

Installation, Operation and Maintenance Instructions



N4X-G30HZ- 115/230 (RE) CONTROL

ERIEZ WORLD HEADQUARTERS: 2200 ASBURY ROAD, ERIE, PA 16506-1402 U.S.A.
WORLD AUTHORITY IN SEPARATION TECHNOLOGIES

Introduction

This manual details the proper steps for installing, operating and maintaining the N4X-G30Hz-115/230 (RE) Controls.

Careful attention to these requirements will assure the most efficient and dependable performance of this equipment.

If there are any questions or comments about the manual, please call Eriez at 814-835-6000 for assistance.



WARNING

This control is capable of variable output voltage over a wide range of frequencies. This model should only be run at the factory set frequency. If modification in output frequency is needed we suggest that the user contact Eriez first. After switching unit off, some components may still be charged due to capacitance. Wait at least five (5) minutes before opening the cover to allow capacitors to discharge.

Table of Contents

N4X-G30Hz-115/230 (RE)

GENERAL	4
INSTALLATION	4
SETUP.....	4
FAULT INDICATIONS.....	5
SPARE PARTS LIST	6
OPERATING INSTRUCTIONS.....	6
Control Elements	6
Commissioning	6
Putting the Equipment into Operation.....	7
Setting Instructions	8
Tuning the Feed System.....	8
Displays	11
Error Messages/Error Reset.....	12
Current Limiting	13
ACCELEROMETER TECHNICAL DESCRIPTION	14



General

Eriez N4X-G30Hz (re) -115/230 control is a 30 Hz variable voltage control. A front panel display and keypad make set-up and operation an easy task. This control can be used for manual or set point control. Other features include; amplitude regulation. Nema 4X and IP 66 ratings are met by the control housing. Control of the vibratory feeder is accomplished by using sinusoidal waveform impulses (modulated). This method results in quiet operation. The control can be used for 115 or 230 VAC input without making a parameter change.

Technical Data

Description	G30Hz (re)
Input Voltage	115/230 V 50/60 Hz
Output voltage	0-110 or 0-220 VAC
Output current	15.0 A max.
Soft start	0 .. .4 sec.
Sensor supply	24 V, 25Ma
Switch on time delay	0 ... 10 sec.
Switch off time delay	0 ... 10 sec.
Empty time	30 ... 180 sec.
Set point source	Keys/ 0 ... 10 V, 0(4) ... 20mA DC
Enable	12-24 V, DC/ Switch
Status relay	Form "C" 250V, 1 A

Installation

Mounting

The control module in a corrosion resistant Nema 4X enclosure, which provides suitable protection for windblown dust and hose directed water. The control enclosure is not suitable for high pressure washdown. It is designed for vertical mounting on a wall or other structure. Refer to drawing 3N-9921369 for mounting dimensions. The mounting site should be relatively free of vibration or steps should be taken to isolate the unit.

Wiring

Refer to wiring diagram 3N-9921369 for connections. The installation of a fused safety switch or branch circuit breaker ahead of the controller is recommended.

Connections

Input Cable 120/230 VAC supply voltage
Output Cable Output - Eriez feeder

Setup

Using the six buttons and the LED display located on a touch plate on the front panel sets up this unit. The feeder throughput adjustment and setting of other parameters can be carried out by using these components. The control can also be operated by external means, such as potentiometers and signal sources. The parameters can be change by scrolling through the menu, which is accessed by a user password. The various functions within the menu are identified with capital letter for ease of recognition. Enable and fault contacts are located inside the control enclosure along with other user connection points. The output power is shown in percent (%), on the LED display, during normal operation. In the programming mode the dimensions are entered according to the setting instructions, see 3N-9921369. Changed settings are saved when leaving programming mode or after a 100 second delay from when the last key was pressed.



Adjustments

- Soft start ramp up time 0, 1 ... 4 Sec.
- Soft stop ramp down time 0, 1 ... 4 Sec.
- Maximum control limit (Umax)
- Minimum control (Umin)
- Changeover for using an external set point source 0 ... 10VDC (or Potentiometer)/ 0 ... 20mA, 4 ... 20mA
- Switch on time delay (for track control)
- Switch off time delay (for track control)
- Invert sensor function
- Empty time delay, if the material sensor does not see product
- Return to factory settings

Parameter Adjustment Procedure

1. Amplitude adjustment
 - Press the programming Mode key (P)
 - Observe a "C 000" in the display
 - Using Cursor keys select "C 002"
 - Press P key, observe "A 000"
 - Now an amplitude setting in percent can be entered Press P key to return controller to normal operation
2. Other feeder values
 - Press P key, using cursor key move to "C 096"
 - Press P key to select required parameter
 - "A 000" = Amplitude (Feeder) [%]
 - "P 000" = Maximum control limit [%], adjustable 20 ... 100%
 - "r 000" = Soft start time
 - "L 000" = Soft stop time [sec.], operates when unit switched off by track sensor
 - Press P key to return to programming mode
3. Set source and Output waveform
 - Press P key, using cursor key move to "C 003"
 - Press P key to select required parameter
 - "E.S.P." = external set point, 0 for keys, 1 for external
 - If 1 is selected control will operate with potentiometer. If remote potentiometer is

used SET Amplitude "A" to 0%. Bias upward by raising amplitude level.

- If 1 is selected press P key and select "4.20 0"
 - Select 1 for set point values 0 ... 10 v, dc or 0 ... 20mA
 - Select 0 for set point values 4 ... 20mA DC
 - Press P key to select "SP.2 0" for track control mode
 - And "SP.2 1" for dual set point operation
 - Output waveform is factory set and should not be adjusted
 - Please consult Eriez for more information concerning Track Control
4. Return to saved settings
 - Press P key, using cursor key move to "C 21 0"
 - Press P key to select required parameter
 - "FAC" = factory settings, using cursor key select "SAFE" (loads factory settings)
 - Press P key to observe "USPA", using cursor key select "SAFE" (return to user parameters)
 - Press P key to return to normal operating model
 5. Storing user parameters
 - Press P key, using cursor key move to "C 143"
 - Press P key to select required parameter
 - "PUSH" = save parameters, using cursor key select "SAFE" (parameters are saved)
 - Press P key to return to normal operating model
 6. When a "OFF" is displayed and will not clear
 1. Go to code "003" and select EN= 1
 2. If control is wired for remote the remote switch should be closed or a jumper placed between term's 5 & 6 (user enable)

Fault Indications

Pressing the P key or switching the unit off and on again clears faults.

- "Error OL" Overload, excessive output current
- "Error Ou" Excessive input voltage, high input voltage
- "Error SE" Sensor time-out. No components detected at sensor

In case another error messages occur, the unit should be checked by Eriez personnel.

Spare Parts List

Eriez 30 Hz control

Model N4X-G30Hz (RE)-115/230

Style 9921369

Description	Part No.	Quantity
Power Control Module	439313	1

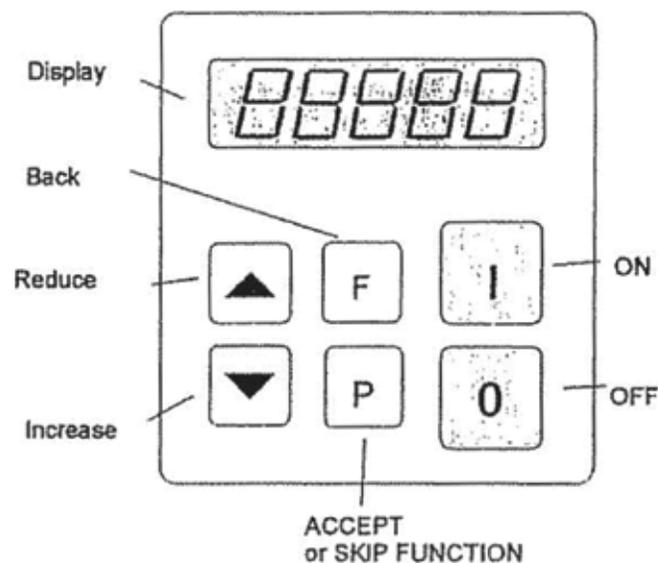
Operating Instructions

Control Elements

Settings

The six buttons and a LED display found in the front panel, are used for operating and setting up the unit. All operating methods and adjustable parameters can be set up through this panel. The "I" and "O" buttons are used for switching the unit ON and OFF, however, **these do not provide mains isolation**, they simply inhibit the power semiconductors.

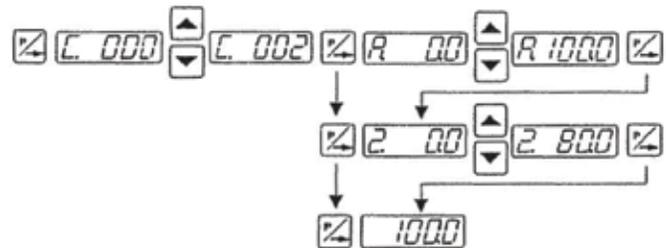
The "P", "F" and "Cursor Buttons" are used for parameter adjustment. Parameters are set by using menu controls which are called up by entering operator codes. The functions are described in greater detail in the section on setting instructions.



The display value can be increased or decreased by units, or tenths of units, by a short press of the cursor buttons. Holding the buttons down will cause the display to change in units of ten. To prevent accidental or unauthorized adjustment the adjustment parameters, in the user menus, are protected A code must be entered to open the user menu There are different pass codes for each function group.

Setting adjustments are automatically saved upon leaving the programming mode or if no button is pressed for a period of 100 seconds.

All setting routines are commenced by pressing the programming button "P". The following diagram should clarify the sequence in which keys are pressed:



1. Press the "P" key
2. Select the code number with the cursor keys.
3. Press the "P" key. This displays the first menu point The required menu point can be found by repeatedly pressing the "P" key (scrolling).
4. The value in the menu point can be changed with the cursor keys
5. Scroll to the next menu point or to the end of the menu, which returns the display to the set point value, by pressing the "P" key. To exit the menu and return back to the normal display, quickly, depress the "P" key for 5 seconds.
6. To return back to the previous position in the menu, press the "F" key



Commissioning

Preliminary Steps

- Check that the unit is correct for the local mains supply (rating plate information) and correctly rated for the feed system
- Connect the controller according to the connection diagram, 3N-9921369



Important Points:

Using the control units described in this document, it is possible to adjust the feed system so that it runs at resonance. In this condition it is possible to obtain excessive output for a very low set point setting. Therefore extreme care should be taken to avoid causing damage to the drive coil, through hammering.

In practice it is not possible to run at resonant frequency without accelerometer feedback because the system would be unstable and uncontrollable. The system must be set safely off resonance i.e. either above or below the natural frequency.

Resonant frequency: Depending on the spring and mass design of the feeder system, it is possible to have resonance at more than one frequency. These additional resonance points are multiples of the main frequency. For this reason in critical situations it is possible that the automatic frequency search will not find true resonance and in such cases the natural frequency must be determined manually.

Operating Frequency of the Feeder Coil

It is possible that the current flowing through the coil will increase for a small frequency adjustment. This should be checked with a true RMS instrument for each new application as well as monitoring the coil for heat build-up.

The coil should be designed for the correct operating frequency to prevent excessive current draw and the consequential overloading of the coil.

Measurement of the Output Voltage and Current

The voltage and current cannot be measured with a regular instrument because the controller output uses an electronic inverter with a pulse width

modulation signal. An effective measuring instrument such as a moving iron meter (analog) must be used. It is recommended that an analog instrument is used rather than an electronic multi-meter which will give a misleading reading.

Putting the Equipment into Operation

1. Establish the vibrating frequency
2. Establish the power of the feed system (maximum permissible current draw)

For a new feeder where settings are unknown: (see also comments below)

Without connecting the feeder, select parameter FAC in menu C210 (reset factory settings), press the cursor key to reset (SAFE) and press the P key to leave the menu. The factory settings are listed in the table in section 7, headed settings.

NOTE: It is possible that a special parameter set, for a machine manufacturer, has been pre-stored under a user code and these can be recalled. In such instances specific machine settings will be loaded and so the next steps are not relevant.

Basic settings:

- Connect feeder
- Set frequency (refer to feeder data sheet). Menu C096 parameter F
- Check current limit (refer to feeder data sheet) Menu C040 parameter I (shows the current limit as a percentage of maximum). If applicable use service menu for setting.
- Increase set point, observe feeder, check running
- Increase set point to maximum and check if power needs limiting (hammering). If necessary adjust the limit as follows:
- Adjust set point to zero
- Set parameter P (maximum limit) in Menu C096 to 50
- Adjust set point A to 100%
- Increase the maximum limit P from 50% until the required amplitude is reached
- The full set point range of 0 ... 100% can now be used

Additional settings e.g. soft start, time delays etc. can be set to suit the particular equipment.

Determining the output frequency (vibrating frequency)

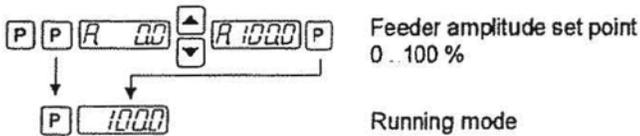
It is essential that the output frequency is adjusted with the set point set at a low frequency, otherwise on hitting the resonant frequency it is possible to achieve a high amplitude with a low output voltage. An analog, effective value, current indicating unit (moving iron meter) must be connected into the output circuit. **Resonant is reached when there is a maximum amplitude for a minimum output current.**

To achieve a stable reed system there must be an offset between the vibrating frequency and resonance (approx. 1.2Hz). This offset must be determined by the user because different feeders have different running characteristics.

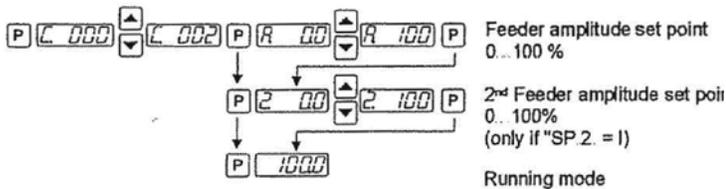
Setting Instructions

User Adjustment of Throughput

Code C. 000



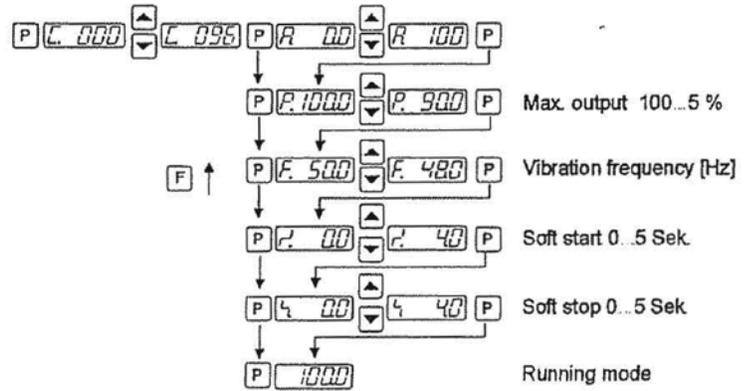
A further set point code can be found under C002 (for use in coarse/fine operation).



Tuning the Feed System

Feeder settings

Code C 020, 096

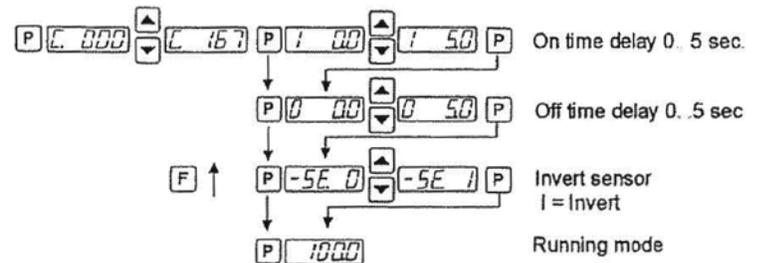


Setting the maximum limit

1. Adjust set point to zero
2. Set parameter P (maximum limit) to 50
3. Adjust set point to 100%
4. Increase the limit P from 50% until the required amplitude is reached 5 The full set point range of 0.. 100% can now be used

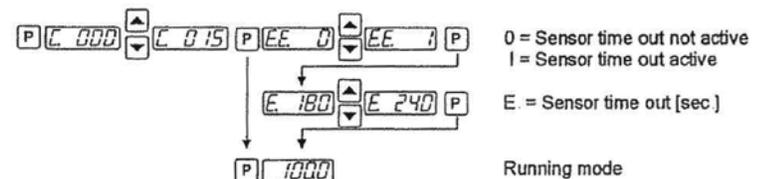
Track Control

Code C 007, 167



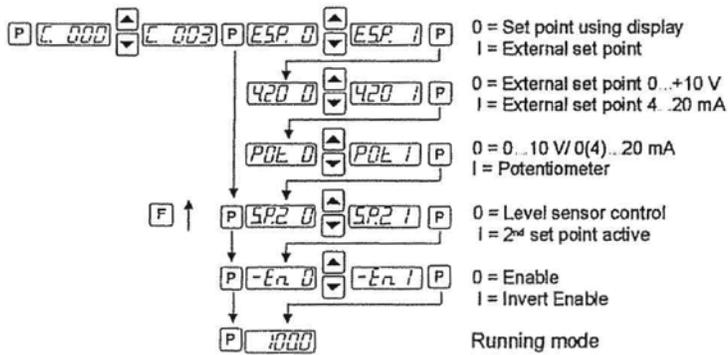
Sensor Time Out

Code C. 015



Set Point Source

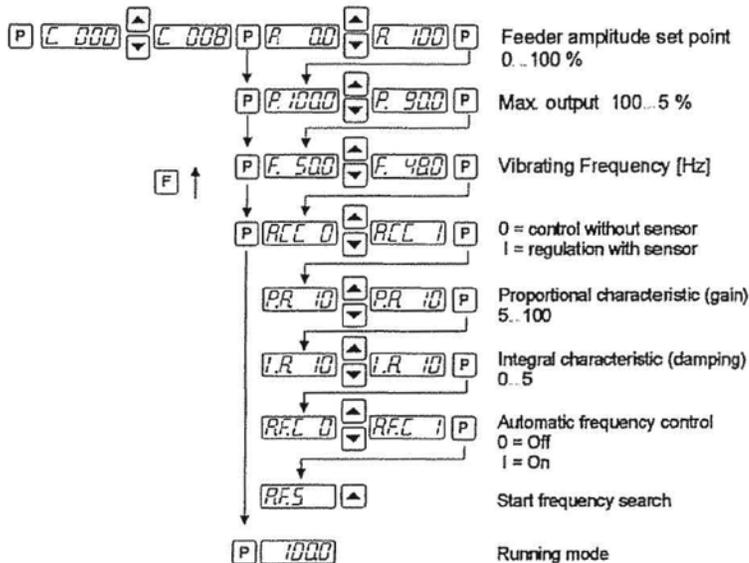
Code C. 003



POT is not available on 16A units.

Regulation Mode

Code C. 008



Instructions for Using Regulation Mode

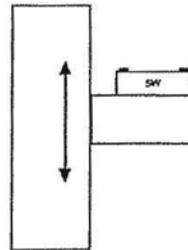
- An accelerometer e.g. SW11 must be fitted to the vibratory feeder in order to run in regulation mode. The accelerometer should have a frequency range corresponding to that of the feeder.
- All vibration signals that are picked up by the accelerometer are used by the regulator circuit. Stray signals generated by neighboring machinery, a flimsy accelerometer mounting,

or an unstable support frame can cause incorrect regulation to occur. It is especially important to ensure that there are no external influences of this type during the automatic frequency search routine.

- Resonant frequencies:** It is possible to have several vibrating frequencies where resonance occurs, depending on the springing and masses of the system. The additional resonant points are at multiples of the dominant resonant frequency. Under extreme circumstances, the automatic frequency search may be unable to differentiate between these frequencies. In these instances, the frequency must be set manually.

Mounting the Accelerometer

The accelerometer should generate signals for the movement and acceleration of the feeder, which are fed back to the regulator circuit of the control unit. Therefore it is very important that no other extraneous vibration signals are picked up by the sensor.

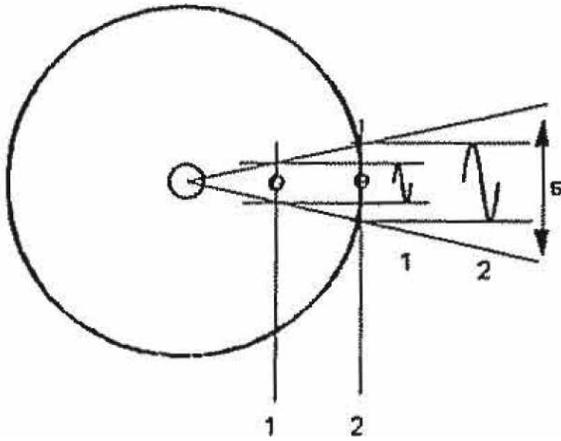


The sensor should be positioned so that it moves in the same direction as the feeder, ideally in the same plane as the springs, and it should be fitted on a solid block that will not generate vibration signals.

In regulation mode the magnitude of the output signal has a direct effect on the maximum amplitude of the feeder.

On bowl feeders it is advisable to fit the sensor as near as possible to the outside diameter and in this position it will be subjected to the greatest movement.

The control range of the set point will be considerably reduced when the sensor signal is weak.



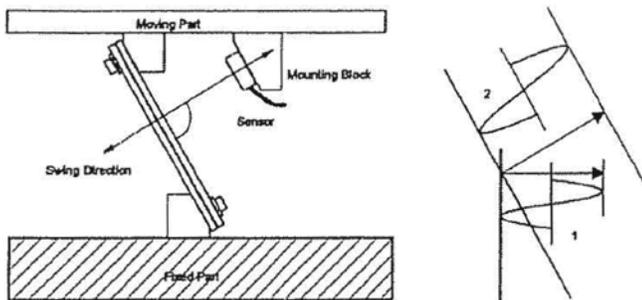
The controller, together with the sensor fitted on the feeder, produce a feedback loop, whereby the signal generated from the sensor determines the control range of the set point i.e. the regulator controls the feeder so that the effective value (feeder power or intensity of vibration) relates to the provided set point value. Because the effective value is dependent on the feeder (frequency, acceleration and amplitude) and in addition depends on the mounting position of the sensor, the regulator must be adapted to suit the output control range.

s = deflection

Mounting position 1 = small deflection

Mounting position 2 = large deflection

Linear Feeder Example



1. Small amplitude because sensor is mounted vertically.
2. Larger amplitude because sensor is mounted in the same plane as the springs.

This is achieved by using the parameter P in Menu C 008. The measured sensor signal range is adjusted by changing this value. In most instances, a value of less than 100 must be entered, so that the set point can reach 100% or can go as high as possible.

When it is not possible to achieve an acceptable range, the accelerometer should be mounted in the location which gives the greatest movement (see the bowl feeder example).

The importance of scaling this value is demonstrated when, for example, a feeder takes a very long time to ramp up, after it has been switched on.

Relationship Between Acceleration and Amplitude

The sensor measures the momentary acceleration of the feeder. It generates a sinusoidal output voltage signal. The acceleration gets higher as the frequency increases. The sensor signal is greater for a higher frequency and lower amplitude than for a low frequency with a higher amplitude.

<p>Acceleration</p> $a = \omega^2 s \quad \text{where} \quad \omega = 2\pi f$ <p>In practice the acceleration is influenced by gravitational force and the applied amplitude is measured in mm and so this gives the following formula:</p> $a[g] = \frac{2^2 \pi^2 f^2 [Hz]^2 s_n [mm]}{9,81 \cdot 2 \cdot 10^3} = \frac{f^2 [Hz]^2 s_n [mm]}{497}$ <p>a[g] = Acceleration (with respect to gravitational acceleration of 9 81 m/s²) S_n[mm] = Applied amplitude</p>	<p>In practice where 497 is approximated to 500 this gives, for example:</p> <ol style="list-style-type: none"> 1. Vibrating frequency 50Hz Amplitude 3mm $a = \frac{50^2 \cdot 3}{\approx 500} = 15 g$ <p>Or</p> <ol style="list-style-type: none"> 2. Vibrating frequency 33Hz Amplitude 5mm $a = \frac{33^2 \cdot 5}{\approx 500} = 10,89 g$
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Using an accelerometer with an output signal of 0.3 V/g the sensor generates a peak voltage of 4.5V for a peak acceleration of 15g (Example 1), corresponding to a 3 18V RMS value.

Example 1: =>15 g=> 4,5 V => 3, 18 Veff

Example 2: =>11 g=> 3,3 V => 2, 33 Veff

Because of the vastly different acceleration values of various feeders there is a big difference in the feedback signals, which makes scaling necessary.

Instructions for Setting up the Controller in Regulation Mode

Connect control unit

Install sensor and connect to controller

Determining the Resonant Frequency

Manual setting of the vibrating frequency

It is essential that the output frequency is adjusted with the set point set at a low frequency, otherwise on hitting the resonant frequency it is possible to achieve a high amplitude with a low output voltage. An analog, effective value, current indicating unit (moving iron meter) must be connected into the output circuit. Resonant frequency is reached when there is a maximum amplitude for a minimum output current.

Automatic frequency search

- The feeder should be empty for a frequency search
- Adjust the set point to zero
- Select regulation mode (Menu C 008, Parameter ACC = I)
- The optimum frequency of the feeder is found, automatically, by initiating the frequency search (Menu C 008, Parameter A.F.S.). When this has been found the controller resets the set point back to its original value (0).

Optimization Controller in Regulation Mode

Setting the control range

1. In Menu C. 096 set parameter P (Max Limit) to 50 %
2. Set A (Feeder throughput) to 100%
3. Increase limit P from 50% until the required maximum feeder throughput is achieved

The full set point adjustment range of 0 – 100% can now be used.

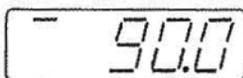
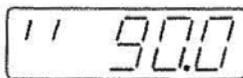
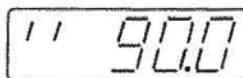
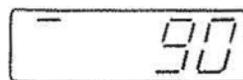
Optimizing regulation: For unwanted feeder oscillation (hunting) or Inadequate feedback regulation for load changes.

The response of the regulation circuit can be adjusted in menu COOS using the parameter PA (Proportional characteristic or circuit gain) and IA (Integral characteristic)

In menu C008 reduce PA until the oscillations are reduced.

Parameter IA should be set to at 100 if possible.

Displays



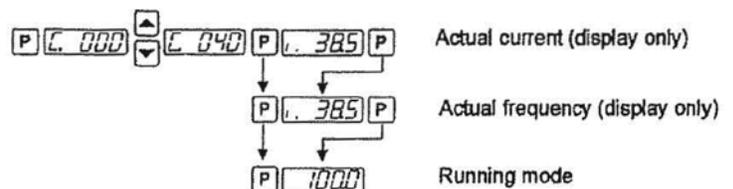
1. The maximum output power of the controller has been reached. The feedback signal from the sensor (acceleration) is too low in comparison with the set point. Reduce parameter P in Menu C096 or C008.
2. The maximum current setting has been reached. The feedback signal from the sensor (acceleration) is too high.

Changing display:

The regulator oscillates too quickly. Reduce parameter PA in Menu C008.

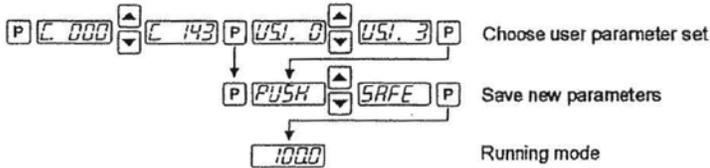
Display Actual Current and Frequency

Code C. 040



Save Selected Parameters

Code C 143



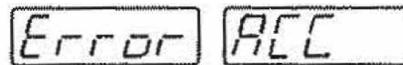
Over Voltage

Supply voltage too high or back EMF from the coil at lower frequencies.



Current Spike Limit

Frequency set too low for installed coil or frequency altered too rapidly during setting up.



Sensor Fault

(only when regulation mode is selected)
Accelerometer not working or faulty.

Error Reset through Menu C009.



Sensor Time Out

After sensor time out has elapsed.

Error Reset is achieved by pressing touch panel keys 0 or I during normal operation or by using Menu C009.

In the event of an error check that this is not caused by incorrect wiring or cable faults, the error message, Error ACC, can also occur if regulation mode is chosen (in Menu COOS) and an accelerometer is not connected, for example.

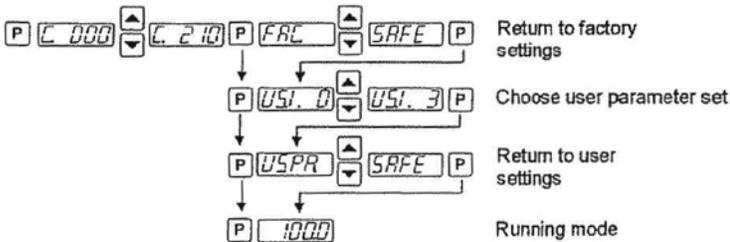
Reset the error In the following manner:

Error Reset



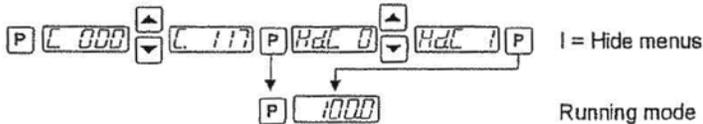
Recall User or Factory Settings

Code C 210



Hide Parameter Menus

Code C 117



Error Messages/ Error Reset

Errors are indicated by an alternating code and Error display.



Overload limit

Output level exceeded e.g. incorrect frequency setting, coil air-gap to wide.

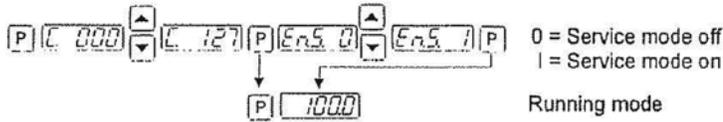


Short Circuit Trip

Faulty coil, short circuit or defective cable.



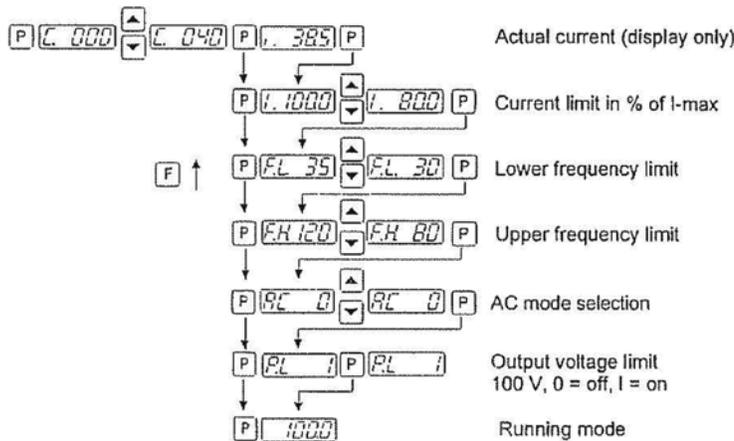
The new functions and the special AC Eriez feature is located in passcode C040. To 'see' C040 (known as the service menu) you must enable it in passcode C127 as follows:



Enable Service Mode

The actual service menu is accessed by opening the service mode.

The normal service menu, containing the output current and frequency limit settings, is accessed by opening the service mode.



Service menu

Code 040

Current Limiting

The current limit is used to set the controller for the rated current of the coil I_M . The current limit I_{MAX} is set by using parameter I. The displayed setting is expressed as a percentage of the controllers rated current I_N (100 % corresponds to the units rated current).

$$I_{MAX} = \frac{I_M \cdot 100}{I_N}$$

To protect the coils the current limit must be set to the rated current for the coil(s) I_M .

When several coils are connected in parallel, the coil current is the sum of all individual currents.

Obviously this function is very useful for damage limitation in fault conditions and ensuring that the feeder/controller combination work within their capabilities at all times.

A typical application that would utilize this function is a large feeder using an accelerometer in a closed loop system. In this state, the feeder reacts to load changes and keeps the feed rate steady. Historically if the customer dumped an unusual level of product onto the feeder, the unit would have tripped out OL-ERROR as it tried to compensate for the load change. However, the new unit will not trip out but will run in current limiting mode until the feeder is clear.

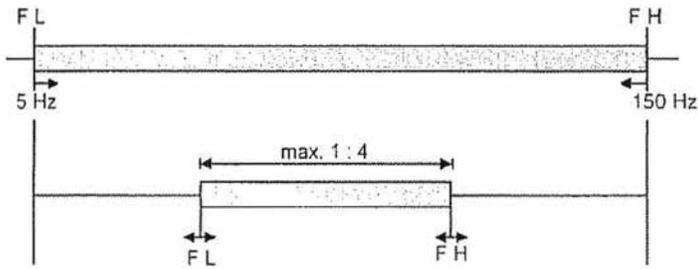
Frequency Adjustment Range

The control unit is supplied with a maximum frequency range of 5-150Hz. Using an adjustable under and over frequency limits, the user range (parameter F) can be restricted to a maximum ratio of 1:4.

In regulation mode, this restricted frequency range has great importance because assists with the accurate determination of the measurement signals from the accelerometer. During the automatic frequency search a maximum sweep range of 1:4 is possible. The lower (FL) and upper (FH) frequency limits restrict the range. A narrow setting of the limits of less than 1:4 is possible and also advisable because this ensures that widely different changes of the frequency cannot occur when the user is selling up the system.

The range of the automatic frequency control (AFC) is also limited by these settings.

A practical setting is +/- 20 % of resonance.



Possible frequency range

Parameter "F L" and "F H" Menu "C 040"

Usable frequency range

Parameter "F"

Menu "C 008", "C 096", C "020"

1. Set lower frequency limit
2. Set upper frequency limit

This function is obvious - it limits the range of frequency to whatever you want it to be - again limiting the potential for damage by untrained persons.

Limiting Output Voltage to 110 V.

Time and time again we have been asked by customers to include this function - I think that you will find it useful, when sending feeders to countries with 230 V mains.

You can still use your 110 V, coils and set this function to know that the rms output voltage will never be able to be increased by the customer up to a level which could cause damage.

Current Measurement

The current measurement functions allows you to easily say if a feeder is running as it should - no more trying to tell customers where to buy an ammeter or how to use one!

Other Useful Functions

- Multi-user settings
The unit now has 3 independent menus where users can save their own settings, these can be restored by the user at anytime
- Hide parameter settings, use this to hide all menus from the customer apart from the speed setting

- Improved Error trips, the unit now has much more sophisticated fault diagnosis and protection, including Accelerometer fault detection

Accelerometer - Technical Description

General

The sensors, which are covered in this description, are used for measuring low frequency amplitude in the range of 2 - 200 Hz, up to a maximum of 20 g.

Inside the unit there is a piezo electric amplitude element connected to an amplifier. The amplitude is detected by the piezo element which generates a proportional voltage which is converted into a usable signal of 400 mV/g by the amplifier.

The components are built into a robust, aluminium housing and are completely epoxy-sealed. Electrical connections are brought out on a four-core, screened cable. The screen is earthed at the control unit end. The reference point (ground), of the operating voltage, is earthed to the suppression circuit inside the sensor housing.

Applications

- Machine protection
- Measurement of mechanical vibration
- Amplitude monitoring i.e. safety braking

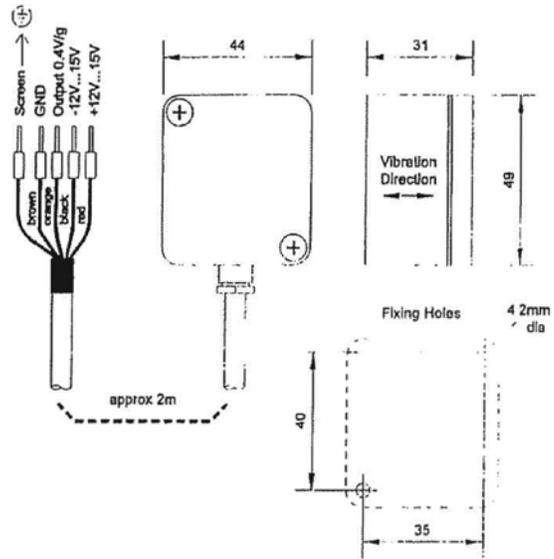
Technical Data

Operating voltage	+/- 12 - 15 V, DC
Output voltage	0,4 V per g
Measurement range	0 - 10 g
Operating temperature	0 - 45 °C

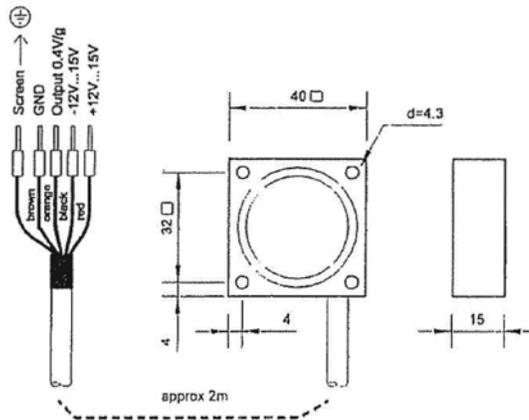


Connections and Dimensions

IP65



IP54



Note: Some safety warning labels or guarding may have been removed before photographing this equipment.
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