THE

Lechintech

SCD 16 Plus

Lechintech
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Lechintech

ION CHARGE ANALYSER
OPERATING AND INSTRUCTION MANUAL

INDEX

Page Number

Due to our policy of continuous improvement, we reserve the right to change or modify design without incurring any obligation to furnish or install such changes or modifications on products previously or subsequently sold.

1. Introduction

The **LECHINTECH ION CHARGE ANALYSER** is an instrument which has been developed to indicate the state of the chemistry in water particulate suspensions. The chemistry of these systems can be monitored by measuring the surface charge of the suspended particles in the fluid medium. The instrument determines the surface charge of the suspension by the steaming current technique, whereby, a current is developed due to the potential induced between two electrodes by the forced movement of the charged particles past the electrodes.

The probe has been designed for use as a laboratory instrument, or as a splash proof field instrument either for the on line measurement and control of a system, or just system monitoring. The ion charge is displayed on a two line 16 digit liquid crystal display, with a two decimal accuracy.

The charge signal is available as a 4-20 mA output. This output type can be used with any standard field instrumentation, for recording and control purposes. This SCD has a built in PI controller and the control output can be set from the menu to be 4-20mA or a pulsed output potential free contact with a range of 20 to 255 pulse/minute relating to the control output range of 0 - 100%

The cost saving benefits of the Ion Charge Analyser are realised through its ability to be used to control the rate of addition of water treatment chemicals for clarification, filtration, retention, or drainage. This is generally done after the relevant trial work has been carried out to establish the optimum control criteria, viz. sampling point, charge control set point, tuning constants of controller, allowing the installation of automatic control and dosing equipment.

2. What is Charge Analysis?

The measurement of the electrokinetic charge of a solution due to the presence of charged particles. The electrokinetic charge can be measured by a number of different methods.

2.1 Applied electric field

- Measure: The relative mobility of the solid or liquid phase
  e.g. Electrophoresis

This is the first method developed for calculating the **ZETA POTENTIAL**. The motion of charged particles under the influence of an electric field was observed and the potential required to achieve a certain particle mobility was measured.

A cell consisting of two flat plates separated by approximately 0.1mm and having an electrode at each end of this cell, as shown in Figure 1. is filled with water containing suspended matter. When an electrical potential is applied to the electrodes, the particles can be observed to drift towards one of the electrodes. This is confirmed by reversing the polarity of the electrodes, and observing the reverse drift of the particles.

The speed of drift is measured, and from this, the Zeta Potential can be calculated. It is effectively then, a measure of the charge on the particles observed.

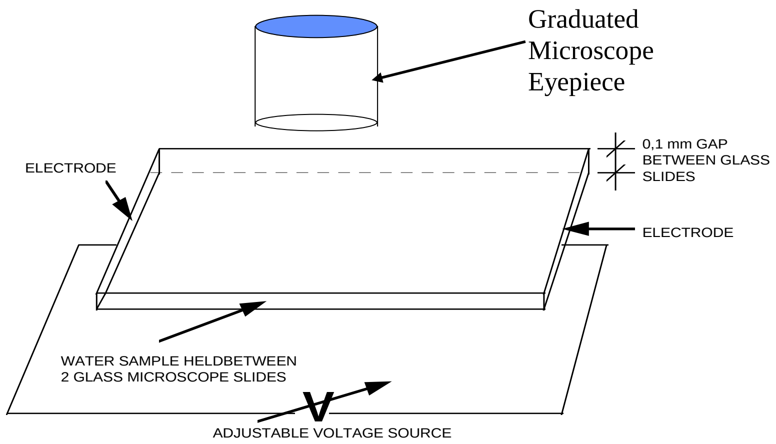


Figure 1. Measurement of Zeta potential using an applied electrical potential.

2.2 Induced electric potential

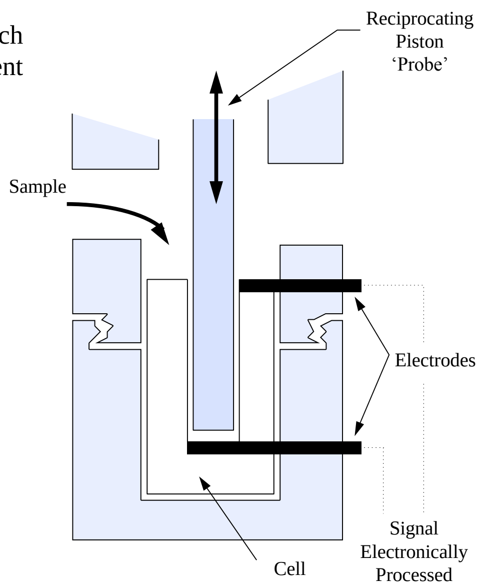
- Measure: The potential developed as a result of the forced movement of particles in the solution.
  e.g. Sedimentation potential
  Streaming potential (Used by Lechintech)

3. The Lechintech Ion Charge Analyser

Just as a generator is to a motor, so the streaming current measurement is to the mobility of charged particles in the presence of an applied potential. The Lechintech Streaming Current Detector works on the principle of generating a current by forcing a flow of charged particles between two electrodes.

Figure 2. Shows a schematic of the Lechintech Streaming current detector. A continuous sample is directed into an annulus inside which a displacement piston, or probe, oscillates at a fixed frequency. The oscillating movement of the piston causes the liquid sample to flow along the wall of the cell.

Figure 2.
The Lechintech Streaming Current Detector.



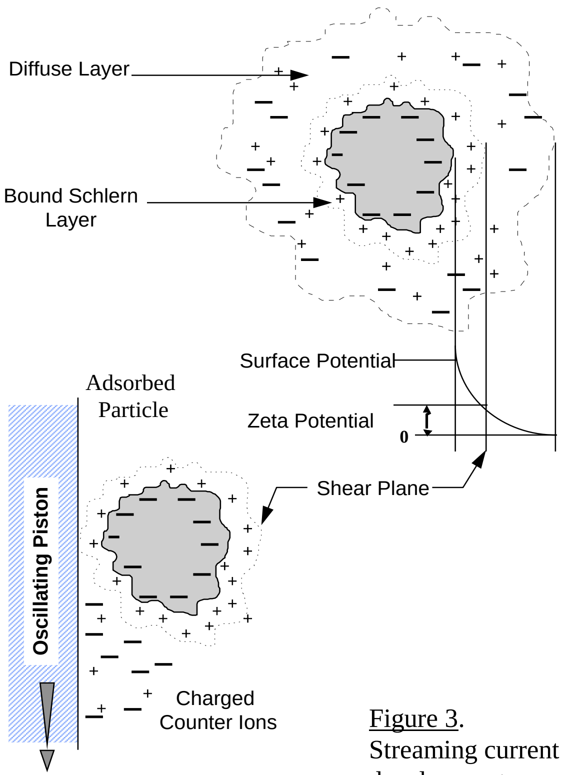


Figure 3.
Streaming current development.

Suspended particles are adsorbed onto the walls under the action of Van der Waal's and electrostatic forces, see Figure 3. As the sample is moved rapidly back and forth, mobile counter ions, surrounding the charged particles, or colloids, are sheared near the surface of the particle and moved past the electrodes.

A potential difference is induced between the two electrodes at the top and base of the cell. The resultant potential developed, proportional to charge, is electronically processed to give a reading of the streaming current in ICu , Ion Charge units.

The streaming current detector has been calibrated so as to give a negative reading if the particles in suspension are negatively charged, and similarly a positive reading for a positively charged system. The greater the magnitude of the current, the higher the charge of the system being measured and consequently the greater the mutual repulsion between the particles in the suspension.

This fact is fundamental to the use of the instrument, as it allows the measurement on line of the Ionic charge of a water system, and from the value obtained, decisions can be made as to the dosage required to maintain the best water quality.

4. Description of the Ion Charge Analyser.

The ION CHARGE ANALYSER has three distinct parts;

a. The body that houses the cell and probe
b. The mechanical drive
c. The electronic pack

4.1. THE BODY

The body has a removable cap, two rubber seals,a set of “O” rings, and a cell and probe set. The cell contains two electrodes between which a potential is developed due to the motion of the probe in the cell interacting with the water and suspended matter. The frequency of the alternating signal is 4 Hz, and the AC signal is sent via the signal cable to the electronics pack. To completely remove the cell from the body, the maskon plug must be unsoldered from the signal cable and the cable pulled through the length of the body. To replace the cell the reverse procedure must be followed. When replacing the cell after opening the end cap, care must be taken to ensure that the locating pin is seated correctly so as not to kink or damage the signal cable. A further consideration is the correct location of the three “o” rings before securing the cell in place, and ensuring that there is no moisture on the cell base and in the body cap. Due to the fine tolerance to which the cell and probe are machined, it is important to ensure that grit particles do not enter the cell area as this will accelerate wear.
The probe can be removed by loosening the 6 mm nut on the underside of the cam follower and unscrewing the probe and connecting rod. To replace the probe the reverse procedure is necessary. Set the depth of the probe to protrude past the end of the body, using a straight edge, to a distance of approx. 1 mm. Replace the cell and cap. Turn the cam by hand to ensure that the probe does not bottom on the cell electrode - this will cause the mechanism to jam. If the probe does bottom out, remove the cap and cell and adjust by turning the probe in one turn. Assemble and check for free operation. The overall length of the probe and adjustment shaft should measure 196 mm. This length is set at the factory but can be adjusted by loosening the nut and screwing the rod into, or out of, the plastic probe section. Ensure the locking nut is tightened if an adjustment is made.

Replacement of the cell and probe is necessary when either one or both of these parts show extreme scoring, or when the span does not exceed 7,50 charge units when it is calibrated in standard positive calibration solution.

4.2. THE DRIVE MECHANISM

The drive mechanism includes a 12 volt D.C. motor / gearbox combination, a mounting bracket and a cam and follower assembly. Mounted on a bracket is the motor and cam adjustment screws. On the sensor card (which is secured on mounting posts attached to the motor bracket), is mounted a photo interrupter which is activated by the slotted wheel at the end of the cam.
The signal derived from this mechanism is used for;

a. The logic part of the instrument which actuates the motor trip relay when the signal is less than 2 Hz.
b. The sample trigger circuit used in the signal generation.

The motor speed is adjusted automatically by the microprocessor based speed control program. The motor direction of rotation must be anticlockwise for the equipment to function correctly. This is done by reversing the polarity of the motor drive cable at the maskon plug on the mother board if necessary.

The cam is pressed onto the gearbox drive shaft and located by means of a 4 mm grub screw. The slotted detector plate has been set at the factory and should not be moved in any instance. The probe connecting rod is screwed into the bottom of the cam follower and tightened into place by a lock nut. A small amount of silicone grease can be used to lubricate the cam and follower.

4.3. THE ELECTRONICS PACK

The electronics pack is made up of the mother board and the display board. This, along with the mechanical drive section is mounted into an ABS enclosure which is splash proof, with IP 53 rating. The digital display and function keys are mounted onto the removable, front cover of the instrument. The side of the box is provided with three cable glands, for the power and two signal connections to the electronic unit. An optional extra includes an interface panel with alarm and application specific plugs for the power and signal cable connection.

Diagrams and circuit layouts are included in the appendix.

5. SPECIFICATIONS AND SAFETY NOTES

Lechintech
SCD 16*Plus*
ION CHARGE ANALYSER

TECHNICAL AND MATERIAL SPECIFICATION

POWER SUPPLY:
- ~ 115-230 VAC 50/60Hz AT 7.5VA,
- ~ 24VDC FUSE - 1A CERAMIC FUSE
- ~ A SOLID EARTH CONNECTION IS ESSENTIAL.

ALARM OUTPUT:
- ~ POTENTIAL FREE N/O OR N/C CONTACTS (JUMPER SELECTABLE) AVAILABLE WITH 1 AMP 250 VAC OR 1 AMP 24 VDC RATING.
- ~ 1. Deviation alarm – Range up to 5% above and below setpoint
- ~ 2. Output alarm – Range from 0 to 100% of output range
- ~ 3. MOTOR/ON – fail safe always on when motor runs and off when motor trips

INDICATION/OUTPUTS:
- ~ 2 LINE 16 DIGIT BACKLIGHT LCD BETWEEN
- ~ 2 OFF 4-20 mA OUTPUTS:
  1. Scaled process value dependant on span setting of the calibration solution
  2. Selectable as a retransmission of the scd value, or the scaled output value or as a % output of the process value
- ~ 1 OFF PULSED OUTPUT (e.g. 120 pulse/minute)

ADDITIONAL I/O:
- ~ 3 OFF DIGITAL INPUTS, POTENTIAL FREE, PLUS 2 OFF ANALOGUE INPUTS:
  1. HOLD: To hold output at instant value
  2. MF SEL: To enable manual forced output from the analogue 4-20mA control output.
  3. CAL: To calibrate instrument remotely
  4. EXT SP: To remotely change the setpoint externally using a 4-20mA signal
  5. MF IN: The 4-20mA signal used to force the output value when MF SEL is enabled

PROBE:
- ~ IMMERSIBLE TO DEPTH OF 120mm IN SAMPLE.
- ~ 6 TO 10 l/min SAMPLE FLOW RATE REQUIRED AT 30kPa MAX.

WETTED MATERIALS:
- ~ HDPE, PTFE, STAINLESS STEEL, NEOPRENE, ABS.

DIMENSIONS:
- ~ 320mm H x 240mm W x 100mm D.

PROTECTION:
- ~ RATED AT IP53.

DIMENSIONS:
- ~ 380mm W x 240mm D x 670mm x L

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE

MODEL SCD 16*plus*
SAFETY

MANUFACTURER:

- LECHINTECH cc REG NO. CK 88/19671/23
- P.O. BOX 6571, ZIMBALI, 4418, REPUBLIC OF SOUTH AFRICA
- TELEPHONE NO.: +27 - 32 - 9461006/ 1085
- TECHNICAL ASSISTANCE IS AVAILABLE FROM THE ABOVE OFFICE OR THE OFFICE OF THE DISTRIBUTOR.

DO NOT UNDERTAKE ANY WORK OR MAINTENANCE ON THIS EQUIPMENT IF YOU ARE NOT QUALIFIED OR TRAINED TO DO SO. USE ONLY SPECIFIED COMPONENTS TO CARRY OUT REPAIRS AND MAINTENANCE

CAUTION:

(I) The mains power point and possibly the alarm connector are supplied from voltage sources external to the instrument. Consider all terminals live until all sources of supply have been disconnected.

a) Isolate the incoming power by switching the instrument off and removing the plug from the socket.
b) With the SCD open check there is no external supply to the alarm connectors.

(ii) Before removing the securing screws and front covers from the SCD, ensure the supply has been isolated. This is necessary to ensure the rotating cam and follower are stationary and cannot start whilst working in the instrument. The rotating cam should be considered a hazard if operating without the front cover in place.

(iii) **DO NOT** allow the SCD to run in an upside down position. Possible ingress of moisture into the electronics could cause a risk of electric shock and damage to the electronics.

(iv) Only remove the front clear cover from the SCD to carry out routine instrument calibration. (Removing the cover allows for access to output connections to facilitate measurement of the mA signals for calibration purposes). Replace the cover securely before placing the instrument into service.

(v) When carrying out routine maintenance and cleaning of the SCD, adhere to all safety rules and conditions applicable to the work being carried out. Use components for replacement supplied by Lechintech only. When cleaning scale from the instrument sensor and body using the mild HCI or NaOH solutions described in the manual, strict adherence to standard safety precautions is required.

(vi) Observe the voltage rating stated above.
(vii) ENVIRONMENTAL OPERATING LIMITS:

a) Ambient temperature 0°C to 40°C.
b) Maximum humidity 90%
c) IP53 rating

(viii) To ensure that no moisture enters the cell electrode connections, the “O” rings should be changed during six monthly maintenance or if they are deformed or damaged.

6. Installation

Electrical: Connections to be made to terminals provided on the main PC board as per attached diagram of the boards.

Take care to provide a good earth connection to the unit to minimise the effect of 50Hz interference. This is normally provided with the 220V/110V input, if fed off a mains three pin connection.

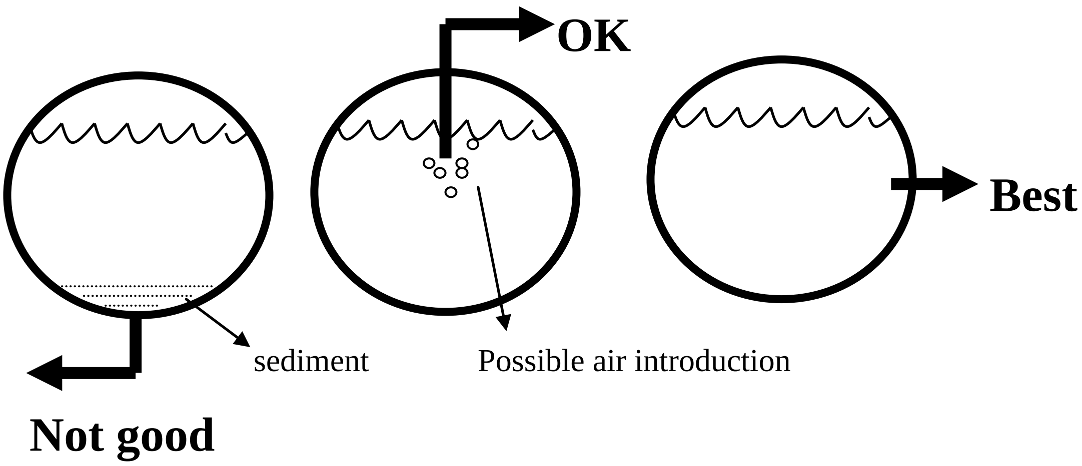
If any external devices are connected to the 4-20 mA output from the unit, e.g. recorders, controllers, the total loop resistance should not exceed 500 ohms. Also the current input circuits of any externally connected devices must be floating with respect to that of the unit's earth.

Cable entry glands are provided on the side of the box.

NOTE: **Unused glands must be plugged to maintain the splash-proof rating of the box.**

Mechanical: The rear of the box is to be used for wall mounting and the sensor cylinder for channel or sample pot mounting of the unit.

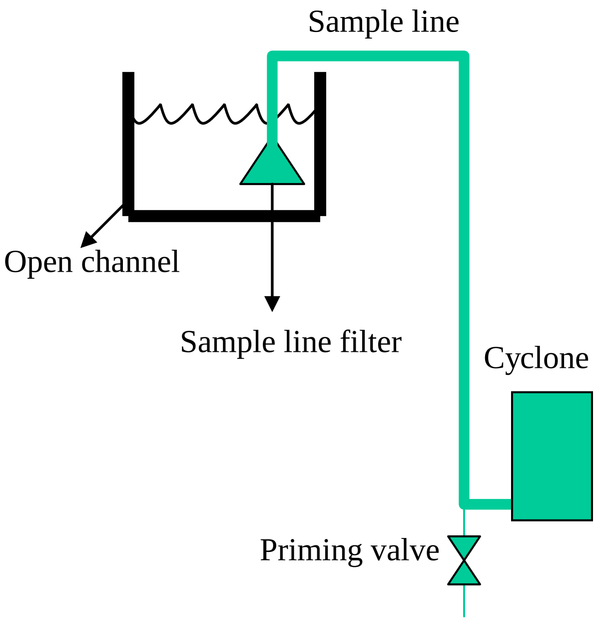
The unit can be located directly in a flowing stream for entry into a clarifier, etc., provided the stream is not contaminated with particulate matter of a solid nature, greater than 0,1 mm particle size.



NOTE: **Water with only flocculated particulate matter does not affect the probe adversely. Fibrous or sandy contaminants scratch the surface of the cell and probe, and the equipment will have to be tested first to establish reliability before using in a control loop.**

The sampling point should be as far from the dosing point as practically possible, to provide sufficient mixing time, but should not be less than 10 pipe diameters away from the dosing point, or 5 diameters after an elbow. The primary objective is to get the best possible mixing of the chemical with the raw water and the lowest possible lag time between the addition point and the measurement point.

For continuous sampling from the pipeline, it is recommended that a flow rate of between 30 and 40 l/min be drawn to a cyclone sample pot, which overflows continually. The unit should be immersed 80 mm below the liquid surface. The bottom drain on the cyclone sample pot is an advantage, and should be open to ensure a continual purge of grit and heavy particles. Should the sample be gravity fed from an open channel then the intake must have a filter to prevent debris from entering the sample line. The suction point must also be positioned far enough below the water surface to prevent the siphon flow from being interrupted when the plant is stopped. Allowance must be made to prime the sample line when utilising this option.



7. CALIBRATION AND TEST PROCEDURES

7.1 Chemical Calibration

Calibration should be carried out on a regular basis, depending upon the application, using a standard commercially available cationic polymer.

The initial laboratory calibration has been carried out before the unit has left our works, and therefore only a routine calibration check should be necessary. Every Ion Charge Analyser leaving the Lechintech factory is calibrated to give a reading of + 5.30 ICu when placed in a 100 ppm (100 mg/litre) of a standard cationic polymer X. A 100 ppm solution represents a saturated solution of the chemical as shown in Figure 9. The charge curve flattens out as the concentration of polymer is increased and a charge reading of + 5.30 ICu is recorded.

Any other cationic polymer may be used to calibrate the SCD, however its characteristic charge/chemical concentration curve will be different. It is necessary to standardise the polymer against polymer X (used in the Lechintech Laboratory) by determining the charge reading for a 100 ppm solution. This charge value can be established by comparison and the reading obtained can be used as the cationic standard for further calibrations, e.g. 100 ppm of polymer P has a standard charge of + 5.00 ICu. Should the situation arise that there is no cationic standard of known strength available to standardise a given cationic chemical, an acceptable alternative would be to make up a 100 ppm solution of the chemical and calibrate the charge analyser to read + 5.00 ICu. All readings after this will be relevant to this initial cationic standard used as the calibration agent.

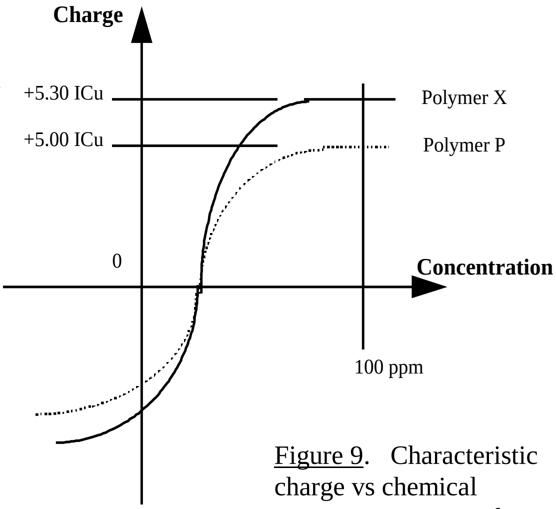


Figure 9. Characteristic charge vs chemical concentration curve for Polymer X and Polymer P

Cationic Standard: This is a 100 ppm solution of the proposed cationic polymer, made up by placing 100 mg of chemical in 1 litre of tap water.

NOTE: The solution should be allowed to stand for one hour after preparing before use, to allow the chemical to activate, otherwise unstable readings may result, due to a non-homogeneous mixture.

7.2 Calibration Procedure:

1. Rinse the Ion Charge Analyser probe out with fresh water.
2. Run the SCD in a beaker of fresh water for a short period (two to three minutes).
3. Place the SCD in a beaker of cationic standard and allow to stand for one minute.
4. Place the SCD in a fresh cationic standard and allow the SCD reading to stabilize.
5. Follow the calibration menu in appendix B to calibrate

An anionic check may be carried out using a 100 mg/l Teepol (soap/Sunlight liquid) solution. The reading should be around -4,0 to -6,0 ICu. Do not re-calibrate to achieve this reading, but merely use it to check.

The cationic standard can be made up using normal tap water. (Experience shows that tap water of high hardness around 300 ppm does interfere, and in this case distilled (not demineralised) water should be used if it is suspected that interference is a problem.)

Once an acceptable calibration check has been carried out, the unit is ready for use. Only long term drift should occur, over two to three months or longer, and frequent calibration changes should not normally be necessary. It is however, recommended that more frequent checks be carried out initially, until the drift rate has been determined for the application.

7.3 Electronic calibration of the Lechintech SCD 16*Plus*:

Requirements:

1. Multimeter to measure AC Volts, DC Volts and mV and DC mA.
2. Cationic standard solution.
3. SCD schematic diagram.

7.3.1. Board Checks

The overview in the Appendix shows detail of the board layout and should be used in conjunction with the other schematic layouts.

If any faults are found, rectify them before continuing with the next stage of the procedure.

- Check the incoming AC voltage For the 24V option check polarity.
- Check the DC voltage on the board as shown in the diagram.
- Ensure that all ribbon cables and other connectors are correctly attached to the various plug points.
- Check to see if the sensor board is correctly positioned under the slotted cam wheel.
- Ensure that the display board is securely mounted to the instrument face and that the push buttons are functional.

7.3.2. Signal Output Calibration

- Attach the two pin test plug to the CON O/P socket and SCD O/P respectively; connect it to the mA meter, set to the 300 mA range. Use the menu structure in appendix E to calibrate the 4-20mA for both control and SCD.

- Set the Deviation alarm to the desired value – Recommended ± 0.5 %
- Set the Output alarm to the desired value – Recommended 5% and 80%

7.3.3. Display Calibration

The only calibration settings available are the contrast and brightness settings for the LCD display, which are set in the workshop and need no further adjustment.

7.3.4. Motor Calibration

The no load setting of the speed control loop is set in the workshop, and no further settings are required.

- Checking the operation of the motor stall trip unit can be achieved by physically stopping the motor cam. While holding the cam stationary check that the motor trips after approximately 2 seconds.
- Reset the instrument drive by following the prompts on the LCD screen.
- Ensure that the motor is rotating in an anti-clockwise direction when viewing the drive from the cam end.

8. OPERATIONAL CHECKS

8.1 Daily checks include:

i. Purging and cleaning the cyclone sample pot and sample pot (if fitted). Select the control system to manual. Remove the SCD from the sample pot and rinse the pot by opening the drain valve and cleaning with a bottle brush. Isolate the sample pot inlet and flush the sample line with clean water by attaching a hose to the siphon valve inlet if fitted. Return the system to normal operating valve line up and check and adjust the sample pot flow rate to between 30 and 40 l/min. Replace the SCD in the sample pot, switch on the instrument, and allow the reading to settle. Return the control loop to automatic.

ii. Check the sampling indicator flashes @ 4Hz (4 flashes / second). Factory adjustment will be required if this is not the case.

8.2 Weekly checks include:

i. Checking for zero drift and chemical calibration if necessary as discussed under section 7.2 of this manual.

ii. Visual check of the drive mechanism and cell and probe.

8.3 Monthly Checks include:

i. Isolate the instrument and remove it to a stable work surface.
ii. Remove the instrument front cover and open the face.
iii. Checking the drive chain and cam and follower wear.

iii.1 Unplug the 3 way ribbon cable from the sensor board mounted on the motor assembly bracket. Loosen the 3mm cap screw and remove the sensor board.

iii.2 Check for play on the gearbox output shaft by gently moving the cam up and down. Maximum play should be movement of about 1mm at end of cam. Replace the motor / gearbox combination should the wear be excessive.

iii.3 Rotate the cam by turning on the slotted wheel. The rotation should be smooth with no tight spots. The following reasons could be the cause of tight spots in the rotation:

iii.3.1 Motor or gearbox component wear or failure - Replace the motor / gearbox unit.

iii.3.2 uneven wear of the cam or follower – Replace the cam and follower set

iii.4 Reinstate the drive mechanism to normal state. Ensure that the Cam adjustment screws are not binding on the follower. The adjustment of the runners screws is made by loosening the lock nut and adjusting the length of the screw.

9. MAINTENANCE CHECKS

a. Six monthly SCD maintenance includes a complete mechanical check and electronic and chemical calibration. All worn parts to be replaced as necessary.

9.1. Cleaning:

Cleaning of the SCD body, cell and probe in the event of scale build up which cannot be removed with a mild acid or alkaline solution.

NOTE A

1. Remove the SCD from the sample pot.
2. Remove the PROBE signal wire from the mother board.
3. Remove the body cap and remove the cell and signal wire completely.
4. Using a size 10 spanner loosen the probe connecting rod lock nut under the cam follower.
5. Unscrew the probe from the cam and remove it from the body.
6. Use a size 5,5 spanner to remove the four motor bracket securing nuts and remove the motor assembly.
7. Remove the two body securing nuts and remove the body from the instrument housing.
8. Soak the body, cap, cell and probe in the HCI/NaOH solution for a few hours depending on the nature of the scale. NOTE : THE CELL SHOULD ONLY BE SUBMERSED IN THE CLEANING SOLUTION FOR A MAXIMUM OF 10 MINUTES TO LIMIT THE EFFECT ON THE ELECTRODES AND CELL. OBSERVE THE NECESSARY SAFETY PRECAUTIONS DURING THIS PHASE OF CLEANING. DO NOT ALLOW THE END OF THE SIGNAL WIRE TO BE IMMERSED IN THE SOLUTION DURING CLEANING.
9. Wash the parts in soapy warm water with a soft scrubbing brush. Clean the body inlet port and body guide area with a bottle brush to remove any scale present in these areas.
10. Once all components are cleaned reassemble the unit in the reverse order of dismantling.
11. In the event that the cell and probe are showing signs of scoring in the measuring are between the electrodes, the cell and probe set must be changed.
12. The cell and cap “O” rings should be changed six monthly to ensure a water tight seal.

NOTE B

1. To restore the sample flow, open the isolation valve on the sample line.
2. Should the flow be inadequate back flush the sample line with fresh water.
3. The flow rate should be between 30 - 40 l/min allowing for the bottom drain valve to purge the sample pot and allow for adequate sample flow to the sensor.
4. Before restoring the SCD supply check the unit power supply is isolated.
5. Connect all cables to the SCD in accordance with the wiring diagram.
6. Reinstate the unit power supply.
7. Allow readings to settle before placing the loop in auto.

10. TROUBLE SHOOTING

SCD

PROBLEM	CAUSE	SOLUTION
L.C.D. not working	Power off	Switch power on
	Unit trip	Power down, power up
	Damaged (water?)	Call instruments department
Motor will not reset	Electronic card failure	Factory inspection required
	Motor burnt out	Call instruments department
	Gear box locked	Call instruments department
	Relay stuck	Call instruments department
SCD diminished sensitivity	Worn cell & probe	Replace cell & probe
	Motor speed low	Call instruments department

SAMPLE LINES AND POTS

PROBLEM	CAUSE	SOLUTION
SCD diminished sensitivity	Sample line / pots / filter, restricted	Back wash and clean system lines
Low flow through cyclone	Sample line / filter blocked	Back wash and clean system lines
High wear on cell and probe	Poor purge on sample pot	Clear drain lines and set correct drain flow

11. BASIC OPERATION OF THE CONTROL LOOP

To be able to operate the system correctly, we need a suitable arrangement of variables. This includes the chemical and electronic calibration of the SCD, the correct tuning constants for the loop, and the correct stroke adjustment of the dosing pump. All these factors together combine to form the stable system for the control of chemical dosing.

The pump stroke length is adjusted to ensure an adequate delivery of chemical at both low and high flows into the plant, as well as catering for the average tribidity changes that can be expected from day to day. Some operator intervention is necessary if unexpectedly low or high flows or turbidity are experienced.

To set up the control parameters, the plant must be at a steady charge value with the controller in manual. Note this charge value. Make a 10% increase in the output value. Start the stopwatch at this time. When the charge value stabilises note the charge value and the time lapsed. From these values one will be able to calculate the proportional band and note the integral time settings for the controller parameters. An example follows for easy reference.

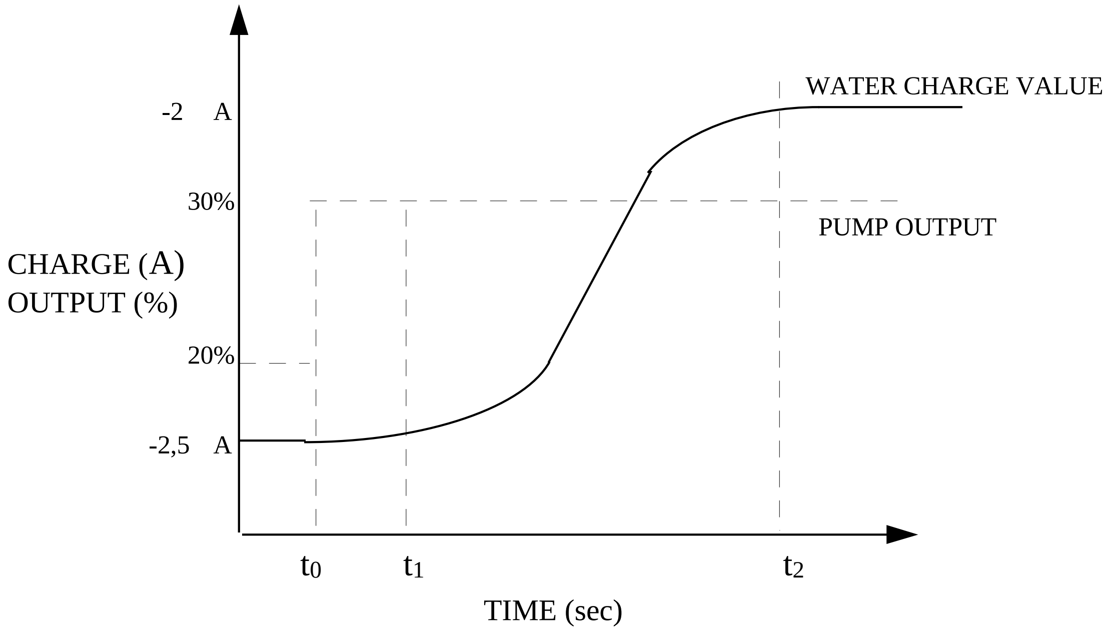


Figure 8. Dosage response curve to determine Proportional and Integral control constants.

The cause of the change in charge was a 10% increase in pump output i.e. 10% more chemical was dosed into the water. Due to the delay time to mix the chemical with the carrier water and move it through the volume to the sample pot, we observe a time lag between the output change and the beginning of the charge curve, t_0 to t_1.

We are interested in the time it takes to fully level out, i.e. t_0 to t_2, which we use as the integral time. The proportional band is calculated as follow:

$$PB = \frac{\%\ \text{effect}}{\%\ \text{cause}} \times \frac{100\%}{1}$$

To calculate the effect we see the difference between the start and the end charge is

0,5ICu. On a scale of 10 ICu, i.e. -5 ICu to +5 ICu , 0,5 ICu represents a change of 5%.

We can then calculate PB:

$$PB = \frac{5}{10} \times \frac{100\%}{1}$$

$$= 50\%$$

To slow the loop down slightly we multiply this value by 1,5 and obtain a setting of 50% x 1,5 = 75% which is used as the controller setting for PB.

Should it be required to use Gain in the calculation rather than PB.

$$GAIN = \frac{100\%}{PB}$$

Once the control parameters are set into the controller, and the dosing pump stroke has been set, the only operator action required is;

a. Change the S.P. as and when required (possible winter/summer change)
b. Ensure the sample is flowing
c. The settling and sample pots are clean
d. The pumps are operating correctly
e. Ensure the P.V. tracks the S.P.

When the initial dosage is determined by tests, either jar test or historical dosing curve, the dosing pump stroke should be set at a value so that the controller output ranges from 20 to 30%. These are ideal parameters for average quality incoming raw water. This allows for really dirty water adjustment as well as trimming back dosage for cleaner value. This will be the initial setpoint (S.P.). Adjust this S.P. by -0,2 ICu each day until the water quality starts to deteriorate, once this happens adjust S.P. by +0,2 ICu to get the actual optimum dosage. Small S.P. changes can be made on a daily basis to trim the final water quality if necessary.

12. MODEL SCD 16plus

CELL & PROBE INSTALLATION INSTRUCTIONS

REQUIREMENTS

1. No. 10 set spanner.
2. Long nose pliers.
3. Solding iron and solder.
4. Instrument screw driver.
5. Small side cutter.

CONTENTS:

1. Cell and Probe Set
2. Connecting Rod
3. Two off Securing Nuts for Connecting Rod
4. Two way Mascon Connector
5. Set of three "O" rings
6. Instruction Sheet

PROCEDURE

1. Isolate the instrument and remove the front cover.

2. Disconnect the power and signal cables from the plugs and remove the cables from the instrument. (DIAG 01)

3. Remove the instrument from the sample pot and conduct the rest of the procedure on a stable work surface.

4. Remove the signal cable from the mother board at plug J01 and cut the plug off the cable. (DIAG 01)

5. Remove the body cap from SCD and pull out cell, completely removing the signal cable from the body. (DIAG 02)

6. Holding the connecting rod with the long nose pliers, loosen the connecting rod securing nut under the cam follower. **NOTE: DO NOT SCORE THE CONNECTING ROD WITH THE PLIERS**. (DIAG 01 & 02)

7. Once loosened, remove the 6mm nut from the top of the connecting rod and withdraw the probe assembly completely from the body. Using fingers only, unscrew the probe and connecting rod from the cam follower through the access allowed with the cell removed. **NOTE: DO NOT USE PLIERS ON THE PROBE TO REMOVE IT.**

8. Install the new probe assembly in the reverse order to above, ensuring that the connecting rods seal is lubricated with light grease.

9. Screw the probe into the cam follower until 1mm of probe protrudes past the body of the instrument with the cam in the bottom dead centre position. **DO NOT TIGHTEN THE CONNECTING ROD SECURING NUT ONTO THE BASE OF THE CAM FOLLOWER AT THIS STAGE.**
   (DIAG 03)

10. Ensure the inner cell seal is in place in the body. Feed the cell signal cable up the hole in the body and push the cell home ensuring the cell locating pin seats in the locating hole in the body. Pull the signal cable through from inside the instrument housing gently when fitting the cell.

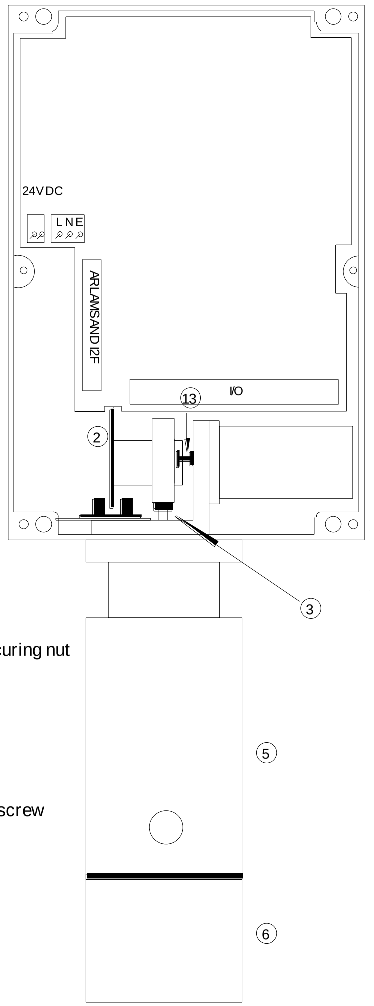
11. Replace the body cap, ensuring that the probe is in the top dead centre position and that the mechanism does not jam. Only hand tighten the cap.

12. Rotate the drive cam, using the slotted wheel, to check whether the probe is bottoming out in the cell. Rotate the probe assembly, using the connecting rod, until the probe just touches the cell bottom when the cam is at bottom dead centre. At this point back the assembly off a half turn and tighten the connecting rod securing nut against the cam follower. This setting is crucial to the correct operating of the Analyser.

13. Reconnect the power and signal cables to the plugs on the mother board.

14. Calibration of the SCD as per the standard operating procedure will be required once the SCD has been running in a tap water sample for about thirty minutes.

Diagram 1



1 = instrument casing
2 = cam assembly
3 = connecting rod securing nut
4 = connecting rod
5 = body
6 = body cap
7 = cam follower
8 = probe
9 = cell
10 = inner cell seal
11 = body seal
12 = o-rings
13 = follower adjusting screw

Diagram 2

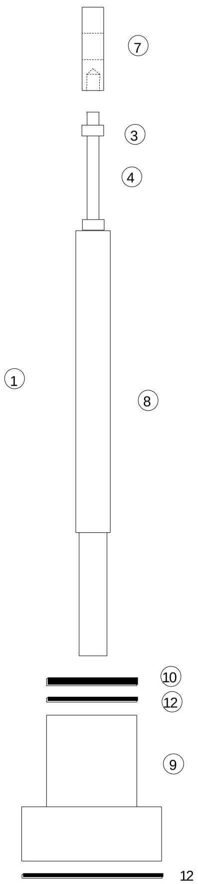
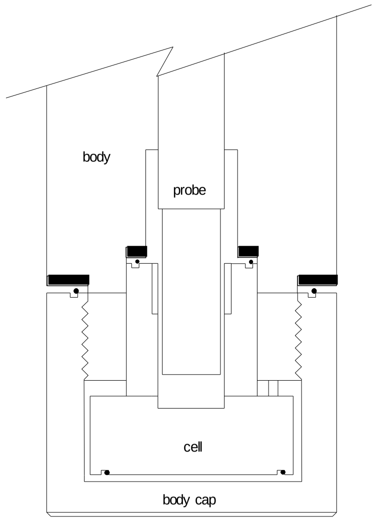


Diagram 4

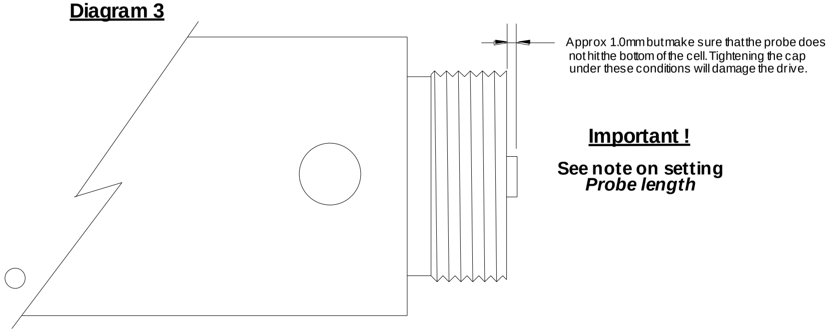


Setting the *Probe lenght*

STEPS

1 Insert probe (8) into cam follower (7) so probe does not hit cell bottom when tightening cap (6).
2 Using long-nose pliers adjust connecting rod depth downwards so that probes just touches bottom of cell, at this stage turn the connectiong rod back, upwards, one turn. (one turn is the max amount of rotation one can get with the long-nose pliers in that given amount of space between the box and motor bracket.)
3 Now turn the connecting rod back 4 turns and tighten the nut.
4 The probe position is now set. Check again that it runs freely without hitting the bottom of the cell.

Diagram 3



Important !

See note on setting *Probe length*

13. Recommended Spares

PART NO.	QUANTITY	DESCRIPTION
91020*	1	Drive Motor
91031	1	Eccentric Cam
88040*	1	Plunger Assembly
88051*	1	Cell
Plus/01	1	Main PC Board
Plus/2	1	Digital Display PC Board
Plus/3*	1	Sensor PC Board
89011*	1 pr	Rubber seals for sensor (pair)
SCD/3o*	SET	Cell “O” Rings

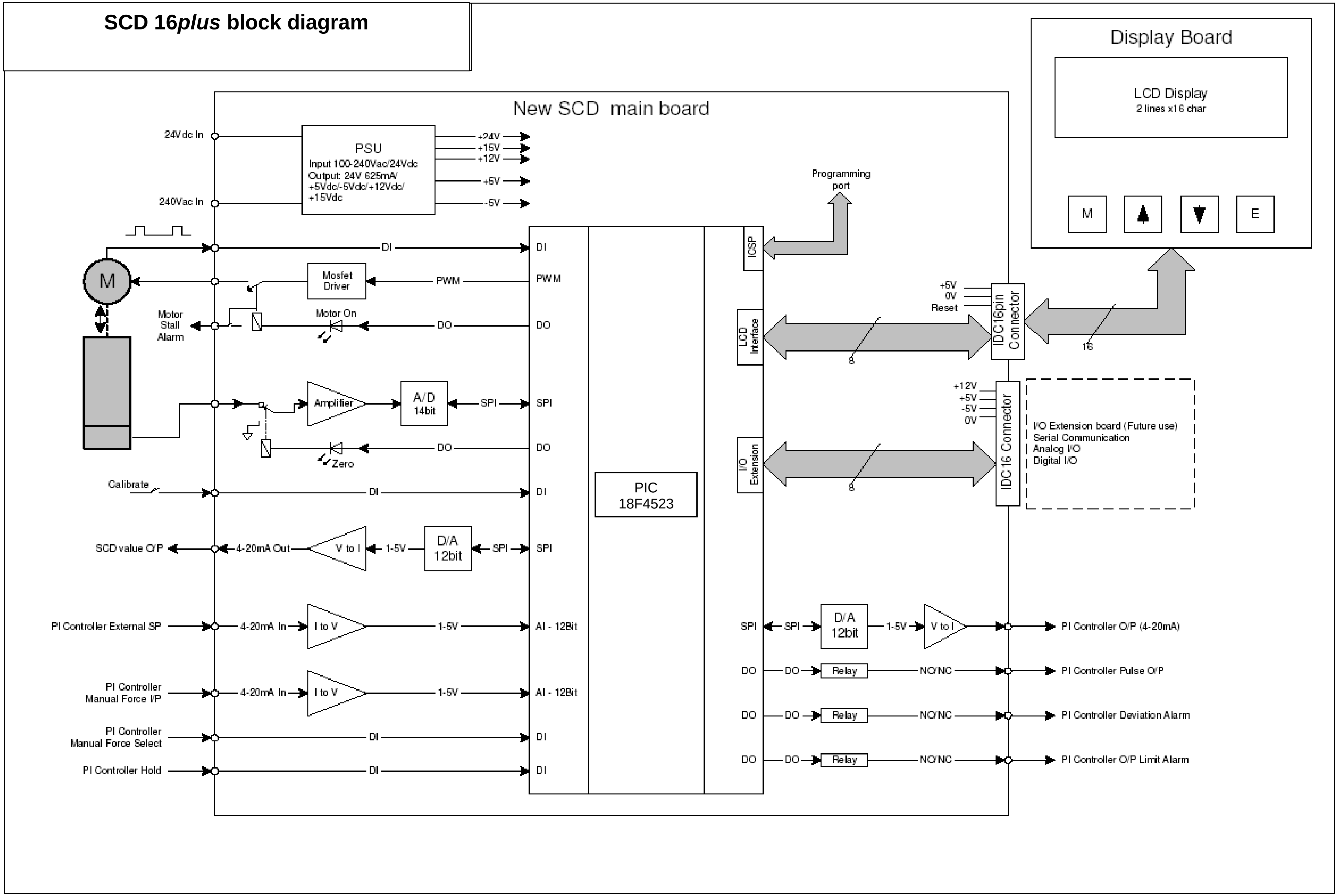
* Strongly recommended

OUR WEB SITE CONTAINS A VARIETY OF LINKED WEB PAGES, INFORMATION ON STREAMING CURRENT. PLEASE FEEL FREE TO ACCESS OUR WEB PAGE FOR FURTHER INFORMATION AND EMAIL ADVISE ON SCD APPLICATIONS. YOU WILL FIND US AT:

www.lechintech.com
lechtech@iafrica.com

manual/scd16plus.doc

APPENDIX A



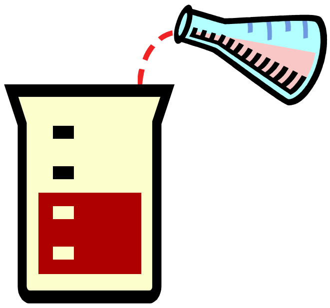
SCD 16plus block diagram
Display Board
LCD Display
2 lines x16 char
M
E
New SCD main board
24Vdc In
240Vac In
PSU
Input 100-240Vac/24Vdc
Output: 24V 625mA/
+5Vdc/-5Vdc/+12Vdc/
+15Vdc
+24V
+15V
+12V
+5V
-5V
Programming
port
ICSP
DI
M
Mosfet
Driver
PWM
Motor
Stall
Alarm
Motor On
DO
LCD
Interface
+5V
0V
Reset
IDC16pin
Connector
8
16
Amplifier
A/D
14bit
SPI
+12V
+5V
-5V
0V
IDC 16 Connector
I/O Extension board (Future use)
Serial Communication
Analog I/O
Digital I/O
I/O
Extension
Zero
Calibrate
PIC
18F4523
SCD value O/P
4-20mA Out
V to I
1-5V
D/A
12bit
PI Controller External SP
4-20mA In
I to V
AI - 12Bit
PI Controller O/P (4-20mA)
Relay
NO/NC
PI Controller Pulse O/P
PI Controller
Manual Force I/P
PI Controller Deviation Alarm
PI Controller
Manual Force Select
PI Controller O/P Limit Alarm
PI Controller Hold

LECHINTECH SCD 16Plus CALIBRATION

1

Add 1ml Cationic Standard to 1litre of distilled water and mix well for 2 to 3 minutes

2



Now add 100ml of the solution to 900ml of distilled water and mix well. Allow the solution to stand for one hour before calibrating the SCD.

3

Rinse the SCD in tap water prior to immersing in the first beaker of calibration solution (500ml)

4

- Allow the SCD reading to stabilise in the calibration solution.
- Replace the 500ml of solution with a fresh 500ml of 100 ppm cationic calibration solution.
- Allow the SCD reading to stabilise, and using the menu prompts, calibrate the instrument.
- Rinse the SCD in fresh water once the calibration routine has been completed and reinstate it in the plant.

We keep you in charge!!!

Lechintech
ION CHARGE ANALYSERS

1 MENU

SCD 0.00ICu *
>ConO/P 0.0% AI

2 **Press** ⬆ **5 times**

3

SCD 0.00ICu *
>CALIBRATE SCD?

ENTER

4 The SCD automatically sets the ZERO and GAIN values as per the screens below.

zSCD 0.00ICu *
#Cal SCD ZERO 99

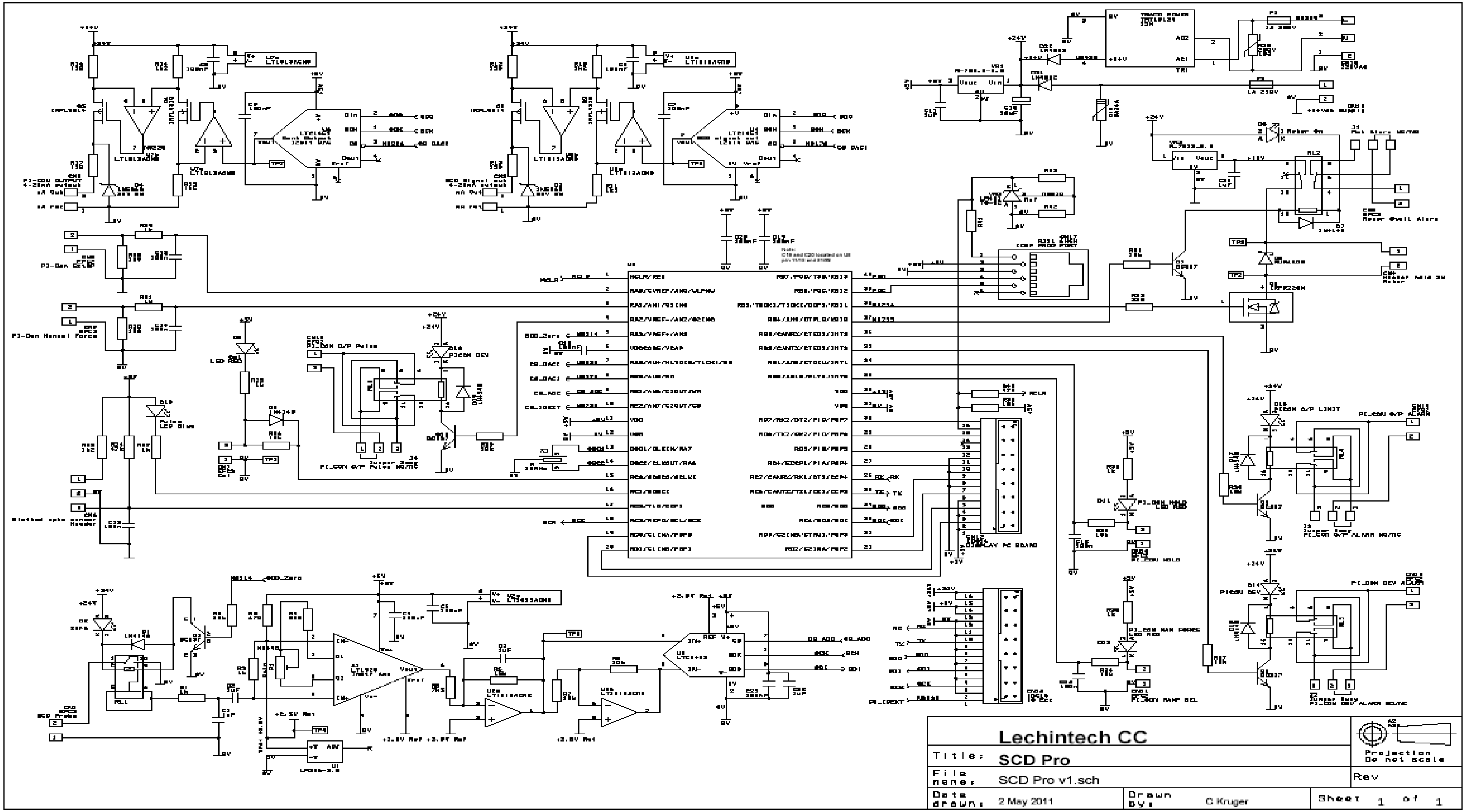
THEN

zSCD 0.00ICu *
#Cal SCD GAIN 99

5 The calibration is complete when the screen displays the following:

SCD 5.30ICu *
>ConO/P 0.0% AI

APPENDIX C

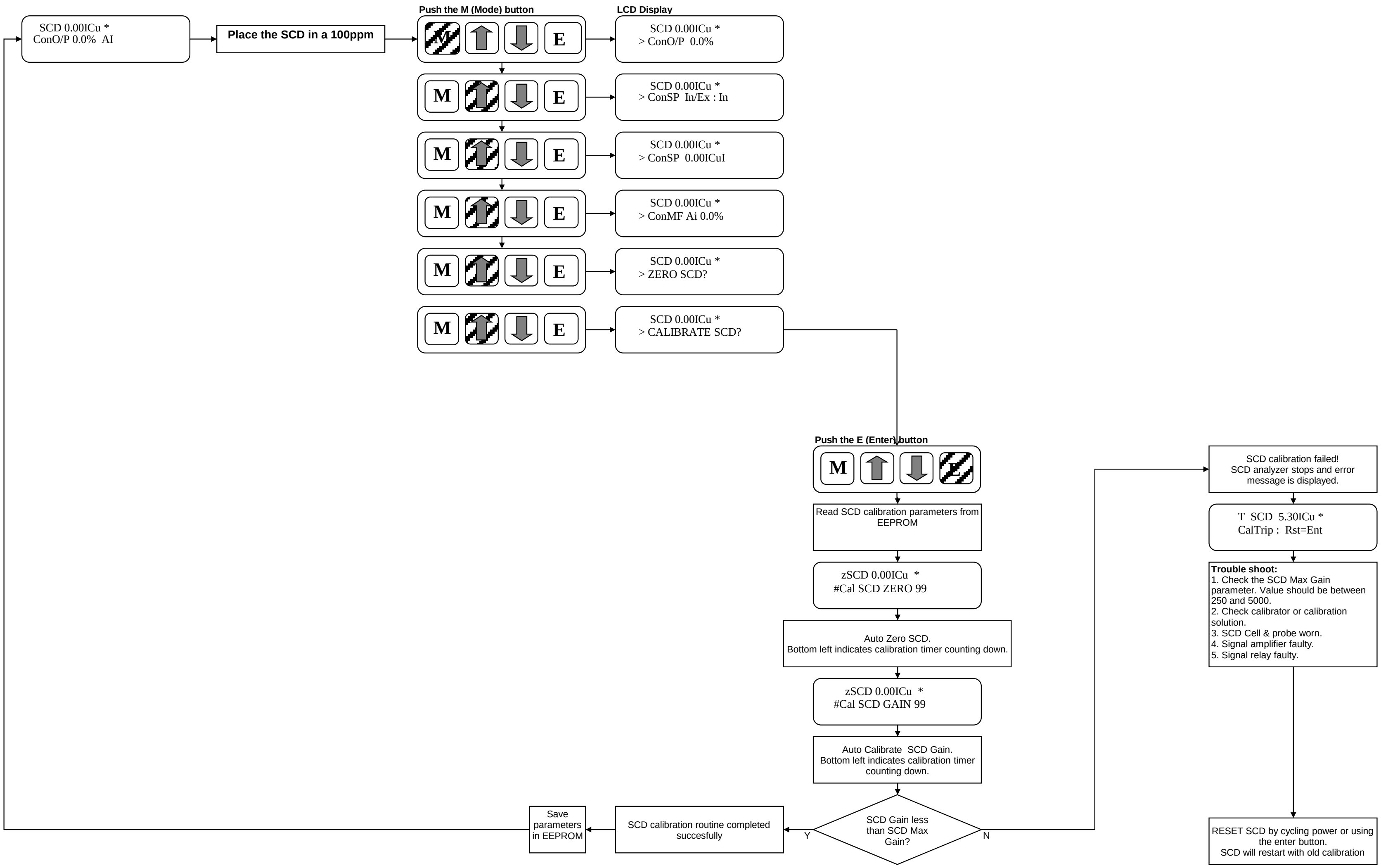

Lechintech CC
Title: SCD Pro
File name: SCD Pro v1.sch
Date drawn: 2 May 2011
Drawn by: C Kruger
Sheet 1 of 1
Rev
Projection Do not scale

APPENDIX D

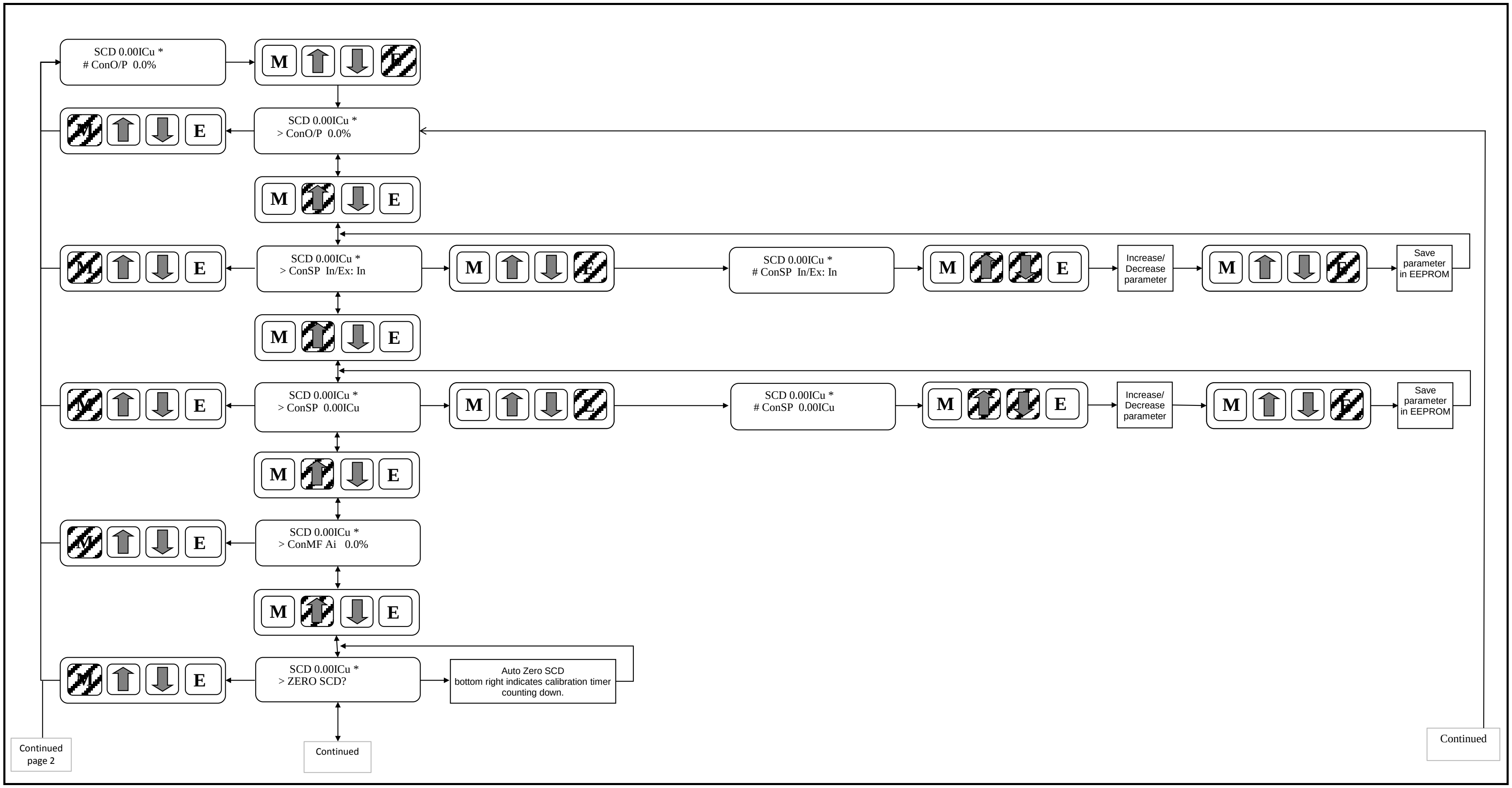
Menu name	Menu#	Display text	Enter Text	Description	Default value	
PINent	1	>PIN REQUIRED	#Enter PIN: 0000	Prompts for pin entry when PIN is enabled and PIN timeout has not expired. If PIN is entered incorrectly the massage "Incorrect PIN" is displayed. If PIN is entered correctly , the next Menu item is displayed - ">Con Mode:Manual" Use Inc key to to increase selected digit value and use Dec key to select next digit.	5000	
ConAM	2	>Con Mode:Manual	#Con Mode:Manual	Change PI Controller operating mode: Select between Manual and Auto	Manual	
ConOP	3	>ConO/P 0.0% MI	#ConO/P 0.0% MI	Change PI Controller Output when in Manual mode	N/A	
ConEX	4	>ConSP In/Ex: In	#ConSP In/Ex: In	Select between Internal and External PI Controller setpoint	Internal	
ConSP	5	>ConSP 5.00ICuI	#ConSP 5.00ICuI	Change PI Controller setpoint when in Internal setpoint mode	2.5	Icu
ConMF	6	>ConMF Ai 0.0%	*Display only*	Displays the value of the PI Controller manual force mA input	N/A	
ZeroSCD	7	>ZERO SCD?	#Cal SCD Zero 92	Performs SCD zero calibration. Once selected the display show the value of the calibration timer counting down.	N/A	
CalSCD	8	>CALIBRATE SCD?	#Cal SCD Zero 92	Performs a two part SCD calibration. Zero cal first followed by the range calibration.	N/A	
			#Cal SCD Gain 92			
SpdCon	9	>SpdCon 240 1000	*Display only*	Displays the speed and output of the motor controller - Speed in rpm on the left and the output (0 to 1000) on the right.	N/A	
Setup	10	>SetupMenuBlockd	#Ent AccCode0110	Prompts for Access coder entry. If ACC code is entered incorrectly the massage "Incorrect Code" is displayed. If ACC code is entered correctly , the next Menu item is displayed - ">PI Con Setup" Use Inc key to to increase selected digit value and use Dec key to select next digit.	0110	
ConGroup	11	>PI Con Setup	goto menu number 20	Press Enter Key to Access the PI Controller setup menu		
SCDGroup	12	>SCD setup Menu	goto menu number 40	Press Enter Key to Access the SCDsetup menu		
mAcal	13	>mA I/O calib.	goto menu number 60	Press Enter Key to Access the mA I/O signal calibration menu		
Security	14	>Security setup	goto menu number 80	Press Enter Key to Access the Security setup menu		
ConGroup						
ConPB	20	>ConP/Band 1000%	#ConP/Band 1000%	Sets the PI Controller proportional band in %	1000	%
ConIt	21	>ConI/Tm 100s/r	#ConI/Tm 100s/r	Sets the PI Controller Integral time in seconds per repeat	100	s/r
ConOPAL	22	>ConOpAlLo 10.0%	#ConOpAlLo 10.0%	Sets the PI Controller output low alarm level in percent	90	%
ConOPAH	23	>ConOpAlHi 90.0%	#ConOpAlHi 90.0%	Sets the PI Controller output hi alarm level in percent	10	%
ConDA	24	>ConDevAl0.10ICu	#ConDevAl0.10ICu	Sets the PI Controller deviation alarm (Setpoint - PV) in Icu	0.1	Icu
ConFS	25	>ConF/S OP 0.0%	#ConF/S OP 0.0%	Sets the PI Controller fail safe output in %	0	%
ConMin	26	>Con MinOP 0.0%	#Con MinOP 0.0%	Sets the PI Controller minimum output	0	%
I2Fr	27	>I2Frate 120ppm	#I2Frate 120ppm	Sets the I to F converter output rate in pulses per minute	120	ppm
I2Fe	28	>I2F O/P:Enabled	#I2F O/P:Enabled	Enables or disables the I to F pulse output	Enabled	
SCDGroup						
SConSP	40	>SpdConSP 240rpm	#SpdConSP 240rpm	Sets the motor speed controller setpoint in rpm	240	rpm
SConG	41	>SpdConGain 5.00	#SpdConGain 5.00	Sets the motor speed controller gain	5	
SConIt	42	>SpdConIntT 5.0	#SpdConIntT 5.0	Sets the motor speed controller integral time in seconds per repeat	5	s/r
SConAH	43	>SdConOPAH100.0%	#SdConOPAH100.0%	Sets the motor speed controller output hi alarm in %	99	%
SCDofs	44	>SCDoffset -82	#SCDoffset -82	Displays and allows adjustment of the SCD signal zero offset. This value is added to the filtered A/D converter number and is determined during the SCD zero calibration. The SCD zero calibration is performed every time on startup or on demand from the menu (Menu 7) or during a SCD calibration. It may also be adjusted manually to zero the SCD signal with this parameter.	8	

SCDgain	45	>SCD Gain 801	#SCD Gain 801	Displays and allows adjustment of the SCD signal gain value. This value is used in the formula SCDval = (ACD_A - SCDoffset) * SCD gain / 10000. Where as SCD_A is the filtered A/D converter value of the SCD signal. The SCD gain is determined during the SCD calibration routine. It may also be adjusted manually with this parameter.	676	
SCDmaxg	46	>SCDMaxGain9999	#SCDMaxGain9999	Sets the maximum allowed SCD gain. If a gain value greater than the Max gain parameter is calculated during the SCD calibration routine, the SCD will trip and the Calibration Fail message will be displayed.	9999	
SCDurv	47	>SCDurv 5.00ICu	#SCDurv 5.00ICu	Sets the upper range value of the SCD signal that corresponds to a 20mA SCD signal output.	5.00	Icu
SCDftc	48	>SCD FilterTC 10	#SCD FilterTC 10	Sets the SCD filter time constant	10	seconds
Cref	49	>CalRef 5.00ICu	#CalRef 5.00ICu	Sets the calibration reference.	5.00	Icu
CalTm	50	>Calib Time 100	#Calib Time 100	Sets the Calibration time	100	(250mA cycles)
StallTm	51	>Stall Time 5	#Stall Time 5	Sets the stall detection time	5	(250mA cycles)
mAcal						
mAlim	60	>mAO/Plim 0.20mA	#mAO/Plim 0.20mA	Sets the mA output over/under limit. Eg. 0.20mA means the that the mA outputs will be limited at 20.2mA maximum and 3.8mA minimum.	0.20	mA
SCD04	61	>CalSCD 4mA? 803	#CalSCD 4mA? 804	Calibrates the SCD mA output minimum output (4mA). The number displayed is the value of the 12bit D/A conveter. Procedure: Connect a mA meter to the SCD mA signal output and adjust the number to obtain 4.00mA on the multimeter. Press enter to save the value. Carry out the 20mA calibration and then repeat the 4mA calibration check.	803	
SCD20	62	>CalSCD20mA?4015	#CalSCD20mA?4016	As above but for the SCD maximum output (20mA)	4015	
Con04	63	>CalCON 4mA? 811	#CalCON 4mA? 812	As per 61 above but for the PI Controller output minimum (4mA)	811	
Con20	64	>CalCon20mA?4047	#CalCon20mA?4048	As per 62 above but for the PI Controller output maximum (20mA)	4047	
ExSP04	65	>ExSP Min: -5.00	#ExSP Min: -5.01	Displays the value of the External SP mA input and allows the zero adjustment of the value. The Inc and Dec keys functions are reversed when adjusting this parameter. Procedure: Connect a 4mA source to the External SP input and use the Inc Dec keys to set the displayed value equal to -SCDurv. Press enter to save.	786	
ExSP20	66	>ExSP Max: 5.00	#ExSP Max: 5.01	Same as above but adjustment of the maximum input value. Procedure: Apply 20mA to the External SP input and use Inc/Dec keys to obtain a displayed value of SCDurv.	3932	
MF04	67	>MF AI Min: 0.0	#MF AI Min: 0.1	Same as 65 above but for the Manual force mA input.	786	
MF20	68	>MF AI Max:100.0	#MF AI Max:100.1	Same as 66 above but for the Manual force mA input	3932	
Security						
PINtm	80	>PINtimeout 300s	#PINtimeout 300s	Sets the PIN timeout value in seconds. Only active if the PIN is enabled (parameter 82). The timer starts when the menu is at zero level and will reset if the menu is re-entered before the timer has expired.	300	s
ACCtm	81	>ACCtimeout 300s	#ACCtimeout 300s	As above but sets the Access permission timeout in seconds.	300	s
PINe	82	>PIN: Disabled	#PIN: Disabled	Enables or disables the PIN code requirement.	Disabled	
PINc	83	>Change PINcode?	#Ent OldPIN:5000	Changes the active PIN code. When selected, you will be prompted to enter the old PIN code and if correct will prompt for the new PIN code to be entered (menu 84)	n/a	
PINn	84	>NewPIN Accepted	#Ent NEWPIN:4000	This menu step is only accessable from menu 83.	n/a	

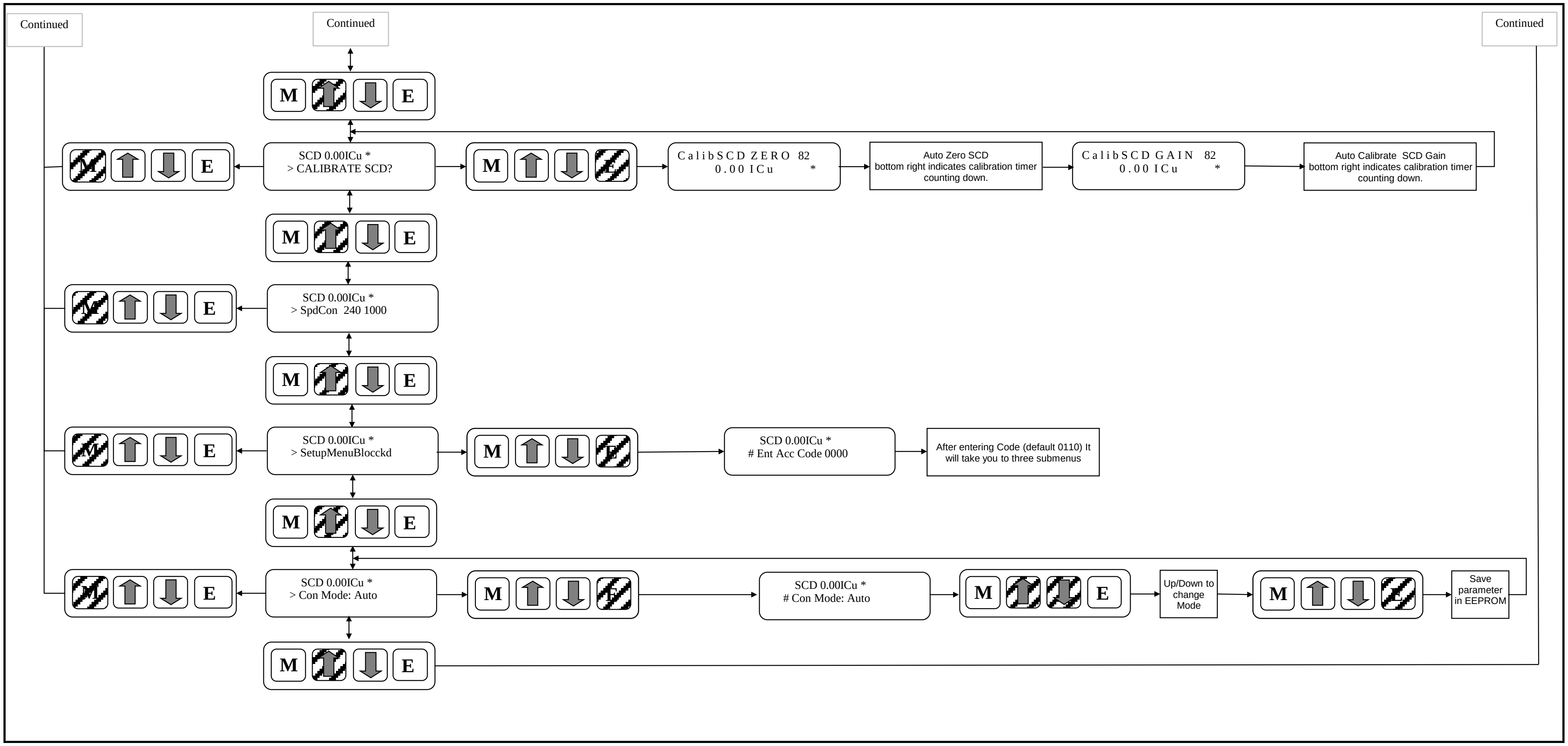
SCD AUTO CALIBRATION FLOWCHART



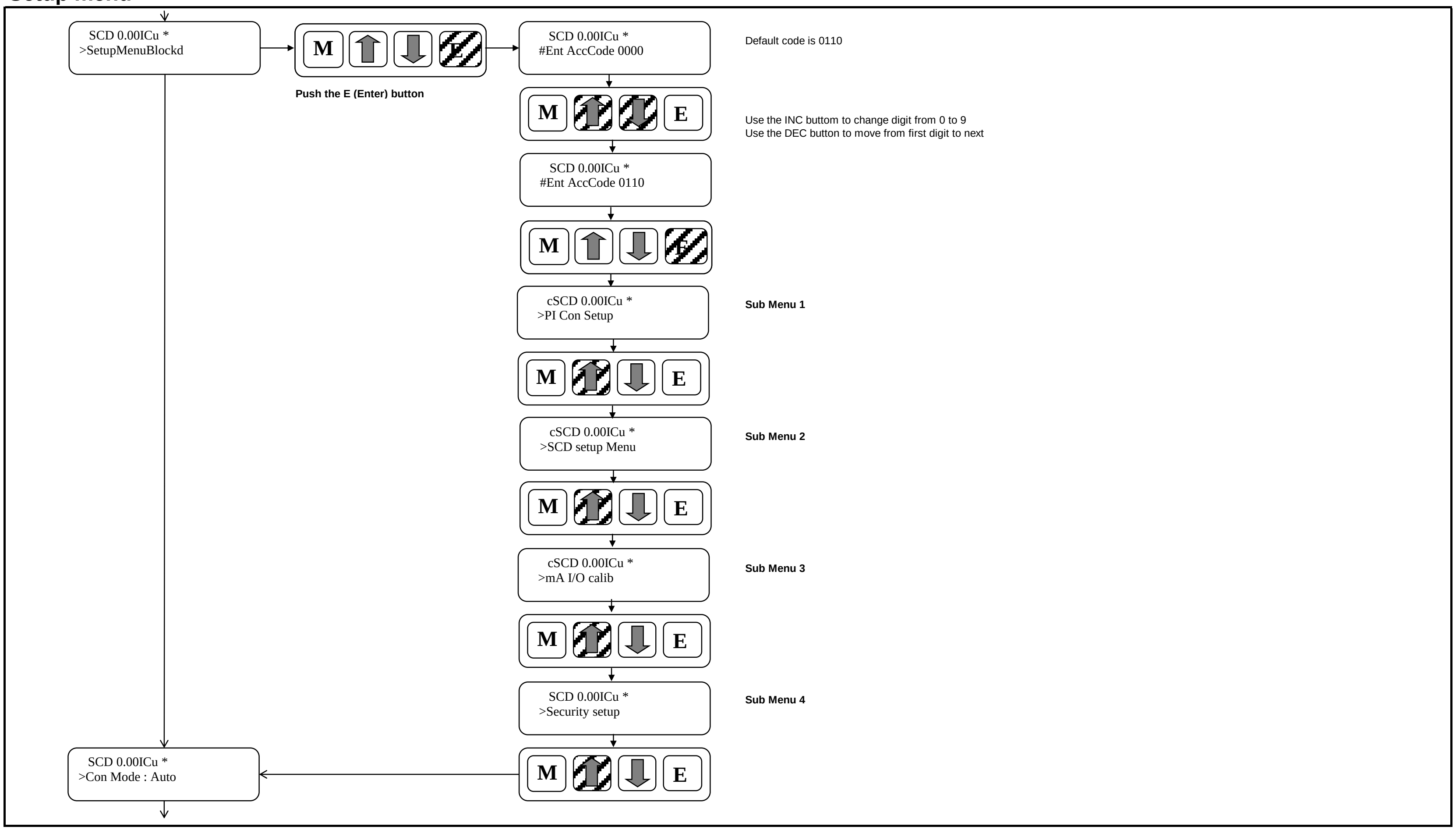
MENU NAVIGATION FLOWCHART



MENU NAVIGATION FLOWCHART CONTINUED

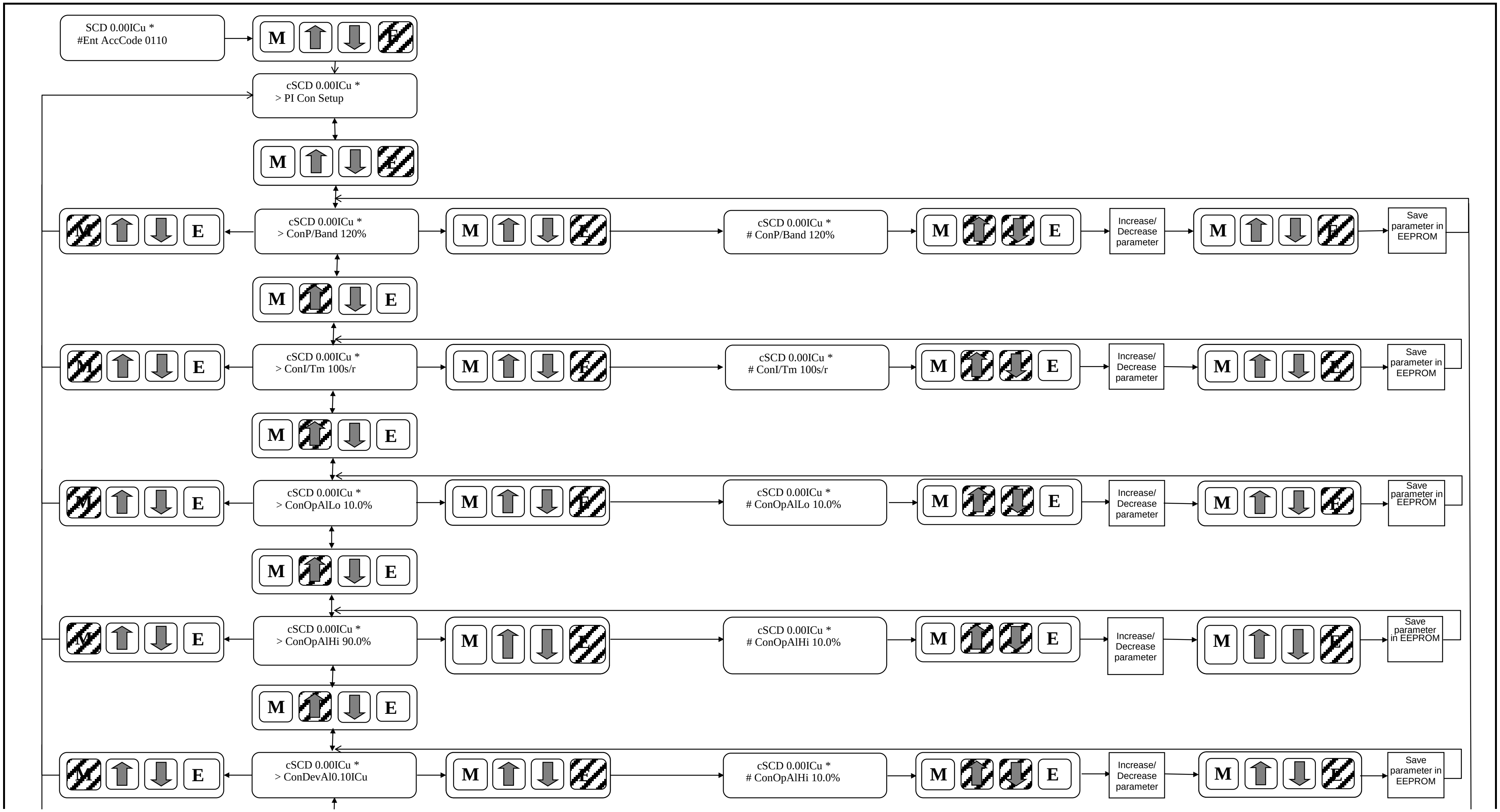


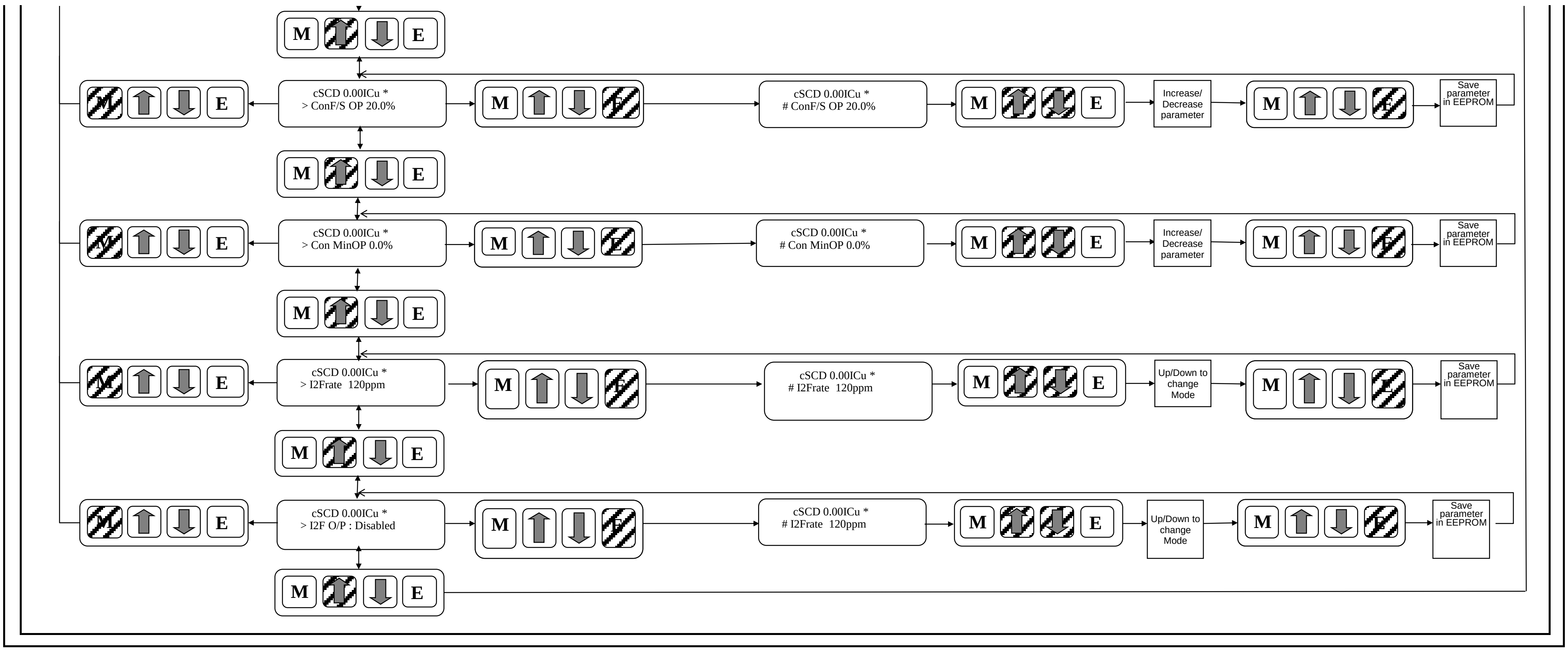
Setup menu



SCD 0.00ICu *
>SetupMenuBlockd
M
E
Push the E (Enter) button
SCD 0.00ICu *
#Ent AccCode 0000
Default code is 0110
Use the INC buttom to change digit from 0 to 9
Use the DEC button to move from first digit to next
SCD 0.00ICu *
#Ent AccCode 0110
cSCD 0.00ICu *
>PI Con Setup
Sub Menu 1
cSCD 0.00ICu *
>SCD setup Menu
Sub Menu 2
cSCD 0.00ICu *
>mA I/O calib
Sub Menu 3
SCD 0.00ICu *
>Security setup
Sub Menu 4
SCD 0.00ICu *
>Con Mode : Auto

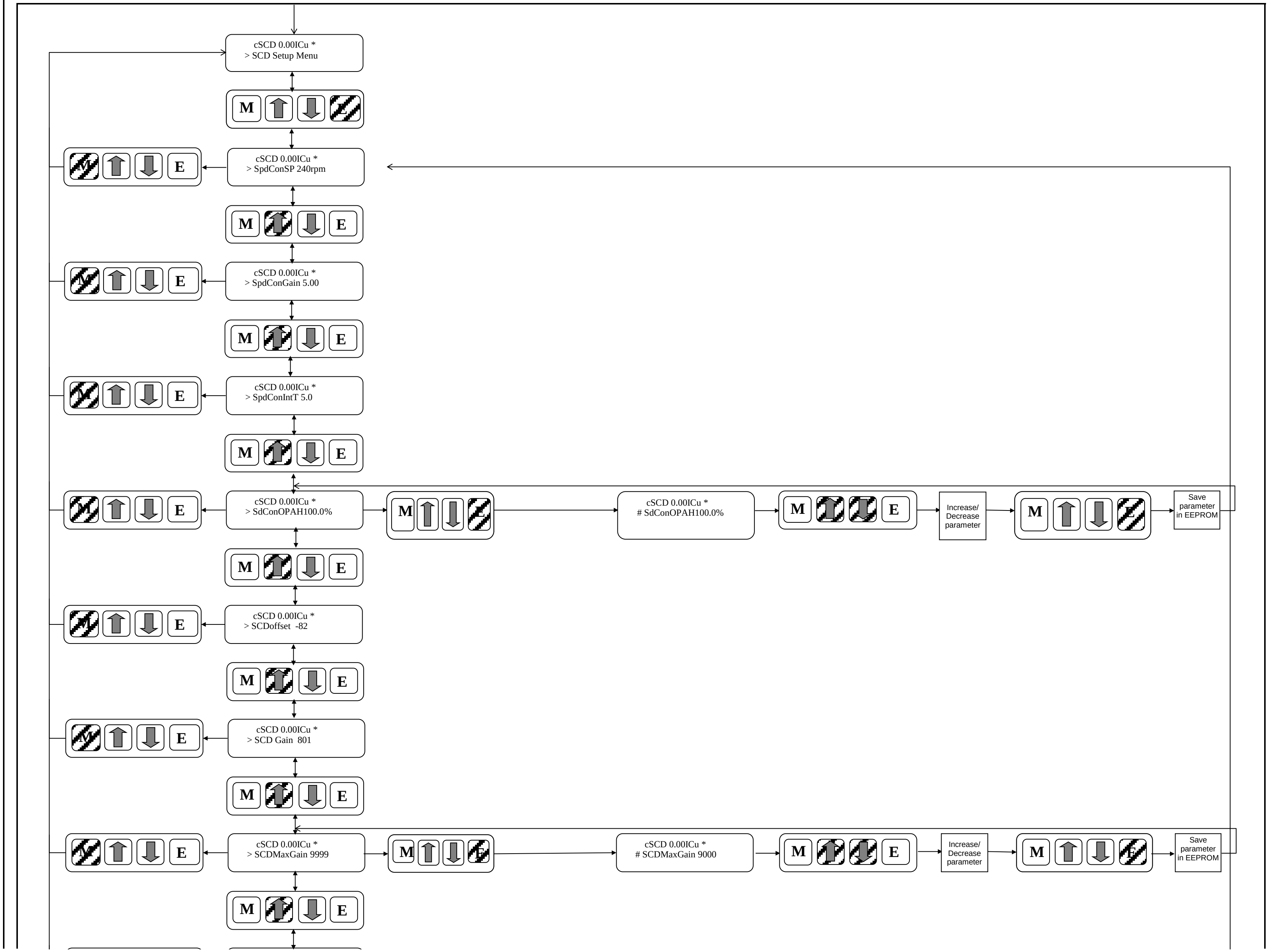
SUB MENU 1


SCD 0.00ICu *
#Ent AccCode 0110
cSCD 0.00ICu *
> PI Con Setup
cSCD 0.00ICu *
> ConP/Band 120%
cSCD 0.00ICu *
ConP/Band 120%
cSCD 0.00ICu *
> ConI/Tm 100s/r
cSCD 0.00ICu *
ConI/Tm 100s/r
cSCD 0.00ICu *
> ConOpAlLo 10.0%
cSCD 0.00ICu *
ConOpAlLo 10.0%
cSCD 0.00ICu *
> ConOpAlHi 90.0%
cSCD 0.00ICu *
ConOpAlHi 10.0%
cSCD 0.00ICu *
> ConDevAl0.10ICu
cSCD 0.00ICu *
ConOpAlHi 10.0%
Increase/ Decrease parameter
Save parameter in EEPROM
M
E



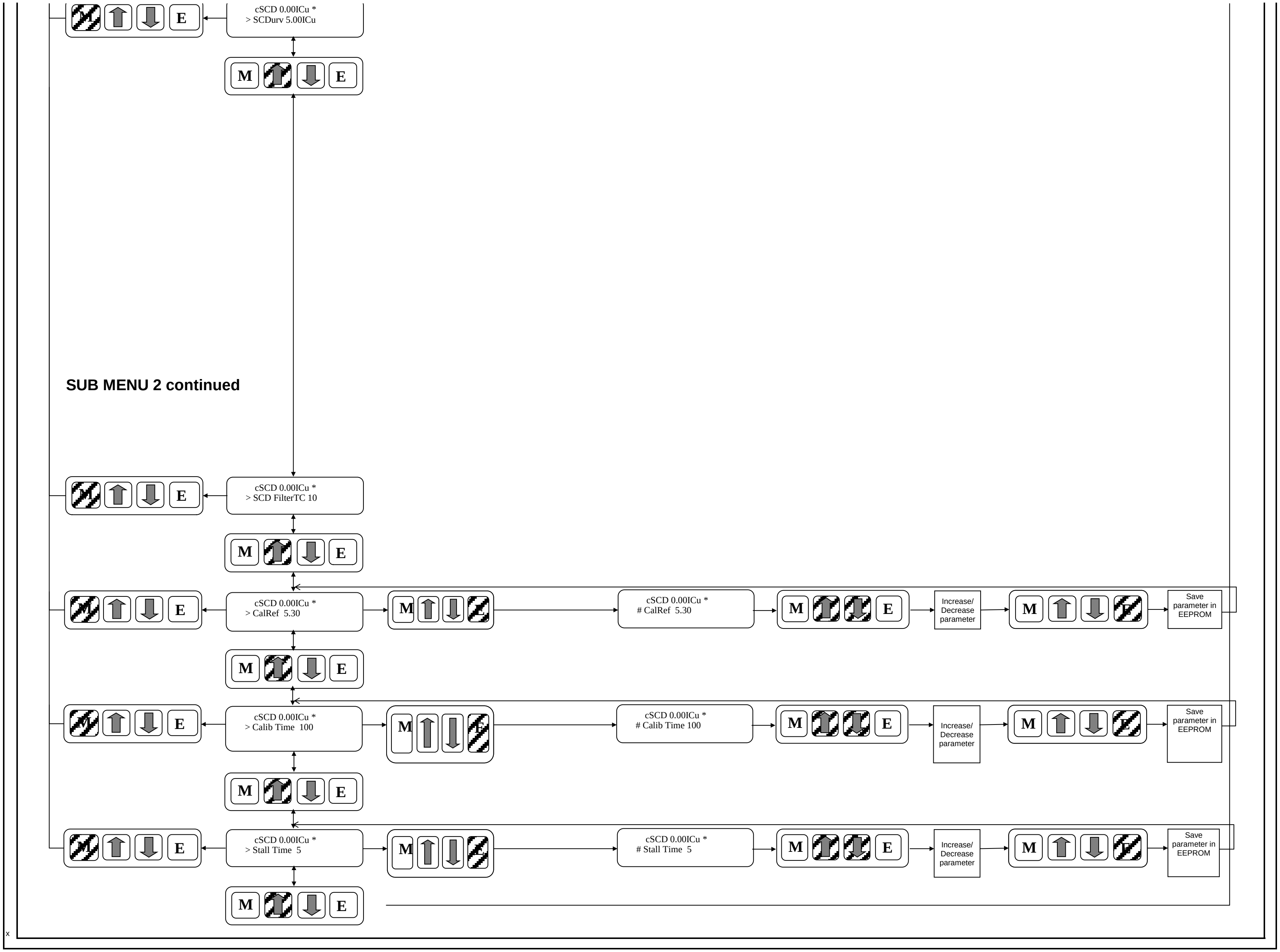
cSCD 0.00ICu *
> ConF/S OP 20.0%
cSCD 0.00ICu *
ConF/S OP 20.0%
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> Con MinOP 0.0%
cSCD 0.00ICu *
Con MinOP 0.0%
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> I2Frate 120ppm
cSCD 0.00ICu *
I2Frate 120ppm
Up/Down to change Mode
Save parameter in EEPROM
cSCD 0.00ICu *
> I2F O/P : Disabled
cSCD 0.00ICu *
I2Frate 120ppm
Up/Down to change Mode
Save parameter in EEPROM

SUB MENU 2

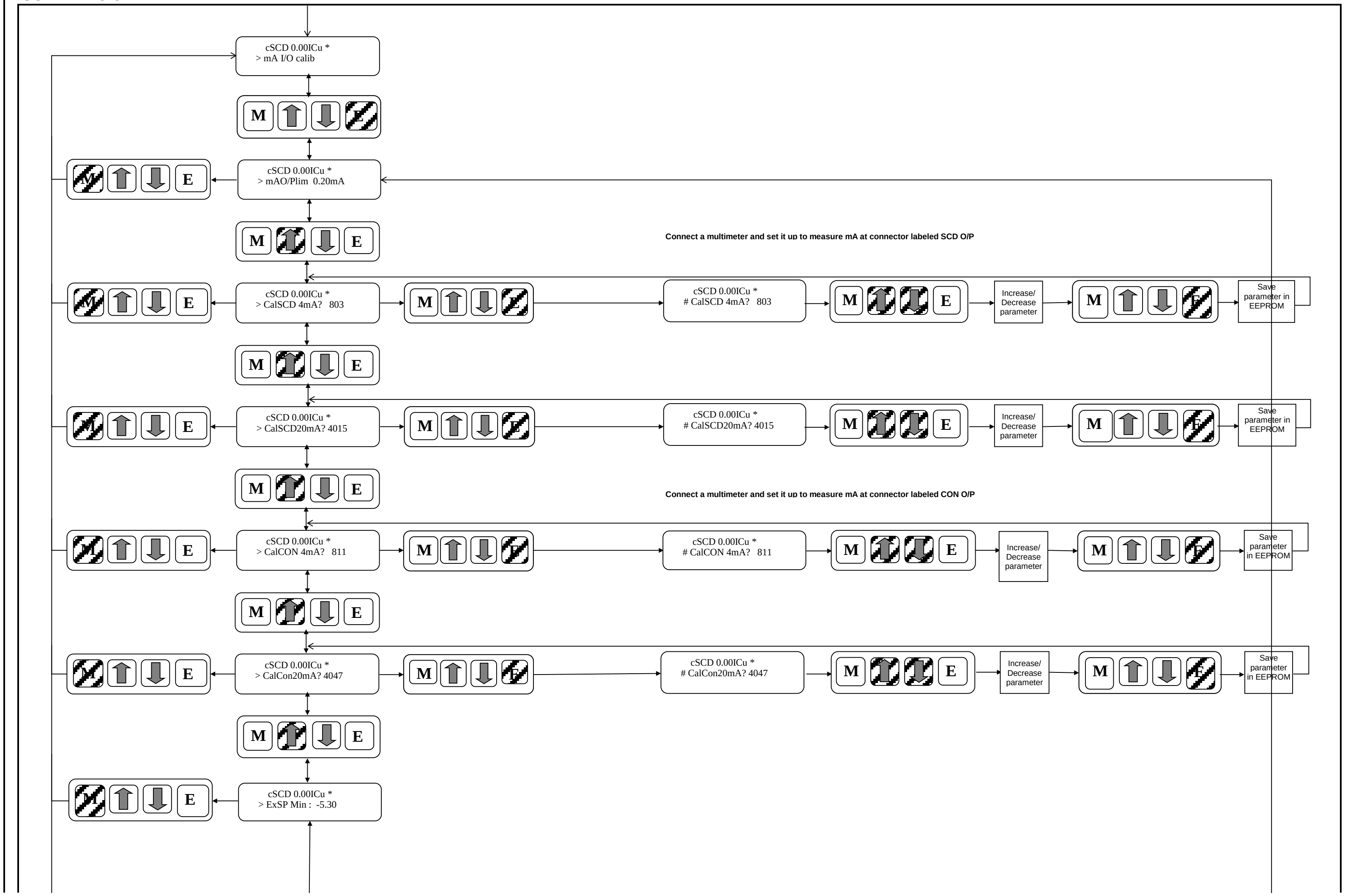


cSCD 0.00ICu *
> SCD Setup Menu
cSCD 0.00ICu *
> SpdConSP 240rpm
cSCD 0.00ICu *
> SpdConGain 5.00
cSCD 0.00ICu *
> SpdConIntT 5.0
cSCD 0.00ICu *
> SdConOPAH100.0%
cSCD 0.00ICu *
SdConOPAH100.0%
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> SCDoffset -82
cSCD 0.00ICu *
> SCD Gain 801
cSCD 0.00ICu *
> SCDMaxGain 9999
cSCD 0.00ICu *
SCDMaxGain 9000
Increase/ Decrease parameter
Save parameter in EEPROM
M
E

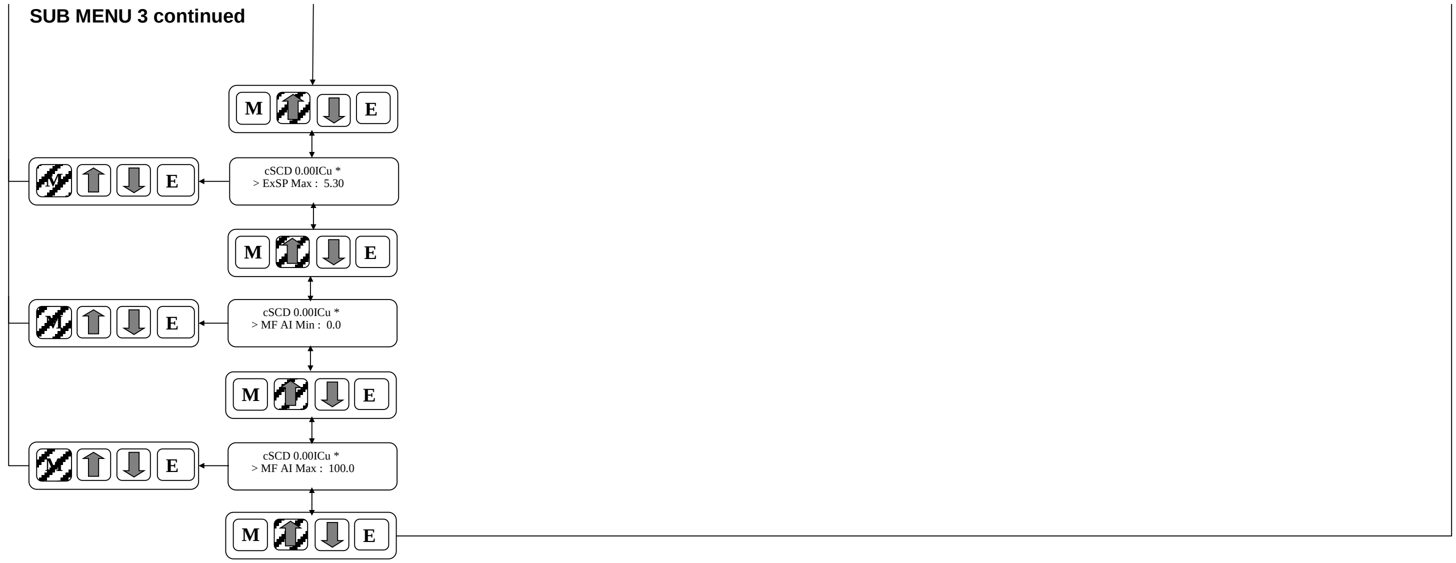
SUB MENU 2 continued



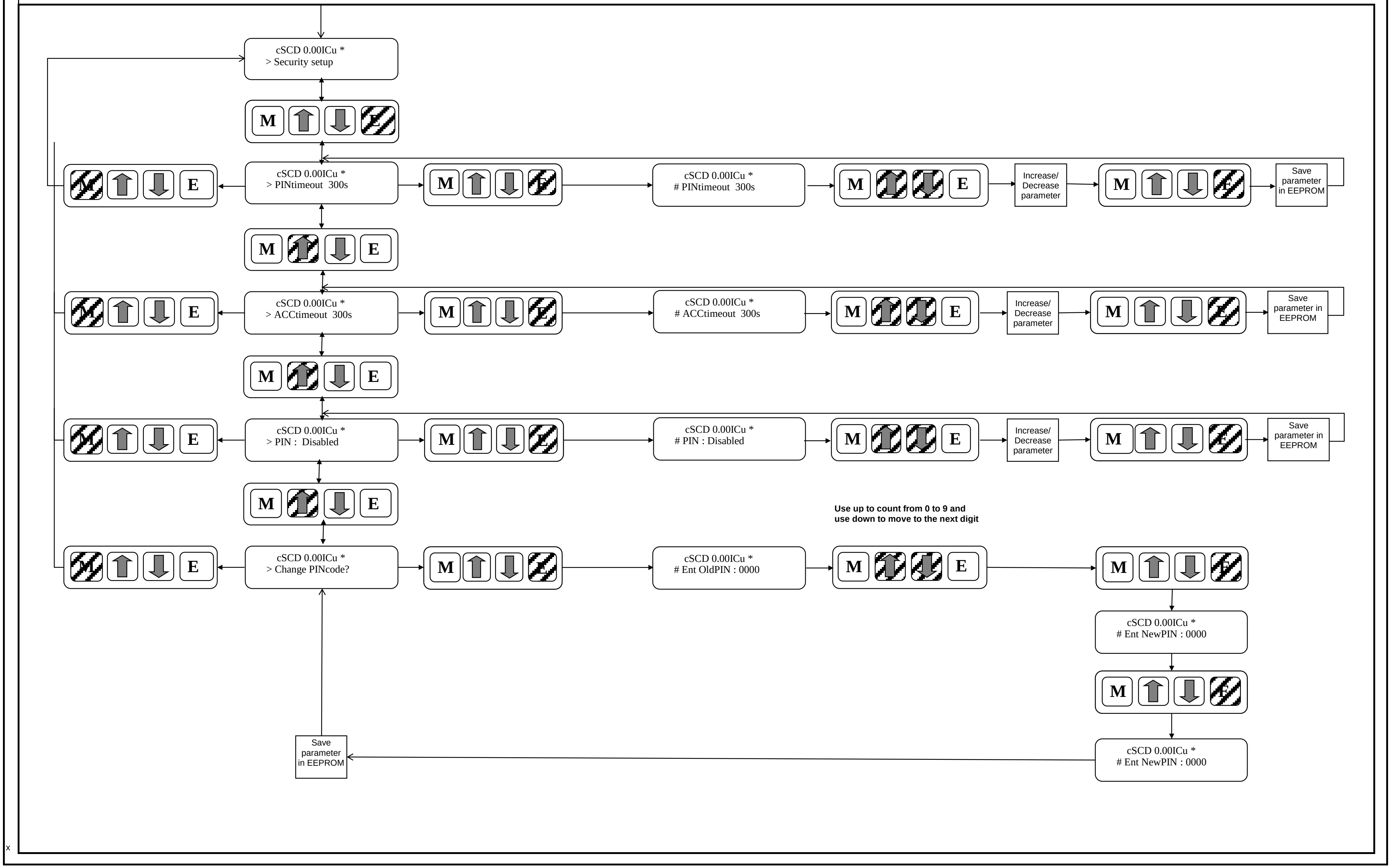
SUB MENU 3


cSCD 0.00ICu *
> mA I/O calib
cSCD 0.00ICu *
> mAO/Plim 0.20mA
Connect a multimeter and set it up to measure mA at connector labeled SCD O/P
cSCD 0.00ICu *
> CalSCD 4mA? 803
cSCD 0.00ICu *
CalSCD 4mA? 803
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> CalSCD20mA? 4015
cSCD 0.00ICu *
CalSCD20mA? 4015
Increase/ Decrease parameter
Save parameter in EEPROM
Connect a multimeter and set it up to measure mA at connector labeled CON O/P
cSCD 0.00ICu *
> CalCON 4mA? 811
cSCD 0.00ICu *
CalCON 4mA? 811
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> CalCon20mA? 4047
cSCD 0.00ICu *
CalCon20mA? 4047
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> ExSP Min : -5.30

SUB MENU 3 continued



SUB MENU 4



cSCD 0.00ICu *
> Security setup
cSCD 0.00ICu *
> PINtimeout 300s
cSCD 0.00ICu *
PINtimeout 300s
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> ACCtimeout 300s
cSCD 0.00ICu *
ACCtimeout 300s
Increase/ Decrease parameter
Save parameter in EEPROM
cSCD 0.00ICu *
> PIN : Disabled
cSCD 0.00ICu *
PIN : Disabled
Increase/ Decrease parameter
Save parameter in EEPROM
Use up to count from 0 to 9 and use down to move to the next digit
cSCD 0.00ICu *
> Change PINcode?
cSCD 0.00ICu *
Ent OldPIN : 0000
cSCD 0.00ICu *
Ent NewPIN : 0000
cSCD 0.00ICu *
Ent NewPIN : 0000
Save parameter in EEPROM

Lechintech c.c.

Reg. No. CK 88/19671/23

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TEST CERTIFICATE

LECHINTECH SCD 16Plus

Instrument

Test date	
Serial number	
Chip type/code protect	
Calibration constant set	
Zero set	
Span set	
4-20mA zero set	
4-20mA span set	
Output range set	
Motor speed control set	

Packaging

Box and foam	
Manual and test certificate	
Calibration standard	

Test conducted by:______________________________

BCP/bcp/C:\QA Sheets\SCD16PLUS