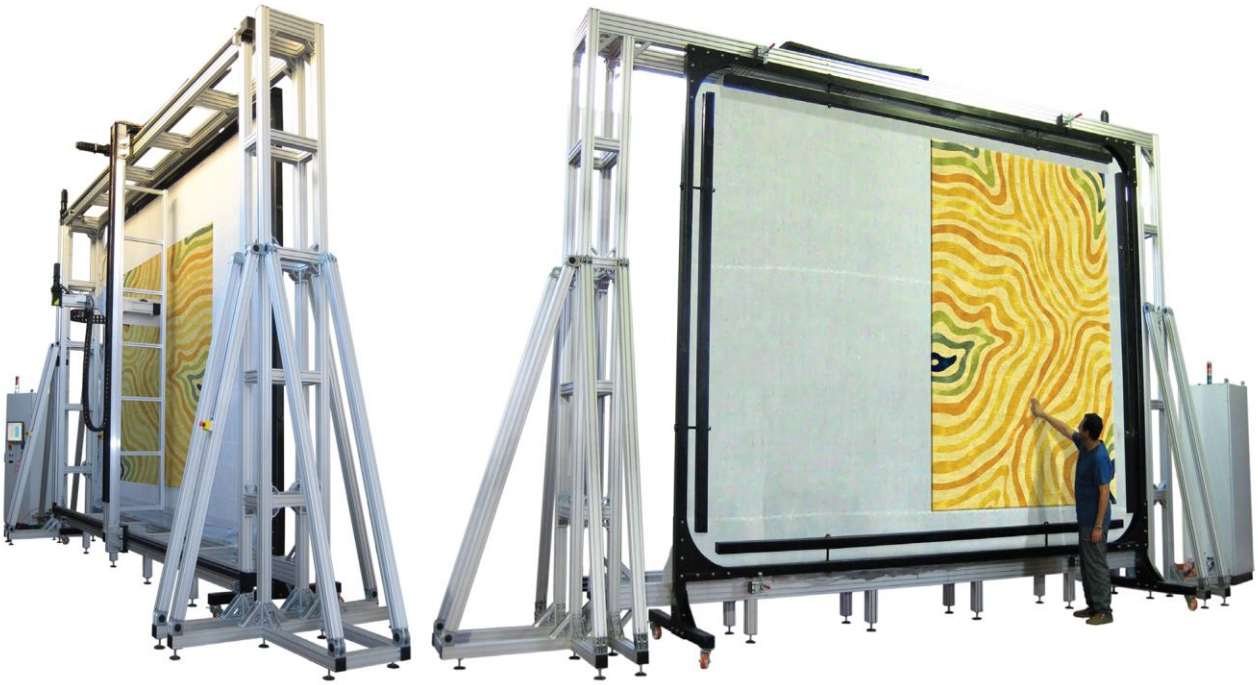
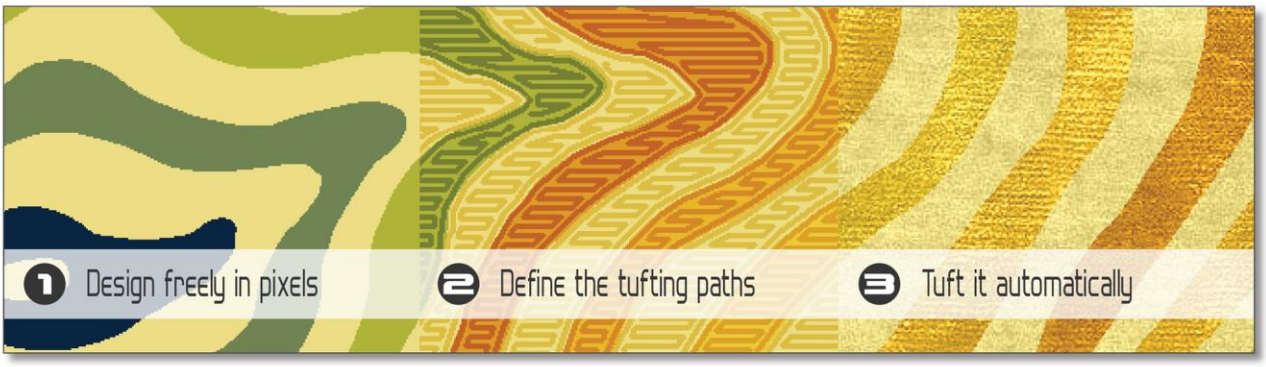
TUFT : ROBOTIC TUFTING SOLUTION

User's Manual

Revision: 2.02 – 2015.05





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1 Introduction

1.1 About this manual

This manual provides important information on how to work with eTuft machine safely and efficiently. The manual is part of the eTuft machine, must always be available for the operators at any time. All personnel and operators working with the eTuft machine are obliged to have this manual read and understood before starting any work. Strict compliance with all specified safety notes and instructions is a basic requirement for safety at work. Illustrations in this manual are intended to facilitate basic understanding, and may differ from the actual design of eTuft machine.

This manual is intended for trained operators with good experience about tufting technology. The operator must be familiar with the following:

- General familiarity with working by industrial machinery
- Sufficient experience in Tufting

This Manual is for the eTuft with tufting gun version V, through release August 2013. This manual is not intended for use with older versions of the eHMI software due to the functional and other differences between eHMI version 5.8 and previous versions.

1.2 Limitation of liability

All information and notes in this manual were compiled under due consideration of valid standards and regulations, the present status of technology and our years of knowledge and experience. EFAB GmbH can not be held liable for damage resulting from:

- disregarding this manual
- unintended use
- employment of untrained personnel
- unauthorized conversions
- unauthorized modifications to the software or hardware of machine
- technical modifications
- use of unapproved spare parts
- use in conjunction with parts and accessories not deemed compatible by eTuft machine

In case of customized versions the actual scope of delivery can vary from the explanations and representations in this manual, because of the utilization of additional options or due to latest technical changes.

Apart from this, the obligations agreed upon in the delivery contract, the general terms and conditions, and the delivery conditions of EFAB GmbH and the legal regulations valid at the time of contract do apply.

We reserve the right to make technical modifications in order to improve usability.

1.3 Copyright

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Violations oblige to compensation. The right for further claims remains reserved.

1.4 Warranty terms

The warranty terms are provided in Power Automation's terms and conditions.

1.5 Safety rules

Please note:

- Using of the machine must be based on the facts presented in this manual.
- Apart from the cases mentioned in this manual, system services should only be done by qualified personnel.
- Read this manual before using the machine.

1.6 Definitions

In this manual and on the body of the machine and the electrical cabinet, different pictures and signs are used as additional information, warning, danger or prohibition signs. Described below the meaning of each of the pictures and signs.

1.6.1 Signs

Note: give some additional information to the operator.

Tips: emphasizes useful hints and recommendations for efficient and trouble-free operation.

Warning: if not avoided could result in malfunctioning of the machine.

Danger: if not avoided could result in personal injury or machine damage.

1.6.1.1 The informative Signs


See manual before the service.

1.6.1.2 Warning signs


Risk of electric shock


Risk of collision with the moving parts of the machine


Risk of finger injury

1.6.1.3 Prohibition signs

Access for unauthorized persons prohibited

Do not step

Do not impact

Touch with wet hands prohibited

1.6.1.4 The electrical signs

Protective earth

1.6.1.5 The written signs

Italic Text: Indicates the machine or software part name.

"Italic Text": Indicates the machine or software message.

1.6.2 Definitions of expressions which used in this manual

In this manual some of the terms frequently used. These terms may have other meanings in other contexts, hence these terms in following described.

Tufting gun: Set of mechanical, electrical and pneumatic parts that have the ability to make the stitches.

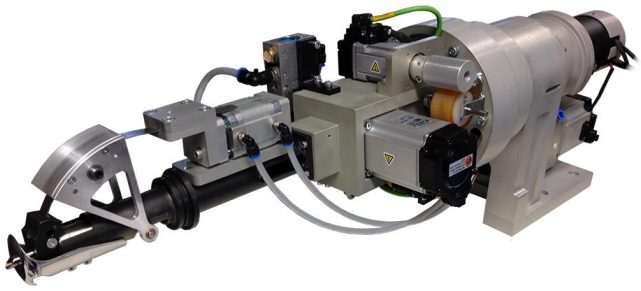


Figure 1: Tufting head

Primary Backing: The fabric that tufting head inserts piles on it.

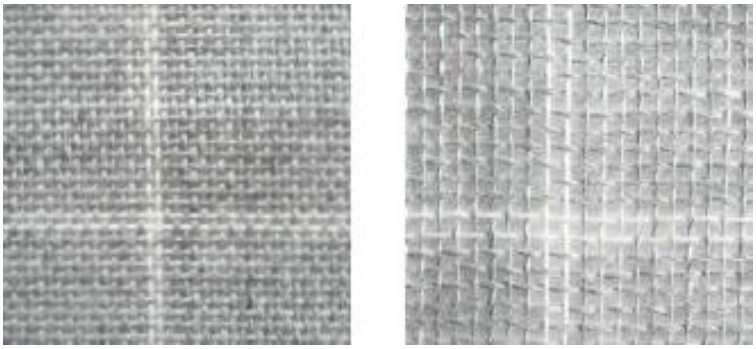


Figure 2: Primary backing fabric

Density:	The number of stitches in one meter straight line.
Gun Speed:	The number of complete stitches in one minute or RPM.
Machine Speed:	The linear speed of machine in millimeter per minute.
Speed Ratio:	The ratio between defined machine speed defined by operator and actual machine speed.
Outline offset:	Outline offset is the distance in millimeter from the color region boundary in the original raster design. This distance should be kept so that the neighboring polygons does not have any overlapping.

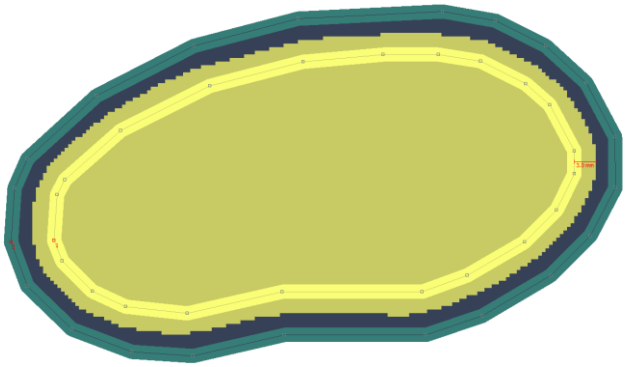


Figure 3: Outline offset

Row spacing:	Row spacing is the distance between two consecutive polygons in the offset polygon or two zigzag steps in zigzag filling algorithms.
Fill offset:	Fill offset is the distance from the outline polygon that should be kept while it is filled with vectors.

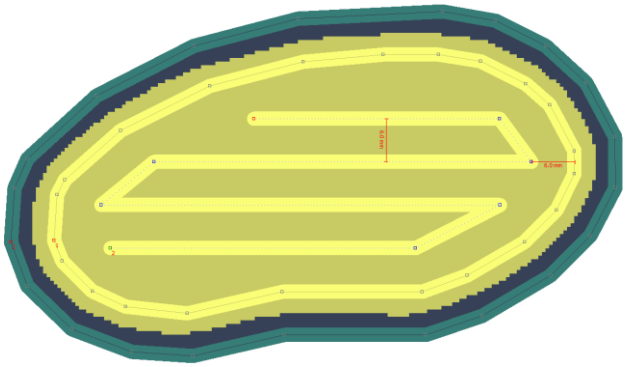


Figure 4: Row spacing and Fill offset

1.6.3 Machine Axes

eTuft machine has 6 axes as below:

1. **X:** Moves tufting head horizontally. There are two linear units on top and bottom of machine connected together by transmission unit on X axis.

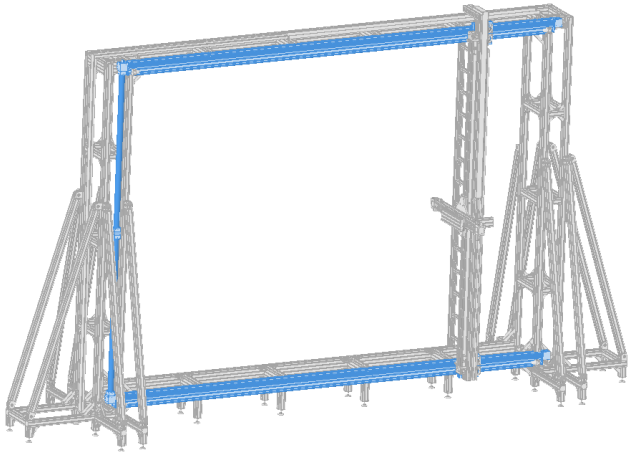


Figure 5: X Axis

2. **Y:** Moves tufting head vertically

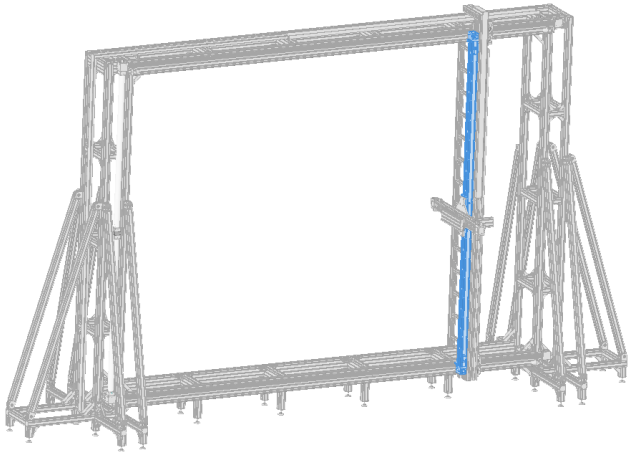


Figure 6: Y Axis

3. **Z:** Moves tufting head into and out of backing

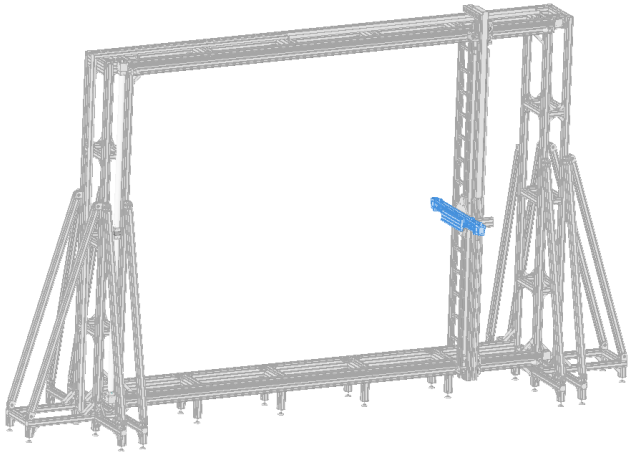


Figure 7: Z Axis

4. **C:** Rotates tufting head needle

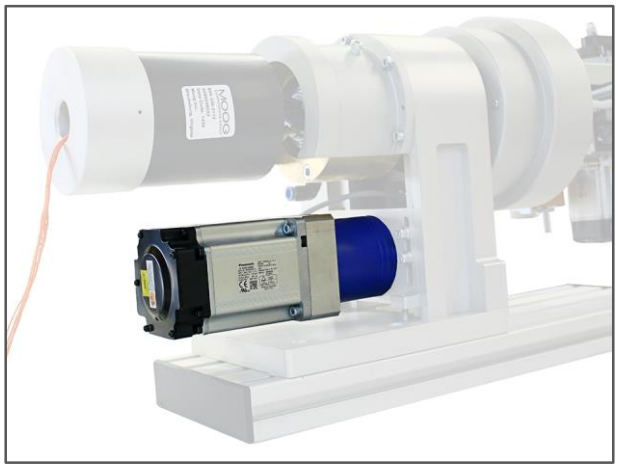


Figure 8: C Axis servo motor

5. **B:** Moves the tufting head needle in and out

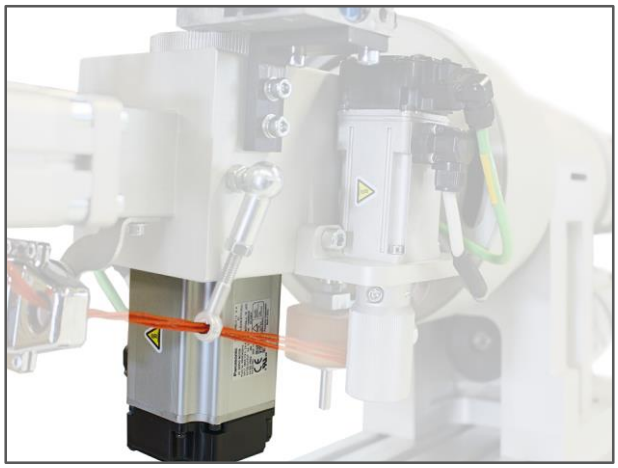


Figure 9: B Axis servo motor

6. **A:** Feeds the yarn through the tufting head into primary backing fabric

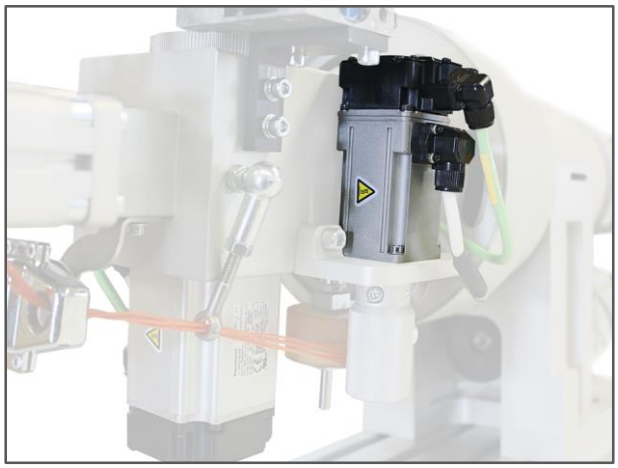


Figure 10: A Axis servo motor

1.6.4 Components

The main components of machine are:

1. Mechanical structure
2. Pneumatic parts
3. Control Unit
4. eHMI Software
5. Tufting Head
6. Laser Pointer
7. Tufting frame
8. Creel
9. eDesigner CAD Software

For more information see section 2 *eTuft Components*.

1.6.5 Optional accessories

- Tufting gun accessories for Ø4.8 mm needles
- Tufting gun accessories for Ø8 or Ø11 mm needles
- Additional tufting frames for continuous production

1.7 Initial working requirements

1.7.1 Flooring

- Floor must be leveled(±2° max)
- Area for robot including frame are:
    - eTuft 3x4: 1000x600x520cm.(LxWxH)
    - eTuft 4x6: 1350x750x630cm (LxHxW)

ⓘ For more information about the required area for eTuft machines, please refer to installation guides documents provided by EFAB GmbH.

1.7.2 Electricity

- Main voltage 220 VAC, 50-60 Hz single phase, 16A ±10%

1.7.3 Compressed air

- Air consumption 400 lit/min, min 8 bar, recommended 600 lit/min 10 bar

1.7.4 Environment

- Temperature 10~40° Celsius
- Humidity less than 85%

⚠ The machine should not be exposed to the metal swarf of welding, grinding and so on.

⚠ The machine should not be used outdoor.

⚠ The machine should not be used in environments with high dust.

⚠ The device should not be exposed to solvents material, strong detergents, acids and corrosive substances.

1.8 Carpet constructions

The look and performance of a particular carpet is determined by its construction, which may be loop, cut or combinations of the two. In corridors, lobbies, offices, classrooms, hotel rooms, patient care facilities and other public areas, loop piles of low, dense construction tend to retain their appearance and resiliency and, generally, provide a better surface for the rolling traffic of wheel chairs or food carts. Cut pile or cut and loop pile carpet are very good choices for administration areas, libraries, individual offices and boardrooms.

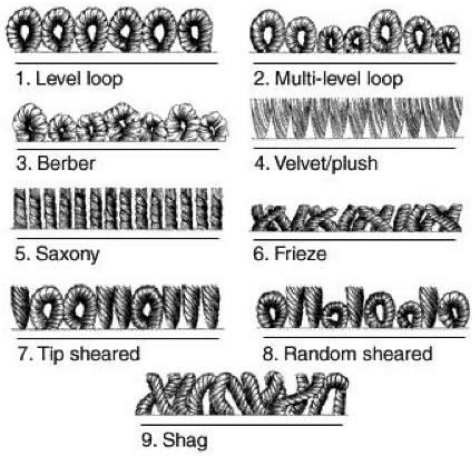


Figure 11: Carpet Constructions

Various types of high performance backing systems have additional advantages, including higher tuft binds, added stability, and imperviousness to moisture and resistance to edge raveling. Consideration should be given to the functional needs of a particular area. Understanding carpet construction assists in specifying elements that will provide the best performance in a particular location.

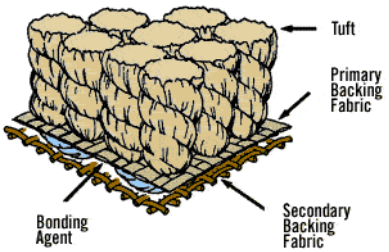


Figure 12: Backing system

Pneumatic tufting is the process of creating carpet with special hallow needle tufting unit. One hallow needle stitch hundreds of rows of pile yarn tufts through a backing fabric called the primary backing. The needle push yarn through a primary backing fabric, where a loop pile or cut pile holds the yarn in place to form a tuft as the needle is removed. Next, secondary backings of various types are applied to render a variety of performance properties.

Here are some key steps in the tufting process:

- Yarn comes from cones on creel racks into the machine.
- The primary backing holds by frame in front of machine.
- Yarn is fed through the yarn feeder (in eTuft Axis A) to tufting head of machine. Hallow needle with pressured air repeatedly penetrate or tuft into the primary backing.
- The tufted carpet is mended and inspected.
- Carpet removed or remains on frame for the next step (whether it’s to be backed).

1.8.1 Fibers

For commercial applications, approximately 80 to 82 percent will be nylon, 8 to 10 percent will be olefin and 8 percent will be wool.

Nylon: Nylon is by far the most prevalent fiber used in commercial carpets. Nylon is excellent in wearability, abrasion resistance and resilience. It is easily cleaned and can be stain resistant. Nylon fibers withstand the weight and movement of furniture and are generally good for all traffic areas.

Olefin: Olefin (polypropylene) is used where resistance to sunlight fading and chemicals is more important than durability to traffic. Olefin is only available as a solution dyed BCF fiber, is colorfast, resists fading, generates low levels of static electricity and is resistant to acid-based stains.

Wool: Wool is a natural staple fiber, is durable, resilient and self-extinguishing when burned. It is noted for its luxury and performance because it is soft, has high bulk and is available in many colors and patterns. Because of its higher cost, wool is usually used as a decorative accent and in lower traffic areas.

Yarns can be either bulked continuous filament (BCF) or staple. Polymer is forced through forced through a spinneret (extrusion) in uninterrupted filaments, which are then formed into a bulked continuous filament yarn. These fibers may be chopped into short fibers and then spun into staple yarn, twisted, and set with heat to hold the twist. A tighter twist is more important in cut pile because it resists the ends of the yarn from untwisting and matting together during wear and cleanings.

1.8.2 Backings

All tufted carpet has some type of backing system or chemistry that helps keep the tufts in place. Backing systems are made from a variety of materials and may also come with various kinds of protective treatments (such as anti-microbial or anti-stain) or beneficial properties (such as anti-static or anti-slipping).

The methods and chemicals used depend upon the performance requirements of the backing and the carpet. These decisions will be based upon the specifier's performance considerations and the manufacturer's recommendations. Performance considerations are especially important for demanding environments. It's important that the specifier identify the highest priority needs for how the carpet will perform, whether that is wear and tear, moisture-resistance, or heavy foot traffic. The manufacturers' end use recommendations help determine which product will meet the established performance expectations.

Carpet backing systems contain the following elements: a primary backing, a chemical adhesive and a secondary backing. In the most common system, the yarn is secured into the primary backing by synthetic latex, and a secondary backing (or cushion) is attached with a bonding agent or adhesive to provide further pile-yarn stability and to add dimensional stability to the carpet structure.

Whether a carpet has a secondary backing depends upon the end use of the carpet and the location of the installation. Carpet for high performance end use generally has a primary backing and a secondary backing.

2 eTuft Components

In this section you can find information about the main components of eTuft machine. The main components are:

1. Mechanical structure
2. Pneumatic parts
3. Control unit
4. eHMI Software
5. Tufting head
6. Laser Pointer
7. Tufting frame
8. Creel
9. eDesigner CAD Software

2.1 Mechanical structure

The main structure of eTuft built with RK BLOCAN Profiles and RK Linear Technology and its advanced rigid construction enables it to work faster and without vibration.

Figure 13: eTuft 3x4 mechanical structure

2.2 Pneumatic parts

eTuft uses pneumatic tufting gun and therefore it equipped with a set of pneumatic parts to prepare the required air flow.

Also eTuft uses pneumatic fixtures for holding tufting frame and actuator for controlling cut/loop mode of tufting gun.

2.2.1 Air preparation unit

This unit consists of these parts:

- 2/3 way manual valve: This is the main valve of air. When you are not using the machine please disconnect the air flow from the machine by using this valve.
- Air regulator/dryer: Operator can set the air pressure for machine by adjusting the valve above the regulator. The air pressure is shown on the barometer.
- Air pressure sensor: Machine use this sensor for measuring low air pressure.
- Air lubricator: Pneumatic actuators need to be lubricated.

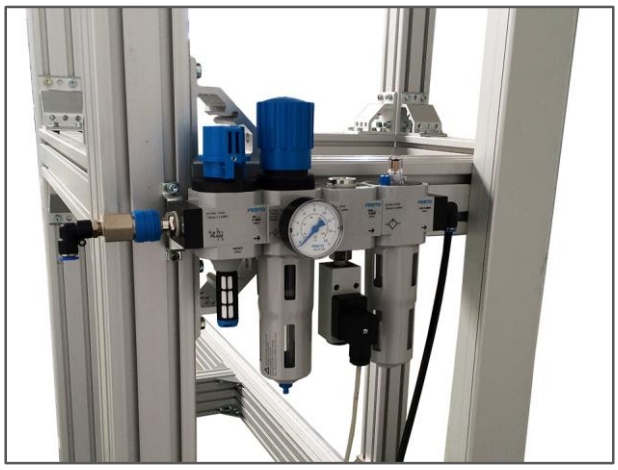


Figure 14: Air preparation unit

If air pressure goes lower than 6 bar then you will get the *Air Low Pressure* message on the eHMI software and machine will stop.

Use hydraulic oil No.40 for lubrication unit.

2.2.2 Fixing clamp for tufting frame

There are two pneumatic fixing clamps in eTuft 3x4 (three pieces in eTuft 4x6) installed at the top of the machine for holding the tufting frame.

Figure 15: Pneumatic fixing clamps

Also there is a manual valve for actuating them on the machine structure. See image below.

Figure 16: Manual valve for actuating fixing clamp

2.2.3 Pneumatic components of tufting gun

There are 4 major pneumatic component in tufting gun as below:

1. Rotary joint.
2. Tufting Air Valve which is responsible for controlling the air flow in tufting process.
3. Pneumatic actuator controls the cut/loop state of tufting head.
4. Cut/Loop pneumatic valve controls the related pneumatic actuator.

Figure 17: Rotary joint

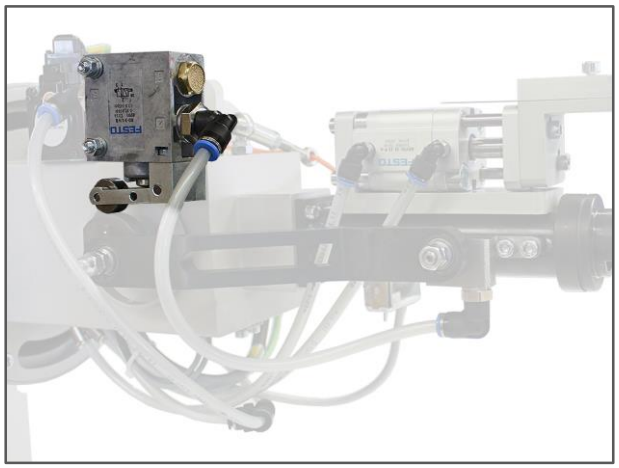


Figure 18: Tufting Air Valve

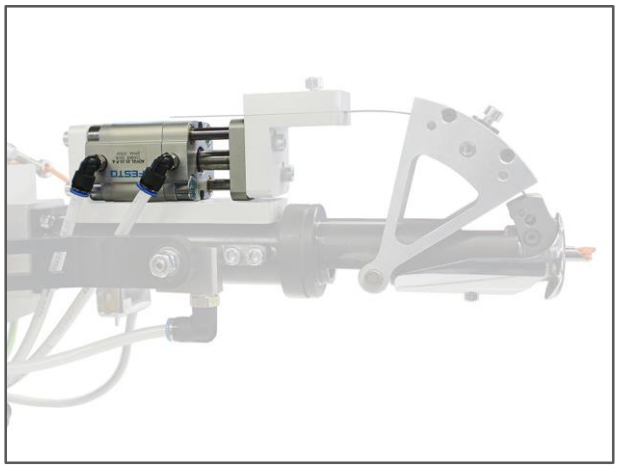


Figure 19: Cut/Loop pneumatic actuator

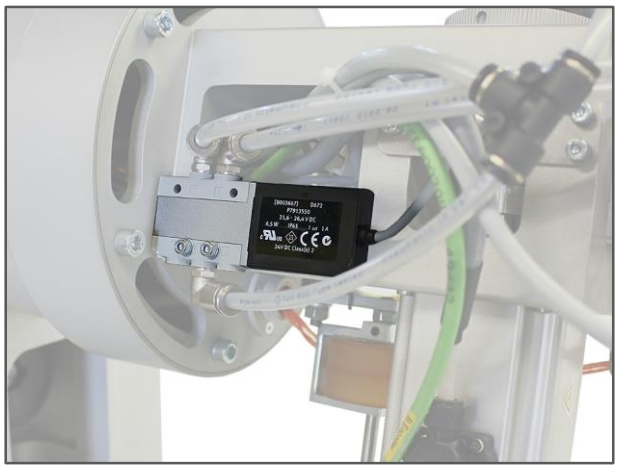


Figure 20: Cut/Loop pneumatic valve

2.3 Control unit

Control unit consists of the following components and parts:

1. Control Panel
2. Remote Control
3. Light Tower
4. Controller
5. 2ENC4A Module
6. Signal Dispatcher Board
7. Servo Drives
8. Fuses
9. Fan thermostat
10. Cabinet light

2.3.1 Control Panel

Control panel consists of (see Figure 21: Control Panel):

1. Touch screen monitor
2. Main Power Switch: This switch is used to power on/off of the machine.
3. Controlling buttons:
   - Start: Starts/Resumes the tufting process or calibration
   - Stop: Pause the active movement
   - Speed -: Decrease the machine speed ratio
   - Speed Reset: Preset the machine speed ratio to 100%
   - Speed +: Increase the machine speed ratio

   The following buttons have been installed in some models of eTuft machines:

   - Gun In: Move the tufting head into the backing
   - Gun Out: Move the tufting head out of backing
   - Forward: Set the direction of tufting program in *Forward* mode (default direction)
   - Backward: Set the direction of tuft program in *Backward* mode
   - Feed Gun: Move tufting head needle in and out
   - Park: Move the machine to the *Park* position/Return it back from *Park* position to *Working* position
4. Emergency Stop
5. Joystick: Move the tuft head vertical and horizontal
6. Indicator lamps:
   - System Ready
   - Servo Fault: One of the servo drives has problem

- Main Power Failure: The main input power disconnected (installed in some models of eTuft machines)
- Air Low Pressure: The input air pressure is less than 5 bar(installed in some models of eTuft machines)

7. USB port (in some models USB hub with 4 USB ports)

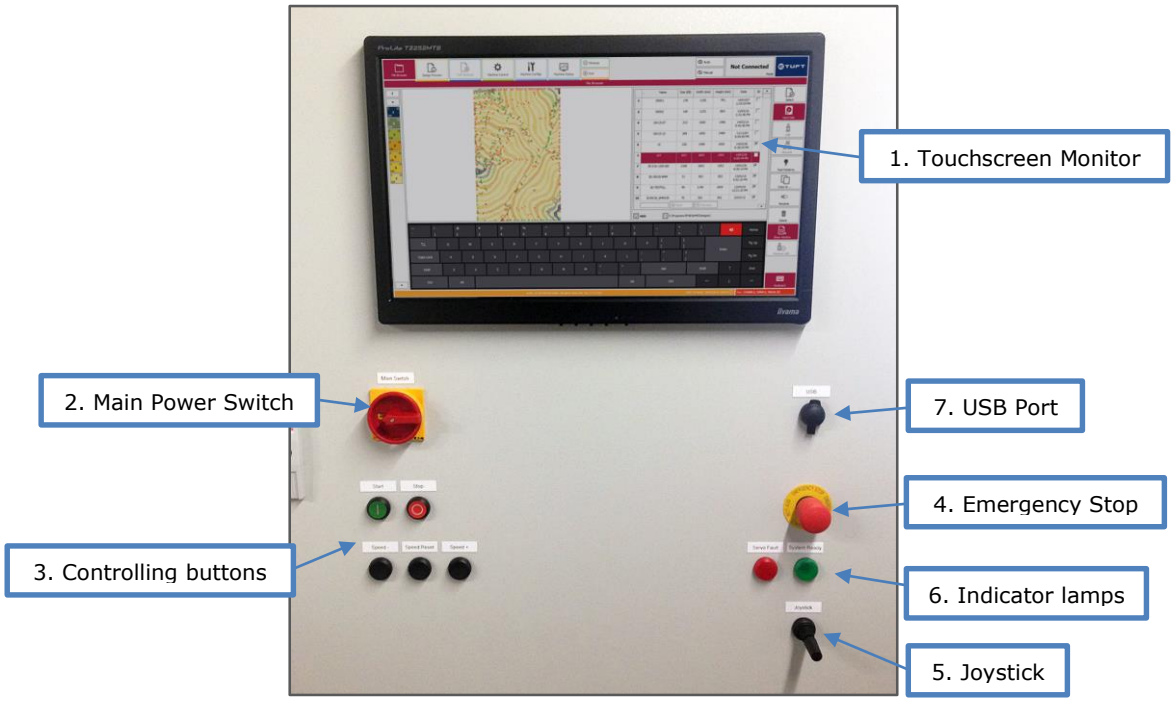


Figure 21: Control Panel

⚠ Turning the device off must be operated according to the instructions given in section 4.2. If you do not comply with the above point, the control computer may be damaged.

⚠ **After turning off the device, avoid turning it on again until 30 seconds. Failure to observe this point may cause damage to the machine drives.**

2.3.2 Remote Control

eTuft equipped with a wireless remote control that operator can use it instead of operator panel, especially when operator wants to work with tufting gun in park position.

Figure 22: Left) Remote Control Commander; Right) Remote Control Receiver

The remote control has two parts: *Remote Control Commander* and *Remote Control Receiver*.

2.3.2.1 Remote Control Commander

The buttons of remote control are:

- Emergency Stop
- Gun In
- Gun Out
- Backward
- Forward
- Park
- Feed Gun
- Stop
- Start
- 1 or Reset (In some models you can use this button to release the *Emergency Stop* of remote control)

The functionality of these buttons is same to the buttons on control panel (See section 2.3.1).

Once you pressed the *Emergency Stop* buttons the emergency stop chain of machine will be opened. For closing the emergency stop chain you need to first release the *Emergency Stop* button and then press the *Start* or *Reset* button on remote control.

2.3.2.2 Remote Control Receiver

Remote control receiver is responsible for receiving commands which sent from the remote machine and sending them to the control computer. It is installed inside of electrical cabinet.

2.3.3 Light Tower

The light tower (with three colors: Green, Yellow and Red) is located on the top of the electrical cabinet. The meaning of each color is as follow:

1. Green: The machine is working.
2. Yellow: This light is turned on in different states including:
    - Yarn rupture or breakage,
    - When the machine is placed in park position,
    - When the machine is waiting for the new yarn to be changed by the operator.

    In this state, the operator can investigate the cause of yellow light in the message window of eHMI software. (For more information refer to 1 *Warning message*)
3. Red: This light is turned on when the machine is in *Emergency Stop* mode.

Figure 23: Light tower on the electrical cabinet

2.3.4 Controller

This part is responsible for controlling the machine and executing of the tufting program. This controller is manufactured by *Power Automation* in Germany. The controller is divided into various parts as follows:

1. Main Controller
2. 2ENC4A Module

2.3.4.1 Main Controller

The main controller is a Windows XP based industrial PC controller which is responsible to control the machine. As explained in section 1.6.3 eTuft machine has 6 axes. The following four axes are controlling with this unit: *X, Y, B and A axes*.

Figure 24: Main Controller

You can find the main input and out puts of main controller as below:

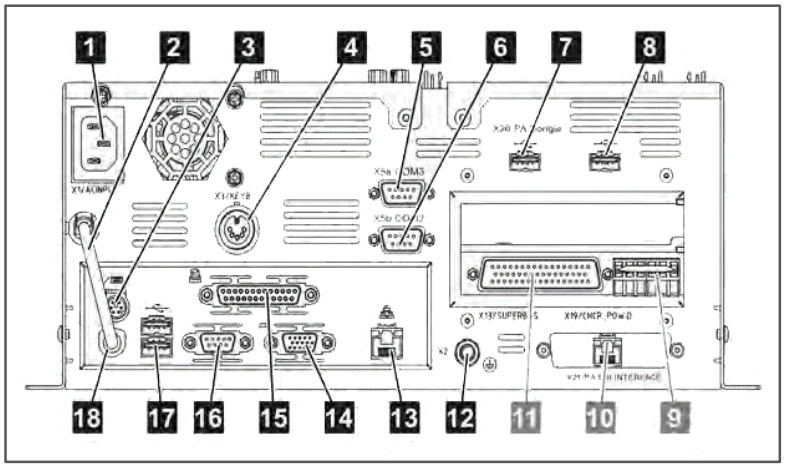


Figure 25: Input and output ports of controller

No	Name	Description
1	Supply voltage Input	
2	Cable keypad on panel	It is not used in this machine.
3	PS2 mouse input	It is not used in this machine.
4	keyboard input for *CNC*	It is not used in this machine.
5	COM1 serial input connector	It is not used in this machine.

6	COM2 serial input connector	It is not used in this machine.
7	CNC hardware lock connector	CNC hardware lock is installed in this part. Note that these locks should not be installed in another location due to causing failure of the machine.
8	EFAB lock hardware connector	Hardware lock must installed in this part. Note that these locks should not be installed in another location due to causing failure of the machine.
9	CNC Ready connector	It is used at emergency stop loop. For more information, please refer to the Electrical Guide.
10	Command Of digital Engine output	It is not used in this machine.
11	Super Bus connector	Interface between the controller and module 2ENC4A.
12	Earth connection	
13	Network connector	This connector can be used to join network devices.
14	VGA connector	It is used to connect a monitor.
15	LPT1 connector	It is not used in this machine.
16	COM1 connector	It is not used in this machine.
17	USB connectors	It is used to join Touch and Hub

Table 1: Controller input and output ports

The controller does not work without hardware locks (or USB dongle).

Never remove hardware locks (USB dongles) from their specific places. Movement of them may cause failure on the machine.

2.3.5 2ENC4A Module

This module is an extending module of main controller for connecting another two axes. The connected axes to this unit are: *Z and C axes*.

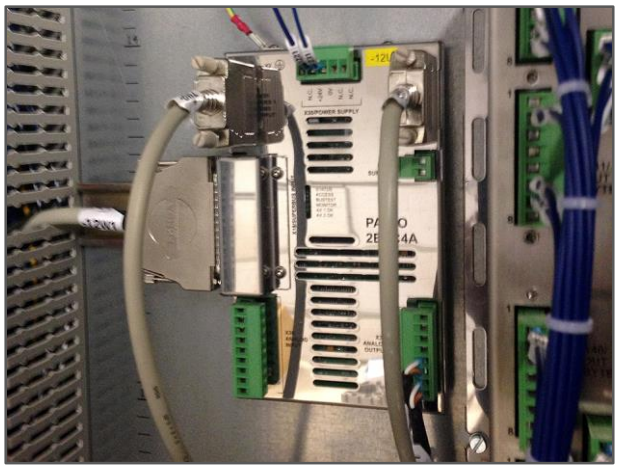


Figure 26: 2ENC4A Module

2.3.6 Signal Dispatcher Board

This electronic board is responsible for establishing communication between controller and servo motor drives. Signal Dispatcher Board shows the status of each drive and you can use the *Reset* buttons on it for clearing the error status from servo drives. The Board has two LEDs (*Ready and Break Release*) which normally should be on, if one of the LED's or both of them are turned off then problem is related to this servo drive. In this case, first check the alarm number displayed on servo drive and by using guidelines from servo drive manual try to find the cause of the error. Then attempt to resolve the error. After fixing the error cause, the *Reset* button on the relevant axis section can be used to clean the alarms.

The *Break Release* LED actually is applicable for Y-axis only. Since Y-axis is vertical axis, it shall be equipped with a brake to prevent collapse in time of power outage. This LED indicates the brake status of this axis. When this LED is on, it means that the brake is not active.

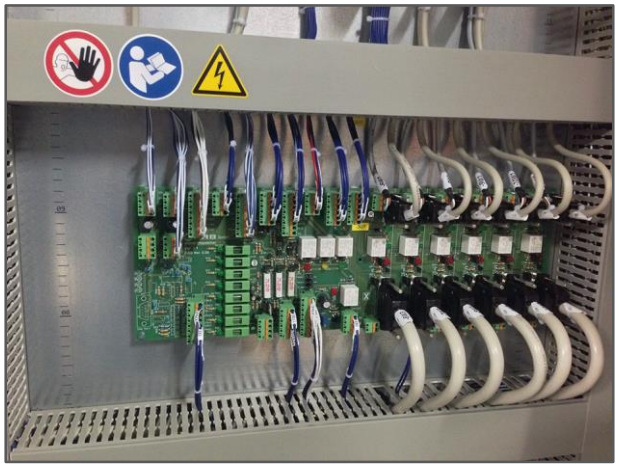


Figure 27: 2.3.6 Signal Dispatcher Board

2.3.7 Servo Drives

The electrical cabinet is equipped with 6 servo drives. Each of them are responsible to control the related servo motor of each axis. These drives has been adjusted before delivery and should not be manipulated by the operator. For more information about the error messages, fine tuning or adjusting the servo drives parameters, advanced users may refer to the user manual of them.

Figure 28: Servo drives,
from left to right: X, Y, Z, C, B and A axes

2.3.8 Fuses

Fuses are located at the bottom of the electrical board and protect the electrical cabinet components.

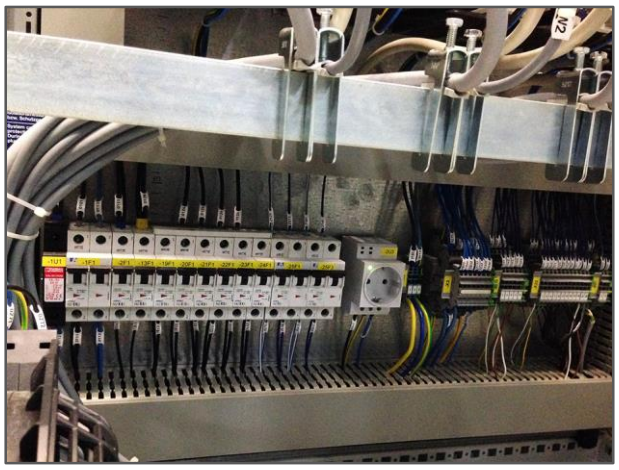


Figure 29: Fuses

For more information about the function of these fuses please refer to the electrical drawings of eTuft machines which is supplied separately from this help manual.

2.3.9 Fan thermostat

The thermostat controls when the electrical cabinet fan's runs. Set the thermostat on the temperature that you want to turn on the fan. The average setting is around 30 degrees. But it is related to the environment conditions.

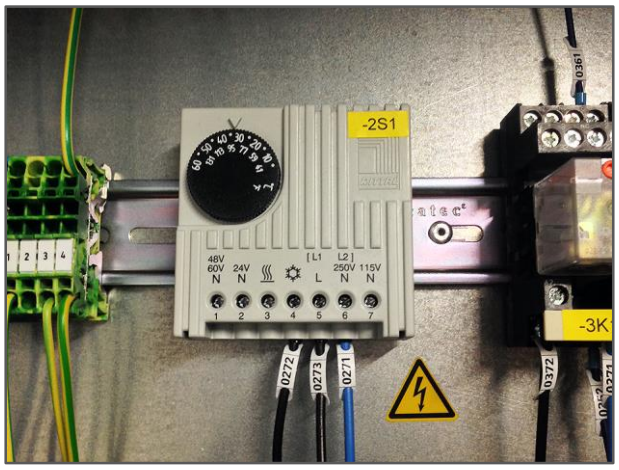


Figure 30: Fan thermostat

2.3.10 Cabinet light

The electrical cabinet equipped with internal system light (see Figure 31: Cabinet light).

By using state switch you can define three state of operation:

- Keep it always ON
- Keep it always OFF
- Turning ON whenever door is opened (triggered by door micro switch)

Figure 31: Cabinet light

2.4 eHMI Software

eTuft use a PC based controller produced by *Power Automation* company. All the controlling units including CNC kernel, PLC kernel and user interface embedded in one package. After system startup power automation software will load automatically. It starts the CNC, PLC and all other required services and then it starts eHMI software. You need to interact with eHMI software to monitor the machine activity and control the tuft operation.

eTuft HMI (Human Machine Interface) software or eHMI is specially developed to ease the robot operator tasks. This user-friendly interface using advanced algorithms to handle the eTuft and provide special reports and controlling items to make the operator runs the robot smoothly. File management, design previews, design selection, tufting process preview, setting the robot parameters like speed and dimensions, ability to view the tufting process on control unit while robot running and more are the capabilities which eHMI provides to the operator. For more information refer to section 3 *eHMI Software*.

2.5 Tufting head

eTuft equipped with a pneumatic tufting head (or tufting gun) with Ø6mm inside diameter hallow needle and 15mm pile height as standard needle (Ø4.8mm, Ø8mm and Ø11mm with different pile heights are available as additional items).

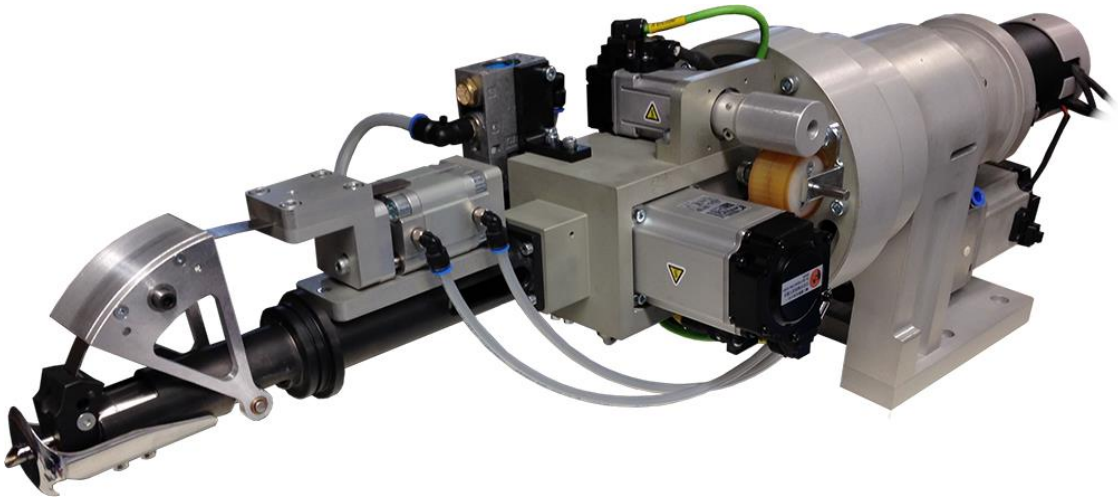


Figure 32: Tufting head version V

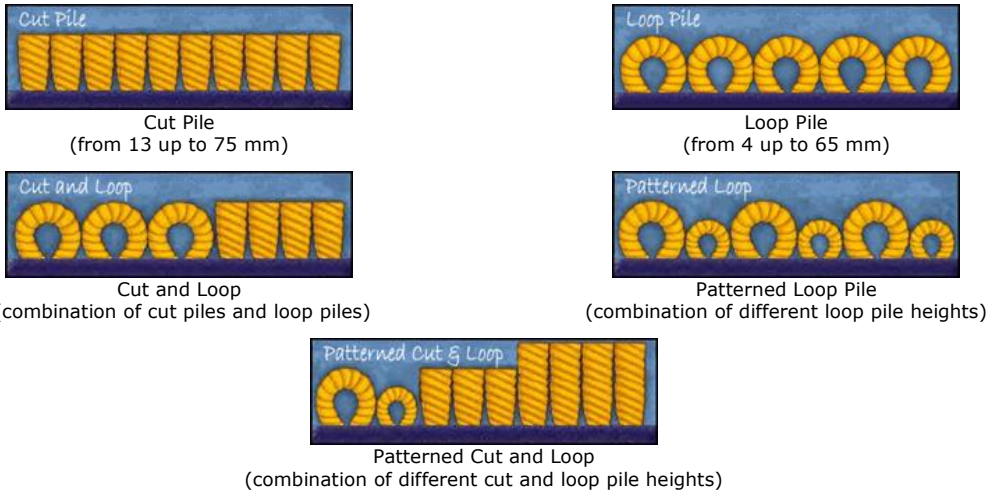
The technical specification of pneumatic tufting gun are:

- Using Ø6mm hallow needle as standard needle
- Piles: U-tuft Cut Pile, J-tuft Cut Pile and Loop Pile
- Cut pile height: 13mm - 75mm (lower pile heights is possible with additional accessories)
- Loop pile height 4mm - 65 mm
- Variable pile height 3D effect Carpets and Rugs
- Smart cut and loop forming system for automatic change over from cut to loop and vice versa without any mechanical settings or machine stoppages
- Maximum density: 500 stitches/meter

⚠ Clean and lubricate tufting gun every 2-4 hours (due to yarn type). This will increase the life time of tufting head and will result the better tufting quality. For more information about cleaning and lubricating the tufting gun refer to section 55 *Cleaning, Lubricating and Maintenance*.

2.5.1 Possible cut and loop effects

Here you can find the possible cut and loop effects by eTuft.



Cut Pile
(from 13 up to 75 mm)

Loop Pile
(from 4 up to 65 mm)

Cut and Loop
(combination of cut piles and loop piles)

Patterned Loop Pile
(combination of different loop pile heights)

Patterned Cut and Loop
(combination of different cut and loop pile heights)

Figure 33: Possible cut and loop effects in eTuft

2.5.2 U-Tuft and J-Tuft

There are two possible cut pile by eTuft pneumatic tufting head: U-Tuft and J-Tuft.

In U-Tuft the both side of cut pile or both legs are equal. But in J-Tuft one leg of cut pile will be longer or shorter than the other leg.

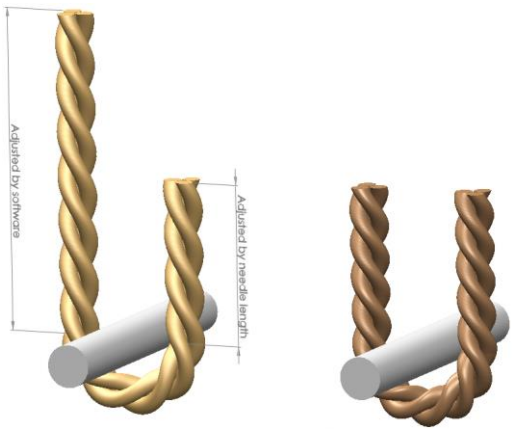


Figure 34: J-Tuft and U-Tuft

In cut pile tufting process there are two legs of yarn which is forming the **U** or **J** shape. The length of the second leg is always fixed and it is calculated by length of the needle. For example, if you have a needle with total length of 19mm then the length of fixed leg (or second leg) of cut pile will be 15mm (19-4=15 mm). If you stand beside the tufting head and it moves from left to right then second leg will be in the right side.

A-Axis controls the total length of yarn feed in tufting process. By adjusting the tufting length in eHMI software you can control the length of the first leg. If it is adjusted accurately then the first leg and the second leg will be equal and you will get the U-Tuft cut pile. But if the adjusted tufted length is higher than the desired value for U-Tuft then the first leg of cut pile will be longer than the second one (see Figure 34: J-Tuft and U-Tuft). If the adjusted tufted length is lower than the desired value for U-Tuft then the first leg of cut pile will be shorter than the second one. (For more information see section 3.5.2 *Layers specifications list*)

Extreme J-Tuft cut pile is a suitable choice for producing the Shaggy carpets. For example, by operator can adjust the machine in a way to have a J-Tuft (with 19mm length needle) to have a cut pile with first leg of 35mm and second leg of 15mm. But for producing Shaggy carpets with U-Tuft then tufting gun shall be equipped with 39mm length needle and the right adjustment in eHMI software to get the U-Tuft in 35mm.

2.5.3 Tufting Gun Components

The major components of tufting head are as below:

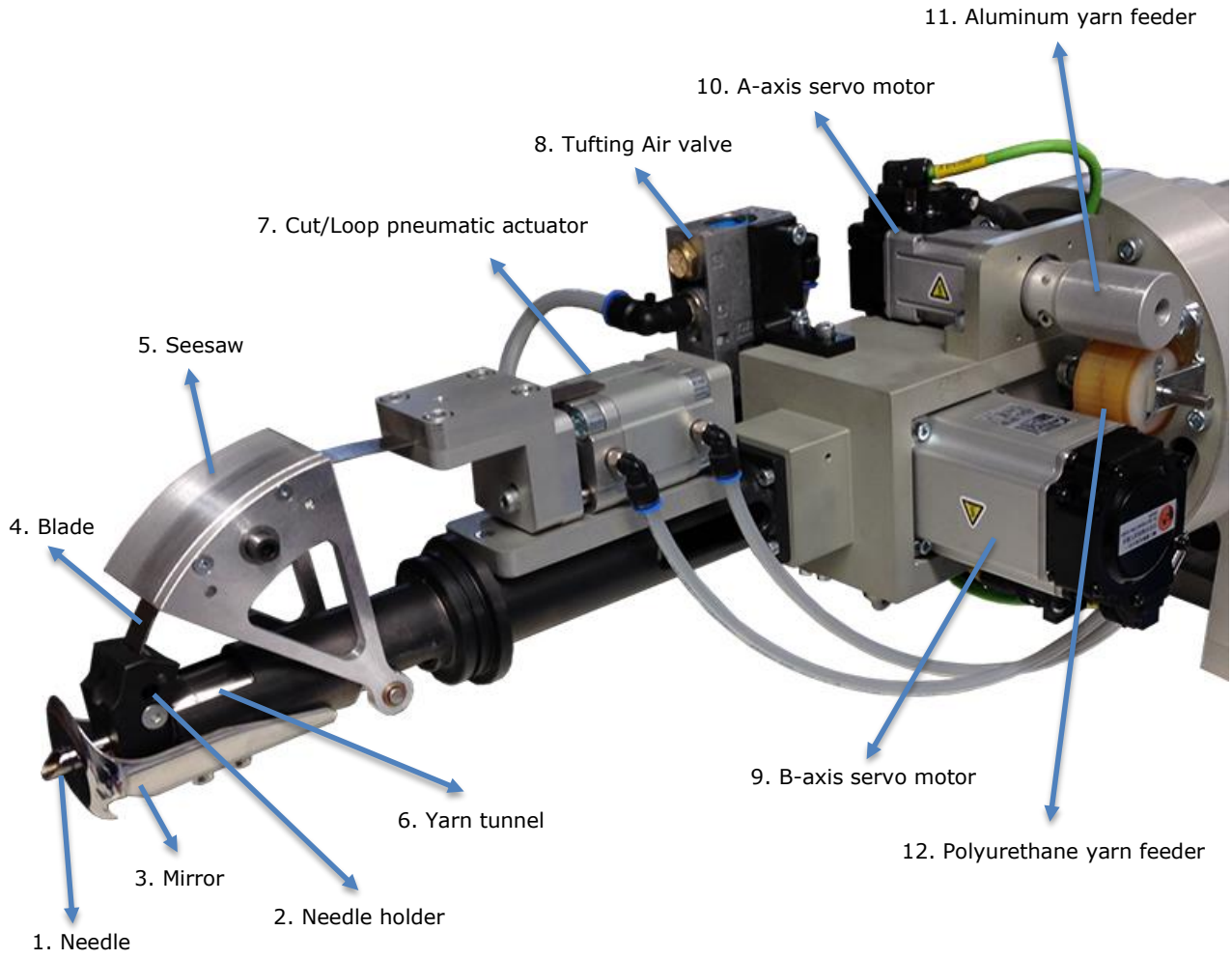


Figure 35: Tufting gun major components (front)

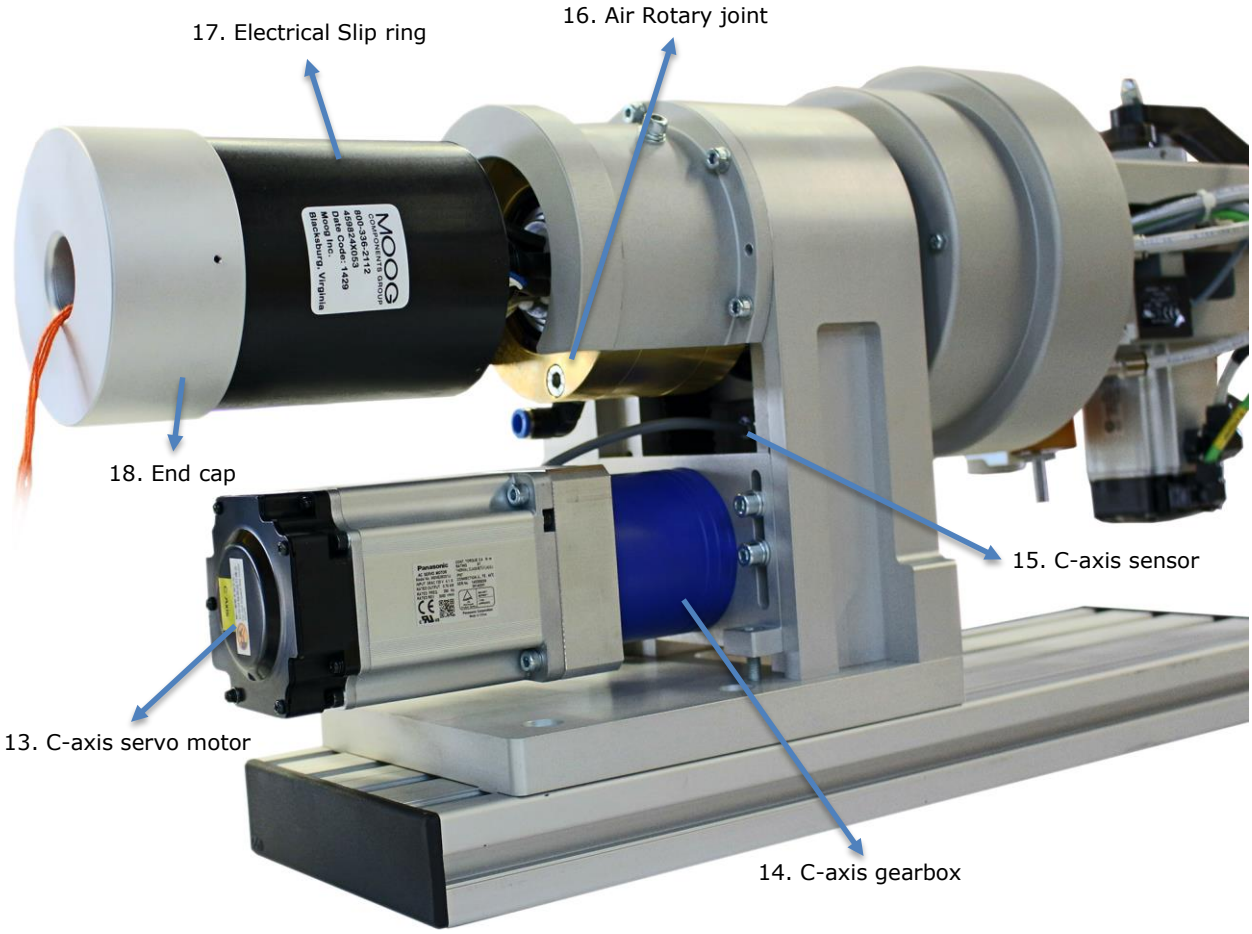


Figure 36: Tufting gun major components (back)

You can find more information about adjusting or replacing the components of tufting gun in section 4.

2.5.4 Smart Cut/Loop components

Pneumatic actuator and related valve control the cut/loop state of tufting head. If the pneumatic actuator stay in front position then the blade will cut the yarn and machine will work on the cut pile mode (Figure 38). If the pneumatic actuator stay in back position then the blade will not cut the yarn and machine will work in loop pile mode (Figure 39).

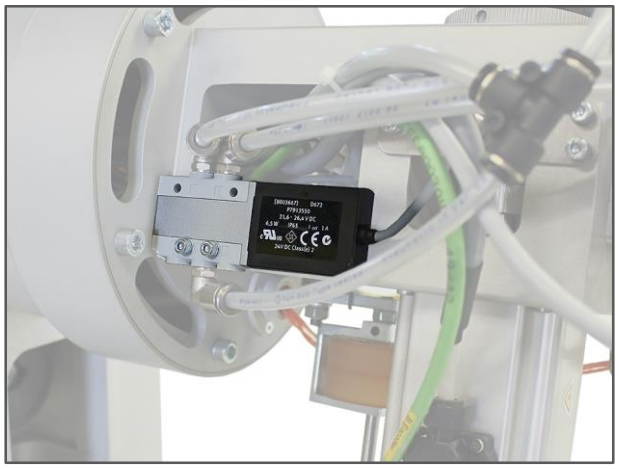


Figure 37: Cut/Loop pneumatic valve

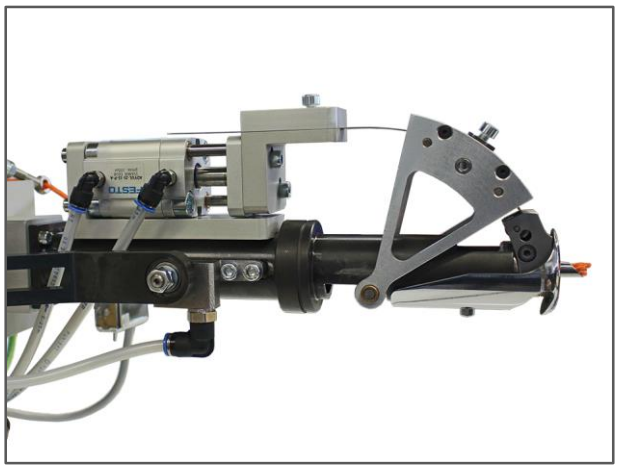


Figure 38: Cut/Loop pneumatic actuator in front position [Cut Pile]

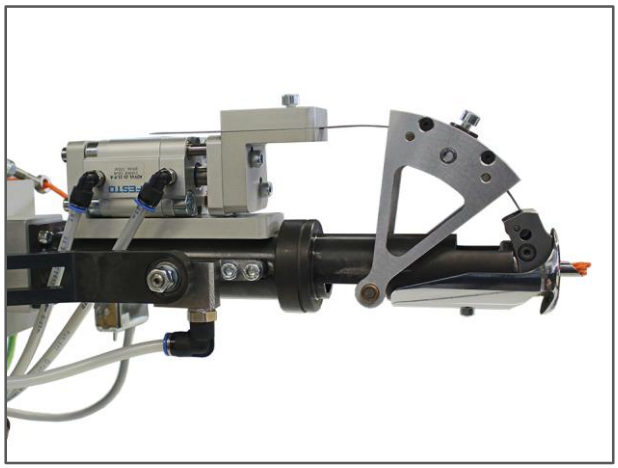


Figure 39: Cut/Loop pneumatic actuator in back position [Loop pile]

2.6 Laser Pointer

The Laser Pointer is located in front of Z-Axis to point to the exact place where the tufting needle will penetrate into the primary backing fabric.

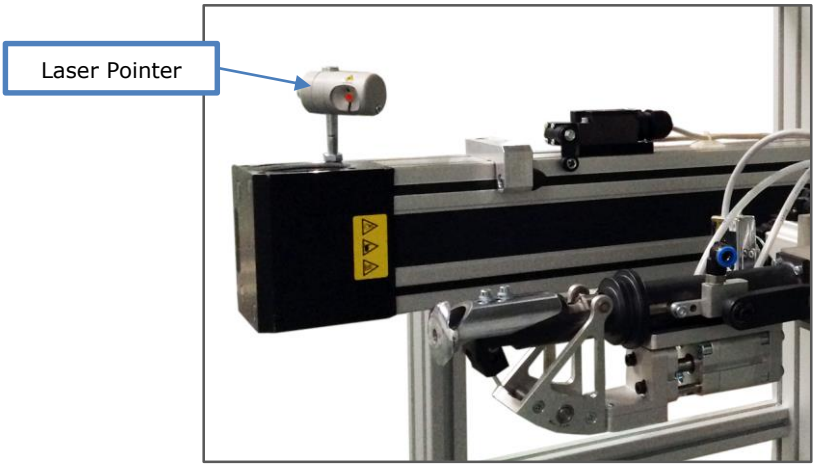


Figure 40: Laser Pointer on Z-Axis

ⓘ The Laser Pointer works only in *Manual* mode of machine.

2.7 Tufting frame

eTuft has a removable metal frame including nail boards and capable to set the backing fabric tension in 3x4 meter models. Tufting frame will be attached to the machine by set of manual and pneumatic fixing clamps. (2/3 manual fixing clamps on the bottom and 2/3 pneumatic fixing clamps on the top of 3x4/4x6 machines respectively).

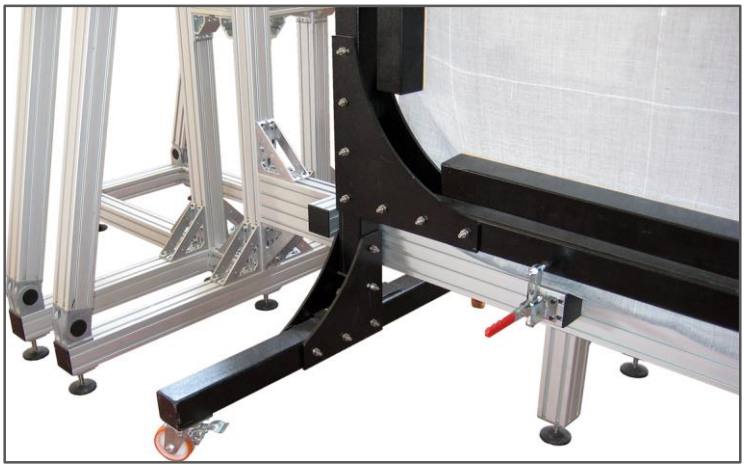


Figure 41: Tufting Frame (Steel frame coated by Black color in 3x4 meter models)

Tufting frame consists of the following components:

1. Main Body
2. Nail Boards for keeping the backing fabric.
3. Tensile bolts for adjusting the fabric tension (in 3x4 meter models only).

You can find more information about preparing the primary backing fabric on the frame in section **Error! eference source not found.** ***Error! Reference source not found.***.

2.8 Creel

eTuft has a *Creel* with 8 eyelet yarn break sensor for keeping the yarn bobbins. (Optional *Rotating Creel* and *Moveable Creel connected to Y-Axis* are available by request).

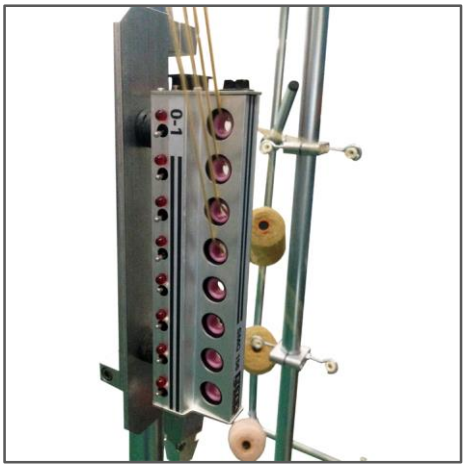


Figure 42: Yarn break sensor with 8 eyelet on Creel

Regardless it is movable or fixed, creel has same components. These components are:

1. Main Body
2. Bobbin holders
3. Conductive yarn eyelets
4. Yarn break sensor with 8 eyelet

Figure 43: Fixed Creel

The yarn break sensor on *Creel* has eight eyelets and beside of each eyelet there are one LED and one Switch. If the yarn is passed through the eyelet then the related Switch of it must be set on position "1". Otherwise the Switch of unused eyelet must on set on position "0". During tufting process if the LED of one of eyelets stays off for 3 seconds then it will cause the machine to stop operation and error message of "Creel Yarn Break" will be displayed on eHMI software.

⚠ There is a switch beside each eyelet of sensor. For the unused eyelets put it at "0" position. Otherwise you will face "*Creel Yarn Break*" error message during the tuft operation and machine will be stopped.

2.9 eDesigner CAD Software

eDesigner is a comprehensive solution which is able to meet all designing tasks for robotic tufted carpet and rug production.

This advanced solution is coming with flexible set of drawing tools and complete range of designing functions and features, which are increasing the designing speed, accuracy and proficiency which is fully compatible with eTuft machines.

For more information about eDesigner CAD software please refer to help manual of it.

3 eHMI Software

In this section you can find how to work with eHMI software.

Figure 44: eHMI intro

3.1 Definitions

3.1.1 Expression of touch screen

Click:	Tapping with a finger or special pen on the touch screen in this manual called "Click" briefly.
Right Click:	Putting a finger on the touch screen and hold it for a few seconds will simulate mouse right-click operations. That moment after holding a finger on the screen appears a hollow circle and the circle is filled, gradually, after a few seconds. After filling the circle, command of right-click is sent to PC.
Drag:	Putting a finger or special pen on the touch screen and move it without lifting a hand will simulate command of Drag.

3.1.2 The terms of software components

Here you can find the main terms of software components as following:

Page:	Each page is dedicated to handle special task and functions, like file management tasks, tuft setting, controlling of machine and …
Box:	Each rectangular box in software that contains data or other software components.
Buttons:	Buttons will do the specific function.
Edit box:	Small editable boxes with white background which the operator can edit the number and values of it.

Figure 45: Edit box

Dialog box for entering the values:	If the operator clicks any of the editable fields in the software like edit boxes then a small dialog box with numeric keys will appeared to edit the value of them (See Figure 46).

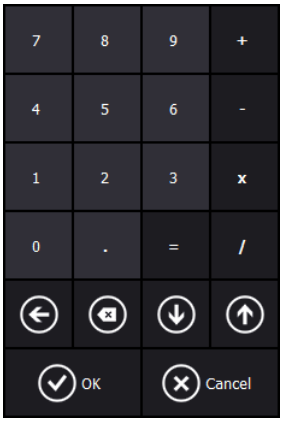


Figure 46: Dialog box for entering the values

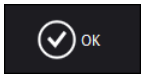
The components of this dialog box are:

It erases the last digit (Backspace)

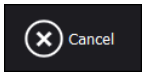
It erases the whole entered value

It decreases one unit of the entered value

It increases one unit of the entered value



It changes the entered value in the edit box and closes this dialog box



It ignores the changes and closes this window

This dialog box can also be used as a calculator as well.

3.2 Main components of the eHMI software

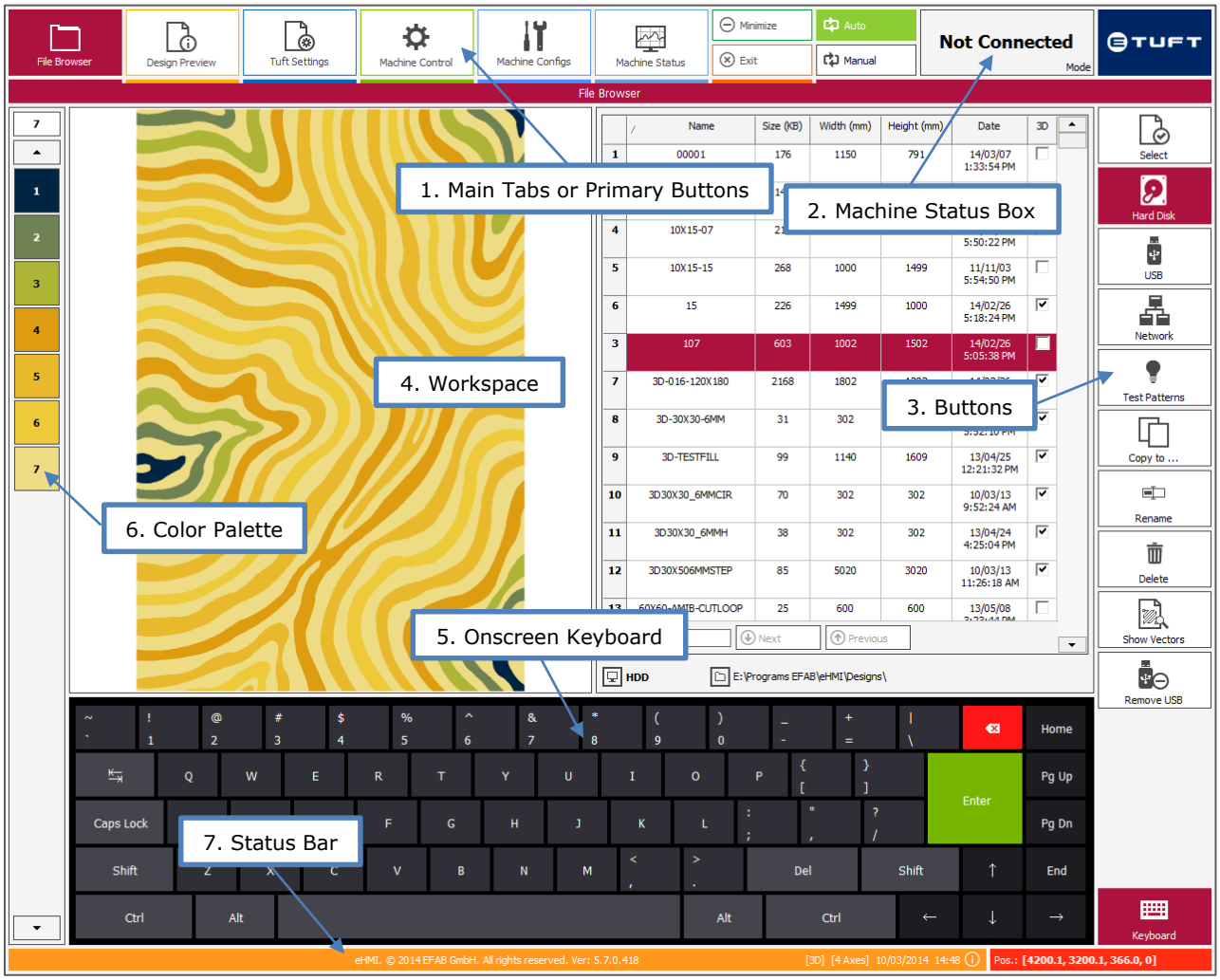


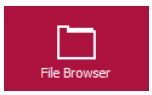
Figure 47: Components of the eHMI software

The user interface of eHmi software has main components as below:

1. Main Tabs or Primary Buttons
2. Machine Status Box
3. Buttons
4. Workspace
5. Onscreen Keyboard
6. Color Palette
7. Status Bar

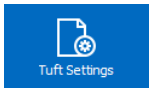
3.2.1 Main Tabs or Primary Buttons

Here is the list of primary buttons:

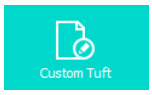


It displays *File Browser* page

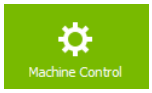
It displays *Design Preview* page



It displays *Tuft Settings* page



It displays *Custom Tuft* page instead of *Tuft Settings* page after choosing this mode from *Tuft Setting* or *Machine Control* pages



It displays *Machine Control* page

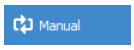
It displays *Machine Configs* page

It displays *Machine Status* page

It minimizes eHMI software

It closes eHMI software

It will change the controller mode into *Automatic*



It will change the controller mode into *Manual*

3.2.2 Machine Status Box

It displays the status of the machine.

Figure 48: Machine Status Box

It is containing four different elements:

1. Background Color as below:
    a. Gray: Waiting for command
    b. Green: Working
    c. Red: Emergency Stop
    d. Orange: calibrating
2. Chain image on upper left corner as below:
    a. Closed Chain: Emergency stop loop is closed
    b. Broken Chain: Emergency stop loop is opened (Machine will not work till releasing all the emergency stop buttons and pressing the *Start* button on remote control).

3. Bold message in the middle as below:
    a. Not Connected
    b. Ready
    c. Stopped
    d. Working
    e. Emergency Stop
4. Small text on lower right corner describing the mode of machine as below:
    a. Auto
    b. Manual
    c. Calibrate

To find more information about the controller status, see section 3.7.7 *Controller Status* and section 3.7.8 *Controller Mode*.

3.2.3 Buttons

In each pages of eHMI software, there are several buttons for specific functions and tasks.

3.2.4 Workspace

Workspace of each pages of eHMI software is in this space.

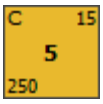
3.2.5 Onscreen Keyboard

Keyboard will be displayed in the *File Browser* and *Machine Configs* pages for entering the required data and parameters.

3.2.6 Color Palette

It displays short information of each layer of selected design. It will be displayed in the *File Browser*, *Design Preview*, *Tuft Settings*, *Custom Tuft* and *Machine Control* pages.

Each small box displays several information as below:



1. Color of Layer
2. Index of Layer in the middle and in bold (in this example is *5*)
3. Pile type on the upper left corner (in this example is *C*)
   It could be:
   a. "C": Cut Pile
   b. "L": Loop pile
   c. "M": Mixture of cut and loop
4. Density in lower left corner (in this example is *250 stitches per meter*)
5. Pile height (in this example it is *15mm*)
   In 3D designs it will shows the minimum and maximum pile height (for example *15-35*)
6. If you hold the mouse cursor or your finger on the specific box then the name of layer will be displayed in the left corner of status bar as below (in this example is *Citrus*).

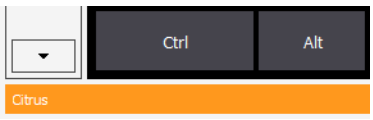


Figure 49: Layer name displayed in status bar

3.2.7 Status Bar

Status Bar of eHMI software is located on the bottom of user interface and containing the following items (from left to right):

1. Hint of each component on the screen
2. eHMI copy right and version information
3. 3D module status
4. Number of simultaneous axes on the controller of machine
5. Current Date
6. Current Time
7. Status of CNC server
8. Position of machine axes [X, Y, Z, C]

Figure 50: Status Bar

3.3 File Browser page

Browse and manage designs stored in computer hard disk, USB memory or shared folder on network will be handled in this page.

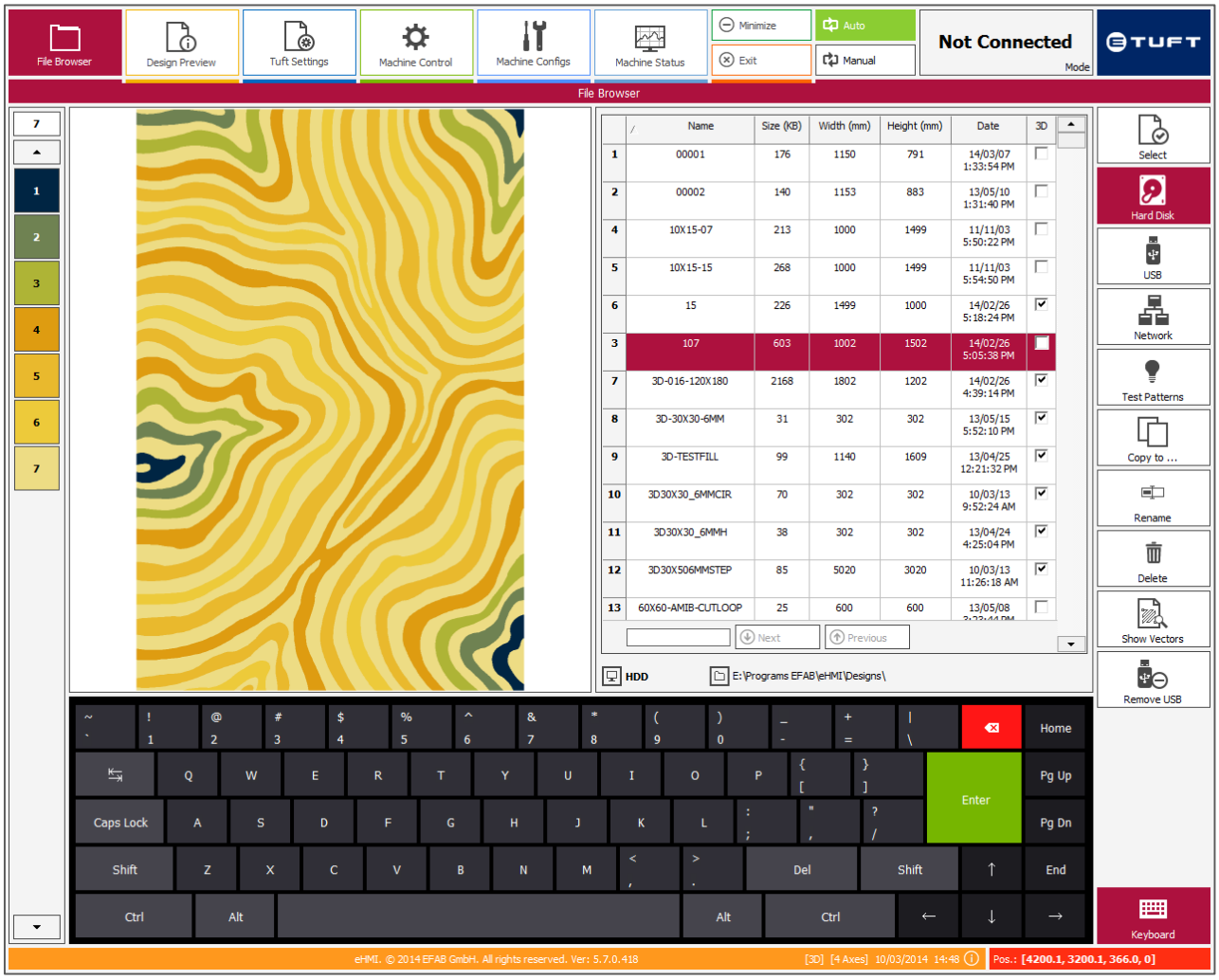


Figure 51: *File Browser* page

3.3.1 Functions and buttons

Show preview of selected design in *Design Preview* page

You can select the following sources of designs:

1. Hard Disk
2. USB memory stick: In case of USB, operator can select the path of designs from folder tree that appeared under the design list. It is possible to select the different folders by using *UP* and *Down* key as well. (See Figure 52)
3. Network. For defining the *Network Path* (please refer to section 3.8.2.3 Paths tab).

Test patterns available in eHMI

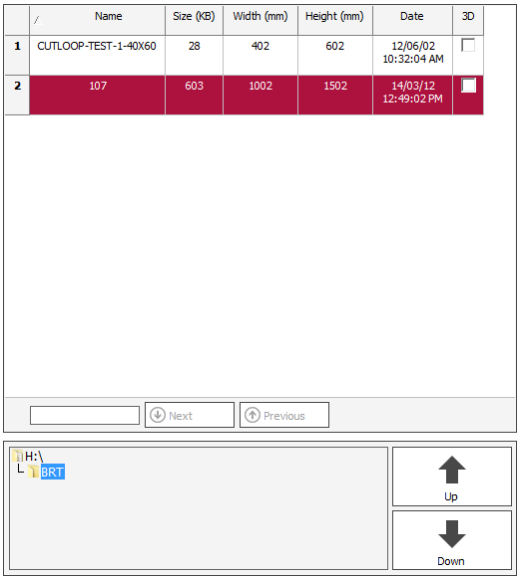
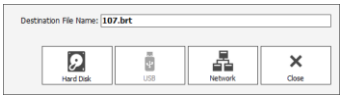


Figure 52: List of folders and files in USB memory stick

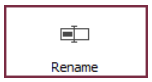
You can only select designs from *Hard Disk* or *Test Patterns* for tufting. But you cannot select designs from *USB* or *Network* directly. For this reason, first you should copy designs from *USB* or *Network* to the *Hard Disk*. (See Section 4.4)

Do not connect more than one USB memory stick to the controller at the same time.

Copies selected file from list to the defined target by operator. Operator can select the target from the available devices. Also operator can change the file name in *Destination File Name* edit box.



For copying a new design file from USB memory stick into machine you can refer to section 4.4



You can change design name in *Destination File Name* edit box.

Use this button to delete the selected design from a list

Be careful about deleting the designs. If the design deleted by operator then it is not possible to recover it again.

Toggles between *Bitmap* view and *Vector* view (see Figure 53)

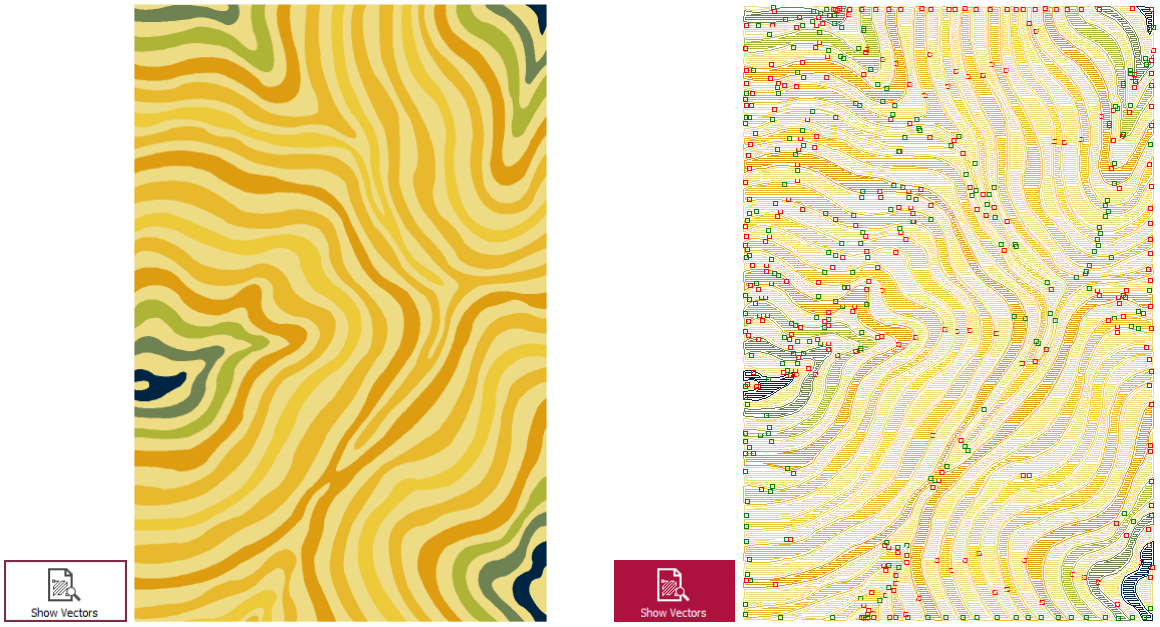
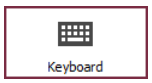


Figure 53: Bitmap view (left side) and Vector view (right side)

Safely remove USB from the controller. Press this button before removing the USB memory stick.

By clicking on *Remove USB* you will reduce the risk of damages to the data stored in USB memory stick.

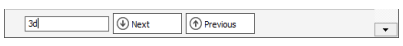
Ignoring to remove the USB memory stick safely, may cause damage to the data in it.



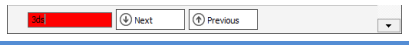
Show/Hide *On Screen Keyboard*

List of designs available in selected device be shown in *Design List* window. *Name*, *Size (KB) Dimension, Modification date* and *3D* status of each design is listed there. You can sort the designs based on these items (Name, Size, Date and …) by clicking on these items.

You can use the *Search Box* to find your desired file. Click on the *Edit Box* inside of *Search Box* edit box. When cursor start blinking inside of it, use the *Onscreen Keyboard* to type your desired design name. You can use the *Next* and *Previous* buttons for going up and down in the lsit as well.



If your desired file name is not exist then the background color of *Edit Box* will be changed in to Red (as below).



3.4 Design Preview page

In this page operator can view the view the details and information of design in *Bitmap*, *Vector* and *3D* modes.

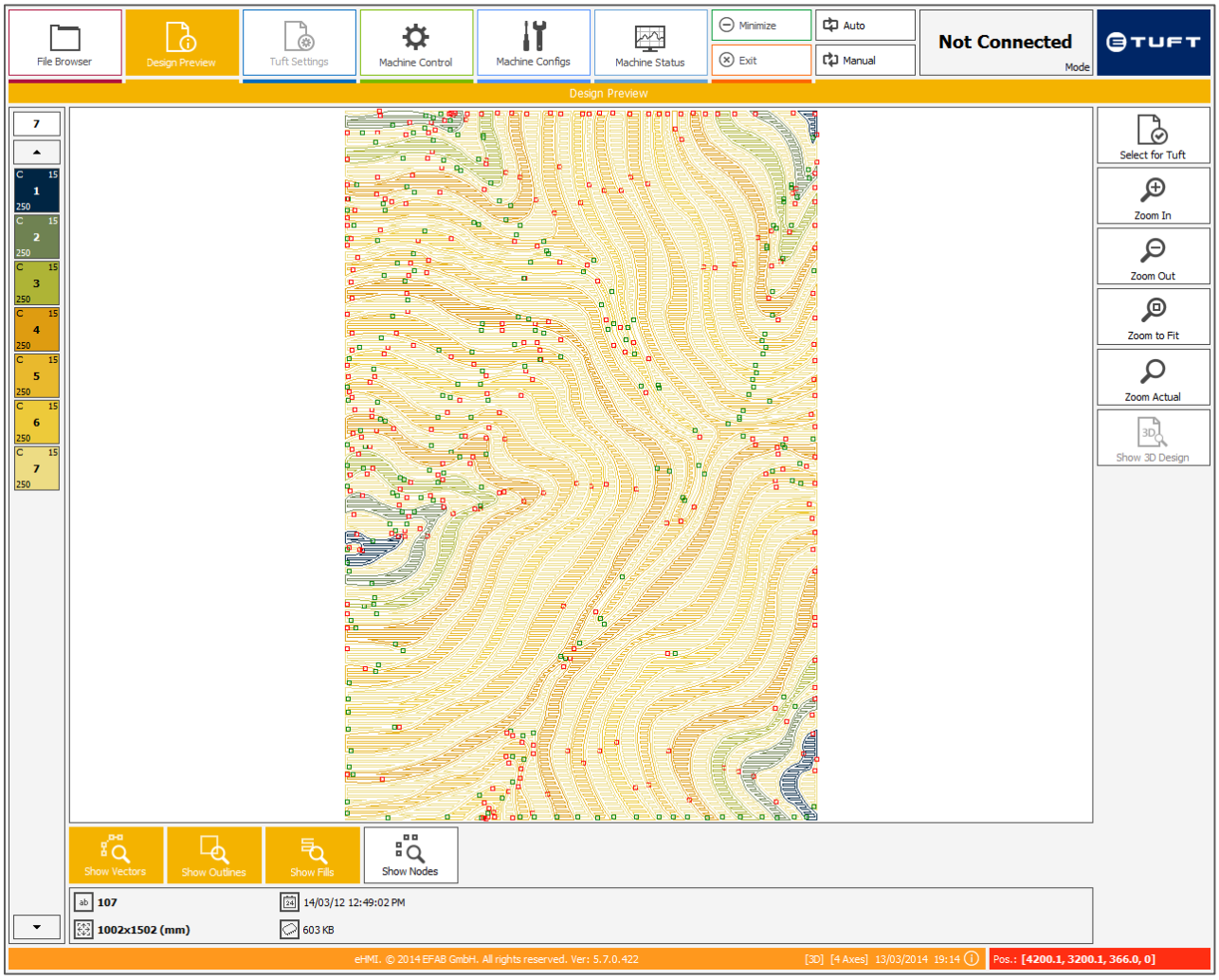
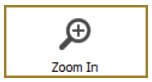


Figure 54: *Design Preview* page

3.4.1 Functions and buttons

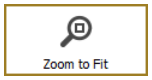
Send the Design to the *Tuft Settings* page for applying tuft settings

> Use *Select for Tuft* button if you want to set the parameters before start tufting.
>
> When machine is working, "*Select for tuft*" button is disabled. It means that operator cannot change the current design while machine is working. To select new design, machine must be stopped.



Zoom in

Zoom out



Zoom to fit the design in the preview area

Zoom to the actual image size

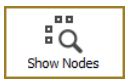
Show/Hide 3D preview of design in case that design has been saved in 3D format

Show 3D Design button is enabled only in case of 3D designs.

Toggle between vector and bitmap view

Toggle between show/hide *Outline vectors*

Toggle between show/hide *Fill vectors*



Toggle between show/hide nodes of vectors

Drag mouse over the preview area to pan.

3.4.2 Design information box

In this box you can find the design information as below:


Design Name


Design dimension in mm


Design modification date


File size (KB)

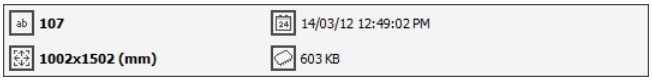
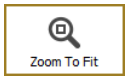


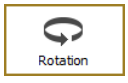
Figure 55: Design information box in *Design Preview* page

3.4.3 3D View

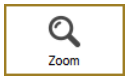
In case of 3D designs, there will be additional 3D view of design as shown in Figure 56. The following buttons are related to this view.



Zoom to fit the 3D design

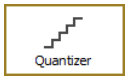


Change the mode of mouse into rotating the 3D design



Change the mode of mouse into zooming the 3D design

Change the mode of mouse into panning the 3D design



Toggle between viewing the 3D vectors in Normal or Quantized mode

Drag mouse over 3D view area to *Rotate*, *Zoom* or *Pan* based on mouse mode buttons mentioned in above.

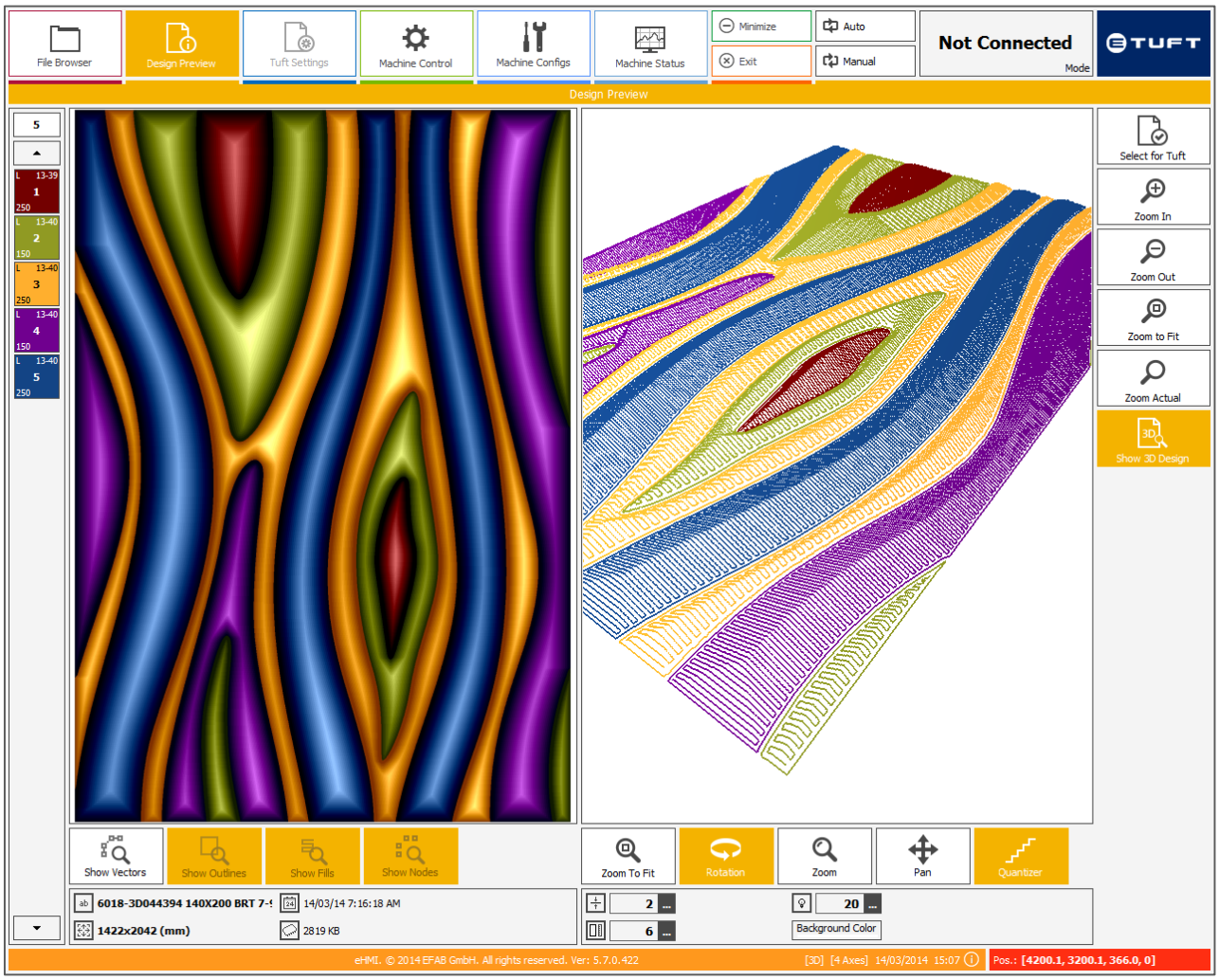


Figure 56: *Design Preview* page for 3D designs

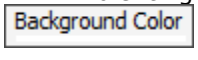
3.4.4 3D View adjustment box

In this box you can find the 3D View adjustments as below:

 Thickness of vector lines

 Height scale

 Ambient light adjustment



Changes the background color

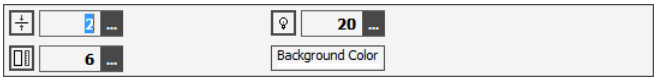


Figure 57: 3D View adjustment box

3.5 Tuft Settings page

In this page operator can prepare design for tufting process. Adjustable tufting parameters are as below:

- Design position in the frame
- Orientation of design
- Order of layers
- Layer parameters:
  - Density
  - Cut or loop pile property
  - Pile height
  - Gun Speed
- Order of tufting for outlines and fills

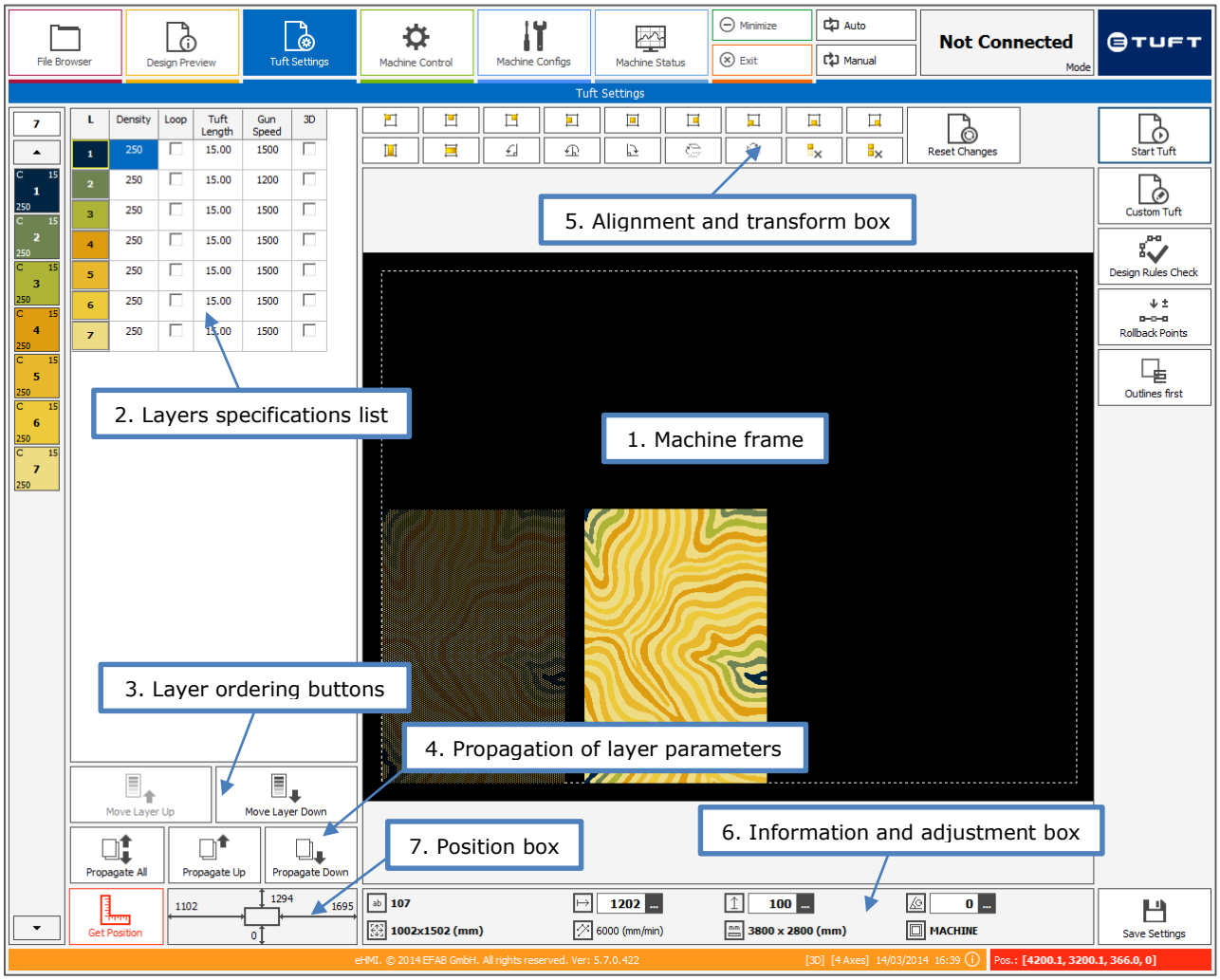


Figure 58: *Tuft Settings* page

The main components of this page are:

1. Machine frame
2. Layers specifications list
3. Layer ordering buttons
4. Propagation of layer parameters
5. Alignment and transform box
6. Information and adjustment box
7. Position box

If the machine is in working mode then all buttons will be disabled in this page. The operator cannot select a new tufting design while machine is working. To select a new design for tufting, the robot should be stopped.

3.5.1 Machine frame

In this area operator can define the place of design in tufting frame. There are different possibilities for doing this job:

a. Dragging:

   It is possible to drag the design to the desired position.

b. Alignment tools:

   By using proper tool in alignment and transform box (see section 3.5.5).

c. Numeric values:

   Manually set the X and Y offset values by two edit boxes in information and adjustment box (see section 3.5.6).

d. Aligning with previous tufted carpets:

   Operator can align the design to the previous tufted designs on the frame. For using this option, be sure that the *Show Tuft History* feature in *Machine Configs* page is enabled (see 3.8.2.2.2 Tufting History).

   Click on the desired tufted design (which is marked with a different color on the frame). Then right click on the green arrows that appeared. Selected design for tufting will be aligned with respect to the location of the flash. The operator can determine the distance between the new and old designs on the frame during the alignment. For this purpose, define the desired values in *Auto Align* section of *Machine Configs* page in section 03.8.2.1.2.

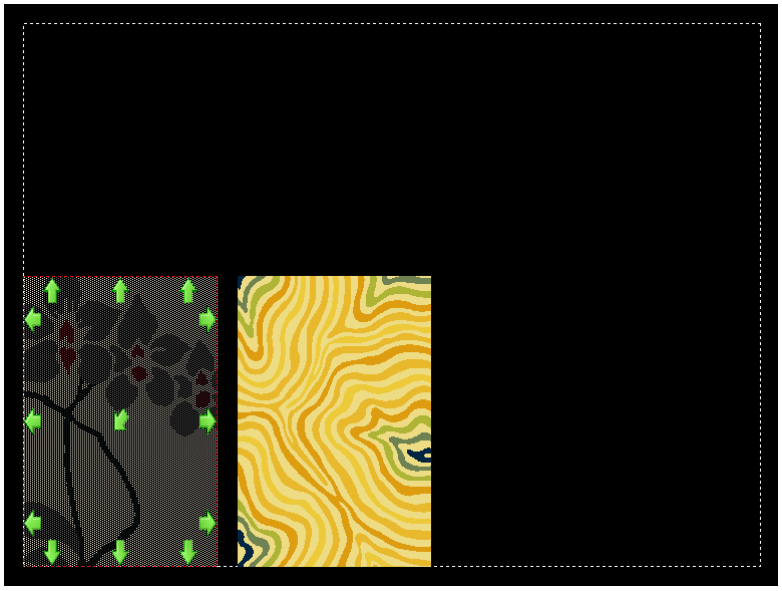


Figure 59: Machine frame view in *Tuft Settings* page

If you hold the mouse pointer on the previous tufted carpet you can see the tufting parameters of it including: X and Y Offsets, Layers properties including pile type, density and tuft length. (See Figure 60: Information on tuft history)

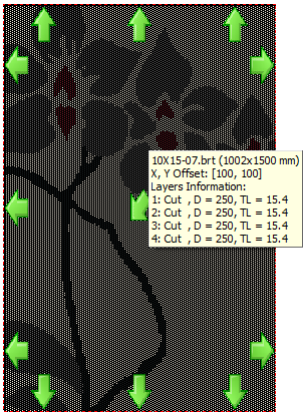


Figure 60: Information on tuft history

e. Getting position from laser pointer:

   By clicking on *Get Position* button, the X and Y offsets of design automatically will be changed into the current tufting head position which is visible by laser pointer on primary backing fabric in *Manual* mode (See 3.5.7).

3.5.2 Layers specifications list

In this section, the prepared design layers for tufting is listed on a table with several information about each layer. The operator can set the density, cut or loop property, pile height and tufting speed of each layer separately in this table before starting the tuft process.

In the layers specifications list operator can change the setting of design layers as below:

- *Density or Stitch length:* Defined by number of stitches per meter (st/m).
- *Loop:* Mark it if you want to tuft the selected layer in loop pile.
- *Tuft length:* You can adjust the pile height of each layer here which is in mm.

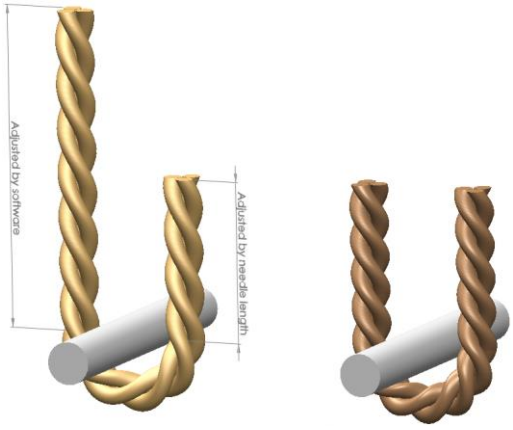


Figure 61: J-Tuft (left) and U-Tuft (right),
direction of tufting horizontally from left to right

By changing the tufting length in eHMI software you can control the length of the first leg in cut pile (for more information refer to section 2.5.2 *U-Tuft and J-Tuft*). If it is adjusted accurately then the first leg and the second leg will be equal and you will get the U-Tuft cut pile. But if the adjusted tufted length is higher than the desired value for U-Tuft then the first leg of cut pile will be longer than the second one (see Figure 61). If the adjusted tufted length is lower than the desired value for U-Tuft then the first leg of cut pile will be shorter than the second one. (For choosing the right needle see section 4.9 *How to choose the right needle size?*)

If you stand beside the tufting head and it moves horizontaly from left to right then the first leg (adjustable lenght by eHMI software) will be on the left side and the second leg (fixed lenght adjustable by needle lenght) will be on the right side.

- *Gun speed:* You can set the desired gun speed based on rpm or stiches/minute here. The linear speed of machine is related to *Gun Speed* and *Density.* The higher density will reduce the linear speed of machine and vice versa.
- *3D:* It shows that this layer is 3D or not. Please note that you cannot change this parameter.

L	Density	Loop	Tuft Length	Gun Speed	3D
1	250	☐	15.00	1500	☐
2	250	☐	15.00	1200	☐
3	250	☐	15.00	1500	☐
4	250	☐	15.00	1500	☐
5	250	☐	15.00	1500	☐
6	250	☐	15.00	1500	☐
7	250	☐	15.00	1500	☐

Figure 62: Layers specifications list

If a layer of design is 3D then it is not possible to change the pile height parameter here. It can be adjusted only on *eDesigner* software.

Although you can increase the *Gun Speed* parameter up to 2000 stiches/min, but for the longer life time of the tufting gun, it is recommended not to use it with speeds over 1700 stitches/min.

It is recommended to reduce the *Gun Speed* for hard cutting materials or when you want to have better tufting quality on the edges of zig-zag fillings.

Although you can change the speed of machine by *Speed+* and *Speed-* on control cabinet but there is a difference between these two options.

Decreasing the speed of machine from control panel by using *Speed-* button will reduce the overall speed of machine. It means that speed of un-tuft moves and rotation of C-axis will be reduced, too.

For this reason the speed of gun rotation (C-Axis) will be decreased as well. This will cause unwanted curves at the end of the zig-zag lines.

But decreasing the *Gun Speed* in *Layers specifications list* will only decrease the tufting gun speed without reducing the overall speed of machine. In this way the speed of gun rotation (C-Axis) will not be decreased and the zig-zag ends will be kept sharp. Meanwhile machine will travel on un-tufted moves with maximum speed.

3.5.3 Layer ordering buttons

You can change the tufting priority of a selected layer by using these two buttons.

Figure 63: Layer ordering buttons

Heavy carpets will cause some unwanted displacements on the primary backing fabric and because of that some over tufting will be happened in these carpets. Besides because of pneumatic tufting gun, tufting the loop piles are very sensitive to over tufting. For these reasons it is recommended to start tufting with small areas of design and with loop piles. Use the *Move Layer Up* and *Move Layer Down* buttons to arrange the tufting priorities.

3.5.4 Propagation of layer parameters

By using these buttons, you can set the value of all/above/below cells equal to the value of selected cell in layer specifications list.

Figure 64: Propagation buttons

3.5.5 Alignment and transform box

Alignment tools are as below:

 Align to the top left of frame.

 Align to the top center of frame.

 Align to the top right of frame.

 Align to the left center of frame.

 Align to the center of frame.

 Align to the right center of frame.

 Align to the bottom left of frame.

 Align to the bottom center of frame.

 Align to the bottom right of frame.

 Align to the X center of frame.

 Align to the Y center of frame.

Transform tools are as below:

 Rotate 90°

 Rotate 180°

 Rotate -90°

 Flip vertical

 Flip horizontal

There are two buttons for deleting the tuft history:

 Delete the selected carpet from history.

 Delete all carpets from history.

Reset button:

Discard all changes that applied to the design.

Note that you can discard all changes that applied to the design by pressing *Reset Changes* button.

3.5.6 Information and adjustment box

You can find detailed information of design at the bottom of the page in this area:

- Design Name
- X offset (position of bottom left of design in frame and in X direction)
- Y offset (position of bottom left of design in frame and in Y direction)
- Design dimension (mm)
- Machine linear speed (mm/min)
- Current active frame size
- Current frame profile name (for more information refer to 3.8.1 *Machine Dimensions*)

Figure 65: Information and adjustment box

Make sure that you are using correct frame profile. Using incorrect frame profile may lead to direct hit between tufting gun and frame which will cause serious damages to tufting head and/or machine.

You can check the dimension of frame in *Manual* mode by getting help form laser pointer of machine. By using the Joystick in Control Panel, you can test the four corner of machine and you can be sure that laser pointer is not pointing to any metal part of frame. (For more information refer to 3.8.1).

Before start travelling by Joystick, use the *Gun Out* button on your Remote Control to put the tufting gun in un-tufting position.

3.5.7 Position box

In the following box you can find the distance of design from each corner of frame.

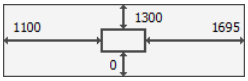


Figure 66: Position box

Automatically set the X and Y offsets of design into the current tufting head position which is visible by laser pointer on primary backing fabric in *Manual* mode.

Use *Get Position* button to move the design into current position of tufting gun.

3.5.8 Functions and buttons

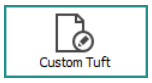
Here you can find more information about other functions and buttons in this page.

After adjusting all the required tufting parameters, click on this button for starting the tufting procedure.

If your selected design have some overlaps with previous designs then you the following message will be appeared.

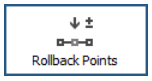
Figure 67: Overlap confirmation message box

Click No to define the new positions for design.



To start or continue tufting from specific position within design, click on this button. It will change this page into *Custom Tuft* page (For more information please refer to section 3.6).

It will check the regular design rules (For more information please refer to help manual of *eDesigner* CAD software).



This function will Add/Remove the *Rollback Points* to/from design.

Rollback Points or *Rollback Nodes* are auxiliary nodes in design help the operators to have more control on tufting process.

In simple designs with long vectors, if some problem happens and operator wants to start from previous position then they shall go back a long distance by removing the previous tufted piles. For example in a 2x3 meter sample if a problem happens in the middle of it then the operator must remove almost 1.5 meter tufted piles before starting machine. By using this function, *Rollback Points* in each few centimeter of design will reduce this distance into defined distance in this function.

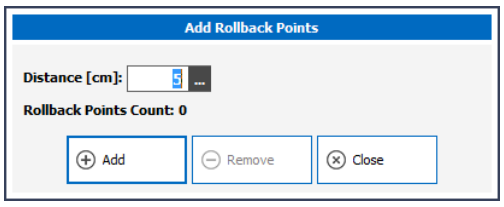


Figure 68: Adding Rollback Points

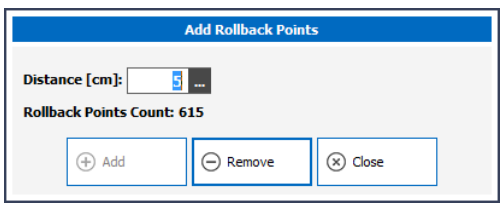
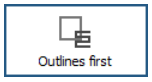


Figure 69: Removing Rollback Points

Despite of other types of points or nodes in designs, *Rollback Points* don't have any effect in speed of production.



This option will change the order of tufting. By selecting this option, machine will tuft outlines of all colors first then after finishing all the outlines it will start tuft filling vectors.

By selecting this option, you will have a better carpet face (with lower possible over tufting or yarn mixtures on borders of two colors). Since in this method you have to change the yarns twice, it will increases the production time for a few minutes.

It is strongly recommended in complex designs or heavy carpets, use the *Outline first* option for avoiding over tufting or yarn mixtures on the borders of two colors.

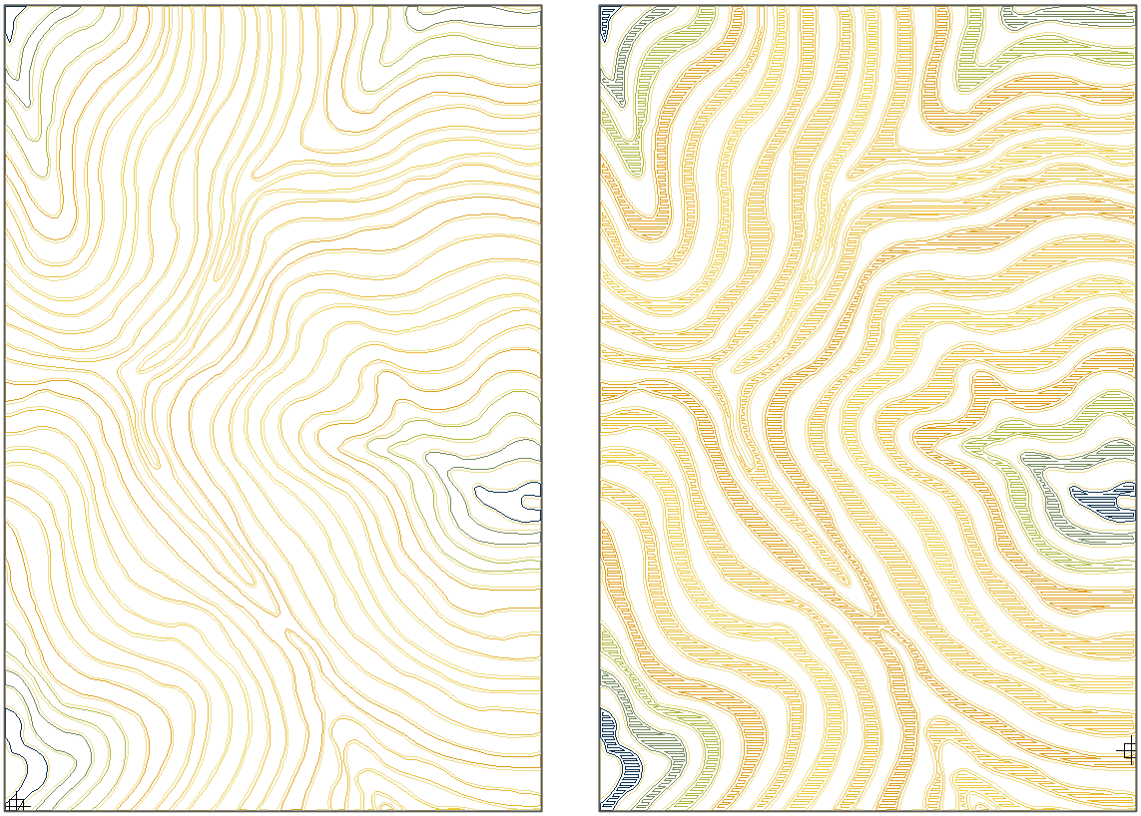


Figure 70: Tufting process when *Outline first* option is selected,
Left) *Outlines* of each color have been tufted, Right) after outlines *Fills* of each color will be tufted

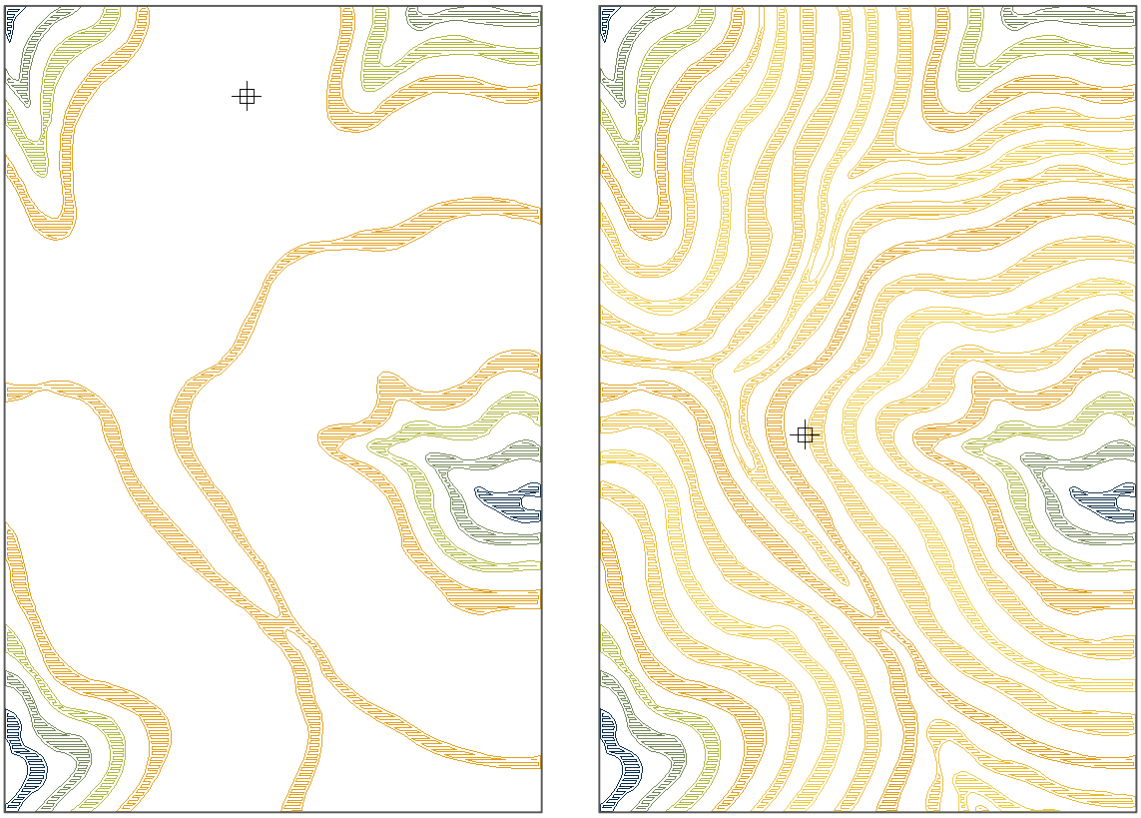


Figure 71: Tufting process when *Outline first* option is not selected,
Tufting *Outlines* and *Fills* of each color together

This button will save all changes made to the design.

If you made some changes on design and you want to leave the *Tuft Settings* page then you will get the following message.

Figure 72: Save confirmation message box

Click on *Yes* button for saving the modifications or click on *No* button to ignore the modifications.

3.6 Custom Tuft page

In this page operator can define the starting point of design for tufting process.

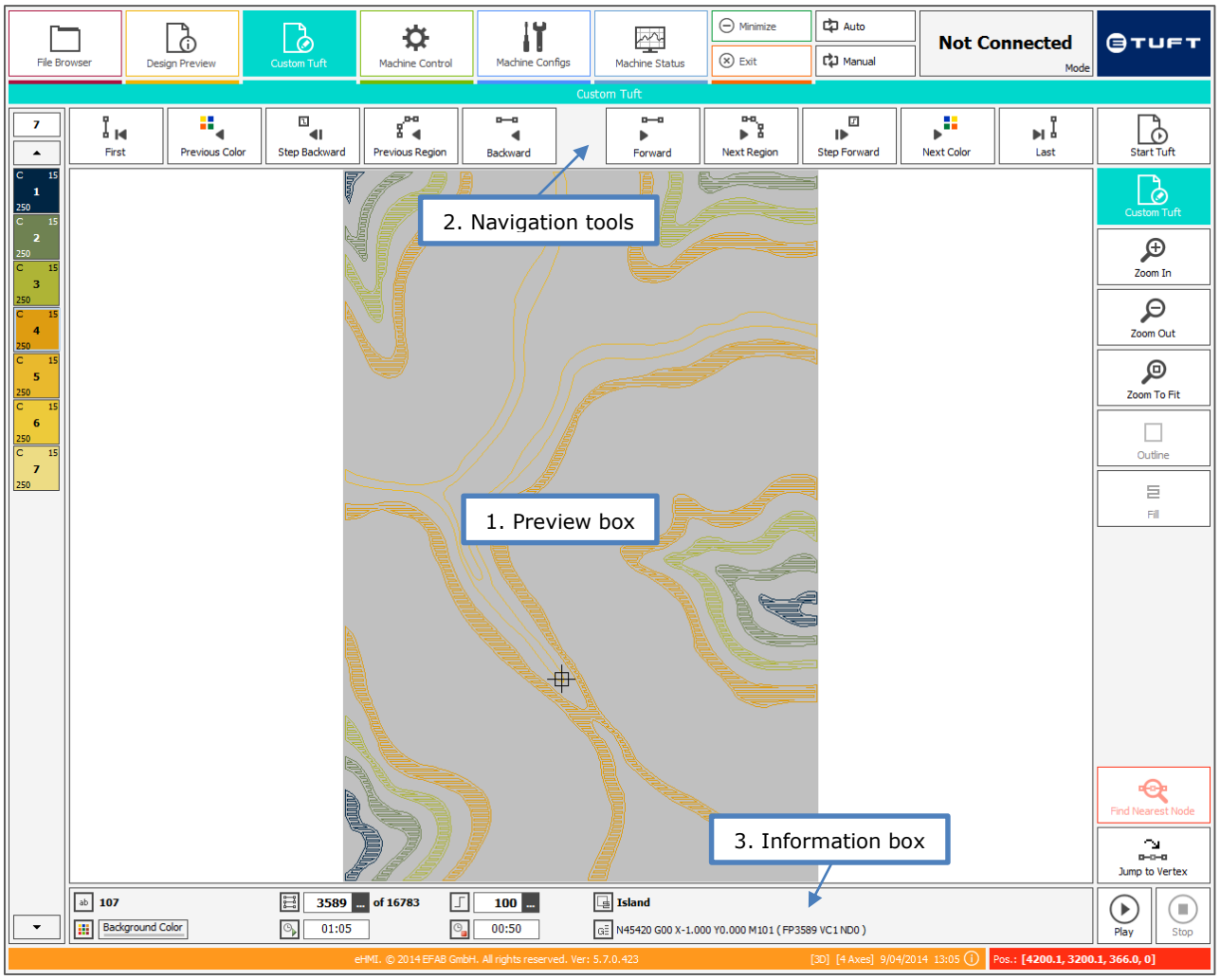


Figure 73: *Custom Tuft* page

Use this page when you want to start or continue from a certain point of the design and not from the beginning of it. This is usually required when operator wishes to continue an unfinished project.

> There are two possible way to change the *Tuft Settings* page into *Custom Tuft* page. By pressing *Custom Tuft* button in *Tuft Settings* and *Machine Control* pages.
>
> By clicking on the *Custom Tuft* button in this page, this page will be changed into *Tuft Settings* page.

The main components of this page are:

1. Preview box
2. Navigation tools
3. Information box

3.6.1 Preview box

Preview box will display vectors of design from beginning to the specified position by operator.

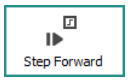
3.6.2 Navigation tools

Increase tuft position by one

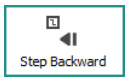
Decrease tuft position by one

Jump to the next region (next outline or fill)

Jump to the previous region (previous outline or fill)

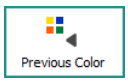


Increase tuft position by the value of *Step* edit box



Decrease tuft position by the value of *Step* edit box

Move the tuft position to the beginning of the next color



Move the tuft position to the beginning of the previous color

Move the tuft position to the end of design

Move the tuft position to the beginning of design

3.6.3 Information box

You can find detailed information of design at the bottom of the page in this area:


Design name.


Tuft position or line number of G-Codes (machine code)


Step value


Outline order (for more information refer to section 3.5.80, Figure 70 and Figure 71).


Background color for preview area


Estimated production time

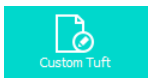

Estimated remaining time


G-Code (machine code) for current tuft position

3.6.4 Functions and buttons

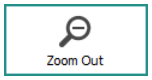
Here you can find more information about other functions and buttons in this page.

To start or continue tufting from specific position within design, click on this button.

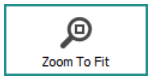


Toggle between *Custom Tuft* page and *Tuft Settings* page

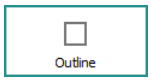
Zoom in



Zoom out

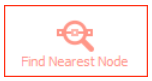


Zoom to fit in the preview area

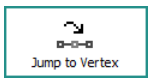


Move tuft position to the first outlined vector

Move tuft position to the first filled vector



When machine is ready and the tufting gun is inside of current design then this function will find the nearest node to the beam of laser pointer.



In carpet designs like 3D or smart cut/loop, there are several control nodes for controlling different states of tufting gun.

When this button is up then all the navigation tools (like *Forward*, *Backward* and …) will consider all the controlling nodes like positioning nodes. But when this button is down then the controlling nodes will be ignored and all the navigation tools will consider only the positioning nodes.

Start/Stop the simulating of tufting process (automatically increases the tuft position by *Step* value)

If the *Outline First* button was checked in *Tuft Settings* page then *Outline* and *Fill* buttons will be enabled.

Operator can sets tuft position to the beginning of each layer, by clicking on the *Color Palette* items too.

By moving the tufting gun in *Manual* mode with Joystick (see 2.3.1) and using *Find Nearest Node* function, you can find the nearest node of current design to the beam of laser pointer.

3.7 Machine Control page

In this page operator can define the machine modes, control the tufting process and find major information about the tufting progress, axes positions, *Controller Status* and *Controller Mode* (see 3.7.7 and 3.7.8).

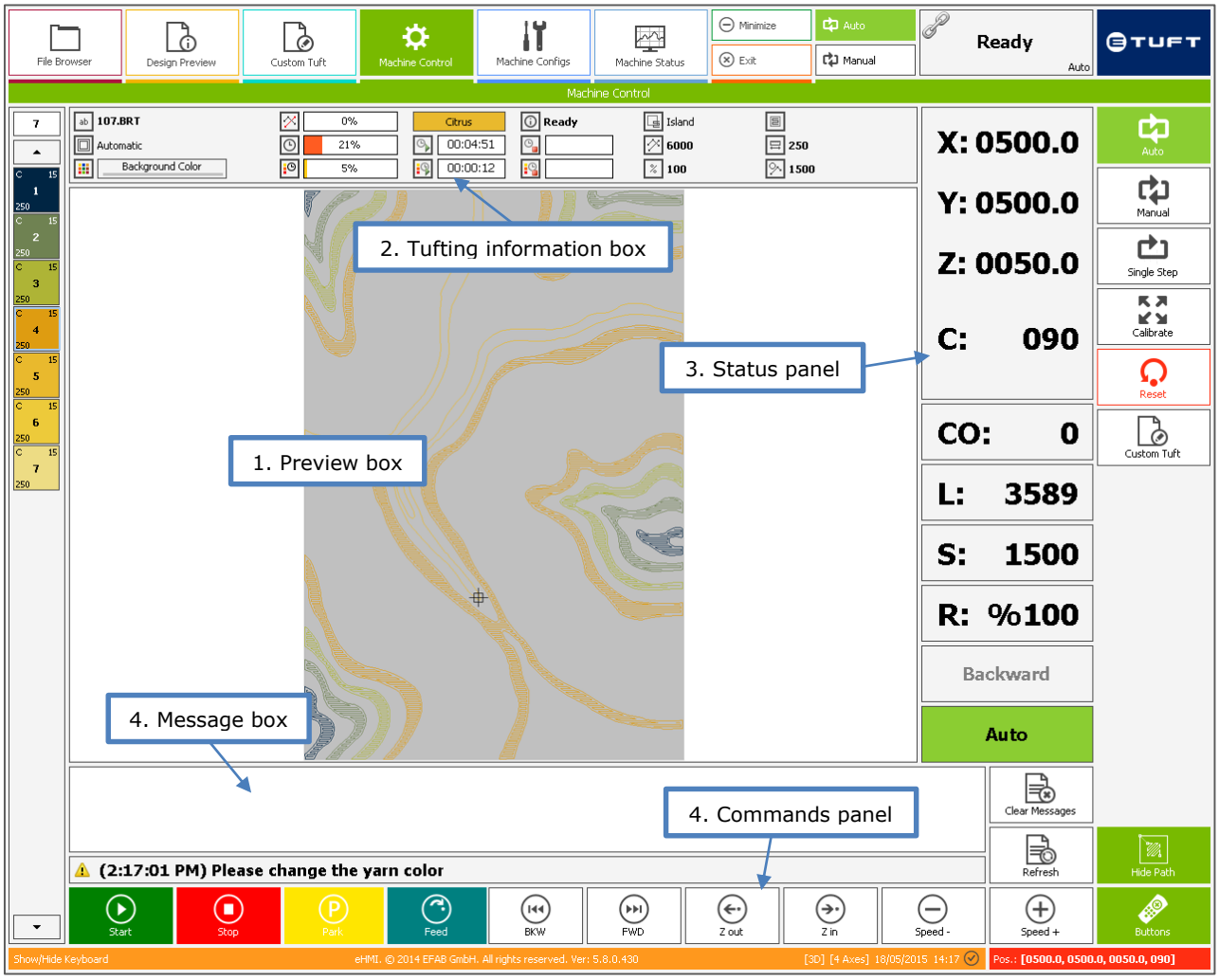


Figure 74: *Machine Control* page

The main components of this page are:

1. Preview box
2. Tufting information box
3. Status panel
4. Message box
5. Commands panel

3.7.1 Preview box

Preview box will display tufted vectors of design from beginning to the current position.

3.7.2 Tufting information box

Information related to the current tufting job will be available in this area.

ab Design filename loaded into controller memory.

Controller Mode (for more information refer to 3.7.8)

Background color for preview area

Current machine speed in percentage

Overall progress for whole design

Elapsed time of tufting since loading

Estimated remaining time for whole design

Overall progress for current color

Elapsed time since the last color change

Estimated remaining time for current color

Indicate the current status of controller (for more information refer to 3.7.7)

Indicate the design vector order (see 3.5.8 *Outline First* button)

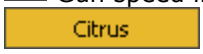
Linear machine speed defined in mm/min

Percent of preset speed and machine speed (see 2.3.1 and 3.5.2)

Tufting order of current design if *Outline First* was enabled in *Tuft Setting* page (see 3.5.8)

Density for current color in stitch/m

Gun speed in stitch/min or RPM



This color box shows the current color and name of the layer to be tufted. After finishing the tufting process of current layer, the machine will show the alarm to change the yarns. In this condition it will show the new color and name and will blink.

If the HMI software cannot find the design file then it will show *"BRT not found"* here. In this case, select a new design for tufting from *File Browser* page.

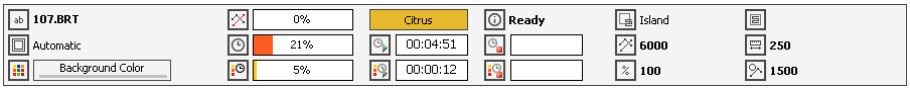
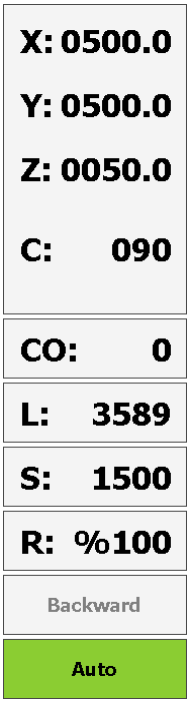


Figure 75: Tufting information box

3.7.3 Status panel

Information related to the current coordinate and state of machine will be available in this panel as below:



X: Position of X-Axes in mm
Y: Position of Y-Axes in mm
Z: Position of Z-Axes in mm
C: Position of C-Axes in degree

CO: Offset of C-Axis which can be defined in *Machine Configuration* page (see 3.8.2.1.4 Needle Offset)

L: Current tuft position or line number of G-Codes (machine code). This number can be used in *Custom Tuft* page for navigating through the design.
S: Speed of tufting in stitches/min or RPM
R: Speed ratio in percentage which can be adjusted by *Speed-* and *Speed+* on Control Panel.

Indicate the current direction of tufting procedure. In case of choosing *Backward* direction it will be in Red color.

It shows the *Controller Mode* (for more information refer to 3.7.8).

3.7.4 Message box

1. Warning message box: Show the last message that generated by controller.
2. Warning messages history box: Shows the history of messages generated by controller.

Clear all messages from message history

Update tufting preview area.

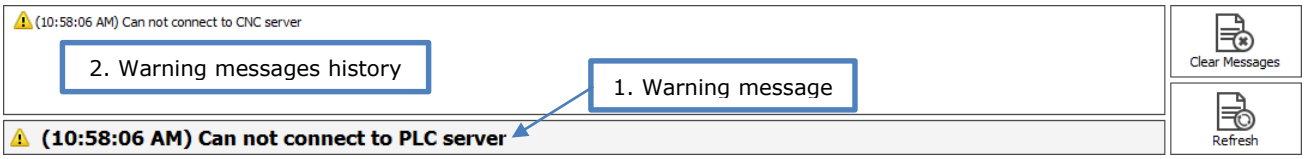
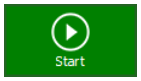


Figure 76: Message box

3.7.5 Commands panel

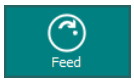
By enabling *Buttons* on lower right side of this page, the commands buttons will be appear in the bottom of this page as below:



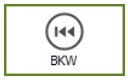
Starts/Resumes the tufting process or calibration

Pause the active movement

Move the machine to the *Park* position/Return it back from *Park* position to *Working* position



Move tufting head needle in and out



Set the direction of tuft program in *Backward* mode

Set the direction of tufting program in *Forward* mode (default direction)

Move the tufting head out of backing

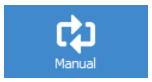
Move the tufting head into the backing

Increase the machine speed ratio

Decrease the machine speed ratio

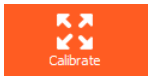
3.7.6 Functions and buttons

Set the *Controller Mode* into *Automatic*. In this mode controller can execute tuft designs.



Set the *Controller Mode* into *Manual*. In this mode operator can move the machine manually by *Joystick* available on the *Control Panel* (see section 2.3.1).

Set the *Controller Mode* into *Automatic Single Step*.

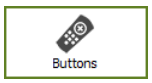


Initiate *Calibration Mode* of machine

Reset the controller

Show C*ustom Tuft* page and automatically sets tuft position into the current tufting position

Show/Hide un-tufted moves in tuft preview



Show/Hide controlling buttons. By enabling this button the controlling buttons will be appear in the bottom of this page (see section 3.7.5).

3.7.7 Controller Status

eTuft controller has four major statuses as below:

1. ***Ready:***

   In this mode controller has the control of all axes and it is ready for receiving command from operator.

2. ***Stopped:***

   When operator stops the active process by pressing *Stop* button or when the machine stops automatically regard to a problem in tufting process (air low pressure, Gun yarn break or creel yarn break and …) the controller status will be "*Stopped*". In this case if operator presses the *Start* button, the process will be resumed again.

   In this state machine has the control of axes and the control loop is closed.

3. ***Working:***

   When a movement on machine is in progress the controller status will be "*Working*". In this case if operator presses *Stop* the movement will be stopped and the status will change to "*Stopped*".

4. ***Emergency Stop:***

   When operator presses the emergency stop button or when an internal positioning error accrued (due to servo motor fault or overload) controller will enter to this state.

   In this state machine opens the control loop and releases all axes. During "*Emergency Stop*" all the axes are free and operator can move them by hand except Y axis. But the controller monitor axes positions.

The status of controller will be displayed on *Machine Status Box* (see section 3.2.2 *Machine Status Box*).

Figure 77: Machine Status Box

Controller will remain in "*Emergency Stop*" state even if operator releases the emergency stop button or if the internal error resolved. To change the controller status to "*Ready*" operator should click on *Reset* button in *Machine Control* page of eHMI.

The Chain sign on upper left corner of Machine status has two states as below:

Closed Chain: *Emergency Stop Loop* is closed. Machine will be ready for receiving the commands.

Broken Chain: *Emergency Stop Loop* is opened. Machine will not work till releasing all the emergency stop buttons and pressing the *Start* button on the remote control.

3.7.8 Controller Mode

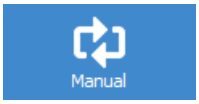
eTuft controller has four major controlling modes as below:

1. ***Automatic:***

In *Automatic* mode controller can execute tuft programs that loaded by eHMI software continuously. During *Automatic* mode operator cannot move tuft head manually in X and Y directions but it is possible to use *Feed Gun*, *Gun In*, *Gun Out* and *Park* commands of course if the controller state was not "*Working"* or "*Emergency Stop*".

For selecting *Automatic* mode simply click on *Auto* button on *Machine Control* page of eHMI.

2. ***Manual:***



In *Manual* mode operator can move tuft head manually by using *Joystick, Gun In, Gun Out* buttons. Also operator can feed the gun by pressing *Feed Gun*.

For selecting manual mode simply click on *Manual* button on *Machine Control* page of eHMI.

In *Manual* mode *Park*, *Stop* and *Start* buttons do not work.

Before moving the tufting gun manually by joystick, make sure the tufting needle is not in the backing. If the tufting needle is in backing fabric then moving the tufting gun will cause tearing of backing fabric and will damage the tufting gun.

Use the *Z Out* button on remote control or *Z Out* command in *Machine Control* page to detach the tufting gun from backing fabric before moving the tufting gun manually.

3. ***Automatic Single Step:***

In *Automatic Single Step* mode controller can execute tuft programs that loaded by eHMI software step by step. During *Automatic Single Step* mode operator cannot move tuft head manually in X and Y directions but it is possible to use *Feed Gun*, *Gun In*, *Gun Out* and *Park* of course if the controller state was not "*Working"* or "*Emergency Stop*".

For selecting *Automatic Single Step* mode simply click on *Single Step* button on *Machine Control* page of eHMI.

4. ***Calibration:***

After turning on, the robot appears in this mode by default. In this case, the calibration process is started by pressing the *Start* button. The machine first calibrates Z and C axes and then calibrates the X and Y axes. During calibration process, the machine axes are moving slowly towards reference point of machine.

To use the machine, all the machine parameters must be calibrated. The operator cannot use the machine if it is not calibrated. In this case if the mode changed to *Automatic* or *Single Stage* then the operator faces the error message.

For selecting *Calibration* mode simply click on *Calibrate* button on *Machine Control* page of eHMI.

If operator presses *Start* button then the *Calibration* process will be initiated.

ⓘ The operator can stop the machine by using *Stop* button during calibration process and by pressing the *Start* button, the calibration process will be started.

ⓘ In calibration all control panel buttons are deactivate except *Start* and *Stop*.

⚠ After system restart operator should calibrate the machine by selecting *Calibrate* mode and pressing the *Start* button.

ⓘ To change the state of the machine, the machine must be stopped. When the machine is being used, its mode cannot be changed. In this case the operator receives an error message and the controller mode will not be changed.

ⓘ To adjust the speed of the machine in all modes use *Speed +*, *Speed Reset* and *Speed –* buttons on control panel.

3.8 Machine Configuration page

In this page operator can define the machine and eHMI software parameters.

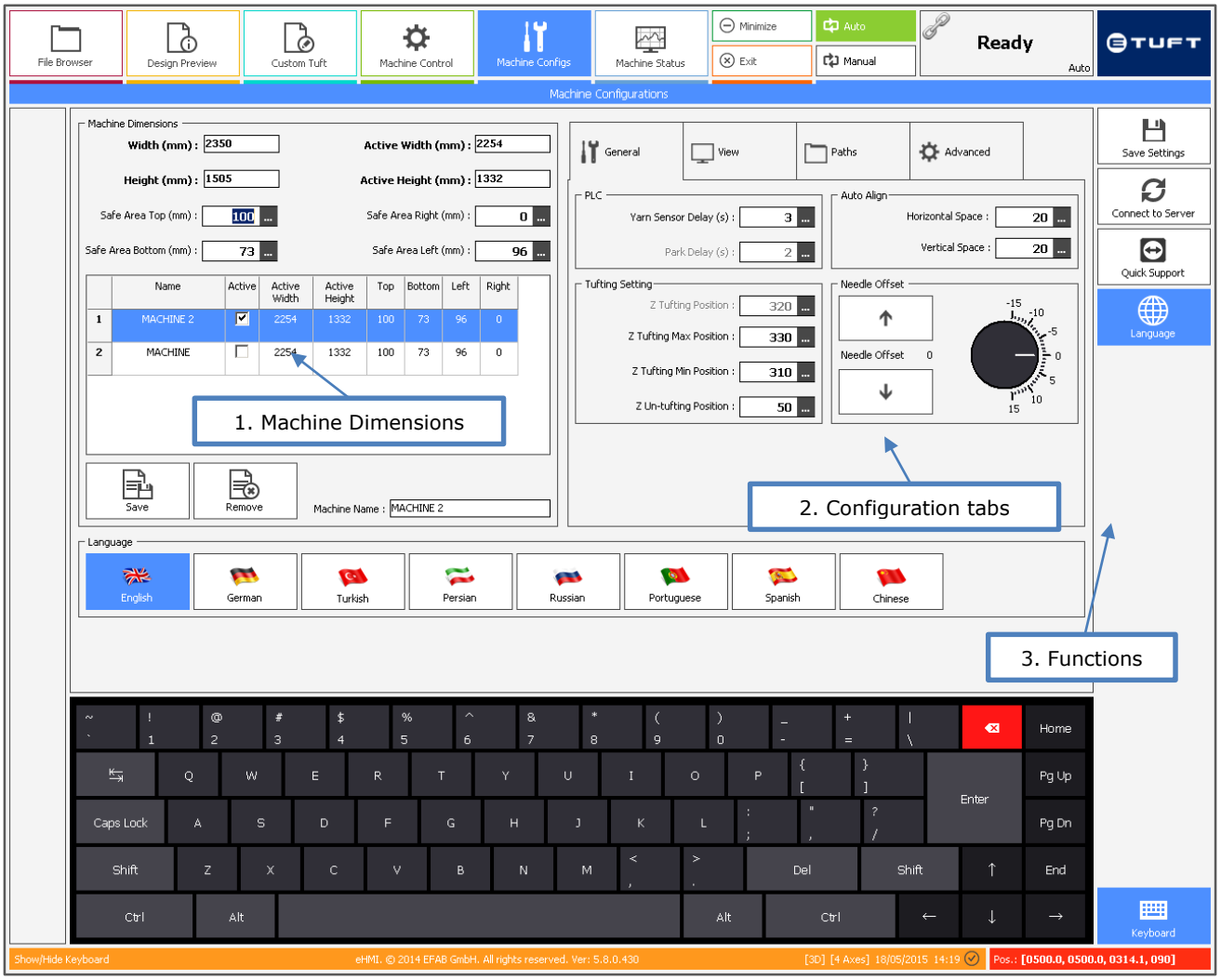


Figure 78: *Machine Configs* page

> **Any wrong adjustment on this page of eHMI software could damage the machine.**
>
> **Before doing any modifications on this page, make sure that you have understand the functionality of it correctly and you are doing the adjustments on the right way.**

The main components of this page are:

1. Machine dimensions
2. Configuration tabs
3. Language bar

3.8.1 Machine Dimensions

It is possible to use several tufting frames with different sizes for tufting.

eTuft usually comes with one standard tufting frame. Dimension and parameters of the frame has been saved in the eHMI software. To use other frames first add the size of the frame to the software. There are six parameters as mentioned below that define a tufting frame.

Working area: It is a two-dimensional space which tufting gun can travel along the X and Y axes. This area along horizontal direction equals to the maximum length that X-axis can move and along the vertical direction equals to the maximum height that Y-axis can move. The working area is constant and depended on the size of machine. It is independent from the tufting frame which will be located in front of machine.

Margin or Safe Area: It is the area in the range of machine working area which the tufting gun can travel but due to the tension of primary backing fabric or size of frame, machine cannot tuft correctly or safely.

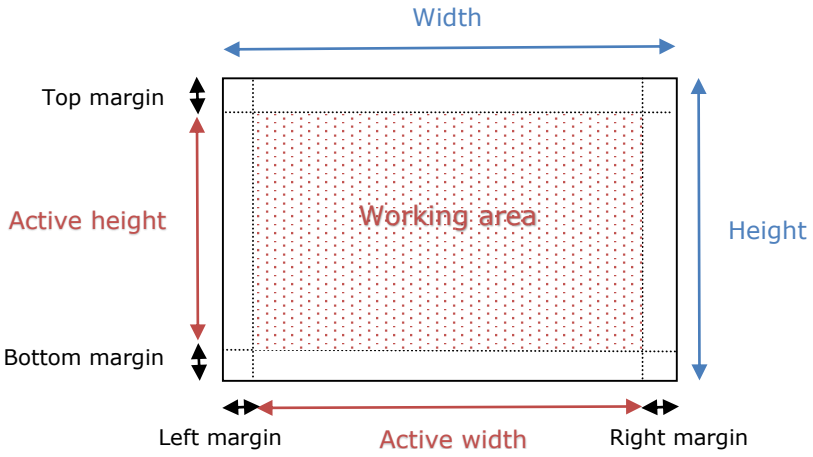


Figure 79: Working area and margins of the machine

In *Machine Dimensions* panel, the *Width* and *Height* of machine will be automatically adjusted by eHMI software based on machine size. By entering the *Margins* or *Safe Area* values (in four directions; left, right, top and bottom) the size of *Working area* or *Active Width* and *Active Height* will be calculated automatically.

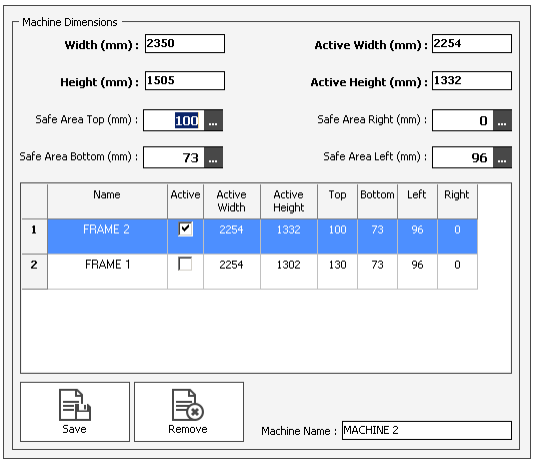


Figure 80: Machine Dimensions

The delivered eTuft machines have a pre-set tufting frame. If the operator wants to use a new tufting frame then the new tufting frame must be defined for the eHMI software. Operator can browse on defined tufting frames through the frame list. Each row of the list shows a frame and its size.

3.8.1.1 Defining a new tufting frame

For defining a new frame, at first the *Margins* or *Safe areas* should be defined and after that it must be added to the list of available frames.

To calculate the *Margins* or *Safe areas* do the following steps:

1. Put the tufting gun in the *Park* position.

2. Set the machine in *Manual* mode to be able to move the tufting gun manually by joystick on control panel.

Before moving the tufting gun manually by joystick, make sure the tufting needle is not in the backing. If the tufting needle is in backing fabric then moving the tufting gun will cause tearing of backing fabric and damaging the tufting gun.

Use the *Z Out* button on remote control or *Z Out* command in *Machine Control* page to detach the tufting gun from backing fabric before moving the tufting gun manually.

3. By using the joystick, move the X-axis toward your left side till the needle tip or laser pointer reaches the distance of ~15 cm of metal frame on left.

4. Enter the position of the X-axis as *Left Margin* or *Safe area left*

5. By using the joystick move the X-axis toward your right side till the needle tip or laser pointer reaches the distance of ~15 cm of the metal frame on right.

6. Decrease the X-axis position from the machine *Width* value and enter the result of it as the *Right Margin* or *Safe area right*.

7. By using the joystick, move the Y-axis down till the needle tip or laser pointer reaches the distance of ~15 cm of the metal frame on bottom.

8. Enter the position of the Y-axis as *Bottom Margin* or *Safe area bottom*.

9. By using the joystick, move the Y-axis up till the needle tip or laser pointer reaches the distance of ~15 cm of metal frame on top.

10. Decrease the Y-axis position from the machine *Height* value and enter the result of it as the *Top Margin* or *Safe area top*.

11. Enter the new name for tufting frame in the *Machine Name* edit box and click on *Save* button on *Machine Dimensions* box (Figure 81).

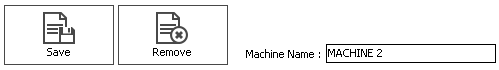


Figure 81: Save, Remove buttons and Machine Name edit box

Make sure that you entered the correct frame size. Using incorrect frame size may lead to direct hit between tufting head and frame and will cause serious damages to the tufting head and/or machine, specially in case of using smaller or customized frames.

3.8.1.2 Selecting the active frame

Tuft Preparation page uses the *Active frame* parameters. To change the frame size of *Tuft Preparation* page you need to change the active frame.

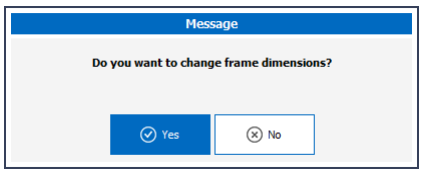


Figure 82: Frame change confirmation message box

If there are more than one frame in frames list then for selecting a new frame simply double click on desired row in frame list and then click *Yes* button on confirmation message box (Figure 82).

The frame showing in the *Tuft Preparation* page is the frame chosen by the operator as an active frame.

If the number of defined tufting frames in the software is more than one then operator must activate the desired frame which is going to put in front of machine for tufting operation. For this reason, double-click on desired frame tin frame list.

3.8.1.3 Editing existing frame

For modifying the size of a frame in a list, simply click on it, change the *Margins* or *Safe areas* and then click *Save* button (Figure 81).

Changing the name of it in *Machine Name* edit box will create a new frame in frame list.

3.8.1.4 Removing existing frame

For removing a frame from list of frames simply click on *Remove* button (Figure 81) and then click *Yes* button on confirmation message box.

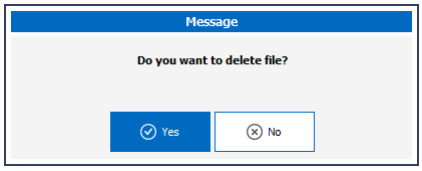


Figure 83: Removing existing frame confirmation message box

3.8.2 Configuration tabs

The Configuration tabs have four tabs as below:

1. General
2. View
3. Paths
4. Advanced

3.8.2.1 General tab

General tab is for adjusting different parameters of machine as below.

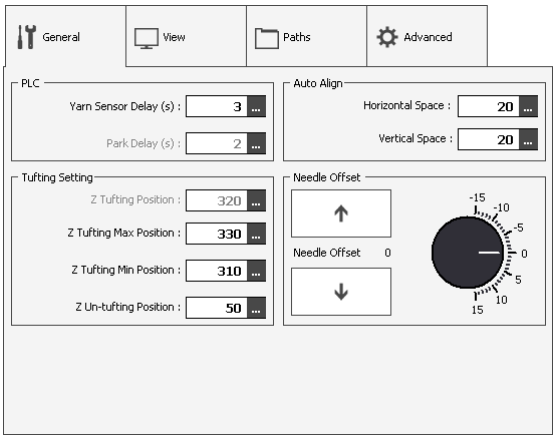


Figure 84: General tab

3.8.2.1.1 PLC Setting

Yarn Sensor Delay: It will specify the time interval which computer which the software will ignore the yarn sensor stop command. If it is too short then there will be lot of stoppage because of accidental commands comes from yarn sensors.

Park Delay: It shows the delay between receiving the Park command and travelling of machine. Due to safety reasons operators cannot change this parameter.

3.8.2.1.2 Auto Align

These parameters will be used in *Aligning with previous tufted carpets* function of *Tuft Preparation* page.

Horizontal space: Assign horizontal space in mm between the tuft history item and design.

Vertical space: Assign vertical space in mm between the tuft history item and design.

For more information see 3.5.1 in *Tuft Preparation* page.

3.8.2.1.3 Tufting Setting

In general there are two modes for controlling the Z-Axis position: Non-Adaptive and Adaptive control.

In Non-Adaptive control mode there will be two position for Z-Axis as below:

1. *Z Tufting Position*:
   Defines the position of Z-Axis during tufting. Depends on the mode of controller, it could be extended into *Z Tufting Max Position* and *Z Tufting Min Position*.
2. *Z Un-tufting Position*:
   Defines the position of Z-Axis during travels without tufting.

In Adaptive control mode there will be three position for Z-Axis as below:

1. *Z Tufting Max Position*:
   Defines the position of Z-Axis during tufting in the middle of the tufting frame.
2. *Z Tufting Min Position*:
   Defines the position of Z-Axis during tufting on the corner and periphery of the tufting frame.
3. *Z Un-tufting Position*:
   Defines the position of Z-Axis during travels without tufting.

For detailed information about these parameters and adjusting them, please refer to 4.7 *How to set the Z-Axis positions? Or how to set the pressure of tufting gun into primary backing fabric?*

⚠ Changing these values during tufting process may cause breakage in primary backing fabric and damage on the needle. Change these parameters carefully during tufting process just by +/-5~10mm and no more!

ⓘ Advanced operator can adjust and fine tune all *Z* Positions during the tufting by changing and saving them.

⚠ If *Z Tufting Position* parameter is set too low then the tufting gun will not penetrate in primary backing fabric as it should be and the quality of tufting processing will be pour.

⚠ If *Z Tufting Position* parameter parameter is set too high then it may cause tearing of backing fabric and damages to tufting gun.

Tufting needle must be completely out of backing at *Z Un-tufting Position*. Otherwise it will damage backing and/or tufting head.

3.8.2.1.4 Needle Offset

Use this parameter for compensating the *Pairing* effect. The default value of it is "0".

3.8.2.2 View tab

View tab is for adjusting viewing parameters of software as below.

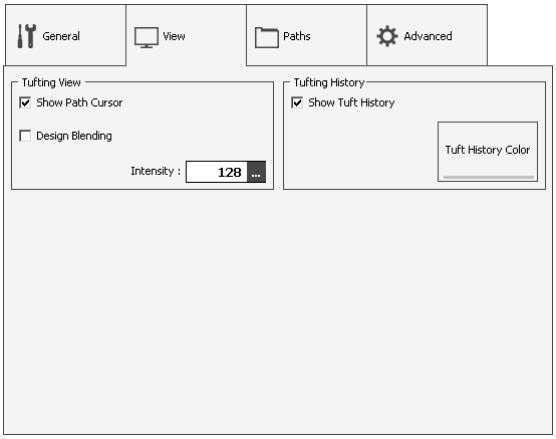


Figure 85: View Tab

3.8.2.2.1 Tufting View

Show Path Cursor: Show/Hide the cursor in preview area of *Custom Tuft* page.

Design Blending: Enable/Disable the preview of vectors after current tufting position, in the *Custom Tuft* page.

Intensity: Intensity of vectors after current tufting position on *Custom Tuft* page. It works if the *Design Blending* was enabled.

3.8.2.2.2 Tufting History

Show Tuft History: *Enable* this check box to view the tuft history on *Tuft Preparation* page.

Tuft history Color: Sets the color of the design history items on *Tuft Preparation* page.

3.8.2.3 Paths tab

It indicates the different paths to store the related files in hard disk. All the paths has predefined folders, except *Network* path (see Figure 86: Paths tab).

Designs: The path that designs (in BRT file format) are saved on controller computer.

Tests: The path that test patterns are saved on controller computer.

GCodes: The path that GCodes are saved on controller computer.

Configs: The path that Configuration files are saved on controller computer.

Net Path: Assign a shared folder in network for designs.

Click on  to define a shared folder on network as *Net Path*. By defining this path, when the operator clicks *Network* button in the *File Browser* page, then the existing files in this path will be browsed (see 3.3.1).

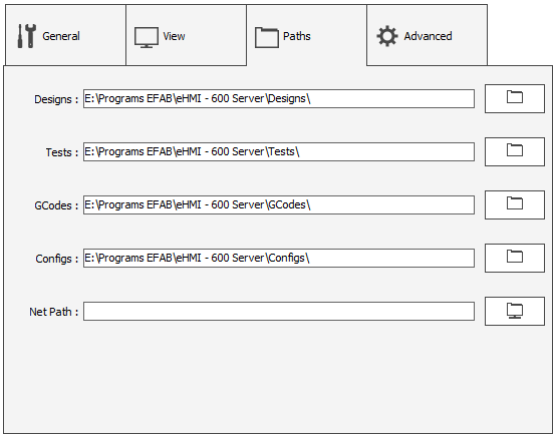


Figure 86: Paths tab

Operator shall not change the *Designs*, *Test*, Gcodes and *Configs* paths.

Click on  to browse the specified folder in File Explorer of Windows.

3.8.2.4 Advanced tab

Advanced tab is for adjusting special parameters which can be changed only by authorized persons of EFAB GmbH or under the direct supervision of them.

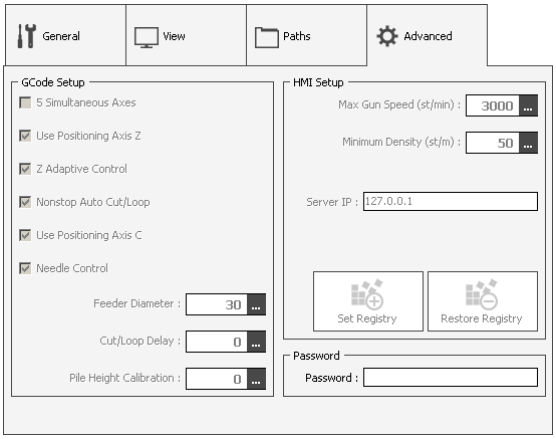


Figure 87: Advanced tab

This tab is password protected and all parameters on it are disabled for avoiding any wrong configuration on machine.

3.8.3 Functions and buttons

Here you can find more information about other functions and buttons in this page.

Save all changes made by operator on this page.

Any wrong adjustment on this page of eHMI software could damage the machine or results pour quality of tufting.

Before saving any modifications, make sure that you have understand the functionality of it correctly and you are doing the adjustments on the right way.

Connect eHMI software into controller server.

If the current status shown on Machine Status Box is "Not connected" or if eHMI cannot get the information such as machine size or axes positions from the controller then click this button.

By clicking on this button the EFAB Quick Support program will be executed. By using EFAB Quick Support software, the support team of EFAB GmbH will be able to connect to the machine via internet.

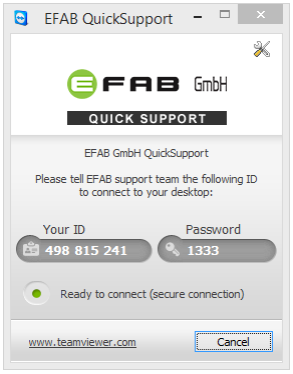


Figure 88: EFAB Quick Support software

To be able to connect to your machine, operator shall forward the ID and Password of Quick Support program to EFAB GmbH support team.

By clicking on this button the Language bar will be appear. After that you can choose your desired language for user interface of eHMI software from there.

Figure 89: Language bar

3.9 Machine Status page

In this page, the internal signals of the machine are available for monitoring and diagnosing.

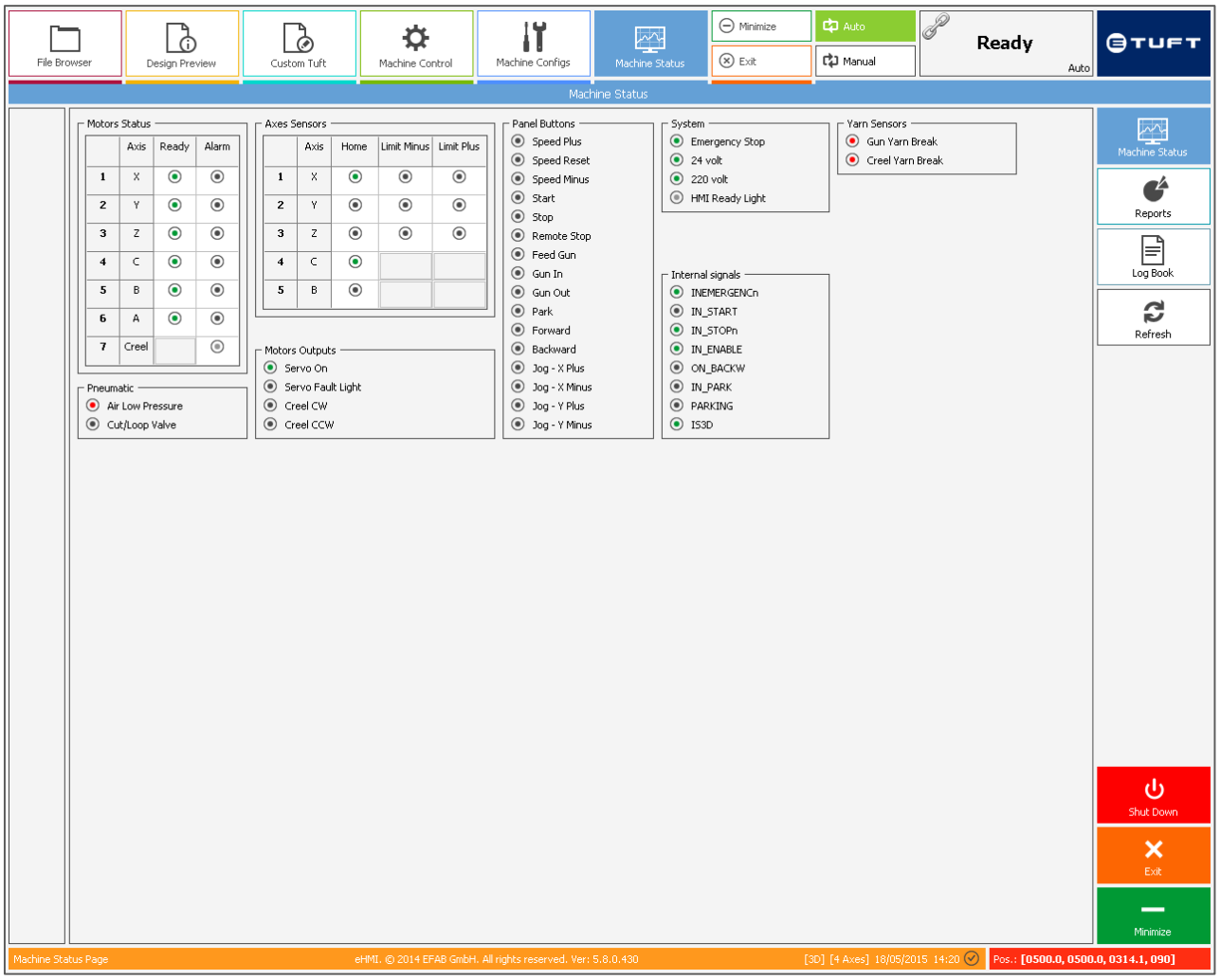


Figure 90: Machine Status page

In this section, the signals inside the machine are visible. In general, normally no lights on this page should be Red. In case of any Red lights, please refer to section 7 for troubleshooting.

There are several sections on this page as below:

Motors Status: In this table, the status of each drive unit is visible. Normally, all engines Ready lights must be on and their Alarm lights must be off.

Axes Sensors: Two sensors has been placed on X, Y and Z axis of device to detect the axis arrival to the beginning point (Limit Plus) and end point (Limit Minus) of travelling path. If any of these sensors is activated then the corresponding lights will be red.

Also one calibration sensor (Homing sensor) is installed on X, Y, Z and C axes. Normally, all lights must be turned off and if the axis is on the calibration mode then it will trigger the sensor once and its light becomes green.

Motors Outputs: This section's signals will be used in order to troubleshooting.

Panel Buttons: It will monitor the status of all buttons on control panel.

Yarn sensors: It will monitor the status of yarn sensors.

Pneumatic: It shows the status of air input sensor and cut/loop actuator.

Internal signals: These signals will be used only for troubleshooting.

System: There are several signals for monitoring the different states and conditions of machine as below.

Emergency Stop: The color of this light becomes red if one of the emergency stop buttons on the machine is pressed or the *Emergency Stop Loop* is opened due to the controller error.

Note if the light of *Emergency Stop* is red then the controller mode cannot be changed. For this purpose, at first the *Emergency Stop Loop* must be closed.

In order to close the *Emergency Stop Loop*:

1. Check all the emergency stop keys located on the control panel, machine and remote control and release them.
2. Press *Start* button on the remote control so, the emergency stop light becomes green on this page or *Closed Chain* sign appears in *Machine Status Box*.
3. The machine will be out of the *Emergency Stop* mode by pressing the *Reset* button on the *Machine Control* page.

24 Volts: It displays the status of the internal 24V voltage of the electrical board

220 Volts: It displays the status of AC voltage.

HMI Ready Light: It indicates the readiness of machine controlling software.

3.9.1 Functions and buttons

Here you can find more information about other functions and buttons in this page.

It will closes the eHMI software and will shuts down the computer.

Turn off the entire machine by manually switching off the *Main Power Switch*.

It will closes the eHMI software.

It will minimize the eHMI software.