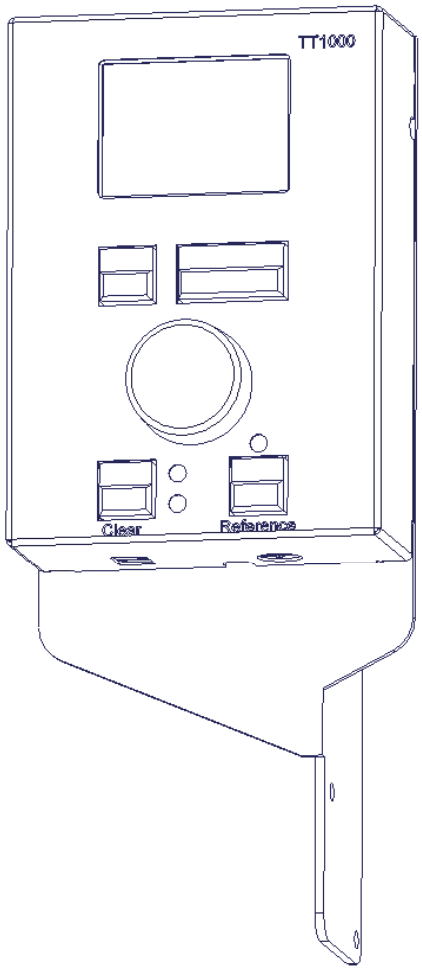
INSTALLATION & USER Guide

Version 1.3 - June 2006

TT1000

CRIMP FORCE ANALYSER

With TT1000R4 Software



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About this manual

The following symbols are used throughout the manual to highlight particular instructions or procedures. The meaning of each is given below.

This symbol is found next to safety notes about work procedures that are potentially hazardous. Pay attention to these warnings and proceed with particular caution.

This symbol is placed next to notes about work procedures during which special care must be taken to prevent damage to the system or other associated equipment.

This symbol is placed next to useful tips or general information about a procedure or instruction.

TT1000 CFA Overview

Crimp Force Analysis Overview

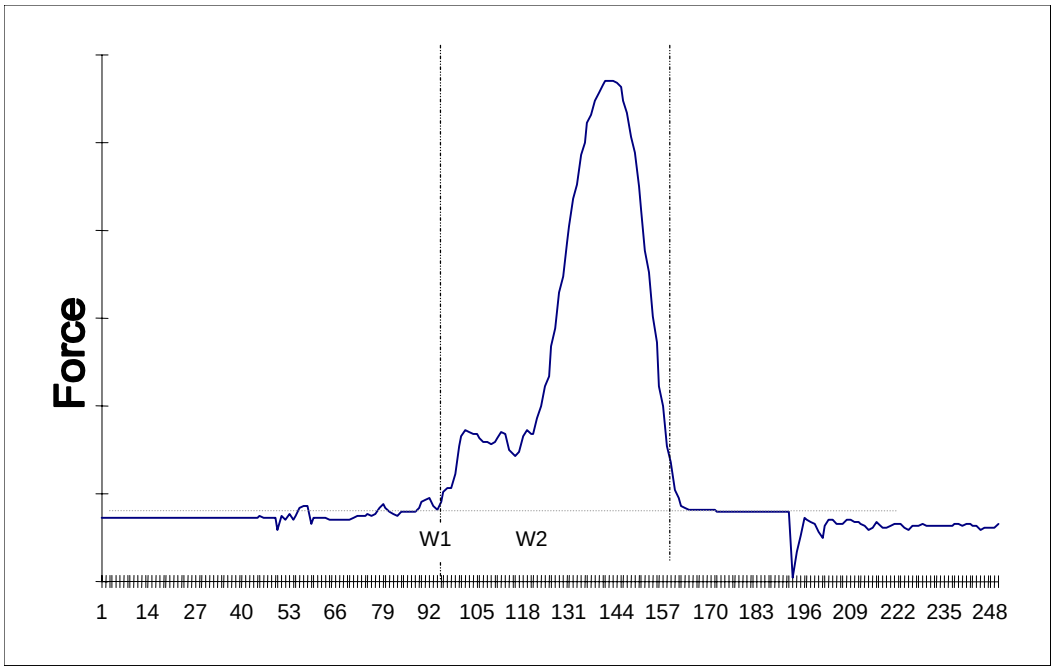
A Crimp Force Analyser or CFA is a sensitive piece of equipment for monitoring and checking the forces applied in forming a crimp terminal.
In use, the CFA is first taught the force profile of known good process cycles by running a prescribed number of TEACH CYCLES. At this stage the CFA does little analysis, but stores the force profiles for later reference. These crimps can then be tested off line for quality, usually using a combination of destructive pull off and visual testing. Once the crimping quality has been checked, the CFA can then compare each subsequent crimp cycle with the reference crimp profile in order to verify the quality of the terminations produced.

This system benefits the wiring manufacturing process in two ways:-

100% testing of terminations.
No production rate impact.

Evaluation Algorithm

The TT1000 represents current state of the art in Crimp Force Analysis. The core technology allows the CFA to offer unprecedented levels of good/bad sorting whilst remaining easy and intuitive to use.



The addition of signed math analysis and results gives more information on the failure mode. This provides information to drive quality improvement schemes.

In order that the CFA can analyse the force profile it must first be taught the force profile of a good termination. This is achieved by performing a TEACH SEQUENCE.

During this sequence the CFA records and scales the force profile and records a *STATIC* REFERENCE profile and a *DRIFTABLE* REFERENCE profile to which all subsequent crimps will be compared.
The CFA also automatically sets the evaluation range during teaching by calculating which portion of the curve should be actively evaluated The CFA compares the force profile at each point within the active portion of the curve against the STATIC REFERENCE and DRIFTABLE REFERENCE profiles recorded during the teach sequence. The mismatch between the profiles is evaluated and two metrics, the SIGNED RESULT (RSO) and the UNSIGNED RESULT (RUO) are calculated.
These values represent the mismatch between the force and reference profiles.
The RUO result is the most sensitive indicator of how closely a curve matches the reference curve.
The TT1000 makes its PASS/FAIL decisions based on the RUO result.

The RSO result is generally less sensitive but can help to indicate the type of fault encountered i.e. more or less force compared to the reference.
RSO values are statistically analysed for each batch, the analysis results can be printed out if required.

The user can establish process limits during teaching and production with a single limit (LIM) and three factors :-

T FACTOR (TEACH FACTOR).
S FACTOR (STOP FACTOR).
D FACTOR (DRIFT FACTOR).

A DRIFT COMPENSATION facility is included, allowing the reference profile to gradually follow the natural process variations and track the process within reasonable limits.

TT1000 Features & Benefits

The TT1000 is a second generation crimp force analyser, derived from the Circuitmaster CFA1000 range but engineered specifically for the Mecal TT benchtop press. Together they provide a highly cost effective solution to the requirement for quality monitored wire termination.

Product highlights include the following:-

- Powerful 16 bit microprocessor allows faster evaluation of more complex algorithms
- On line statistics capability including mean,stdev,cp and cpk analysis
- Graphical Control Panel (GCP) allows on line viewing of force curves aiding fault diagnostics.

- Operator Menus in English,German,Italian,Spanish and Portugese languages.
- Four digit alphanumeric password facility.
- Useful batch counter facility for bench top applications.
- Ram sensor developed specifically for TT press.
- Additional freely programmable I/O available.
- Non-volatile terminal batch buffer holds the RUO results of the last 1000 terminations.
- Rugged high quality enclosure.
- Software upgrades can be easily installed to the CFA in the field.

TT1000 main components

The CFA consists of four main components.

The CPU or Main Processor

The CPU (Central Processing Unit) contains the microprocessor and associated circuitry to capture and analyse the force profile.
The CPU also connects to the Press control circuitry, conditioning the power from it and providing a signal to disable the press when faulty crimping is detected.
In addition the CPU software can be upgraded in the field allowing algorithm developments or customer specific software to be incorporated easily and economically.

The GCP

The GCP (Graphical Control Panel) provides the operator interface for set-up and adjustment. It is a generic user interface across the cfa1000 range. The GCP is designed to give cfa1000 equipment a consistent and easy to learn user interface in order that operator training costs are kept to a minimum.

For the Mecal TT press, the physical arrangement of the buttons on the CGP has been modified to provide a more compact form-factor.
The CPU and GCP are normally installed together in one single enclosure the MAIN UNIT, but in special circumstances, these parts could be physically separated.

The GCP has the following salient features:-

Graphics Screen

The LCD display screen is a 64x128 pixel text/graphics module used to display menus, scroll bars and parameter editing screens. The unit is back-lit and the contrast can be adjusted to aid viewing.

Control Knob

The function of the control knob changes with the specific menu displayed. Common uses of the control knob include incrementing/decrementing parameter values and scrolling through menus.

Menu Select Keys

The function of the menu select keys is modal, that is, it changes depending on which screen is displayed. The actual function of the keys at any time is displayed on the PROMPT LINE of the display.

Pass LED

The green pass LED is lit when a good wire is produced.

Fail LED

The red fail LED is lit when a bad wire is produced. This may be accompanied by the integral buzzer sounding if this feature has been enabled.

Clear Key

The Clear key is used to reset the CFA after a bad wire has been detected.

Reference Key

The Reference key is used to initiate a TEACH SEQUENCE.

Reference LED

The Yellow Led is lit during the TEACH SEQUENCE. During production this LED is off.

The Force Sensor

The PiezoCeramic force sensor converts the force applied by the press into an electrical signal which can be captured by the CPU. The force sensor is mounted in-line with the press ram so that all the force applied in producing the terminal is sensed and transmitted to the CPU.

The Encoder

An optical incremental shaft encoder is used to accurately determine the direction, speed and position of the press drive shaft. The CPU uses the output of this sensor to synchronise the capture of the force profile.

For the CPU to compare successive crimp cycles correctly, sampling must be consistent from cycle to cycle. Since the press speed can vary, due to heating of the motor or mains frequency fluctuations for example, an effective way of synchronising the sampling is to measure the press output shaft angle. The encoder is mounted directly on the output shaft of the press gearbox.

The unit fitted to the TT1000 can resolve ¼ degree (15 minutes) of angular displacement.

TT1000 CFA Installation Guide

The following describes the installation of a TT1000 on a MECAL TT Benchtop press.

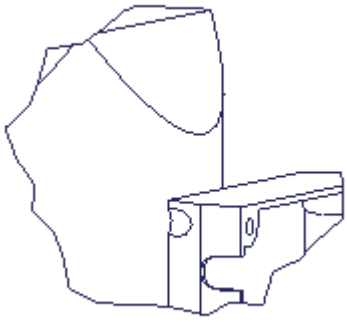
Installation should take roughly 10 minutes and requires the following tools:-

2mmA/F, 5mmA/F and 6mmA/F Allen Keys,Terminal screwdriver, 10mm diameter drill, small hacksaw, 10mm A/F, ½ inch or 13mm A/F, 19mm A/F spanners, torque wrench with 5mm A/F allen key head.

Main Unit Installation

Isolate the mains supply before carrying out this procedure.

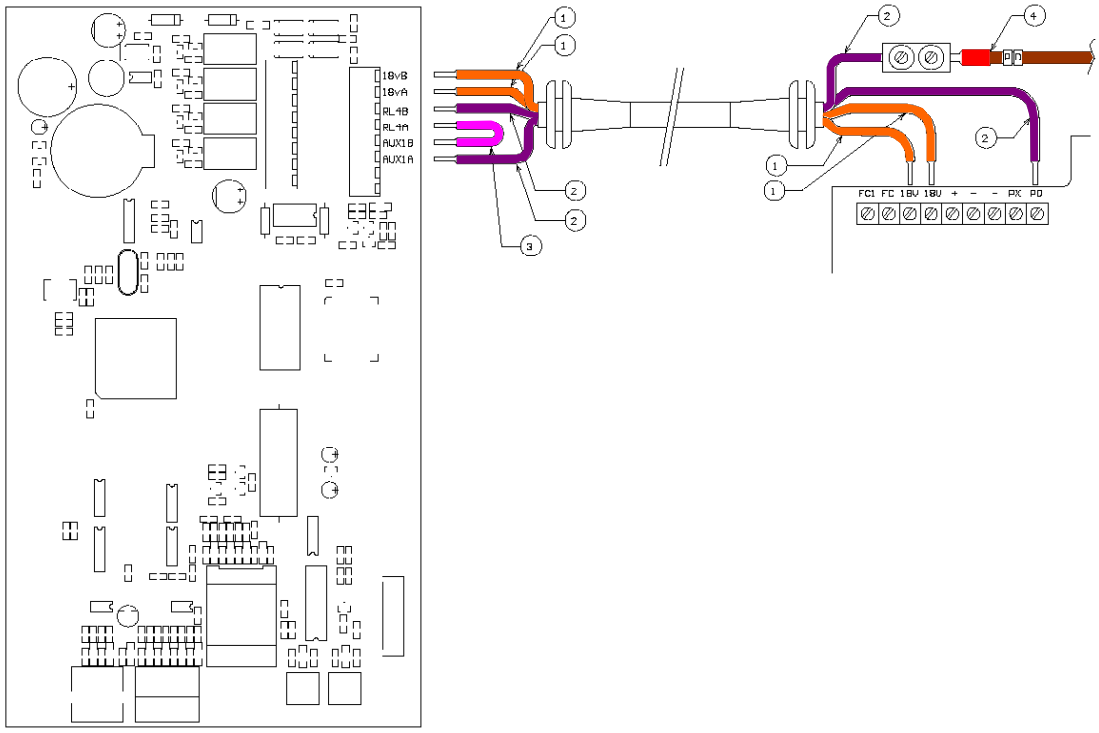
Remove the cover from the TT press control box
and drill a 9,6 mm diameter hole, centered approximately 18mm below the top of the box and 9mm from the front face. Convert the hole to a U slot as shown in the drawing using a small hacksaw. This slot will allow wiring between the CFA and the Press.



Remove the tubular terminal reel holder then unscrew and remove the reel holder bracket from the side of the press .
Refit the reel holder bracket to the press, but now using it to clamp the TT1000 main unit mounting bracket to the side of the press.

Wiring to Mecal TT Press

Fit the grommet of the CFA wiring loom into the new U slot of the control box and make the wiring connections as shown at the right hand side of this diagram. Note the left hand connections should already have been made inside the CFA enclosure and are drawn for reference only.



Connections:

1) Orange wiring supplies 18Vac power from the press to the CFA, polarity is not important.
   Connect to terminals marked 18V inside the press control box.
2) Violet wiring allows the CFA to break into the footpedal circuit, polarity is not important.
   Remove footpedal wire (4) {Brown, marked PD} from terminal PD and connect it to one of the violet wires using an inline terminal block.
   Connect the remaining violet wire to terminal PD.

The cover may now be refitted to the TT press control box.

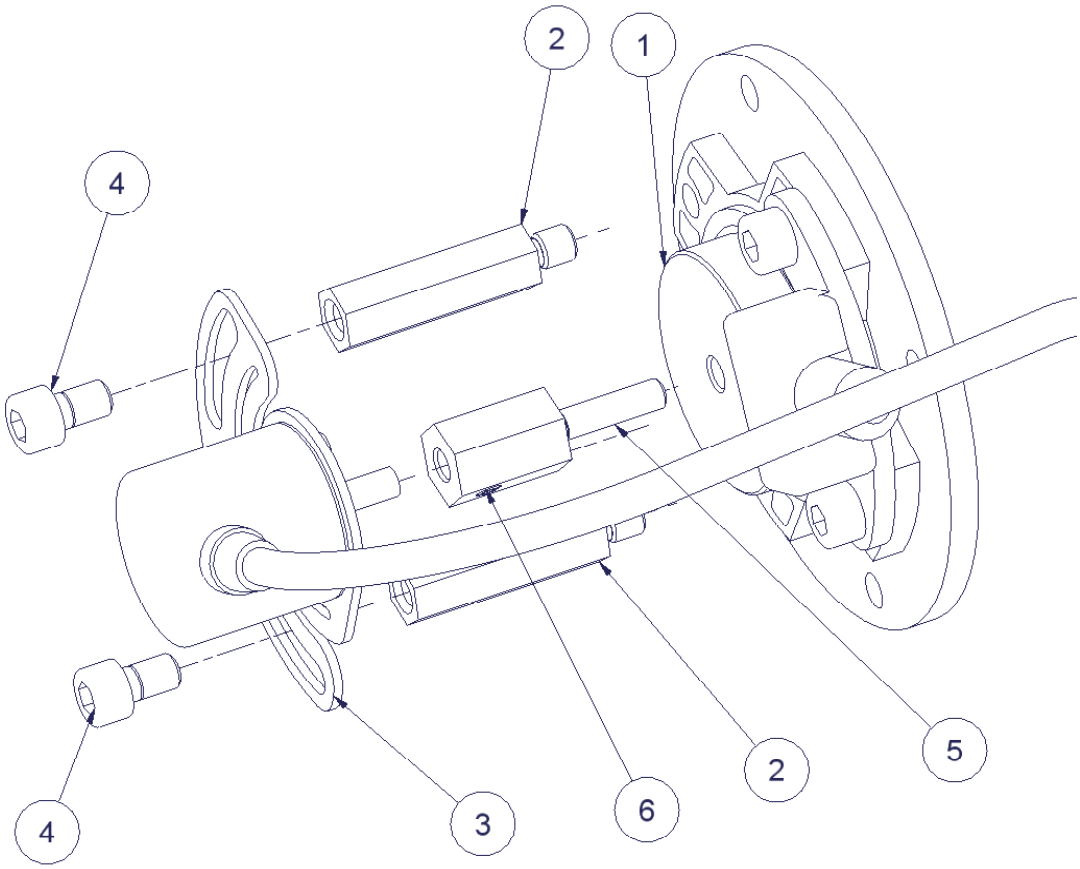
Additional wiring information:

The violet wiring primarily allows the CFA to disable the footpedal circuit by opening a relay RL4 in the event of crimping errors being detected.
The CFA can also sense when the footpedal is pressed since the footpedal current is passed through an optoisolated input (AUX1) by means of a wire link (3) {Pink}.
The optoisolator input is a bi-directional type, consisting internally of two LEDs connected back-to-back.
This scheme allows for the future possibility of encoderless operation although at the time of writing this document, the sensing feature is not used.

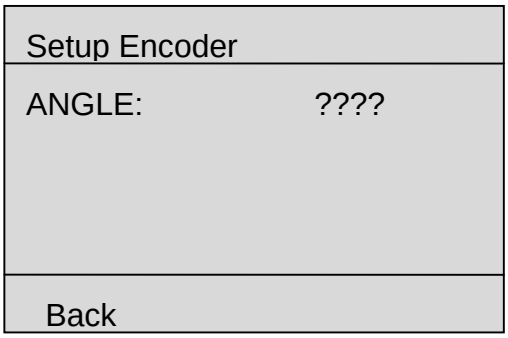
Main unit installation is now complete

Encoder Installation and adjustment

Be careful, excessive force on the drive shaft can damage the encoder.



1. Set the press to its normal rest position, the ram should be at the top of its stroke, this is called TOP DEAD CENTRE (TDC) position.
2. Working at the rear of the press, note or mark the position of the cutout in the cam disc (1), the disc can rotate freely when the central screw is unfastened, the cutout must remain in the same position when the installation is complete.
3. Remove the central screw (not shown) from the cam disc and fit the Encoder Coupling(5) in its place. It may help if the motor handwheel supplied with the press is used to prevent the driveshaft from turning.
4. Fit the two spacing pillars (2) to the holes in the gearbox flange.
5. Power up the CFA and go to *SETUP…OPTIONS…ENCODER SETUP* .



6. Turn the encoder shaft until numbers appear on the display.
7. Turn the encoder shaft so that the Angle on the display reads *960 (+/- 10)*
8. Position the encoder and mounting plate(3) so that the adjustment slots are centrally aligned with the spacing pillars. Slide the encoder shaft into the central hole of the encoder coupling until the mounting plate touches the spacing pillars.
9. Recheck that the press is at TDC position and the angle on the display reads *960 (+/- 10)* , repeat the shaft alignment if necessary , then tighten the coupling set screw(6).
10. Loosely fit the cap head screws(4).
11. The encoder mounting plate can now be rotated slightly to finally position it close to angle 960, then finally tighten the cap head screws.
12. Press the *BACK* key to leave ENCODER SETUP mode
13. The encoder cable should be routed neatly and may be held in place with ties.

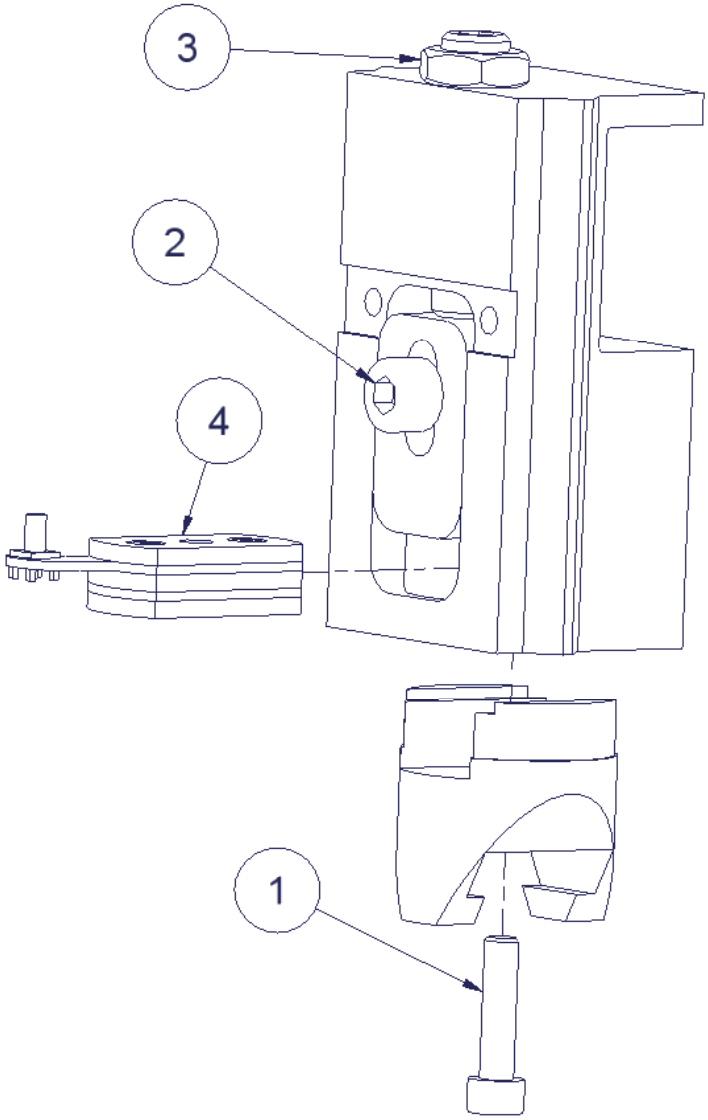
Encoder installation is now complete

Force Sensor Installation

STOP	Switch off the press power and remove any application tooling from the press before carrying out this procedure.

Note that early Mecal TT presses were designed to accept a small circular force sensor. It will be necessary to exchange the whole ram slide assembly for the later design in order to fit the later sensor.

Working at the front of the press, remove the safety cover and any applicator/tooling from the press.



1. Unfasten and remove screw(1), the Ram Socket can then be removed.
2. Unfasten the stroke regulator locking nut(3) and fully back-off the regulator screw.

3. Slacken the regulator clamping screw(2). It should now be possible to slide the regulator block to the top of it's adjustment range.
4. Insert the force sensor(4) into the space below the regulator block then replace the ram socket and its fixing screw(1).
5. Tighten the fixing screw to a torque of 5Nm.
6. Adjust and lock the shut-height as required (the standard clearance is 135.8mm) using the regulator screw, locknut and clamping screw.
7. Plug the force sensor cable onto the force sensor connector and route it to the connector on the bottom face of the CFA main unit. The cable may be held in place with ties but please allow adequate service loops for flexing when the press is operated and to clear the safety covers.
8. Refit application tooling, adjust as necessary and replace the safety covers.

After installing of the force sensor always turn the press over by hand and check the stroke/shut height adjustment before operating the press with power ON. Failure to do so may cause damage to the press and/or tooling.

Force sensor installation is now complete

Adjusting the Display Contrast

This may be necessary if the CFA is installed in a location with an unusually high or low ambient temperature.

Power-off the CFA by switching off the press power.
Hold down the **large** menu select key and power-on the CFA,.
Continuing to hold down the key, adjust the contrast to the desired setting by rotating the control knob.
To save the contrast setting release the large menu select key.

Normal CFA menu operation should then resume after a short delay.

Setting the Real Time Clock RTC

The RTC only needs to be set if the user wishes to use the 'Print Report' feature.
If the RTC is being used, it will need to be reset whenever the battery on the main processor board has been replaced or if the ribbon cable between the main processor and GCP has been disconnected.

To access the Time & Date set menu:-

Power-off the CFA by switching off the press power.
Hold down the **small** menu select key and power-on the CFA,.

To adjust the time:-

Turn the control knob until the TIME is highlighted, then select EDIT
Adjust the HOURS by rotating the control knob, select OK to save the value or QUIT to replace the old value.
Repeat the above for the MINUTES.

Note that the TIME must be entered in 24 hour clock format

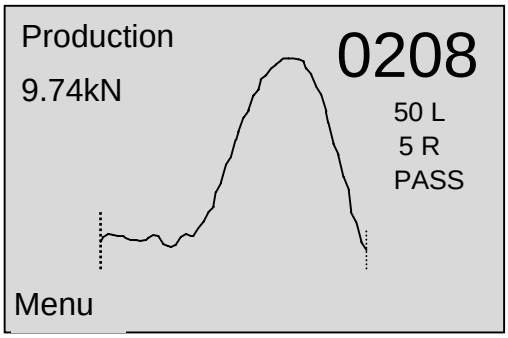
To adjust the date:-
Turn the control knob until the DATE is highlighted, then select EDIT
Adjust the DAY by rotating the control knob, select OK to save the value or QUIT to replace the old value.
Adjust the MONTH by rotating the control knob, select OK to save the value or QUIT to replace the old value.
Repeat the above for the YEAR.

Note that the DATE must be entered in dd/mm/yy format

To complete setting of the RTC, select OK.

Normal CFA menu operation should then resume after a short delay.

The Production Screen



The main screen area displays the force and reference curves.

The parameters shown on the left and right hand side of the screen are as follows:-

9.74kN : The approximate peak force (not calibrated,±20%)
50 L : Shows the current overall evaluation limit.
5 R : Shows the overall evaluation result RU0.

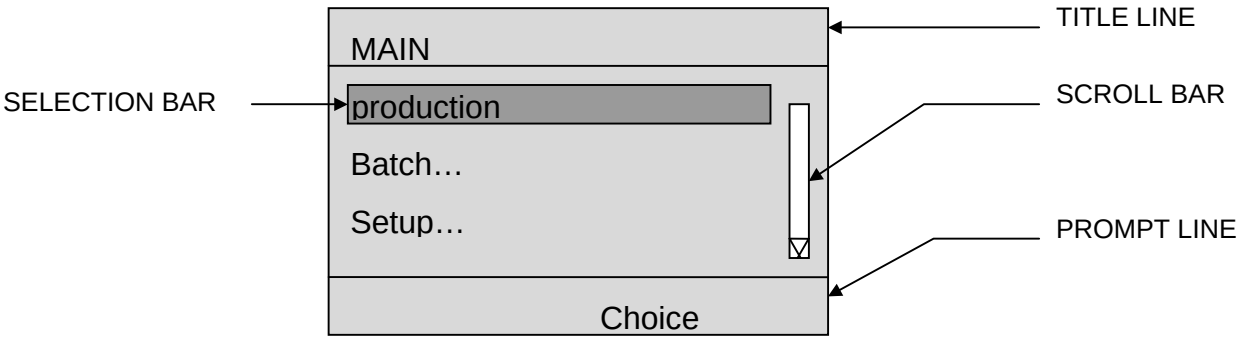
In benchtop mode, a batch counter is displayed in large digits at the top right of the screen.

Error Histogram

It is also possible to produce an 'error histogram' which serves to highlight and pinpoint the mismatches between the force and reference curves.
The curve is divided into a number of sections according to the current *resolution.* The sign and magnitude of mismatch is evaluated within each section and a histogram of the results is displayed.
This display may help the user to diagnose the cause of a fault.
When the histogram display is active, the force and reference curves are compressed towards the top of the screen.
The vertical scale is automatically adjusted to make best use of the available screen area.
To activate the histogram or to increase its resolution, turn the control knob to the right.
To decrease the resolution or deactivate the histogram, turn the control knob to the left.

The production screen is displayed when the CFA is first switched on, this screen is usually left visible during normal use.
Pressing the MENU key from here switches to the menu system.

Selection Menus



Setting of CFA parameters is achieved by way of menus. A typical menu is shown above. Although there are a number of different types of menu used on the CFA, the basic features of each are common:-

TITLE LINE

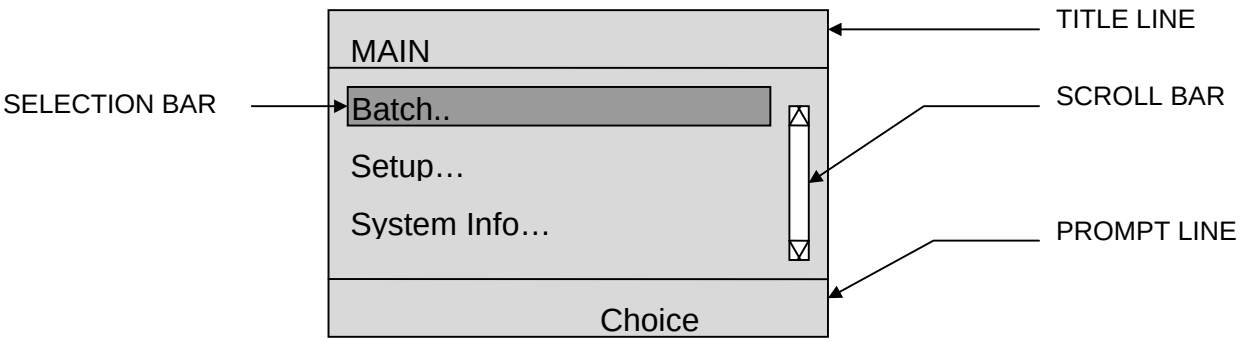
The title line is separated from the rest of the menu by a horizontal line. The title line shows the name of the currently active menu.

SELECTION BAR

The selection bar highlights the currently selected item on the menu. The GCP control knob is used to move the highlight bar to the item required. Where a selection name is followed by three dots (…), this usually indicates that selecting this item will cause a submenu to appear.

SCROLL BAR

The menu scroll bar is displayed if there are more items in the menu than those currently displayed. In the menu above, the bottom arrow shows that more items exist further down the menu. To access these items the user moves the highlight bar down towards the bottom of the menu, using the control knob. When the last visible selection is highlighted, further movement of the highlight bar causes the menu to SCROLL UP. The menu now looks as follows:-



The Scroll bar now shows that there are items above and below the items currently displayed.

PROMPT LINE

The prompt line displays at any point in time the exact function of the MENU

SELECT KEYS.

The user can jump quickly back to the production screen from most selection menu screens by pressing and holding down the small menu select key.

Production Process Limits

During production the user has one limit and two factors which specify the process limits:-

LIM – LIMIT of tolerance to mismatch

This limit is used by the TT1000 along with user factors (see below) to calculate all the other limit types. LIM is the basic error tolerance.
The difference between the current force profile and the DRIFTABLE REFERENCE is evaluated against LIM.

S FACTOR - STOP FACTOR

This factor is used to determine the STOP LIMIT as a multiple of the LIM value.
A mismatch error higher than the STOP limit might be used, for example, to stop automated production in order to investigate and clear the problem before tooling damage could occur.

The difference between the current force profile and the DRIFTABLE REFERENCE is evaluated against the STOP LIMIT.

D FACTOR - DRIFT FACTOR

This factor is used to determine the DRIFT LIMIT as a multiple of the LIM value.
The difference between the current force profile and the STATIC REFERENCE is evaluated against the DRIFT LIMIT.
It therefore effectively limits the allowable process drift through the DRIFT COMPENSATION facility.

Setting LIM – limit of tolerance to mismatch

LIM sets the tolerance at which the terminal is deemed BAD. The PROD BAD relay event is generated.

The limit of tolerance to mismatch, LIM, is located in submenu:
SETUP… LIMITS … LIM

Setting S Factor – Stop Factor

The STOP LIMIT LIM x S Factor sets the tolerance at which the machine should be stopped. The PROD STOP relay event is generated.

The Stop Factor parameter, S is located in submenu:
SETUP… LIMITS … S FACTOR

Setting D Factor – Drift Factor

The DRIFT STOP LIMIT LIM x D Factor sets the tolerance at which the machine should be stopped due to excessive process drift. The PROD STOP relay event is generated.

The Drift Factor parameter, D is located in submenu:
SETUP… LIMITS … D FACTOR

The Teach Sequence

A CFA can be thought of as a repeatability monitor, it has no way of inherently knowing what force profile constitutes a good termination.

The CFA must therefore be taught what a good crimp force profile looks like, this is the primary reason for the teach sequence.

The force curve must be scaled to fit the CFAs input range to maintain resolution and accuracy over widely differing applications.

The teach sequence is a procedure that must be carried out when first setting up the CFA for a particular application, or when wire or terminals are changed.

It consists of a user selectable number of cycles (Odd 3-19) from which the CFA can scale and store its reference force curve.

On the first teach cycle the CFA captures the force curve with its input amplifiers set for the largest possible crimp force the unit is able to cope with. This allows the unit to gauge the force applied relative to its maximum. The CFA then calculates how much to scale the input signal, to give best resolution and accuracy.

Having set its AGC (Automatic Gain Control) circuit, on the second teach cycle, the CFA stores the force profile, first checking that the curve has been scaled correctly. Thus an initial STATIC REFERENCE profile has been recorded. The Evaluation range is also calculated at this time.

Subsequent teach cycles are used to produce an *average* of the stored references in order that the reference to be used for production analysis closely represents the average of the crimps which were seen in the teach sequence.

Analysis is performed on these cycles against the initial STATIC REFERENCE curve with the T FACTOR and LIM being the relevant user editable parameters.

At the end of teaching, the averaged STATIC REFERENCE is copied into the DRIFTABLE REFERENCE , both reference profiles are used during production.

If during the teach sequence a result produced is in excess of the TEACH LIMIT T FACTOR x LIM, the teach sequence will restart automatically.

Setting T Factor – Teach Factor

The Teach Factor parameter, T is located in submenu:
SETUP… LIMITS … T FACTOR

The TEACH STOP LIMIT LIM x T Factor sets the tolerance at which the machine should be stopped due to failure during the teach sequence. The TEACH STOP relay event is generated.

Setting the number of Teach Cycles

The user can select the number of teach cycles the CFA will perform by editing the TEACH CYCLES parameter.

Odd values between 3 (Default) and 19 are valid.

The Number of teach cycles parameter, is located in submenu:
SETUP… ANALYSIS … TEACH CYCLES

It is recommended that 3 or 5 teach cycles be set for a manual benchtop installation.

Starting a new Teach Sequence

A new teach sequence should be started whenever the crimping process has been adjusted or changed in some way.
Press the REFERENCE key on the GCP.
A confirmation screen will be displayed on the display screen.
Accept this screen by pressing the right hand menu select key.

The yellow REFERENCE LED will now be lit indicating that the CFA is in TEACH mode. After the teach sequence has finished the REFERENCE LED will go out indicating PRODUCTION mode.

Drift Compensation

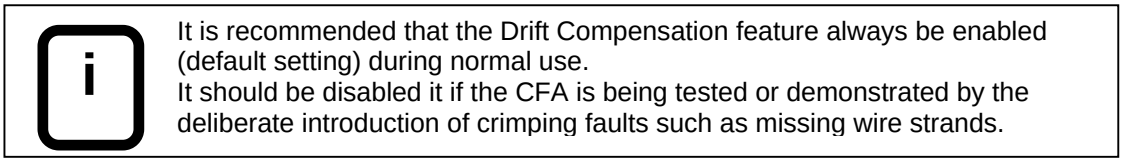
A process under control will exhibit fluctuations due to *common causes* within the manufacturing process. These common causes include tolerances of wire cross section, terminals and limits of reproducibility of the press and tooling. This slow common cause drift is normal within any production process.
Special cause is fast changing drift in a process, caused by a malfunction of the process or process equipment.
Ideally a process monitoring device should be insensitive to common cause drift within the process and sensitive to special cause drift.
The drift compensation facility on the CFA is included to allow the reference profile to follow this slow common cause fluctuation.
The DRIFT RESULT is the result of evaluating the force profile with the STATIC REFERENCE recorded during the teach sequence. It therefore is a measure of the total process drift since the initial teach sequence.
By setting the DRIFT LIMIT (= LIM x D Factor), we control the maximum allowable process drift.
The RUO and RSO are the results of evaluating the force profile with the DRIFTABLE REFERENCE.
After the last teach cycle, the DRIFTABLE REFERENCE is formed by copying the STATIC REFERENCE, which is a mathematical average of all the terminals in the teach sequence, and thus at this point in time the DRIFTABLE REFERENCE is the same as the STATIC REFERENCE.

DRIFT COMPENSATION allows the DRIFTABLE REFERENCE to follow the process and operates as follows:-

If a crimping operation results in a PASS result, the DRIFTABLE REFERENCE is allowed to creep by one step closer to the force curve at each point of the curve.
If a crimping operation results in a BAD (or STOP) result, the DRIFTABLE REFERENCE is held fixed.
Since the force profile is compared also to the STATIC REFERENCE, the DRIFT LIMIT acts as a total process drift limit.
DRIFT COMPENSATION therefore allows the CFA to follow slow changing variations due to common causes yet still maintain sensitivity to detect process special causes.

Controlling Drift Compensation

The Drift Compensation setting is located in submenu:
SETUP… ANALYSIS … DRIFT COMP.



Viewing Batch Statistics

A statistical analysis of the RSO values for all crimps in the batch can be viewed in submenu:
SYSTEM INFO … STATISTICS …

The Batch Counter

The batch counter facility is particularly useful for bench top applications.
In such applications, an operator is often required to produce batches of a certain number of wires.
This facility eases this task by counting the number of good and bad wires produced and automatically deducting the GOOD WIRE COUNT from a user entered TARGET batch size.
The unit also displays a TO DO count which is the number of wires in the batch still to be made.
An end of batch EVENT is triggered when the TO DO count reaches zero.

Setting the Batch Counter

To setup a new batch:-

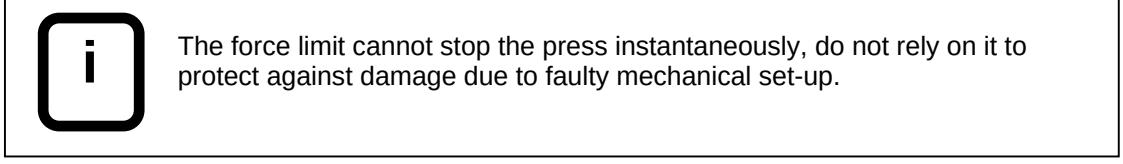
The desired Batch Size parameter, *TARGET* is located in submenu:
BATCH… TARGET

The batch count may be cleared at any time from the submenu:
BATCH… <RESET>

When the batch is completed, an end of batch relay EVENT is triggered.

This event can cause a user specifiable ACTION on any one of the 4 relays, for example to switch on an indicator or annunciator.

Force Limit



The CFA can impose a limit on the maximum crimping force, this can help to protect the press against accidentally exceeding its rating.
If the peak force exceeds the limit, the FORCE LIMIT relay EVENT is generated.

The FORCE LIMIT event may occur in conjuntion with a PASS event. However the FORCE LIMIT event will occur later.

Setting the Force Limit

The Force Limit parameter, is located in submenu:
SETUP… LIMITS … FORCE LIMIT(kN)

More information on setting up relay actions is available in a later section on relays.

TT1000 CFA Additional features and options

Auxiliary Inputs and Outputs

The CFA has two input opto-isolators and four output relays on the CPU board. The TT1000 is supplied with pre-installed wiring suitable for connection and interface with the Mecal TT press.
It is possible to implement interfaces to other equipment. In many cases it will then be necessary to make additional connections to the the interface terminal blocks on the CPU board.

INPUTS

There is one opto-isolated 20mA current sensing input (AUX1), **reserved on the TT1000 for footpedal sensing** .
There is also one free 24v non polarised opto-isolated input line (AUX2).

Signal changes at these inputs generate EVENTs There are four events available from these input lines:-

AUX1H	Occurs when the AUX1 input changes from a low to a high level
AUX1L	Occurs when the AUX1 input changes from a high to a low level.
AUX2H	Occurs when the AUX2 input changes from a low to a high level.
AUX2L	Occurs when the AUX2 input changes from a high to a low level.

In the above, HIGH means current is flowing through the isolator's input terminals, the actual polarity of the applied voltage is not important

OUTPUTS

The TT1000 has four relay outputs for signalling or load switching. The relay outputs are rated at 124Vac, 1mA to 1A.

If it is required to switch higher currents or Inductive loads, the relay should be used to drive a more suitable relay for the particular application.

The relays are EVENT driven, that is one of 5 specific user programmable ACTIONS can be performed by the relay in response to a given CFA EVENT. Custom user programming can be achieved using the RELAY MATRIX screen.
These features allow custom signalling interfaces to be implemented.

Relays 1 to 3 are free for custom use.

Relay 4, **reserved on the TT1000 for disabling the footpedal circuit** in the event of crimping errors being detected. The operator can acknowledge the fault and re-enable the footpedal.

Quick Set Relay schemes

The actions of relays 1&2 in particular can be preset in a number of signalling schemes.
Some of these schemes are intended for interfacing to automatic machines.

Relay Quick Set

Relay Quick-Set programming , is located in submenu:
SETUP… RELAYS … QUICK SET

If the Relay mode is quickset to BenchTop mode (the default setting for TT1000), some other features become active as follows:-

The batch count is displayed in the top right hand corner of the PRODUCTION SCREEN display in large numbers for the convenience of the operator. It may be reset from this menu by holding down the MENU key until a confirmation message is displayed. Pressing the CONFIRM key at this point clears the batch counters, pressing BACK will leave the batch counters unchanged.

When an error EVENT occurs the buzzer will sound, and the corresponding BAD or STOP relay ACTION will be performed. Pressing the CLEAR key at this point will clear the error condition by silencing the buzzer and causing the OP RESTART relay ACTION to be performed.

Relay Programming Matrix

In some applications, customising of relay behaviour may be desired. The relay matrix allows EVENTS to trigger ACTIONS by any of the four relays.

Events which can trigger relay Actions

In the CFA recognises many event types, listed below:-

START	The start of an analysis cycle.
PROD PASS	A pass in production
PROD BAD	A fail in production
PROD STOP	A gross failure in production
TEACH PASS	A pass in the teach sequence
TEACH BAD	A fail in the teach sequence
TEACH STOP	A gross failure in the teach sequence
T AMP PASS	A pass on the first teach cycle (Cal amplifiers)

T AMP FAIL	A fail on the first teach cycle (Cal amplifiers)
FORCE LIMIT	Peak Force above limit
END BATCH	The batch counter TO DO count is zero.
OP RESTART	Operator acknowledges an error.
AUX1 HI	The level is HIGH on AUX1 i/p line
AUX1 LO	The level is LOW on AUX1 i/p line
AUX2 HI	The level is HIGH on AUX2 i/p line
AUX2 LO	The level is LOW on AUX2 i/p line

Relay Actions

There are five possible relay actions:-

1	TURN ON	Contacts Close
0	TURN OFF	Contacts Open
T	TOGGLE	Change State
S	STROBE	Contacts close after delay, then open after Delay
X	DO NOTHING	Contacts stay in same state

Linking Events with Actions

The relay matrix lists all the available events against the available relays. By editing the actions user specific relay actions may be easily accomplished.

	RELAY 1 2 3 4
START	1 0 X X
PROD PASS	1 S T 0

Two typical lines from a matrix screen are shown above. On the left are the EVENTS (START and PROD PASS).

The four columns to the right labelled 1-4 specify the relay numbers.

Notice that for each of the EVENTS (ROWS) there is a corresponding ACTION (1,0,S,T,X) specific to each relay (COLUMNS).

The example above specifies that:-

On START of cycle RELAY1 Closes, RELAY2 Opens, RELAYS 3&4 Do Nothing.

On PROD PASS RELAY1 Closes, RELAY2 Strobes, RELAY3 Toggles and Relay 4 Opens.

By specifying ACTIONS for each of the EVENTS the user can easily customise the function of any or all of the relays.

Setting a Relay Action

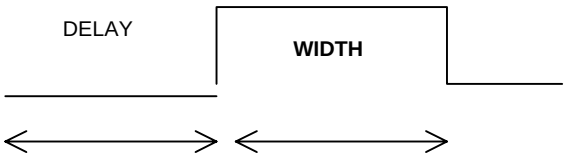
Relay ACTIONS can be specified in submenu:
SETUP… RELAYS … MATRIX

With the control knob select the required relay and press CHOICE.
Again using the control knob select the required ACTION and press CHOICE.
Press BACK once to select another relay or twice to select another event.
Press BACK again to select another event.

Important note on the interface wiring to the TT press

The TT1000 CFA normally leaves the factory with AUX1 pre-wired in series with Relay4 ready for break-in connection to the footpedal circuit. AUX1 can detect when the footpedal has been operated and Relay4 can disable the footpedal from operating the press. Please bear this in mind when reprogramming AUX1H or AUX1L events or RL4 actions.

Relay Strobe Timings



When a strobe action is specified for a relay, the relay timing is governed by the settings in the STROBE TIMING menu. The two editable parameters are shown pictorially above.
Strobing is often used in the interface to an automatic machine, the CFA result may be set on one relay and after a delay to allow that relay to settle, the result is strobed to the machine using a second relay.

The DELAY is the delay before the relay contacts close specified in mS (milliseconds)
The WIDTH is the delay after the relay contacts close before they open again specified in mS (milliseconds).

Setting Relay Strobe Timings

Relay timing parameters for STROBE EVENTS can be specified in submenu:
SETUP… RELAYS … TIMING

Printing a batch report using the optional printer

A thermal printer can be connected. This allows a hardcopy batch report to be obtained, listing the following information.

Current Time and Date
Batch Start Time and Date
Current CFA settings
Batch statistics

The system currently supports the Seiko DPU-414 thermal printer.

A batch report can be printed at any time form submenu:
SYSTEM INFO… PRINT REPORT

Make sure that the printer is powered up,on-line and connected to the printer socket with the lead supplied.

If a printer is connected, a batch report will automatically be printed when the batch counters are reset.

Data Capture Triggering

The CFA can operate in two data capture modes:-

Encoder trigger mode This is the normal mode, an encoder triggers and synchronizes data capture.

Time triggering Mode A software timer controls data capture. Data collection is initiated by a trigger sensor (a simple switch) in place of the encoder. This method might be used when it is impossible to attach an encoder to the press.

Setting the data capture mode

The capture mode can be specified in submenu:
SETUP… OPTIONS … CAPTURE MODE…TRIGGER

If TRIGGER is set to TIME, It may be necessary to adjust the RPM parameter to suit the press motor/gearbox combination.

The RPM figure associated with this menu is used only in the TIME trigger mode. If operating in the time trigger mode enter the press output shaft speed. This is simply the motor speed RPM / gearbox reduction ratio.

Network Interface

The CFA can communicate with a central PC over a proprietary coaxial network.

Networking offers the following possibilities:-

Allows remote setup of parameters and options by machine or remote PC.
Allows downloading ,viewing and storage of batch information, force and reference profiles.
Allows data from benchtop applications to be included in auto data collating/networking schemes.

The Batch Buffer and Online Statistics

The CFA is capable of calculating process statistics online, based upon the contents of the batch buffer. The process parameters and capability metrics that are available online are discussed below.

The CFA incorporates a non-volatile ring buffer called the BATCH BUFFER which stores the last 1000 good crimp results (RUO).

Remote access to the batch buffer is achieved via a coaxial interface. This allows for data collating and off-line analysis.

Process Mean

The CFA calculates the Mean of the RU0 values.
Process Standard Deviation

The CFA calculates this process parameter according to the following formula:-

$$\sigma = \frac{1}{n^{2}} \sqrt{n \sum x^{2} - \left(\sum x \right)^{2}}$$

where:
n= the number of items
x= the value of each item

Process Capability Parameter - Cpk

The CFA calculates this process parameter according to the following formula:-

$$Cpk = \frac{BadLimit - \sum x / PassCount}{3\sigma}$$

Where BadLimit = LIM

Process Capability Parameter Cp

The CFA calculates this process parameter according to the following formula:-

.

$$Cp = \frac{2 * BadLimit}{6\sigma}$$

Where *BadLimit* = LIM

In addition to the above calculations, the CFA also calculates

Min and Max result values
Total number of crimps in the BATCHBUFFER
Total number of GOOD crimps
Total number of BAD crimps
% of GOOD and BAD crimps

Setting the coaxial interface node address

Each CFA connected to a coaxial interface network must be uniquely identified by its coaxial interface NODE ID.

This can be specified in submenu:
SETUP… COMMS … NODE ID

> **i** Address 0 is the NETWORK MASTER (PC or MACHINE) address and address 255 is a reserved broadcast address and therefore cannot be set for a CFA.

Controlling buzzer operation

The buzzer can be used to provide an audible warning of a bad termination. Buzzer operation may be enabled or disabled through the OPTIONS menu.

This can be done in submenu:
SETUP… OPTIONS … BUZZER

Setting of new teaching in remote control

The teaching cycle can be started in remote control by an external input on the electronic board of the crimp force analyser, called IN2A/IN2B.

This can be set in the following sub-menu:
SETUP… OPTIONS … In2=Ref

Restoring Factory Default Settings

New users often want to experiment with the effect of changing various parameters. It is useful to have a way to return all the settings to their default states.

This can be done in submenu:
SETUP… OPTIONS … SET DEFAULTS

Press cycle counter facility

The CFA incorporates counters for logging the number of press cycles and the total 'impulse' applied to the press (sum of peak force for all cycles)
The counts may be used to schedule preventive maintenance such as lubrication for example.

Two facilities are provided :-

CYCLES <reset>	A resettable counter for the number of cycles.
CYCLES TOTAL	A non-resettable counter for the number of press cycles.
FORCE <reset>	A resettable counter for the peak force sum.
FORCE TOTAL	A non-resettable counter for the peak force sum.

Viewing the press cycle counters

The counters are located in submenu:
SYSTEM INFO… COUNTERS …

The counts may be displayed as a number followed by:
K (kilo, x 10E3)
M (mega, x 10E6)
G (giga, x 10E9)

Clearing the resettable press counters

To clear the resettable counters:-

Move the highlight bar over the resettable item and press CHOICE.
This will bring up a final confirmation screen.

The Password Feature

Parameter editing on the TT1000 is quick and easy using the GCP menu.
It is a common requirement however, to restrict editing access to basic parameters within a unit.
In recognition of this fact the TT1000 has a password facility which allows the production engineering staff to prevent unauthorised personnel from gaining access to menus which allow editing of such parameters.

Setting the system password

The system password is any four character alpha-numeric string.

Password setup is located in submenu:
SETUP… PASSWORD …CHANGE PASSWORD

Use the control knob to select the required alphanumeric and press ENTER.
Repeat for all the characters in the required password.
Press ESC to leave character editing mode and set the password.

Manually Locking and Unlocking Menus

Password locking and unlocking can be achieved in submenu:
SETUP… PASSWORD …LOCK MENUS (if the CFA is unlocked*)*
Or
SETUP… PASSWORD …UNLOCK MENUS (if the CFA is locked)

LOCK MENUS has a confirmation screen, *UNLOCK MENUS* requires the user to enter the correct system password.

Automatic locking

If a system password other than the default '****' has been set, the CFA always powers up in the locked state.
To disable this feature, reset the system password to the default:

1. Manually unlock the CFA.
2. Reset the system password to '****' (in *SETUP… PASSWORD …CHANGE PASSWORD* , press ENTER 4 times)

Lost Password Utility

If the system password has been lost or forgotten, there is no way for the user to regain access to the locked menus.
In these circumstances, a MASTER PASSWORD can be used to unlock the system.

1. Go to submenu:*SYSTEM INFO… S/W VERSION …SERVICE:* Note the 4 digit number
2. The manufacturer can generate an 'unlock code' using this service number.
3. Follow the procedure for UNLOCKING MENUS and enter the unlock code as the system password. The CFA should now be unlocked.
4. Immediately, set a new system password.

Do not operate the press while performing this procedure since the service number changes each time the press is operated.

Locking the REFERENCE key

The “teach” procedure that is enabled by pressing the REFERENCE key, can be locked through the system password.
The setup of this option can be found on the submenu:
SETUP… PASSWORD… REF LOCKING

Locking the CLEAR key

The CLEAR key that is normally used to reset the CFA after that a bad crimp is performed, can be locked through the system password.
The setup of this option can be found on the submenu:
SETUP… PASSWORD… CLR LOCKING

Appendix A: TT1000 CFA Menu Structure

Main Item	*Sub level*	*Sub level*	*Sub level*	*What does it do?*
Production				Switches to production screen
Batch…	<Reset>			Resets Batch counters
Batch…	Target			Sets target batch size
Batch…	To Do			Shows passes needed to reach target
Batch…	Passes			Shows Pass count
Batch…	Fails			Shows Fail count
Setup…	Limits…	LIM		Sets Basic Error limit (p.p.mil)
Setup…	Limits…	T Factor		Sets Teach limit as a multiple of LIM
Setup…	Limits…	D Factor		Sets Drift limit as a multiple of LIM
Setup…	Limits…	S Factor		Sets Stop limit as a multiple of LIM
Setup…	Limits…	Force (kN)		Sets Peak force limit
Setup…	Analysis…	CFA Function		Switches CFA active/inactive
Setup…	Analysis…	Teach Cycles		Sets number of teach crimps
Setup…	Analysis…	Drift Comp.		Switches Drift Compensation on/off
Setup…	Password…	Lock Menus		Switches to locked menu structure
Setup…	Password…	Unlock Menus		Switches to unlocked menu structure
Setup…	Password…	Change Password		Sets the password for unlocking
Setup…	Password…	REF locking		Locking the reference key
Setup…	Password…	CLR locking		Locking the clear key
Setup…	Language	English		Switches Menu Language
Setup…	Language	Deutsch		Switches Menu Language
Setup…	Language	Francais		Switches Menu Language
Setup…	Language	Italiano		Switches Menu Language
Setup…	Language	Espagnol		Switches Menu Language
Setup…	Language	Portugues		Switches Menu Language
Setup…	Relays…	Quick Set…	K40 Mode	RL1 & RL2 interface to Komax 40
Setup…	Relays…	Quick Set…	Alpha Mode	RL1 & RL2 interface to Komax Alpha
Setup…	Relays…	Quick Set…	Benchtop Mode	RL4 interface to footpedal
Setup…	Relays…	Matrix…	Start	Sets relay actions at cycle start
Setup…	Relays…	Matrix…	Prod Pass	Sets relay actions, pass in production
Setup…	Relays…	Matrix…	Prod Bad	Sets relay actions, bad in production
Setup…	Relays…	Matrix…	T Pass	Sets relay actions, pass while teaching
Setup…	Relays…	Matrix…	T Bad	Sets relay actions, bad while teaching
Setup…	Relays…	Matrix…	T Stop	Sets relay actions, stop while teaching
Setup…	Relays…	Matrix…	T Amp Pass	Sets relay actions, pass 1st teach
Setup…	Relays…	Matrix…	T Amp Fail	Sets relay actions, fail 1st teach
Setup…	Relays…	Matrix…	Force Limit	Sets relay actions, force overload
Setup…	Relays…	Matrix…	End Batch	Sets relay actions, (To Do =>0)
Setup…	Relays…	Matrix…	Op Restart	Sets relay actions,operator clears error
Setup…	Relays…	Matrix…	Aux 1 Hi	Sets relay actions, AUX1 goes active
Setup…	Relays…	Matrix…	Aux 1 Lo	Sets relay actions, AUX1 goes inactive
Setup…	Relays…	Matrix…	Aux 2 Hi	Sets relay actions, AUX2 goes active
Setup…	Relays…	Matrix…	Aux 2 Lo	Sets relay actions, AUX2 goes inactive
Setup…	Relays…	Strobe Timing…	Delay (mS)	Sets relay delay before strobe 1st edge
Setup…	Relays…	Strobe Timing…	Width (mS)	Sets relay delay 1st edge to 2nd edge
Setup…	Comms…	Node Id		Sets node address for networking
Setup…	Options…	Capture Mode…	Trigger	Sets capture, encoder/timer triggered
Setup…	Options…	Capture Mode…	RPM	Sets capture rate if timer triggered
Setup…	Options…	Encoder Setup		Goes to encoder setup utility
Setup…	Options…	Buzzer		Switches buzzer on/off
Setup…	Options…	In2=Ref		Set input In2 for new reference
Setup…	Options…	Reload Software		Prepares to reload software
Setup…	Options…	Set Defaults		Restores factory default settings
System Info…	Counters…	Cycles <reset>		Shows total cycles since last reset
System Info…	Counters…	Cycles total		Shows total cycles
System Info…	Counters…	Force <reset>		Shows total impulse since last reset
System Info…	Counters…	Force total		Shows total impulse
System Info…	Statistics…	Mean RSO		Shows mean of RSO results in batch
System Info…	Statistics…	Std. Dev. RSO		Shows St Dev of RSO in batch
System Info…	Statistics…	CPK RSO		Shows CPK of RSO in batch
System Info…	Statistics…	CP RSO		Shows CP of RSO in batch
System Info…	Statistics…	Min RSO		Shows Min RSO in batch
System Info…	Statistics…	Max RSO		Shows Max RSO in batch

System Info…	Statistics…	Tot. Crimps		Shows number of crimps in batch
System Info…	Statistics…	Good Crimps		Shows num of good crimps in batch
System Info…	Statistics…	Bad Crimps		Shows num of bad crimps in batch
System Info…	Statistics…	Good Crimps %		Shows num of good crimps in batch
System Info…	Statistics…	Bad Crimps %		Shows num of bad crimps in batch
System Info…	SW-Version…	Doc Nr		Shows software version name
System Info…	SW-Version…	Date		Shows software release date
System Info…	SW-Version…	Service		Shows service number (for unlocking)
System Info…	Diagnostics…	P0 Offset		*Used for test during manufacture*
System Info…	Diagnostics…	P1 Offset		*Used for test during manufacture*
System Info…	Diagnostics…	Amp Gain		*Used for test during manufacture*
System Info…	Diagnostics…	Pot Value		*Used for test during manufacture*
System Info…	Diagnostics…	Int. Cap nF		*Used for test during manufacture*
System Info…	Diagnostics…	Cal mV		*Used for test during manufacture*
System Info…	Print Report			Sends Batch report to printer

Appendix B: TT1000 CFA Troubleshooting

CFA intermittently fails good terminals.

This problem is often caused by the encoder slipping. Go through the encoder setup procedure and check the readings at the end of each press cycle. If the readings vary, then the encoder fixing screws or securing screw is loose. It is also quite common for multi-stranded cable to be cut and stripped on process equipment using 'V' blades. In these circumstances it is easy to intermittently cut individual strands out of the cable. Check for the tell-tale signs of 'coppering' of the strip blades or loose wire strands falling below the blades.

No force profile shown on GCP when press is fired.

Check the encoder operation by rotating the press by hand and watching the angle increase on the ENCODER SETUP menu.
Check that the sensor is fitted securely and that the sensor cable is fitted between the sensor and the FORCE input on the evaluation unit.

Yellow REFERENCE led is lit all the time.

This is because the teach sequence is not being completed properly, due to the CFA failing one of the terminals,and is therefore restarting automatically. The reason for the processing failure should be investigated.

Problems Printing

If problems are experienced trying to print batch reports, check the folowing points before calling for assistance.

Check the printer lead supplied is connected between the SERIAL socket on the printer, and the ISP/PRINTER socket on the CFA.
Check that the printer is powered up using the power supply provided (Green LED on front panel lit), and is ON LINE (Green ON LINE light illuminated).
Check that there is sufficient paper in the printer and that the PAPER END led is OFF.
Finally check that the printer settings are correct as follows:-
Switch OFF the printer.
Switch ON the printer whilst holding down the small front panel key.
Release the key once printing of the settings commences.

Check that the following key settings are correct:-

DIP SW -1	*1(OFF)*	*Input = Serial*
DIP SW -2	*5(ON)*	
	6(ON)	
	7(OFF)	
	8(OFF)	*International Character Set = England*

DIP SW -3	*1(ON)*	*Data Length = 8 bits*
	2(ON)	*Parity Setting = No*
	4(ON)	*Busy Control = H/W Busy*
	5(OFF)	
	6(ON)	
	7(ON)	
	8(ON)	*Baud Rate = 9600 bps*

If settings are found to be incorrect, refer to the printer manual for more details on how to change them.