KNIT CAD AND STRUCTURES

Of all knitting technologies, the modern electronic V-bed flat machine, with its extensive patterning and shaping capabilities, is unique in the range of structures and shapes which can be developed. This versatility has led to the development of complex cad/cam programs which allow the programmer complete control of the knitted product. All knitting machine cad programs work on a graphical interface which allows the designer to input the knitted sample stitch for stitch. Each stitch will be represented by either an icon or colour number which carries out a specific function. It is important to remember that in V-bed flat knitting the basic building blocks of each knitted structure consists Knit, Tuck, Miss and Transfer, however it is the combination of these build blocks which leads to numerous permutations of structure.

Shima Seiki SDS ONE/APEX

Shima Seiki is one of the largest V-bed machine manufacturers in the world, they produce complete design, patterning and programming systems called the SDS One and SDS ONE – APEX, the APEX is their top of the line programming system with added functionality. The cad software offers a range of functions from design artwork preparation, to pattern drafting and cutting, to knit machine programming. It is in the KnitPaint program that all knit structures are developed for the knitting machine.

Main menu screen for KnitPaint

Basic Operation
The SDS ONE uses a pen and graphics tablet, the pen is moved along the tablet to a position relative to a point on the screen, it is important to remember that the pen is not a mouse and each point on the tablet relates to a specific point on the screen. Along the base of the KnitPaint screen an array of colour numbers is positioned horizontally, with each colour number carrying out a specific action (see fig).

### Basic Colour Operation list

#### KNIT

<table>
<thead>
<tr>
<th>Colour Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FRONT BED KNIT (LINKS LINKS)</td>
</tr>
<tr>
<td>2</td>
<td>BACK BED KNIT (LINKS LINKS)</td>
</tr>
<tr>
<td>3</td>
<td>FRONT &amp; BACK BED KNIT</td>
</tr>
<tr>
<td>51</td>
<td>FRONT KNIT (NO TRANSFER)</td>
</tr>
<tr>
<td>62</td>
<td>BACK KNIT (NO TRANSFER)</td>
</tr>
</tbody>
</table>

#### TUCK

<table>
<thead>
<tr>
<th>Colour Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>FRONT TUCK</td>
</tr>
<tr>
<td>12</td>
<td>BACK TUCK</td>
</tr>
</tbody>
</table>

#### MISS

<table>
<thead>
<tr>
<th>Colour Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NO NEEDLE SELECTION</td>
</tr>
<tr>
<td>16</td>
<td>NO NEEDLE SELECTION</td>
</tr>
</tbody>
</table>

#### TRANSFER

<table>
<thead>
<tr>
<th>Colour Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>FRONT KNIT + TRANSFER 1 POSITION LEFT</td>
</tr>
<tr>
<td>7</td>
<td>FRONT KNIT + TRANSFER 1 POSITION RIGHT</td>
</tr>
<tr>
<td>8</td>
<td>BACK KNIT + TRANSFER 1 POSITION LEFT</td>
</tr>
<tr>
<td>9</td>
<td>BACK KNIT + TRANSFER 1 POSITION RIGHT</td>
</tr>
<tr>
<td>20</td>
<td>FRONT KNIT + TRANSFER TO BACK OPPOSITE NEEDLE</td>
</tr>
<tr>
<td>30</td>
<td>BACK KNIT + TRANSFER TO FRONT OPPOSITE NEEDLE</td>
</tr>
</tbody>
</table>
HOW TO CREATE A NEW SAMPLE

1 GO TO NEW IN THE TOP LEFT HAND CORNER AND DOUBLE CLICK

2

1 INPUT FILE NAME
2 STORE TO YOUR FOLDER
3 CHOOSE MACHINE TYPE AND GAUGE
4 INPUT SAMPLE SIZE
5 CHOOSE KNITTING TYPE E.G. STRUCTURE
6 PRESS EXECUTE

3

INPUT COURSES X WALE IF YOU HAVE THE STITCH DENSITY
IF NOT SELECT DEFAULT

SELECT OK

4 USING THE COLORS ARRANGED ALONG THE BOTTOM OF THE SCREEN PROGRAMME YOUR STRUCTURE
EACH COLOR NUMBER CARRIES OUT A SPECIFIC FUNCTION
EXAMPLE

<table>
<thead>
<tr>
<th>KNIT</th>
<th>TUCK</th>
<th>MISS</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOUR 1 = FRONT BED KNIT</td>
<td>COLOUR 11 = FRONT TUCK</td>
<td>COLOUR 16 = NO SELECTION</td>
</tr>
<tr>
<td>COLOUR 2 = BACK BED KNIT</td>
<td>COLOUR 12 = BACK TUCK</td>
<td></td>
</tr>
<tr>
<td>COLOUR 3 = FRONT AND BACK KNIT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HOW TO MAKE AN AREA AND COPY

1 SELECT THE AREA ICON
2 INPUT THE BOTTOM CORNER OF THE AREA WITH ONE PEN CLICK
FOLLOWED BY THE TOP CORNER OF THE AREA WITH ANOTHER PEN
CLICK
3 WHEN THE AREA IS CORRECT PRESS OK ON THE AREA DIALOG

HOW TO COPY AN AREA

1 MAKE AN AREA
2 SELECT THE COPY ICON
3 ON THE COPY DIALOG SELECT COPY MIRROR OR CHEVRON
TO COPY POINT SET
1 SELECT COPY ON THE MODE SECTION OF THE COPY DIALOG
2 SELECT POINT SET ON THE TYPE SECTION OF THE COPY DIALOG
3 PRESS EXECUTE
4 WITH YOUR PEN POSITION THE COPIED AREA
TO DESIRED LOCATION

HOW TO LINE COPY A SMALL AREA INTO A LARGER AREA

TO COPY LINE
1 MAKE AN AREA OF THE PATTERN YOU WISH TO REPEAT
2 SELECT COPY ON THE MODE SECTION OF THE COPY DIALOG
3 SELECT LINE ON THE TYPE SECTION OF THE COPY DIALOG
4 PRESS EXECUTE
5 SELECT COPY AREA ON THE LINE COPY DIALOG
6 MAKE A LARGER AREA YOU WISH TO COPY YOUR SMALLER AREA PATTERN INTO
7 PRESS EXECUTE
WHEN YOUR PATTERN HAS BEEN DESIGNED SELECT YES PAINT.

A SERIES OF QUESTIONS WILL THEN BE ASKED:

1. Do you want to perform the package development continuously? 
   - SELECT YES

2. Do you want to perform the package development continuously? 
   - SELECT OK

3. ONCE YOU PRESS EXECUTE A SET OF LINES ARE DRAWN EITHER SIDE OF YOUR PATTERN. THESE ARE REFERRED TO AS OPTION LINES, WITH A SET OF RIGHT OPTION LINES AND A SET OF LEFT OPTION LINES. EACH LINE CARRIES OUT A SPECIFIC FUNCTION. ALL CARRIER INFORMATION, STITCH INFORMATION AND TAKEDOWN VALUES MUST BE INPUT TO THESE LINES.
   - SEE BELOW FOR A BREAKDOWN OF EACH LINE

4. TO PROCESS PATTERN FOR MACHINE:
   - ANY YARN CARRIER CHANGE MUST BE CARRIED OUT IN R OF LINE 3

   1. CHOOSE YARN FOR RIB WASTE
   2. INPUT REPEAT FOR RIB
   3. INPUT YARN CARRIERS
   4. CHECK YARN CARRIERS AND PRESS EXECUTE
**Inputting a Pattern on the Screen**

When drawing a stitch pattern on the KnitPaint screen it is recommended to zoom the screen until a grid appears. Each square of the grid represents a stitch therefore a grid size of 6 x 6 would represent 6 wales by 6 courses see fig.

![Grid Diagram]

**Creating a Basic Knit Program**

When creating your program, first, draw the pattern part with the relevant colour number for the structure required (refer back to basic colour operation list) e.g.

![Knit Program]

<table>
<thead>
<tr>
<th>Colour Number 1</th>
<th>FRONT BED KNIT (LINKS LINKS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour Number 2</td>
<td>BACK BED KNIT (LINKS LINKS)</td>
</tr>
<tr>
<td>Colour Number 6</td>
<td>FRONT KNIT + TRANSFER 1 POSITION LEFT</td>
</tr>
<tr>
<td>Colour Number 7</td>
<td>FRONT KNIT + TRANSFER 1 POSITION RIGHT</td>
</tr>
</tbody>
</table>
machines each knitted article has a rib at the base of the structure, this rib ensures a finished edge which will not unravel. The most common use of ribs is at the welt or cuff of a garment.

In electronic flat bed knitting the main supported rib structures are

- 1x1 ½ gauge
- Tubular
- 2x1
- 2x2

Ribs are usually defined as the number of front wales X back wales, therefore a 2x2 rib has 2 front wales by 2 back wales (see fig) If the rib required is larger than the supported ribs it is usual to set up in 1x1 ½ gauge and immediately transfer out to the required rib (see Fig)

Once the rib has been decided on and drawn, you must draw the automatic set up, this consists of one line of colours 1, 2, 3 and 4 repeated across the width of your pattern. The 2nd line is the exact same as the rib you’ve chosen. See below
**Function of Automatic Set-up**

When knitting, some form of take-down force must be acting upon the fabric, this take-down helps ensure the consistent quality of knitting and also ensures the knitability of the fabric. Without any take-down force acting upon the fabric the loops would rise up between the needle beds affecting loop formation.

On hand flat machines, after the first or set-up course of rib is taken by the needles, a fabric comb is hand-inserted into it, upwards from under the needle beds, so that the eyelet holes of the comb protrude above the course. The comb wire is then inserted through the eyelets, over the set-up course, so that the comb is suspended from the course, and a takedown weight is attached to it.

On Electronic machines this method is unsuitable as the force of an automated comb would effect, distort and possibly destroy the set-up course, to circumvent this; the initial courses are knitted in a low modulus yarn (high stretch) which can take the strain of the comb. Once the comb has attached itself to the elastomeric yarn, the yarns to be used in the knitted article are knitted in attaching to the comb via the previous knitted course of elastomeric yarn. A draw thread, which is a slippery nylon thread, is then used to separate (after the knitting process) the waste yarn caught by the comb and the knitted fabric. This process of comb insertion and waste knitting can take place over many knitted courses, to simplify this; the automatic set up is drawn to automate the insertion of the comb and waste knitting.

Similar to the Auto set-up is the Auto press off, this will automate the taking out and gripping of yarns and also the pressing off of the knitted fabric. One line of colour 3 is draw along the width of the program. See fig

Auto colours for set-up and press-off are not structure colours they represent automated knitting data.
When knitting, yarn carriers are used to deliver yarn to the active needles, once past the active knitting zone the carriers need to be parked prior to the next knitted course. On Hand-Flat machines this function is carried out by yarn carrier stop blocks, which physically stop the carrier advancing past the block area. When creating a shaped sample on Hand-flat the carrier blocks have to be manually moved in relation to the width of knitted course. This method would be impractical on electronic machine so virtual stop blocks are created on the knit program. For each knitted course a start and an end point are required, colour number 13 is set either side of the structure program and always works in pairs, the start and the end point of each knitted course.

Colour 13 is not a structure colour it sets the width to knit for the yarn carrier
Option lines

When knitting on the hand-flat the machine operator has to make many decisions and choices on how to knit, Stitch size, take-down, speed, number of knit courses, pattern repeats and yarn carrier choice are all taken into consideration during the knit process. When programming, this information also needs to be included, either side of the structure pattern a set of 20 lines are positioned, these are referred to as option lines, a right set and a left set. Each line represents a specific function during the knit process.

When input information in the option lines you draw to the right of the right option line and the left of the left option line

Basic Setting up of Option Lines

RI Jump Economizer

A repeat area on the pattern is indicated by colour number 1, all repeat areas are even i.e. 2,4,6,8 etc multiply repeat areas can be set for the pattern see below.
By altering the repeat setting on the machine various lengths of rib and structure can be attained.

**R3 Yarn Carrier Change**

For every line of knit instruction corresponding yarn carrier information is required. This is input in R3; a colour number will act as an address for the yarn carrier information. It is considered best practice to use the corresponding colour number for the yarn carrier e.g. colour 1 = yarn carrier 1 colour 2 = yarn carrier 2 etc.

If there is a knit command on the pattern and no yarn carrier information is included in R3 the knit fabric will press off the machine.

*For ever knit command you must have a yarn carrier selected*

**R4 Knit System Choice**

Usually when knitting on a Hand-Flat; only 1 knit course is possible in any direction, this is because there is only one set of raising and lowering cams front and back. However if an additional cam box is placed beside the existing cam box there is now 2 sets of raising and lowering cams front and back, so 2 courses can be knit in 1 direction this is now effectively a 2 system machine.

On electronic flat bed machines the number of systems can usually range between 2 and 6. In R3 the knit system is selected, if no colour is input the knit is single system if however 2 squares of colour 6 followed by 2 squares of colour 7 are input the knit system choice is 2 system. Consequently 3 squares of colour 6 followed by 3 squares of colour 7 are input the knit system choice is 3 system. See fig.
When knitting single system (1 System) only 1 yarn carrier is knit in 1 carriage movement. When knitting double system (2 System) 2 yarn carriers are taken across in 1 carriage movement.

**R 5 Knit Cancel and Carriage Move**

Large amounts of program colour numbers consist of a knit and transfer command; however in some instants the knit command is not required. Therefore in R5 colour number 1 is included to cancel the knitting instruction. When using colour 1 in R5 no knit commands are input on the corresponding structure line to the knit cancel line. See fig
Carriage Move

Usually when knitting with more than one yarn carrier, it is considered good practice to keep all knit courses even to finish knitting on the side where the next carrier is positioned. However, this is not always possible, when you finish a yarn carrier on the opposite side to the next chosen yarn carrier you can input a command, colour number 2, to move the cam box to the correct side to select the next yarn.
When inputting rack commands

- colour 1 = 1 rack position
- colour 2 = 2 rack position etc

**L4 Racking left/right**

When racking the machine can move either left or right. With colour 0 in L 4 the racking will be to the right and with colour 1 the racking will be to the left. In the above pattern the stitch is being deflected right and left, but there is no left command in L 4 this is because all the racking is to the right of 0 position see below

"0" POSITION IS THE DEFAULT POSITION OF THE NEEDLE BEDS IN RELATION TO EACH OTHER
**L5 & 6 Knit & Transfer Speed**

When nothing is input in L5 & 6 the pattern will be automatically knit on a high speed if additional speeds are required see below

- Colour 0 = High speed
- Colour 1 = Low speed
- Colour 2 = Middle speed
- Colours 11-17 = Speeds 1-7

L5 inputs the knit speeds
L6 input the transfer speeds

**L10 & 11 Knit and transfer Takedown**

When programming various knit structures it may be necessary to change the takedown tensions on the fabric this can be achieved by inputting different colour numbers in L10 for knit and 111 for transfer, the colour number provides an address on the machine to make a takedown adjustment
**R 6 Stitch Size**

To indicate stitch setting a colour no is input in R6, any colour number between 1 and 44 can be input. Col 0 in R 6 defaults to stitch address 5 on the machine.

Please note

*THE COLOUR NUMBER DOES NOT INDICATE STITCH SIZE IT REPRESENTS AN ADDRESS ON THE STITCH MENU OF THE MACHINE WHERE THE ACTUAL STITCH SIZE IS INPUT*

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**R8 Yarn-in / Yarn-out**

Sometimes during knitting it is necessary to move a carrier to its rest position outside of the knit area. To move a carrier out input colour number 31 on the last knitted row of the carrier. If the carrier is later used for knitting colour number 32 is input on the first row of knitting to bring the carrier back in.

**R10 Gripper & Cutter**

When knitting on a hand-flat you must manually tie the yarn ends onto the side of the machine to secure them before knitting. This process is carried out automatically when you input colour number 41 in R 10, the yarns are gripped and cut by a gripper device at the side of the machine. The colour can be positioned anywhere in the first 20 courses except in the rib economizer.

*NB NEVER OPERATE THE GRIPPER & CUTTER ON THE MACHINE UNLESS SUPERVISED BY THE RELEVANT MEMBER OF STAFF*
**R11 Stitch Presser**

The stitch presser is attached to the cam box and can be activated by input colour number 1 in R 11. When activated, the stitch presser will drop down between the needle beds and push the knitted fabric down.

Generally it is recommended that the stitch presser be turned off for knitting 1x1 all needle structure.

![Stitch Presser out of action](image1)

![Stitch Presser in action](image2)

**LEFT OPTION LINES**

**L2 RACKING POSITION**

On flat-bed knitting machines racking is a very important function which facilitates stitch transfer and movement. When racking one needle bed is laterally moved in relation to the opposite needle bed, usually the back needle bed is displaced.

When programming with colour numbers e.g. 92 (back knit and move 2 positions left) the software will organize the racking sequence there is no need to input additional racking information in L2.

**WHEN TO USE L2**

Initially the most common use for L2 will be in the creation of Racked stitch patterns. By raking you deflect one set of stitches in relation to another.