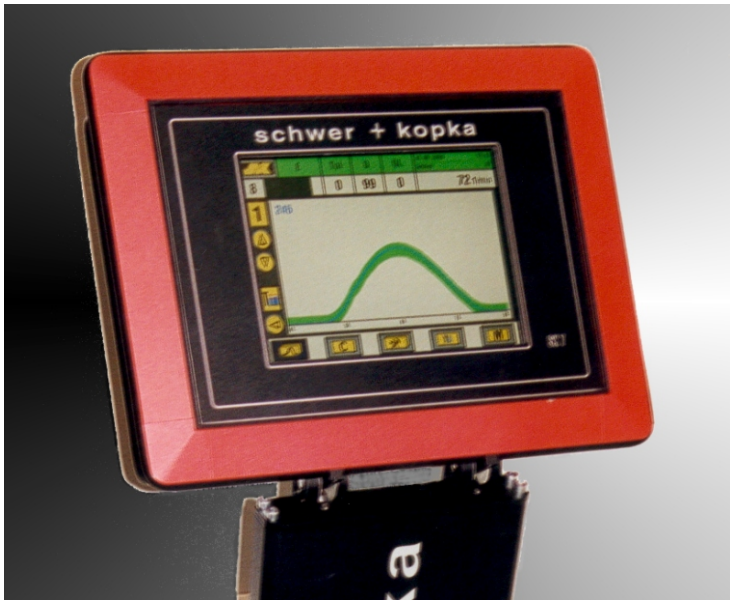
Operating Manual

SK 7

Process Monitoring System for Cold Forming Machines



10/04

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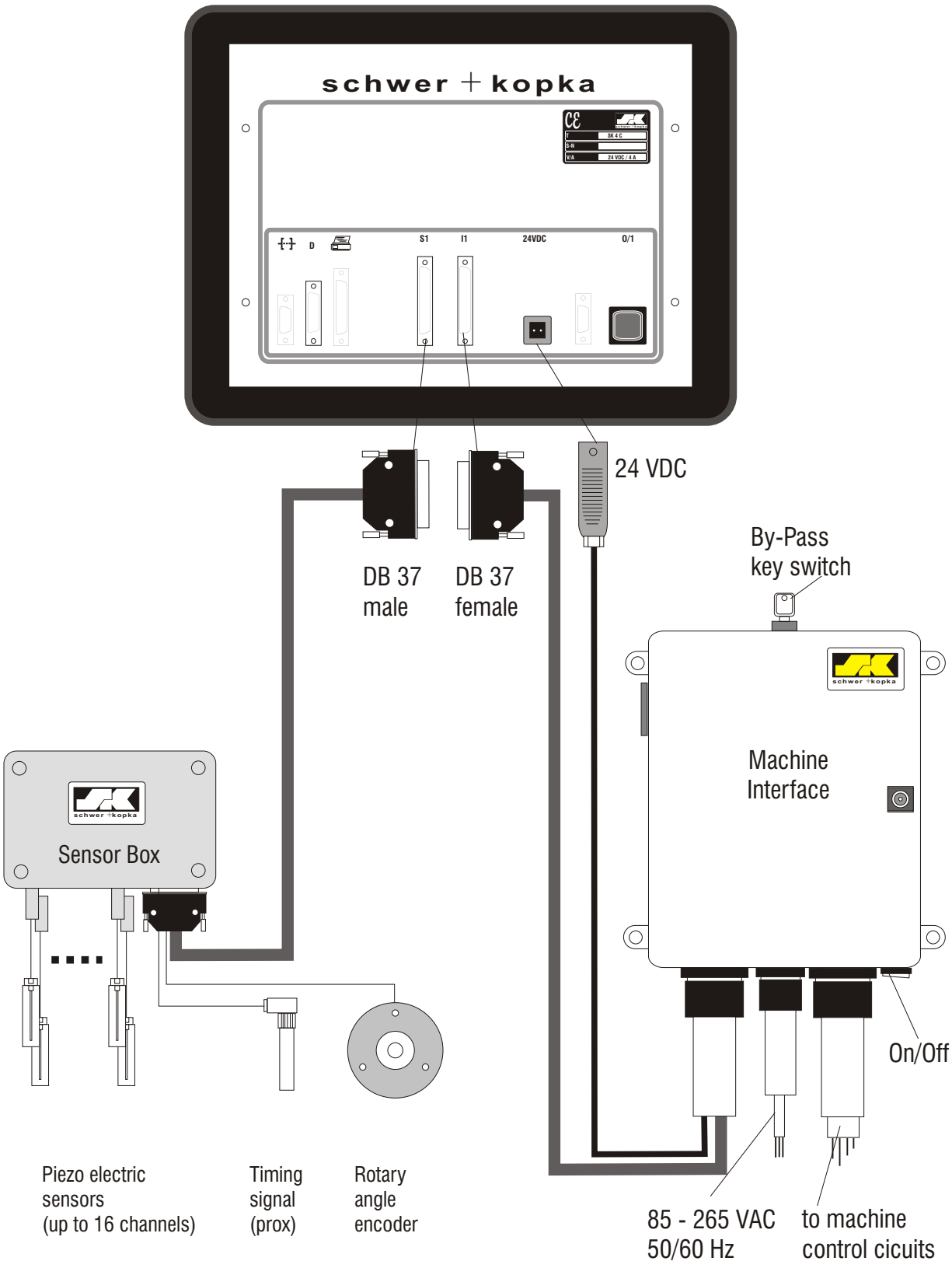
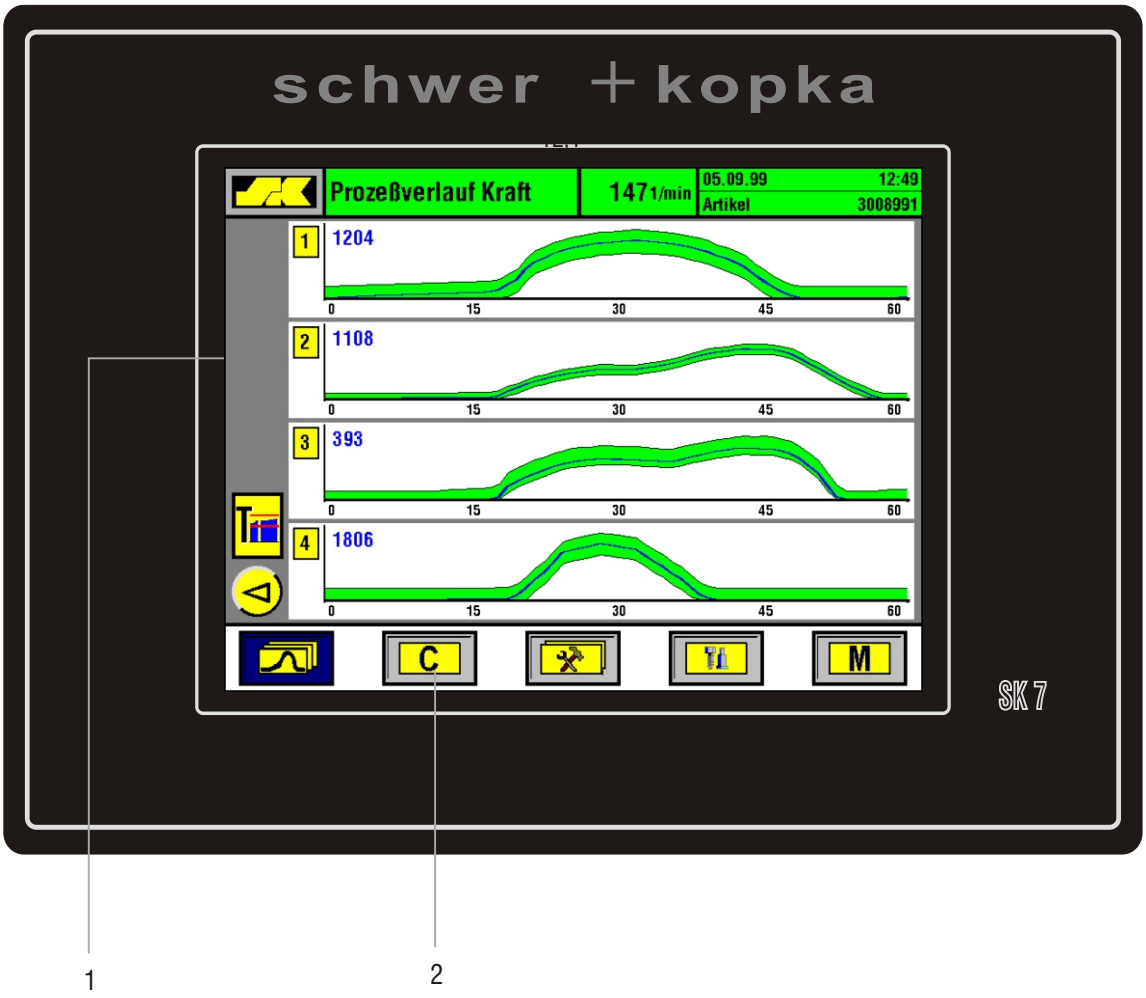
Contents

Please note that some of the features described in this manual are optional and/or may not be available for all models or applications.
Technical details are subject to change without prior notice.

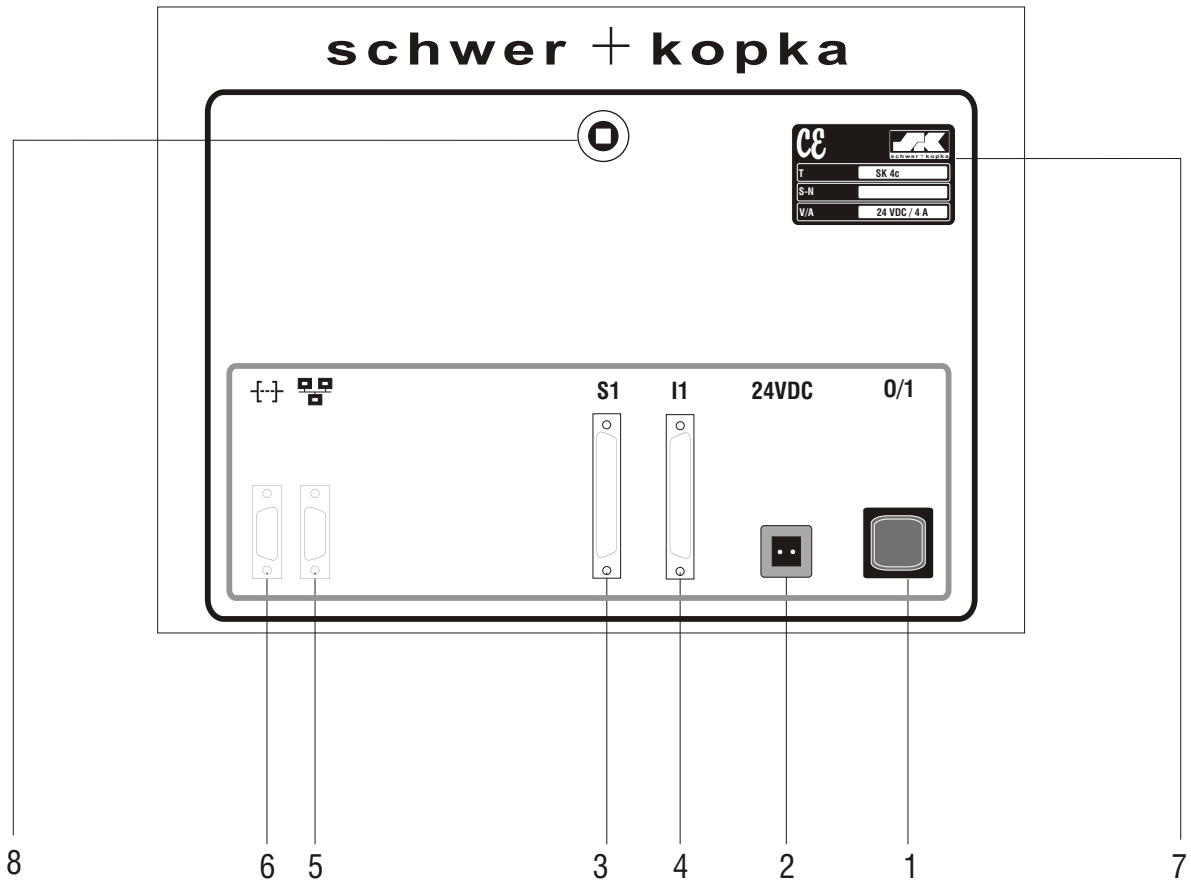

schwer + kopka
S1
I1
24VDC
O/1
24 VDC
DB 37
male
DB 37
female
By-Pass
key switch
Machine
Interface
Sensor Box
On/Off
Piezo electric
sensors
(up to 16 channels)
Timing
signal
(prox)
Rotary
angle
encoder
85 - 265 VAC
50/60 Hz
to machine
control cicuits

Front Panel



1. 12,1”-LCD-colour-screen (TFT)
   with Touch-Screen Surface

2. Function keys / Symbol keys
   (touch elements)



1. On/Off switch
2. Power Supply connector 24VDC
3. Connecting socket for Sensor Cable (S1
4. Connecting socket for Interface Cable (I1)
5. Network socket
6. Serial port (RS 232)
7. Serial number plate
8. Rear panel lock

Start (switching the system on)

The electronics of the **SK** unit are switched on via the On/Off push button located on the rear panel (unit is tyically installed inside the main machine control box, see also page 4).The operating screens for the process monitoring functions are called up by pressing the respective function key (often F6) on the main PC control panel. The first screen will show the force curves.

Selecting the different functions

The **SK** system is designed to work with Touch-Screen controls as well as with regular push-button operating panels. The decription in this manual concentrates mainly on touch-screen.

The touch-screen version has a row of function symbols at the bottom of the screen. The symbols can change depending upon the selected functions. Just touch the respective symbol to call-up the desired function. Where numerical entries are required, a numerical keyboard window will automatically pop-up.

With push button controls, just press the function key (F1 - F10) belonging to the desired symbol in order to start the respective function. For numerical entries please use the number keys on the front panel.

Screen layout

Many features and operational steps are similar on the differents screens. These are briefly explained below using the example of the multi-curve screen:

The upper left corner describes the currently selected function screen. When in STOP, this line gives in red the reason why the machine was stopped.

The background color changes with the selected operation mode:
- yellow: set-up (MAN)
- green: automatic mode (AUTO)
- red: machine is in STOP

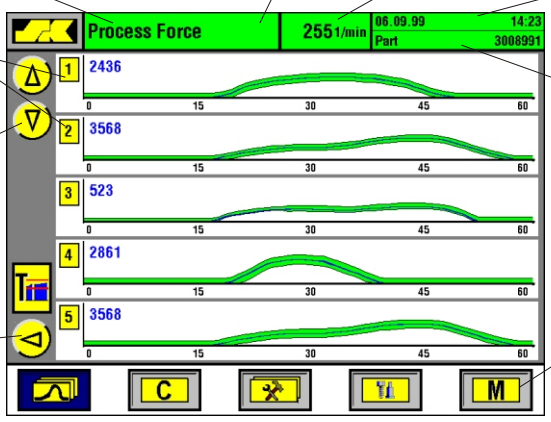
Upper right corner always shows current machine speed in strokes/minute

Current date and time

Pressing the channel number on the keyboard (or touching the curve) will give an enlarged view of that channel

If machine has more than 5 channels press the cursor key to advance to other channels

Change to trending screens



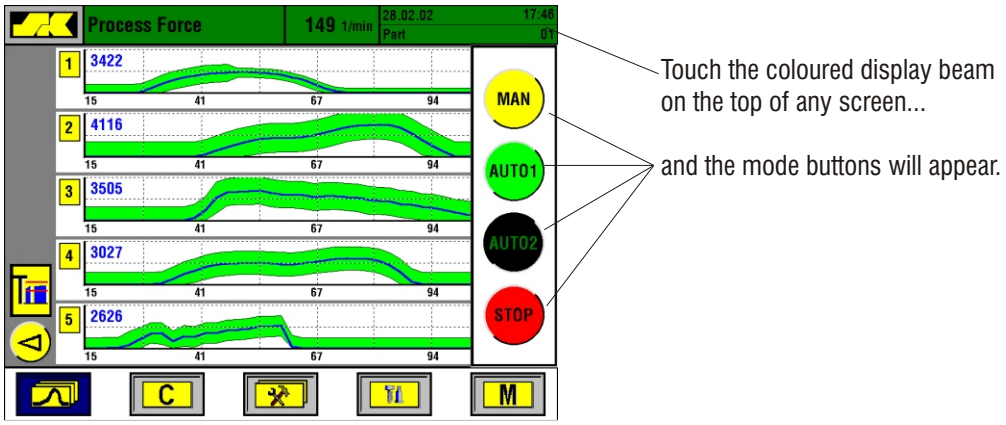
Shows current part number if unit is equipped with part data memory

The symbol boxes indicate which functions are currently available

The symbol key labelled SPS or PLC (mostly F6) will switch back to the main machine controls.

Selecting operation modes

The different operation modes are selected via the mode buttons when touching the coloured display beam on the top of any screen. They include functions such as set-up mode or automatic mode for regular or unmanned shifts. The colour of each display beam indicate which mode is currently running.



MAN mode (yellow)

The MAN mode is not actively monitoring the process. However, the unit registers and displays the force signals to help the operator set up the machine. The MAN mode is normally selected after each STOP to release the stop relays. In this case , the system will learn new envelope limits after it enters AUTO mode. The time spent in MAN mode can be limited to an adjustable number of strokes after which the unit will switch into AUTO mode by itself (adjustment is done within the set-up menu). If wanted, the system can be set so that it re-uses the previous envelopes without relearning. In this case, after a stop condition, the system should go directly into AUTO mode.

AUTO1 mode (green)

The green mode starts the automatic monitoring mode. The unit is immediately active after the green mode commenced. The system either starts learning fresh limits or returns to the previous envelopes (depending on the mode change). In the second case, the unit will wait for a few machine strokes before it resumes the previous envelopes to allow the machine to reach consistant speed.The monitoring limits (force and acoustic envelopes) are dynamically updated and matched with the process variation. Counting of good parts made starts also. Every impermissible deviation of the process curve signal will cause the unit to react.

AUTO2 mode

Automatic mode offers the same functions as in AUTO1, but is used when running unmanned shifts. In addition, the AUTO2 parts counter provides a separate count for parts made during AUTO2 mode. When stopping the machine during AUTO2, the unit fires the separate EMERGENCY-STOP relay that switches off the machine entirely (AUTO1 mode will only fire the MOTOR-STOP relay).

STOP (red)

The STOP light comes on every time the unit has switched off the machine. In addition, a machine stop can be initiated by pushing the STOP key manually. The unit always will prompt a stop message on the display to identify the reason for switching the machine off.

Envelope monitoring

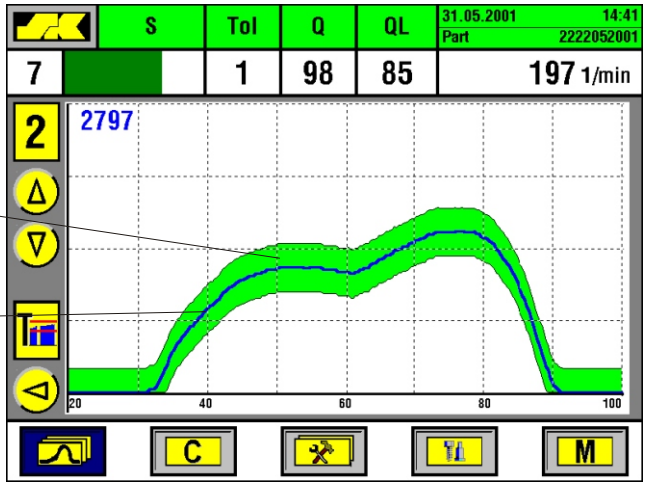
The envelope monitoring technique scans the entire force wave form from start to finish (as determined by the established timing window). Each point scanned is compared to a previously memorized "good parts wave form" by using the upper and lower envelope threshold curves. These are automatically established by the monitoring system each time it is put into AUTO-mode.

Envelope display

Pressing the Curve function key will display the force wave form together with the envelopes. The display shows either multiple-curves (up to 5 sensors at a time) or single curves representing one sensor only. Channel selection from one sensor to another is made by simply pressing the number of the channel you wish to see.

Changing from multiple to single curve presentation and vice versa is initiated by pressing the Curve function key, or by directly pressing the number key for the desired channel. If the monitor has more than 5 channels, use the up and down cursor keys to change the channel displayed.

Single curve



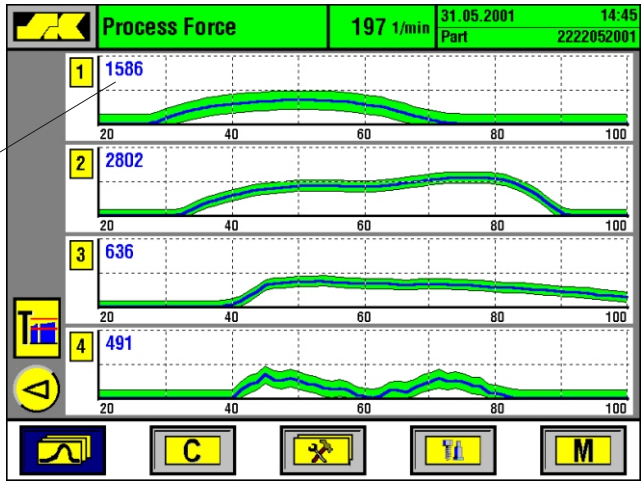
Envelope band (green)

Current force (blue)

Shown while single curve display is active:
S: Sensitivity
Tol.: Tolerance
Q: Q-Factor
QL: Q-Limit

To alter any of the settings, press the **C**-key once, then change the numbers, and confirm by pressing the **E**-key

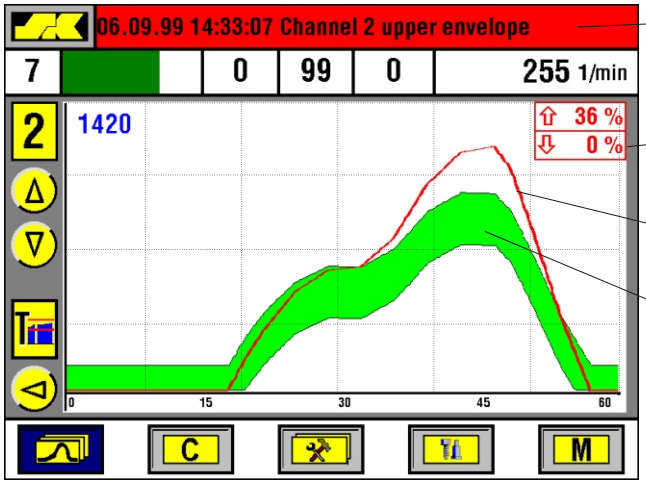
Multiple curves



This number (in millivolts) indicates the peak reading of the signal for the last stroke

Machine stop with envelope error

If a channel's force curve exceeds the upper envelope curve or drops below the lower envelope, the monitoring system will immediately initiate an appropriate stop action. The LCD screen automatically switches to the single curve display of the channel in question making it easy to locate the error. The reason why the machine was stopped along with a date and time stamp for the error are displayed in the red portion at the top of the screen.



Stop reason
Stop time
on the display beam

Shows error size
(here is 38 % of the force
curve above upper envelope)

Error curve (red

Envelope band (green)

Restart after Stop

After stopping the machine due to a force error, it is necessary to determine and to eliminate the cause of that error before you restart production. This prevents the system from learning an improper setup and establishing ineffective control limits. Once this has been done, one of the following procedures should be performed.

The system switches from adjusting mode (yellow beam/MAN-Mode) into AUTO Mode. Alternatively, you can skip into the AUTO-Mode (if your unit is programmed to re-use the previously established envelopes).

The monitoring mode (AUTO) is reached, when the display beam on the top of the screen appears in green.

Or restart the machine after confirming that the cause of the error is eliminated. Then press the AUTO-key to switch the unit back into monitoring mode. The **SK bbx** now calculates new envelope limits, or returns to the previous envelopes if you already pressed the AUTO-key (please refer to page SKbbx-06, selecting the MAN-mode).

Adjusting monitoring accuracy

Sensitivity and Tolerance

The accuracy or precision of the enveloping technique typically is set automatically by the **SK** unit to match the stability and repeatability of each curve segment. Thus, it is not necessary to fine tune this any further through manual adjustments, however, the **SK** does provide the possibility to alter within a certain range the settings for "**Sensitivity**" and "**Tolerance**" individually for each connected channel.

Sensitivity (S) can be adjusted in steps from **1 - 9** (1=coarse, **9**=fine). The sensitivity setting has an effect on the basic width of the envelope which is the distance between upper and lower envelope curve. A coarse setting (= low sensitivity numbers) widens the gap between upper and lower threshold, while a fine setting (= high sensitivity numbers) narrows the gap down which represents a more precise control. Setting the sensitivity to "**0**" switches the monitoring off for this channel (no more envelope curves are being displayed).

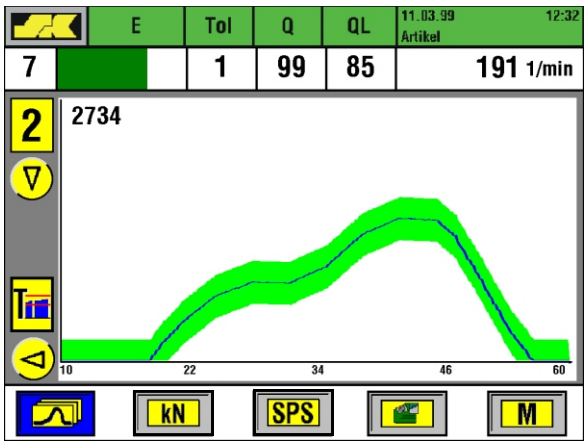
The optional **SK**Profile*master* software (see page 27) provides a segmented envelope profile around the force curves (tight where needed; loose where necessary).

The **Tolerance** (Tol) setting determines how many consecutive "bad" parts with force signals outside the envelope are ignored or "tolerated" **before** the machine is stopped. Therefore, the tolerance setting prevents undesired machine stoppages caused by random or erratic force errors. Tolerance can be set to values from **0 - 9** with the following meanings:

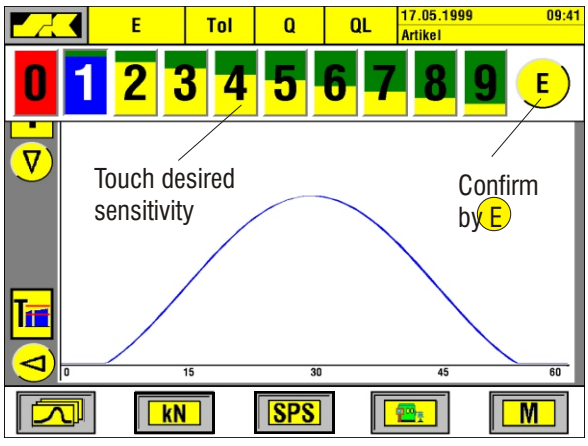
0: No "bad" parts are tolerated. The first "out-of-limit" part will stop the machine.
1: One "bad" part is tolerated. If it is followed by another "bad" one, the machine stops..
9: 8 consecutive "out-of-limit" parts will be tolerated. The 9th "bad" part stops the machine.

NOTE: Use of tolerances should be scrutinized carefully. Remember, an input essentially bypasses the machine for the number of tolerances entered. Serious damage to tooling could result if this feature is improperly used.

How to alter S and Tol:
Select sensor chanel and touch the desired field **S** or **Tol**; enter desired value and confirm by **E**



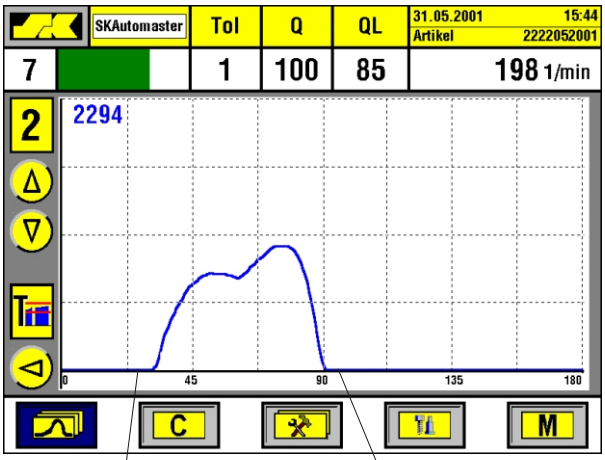
Example:
Adjusting of **S** (sensitivity)



SKAuto*master* automatic envelope setting

The **SK**Auto*master* function offers a unique procedure to always obtain perfect envelope settings and timing windows without any operator assistance. **SK**Auto*master* automatically locates and zooms in on the appropriate forming signal without the need for any manual interference. As a result, the monitoring accuracy is always set to the optimum efficiency.

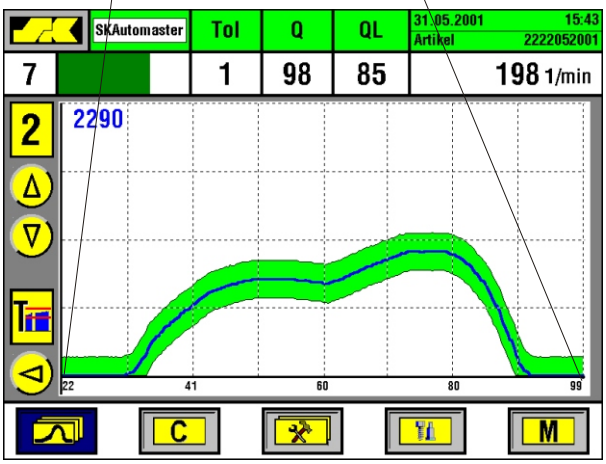
In most application, the basic sensitivity setting can be kept on tight numbers keeping the envelope width as narrow as possible. The special **SK**Auto*master* software routines will in addition assure that the envelope band is properly adjusted.



While running in MAN-mode, the system will use a timing which is set overly wide to make sure that the force signals for all different parts will fall within this base frame.

This technique guarantees that even unusually wide force curves which may occur when changing from one part to another, still will be within the set timing window.

ZOOM



When advancing into AUTO-mode,the **SK**Auto*master* automatically locates the forcve curve and zooms in on it.

The force curve is basically stretched such that is uses the full width of the screen without wasting any monitoring capabilty for idle signal before or after the actual force curve.

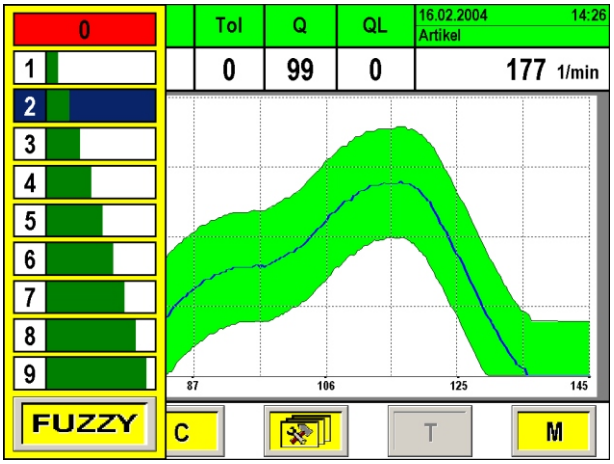
SKFuzzy*master* fully automatic envelope setting

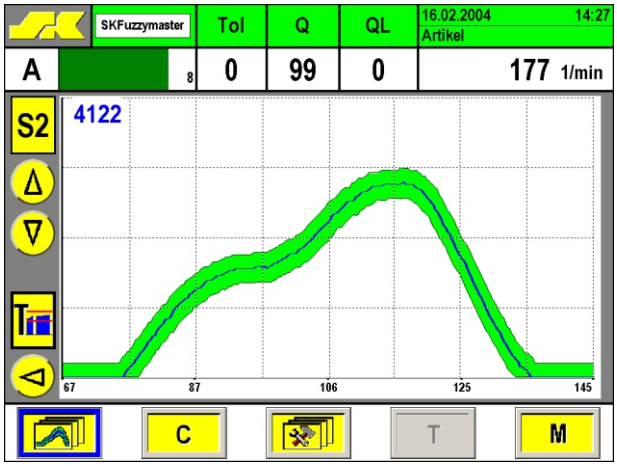
The **SK**Fuzzy*master* technique features for the first time a procedure which will adjust the monitoring envelopes in a fully automatic way to always give a perfect fit around the current variation of the process.

Starting with a selectable minimum sensitivity, the Fuzzymaster will gradually narrow down the envelope width step-by-step to more sensitive settings, depending upon what the current process will allow it to be. This procedure ensures that the monitoring system always works with the best possible monitoring accuracy for the given situation.

If the process should become a bit more “erratic” during running production, the system will automatically reduce the sensitive, but only by one step. If this is not sufficient, the machine will be stopped to allow the operator to determine the cause of the increase in process variation.

Fuzzymaster is activated by selecting “FUZZY” within the sensitivity setting bar.





NEW: Envelope Profile Monitoring

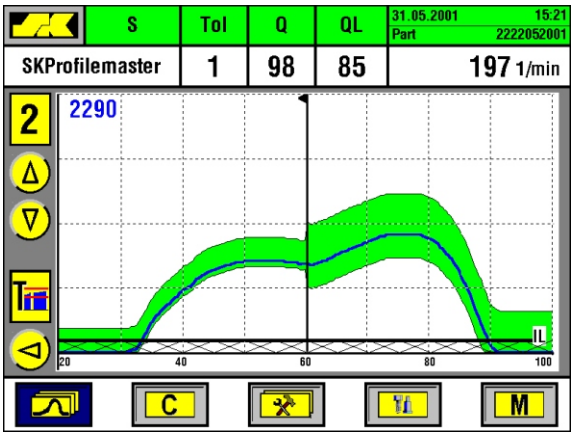
The **SK**Profile*master* monitoring technique represents the next generation of force monitoring procedures. The conventional enveloping technology had to accommodate the often widely varying force curve areas with one sensitivity setting only. So you were either not sensitive enough where it mattered (in those areas where tools actually formed the metal), or you had to live with too many unjustified machine shut-downs.

The **SK**Profile*master* technique now allows you to set different sensitivity profile zones that will perfectly match with the varying stability of your forming processes. Sensitive enough where needed, and loose enough where necessary.

Each force channel can have the following individual settings:
- different sensitivity settings for upper and lower profile limits
- one, two, or three adjustable profile zones

(see supervisor's manual for settings, modification and erasing of profile zones).

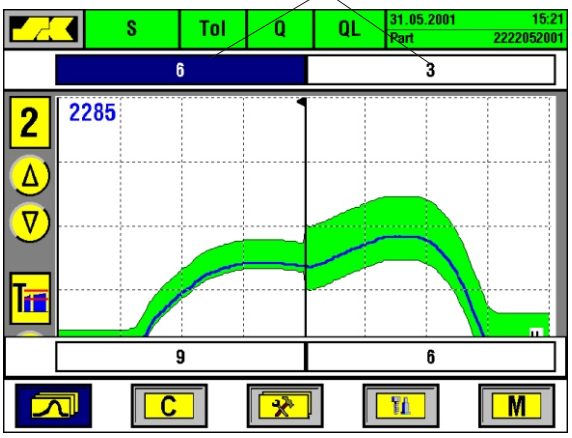
The example below shows a profiled envelope band (2 zones) with different upper and lower Sensitivity settings per zone:



The SK Profile*master* **envelope profile band.**
Each segment has it's own profile limit setting allowing you to find a perfect balance between tight limits where needed (to detect smaller tool failures), and loose limits in other areas to prevent unnecessary machine stoppages due to random variation.

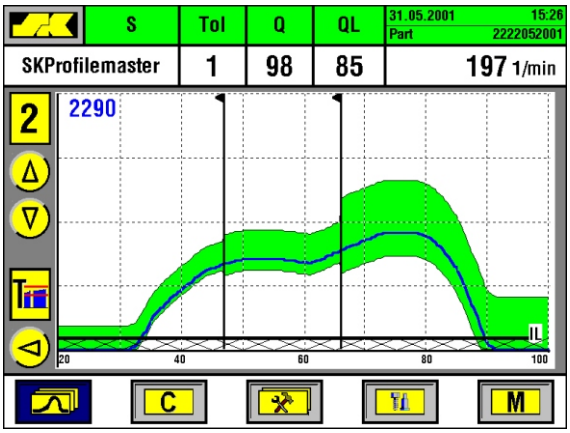
The channel shown on the left side works with 2 profile zones, each having individual high and low profile limits.

Sensitivity windows

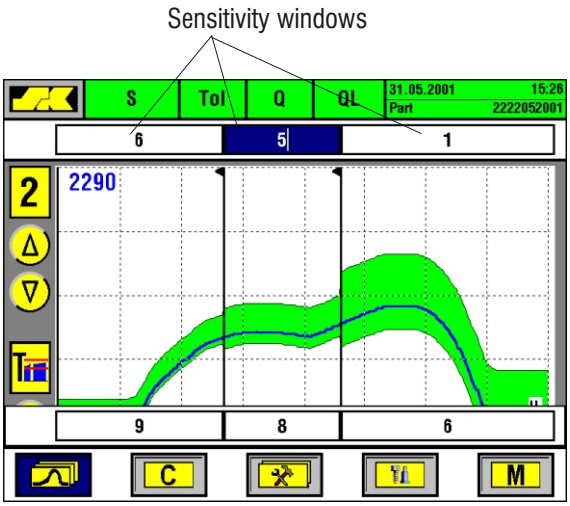


How to set the SK Profile*master* **band:**
- touch the SK Profilmaster box to access sensitivity entry mode in the single force curve screen
- separate sensitivity windows pop up for each individual profile zone
- touch the border line directly to modify the zone size
- set each zone's desired sensitivity from **1** to **9** (1=coarse; 9=fine)
- confirm each zone's selection by pressing the **E** key (you are able to view immediately how your setting is affecting the envelope width in each zone)

The next example below shows a 3-zone profile envelope band with different upper and lower Sensitivity settings per zone:



The SK Profile*master* **envelope profile band.**
The 3-zone setting allows for an even closer match between curve segment variation and adopted profiles.



How to set the SK Profile*master* **band:**
- touch SKProfilmaster box in the single force curve screen to access sensitivity entry mode
- separate sensitivity windows pop up for each individual profile zone
- touch the border lines direktly to modify the zone sizes

- set each zone's desired sensitivity from **1** to **9** (1=coarse; 9=fine)
- confirm each zone's selection by pressing the **E** key (you are able to view immediately how your setting is affecting the envelope width in each zone)

Please note:

Changing the timing window will automatically erase the profile zones on the channel in question, and you will have to go to the MENU section (page 4/4, **SK**Profile*master*) and re-activate the number of profile zones you wish to have for the new timing window.

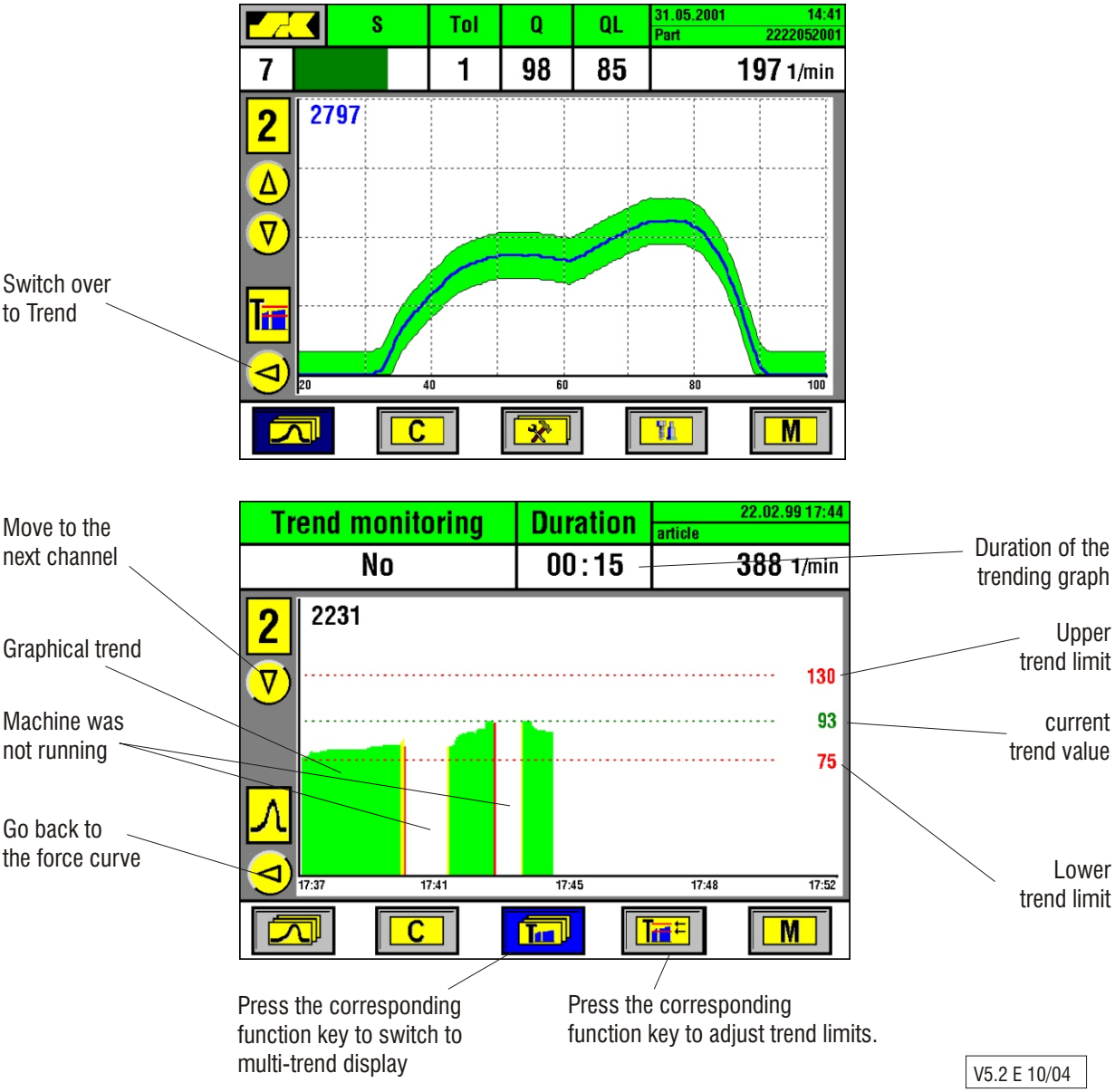
The trending feature allows to visualize and to monitor gradual changes in your forming process such as a steady but slow rise or fall of the forming load. Trending can be activated individually for each channel.

Graphic trend display with Stop/Go

The **SK bbx** offers graphic trending on it's color display. The presentation includes the display of the average forces over time, the selected trend limits, and any machine stops in between. The trending screens can be accessed as follows:

1) Press the **M** function key, then select **Trend** (press key **1**), or

2) From the single force curve screen, press the **Cursor**-key to go to the trending screen for the same sensor channel.



How to set the trending parameters

The following parameters can be set in connection with trend monitoring (select single trend screen first to get access to entry mode):

- "**Trend monitoring**" active "**Yes**" / "**No**"
  When set to "**Yes**", the trend limits will be shown as thick solid lines.
  When set to "**No**", the trend limits will be shown as thin dotted lines.
- "**Duration**" determines the length of the trend graph on the screen from left to right. Time frame can be set between 15 minutes and 24 hours. Each channel can be set to it's individual time.

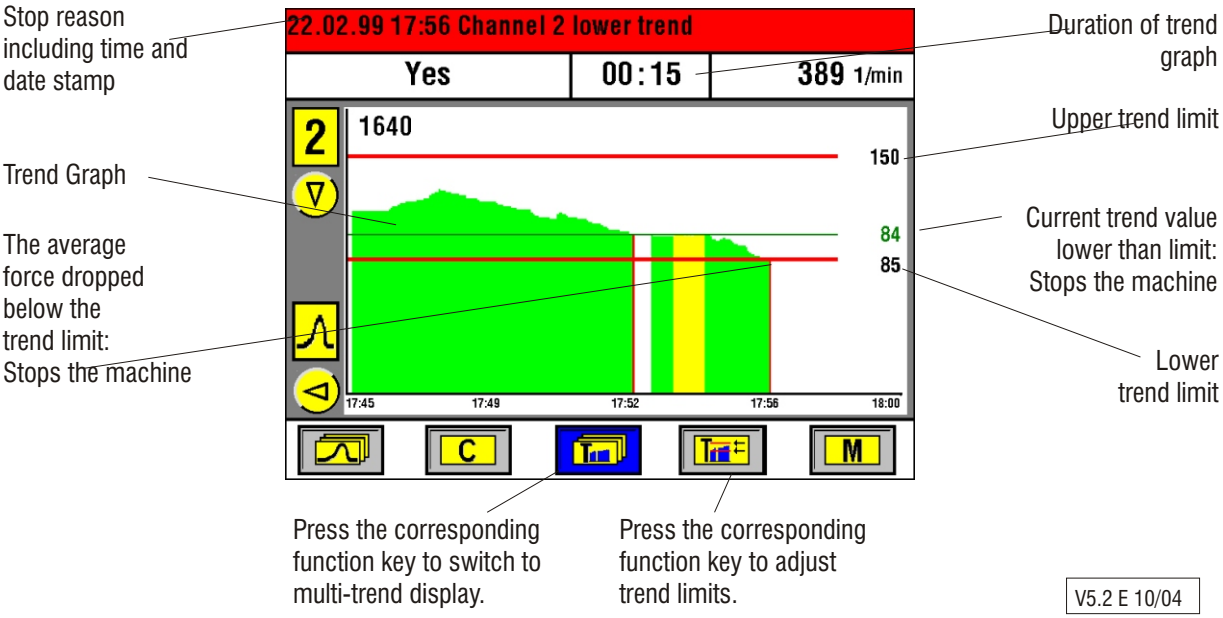
Adjusting the trend limits

The trend limits can be adjusted independently for each monitored channel. Press the **Trend Limits** function key. A windows will come up on the left side of the screen giving you access to altering the limits.

How to set the limits:

- use the cursor **up** or **down** keys to move the limit to the desired set point, and confirm by pressing the **E**-key, or
- enter the new numbers with the numeric keypad, and confirm with the **E**-key.

The trend graph will be plotted on the screen from left to right according to the selected duration of the graph. Machine running time in AUTO mode is plotted in green with the height of the graph showing the trend of the average peak force reading. When the graph has reached the right end of the screen it will jump back to about the middle of the screen and continue from there. The gaps in between indicate that the machine is down in STOP mode, while time in MAN mode is shown in yellow. If the average peak force goes above or below the trend limits, the machine will be stopped (provided you have "Trend Monitoring" active for that channel).



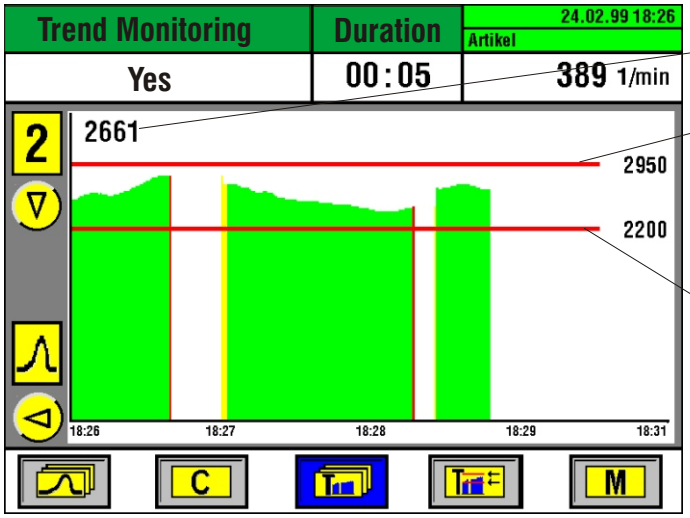
Relative or absolute trend limits

The trend limits can be set either in relative or in absolute numbers (set this within the Menu-section under "**Monitoring Parameters**").

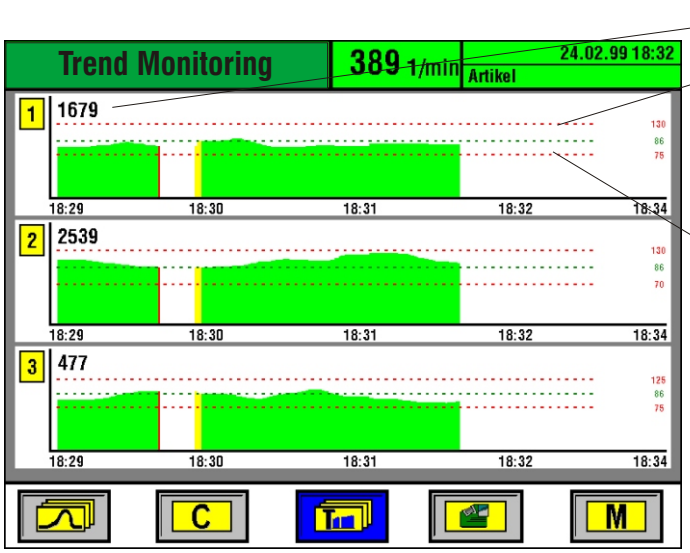
When choosing **relative limits** (as shown in the graphs on the previous pages), the current trend value representing the average peak force at that time, will be set to 100% each time you start a new learn. The trend limits also read in relative numbers. If the lower trend limits is set at 85% (as shown in the graph on the previous page), the average force is allowed to gradually drop by maximum 15 percent. If it continues to drop, the machine will be switched off. Working with relative trend limits has the advantage that the limits can remain active even when you change the machine over to another product which typically would mean totally different actual forces.

Absolute trend limits are based on the actual force scale the monitor works with (incoming voltage or calibrated references). Thus, absolute limits typically need to be adjusted every time you change the product. Absolute trending is mainly designed to be used in conjunction with calibrated sensors.

Trend monitoring with absolute limits



Trend monitoring with relative limits (shown on the multi trend display)



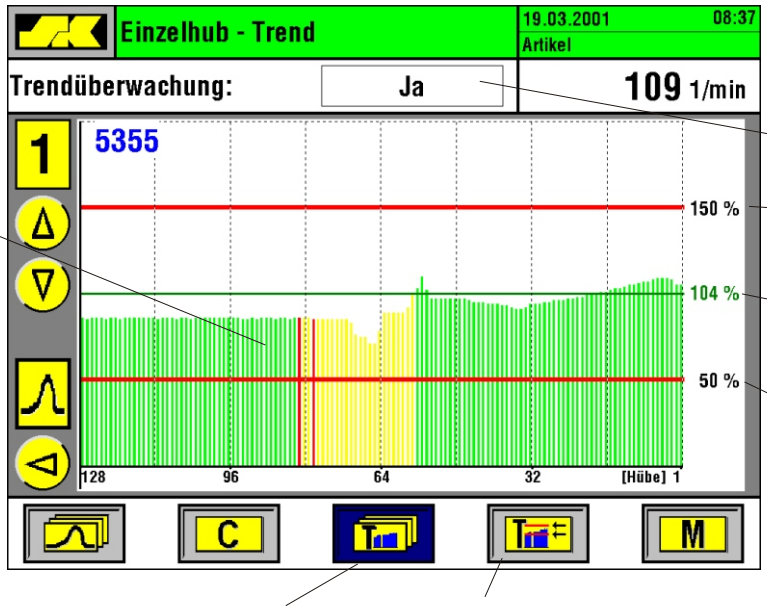
Single Stroke Trending

The trend graph can be programmed as an optional feature to show single stroke values rather than the trending over the average force value (re-programming is done within the menu section).

The single stroke trend graph “plots” the maximum force values as thin vertical lines from left to right. The full screen will the show the peak values of the last 128 parts. A new part is added to the right, while the frist part on the left side will drop out.

Setting the trend limits is identical to the procedure explained previously on page 20.

NOTE: Single stroke trending is based on individual parts, and not on the average over many parts. This means of course that a single part which is above or below the set limits will stop the machine. Before, the average calculated from the last 100 parts had to exceed the limits.



Trend graph shows single strokes as vertical lines. The color of each line indicates the operation mode in which this line was plotted
- green: AUTO
- yellow: MAN
- red: STOP

Trend Limits are activated (Monitoring = Yes)

Upper Trend Limit

Current Trend Value

Lower Trend Limit

Press to change screen to multiple channel trend

Press to adjust Trend Limits

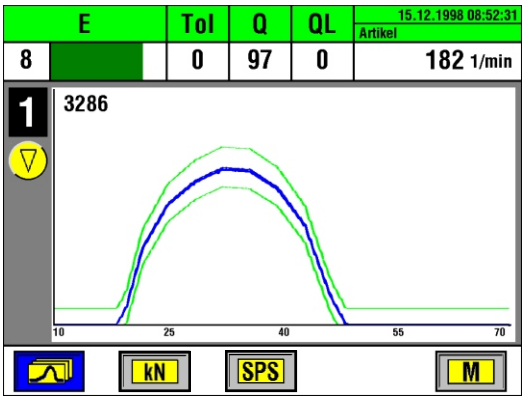
Q-factor (process stability / process quality)

The Q-factor is an indicator which expresses the stability or repeatability of the forming process from stroke to stroke as a percentage number. A low Q-factor (e.g. less than 90%) would result from a very unstable process where the forming force curves are changing significantly from stroke to stroke. As a consequence, this would lead to fairly wide envelopes with little sensitivity. Subsequently, this would also have an adverse effect on the consistency of parts quality.

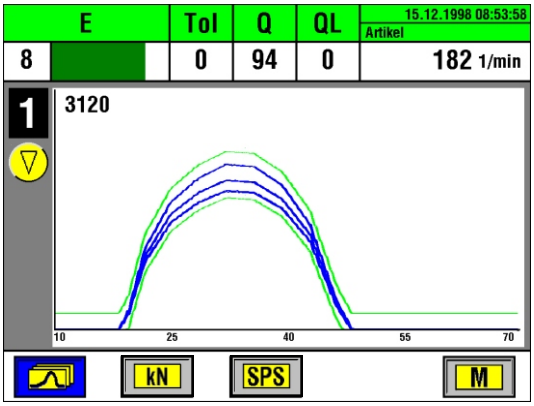
Alternatively, a calm and stable process will produce high Q-readings of e.g. 95% or better indicating the high degree of repeatability. Such a process can be monitored very closely with tight envelope curves.

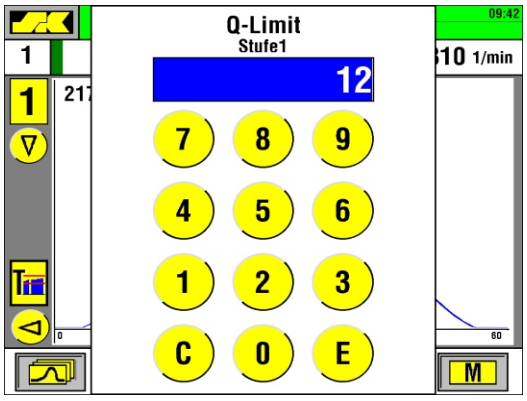
A separate Q-factor is being calculated for every sensor channel, and is shown as **Q** on the single curve screen for this sensor. In addition, you can program a limit value **QL** which allows to set a required minimum Q-reading. If the current Q-factor drops below your desired minimum (e.g. because of an unstable forming process caused by poor material quality or other inconsistencies), the machine can be stopped.

Calm and stable process with a high Q



Unstable process with a lower factor Q





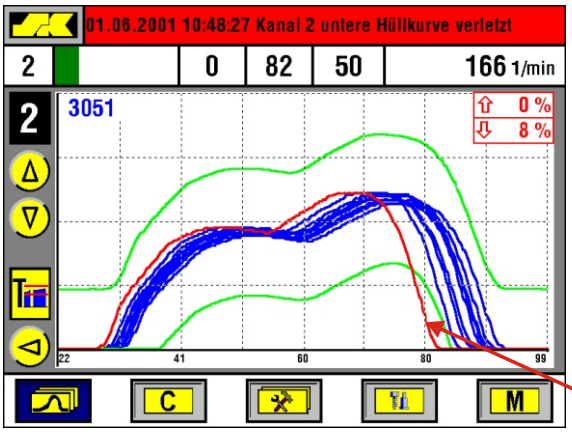
How to set **QL** (Q-Limit)
- select the desired sensor chanel
- touch the field **QL** (field appears blue)
- set the new value vor **QL** (compare picture above)
- if necessary correct the value by C
- confirm by E

SKQ*master* (machine inconsistency compensator)

Some machines tend to vary slightly in speed during the run, or may have a trigger pulse taken from an unstable running side shaft (instability often observed on machines with chain-driven side shafts).

The RPM fluctuation will cause the force waves forms to bounce sidewards left and right. In order to overcome this, you would typically open the envelope band to accommodate for that. At the same time, however, you will loose sensitivity but still experience occasional nuisance shut downs.

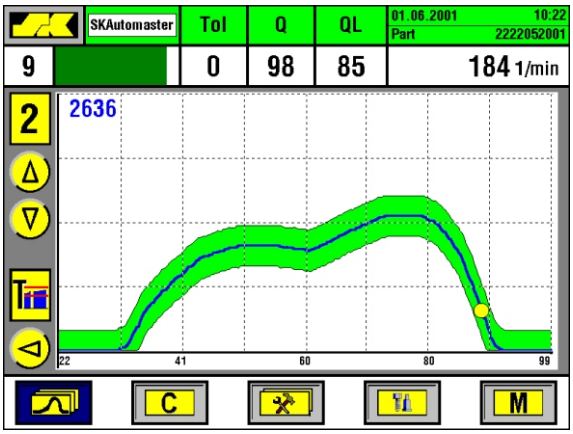
The **SK**Q*master* function now stabilizes the force signal by automatically compensating left-right bouncing of the wave form. This allows you to run the usual tight envelopes or envelope profiles, and it significantly minimizes nuisance shut-downs.



This force curve is outside envelope!

Without **SK**Q*master*:

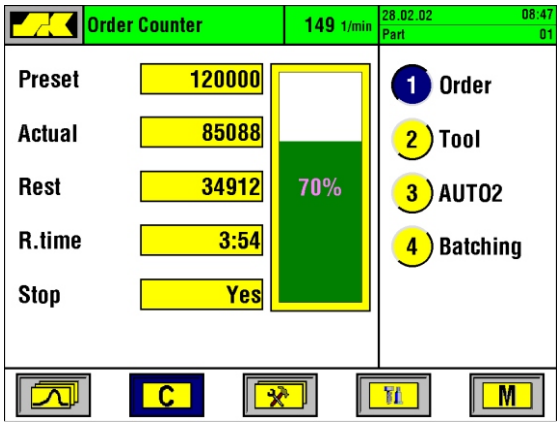
- machine speed inconsistencies cause the force curves to bounce left and right
- envelope limits need to be set wide open to allow the machine to run. You loose sensitivity.
- still erratic force curves occur causing the machine to stop without apparent reason

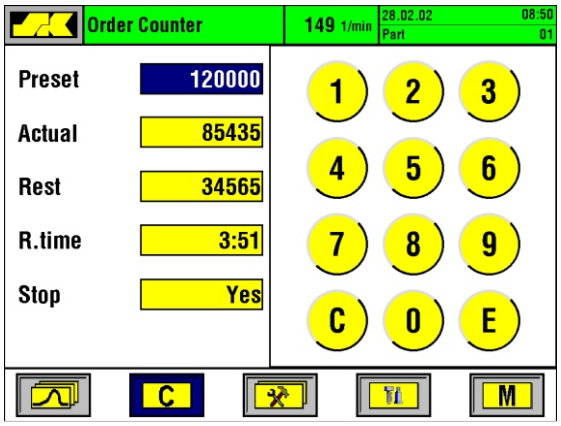


With **SK**Q*master:*

- the signal is automatically stabilized. RPM fluctuation is compensated.
- envelope now can be set close around the actual process. You regain the necessary sensitivity.
- nuisance shut-downs are avoided.

The **SK** monitoring system provides four (4) different part counters for order size, tool life, unmanned shift (AUTO2-mode) and batching. The counter section is called up on the screen by pressing the **C** function key below the **C** function symbol. Changing from one counter to another is done by pressing the related numerical key **1**, **2**, **3** or **4**. The number and designation of the actively displayed counter is highlighted in blue (e.g. **1** in the graph below). Each counter's display shows the preset quantity, the number of parts already made, the remaining quantity, and the remaining running time needed to reach the target count (provided the machine keeps on running at current speed). The green bar graph on the right side of the display tells you which percentage of the preset quantity has been completed already.





How to set the counter

Touch the field '**Preset**' and press the **C**-key on the numerical keypad (on the right of the display) to switch into entry mode (color of the preset count box changes to blue). Enter the new quantity, check the display to be sure you have typed in the correct number, and confirm with the **E**-key. The made-count automatically
resets to zero, and the green percentage bar drops down to zero. You can also enter a different quantity for the made count. This allows you to preset a made count (e.g. if you have already made some parts for this order). You can also choose whether you want the machine to stop when it reaches the preset order size.

Order size counter

The order size counter counts all good parts produced while running in AUTO1 or AUTO2 operation mode. If desired you can also add all parts made during MAN-mode to the order size count (see set-up section for programming this). When the current count reaches the preset order size, the Machine can be stopped in order to prevent over runs.

Tool life counter

The tool life counter counts all parts being made during MAN, AUTO1, and AUTO2 mode (basically all modes which consume tool life). The tool life counter is typically used to stop the machine at regular intervals for tool changes or, if you wish, other kinds of regular checks (e.g. periodic adjustments, inspections, maintenance, etc.).

3

AUTO2-counter

The AUTO2-counter works just like the previously described order size and tool life counters. It counts all parts made while the unit runs in AUTO2 mode. This is in addition to the counts taken by the order and tool counters. The AUTO2 counter is typically used to count production and /or to limit running time for unattended shifts.

4

Batching counter

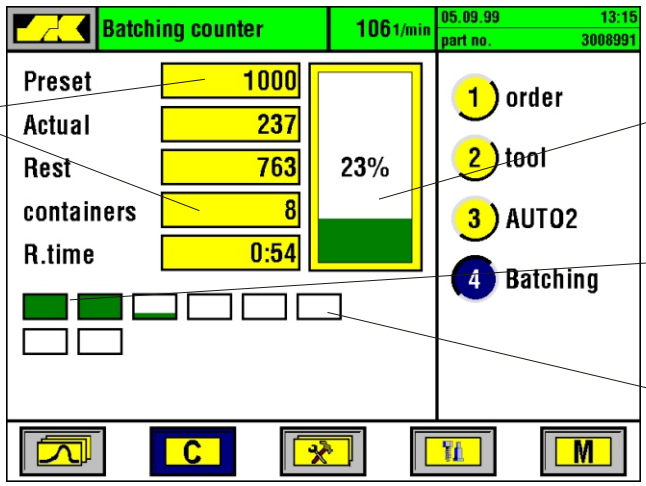
The batching counter is designed to control the function of an external batching unit. Such units are used to distribute the produced parts into several, consecutive containers. After a preset number of parts, the **SK** system will give out a pulse (standard pulse length is 1.5 sec) which is used to switch the batching unit to the next fresh container. When all available containers are filled, the MOTOR-STOP relay is fired to switch the machine off. The display indicates how many containers are filled already, and to what percentage the current container is filled. The remaining run time shows how much time is needed to fill all containers.

Touch the '**Preset**' box directly or the **C**-key on the numeric pad switches into entry mode ("preset" box color changes to blue). Enter your desired quantity per container and confirm with the **E**-key. Then enter the number of containers available on your batching unit (up to 15 possible). Confirm again with the **E**-key.

If you set the number of containers to "0" a batching pulse is given continuously after every filled container without stopping the machine at any number of filled containers.

The batching function is switched off when both, the preset quantity and the number of containers, are set to "0".

This example has a batching unit with a capacity of 8 containers at 1000 parts each



The currently loading container (number 3) is 23 % filled.

These 2 green containers are already full.

The 5 white containers are still empty.

Header set-up assistance by "freezing" force wave forms

Setting up a cold forming machine properly is often a matter of uncertainty: Are the tools set so that the resulting forming pressure is sufficient, or are the parts incorrectly formed? Are all forming stations adjusted such that the loading is uniformly distributed, or are some stations critically overloaded? Would it be possible to form a good or even better part with less pressure which could even increase tool life? But how would one know if and by how much a set-up change improves the setting?

The **SK**Tool*master* system can help you optimize your machine set-up using simple steps. The system indicates if set-up corrections improve the setting, or if they make it worse. At a simple touch of a button, you can "freeze" the current force wave forms on your screen. After trying to improve the setting and restarting the machine, you can immediately see if the new force curves are better than the previous "frozen" ones. Generally speaking, it is advisable to produce a part with the least amount of pressure possible. Low pressures are generally considered to be better for the machine and the tooling.

In addition, the shape of the forming force curves will tell you the progression of the metal deformation as it takes place between your tooling. You can also learn to spot unusual wave forms indicating improper settings or bad tooling.

Using **SK**Tool*master* to set up your machine

The **SK** unit can help you improve machine set-up. Try the following procedure:

Put your monitor in MAN-mode (yellow display beam) and let the machine run and produce parts. Watch the wave forms and compare with your previous experience. If you're not satisfied (e.g. too much pressure in some stations, pressure not properly distributed across the stations, erratic patterns, etc.) press the “snow flake”function key to “freeze” the current wave forms.

These are now shown in red on the screen while the blue lines show the forces of the still running machine. The blue colored “snow flake”function symbol indicates that frozen curves are in memory. They will remain "frozen" until you press the “snow flake” function key again (in MAN-mode; the key will turn back to it’s regular color), or you switch off the monitor.

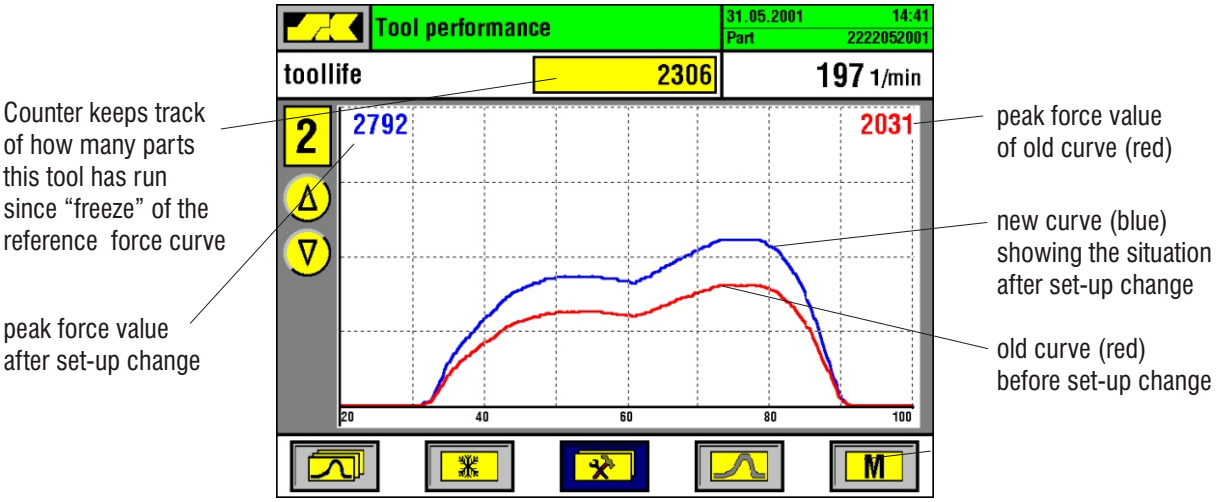
Now stop your machine and make your desired adjustments.

Re-start the machine and watch how the current force curves (blue) differ from the previous (red) force curves. In addition, you may also want to look at the digital peak force readings and the arrows pointing the direction of change.

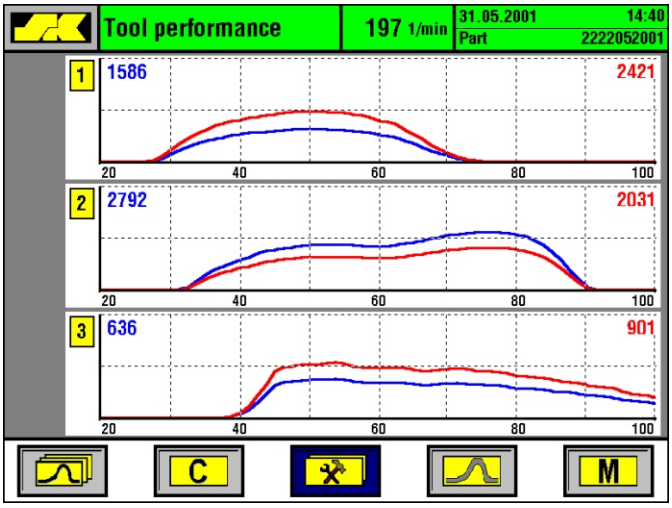
The single curve picture shown below (top) has a situation where the new forces are higher than the previous ones. This would indicate that the adjustments worked the wrong way (when we assume that lower forces are better for machine and tooling).

The procedure described here can help to improve the machine set-up step-by-step.

Single curve presentation



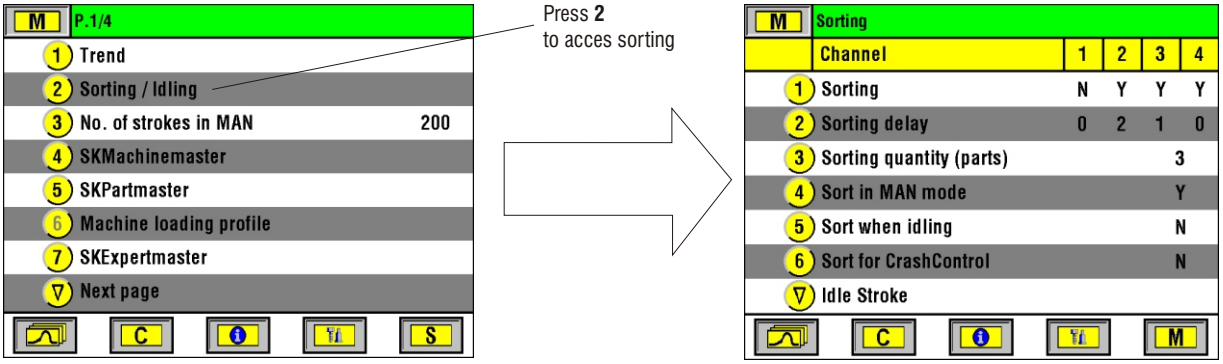
Multiple curve presentation (example for 3 curves)



The sorting function

All **SK** process monitoring systems are designed to operate in conjunction with suitable parts separation devices such as gates or traps in order to separate any detected faulty parts from the previous good parts production. The **SK bbx** unit will give a sort signal via its sort relay to open and close such devices. It is recommended that the machine be stopped at the same time so that the operating personnel can evaluate the type of defect and to initiate possible corrective action. Alternatively, the machine may be allowed to carry on producing while randomly occurring defects are automatically segregated. The machine will only be stopped by the process monitor if too many consecutive bad parts are made (adjustable via the "**Tolerance**" setting, see page 09).

The settings for sorting can be found inside the menu section (accessible via the **M** function key and entry of an access code).



Setting the sorting parameters

Touch the numbered key to select the desired function. The related data field on the right side turns dark. Enter the desired number, or press any number key to switch between **Yes** and **No**.

1. Sorting (Yes/No):
Sorting function is active for this channel when set to "**Y**".
When set to "**N**" this channel is not used for sorting.

2. Sorting delay:
Allows you to delay the sort signal. This feature is useful in cases where the detected bad part needs some time to get to the actual sort position. The delayed signal prevents too many of good parts from being sorted along with the bad one. The delay is entered in number of parts (or stokes).

3. Sorting quantity (parts):
Determines the number of machine cycles or strokes for which the sort signal will be given. This ensures that the faulty part has really passed the gate position. Any setting higher than 1 will sort one or more good parts along with the bad one which is generally recommended for quality control assurance.

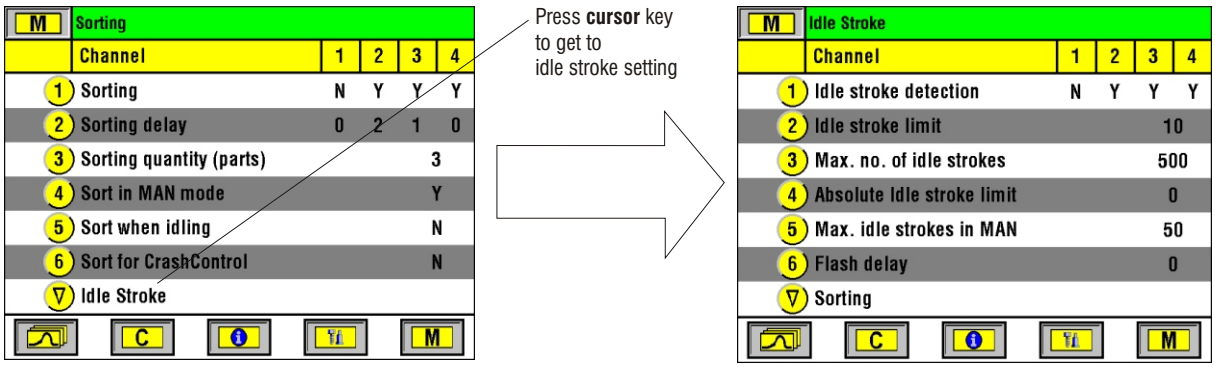
4 Sort in MAN mode: When set to "**Y**" the sort signal will be activated when the **SK bbx** runs in MAN mode. All set-up pieces and non-monitored parts are sorted which prevents possible contamination.

5 Sort when idling: When set to "**Y**", the sort signal will be activated every time the process monitor detects an idle stroke. On some machines certain faults have very low force readings and may look like an Idle stroke. Idle strokes, however, are typically allowed on these machines and would not prompt a sort signal. In such a case, the sort gate can be activated for safety reasons every time an idle stroke or a "would-be idle" stroke is detected.

6 Sort for CrashControl: when set to "**Y**" the sort signal will be activated for every so-called crash-control stroke. These are machine strokes where due to feeding problems, or in case of detected short feeds, the forces are not monitored with their regular envelopes but are only checked for heavy overloads (crash). These potentially suspicious parts can all be sorted.

Idle stroke adjustment

Some machines tend to occasionally run idle stokes due to problems in feeding blanks down the feed rails. Normally, an idle stroke is considered to be a "fault", and the monitor would stop the machine. To prevent that, the monitor is capable of seeing the difference between an idle stroke and other faults, and can tolerate idling for a certain period of time. The machine will be stopped only if idling continues (e.g. when feeder bowls are empty). The following parameters can be set to tell the monitor what idle strokes look like:



1 Idle stroke detection

Allows you to select which channels will tolerate idle strokes. Set those channels to "**Y**".
In those channels where you don't want to allow idle strokes put a "**N**". Confirm your settings with the "**E**" key.

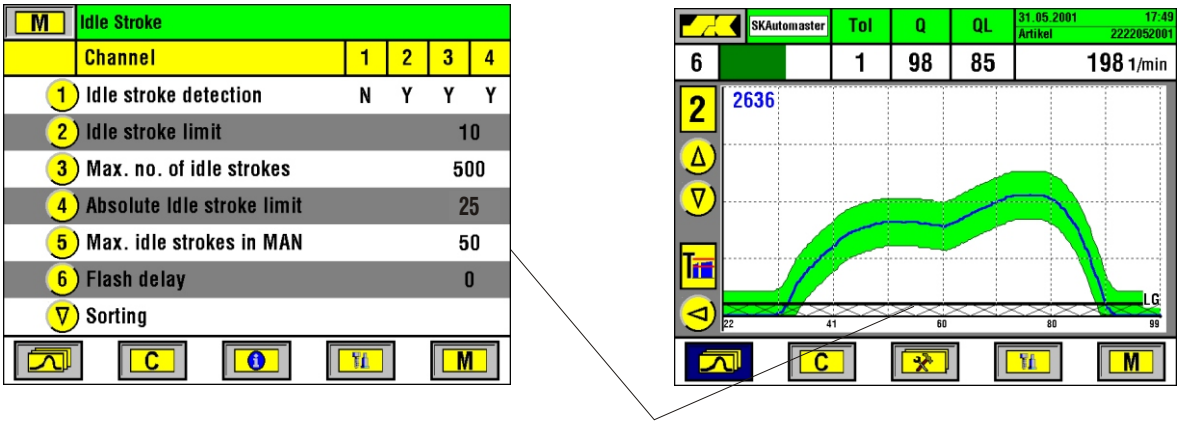
2 Idle stroke limit

Determines the limit for idles strokes as a percentage of the normal peak force reading. If a force reading is below the threshold, this stroke will be considered an idle stroke. The example above will see idle strokes if the peak forces are less than 10 % of the normal load.

3 Max. number of idle strokes
Determines the maximum number of tolerated consecutive idle strokes before the machine is switched off (example above: 500 strokes). During this time, the optional warning lamp will flash to alert the machine operator of an unproductive machine condition.

4 Absolute Idle Stroke Limit (**SK**Single*master* option)
This setting will prevent that very small force signals (peak lower than the set limit value) are considered to be valid force curves but are treated like idle strokes. This feature ensuress that idle stroke signals (important on thread rollers) are ignored during teach-in.

If your monitor is equipped with this option, the force curve display will visualize the set absolute idle limit as a shaded area.



Absolute Idle Stroke Limit

5 Max. idle strokes in MAN (0 .. 9999), Option **SK**Single*master*
Determines how many consecutive idle strokes will be accepted in MAN mode (only in conjunction with the function described at 4 above).

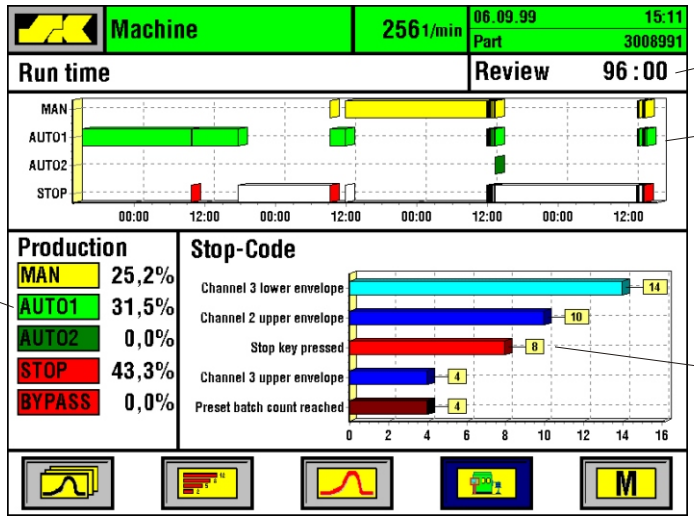
6 Flash delay
Determines when the optional warning lamp starts flashing in case of idle strokes (number of consecutive strokes after which the lamp starts). This feature prevents that the lamp flashes all the time in case of irregular no-feeds.

Statistical machine and process data analysis (optional)

The **SK bbx** offers as an option the possibility to memorize machine running data over a period of time, and to provide some statistics from that data. This function is accessible via the first page of the Menu section, item no. 4, "**SKMachinemaster**".

Machine run time diagram

This screen summarizes the machine performance over a certain time frame (history). This includes up and down times, utilization percentages and down code statistics. The review (history) can be set between the last 30 minutes up to the last 96 hours (touch the **Review box** to gain ac-



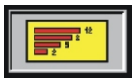
Review time

Machine "run time recorder" including up and down times

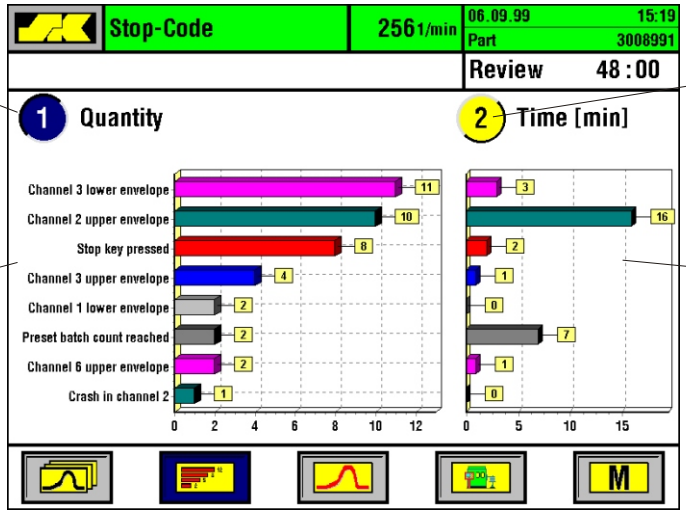
Distribution (%) of the up and down time intervals (efficiency)

Histogram of the 5 most frequent events causing downtime

Stop frequency



Press the function key to see a detailed error and stop code analysis .The error listing can be either put in sequence of their frequency (press **1**) or in order of the down time caused by each type of error (press **2**).

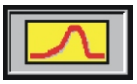


Press **1** to sort by frequency/ quantity (as in example on the right)

Press **2** to sort by the down time caused by each type of error

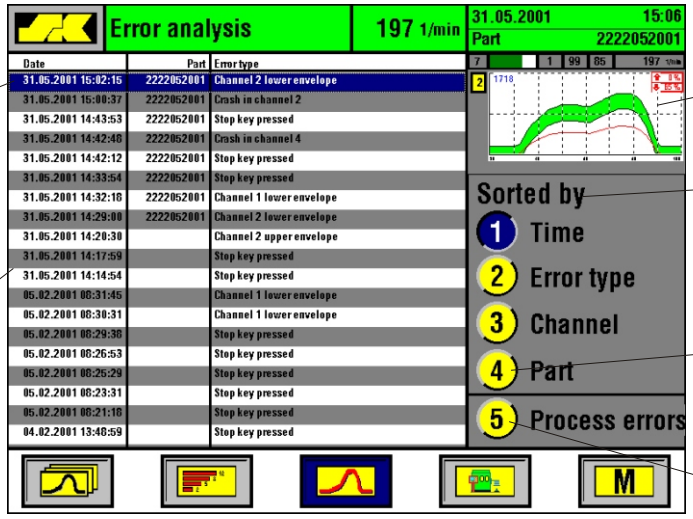
The left column shows how often each error occurred in the selected review time frame (history)

The right column shows the amount of down time (min) caused by the listed errors



Error analysis (failure curve memory)

All errors and machine stoppages are kept inside the monitor's memory, and are available for later analysis over a period of time. Press the **Error Curve** function key below the function symbol shown on the left.



Use the cursor keys to scroll the blue bar to the desired position (the related error curve will automatically insert in the upper right corner)

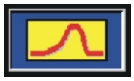
Listing of all recorded errors

Appearance of a process error (failure curve)

Sort list: by time of error (press **1**), by type of error (press **2),** or by channel (press **3**).

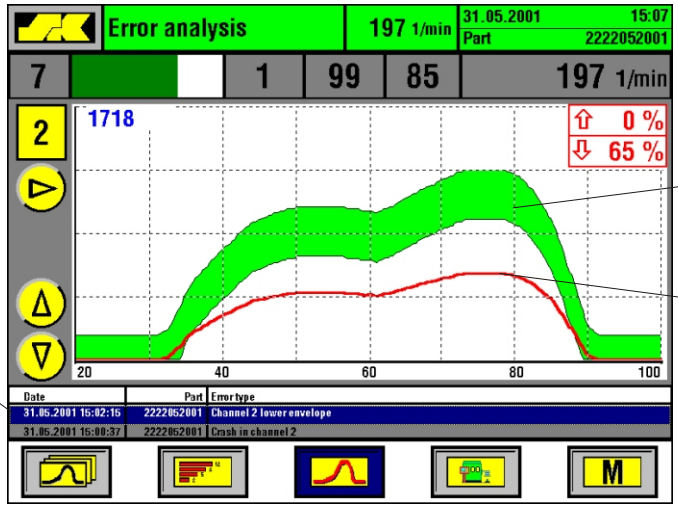
Press **4** to just list process errors (without counter stops, etc.).

Press **5** to list all errors made while the current part was running.



Enlarged error curve display

Press the **Error Curve** function key again to obtain an enlarged image of the error curve you are just looking at to see more details:



Example of a force error:

This was the envelope valid at the time the error occurred

The actual error curve is shown in red

The blue bar marks the currently displayed error

Load distribution profile

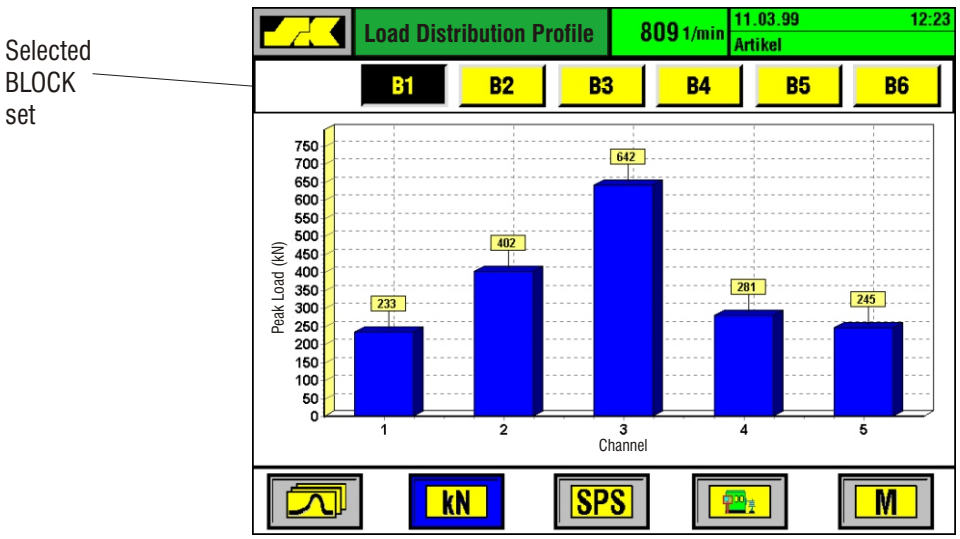
The load distribution profile can be accessed from the first page of the MENU SECTION (press **M** and **6**). This screen shows the distribution of the current peak force readings (blue bars) for each channel. This information allows you to view the actual distribution of the forming work among the channels and to decide whether or not you'll find the distribution acceptable.

On multi-station machines, it is normally desirable to have a fairly uniform distribution of the forming work in order to obtain good tool life. A distribution heavily out of center, on the other hand, is typically not acceptable because this would wear out the ram slide bearings.

The numbers shown in the diagram are either based upon the **SK bbx**'s internal scale (directly associated with the strength of the incoming sensor signal), or they can be actual tonnage (kN) readings in case you use calibrated sensors.

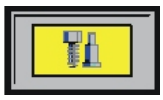
If your machine is equipped with exchangeable tool packs with calibrated sensors installed in each pack, you can have several sets of calibration parameters stored under **BLOCK 1** to **BLOCK 6.** Whenever you change a tool pack, you can call up the associated calibration BLOCK and have the correct absolute load readings off the sensors installed in this tool pack.

If your monitor is also equipped with the optional “Part Data Memory”, the load distribution profile diagram will show in addition any reference load distribution that may have been stored under the Respective part number (see next chapter Part Data Memory).



Part Data Memory (optional SKPart*master*)

The memory function of the **SK bbx** system allows one to store by part number important information relative to the setting parameters such as sensitivities, tolerances, timing windows, profile zones etc., and to re-use them for repeat jobs. If your monitor is also equipped with the respective optional features, the unit will also memorize the target force wave forms and the machine loading profile.

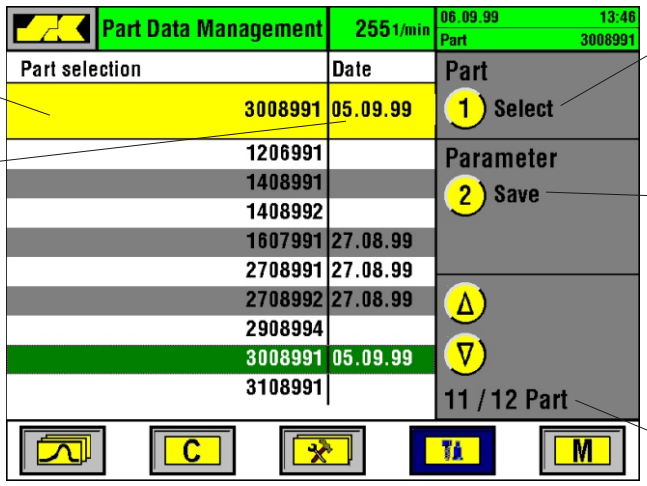


Access to Part Data Memory

Access to enter a new part, to recall part data from memory, or to refresh data for an existing part number is via the **PARTS** function key.

The upper yellow line shows which part is currently selected

The date marked shows that and when data has been memorized for this part.



Press **1** (Select Part) to:
- enter a new part number
- select an already existing part number from the list

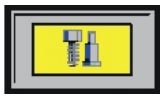
Press **2** (Save Parameter) to store part data into the memory:
- first set of data for a new part
- overwrite data for an existing part

Shows the position of the cursor bar (example: cursor is at part 11 out 12)

Every attempt to enter data (pressing **1** for picking a part number, or **2** for saving part data, followed by **E**) is followed by a security question asking whether or not you really wish to make that entry:

- SELECT PART ? YES / NO
  When you picked an existing part number (without data in memory), or when you entered a new part number.

- LOAD PARAMETERS? YES / NO
  When you picked a part with data in memory. Answering yes (press **E**-key) will re-load and automatically activate that data (only possible while the monitor is in MAN or STOP). This function is used when re-calling data from a previous run for a repeat job.



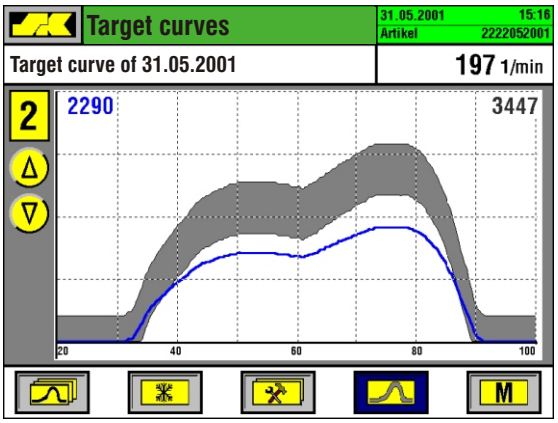
- STORE PARAMETERS? YES / NO
  When you wish to enter data for the selected part number the first time. Please note that this is only permitted while the unit runs in AUTO mode. Normally, you want to memorize data only after the part has run and performed well for a certain time (tooling run-in, machine warmed-up, consistent material, etc.)

- OVERWRITE PARAMETERS? YES / NO
  When you wish to refresh an existing set of data for the selected part number. This may be the case when you have found better settings during a run or repeat run of that part.

Re-activating a previously produced part will do the following:
- reset all relevant parameters back to the settings of the previous run
- show you the former target force curves and your current forces (optional function)
- give you the load distribution diagram (old and new peak loads in comparison; optional function)

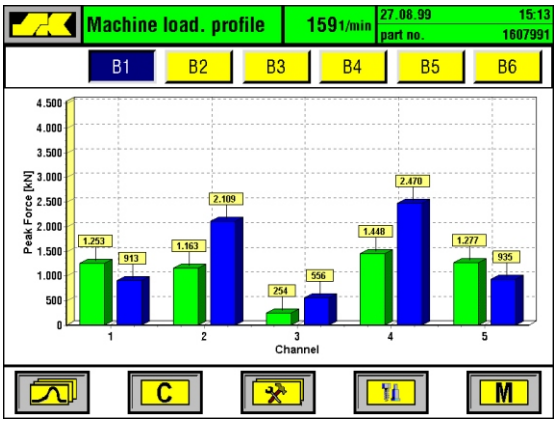
To see the target force curves versus your current forces press the **TOOL** function key. The graph shows channel by channel (or in multi-channel presentation) how your current forces (blue lines) compare against the memorized target area (gray envelope zone).

To see the load distribution diagram press **M** for Menu and then **6** for “Machine Loading Profile”.



Tool Performance / Target Force Curves
Shows the current force curve (in blue) vs the memorized target forces from a previous run (stored on 31.05.2001). The example here shows that channel number 2 is currently working at much less load than before (peak force reading now is 2290 vs. 3447 earlier).

Press the Curve function key to see the target curves for all channels on one screen.



Machine loading profile
Shows for each channel the current peak force readings (blue bars on the right side) vs the memorized previous readings (green bars on the left side).

Functions of Machine Interface

General description

The machine interface serves as connection between the SK process monitoring systems and the machine controls. Firstly, the interface contains a set of relays which are used to transfer switching signals towards the machine (e.g. stop machine, flip sorting gate, etc.). Secondly, the interface has terminal connectors which are used to input various digital signals from the machine, such as the timing signal, finger-open signal on multi-die machines, ESA-input on hot formers, etc.). In addition, the interface also provides through it's built-in supply unit the 24 VDC power to the IMPAX-SK unit.

Switching functions

The standard interface contains 6 relays rated at 12A/250VAC. Each relay offers normally-open and normally-closed contacts. The LED next to the relay shows it's current status. If the LED is lit relay coil is powered; if the LED is off the relay coil is powerless (low).

Relay #1 (Sorting) / Relay #2 (Batching):

Both relays are normally powered. They will drop to give the sorting or batching signal.

Relay #3 and #6 (Motor-Stop) / Relay #4 (Emergency Stop):

All 3 relays are normally powered. They will drop to switch the motor off or to switch emergency stop. The "Motor Stop" relays #3 and #6 will switch every time the process monitor goes into stop. Relay #4 "Emergency Stop" will be switched in addition with a delay of about 1 minute when a stop signal is given during AUTO2-mode (unmanned shifts). This relay is typically used to switch off every electrical component on the machine when it stops during unmanned shifts.

By-Pass key switch

The by-pass key switch located on the outside of the interface box will force all relays to stay in their normal position. The process monitoring system can now be removed from the machine, and the machine is able to run without the monitor. In case of total power failure inside the interface, all relays must be bridged in order to run the machine without the monitoring system.

Good-part-made pulse output

The good-parts-made output pulses a short signal for every good part made when the machine is running. Some data networking systems require such a signal to tell if the machine is running or not. No output signal is given in case of machine downtime, or when the machine runs idle.

Digital inputs

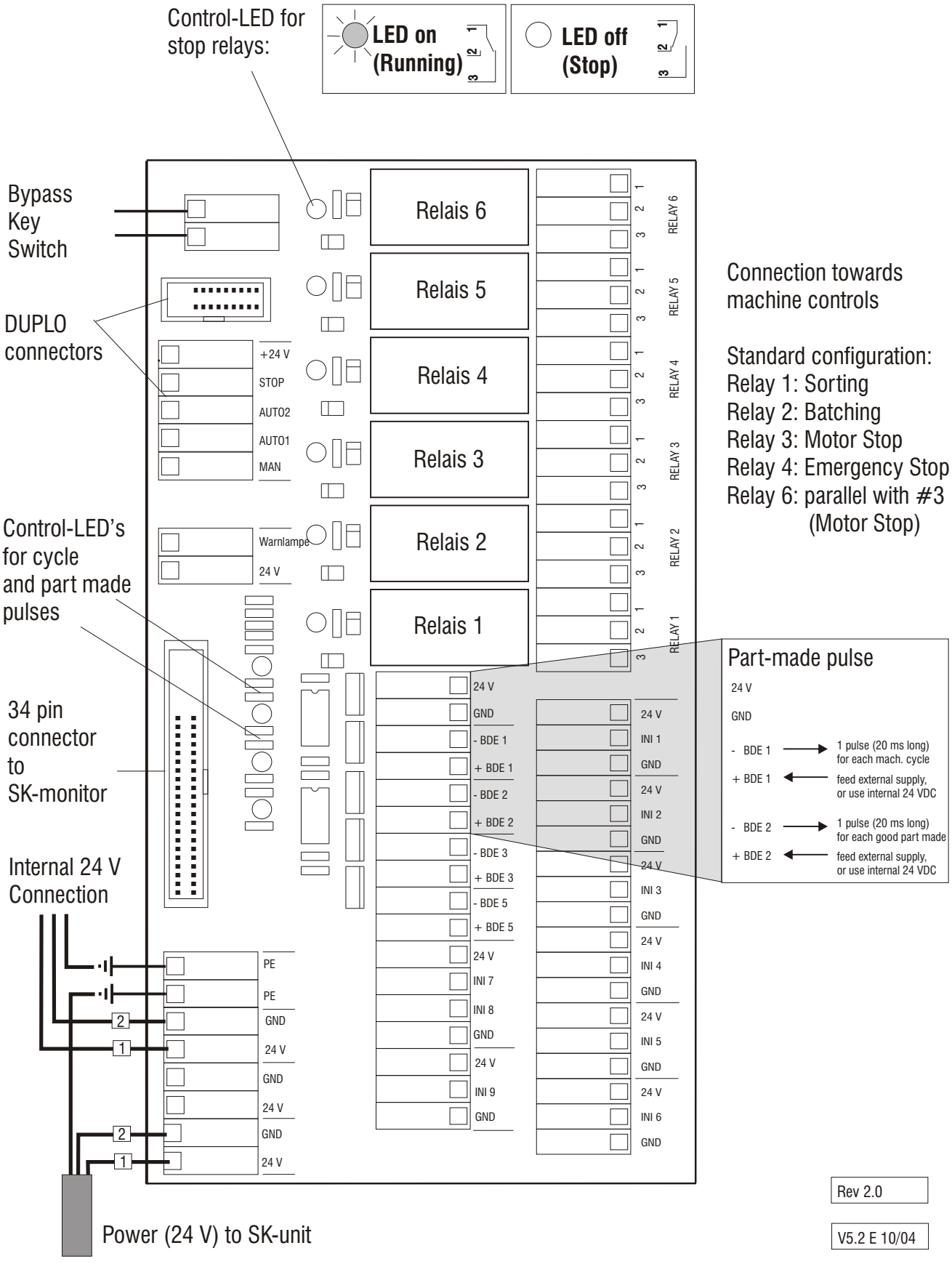
The following digital inputs are reserved for fixed functions:

INI 1: timing signal input (proximity switch)

INI 2: second timing signal input, only needed for synchronization on rotary die headers! (normally, prox switches are not connected here but inside the sensor box)

The other inputs are reserved for future functions.

Machine interface connection (Rev 2.0)



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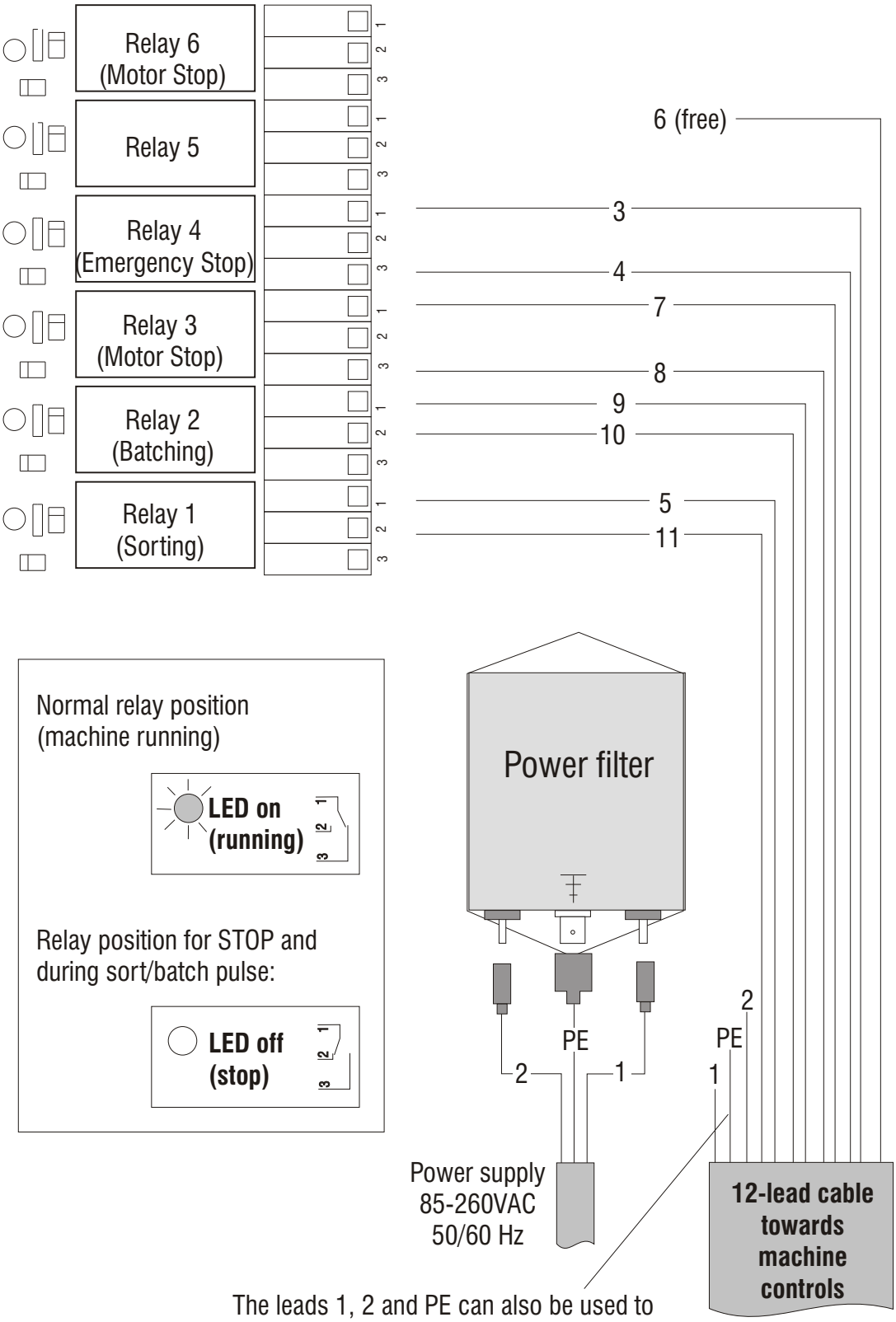
Connection Interface - Machine Controls



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