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Operation Manual

SK 2 / SK 5

Process Monitoring Systems

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We reserve the right to alter technical details without prior notice.

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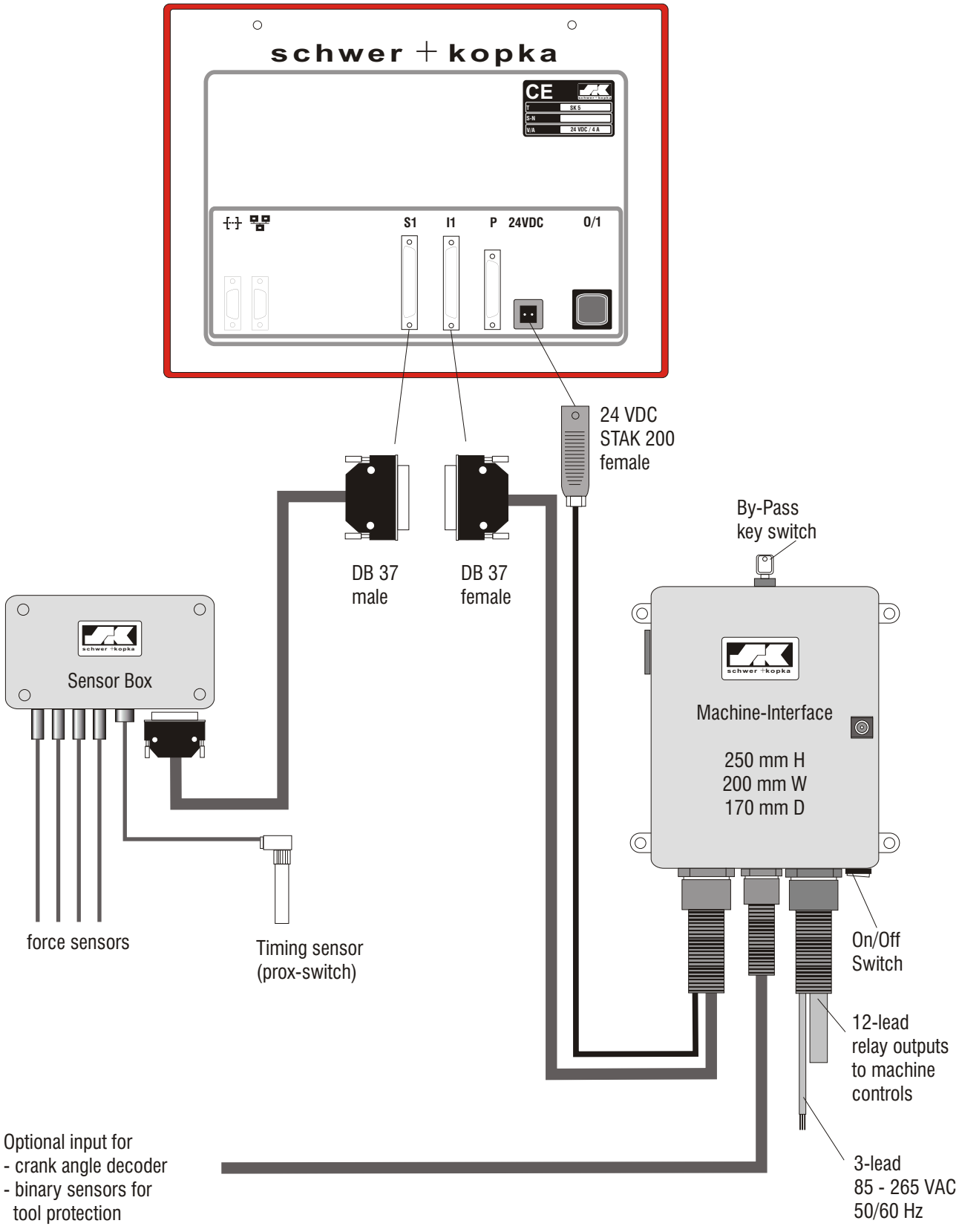
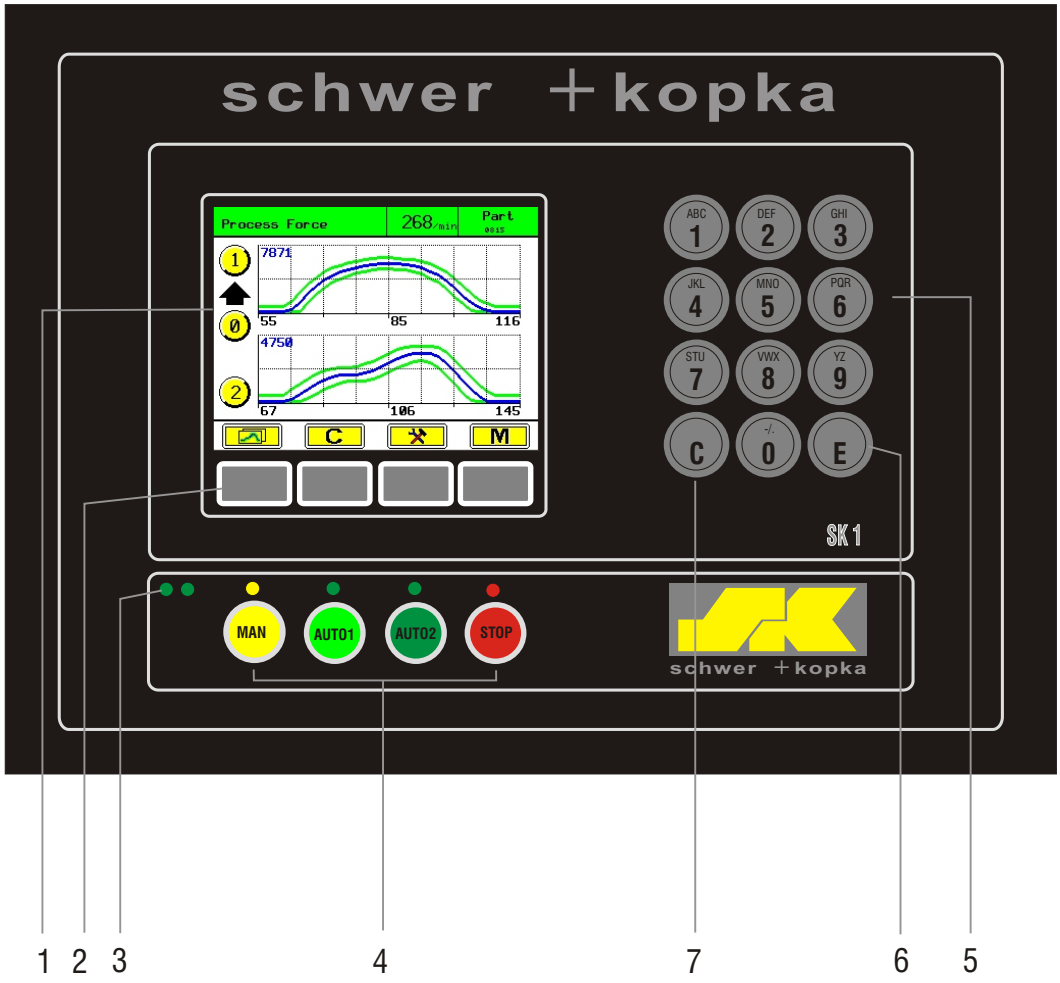
Contents

Please note that some of the features described in this manual are not available for all models or applications, or may be optional.
Some models may contain functions and features not described in this manual.

System Layout



Front panel



1. LCD color graphic display (5.7“)

2. Function keys

3. Timing signal indicator lights 1 and 2

4. Operating mode selection with indicator LED:
   - MAN - mode (manual/set-up)
   - AUTO 1 - mode (normal shift)
   - AUTO 2 - mode (after hour shift)
   - STOP (machine switched off)

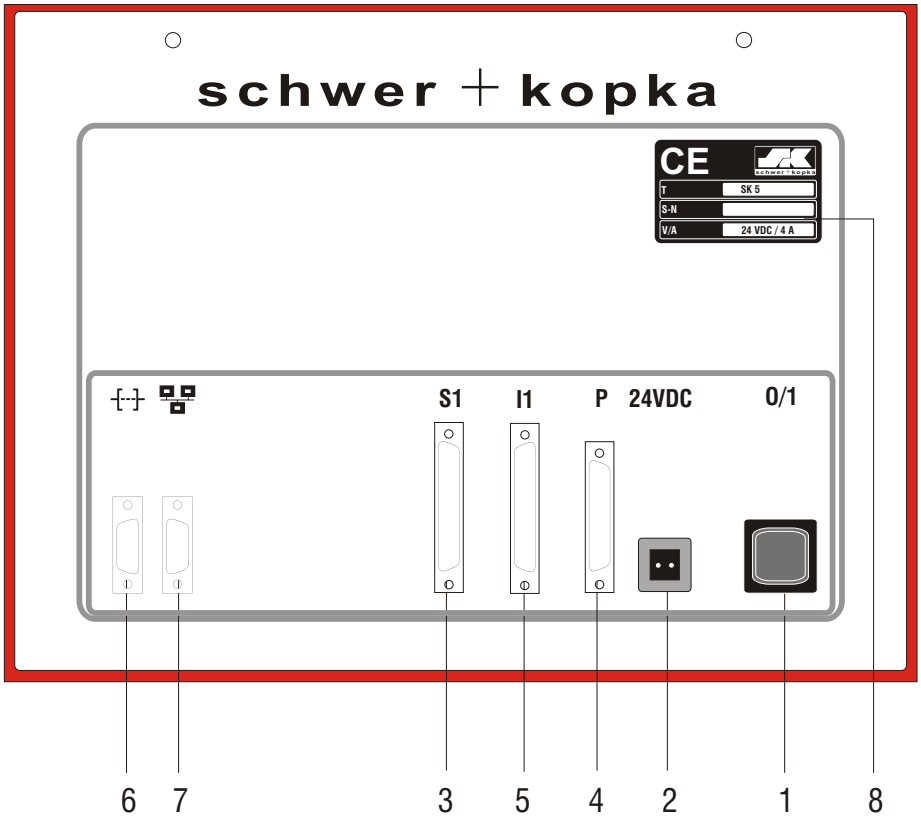
5. Numerical keypad 0 - 9
   (and optional alphanumerical entries)

6. Enter key (E-key)

7. C-key (Clear/change display mode, activates entry mode)

Operating controls and connections

Rear Panel



1. On/Off push button
2. Power supply connector (24VDC)
3. Sensor cable connector (S1)
   input from sensor box
4. Optional input (P) for
   additional binary senors
5. Machine interface connector (I1)
6. Serial port RS 232
7. Optional Ethernet-port for data collection
8. Model identification plate

Start (switching the system on)

The **SK** unit is switched on via the On/Off push button located on the rear panel. Please note that the machine interface must also be switched on via it's On/Off switch in order to obtain power.

After switching on, the following will appear:

- set-up mode is on (unit is in MAN-mode, yellow LED is illuminated)
- the display turns on. For a few seconds, a test screen with the SK-Logo will appear. After that, the force display screen will come on (without force curves at this point in time because the machine is still off).

Now, you can start the machine. The display will show the measured force curves and you can start monitoring these by switching the unit into AUTO mode.

Selecting the different functions

Just below the LCD-display you will find 4 function selection keys which provide a very simple way of operating the system. The available function of each key is identified by the symbol box on the bottom line of the display just above the keys. The selected function is highlighted in blue.

Screen layout

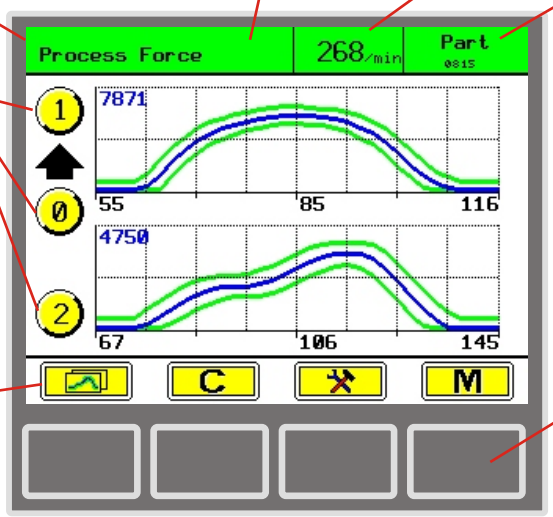
Many features and operational steps are similar on the different screens. These are briefly Explained below (shows a screen with dual curves):

The upper left corner describes the selected function screen. When in STOP, this line turns red and indicates why the machine was stopped and the time 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

Shows current machine speed in RPM.

Shows recalled part number (if the optional **SK**Part*master* software is installed)



Numbered circles indicate that a particular function can be activated by pressing the appropriate numerical key (change to single curve display with #1 or #2, or press #0 to scroll the double curves)

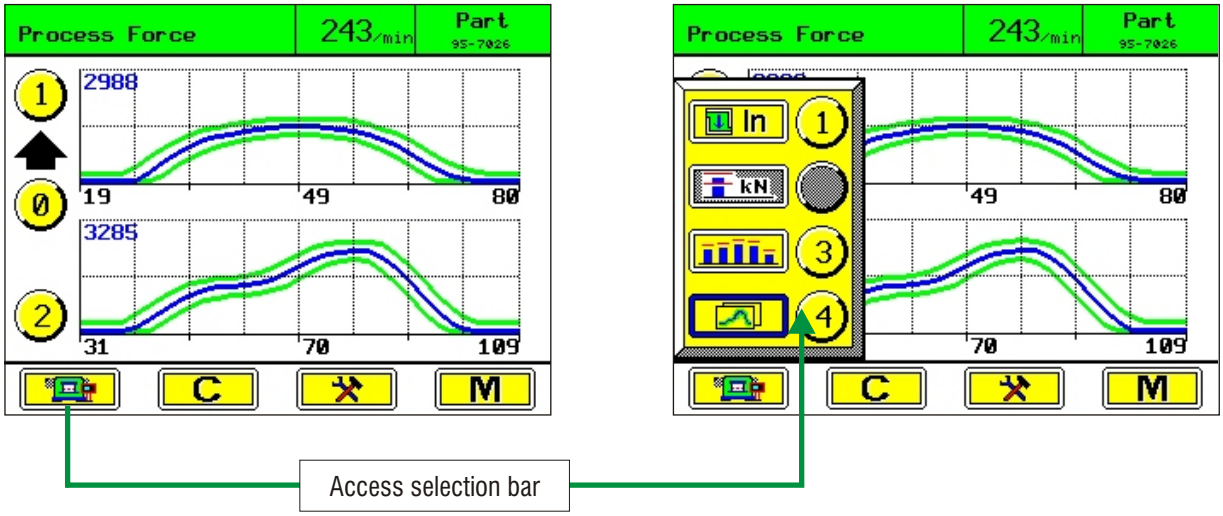
Symbol box

Function keys

Switching to other monitored parameters

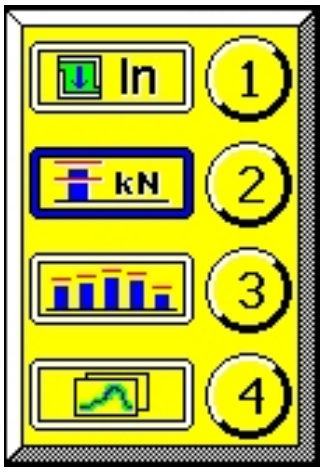
Besides standard enveloping, your monitor may be equipped with other monitoring features such as total load indicator, or may monitor other types of sensors.

If this is the case, your display will include a **selection bar** which allows you to access the other monitoring features. The selection bar is called up on the screen by pressing the left function key showing the little **machine symbol**. If your unit does not show the machine symbol, the selection bar is not available.



How to use the selection bar

The selection bar lists the options installed on your unit. Press one of the number keys 1 - 4 on the front panel's keyboard to access the respective function. Functions not available on this unit are shown in shaded grey and cannot be accessed.



Monitoring of binary sensors used for tool protection purposes. These are often used on stamping presses to monitor strip feed length or part ejection from the tool (typically not in use with cold forming machinery).

Total load indicator and overload protection.
The screen shows a graphical machine symbol with 2 bar graphs indicating the press load on left and right side (s. page 8)

Indication of machine loading profile in multi bar graph (see page 12)
and optional station-by-station overload limits (Protectionmaster)

Monitoring of force signals using peak load or enveloping
- peak load monitoring; see page 10
- enveloping: see page 13

Selecting operation modes

The different operation modes are selected via the mode keys on the front panel, or via the supplementary MAN and AUTO buttons provided on the optional DUPLO remote control box. The operation modes include functions such as set-up mode or automatic mode for regular or un-manned shifts. The LED's above each mode key indicate which mode is currently running.

MAN mode (set-up)
The MAN mode is not actively monitoring the process. However, the unit registers and displays the force signals to assist the operator in setting up. The MAN key can be pressed after STOP to release the stop relays. In this case, the system will learn new envelope limits after the next AUTO. Running time 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 desired, the system can be set so that it re-uses the previous envelopes without relearning. In this case, go directly into AUTO mode after STOP.

STOP to **MAN** to **AUTO -** System learns new envelope limits
STOP to **AUTO -** System uses previous envelope limits

AUTO1 mode
Pushing the AUTO1 key will start the monitoring mode. The unit is immediately active after pressing the key. The system either returns to the previous old envelopes, or starts relearning (see explanation above for MAN-mode). In the first case, the unit waits a few machine strokes before it resumes the previous envelopes so that the machine achieves a constant speed. The monitoring limits (force and acoustic envelopes) are dynamically updated and matched with the process variation. Counting of good parts made starts also. Any deviation of the process curve signal will cause the unit to react.

AUTO2 mode
Auto2 offers the same functions as AUTO1, but is used when running unmanned production. In addition, the AUTO2 parts counter is started to provide a separate count for parts made during AUTO2 mode. When stopping the machine during AUTO2, the unit fires the separate EMERENGENCY-STOP relay that switches off the machine immediately (AUTO1 mode will only fire the MOTOR-STOP relays.

STOP
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 will always prompt a stop message on the display to identify the reason for switching the machine off.

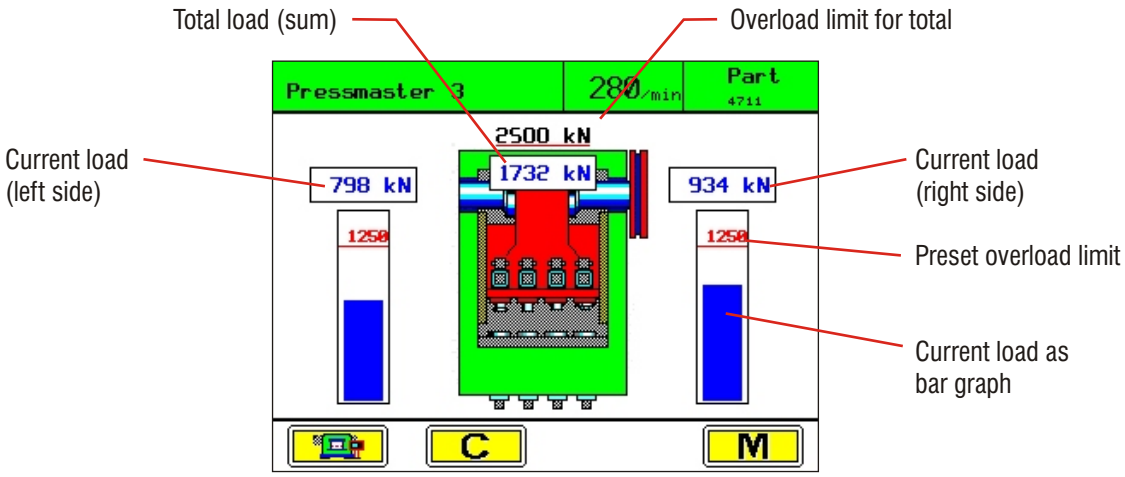
If the red LED flashes, this indicates that the monitoring system is currently in BYPASS via the key switch located on the machine interface box.

Overload protection

Overload protection compares the total force value of every machine cycle against a preset overload limit. The total loads are typically measured with special load cells mounted to the machine frame. They are normally calibrated and the display scale is in kN. Besides the total loads for left and right machine side, the system can also indicate the total sum with a separate overload limit. Every force value above the preset limits will immediately stop the machine! Overload protection is active in all modes of operation (MAN, AUTO1 and AUTO2).

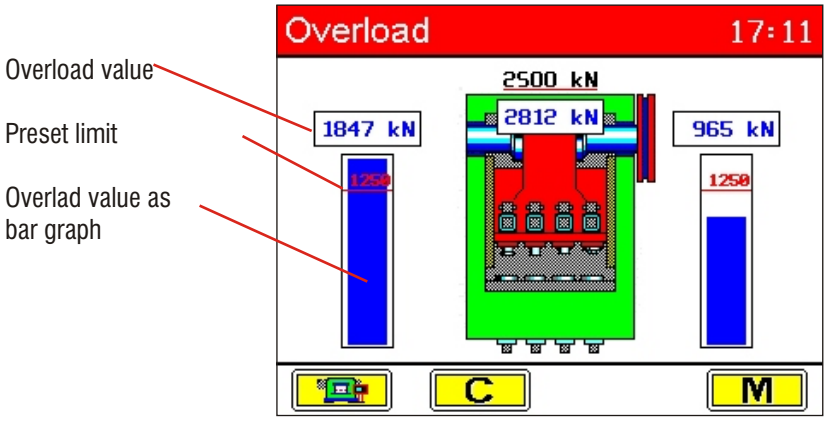
Total force indicator

The main screen showing the total load either comes up immediately after switching the unit on, or can be called up by pressing the kN-button from the selection bar.
The screen shows a graphical machine symbol with bar graphs for left and right load values:



Machine Stop in case of overload

The screen below shows an overload situation where the force on the left side of the machine surpassed the preset limit. The machine is stopped immediately, and the upper portion of the display turns red and shows the stop reason and the time of the stoppage.



Setting of overload limits

The preset overload limits are machine related and must not be altered during normal use. The limits are adjusted during the initial installation by the **SK** service technician and are protected afterwards through an access code.

Restart after overload stop

Should an overload situation occur, the monitoring system will immeditately produce a signal to stop the machine. The monitor will go into STOP-mode.

Before re-starting the machine, it is necessary to determine the cause of the overload and remedy the problem.

To release the machine stop relay, press the MAN-mode button. The machine may now be restarted. The set overload limits are immediately active again, and will stop the machine should the current force reading still be in the overload range.

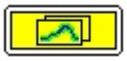
If the force readings are below the overload limits, the monitor can be switched back into AUTO-mode again.

In addition, the monitor will automatically switch by itself from the manual set-up mode (MAN) to automatic mode (AUTO) when it reaches the number of strokes it is allowed to run in MAN-mode (this number can be programmed within the set-up section, accessible via the M-key).

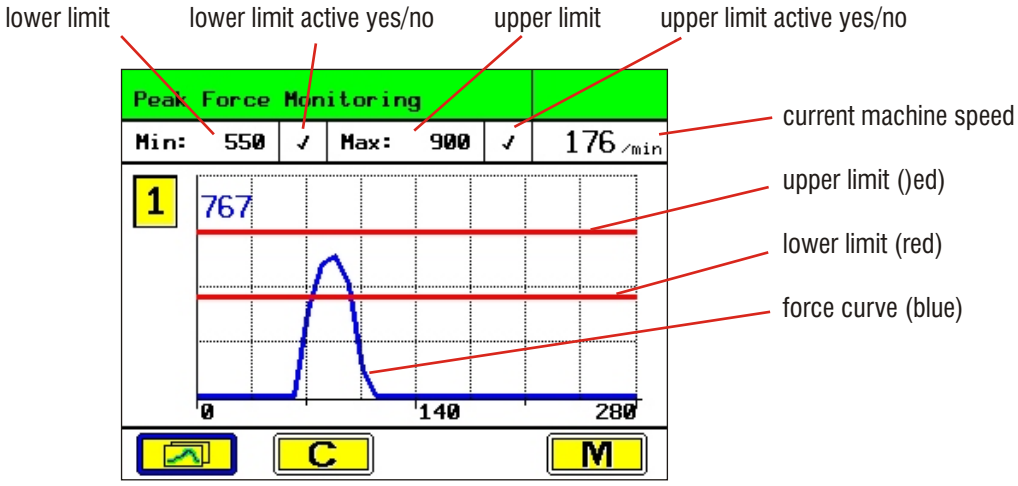
Peak force monitoring

Some forming operations can be too erratic for enveloping. In such cases it is advisable to monitor such signals using conventional peak force techniques.

The selection of peak force or enveloping is made inside the service menu section.

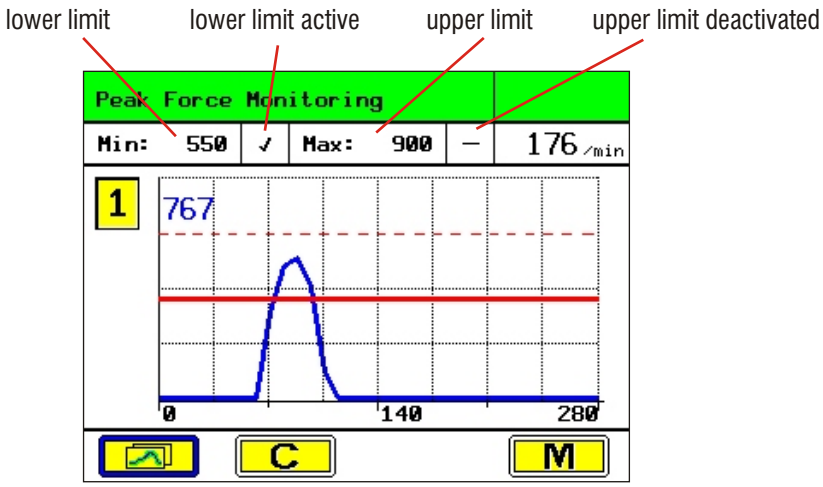


The example below shows how a sensor signal is monitored using peak limits. The limits for high and low are visible. Active limits are shown in thick red lines, deactivated limits are shown as dotted thin lines.



Short feed monitoring

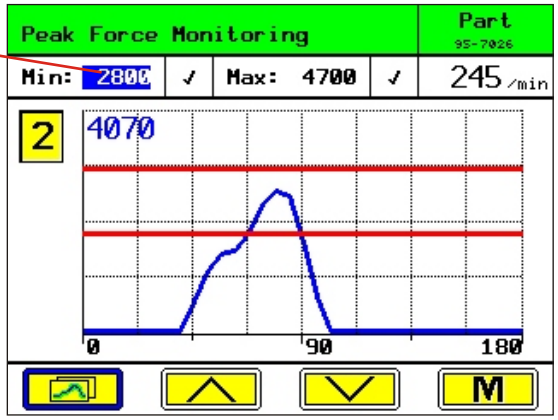
The example below shows the typical set-up when monitoring a wire feed stop for a short feed. Only the lower limit is active. If the force signal measured on the feed stop goes above the limit, the wire has actually reached the stop and the cut-off is of the correct length.



How to adjust the limits

Peak force limits may be adjusted when the single curve display is called up. Please note that limits may be set as a percentage of the peak reading or on the same scale as the peak reading:

Entry mode:
window is blue



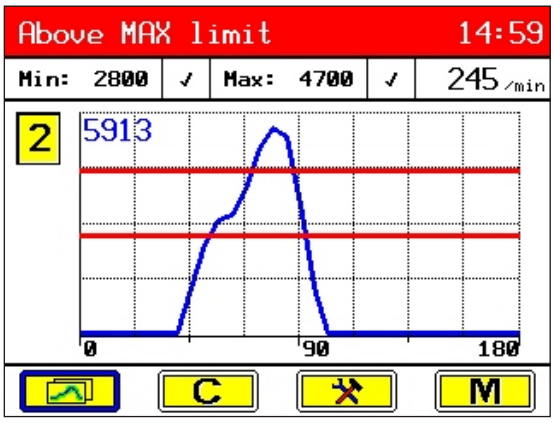
Set limit values:
- Press (C)-key
- Enter value for **Min** and/or **Max**
- Press (E)-key to confirm

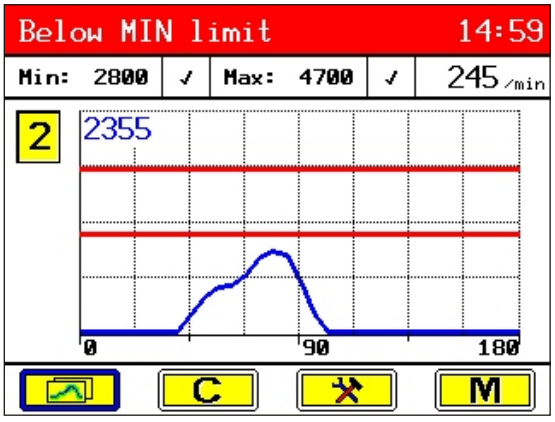
Activate/deactivate a limit:
- press any numerical key to change between activated (✓) or deactivated (-).
- Press (E)-key to confirm

Limit on: thick straight line
Limit off: thin dotted line

Stop due to high or low readings

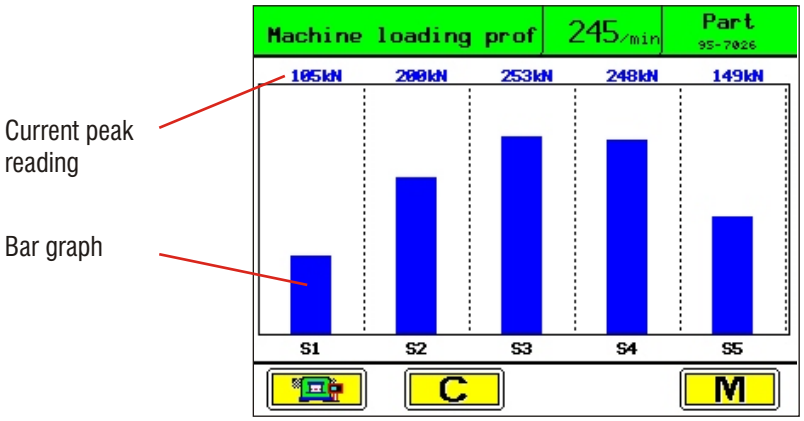
If the current value is above or below the selected limits, the machine will be switched off immediately. The upper portion of the display will turn red and show the stop reason and the stop time:





Machine loading profile with peak force readings

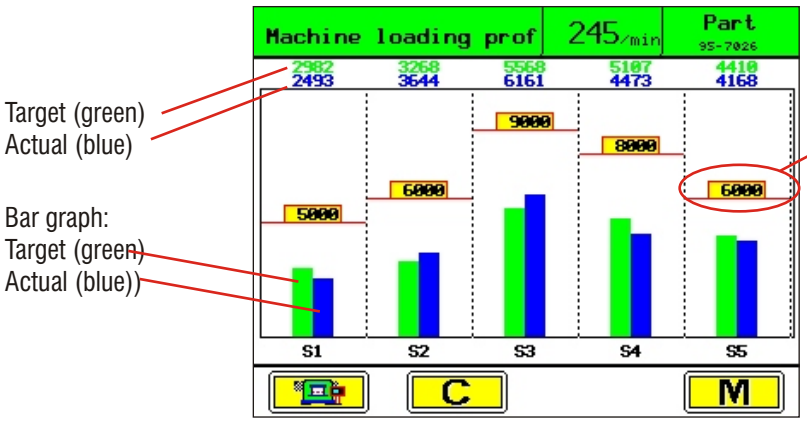
The peak reading of all connected sensors can also be shown as a machine loading profile on an easy-to read graph. The maximum reading from each sensor (value on a relative scale or when sensors are calibrated, in kN) is plotted as blue bar on the screen. The machine loading profile is accessible via the selection bar (see page 5). The example below shows a machine with 5 channels and calibrated sensors (kN-scale):



Station-related overload protection with SKProtection*master* (optional)

Each sensor can be given a specific fixed overload limit. The current peak forces are never allowed to go above those limits, which is why they are active in all modes of operation (MAN, AUTO1 and AUTO2). The entered limit values are always based on the current relative or absolute scale of the force readings. The limits should be set such that normal forming loads are allowed, but any forces beyond those values will stop the machine.

The example below shows a machine with 5 channels and relative force readings. For each sensor, an overload limit has been set. This monitoring unit has additional memory for part data (optional **SK**Part*master*), and shows memorized target force readings (green numbers and bars) in comparison with the actual readings (blue numbers and bars). This is a valuable tool for machine set-up assistance as described on page 32.



Protectionmaster with separate overload limit per sensor

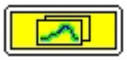
How to adjust the limits:

- press (C) on your keyboard
- the limit value turns blue
- enter the desired numbers (start with sensor 1)
- confirm each sensor by pressing the (E)-key

Envelope monitoring

The envelope monitoring technique scans the entire force signal from start to finish. Each complete waveform is scanned and 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. The limits of the enveloping technique are calculated so that they always provide a perfect fit around the current variation of the process. Thus, a calm and stable process will be monitored with tight envelopes, while an unstable process will run with wider envelopes. This ensures optimum sensitivity and accuracy in detecting faults, while at the same time avoiding “nuisance” machine shut downs. Further improvements are obtained with the optional **SK**Profile*master* function or automatic analysis techniques such as **SK**Prozzy*master* (see later).

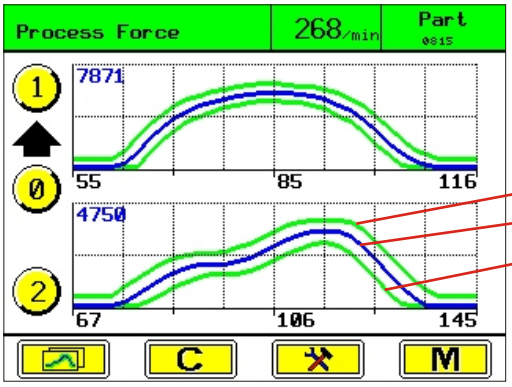
Envelope display



Pressing the **curve** key will display the force wave form together with the envelopes. The display shows either double-curves (2 sensors at a time) or a single curve 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 double to single curve presentation is done by pressing the number key for the desired channel. Going back to double curve display is done by pressing the **curve** key again.

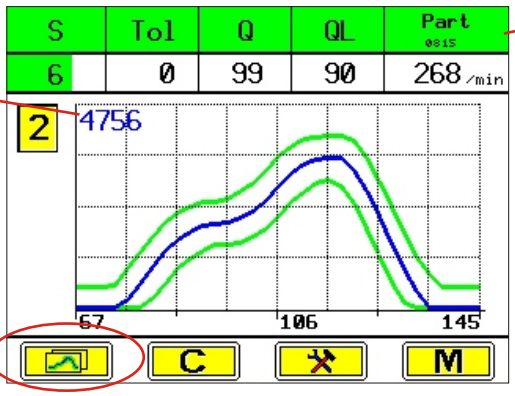
Pressing “**0**” will scroll the double curve display to another sensor combination, i.e. From 1-2 to 2-3, 3-4 and back to 1-2 (e. g. on a 4-channel machine).

Double curves



Upper envelope (green)
Current force signal (blue)
Lower envelope (green)

Single curve



This number indicates the peak reading of the force signal (max. pressure) for the last stroke.

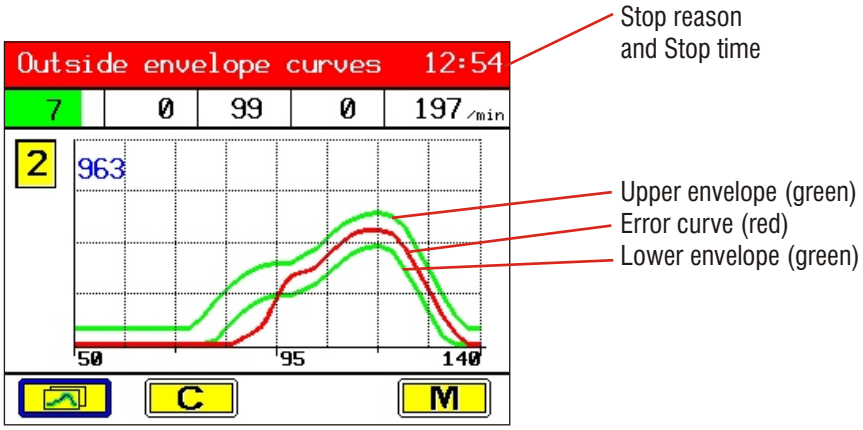
Returns to the double curve display.

Displayed when single curves are called up on the screen:
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.

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 red LED right above the STOP key is lit as well as an optional external warning lamp that may have been connected. 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.



Restart after Stop

After a force error stoppage, 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. Press the MAN-key once to release the Stop-relay(s) which allows you to jog the machine. Alternatively, you can directly press AUTO if you wish to re-use the previously learned envelopes.

Restart the machine after confirming that the cause of the error is eliminated. If you wish to reuse the previous envelopes (you directly press AUTO), the monitor will automatically resume the AUTO-mode once the machine has reached a consistent production speed. If you wish to learn new envelopes (you press MAN first), please press the AUTO-key after the machine is back to full production speed. The **SK** monitor will now calculate the new envelope limits.

In addition, the monitor will automatically switch by itself from the manual set-up mode (MAN) to automatic mode (AUTO) when it reaches the number of strokes it is allowed to run in MAN-mode (this number can be programmed within the set-up section, accessible via the M-key). This feature prevents the machine from being left running for long periods of time in MAN mode (e.g if someone forgot to switch from MAN into AUTO-mode after completing the set-up)

Adjusting monitoring accuracy

Sensitivity and Tolerance

The final high and low limits of the envelope are 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 monitor does provide the possibility to alter the "**Sensitivity**" and "**Tolerance**" settings within a certain range 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 related to the force curve. A coarse setting (low sensitivity numbers) leaves a wider gap between the upper and lower threshold, while a fine setting (high sensitivity numbers) narrows the envelope width resulting in more precise control. Setting the sensitivity to "0" switches the monitoring off for this channel (no envelope curves are displayed).

The **Tolerance** (Tol) setting determines how many consecutive "bad" force signals (outside the envelope) are ignored or "tolerated" **before** the machine is stopped. Therefore, the tolerance setting prevents nuisance machine stoppages caused by erratic force values typically associated with material or machine variation.

Tolerance can be set to values from **0 - 9** with the following meanings:

0: No "bad" force value is tolerated. The first "out-of-limit" force value will stop the machine.

1: One "bad" force value is tolerated. If it is followed by another "bad" force value, the machine stops.

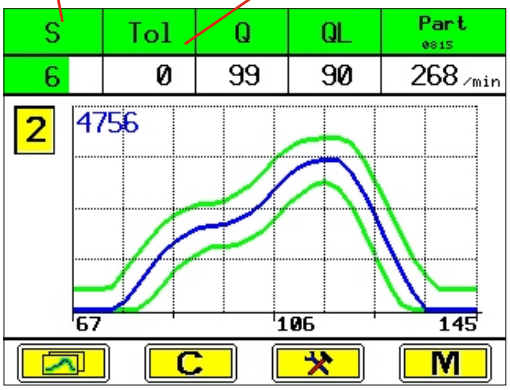
.

8: Eight consecutive "bad" force values will be tolerated. The 9th "bad" force value stops the machine

9: Nine consecutive "bad" force values will be tolerated. The 10th "bad" force value stops the Machine.

Sensitivity (S)
length of green bar shows
degree of sensitivity

Tolerance (Tol.)



How to alter **S** and **Tol**:

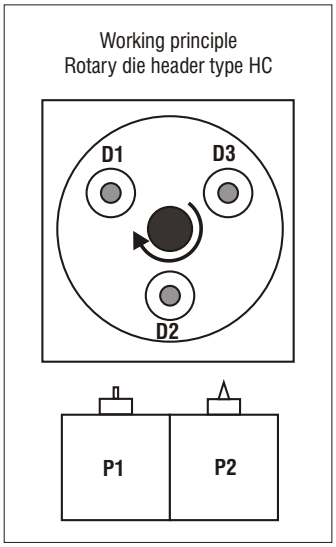
- Select the desired sensor channel
- press the (C) key on the numerical pad (this switches into entry mode)
- the current value for **S** is highlighted in blue
- enter the new number (1 - 9)
- confirm by pressing the (E) key
- the blue box moves on to **Tol.**
- enter your new setting (Usually 0)
- confirm again with the (E) key

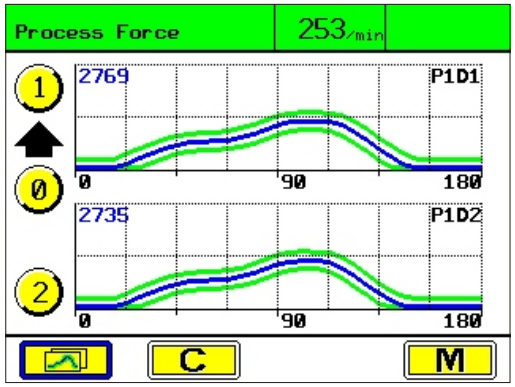
Entry mode is terminated automatically if you haven't pushed a button for several seconds (blue box disappears).

Special version for machines with rotary die holder

Single die monitoring with SKROT*master*
The ROT*master* option allows to activate individual monitoring channels for every punch/die combination. If desired, every combination can even have it's own enveloping limits.

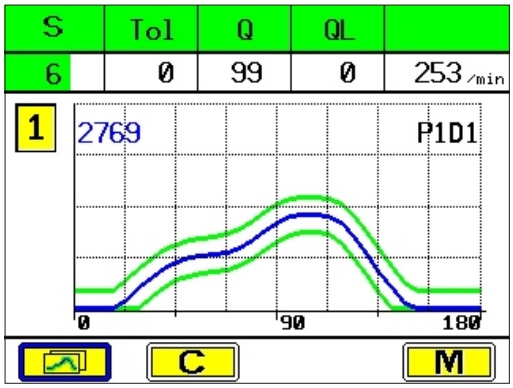
The following screens show as an example the situation on the Hilgeland HC type of header which has 2 punches working on a rotary holder with 3 dies. The monitoring system will automatically assign the correct punch/die combinations.





Example:
Dual curve screen 1 and 2 with the combination P1D1 (Punch1/Die1) and P1D2 (Punch1/Die2).

Press the number of the respective channel to switch to single curve view.
Press "0" to advance to the next combination.



Single curve view
of the combination
P1D1 (Punch 1 /Die1)

All punch/die combinations are assigned as follows to the channels 1 - 6:

Channel 1:	P1D1	(Punch 1 /Die 1)
Channel 2:	P1D1	(Punch 1 /Die 2)
Channel 3:	P1D1	(Punch 1 /Die 3)
Channel 4:	P1D1	(Punch 2 /Die 1)
Channel 5:	P1D1	(Punch 2 /Die 2)
Channel 6:	P1D1	(Punch 2 /Die 3)

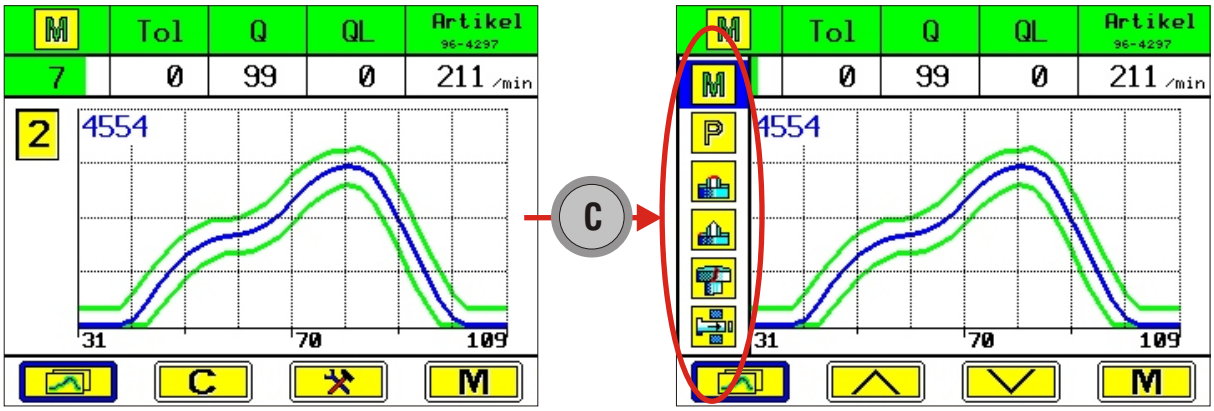
1 Pressing the numbers 1 to 6 will display the curve (channel) of that combination. Each channel has got it's own settings for sensitivity, tolerance and Q-limit.

Program selector switch for optimum monitoring results

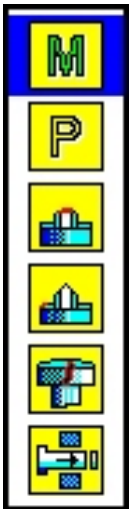
It must be stated that certain small types of errors will only have a minimal impact on the measured force signals. In addition, each type of error causes a unique change to the measured signals making it difficult to detect all types of errors with the same, universally-designed automated Monitoring routine.

The SKPuzzlemaster is now being used in the operation of process monitoring systems for manufacturing machines. The name of this feature indicates that the user picks from a catalogue of programs or "puzzle pieces" those items which perfectly match the monitoring requirements of the current part. The operator combines them into a specific monitoring puzzle. Each sensor or monitoring type can have its own puzzle piece assigned. Once a puzzle has been found to be successful detecting a specific type of error, an operator can put it in memory and recall it the next time the same part is produced (with optional **SK**Part*master*).

C To select a puzzle piece from your list, just press the **C**-key on the keyboard. A selection switch or bar with the available puzzle pieces pops up:



Examples of available puzzle pieces:



M: manual setting of all paramters

P: Prozzymaster fully automatic enveloping (see next page)

Tool tip breakage on internal drive types of parts

Slot breakage on Phillips punches

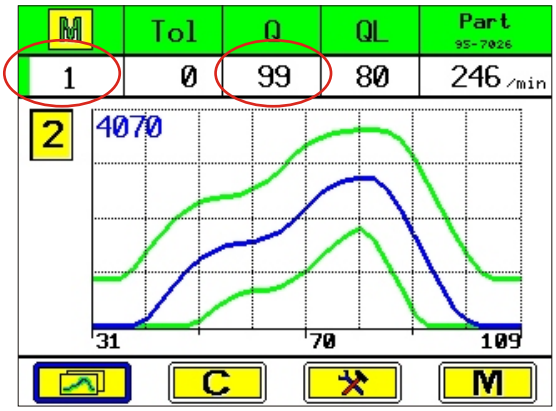
Cracked head detection

Piercing operation (peak force monitoring)

Dynamic envelope matching

SKProzzy*master* stands for a new procedure which provides highly dynamic, automatic matching of the envelope width with the current variation of the process. In fact, every single point scanned on the force curve will have its own, individually calculated, upper and lower envelope band.

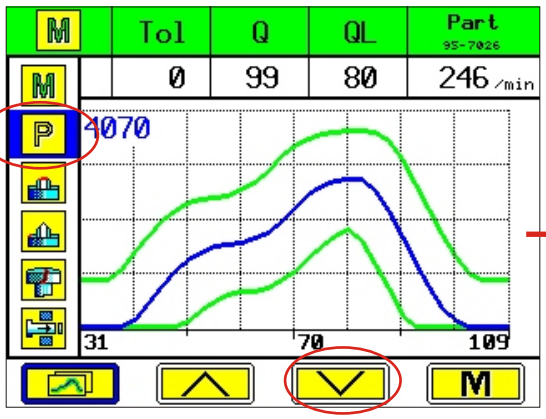
Starting from a selectable minimum sensitivity, **SK**Prozzy*master* reduces the envelope width using automatic sensitivity control that matches the envelope to the process variation. This procedure ensures that the best possible monitoring quality is always maintained. Should the process over time become more erratic, **SK**Prozzy*master* will switch one step back in sensitivity. If that should not be sufficient, the machine will be stopped for examination.

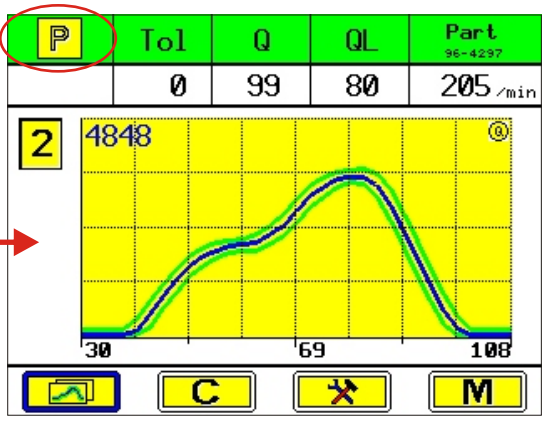


Without **SK**Prozzy*master*:

Although this process is running fairly stable (as can be seen from the very good Q-factor of 99!), the envelope width is set to the lowest possible sensitivity of S=1.

This setting was acceptable for the part that ran previously but not now. A more sensitive setting is required for the current job.





How to start **SK**Prozzy*master*:

1) Press (C) on the keyboard.
The puzzle selection bar pops up (as shown above).

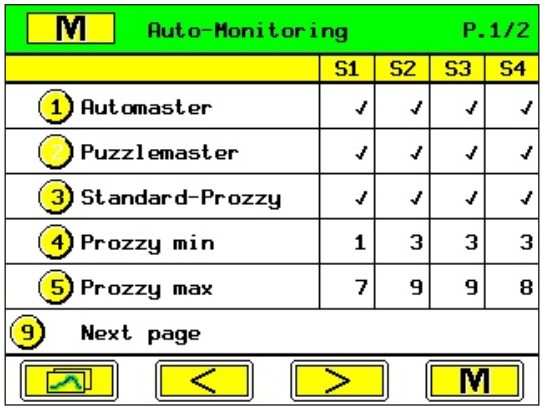
2) Use the cursor buttons to move the blue box to **P** (Prozzy).
Confirm by pressing the (E)-key.

With **SK**Prozzy*master*:

The envelope band is adjusted to a sensitivity setting which is perfect for the current process variation. This adaptation actually is performed automatically for every single point of the curve!

Parameter settings for SKProzzy*master*

The menu section on page 1, item 5 "**Auto-Monitoring"** holds all relevant parameters for **SK**Prozzy*master*:



Auto-Monitoring page 1/2

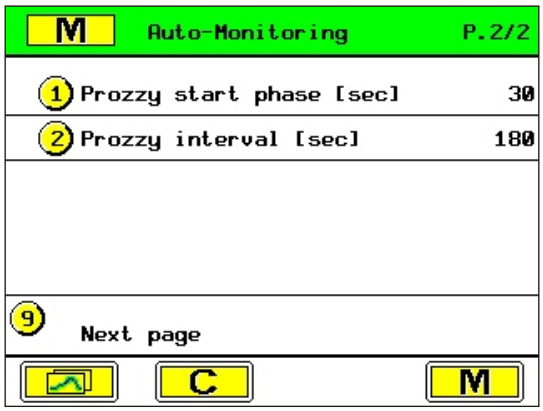
1) Automaster (yes/no)
Will automatically activate for those channel where Prozzymaster is switched on

2) Puzzlemaster
Determines which channels will have access to the installed list of puzzle pieces

3) Standard-Prozzy (yes/no)
- when set to "yes"(√), very small signal changes will be tolerated.
- when set to "no", every impermissible signal change will stop the machine (very sensitive)

4) Prozzy min
Sets the minimum sensitivity with which Prozzymaster will commence in this channel

5) Prozzy max
Sets the maximum sensitivity up to which Prozzymaster will tighten the envelope provided process variation allows it to do so.



Auto-Monitoring page 2/2

1) Prozzy start phase (sec)
Time frame running in AUTO (seconds) after which Prozzymaster calculates the first envelope update.

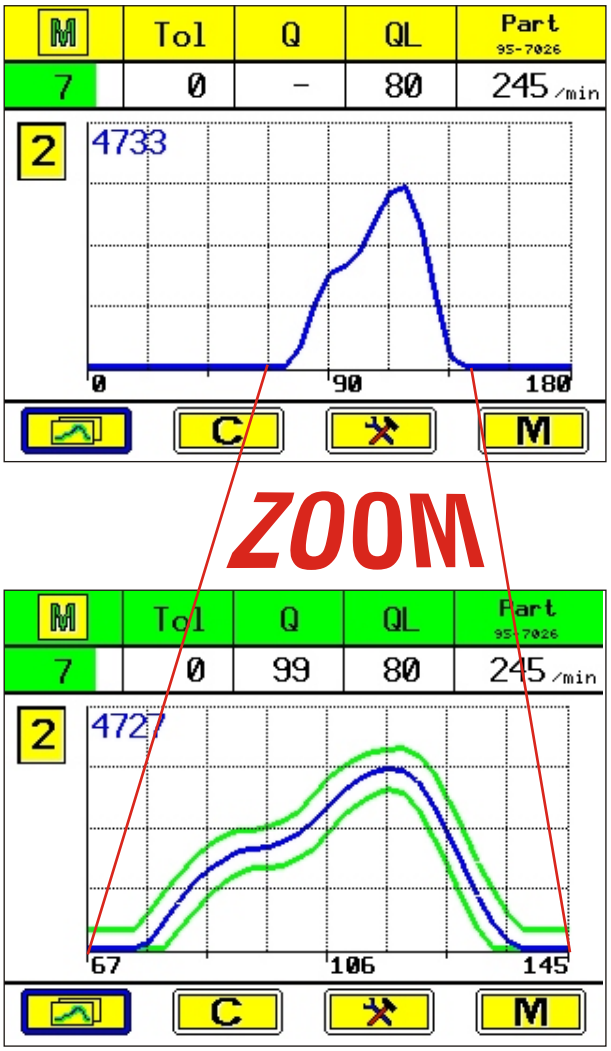
2) Prozzy interval (sec)
Time interval (machine running) after which Prozzymaster checks if current sensitivity can be improved. If yes, sensitivity setting will go 1 up to the next finer level.

SKAuto*master* automatic seting of timing windows

The **SK**Auto*master* option allows a perfect fit of the timing window for the given curve width.

The timing window will automatically “zoom” in to the actual width of the force curve signal. This happens each time the monitoring unit is put from MAN-mode into AUTO-mode.
SKAuto*master* ensures that the monitoring resolution of the system is concentrated on actual force signals and not machine noise, cross-talk, etc.

SKAuto*master* is automatically activated with the different puzzle elements described on the previous pages.



While in MAN-mode (set-up), the system uses the basic settings of the timing window (typically wider than necessary, especially at the start of the window).

A ”wider than necessary” timing window guarantees that the curves will always fit into the window even if there are significant changes in the width of the signal when changing from job to job.

When advancing into AUTO-mode, **SK**Auto*master* will automatically adjust (narrow) the timing window such that the force signal stretches to fit the width of the screen.

This ensures that the monitoring capabilities are fully utilized for the actual force curve, and not being wasted on any “idle” sections before and after the actual forming operation.

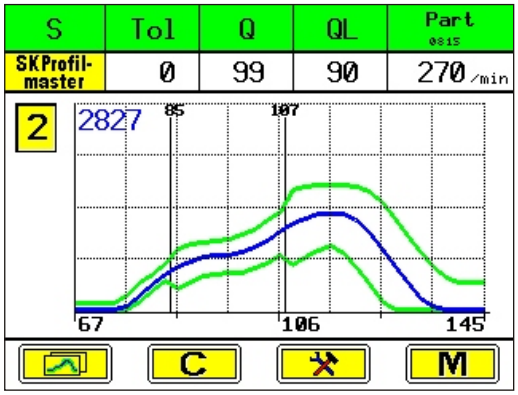
Envelope Profile Monitoring

The **SK**Profile*master* monitoring technique represents an advanced approach to envelope monitoring. The conventional enveloping technology has to accommodate widely varying force curve areas with one sensitivity setting only. Thus, the monitor was either not sensitive enough where it mattered (in those areas where tools actually formed the metal), or the monitor caused too many unjustified machine shut-downs.

The **SK**Profile*master* technique allows you to set up to three (3) different sensitivity "**profile zones**" for each force curve that will closely match the variations 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).

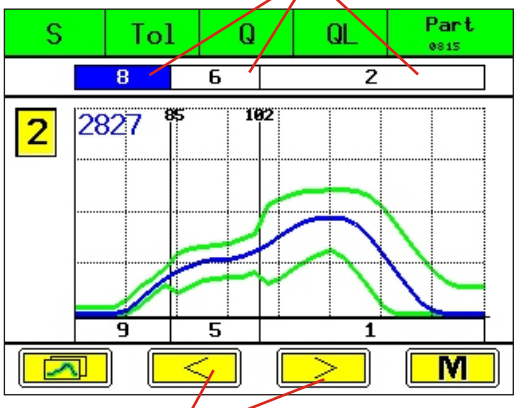
The example below shows a profiled envelope band (3 zones) with different upper and lower Sensitivity settings per zone:



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

The channel displayed on the left works with 3 profile zones, each having individual high and low profile limits.

3 Sensitivity windows



Cursor keys to move the profile zone boundaries

How to set the SK Profile*master* **band:**
- press Ⓒ to access sensitivity entry mode
- separate sensitivity windows pop-up for each profile zone
- use the cursor function selection keys at the bottom to move the boundary between two neighboring zones
- set the desired sensitivity (blue box) for each zone from **1** to **9** (1=coarse; 9=fine)
- confirm each zone's selection by pressing the Ⓔ key (immediately see how your setting is affecting the envelope)
- confirm your settings for **Tol** (tolerance) and **QL** (Q-Factor limit)

Please note that entry mode (blue box) automatically stops if you haven't pushed any button for several seconds.

Monitoring for errors inside the envelopes

The standard envelope monitoring technique is designed to react if and when the current force signal leaves the envelope band. This is considered an error. Very often, however, certain errors cause only minor changes in the force signal, and the signal remains within the envelopes.

SKWart*master* now offers an entirely new approach by trying to recognize errors within the envelopes! The Wartmaster software watches the shape of the force curve and may see if the current force signal has a different characteristic as opposed to the initial signal when the job started. This could be the case when a tool fails. The software will highlight the area of the force signal where it sees a change by popping up a “wart” in the lower half of this channel’s screen.

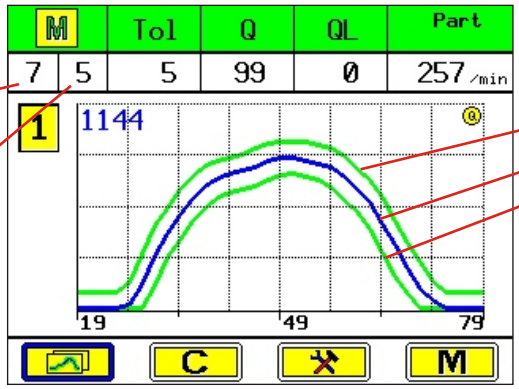
If the change persists (which, of course, would be the case when a tool has failed), the “wart” will continue to grow and eventually stop the machine when reaching the maximum allowed wart size (this is selectable). If the change is only of temporary nature, the wart will disappear again. This avoids that non-systematic changes in the process stop the machine for no reason.

It is possible to detect small process variations even if there is more than one wart on the same force curve. Each wart is being monitored individually.

Process okay

Envelope sensitivity (A=Automaster)

Wart sensitivity (W=Wartmaster)

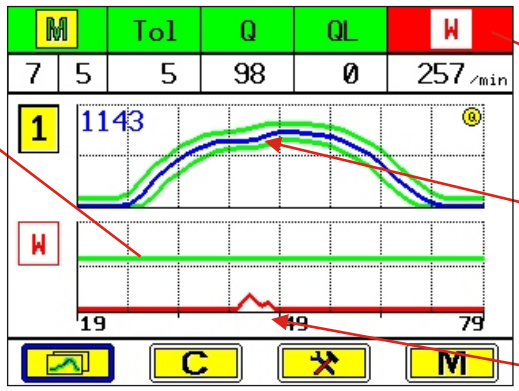


upper envelope (green)
current force curve (blue)
lower envelope (green)

Error

Maximum wart limit.

If the wart grows bigger than this limit, the machine will be stopped.



Red Wart-alert flashes

The monitor has recognized a minor change in the shape of the force curve inside the envelope.

At that sector of the curve, the wart builds up.

M

The trending feature allows you to visualize and monitor gradual changes in your forming process such as a steady but slow increase or decrease of the forming load. The Trending screen is accessible via the Menu-Section (press the function selection key labeled **M**, then select function **# 1** "**Trend**".

Graphic Trend Display with Stop/Go

The **SK** unit offers graphic trending on its color display. The presentation includes the display of the average force (peak value) over time, the selected trend limits, and any machine stops. The trend option can be activated individually for each channel. In addition, each channel's time span (width of the trend graph on the display) can be set between 00h 1min and 23h 59min. To change your current settings go to the trend screen of the desired channel and press Ⓒkey:

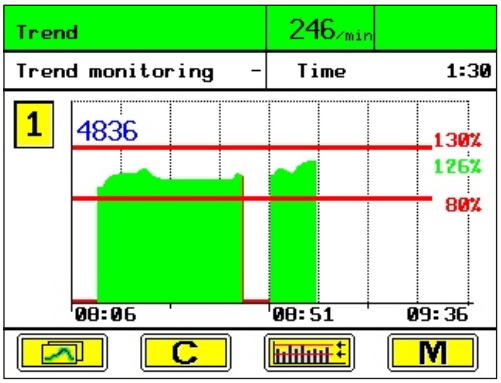
- the "Trend Monitoring" box (- /✓) will turn blue. Select between Trend Monitoring being active(✓) or switched off (-) by pressing any numbered key. Confirm your choice by pressing the Ⓔ key.
- the trend limits will be shown as thick red lines when trending is activated, and will be light dotted red lines when trending is switched off.
- next, the "Time" box will turn blue allowing you to select the time span you wish to observe the trend. Enter figures for hours and minutes separately confirming each with the Ⓔ key.

Trending is calculated on a relative percentage basis or on an absolute basis. The choice of relative or absolute trending can be made in the main menu section (**M**) on page 2/4, at function **#2 "Monitoring Parameters"**. Go to page 2 and activate **#4 "Norm. to 100**" to relative or absolute trending.

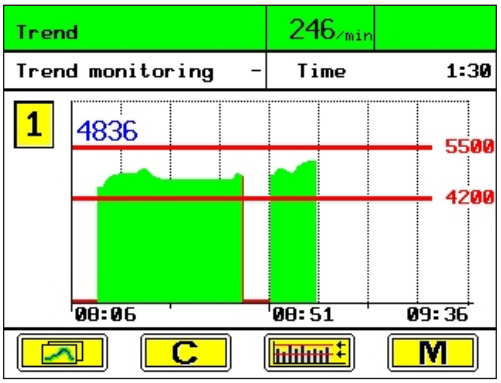
With relative trending, each time you move from the MAN set-up mode to AUTO mode, the measured peak forming load is set to read 100%. Any gradual changes in peak force over time will now show in a deviating trend value based on a percentage change. If the current trend value exceeds the upper or drops below the lower trend limit, the machine will be stopped provided "Trend Monitoring" is activated (switched on).

The trend graph will now be plotted in green (machine runs) from left to right according to the selected "Time" setting. Gaps will show for periods where the monitor is in STOP or MAN modes identifying non-productive time intervals.

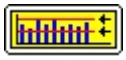
Relative Trending



Absolute Trending

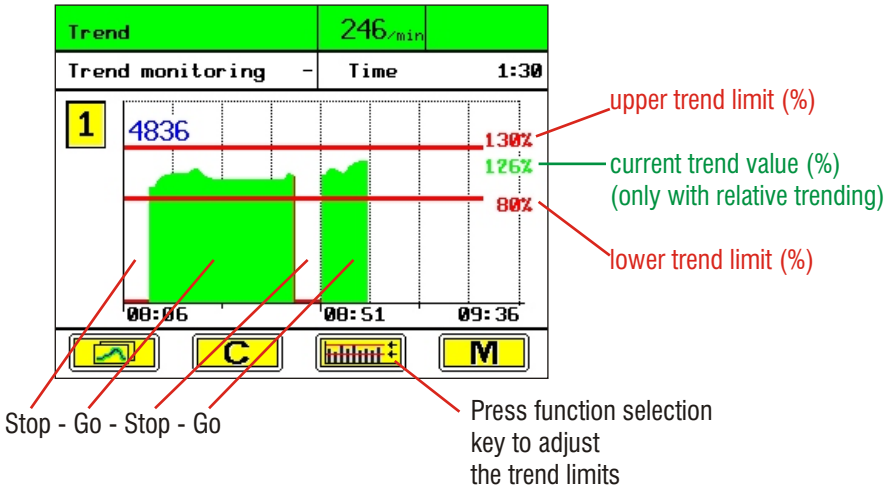


How to adjust the Trend limits

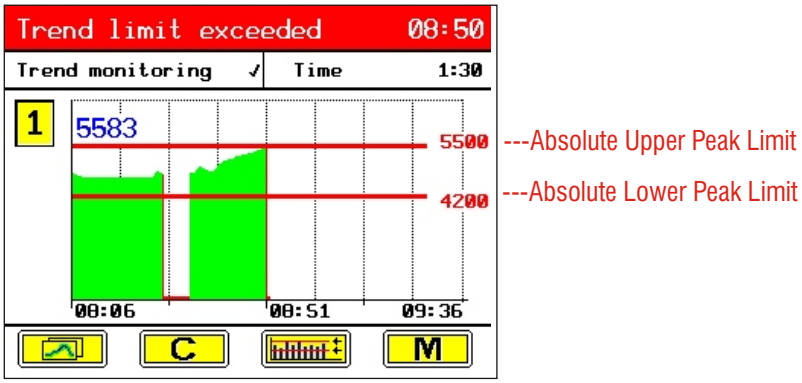


Press the function key “Trend limits” shown at left. The upper trend limit value will turn blue. Enter the new limit and confirm by pressing the E key. Next, enter the value for the lower trend limit and confirm again. The trend limit lines will now change to the set points.

The limit lines will appear in thick red whenever trending is activated. When trending is deactivated, the limits will show as thin dotted lines, and the trending screens will only be for information purposes on how force levels change over time.



If the current trend value exceeds the upper or drops below the lower trend limit, the machine will be stopped provided “Trend Monitoring” is activated (switched on). The example below shows a situation where the force level has gradually increased and eventually grew above the upper limit.



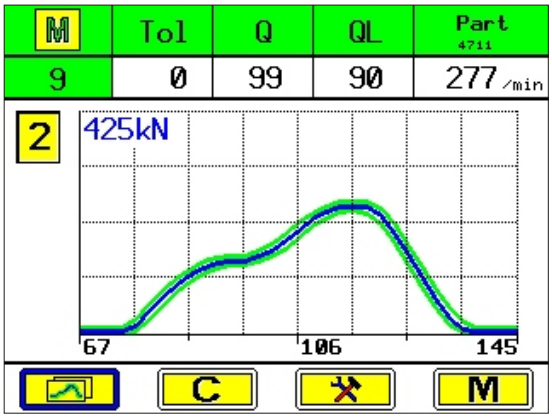
Q-factor (process stability / process quality)

The Q-factor is an indicator which displays the stability or repeatability of the forming process from stroke-to-stroke as a percentage number. A low Q-factor (e.g. less than 80%) would result from a very unstable process where the forming force curves are changing significantly from stoke-to-stroke. As a consequence, this would require using fairly wide envelopes with low sensitivity. Subsequently, this would also have an adverse effect on the consistency of parts quality.

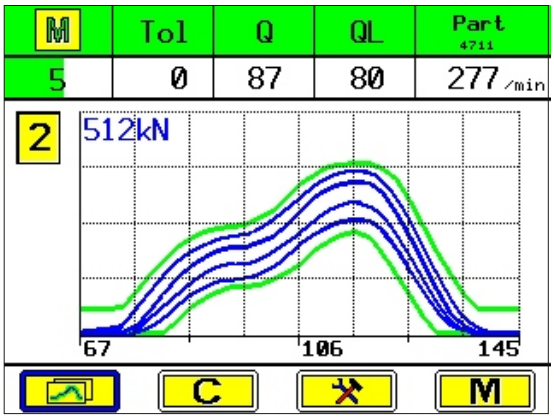
In contrast, a consistent and stable process will produce high Q-readings (e.g. 98% or better) indicating the high degree of repeatability this process has. Such a process can be monitored very closely with tight envelope curves.

A separate Q-factor is calculated for every sensor channel, and is shown as **Q** on the single curve screen for that sensor. In addition, you can set a limit value **QL** which enforces a 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) the machine can be stopped.

Calm and stable process with a high Q



Inconsistent process with a low Q



How to set **QL** (Q-Limit)

- select the desired sensor channel

C - press (C) key on the numerical keypad (entry mode is activated)

E - press (E) key several times until the blue entry box is on **QL** (old **QL**-value is now in blue)

- enter your new **QL** setting

- press (E) key to confirm

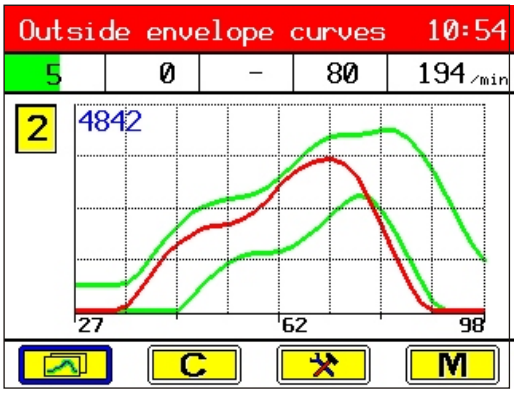
Entry mode is terminated automatically if you haven't pushed a button for several seconds (blue box disappears).

SKQ*master* (speed inconsistency compensator)

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

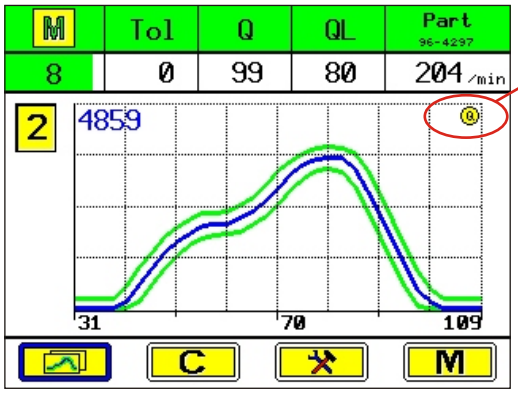
The RPM fluctuation will cause the force wave forms to bounce sideways left and right. In order to overcome this, you would typically open the envelope band to accommodate for this condition. At the same time, however, you will loose sensitivity but still experience occasional nuisance shut downs.

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 tight envelopes or envelope profiles, while minimizing nuisance shut-downs.



Without **SK**Q*master*:

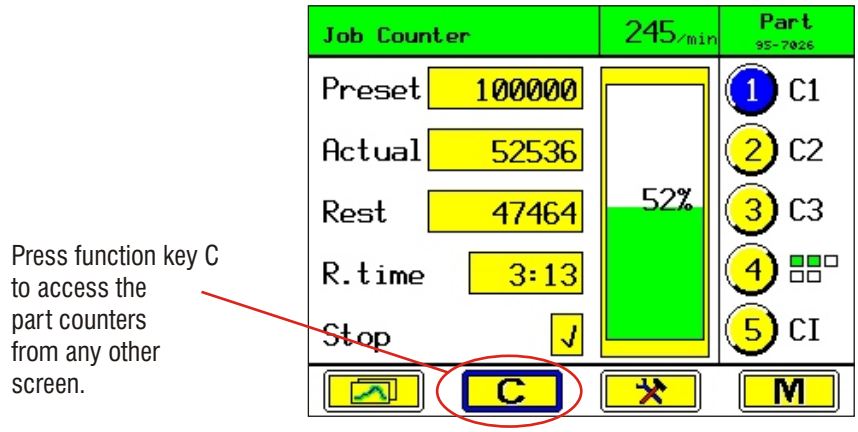
- machine speed inconsistencies cause the force curves to bounce left and right
- envelope limits need to be set wide open to allow the machine to run. You lose sensitivity.
- still erratic force curves occur causing the machine to stop for no apparent reason



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 (C1), tool life (C2), unmanned shift (C3), batching (4) and an interval counter (CI). The counter section is called up on the screen by pressing the C function selection key. Changing from one counter to another is done by pressing the related numerical key 1, 2, 3, 4 or 5. The number and designation of the actively displayed counter is highlighted in blue color (e.g. **1** and **C1** 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 bar graph on the right side of the display tells you what percentage of the preset quantity has been completed already.



How to set the counter

Press the **C**-key on the numerical keypad 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 already made some parts for this order). You can also choose whether you want the machine to stop upon reaching the preset order size. Press any key on the numerical pad numerical key where Stop = Yes (✓) and Stop = No (-)

Order size counter (C1)

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

Tool life counter (C2)

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 other kinds of inspections (e.g. Periodic adjustments, quality inspections, maintenance, etc.).

3 AUTO2-counter (C3)

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. Upon reaching the preset count (or with an envelope error) while in AUTO2-mode, the system will switch the emergency stop relay (with a time delay) to turn off all electrical devices on the machine (see also description for machine interface at the end of this manual).

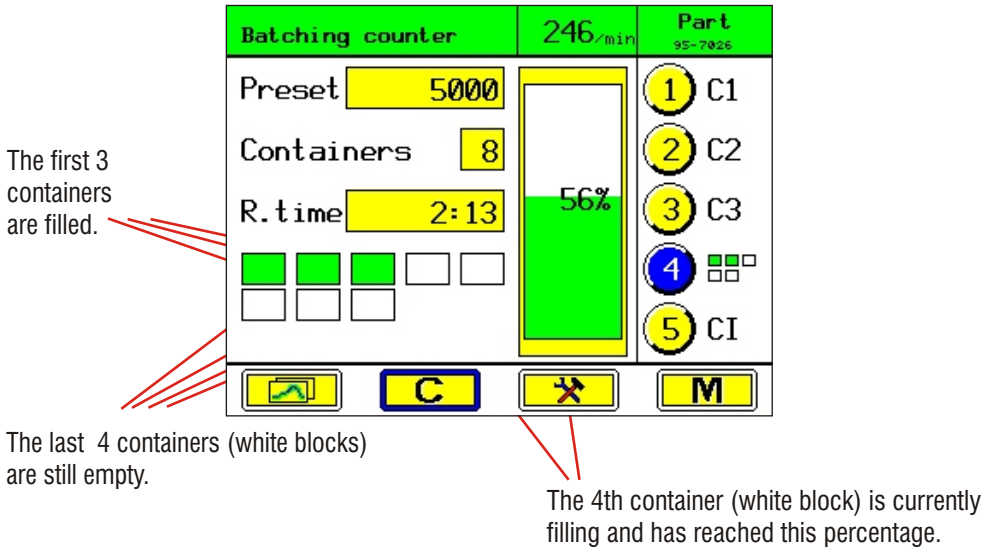
4 Batching counter

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 an output 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.

Pressing the **C**-key on the numerical pad switches into entry mode ("preset" box 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. This pulse may also be used to control an alert light to indicate a filled container.

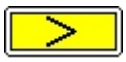
The batching function is switched off when both the preset quantity and the number of containers are set to "0".



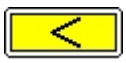
Multiple Tool Counter

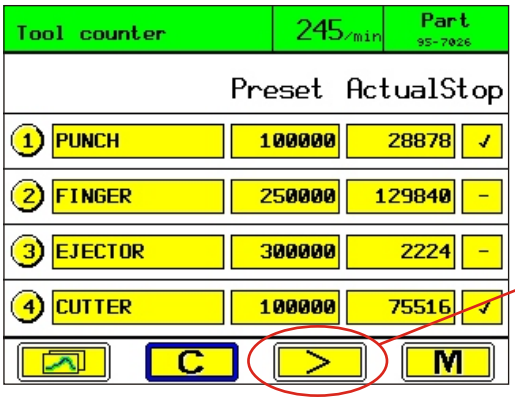
The optional tool counter is available as a multiple counter for up to 8 different tools. Each tool can be given an individual name and an expected tool life.

To enter tool data, press the related number of the tool (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. You can also choose whether you want the machine to stop upon reaching the preset order size. Press any key on the numerical pad numerical key to switch between **Stop = Yes (√)** and **Stop = No (-)**.



To access the name box of the tool, use the left cursor key shown while in entry mode. Use the alphanumerical keypad to enter the desired name. Typing errors can be corrected by using the **C**-key.

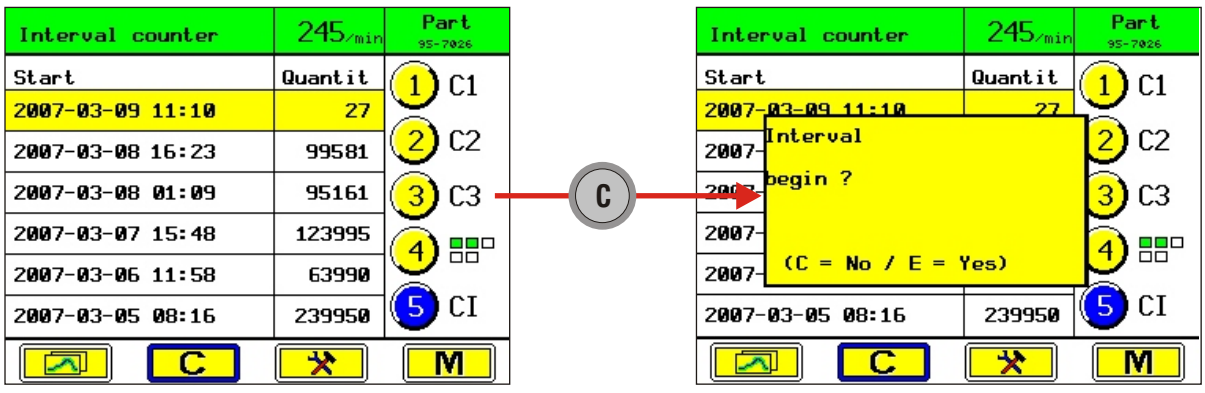




Press cursor key to advance to the next page with counters 5 - 8

Interval Counter (Shift Counter)

The optional interval counter can be used to count the number of parts produced during a certain time interval such as a shift, or to keep track of maintenance or other regular inspection intervals. To start a fresh interval, press the **C**-key on the numerical keypad. If you answer the “Interval Begin?” question box by pressing the **E**-key, a new time interval is started with current date and time stamp. The previous intervals will drop down 1 line so the last 5 intervals (or shifts) are visible on the screen.



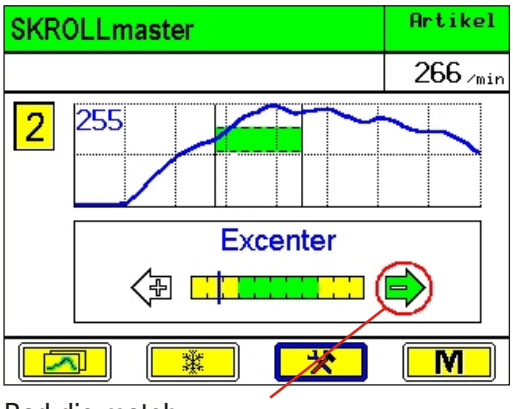
Setting up thread rollers using SKROLL*master*®

Thread rolling machine set-ups can be greatly facilitated by observing the wave forms of the different rolling force signals that occur in both directions, horizontally and vertically, and by checking the **die match indicator**. The **SK**ROLL*master*® feature has been developed to utilize the visual indication of the roll forces to perfect die set-up and tool performance.

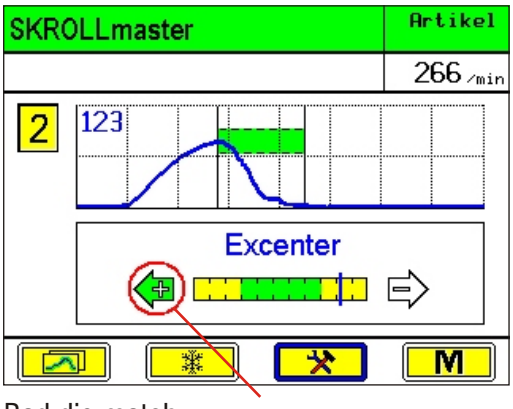
The horizontal (or radial) forces are responsible for “squeezing” the thread profile on to the shaft. It is important that these forces are evenly distributed over the length of the roll. Too much pressure at the start or at the end of the roll should be avoided. In addition, the force wave form should be free of excessive spikes or erratic movements, and show as little variation as possible from part to part.

Vertical forces appear when both dies are not in perfect alignment to each other over the length of the stroke. Any “mismatch” between the two thread profiles formed by both dies will force the dies to move upwards or downwards against each other to get back into “balance”. Typically, this misalignment is corrected by moving the machine’s excenter to for a better match point.

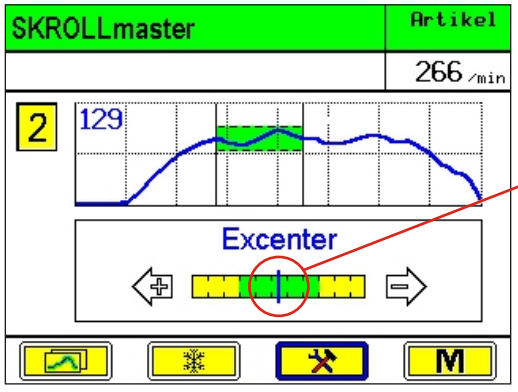
The **SK**ROLL*master*® **die match indicator** on the screen shows the machine operator in which direction he should move the excenter to correct an existing mismatch:



Bad die match:
move excenter in “minus” direction



Bad die match:
move excenter in “plus” direction



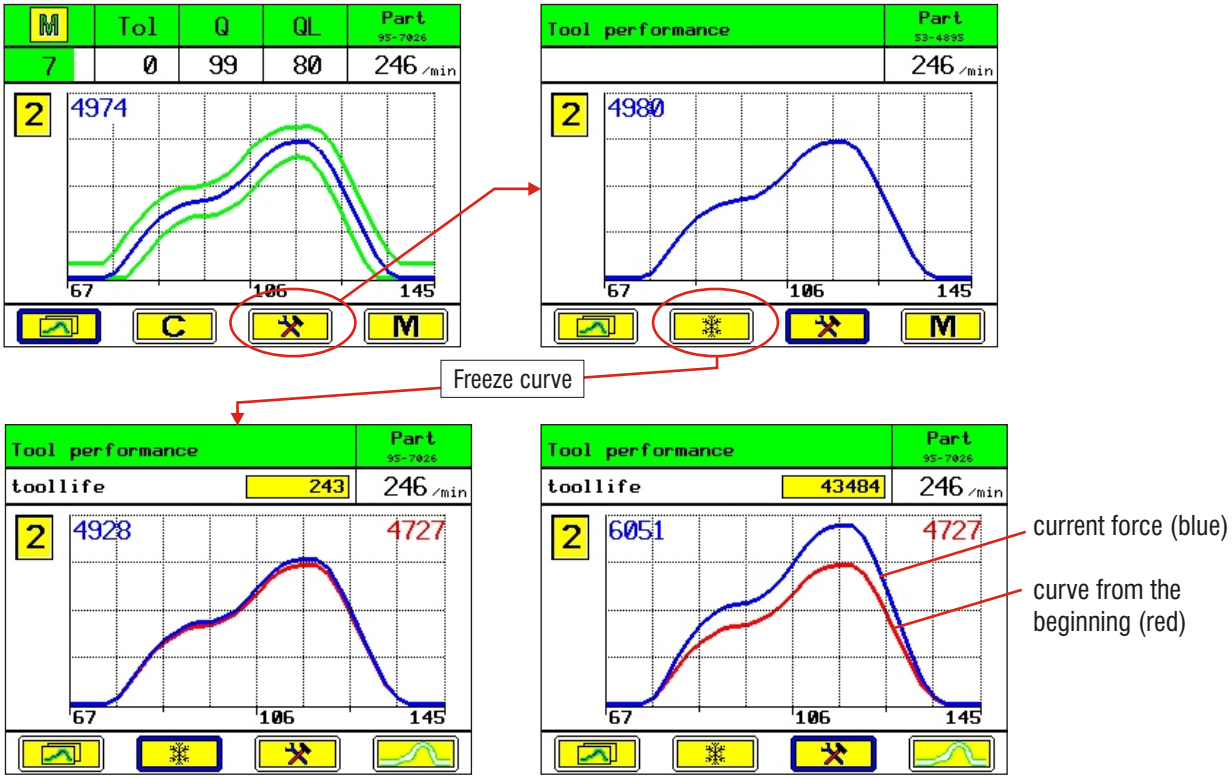
Good die match shows with the indicator being in the center of the green segment

Check and improve general machine and tool set-up with SKToolmaster

The optional SKToolmaster function offers the possibility to improve machine set-up procedures on all types of production machinery. This feature allows you to observe how force curves change over time by obtaining a visual comparison between a “frozen” curve made when the tool was new, and the current force curve after a certain amount of run time. This could help in identifying tool wear trends, or to determine were the monitoring envelopes should be set tightly in order to safely detect faults.

In order to “freeze” a force signal to mark the starting reference point, the **SK** monitor must be run in AUTO-mode. Press the “**tool**” function key (screen changes to “Tool Performance”). Then press the “**freeze**” key to store the current wave form as your red reference force line. The “Tool Life” counter will start counting the parts made and tell you exactly how many parts have been made since the reference curve was frozen. At any time, you will be able to observe the changes of the current blue force line versus the frozen reference, and the parts count interval. Each channel can be “frozen” individually as needed.

The procedure is also useful in finding out how a defect such as a tool breakage will affect the force signature. You will be able to see where the change caused by the defect is most obvious in comparison to the original target curve, and you will know where you must tighten your envelope limits in order to safely detect that defect.



At the beginning:
current curve (blue) and frozen reference curve (red) are almost identical

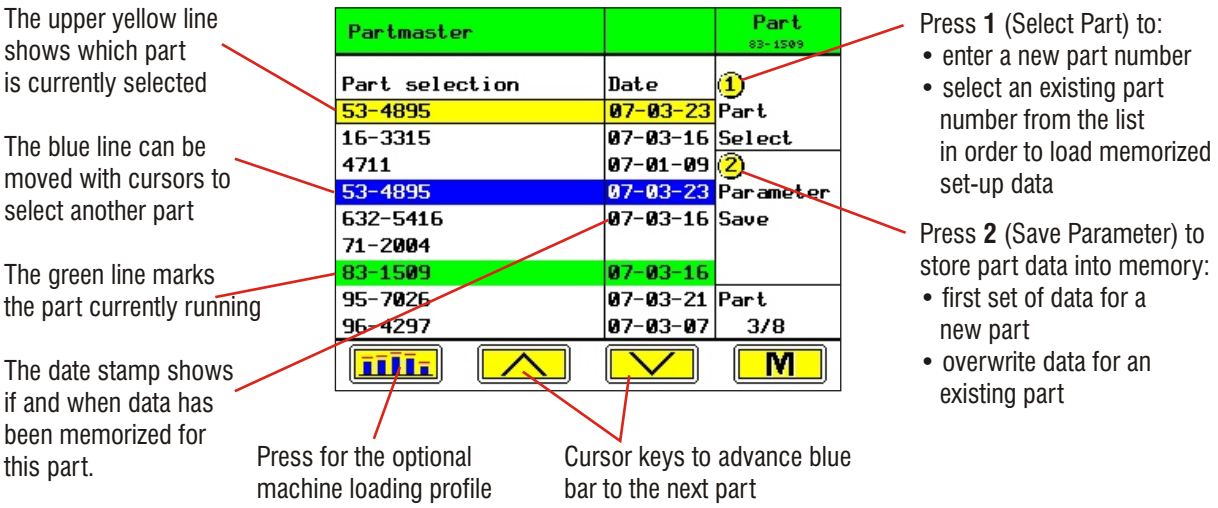
After 43484 parts:
current force reading has risen from 4727 to 6051 point on the display scale

SKPart*master*: memorize part related set-up data for future reference

This optional memory function of the **SK** system stores (by part number) important information relative to the setting parameters such as sensitivities, tolerances, timing windows, profile zones etc., and re-uses them for repeat jobs. If your monitor is also equipped with the required optional features, the unit will also memorize the target force wave forms and will serve as a visual aid to set up a repeat job. Up to 30 parts can be memorized inside the **SK** unit.

Access to Part Data Memory

To enter a new part, to recall part data from memory, or to refresh data for an existing part number is via the menu section (**M**), function **#4 "Partmaster":**



Part numbers may also be entered as alpha-numeric characters (optional function). If this option is available, every pressing of the respective numerical key will advance from the number to the letters printed on this key (e. g. key "**1**" contains also "A", "B" and "C", and key "9" has besides "X" and "Y" a blank on it's third position. Pressing another key will immediately move to the next digit. If you have to use the same key several times, please wait about a second to let the mark move to the next digit. Confirm your final part number entry by pressing the "**E**"-key.

Every attempt to enter data (pressing **1** for picking a part number, or **2** for entering 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 selected an existing part number (without data in memory), or when you entered a new part number.

- LOAD PARAMETERS? YES / NO
  When you selected a part with data in memory. Re-loads and automatically activates data from a previous run for a repeat job (only possible while the monitor is in MAN or STOP).

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

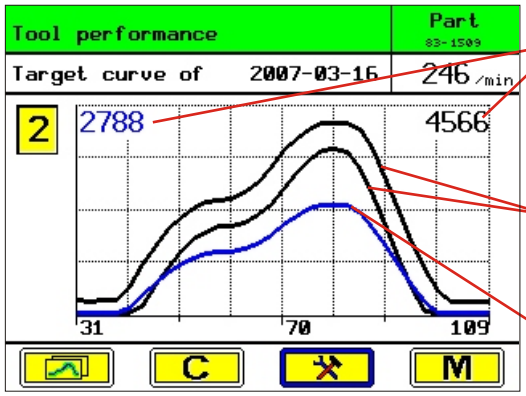
- OVERWRITE PARAMETERS? YES / NO
  When you wish to refresh an existing set of data for the selected part number. This may be the case when you have found better settings during a run or repeat run of that part.

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 vs your current forces press the **TOOL** function key to access the "Tool Performance" information screens.

Tool Performance/Target Curves
Shows the force curve of the current run (blue) vs. the memorized target band (black) from a previous run of that part.

The example on the right reveals that the current force of 2788 is significantly lower than earlier force value of 4566, and would be outside the old envelope band.



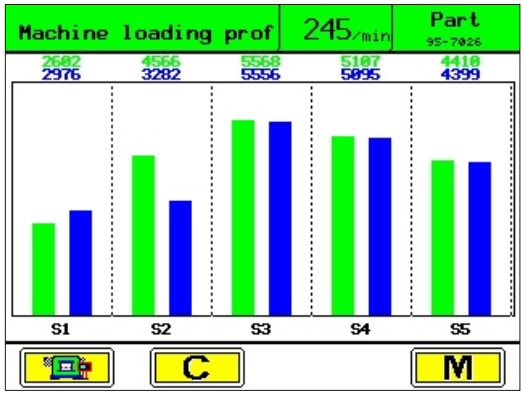
Max. peak force values of the current run (blue numbers on the left) and the memorized target envelope band (black numbers on the right)

Target envelope band (black) from the previous memorized production run.

Current curves (blue)

Machine Loading Profile
Shows in a bar graph the current peak force readings /blue) vs. the memorized targets (green).

At a glance is visible
- in which station does the actual not meet the memorized target
- how the machine is loaded over all forming stations



SK-go! terminal function (option)

SK-go! data networking terminal

All **SK** process monitoring units can also act as machine data terminal if used in conjunction with the **SK-go!** factory data networking system. In this case, the monitoring system will have an Integrated Ethernet-card to connect to the factory's computer network.

The following information is typically handled via the network:
- automatically report number of parts produced
- automatically report uptime and downtime
- start, finish or interrupt jobs
- report reasons for downtime
- report scrap production
- enter personnel data
- etc.

A separate manual is provided to customers who are using their process monitor as machine data terminal.

In the United States, there is a second option for gathering production information from the shop floor. An IMPAX TSS System can directly link to the good parts pulse generated by the SK unit. In addition, the IMPAX TSS Systems can be connected to machines using other types of monitoring devices or connected to machines with no monitoring devices. All types of shop floor information can be Viewed, Collected, and Analyzed, and many reports can be generated automatically.

Go to: www.impaxptg.com for more information.

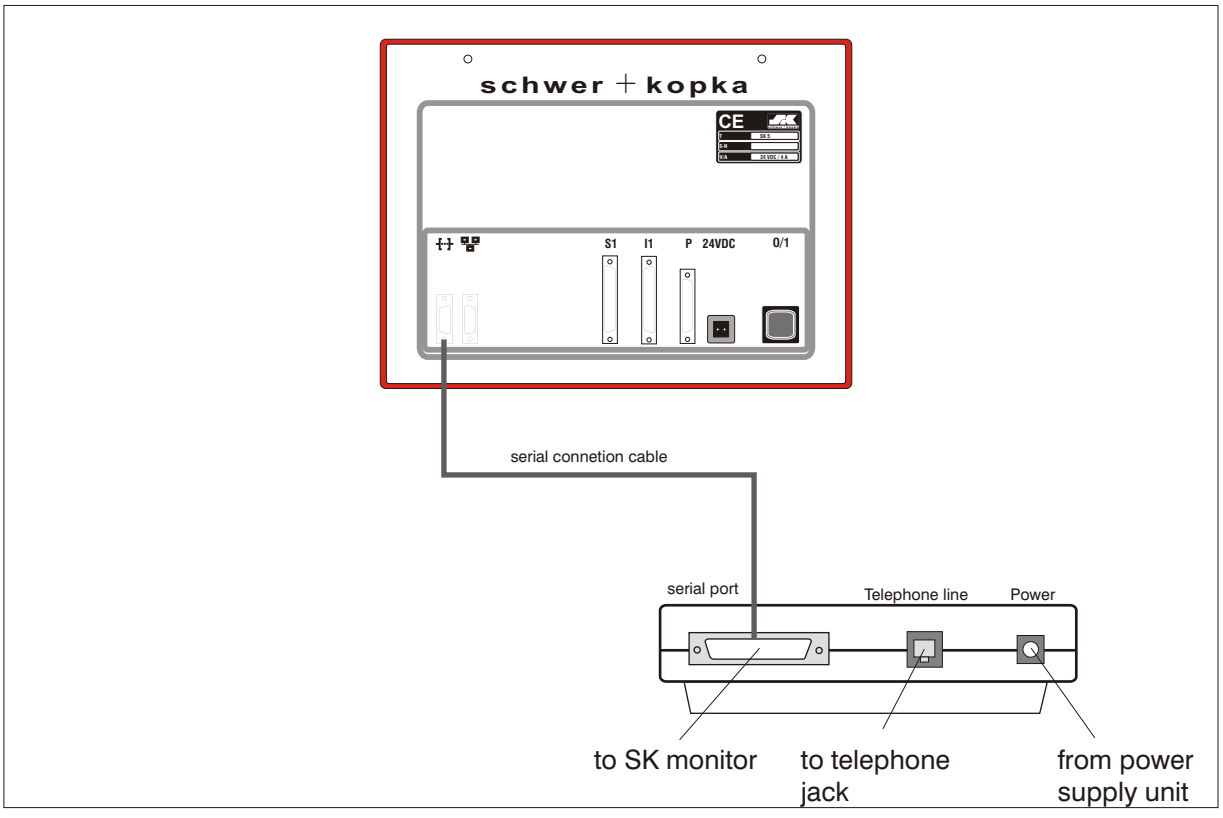
SKTELE*master*

The Teleservice function connects your process monitor via modem and a telephone line to the SK-service-computer. Our service department then has the opportunity to remotely “view” all the settings of the monitor, to see your machine running and to verify or correct all set parameters. In addition, we will be able to assist you in finding the optimum settings for difficult applications or parts. All you need to do is to connect a suitable telephone modem (*USRobotics Fax Modem 56k*) to the serial outlet of you monitor and to a phone jack near the machine. This phone extension must be accessible from the outside by direct dialing.

Start Teleservice

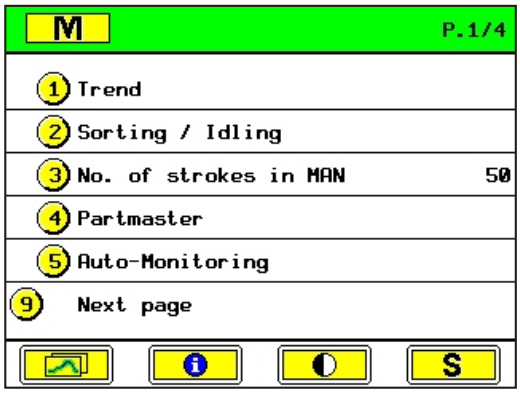
1) **Switch off** your monitoring system
2) **Connect** the modem (serial cable to SK unit, power supply and phone cable)
3) **Switch on** the modem
4) **Switch on** the SK unit

Your system is now ready to be teleserviced. You can restart the machine. The SK teleservice computer can now connect to your monitor.



The Menu Section

The Menu-Section contains settings and functions which are adjusted less frequently in day-to-day operation. From here, the actual “Service-Section” can also be reached where all vital settings and machine-specific parameters are set by our service personnel (accessible only after entry of the Access code). Some important Menu functions are explained hereafter:



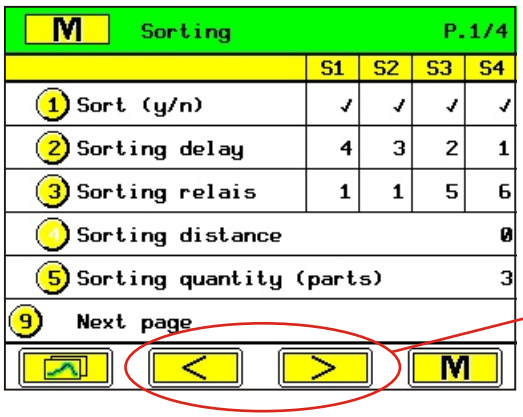
Adjusting screen brightness

Press the “Contrast” function selection key to gain access to setting screen brightness. It can be adjusted in different steps to brighter (press (1)) or to darker (press (2)).
Press key (3) to reset brightness to it’s original factory setting.

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 sort any detected faulty parts from the good parts production. The **SK** unit will give a sort signal via its sort relay to open and to close such device. It is recommended to stop the machine at the same time in order to allow the operating personnel to evaluate the type of defect and to initiate possible remedial action.
Alternatively, the machine may be allowed to continue producing while randomly occurring defects are automatically sorted. The machine will only be stopped by the process monitor if too many consecutive bad parts are made (adjustable via "Tolerance" setting, see page 15).

The settings for sorting can be found inside the menu section, first page, item 2 “**Sorting / Idling**” as well as all settings relating to idle stroke recognition.



Cursor keys come on units with more than 4 channels. Cursors are used to advance to the settings of other channels.

Press the related number key (**1** to **5**) in order to access entry to the function where you wish to alter the data. The number box on the right side turns blue. Enter the desired number, or press any number key to switch between **"Yes"** and **"No"**.

1. **Sorting (yes/no)**: sorting is active for this channel when you see the check mark. If you see a dash this channel is not used for sorting. Press the (E) key to advance from channel to channel.

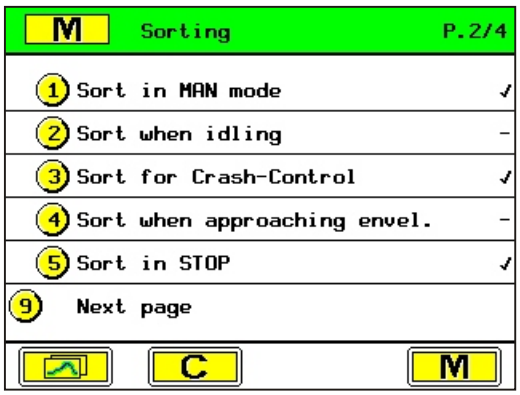
2. **Sorting delay:** allows you to delay the sort signal. This feature is useful in cases where the detected bad part needs some time to get to the actual sort position. The delayed signal prevents too many of the previous parts from being sorted with the bad one. The delay is entered in number of parts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

3. **Sorting Relay:** as an option, it is possible to assign each channel a different sort relay. The standard sort relay is #2, in addition relays #5 and #6 may also be used to provide sort output signals. Please refer to the description of the machine interface for relay functions (last pages of this manual).

4. **Sorting distance**: special function, currently not in use.

5. **Sorting quantity (parts):** determines the number of machine cycles or strokes for which the sort signal will be given. Ensures that the faulty part has reached the gate position. This means, of course, that any setting higher than 1 will sort one or more good parts along with the bad one which is well accepted for quality reasons.

Press key **9** to advance to the next page with more sort parameters.



Press the related number key (**1** to **5**) in order to access entry to the function where you wish to alter the data. The number box on the right side turns blue. Enter the desired number, or press any number key to switch between **“Yes” (check mark)** and **”No” (dash)**.

1. **Sort in MAN mode:** when set to "**Yes**" (check mark), the sort signal will be activated as long as the SK unit runs in MAN-mode. All set-up pieces and non-monitored parts are sorted.

2. **Sort when idling:** when set to "**Yes**" (check mark), the sort signal will be activated every time the process monitor detects an idle stroke. On some machines such as thread rollers, certain faults have very low force readings and, thus, 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.

3. **Sort for Crash-Control:** when set to “**Yes**” (check mark), turns on sorting during Crash-Control mode (Crash-Control is typically active on multi-die machines during periods where wire feed is stopped on the fly, or where cut-offs are dropped before forming). This feature ensures that all parts made during Crash-Control mode are sorted and not mixed with the normal production parts.

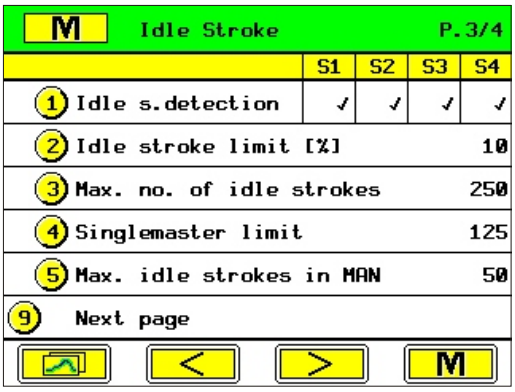
4. **Sort during envelope adjust:** when set to “**Yes**” (check mark), turns on sorting during the envelope adjust periods e. g. after idle strokes or during STOP-AUTO transition. This ensures that all parts made with those automatically widened envelopes will not mix with previously made good parts.

5. **Sort in STOP**: when set to “**Yes**” (check mark), turns on sorting as long as the monitor is in STOP mode.

Press key **9** to advance to the next page with the “idle stroke” recognition settings.

M Idle stroke adjustment

Some machines such as thread rollers tend to run idle 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 this, 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 (e .g. when feeder bowls are empty, the machine will be stopped). The following parameters can be set to tell the monitor what an idle stroke looks like and how to handle it:



1. Idle stroke detection

Allows you to select in which channels you wish to tolerate idle strokes. Set those channels to "✓ ". Those where you don't want to allow idle stroke put to " - ". Confirm your settings with the **E** key.

2. Idle stroke limit (%)

Determines the limit for idle 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 detect an idle stroke 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: 250 strokes). During this time, an optional warning lamp can flash to alert the machine operator of an unproductive machine condition

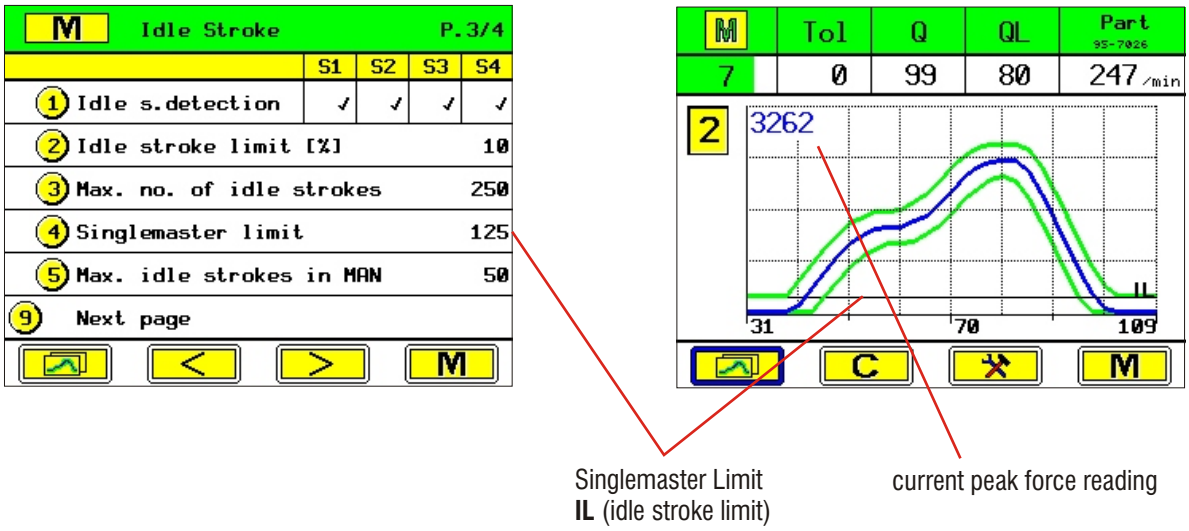
4. Singlemaster Limit

see next page

Ignoring idle strokes during teach-in with Singlemaster Limit (Option)

The Singlemaster limit works with the Idle Stroke Detection setting to eliminate using idle values when the system calculate its envelope limits during learn (AUTO). This feature allows the user to start AUTO mode immediately even on machines with irregular parts feeding.

If the monitor is equipped with this option, the force curve screen will show the Singlemaster limit as a line on the display.



4. Singlemaster limit (0 .. 99999)

Preset minimum limit for a force reading. Any value below this will be considered an idle stroke. (also active in MAN). Ensures that idle strokes are ignored when learning the original waveform values (important for threaders).

5. Max. idle strokes in MAN (0 .. 9999); only with option "SK Single*master*")

Max. number of idle strokes allowed in MAN-mode (only in conjunction with item 4 above).

6 Flash delay (on page 3/3 of this menu section)

This number determines after how many consecutive idle strokes will an warning lamp start flashing. This feature prevents constant flashing of the warning lamp if you have erratic feeding. Flashing only starts if feeding is truly disrupted.

No. of strokes in MAN (page1/4, # 3)

Determines the number of strokes in MAN mode after which the **IMPAX-SK** monitor will switch itself into AUTO mode. This feature is meant to act as a "safety net" to prevent unmonitored production if the operator forgets to activate AUTO manually by pressing one of the AUTO buttons.

SKPartmaster (page 1/ 4, # 4)

Part Data Memory, see description on page 32.

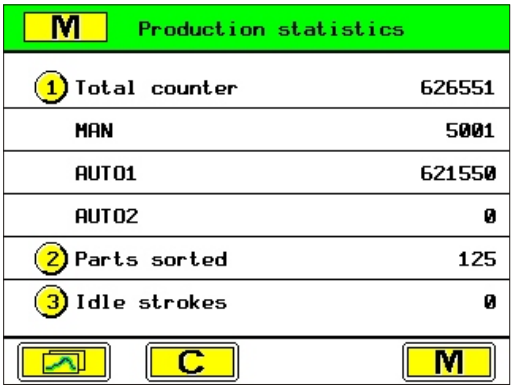
Auto-Monitoring (page 1/4, #5)

Submenu for activating the optional monitoring functions such as Auto*master*, Puzzle*master*, Prozzy*master* or Wart*master* (please refer to the respective pages of this manual for more information).

Production statistics (page 2/4, # 1)

This is a separate screen which tracks the total count of parts made on this machine, and lists the counts for the parts made in the different modes of operation AUTO1, AUTO2 and MAN. It also tracks the counts of all parts that have been sorted (if you are using the sorting function) and of all idle strokes (e. g. if you have them allowed on a thread rolling machine).

The total count as well as the sorted parts and the idle strokes can be each reset to zero independently. This feature allows you to keep track of your weekly or monthly production figures. Press "**1**" to reset the total count, press "**2**" to reset the number of sorted parts, and press "**3**" to reset the amount of idle strokes. Answer the appearing question "Delete count ?" with "**E**" (=yes) to zero the counter, or cancel by pressing "**C**" (=no).



Monitoring parameters (page 2/4, # 2)

Gives a condensed survey of the important parameters and their settings. Parameters may be altered on this screen as well.

schwer + kopka

Functions of Machine Interface

SK 2/5-INTF1

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 the 24 VDC power to the 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, the relay coil is powered; if the LED is off, the relay coil is not powered.

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

Both relays are normally powered. They will switch 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 switch the motor off or switch the emergency stop. The “Motor Stop” relays #3 and #6 will switch every time the process monitor goes into stop.
In addition, Relay #4 "Emergency Stop" will be switched 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.

As an option, Relay # 5 and # 6 can be programmed to act as sorting relays (please refer to the sorting function described in the manual).

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 short signals (20 ms on all BDE outputs) 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.

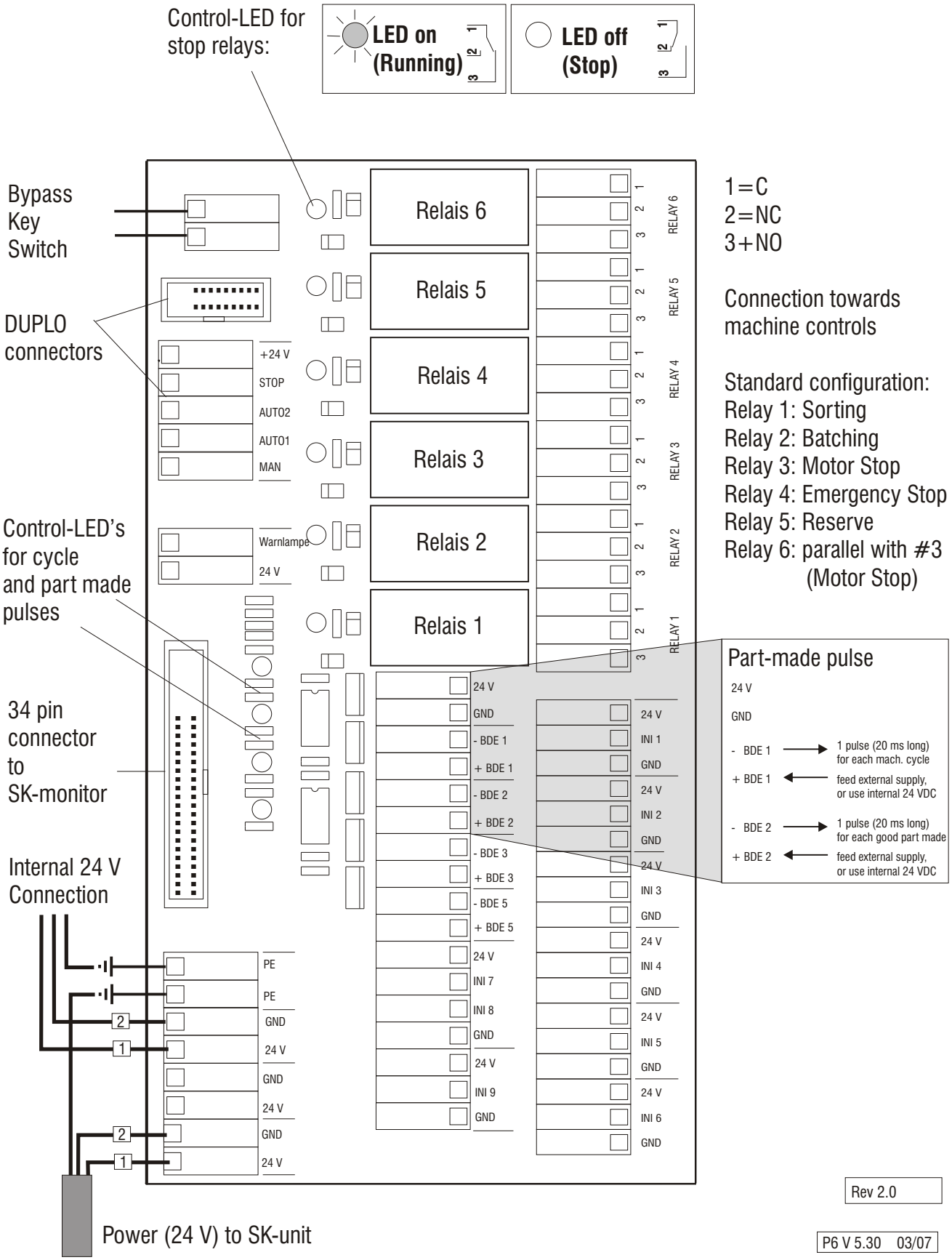
Digital inputs

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)

Machine interface connection (Rev 2.0)

SK 2/5-INTF-2



Rev 2.0

P6 V 5.30 03/07

Connection Interface - Machine Controls

SK 2/5-INTF-3