diagram to show wire details on the connector symbol**
  - ⇒ Access your style sets again
  - ⇒ Select **connector pin / Related Entities / Add**
  - ⇒ Select **Wire/Datum Symbol**
  
- You will now define what wire information you wish to display in the connector cavity symbol:
  - ⇒ Click **Attributes / Add / Wire Color / OK**
  - ⇒ The **nominal origin** for the Wire color should be top left, owner
  - ⇒ **Horizontal offset** – 0.5
  - ⇒ Repeat the step to add a **wire CSA** attribute
  - ⇒ Select the **Wire CSA / Nominal Origin –Attribute / Wire Color**
  - ⇒ **Horizontal Offset** / 0.5
  - ⇒ Ensure that the text justification and nominal origin grid settings are top left corner:



- ⇒ Select **Wire Material Attribute / Nominal Origin –Attribute / Wire CSA**
- ⇒ **Horizontal offset – 0.5**
- ⇒ Ensure that the text justification and nominal origin are both set to top left hand corner
- ⇒ Click **OK**
- ⇒ Re-apply the style set to your diagram – you should now see the wire details in the connector symbol

If you have time, use the style sets to change the graphical representation of the connector symbol

## Exercise : Connector Constraint Symbols

- **Add a border to your diagram:**
  - ⇒ **Graphics / Border** – select the A0 Border
- **Ammend the style set:**
  - ⇒ Open your style set
  - ⇒ Navigate to the **Design / Decorations / Related Entities** folder
  - ⇒ Add a new entity: **Connector /Grid**– this may be renamed if you wish
  - ⇒ Check the **symbol constrained box**
  - ⇒ Select the constraint symbol you created earlier
  - ⇒ Select Main symbol decoration
  - ⇒ Set the subsequent grid placement to Right with an offset of 10
  - ⇒ Set the **symbol justification** to bottom left corner
  - ⇒ Set the **nominal origin** to top left corner
- We will now associate this related entity to the connector symbol:
  - ⇒ Select Design/Decorations/Related Entities/connector /Symbols
  - ⇒ **Add** / select the connector symbol you created earlier
  - ⇒ Retain the default settings
- We want to ensure we know which component the symbols in the constraint box are relating to so we will now add a 'Name' Attribute to the Connector Related Entity
  - ⇒ Select Design/Decorations/Related Entities/connector/ Attributes / Add / select Name / OK
  - ⇒ Change the font information to your desired settings
  - ⇒ Specify the **text justification** to bottom center
  - ⇒ Specify the **nominal origin** as top left corner
  - ⇒ Select symbol as the nominal origin
  - ⇒ In the second table select the connector symbol as the related symbol / **OK**
- We want to ensure that the system knows we are associating the constraint box to our specified border symbol so we will now define this:
  - ⇒ Under the **Decorations** folder select the **Symbols** sub-folder and add the A size border
  - ⇒ Click **Apply** and close the style set form
  - ⇒ Select All in the diagram and Apply the style set
  - ⇒ Select **Actions / Update / Border**
- Notice how the constraint box has been placed on the harness diagram

## Backshell Exercise: Styling connector backshells and keyway orientations

In this exercise users will define 3 queries for the backshell base, backshell orientation and keyway orientation.

- Open Capital Project and navigate to the system folder / Query Expressions

Create a new query to identify if the connector has a backshell or not:

- Click **New** and type a name for the query: HasBackshell
- Select the **for input-types evaluate expression** template. Leave the default input type of **Connector** selected
- Highlight the second line in the **Expanded Form** field (**expression = unspecified**) and select the **first-predicate-expression** or **second-predicate-expression** template
- Highlight the third line (**first-predicate-expression = unspecified**) and select the **value exists value-name** template
- With the fourth line (**value-name = unspecified**) highlighted, select the **attribute attribute-name** template
- In the fourth line, click **unspecified** and select **Backshell Orientation** from the dropdown list
- Click **OK**
- Highlight the fifth line (**second-predicate-expression = unspecified**) and again, select the **value exists value-name** template
- Highlight the sixth line (**value-name = unspecified**) and select the **attribute attribute-name** template
- Highlight the 6<sup>th</sup> line again, click **unspecified** and select **Keyway Orientation** from the dropdown list
- Click **OK**

The contents of the **Collapsed Form** field should now read:

**for (Connector) evaluate ((value exists (attribute Backshell Orientation)) || (value exists (attribute Keyway Orientation)))**

- Click **OK** to save the expression

The next step is to define the query for the Backshell Orientation:

- Click the **New** button and type **GetBackshellOrientation** into the **New Query Expression Name** field
- Click **OK**

The Edit Query Expression dialog switches into editing mode.

- Select the **for input-types evaluate expression** template. Leave the default input type of **Connector** selected
- Highlight the second line in the **Expanded Form** field (**expression = unspecified**) and select the **attribute attribute-name** template
- In the second line, click **unspecified** and select **Backshell Orientation** from the dropdown list
- Click **OK**.

The contents of the **Collapsed Form** field should now read:

**for (Connector) evaluate (attribute Backshell Orientation).**

- Click **OK** to save the expression.

The final step is to define the query for the Keyway Orientation:

- Click the **New** button and enter **GetKeywayOrientation** into the **New Query Expression Name** field
- Click **OK**.

The Edit Query Expression dialog switches into editing mode.

- Select the **for input-types evaluate expression** template. Leave the default input type of **Connector** selected
- Highlight the second line in the **Expanded Form** field (**expression = unspecified**) and select the **attribute attribute-name** template
- Again in the second line, click **unspecified** and select **Keyway Orientation** from the dropdown list
- Click **OK**.



The contents of the **Collapsed Form** field should now read:

**for (Connector) evaluate (attribute Keyway Orientation).**

- Click **OK** to save the expression.

### **Exercise 10: Assigning the backshell and keyway orientation queries to the style set**

In this exercise users will assign the queries created in the previous exercise to the default style set

- In Capital HarnessXC, open your XY –Quickflow project
- Select **Edit / Styles / Style Sets** from the menu. The [Style Sets Dialog](#) is displayed.
- In the tree menu, select the default style set, then navigate to **Connector / Decorations** and select **Symbols**.
- Click the **Add** button to display the [Symbol Selection Dialog](#). Select the appropriate [Symbol Library Set](#), then browse to the library in which you created the orientation symbols
- Select the **OrientationBackground** symbol and click **OK**
- An item called **OrientationBackground** is added to the **Symbols** set.
- Select the **OrientationBackground** item; the right-hand side of the screen displays the [Styling Options](#) applicable to symbols. Select the following options:
  - In the [Symbol Justification](#) grid, select the top-left point.
  - Leave the [Orientation](#) settings at their defaults.
  - In the [Nominal Origin](#) grid, select the top-right point. In the field to the right of the grid, select **Symbol**, then when the second field to the right is displayed, select **default ConnectorSymbol**.
- Set the [Horizontal Offset](#) to **5**, but leave the [Vertical Offset](#) set to **0**.
- Ensure that the [Visible](#) option is selected, and that the [Locked](#) option is not selected.

- Select **HasBackshell** from the **Query** dropdown list.
- Click **Apply**.

Now you will define the Backshell Orientation symbol style

- Click the **Add** button to display the [Symbol Selection Dialog](#). Select the appropriate [Symbol Library Set](#), then browse to the library in which you created the orientation symbols
- Select the **BackshellOrientation** symbol and click **OK**
- In the [Symbol Justification](#) options, select [Use Symbol Origin](#)
- Leave the [Orientation Type](#) set to **Relative to Owner**, and select **GetBackshellOrientation** from the [Orientation Angle](#) dropdown list
- In the [Nominal Origin](#) options, in the field to the right of the grid, select **Symbol**, then when the second field to the right is displayed, select **OrientationBackground**. Select both the [Lock Position](#) and [Use Symbol Origin](#) options
- Leave both the [Horizontal Offset](#) and [Vertical Offset](#) set to **0**
- Ensure that the [Visible](#) option is selected, and that the [Locked](#) option is not selected

Now you will define the Keyway Orientation style

- Click the **Add** button to display the [Symbol Selection Dialog](#). Select the appropriate [Symbol Library Set](#), then browse to the library in which you created the orientation symbols
- Select the **KeyWayOrientation** symbol and click **OK**
- In the [Symbol Justification](#) options, select [Use Symbol Origin](#)
- Leave the [Orientation Type](#) set to **Relative to Owner**, and select **GetKeywayOrientation** from the [Orientation Angle](#) dropdown list
- In the [Nominal Origin](#) options, in the field to the right of the grid, select **Symbol**, then when the second field to the right is displayed, select **OrientationBackground**
- Select both the [Lock Position](#) and [Use Symbol Origin](#) options

- Leave both the [Horizontal Offset](#) and [Vertical Offset](#) set to **0**
- Ensure that the [Visible](#) option is selected, and that the [Locked](#) option is not selected
- Click **OK** to close the [Style Sets Dialog](#)

Now you will implement the styling changes

- Open your XY Quickflow Harness diagram and **Edit / Select all**
- Right Click / **Apply Style**

If your connectors do not have any backshell or Keyway orientation attributes you may need to modify them:

- Right Click the connector for the WF SP device and **Edit Connector**
- Add the following attributes to the connector

**Backshell Orientation: 95**

**Keyway Orientation: 120**

- Select the connector and **right click / Apply Style**
- View the results. If you have time change the attributes again and re-apply the styl3 set to view how the changes affect the orientation symbols

## Wire Table Exercise

- Add a wire table to your style set:

Design / Decorations / Tables / Add

- Define the information you wish to display in the wire table:
- Highlight the wire table and click Edit – this will display a columns form where you can select/de-select the information to be displayed.
- Place the wire table in relation to the border (nominal origin/symbol/border)
- Insert a border on your diagram and update the border and style set to show the wire table on the drawing
- Now you will create a separate sheet to contain wire from/to information:

- In **Capital Symbol** create a new comment symbol named xy-from-to where xy are your initials.
- Create a large rectangle at least 50 x 50 major grid points high and wide.

- Add a constraint box : **Add / Add RED Datum / Constraining Box**

The constraint box should be as wide as the rectangle with an offset of 1 grid space.

- Add the following text somewhere on the symbol : WIRE FROM TO LIST
- Within Harness XC refresh the symbol libraries
- Add this constraint to the style set:

Under Design / Decorations / symbols

- Click **Add** and select the from/to constraint symbol you created.  
The symbol should have a nominal origin associated to the symbol border
- Now add another wire table to the style set :

Design / Decorations / Tables – edit this table to show only the following:

**Wire number  
Cavity**

**From  
To**

- Now place this wire table so that it has a nominal origin set against the symbol, the symbol you select should be your xy-from-to symbol.
- Apply the style and close the style set, apply the style set to your diagram – remember you may need to update your border.

N.B. You may need to change the nominal origin or the size of the from/to symbol to ensure that the new wire table fits inside the from/to frame

INTERNAL

**PART NUMBER: 072634**